Control	**0465-02-027, ETC.**
Project	**STP 2023(954)MM, ETC.**
Highway	**FM 1518**
County	**BEXAR**

ADDENDUM ACKNOWLEDGMENT

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

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

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

ADDENDUM NO. 1 ☐

ADDENDUM NO. 2 ☐

ADDENDUM NO. 3 ☐

ADDENDUM NO. 4 ☐

ADDENDUM NO. 5 ☐

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

This page intentionally left blank.

Control	**0465-02-027, ETC.**
Project	**STP 2023(954)MM, ETC.**
Highway	**FM 1518**
County	**BEXAR**

PROPOSAL TO THE TEXAS TRANSPORTATION COMMISSION

2014 SPECIFICATIONS

WORK CONSISTING OF WIDEN ROAD - ADD LANES

BEXAR COUNTY, TEXAS

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

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

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

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

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

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

By signing the proposal the bidder certifies:

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

- **Signed: ****

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

Print Name:

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

Title:

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

Company:

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

- Signatures to comply with Item 2 of the specifications.

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

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

NOTICE TO CONTRACTORS

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

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

TEXAS DEPARTMENT OF TRANSPORTATION

BID BOND

KNOW ALL PERSONS BY THESE PRESENTS,

That we, (Contractor Name) _____

_____

Hereinafter called the Principal, and (Surety Name) _____

_____

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

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

Control	**0465-02-027, ETC.**
Project	**STP 2023(954)MM, ETC.**
Highway	**FM 1518**
County	**BEXAR**

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

Signed this _____ Day of _____ 20_____

By: _____

(Contractor/Principal Name)

_____

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

*By: _____

(Surety Name)

_____

(Signature of Attorney-in-Fact)

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

Impressed Surety Seal Only

This form may be removed from the proposal.

This page intentionally left blank.

BIDDER'S CHECK RETURN

IMPORTANT

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

NOTE

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

RETURN BIDDERS CHECK TO (PLEASE PRINT):

Control	**0465-02-027, ETC.**
Project	**STP 2023(954)MM, ETC.**
Highway	**FM 1518**
County	**BEXAR**

IMPORTANT

PLEASE RETURN THIS SHEET IN ITS ENTIRETY

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

Check Received By: _____ Date:_____

Title: _____

For (Contractor's Name): _____

Project _____ County_____

This page intentionally left blank.

NOTICE TO THE BIDDER

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

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

$_____

Total Bid Amount

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

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

EXAMPLE

Total Bid Amount _____$2,664.00_____

Signed _____
Title _____
Date _____

Additional Signature for Joint Venture:

Signed _____
Title _____
Date _____

EXAMPLE OF BID PRICES SUBMITTED BY COMPUTER PRINTOUT

EXAMPLES

BID PRICES SUBMITTED BY HAND WRITTEN FORMAT

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

Unit price for each plant in place

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

Unit price for each ton of Flexible Base

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

Unit price for each cubic yard of Concrete

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

Unit price of each Roadway Illumination Assembly

This page intentionally left blank.

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	309.000	1
	104	6009		REMOVING CONC (RIPRAP) DOLLARS and CENTS	SY	2,234.000	2
	104	6011		REMOVING CONC (MEDIANS) DOLLARS and CENTS	SY	116.000	3
	104	6013		REMOVING CONC (FOUNDATIONS) DOLLARS and CENTS	SY	12.000	4
	104	6015		REMOVING CONC (SIDEWALKS) DOLLARS and CENTS	SY	2,344.000	5
	104	6017		REMOVING CONC (DRIVEWAYS) DOLLARS and CENTS	SY	1,598.000	6
	104	6021		REMOVING CONC (CURB) DOLLARS and CENTS	LF	3,533.000	7
	104	6037		REMOVE CONC (RAIL) DOLLARS and CENTS	LF	217.000	8
	105	6002		REMOVING STAB BASE AND ASPH PAV (2") DOLLARS and CENTS	SY	12,289.000	9
	105	6116		RMV TRT & UNTRT BASE & ASPH PV(10"-15") DOLLARS and CENTS	SY	116,737.000	10
	105	6170		REM TRT & UNTRT BASE & ASPH (4"-10") DOLLARS and CENTS	SY	8,229.000	11

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	110	6001		EXCAVATION (ROADWAY) DOLLARS and CENTS	CY	73,614.000	12
	132	6005		EMBANKMENT (FINAL)(ORD COMP)(TY C) DOLLARS and CENTS	CY	63,703.000	13
	160	6003		FURNISHING AND PLACING TOPSOIL (4") DOLLARS and CENTS	SY	147,833.000	14
	162	6002		BLOCK SODDING DOLLARS and CENTS	SY	133,968.000	15
	164	6023		CELL FBR MLCH SEED(PERM)(RURAL)(CLAY) DOLLARS and CENTS	SY	13,865.000	16
	164	6041		DRILL SEEDING (TEMP) (WARM) DOLLARS and CENTS	SY	130,815.000	17
	164	6043		DRILL SEEDING (TEMP) (COOL) DOLLARS and CENTS	SY	130,815.000	18
	168	6001		VEGETATIVE WATERING DOLLARS and CENTS	MG	6,391.200	19
	169	6001		SOIL RETENTION BLANKETS (CL 1) (TY A) DOLLARS and CENTS	SY	529,566.000	20
	247	6475	003	FL BS (CIP)(TY D GR 1-2, OR 5)FINAL POS DOLLARS and CENTS	CY	44,404.000	21
	260	6016		LIME (HYD, COM, OR QK(SLURRY)) DOLLARS and CENTS	TON	4,950.000	22
	260	6073		LIME TRT (SUBGRADE)(8") DOLLARS and CENTS	SY	206,247.000	23

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	310	6027		PRIME COAT(MC-30 OR AE-P) DOLLARS and CENTS	GAL	38,675.000	24
	316	6224	002	AGGR(TY-PB GR-4 SAC-B) DOLLARS and CENTS	CY	1,816.000	25
	316	6410	002	ASPH(AC-15P,AC-20-5TR,AC-20XP,AC10-2TR) DOLLARS and CENTS	GAL	65,455.000	26
	400	6005		CEM STABIL BKFL DOLLARS and CENTS	CY	7,838.000	27
	400	6008		CUT & RESTORE ASPH PAVING DOLLARS and CENTS	SY	422.000	28
	401	6001		FLOWABLE BACKFILL DOLLARS and CENTS	CY	1,809.000	29
	402	6001		TRENCH EXCAVATION PROTECTION DOLLARS and CENTS	LF	37,396.000	30
	403	6001		TEMPORARY SPL SHORING DOLLARS and CENTS	SF	5,285.000	31
	416	6002		DRILL SHAFT (24 IN) DOLLARS and CENTS	LF	2,034.000	32
	416	6004		DRILL SHAFT (36 IN) DOLLARS and CENTS	LF	500.000	33
	416	6005		DRILL SHAFT (42 IN) DOLLARS and CENTS	LF	218.000	34
	416	6031		DRILL SHAFT (TRF SIG POLE) (30 IN) DOLLARS and CENTS	LF	11.000	35

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	416	6032		DRILL SHAFT (TRF SIG POLE) (36 IN) DOLLARS and CENTS	LF	104.000	36
	416	6034		DRILL SHAFT (TRF SIG POLE) (48 IN) DOLLARS and CENTS	LF	66.000	37
	420	6003	001	CL A CONC (MISC) DOLLARS and CENTS	SY	390.000	38
	420	6013	001	CL C CONC (ABUT) DOLLARS and CENTS	CY	36.000	39
	420	6029	001	CL C CONC (CAP) DOLLARS and CENTS	CY	150.000	40
	420	6037	001	CL C CONC (COLUMN) DOLLARS and CENTS	CY	121.000	41
	420	6066	001	CL C CONC (RAIL FOUNDATION) DOLLARS and CENTS	CY	31.000	42
	422	6011		BRIDGE MEDIAN DOLLARS and CENTS	SF	9,738.000	43
	422	6013		BRIDGE SIDEWALK DOLLARS and CENTS	SF	11,770.000	44
	422	6015		APPROACH SLAB DOLLARS and CENTS	CY	285.000	45
	422	6023		SHEAR KEY DOLLARS and CENTS	CY	41.000	46
	422	6037		REINF CONC SLAB (BOX BEAM)(EXT SLAB) DOLLARS and CENTS	SF	7,682.000	47

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	422	6039		REINF CONC SLAB (SLAB BEAM)(EXT SLAB) DOLLARS and CENTS	SF	14,567.000	48
	423	6001		RETAINING WALL (MSE) DOLLARS and CENTS	SF	23,611.000	49
	425	6001	001	PRESTR CONC BOX BEAM (4B20) DOLLARS and CENTS	LF	1,637.000	50
	429	6008		CONC STR REPR(RAPID VERT AND OVER-HEAD) DOLLARS and CENTS	SF	49.000	51
	429	6009		CONC STR REPAIR (STANDARD) DOLLARS and CENTS	SF	12.000	52
	432	6001		RIPRAP (CONC)(4 IN) DOLLARS and CENTS	CY	7.000	53
	432	6002		RIPRAP (CONC)(5 IN) DOLLARS and CENTS	CY	716.000	54
	432	6006		RIPRAP (CONC)(CL B) DOLLARS and CENTS	CY	98.400	55
	432	6033		RIPRAP (STONE PROTECTION)(18 IN) DOLLARS and CENTS	CY	149.000	56
	432	6034		RIPRAP (STONE PROTECTION)(21 IN) DOLLARS and CENTS	CY	274.000	57
	432	6045		RIPRAP (MOW STRIP)(4 IN) DOLLARS and CENTS	CY	59.000	58
	442	6007	001	STR STEEL (MISC NON - BRIDGE) DOLLARS and CENTS	LB	8,496.000	59

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	450	6032	001	RAIL (TY C223) DOLLARS and CENTS	LF	4,186.000	60
	450	6048	001	RAIL (HANDRAIL)(TY B) DOLLARS and CENTS	LF	1,780.000	61
	450	6052	001	RAIL (HANDRAIL)(TY F) DOLLARS and CENTS	LF	114.000	62
	450	6054	001	RAIL (TY SSTR) (W/DRAIN SLOTS) DOLLARS and CENTS	LF	40.000	63
	454	6003		ARMOR JOINT DOLLARS and CENTS	LF	50.000	64
	454	6021		TYPE A JOINT DOLLARS and CENTS	LF	262.000	65
	460	6003		CMP (GAL STL 24 IN) DOLLARS and CENTS	LF	424.000	66
	462	6001	002	CONC BOX CULV (3 FT X 2 FT) DOLLARS and CENTS	LF	688.400	67
	462	6003	002	CONC BOX CULV (4 FT X 2 FT) DOLLARS and CENTS	LF	242.000	68
	462	6006	002	CONC BOX CULV (5 FT X 2 FT) DOLLARS and CENTS	LF	228.000	69
	462	6007	002	CONC BOX CULV (5 FT X 3 FT) DOLLARS and CENTS	LF	211.000	70
	462	6014	002	CONC BOX CULV (7 FT X 3 FT) DOLLARS and CENTS	LF	108.000	71

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	462	6015	002	CONC BOX CULV (7 FT X 4 FT) DOLLARS and CENTS	LF	1,039.400	72
	462	6016	002	CONC BOX CULV (7 FT X 5 FT) DOLLARS and CENTS	LF	212.000	73
	462	6021	002	CONC BOX CULV (8 FT X 6 FT) DOLLARS and CENTS	LF	69.000	74
	462	6058	002	CONC BOX CULV (7 FT X 3 FT)(EXTEND) DOLLARS and CENTS	LF	46.000	75
	462	6099	002	CONC BOX CULV (6 FT X 2 FT) DOLLARS and CENTS	LF	294.500	76
	464	6003	001	RC PIPE (CL III)(18 IN) DOLLARS and CENTS	LF	426.000	77
	464	6005	001	RC PIPE (CL III)(24 IN) DOLLARS and CENTS	LF	19,761.000	78
	464	6007	001	RC PIPE (CL III)(30 IN) DOLLARS and CENTS	LF	1,697.000	79
	464	6008	001	RC PIPE (CL III)(36 IN) DOLLARS and CENTS	LF	1,368.000	80
	464	6009	001	RC PIPE (CL III)(42 IN) DOLLARS and CENTS	LF	562.000	81
	464	6010	001	RC PIPE (CL III)(48 IN) DOLLARS and CENTS	LF	68.000	82
	464	6011	001	RC PIPE (CL III)(54 IN) DOLLARS and CENTS	LF	1,244.000	83

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	464	6012	001	RC PIPE (CL III)(60 IN) DOLLARS and CENTS	LF	472.000	84
	464	6013	001	RC PIPE (CL III)(66 IN) DOLLARS and CENTS	LF	4,961.000	85
	464	6030	001	RC PIPE (ARCH)(CL III)(DES 1) DOLLARS and CENTS	LF	184.000	86
	464	6033	001	RC PIPE (ARCH)(CL III)(DES 4) DOLLARS and CENTS	LF	53.000	87
	465	6002	001	MANH (COMPL)(PRM)(48IN) DOLLARS and CENTS	EA	1.000	88
	465	6012	001	JCTBOX(COMPL)(PJB)(8FTX8FT) DOLLARS and CENTS	EA	26.000	89
	465	6013	001	INLET (COMPL)(PCO)(3FT)(NONE) DOLLARS and CENTS	EA	51.000	90
	465	6014	001	INLET (COMPL)(PCO)(3FT)(LEFT) DOLLARS and CENTS	EA	62.000	91
	465	6015	001	INLET (COMPL)(PCO)(3FT)(RIGHT) DOLLARS and CENTS	EA	72.000	92
	465	6016	001	INLET (COMPL)(PCO)(3FT)(BOTH) DOLLARS and CENTS	EA	10.000	93
	465	6017	001	INLET (COMPL)(PCO)(4FT)(NONE) DOLLARS and CENTS	EA	3.000	94
	465	6018	001	INLET (COMPL)(PCO)(4FT)(LEFT) DOLLARS and CENTS	EA	11.000	95

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	465	6019	001	INLET (COMPL)(PCO)(4FT)(RIGHT) DOLLARS and CENTS	EA	2.000	96
	465	6021	001	INLET (COMPL)(PCO)(5FT)(NONE) DOLLARS and CENTS	EA	1.000	97
	465	6022	001	INLET (COMPL)(PCO)(5FT)(LEFT) DOLLARS and CENTS	EA	3.000	98
	465	6025	001	INLET (COMPL)(PCO)(6FT)(NONE) DOLLARS and CENTS	EA	1.000	99
	465	6026	001	INLET (COMPL)(PCO)(6FT)(LEFT) DOLLARS and CENTS	EA	3.000	100
	465	6027	001	INLET (COMPL)(PCO)(6FT)(RIGHT) DOLLARS and CENTS	EA	2.000	101
	465	6060	001	INLET (COMPL)(PSL)(SL)(6FTX6FT) DOLLARS and CENTS	EA	1.000	102
	465	6061	001	INLET (COMPL)(PSL)(SL)(8FTX8FT) DOLLARS and CENTS	EA	1.000	103
	465	6070	001	INLET (COMPL)(PSL)(RC)(3FTX3FT) DOLLARS and CENTS	EA	1.000	104
	465	6071	001	INLET (COMPL)(PSL)(RC)(4FTX4FT) DOLLARS and CENTS	EA	2.000	105
	465	6077	001	INLET (COMPL)(PSL)(RC)(8FTX8FT) DOLLARS and CENTS	EA	3.000	106
	465	6126	001	INLET (COMPL)(PSL)(FG)(3FTX3FT-3FTX-3FT) DOLLARS and CENTS	EA	9.000	107

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	465	6128	001	INLET (COMPL)(PSL)(FG)(4FTX4FT-4FTX-4FT) DOLLARS and CENTS	EA	9.000	108
	465	6130	001	INLET (COMPL)(PSL)(FG)(3FTX5FT-3FTX-5FT) DOLLARS and CENTS	EA	5.000	109
	465	6233	001	INLET (COMP) (TY SIDEWALK BRIDGE) DOLLARS and CENTS	EA	20.000	110
	465	6671	001	JCT BOX (COMPL)(CIP)(SPL)(9FTX5FT) DOLLARS and CENTS	EA	1.000	111
	466	6153		WINGWALL (FW - 0) (HW=6 FT) DOLLARS and CENTS	EA	2.000	112
	466	6179		WINGWALL (PW - 1) (HW=4 FT) DOLLARS and CENTS	EA	4.000	113
	466	6180		WINGWALL (PW - 1) (HW=5 FT) DOLLARS and CENTS	EA	2.000	114
	466	6181		WINGWALL (PW - 1) (HW=6 FT) DOLLARS and CENTS	EA	1.000	115
	466	6182		WINGWALL (PW - 1) (HW=7 FT) DOLLARS and CENTS	EA	5.000	116
	466	6184		WINGWALL (PW - 1) (HW=9 FT) DOLLARS and CENTS	EA	1.000	117
	466	6186		WINGWALL (PW - 2) (HW=11 FT) DOLLARS and CENTS	EA	1.000	118
	466	6234		HEADWALL (CH-PW-0)(SPL) DOLLARS and CENTS	EA	1.000	119

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	467	6134		SET (TY I)(S= 4 FT)(HW= 2 FT)(6:1) (P) DOLLARS and CENTS	EA	4.000	120
	467	6165		SET (TY I)(S= 5 FT)(HW= 2 FT)(3:1) (P) DOLLARS and CENTS	EA	2.000	121
	467	6178		SET (TY I)(S= 5 FT)(HW= 4 FT)(4:1) (P) DOLLARS and CENTS	EA	8.000	122
	467	6359		SET (TY II) (18 IN) (RCP) (4: 1) (P) DOLLARS and CENTS	EA	35.000	123
	467	6379		SET (TY II) (24 IN) (CMP) (6: 1) (C) DOLLARS and CENTS	EA	2.000	124
	467	6380		SET (TY II) (24 IN) (CMP) (6: 1) (P) DOLLARS and CENTS	EA	10.000	125
	467	6388		SET (TY II) (24 IN) (RCP) (3: 1) (C) DOLLARS and CENTS	EA	8.000	126
	467	6390		SET (TY II) (24 IN) (RCP) (4: 1) (C) DOLLARS and CENTS	EA	1.000	127
	467	6391		SET (TY II) (24 IN) (RCP) (4: 1) (P) DOLLARS and CENTS	EA	2.000	128
	467	6392		SET (TY II) (24 IN) (RCP) (5: 1) (C) DOLLARS and CENTS	EA	1.000	129
	467	6517		SET (TY II) (DES 1) (RCP) (4: 1) (P) DOLLARS and CENTS	EA	10.000	130
	467	6555		SET (TY II) (DES 4) (RCP) (6: 1) (P) DOLLARS and CENTS	EA	1.000	131

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	479	6006		ADJUSTING INLET (CAP) DOLLARS and CENTS	EA	1.000	132
	496	6002		REMOV STR (INLET) DOLLARS and CENTS	EA	9.000	133
	496	6004		REMOV STR (SET) DOLLARS and CENTS	EA	60.000	134
	496	6005		REMOV STR (WINGWALL) DOLLARS and CENTS	EA	7.000	135
	496	6006		REMOV STR (HEADWALL) DOLLARS and CENTS	EA	16.000	136
	496	6007		REMOV STR (PIPE) DOLLARS and CENTS	LF	1,543.000	137
	496	6008		REMOV STR (BOX CULVERT) DOLLARS and CENTS	LF	1,087.000	138
	496	6025		REMOV STR (APPROACH SLAB) DOLLARS and CENTS	EA	2.000	139
	496	6040		REMOV STR (RET WALL) DOLLARS and CENTS	LF	300.000	140
	496	6069		REMOV STR (SLOTTED DRAIN INLET) DOLLARS and CENTS	LF	104.000	141
	496	6099		REMOVE STR (RAIL) DOLLARS and CENTS	LF	38.000	142
	500	6001		MOBILIZATION DOLLARS and CENTS	LS	1.000	143

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	502	6001	008	BARRICADES, SIGNS AND TRAFFIC HANDLING DOLLARS and CENTS	MO	48.000	144
	506	6001	005	ROCK FILTER DAMS (INSTALL) (TY 1) DOLLARS and CENTS	LF	470.000	145
	506	6011	005	ROCK FILTER DAMS (REMOVE) DOLLARS and CENTS	LF	525.000	146
	506	6020	005	CONSTRUCTION EXITS (INSTALL) (TY 1) DOLLARS and CENTS	SY	461.000	147
	506	6024	005	CONSTRUCTION EXITS (REMOVE) DOLLARS and CENTS	SY	461.000	148
	506	6038	005	TEMP SEDMT CONT FENCE (INSTALL) DOLLARS and CENTS	LF	58,367.000	149
	506	6039	005	TEMP SEDMT CONT FENCE (REMOVE) DOLLARS and CENTS	LF	56,402.000	150
	506	6040	005	BIODEG EROSN CONT LOGS (INSTL) (8") DOLLARS and CENTS	LF	7,752.000	151
	506	6043	005	BIODEG EROSN CONT LOGS (REMOVE) DOLLARS and CENTS	LF	7,040.000	152
	508	6001		CONSTRUCTING DETOURS DOLLARS and CENTS	SY	79,045.000	153
	512	6001		PORT CTB (FUR & INST)(SGL SLOPE)(TY 1) DOLLARS and CENTS	LF	2,490.000	154
	512	6009		PORT CTB (FUR & INST)(LOW PROF)(TY 1) DOLLARS and CENTS	LF	15,280.000	155

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	512	6010		PORT CTB (FUR & INST)(LOW PROF)(TY 2) DOLLARS and CENTS	LF	1,940.000	156
	512	6033		PORT CTB (MOVE)(LOW PROF)(TY 1) DOLLARS and CENTS	LF	49,920.000	157
	512	6034		PORT CTB (MOVE)(LOW PROF)(TY 2) DOLLARS and CENTS	LF	6,440.000	158
	512	6049		PORT CTB (REMOVE)(SGL SLP)(TY 1) DOLLARS and CENTS	LF	2,490.000	159
	512	6057		PORT CTB (REMOVE)(LOW PROF)(TY 1) DOLLARS and CENTS	LF	15,680.000	160
	512	6058		PORT CTB (REMOVE)(LOW PROF)(TY 2) DOLLARS and CENTS	LF	1,580.000	161
	529	6001		CONC CURB (TY I) DOLLARS and CENTS	LF	94,006.000	162
	529	6017		CONC CURB (TY F2) DOLLARS and CENTS	LF	394.000	163
	529	6018		CONC CURB (TY F3) DOLLARS and CENTS	LF	1,061.000	164
	530	6005		DRIVEWAYS (ACP) DOLLARS and CENTS	SY	7,918.000	165
	530	6017		DRIVEWAYS (CONC) (HES) DOLLARS and CENTS	SY	1,692.000	166
	531	6001		CONC SIDEWALKS (4") DOLLARS and CENTS	SY	46,047.000	167

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	531	6004		CURB RAMPS (TY 1) DOLLARS and CENTS	EA	14.000	168
	531	6005		CURB RAMPS (TY 2) DOLLARS and CENTS	EA	30.000	169
	531	6008		CURB RAMPS (TY 5) DOLLARS and CENTS	EA	2.000	170
	531	6010		CURB RAMPS (TY 7) DOLLARS and CENTS	EA	21.000	171
	531	6016		CURB RAMPS (TY 21) DOLLARS and CENTS	EA	4.000	172
	531	6017		CURB RAMPS (TY 22) DOLLARS and CENTS	EA	1.000	173
	540	6001	001	MTL W-BEAM GD FEN (TIM POST) DOLLARS and CENTS	LF	325.000	174
	540	6006	001	MTL BEAM GD FEN TRANS (THRIE-BEAM) DOLLARS and CENTS	EA	4.000	175
	540	6016	001	DOWNSTREAM ANCHOR TERMINAL SEC-TION DOLLARS and CENTS	EA	1.000	176
	542	6001		REMOVE METAL BEAM GUARD FENCE DOLLARS and CENTS	LF	1,875.000	177
	542	6002		REMOVE TERMINAL ANCHOR SECTION DOLLARS and CENTS	EA	2.000	178
	542	6003		REMOVE DOWNSTREAM ANCHOR TERMI-NAL DOLLARS and CENTS	EA	3.000	179

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	542	6004		RM MTL BM GD FENCE TRANS (THRIE-BEAM) DOLLARS and CENTS	EA	6.000	180
	544	6001		GUARDRAIL END TREATMENT (INSTALL) DOLLARS and CENTS	EA	3.000	181
	544	6003		GUARDRAIL END TREATMENT (REMOVE) DOLLARS and CENTS	EA	10.000	182
	545	6005		CRASH CUSH ATTEN (REMOVE) DOLLARS and CENTS	EA	9.000	183
	545	6018		CRASH CUSH ATTEN (INSTL)(S)(N)(TL2) DOLLARS and CENTS	EA	9.000	184
	560	6014		MAILBOX INSTALL-S (TWG-POST) TY 4 DOLLARS and CENTS	EA	65.000	185
	560	6022		MAILBOX INSTALL-D (TWG-POST) TY 4 DOLLARS and CENTS	EA	3.000	186
	560	6023		MAILBOX INSTALL-M (TWG-POST) TY 4 DOLLARS and CENTS	EA	5.000	187
	618	6023		CONDT (PVC) (SCH 40) (2") DOLLARS and CENTS	LF	2,100.000	188
	618	6046		CONDT (PVC) (SCH 80) (2") DOLLARS and CENTS	LF	951.000	189
	618	6047		CONDT (PVC) (SCH 80) (2") (BORE) DOLLARS and CENTS	LF	1,033.000	190
	618	6053		CONDT (PVC) (SCH 80) (3") DOLLARS and CENTS	LF	835.000	191

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	618	6054		CONDT (PVC) (SCH 80) (3") (BORE) DOLLARS and CENTS	LF	2,418.000	192
	620	6009		ELEC CONDR (NO.6) BARE DOLLARS and CENTS	LF	4,522.000	193
	620	6010		ELEC CONDR (NO.6) INSULATED DOLLARS and CENTS	LF	82.000	194
	621	6005		TRAY CABLE (4 CONDR) (12 AWG) DOLLARS and CENTS	LF	2,655.000	195
	624	6002		GROUND BOX TY A (122311)W/APRON DOLLARS and CENTS	EA	38.000	196
	624	6009		GROUND BOX TY D (162922) DOLLARS and CENTS	EA	8.000	197
	624	6010		GROUND BOX TY D (162922)W/APRON DOLLARS and CENTS	EA	8.000	198
	628	6144		ELC SRV TY D 120/240 060(NS)SS(E)PS(U) DOLLARS and CENTS	EA	3.000	199
	636	6001	001	ALUMINUM SIGNS (TY A) DOLLARS and CENTS	SF	1,210.300	200
	644	6001		IN SM RD SN SUP&AM TY10BWG(1)SA(P) DOLLARS and CENTS	EA	63.000	201
	644	6002		IN SM RD SN SUP&AM TY10BWG(1)SA(P-BM) DOLLARS and CENTS	EA	17.000	202
	644	6004		IN SM RD SN SUP&AM TY10BWG(1)SA(T) DOLLARS and CENTS	EA	27.000	203

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	644	6007		IN SM RD SN SUP&AM TY10BWG(1)SA(U) DOLLARS and CENTS	EA	7.000	204
	644	6030		IN SM RD SN SUP&AM TYS80(1)SA(T) DOLLARS and CENTS	EA	2.000	205
	644	6033		IN SM RD SN SUP&AM TYS80(1)SA(U) DOLLARS and CENTS	EA	4.000	206
	644	6034		IN SM RD SN SUP&AM TYS80(1)SA(U-1EXT) DOLLARS and CENTS	EA	2.000	207
	644	6035		IN SM RD SN SUP&AM TYS80(1)SA(U-2EXT) DOLLARS and CENTS	EA	1.000	208
	644	6066		IN SM RD SN SUP&AM (RAIL MOUNT) DOLLARS and CENTS	EA	3.000	209
	644	6075		RELOCATE SM RD SN SUP&AM(SIGN ONLY) DOLLARS and CENTS	EA	25.000	210
	658	6013		INSTL DEL ASSM (D-SW)SZ (BRF)CTB DOLLARS and CENTS	EA	10.000	211
	658	6014		INSTL DEL ASSM (D-SW)SZ (BRF)CTB (BI) DOLLARS and CENTS	EA	3.000	212
	658	6015		INSTL DEL ASSM (D-SW)SZ (BRF)GF1 DOLLARS and CENTS	EA	7.000	213
	658	6016		INSTL DEL ASSM (D-SW)SZ (BRF)GF1 (BI) DOLLARS and CENTS	EA	6.000	214
	658	6080		INSTL DEL ASSM (D-SW)SZ 1(WFLX)GND DOLLARS and CENTS	EA	37.000	215

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	658	6102		INSTL OM ASSM (OM-3L)(WFLX)SRF)SRF DOLLARS and CENTS	EA	2.000	216
	658	6104		INSTL OM ASSM (OM-3R)(WFLX)SRF)SRF DOLLARS and CENTS	EA	2.000	217
	662	6067		WK ZN PAV MRK REMOV (W)6"(SLD) DOLLARS and CENTS	LF	71,054.000	218
	662	6098		WK ZN PAV MRK REMOV (Y)6"(SLD) DOLLARS and CENTS	LF	79,805.000	219
	666	6018	007	REFL PAV MRK TY I (W)6"(DOT)(100MIL) DOLLARS and CENTS	LF	7,534.000	220
	666	6030	007	REFL PAV MRK TY I (W)8"(DOT)(100MIL) DOLLARS and CENTS	LF	2,395.000	221
	666	6036	007	REFL PAV MRK TY I (W)8"(SLD)(100MIL) DOLLARS and CENTS	LF	28,864.000	222
	666	6045	007	REFL PAV MRK TY I (W)18"(SLD)(100MIL) DOLLARS and CENTS	LF	339.000	223
	666	6048	007	REFL PAV MRK TY I (W)24"(SLD)(100MIL) DOLLARS and CENTS	LF	5,471.000	224
	666	6054	007	REFL PAV MRK TY I (W)(ARROW)(100MIL) DOLLARS and CENTS	EA	187.000	225
	666	6063	007	REFL PAV MRK TY I(W)(UTURN ARW)(100MIL) DOLLARS and CENTS	EA	8.000	226
	666	6078	007	REFL PAV MRK TY I (W)(WORD)(100MIL) DOLLARS and CENTS	EA	193.000	227

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	666	6102	007	REF PAV MRK TY I(W)36"(YLD TRI)(100MIL) DOLLARS and CENTS	EA	12.000	228
	666	6132	007	REFL PAV MRK TY I (Y)6"(DOT)(100MIL) DOLLARS and CENTS	LF	125.000	229
	666	6156	007	REFL PAV MRK TY I(Y)(MED NOSE)(100MIL) DOLLARS and CENTS	EA	1.000	230
	666	6306	007	RE PM W/RET REQ TY I (W)6"(BRK)(100MIL) DOLLARS and CENTS	LF	32,976.000	231
	666	6309	007	RE PM W/RET REQ TY I (W)6"(SLD)(100MIL) DOLLARS and CENTS	LF	213,192.000	232
	666	6321	007	RE PM W/RET REQ TY I (Y)6"(SLD)(100MIL) DOLLARS and CENTS	LF	300,636.000	233
	672	6009		REFL PAV MRKR TY II-A-A DOLLARS and CENTS	EA	1,544.000	234
	672	6010		REFL PAV MRKR TY II-C-R DOLLARS and CENTS	EA	1,519.000	235
	677	6002		ELIM EXT PAV MRK & MRKS (6") DOLLARS and CENTS	LF	187,143.000	236
	677	6008		ELIM EXT PAV MRK & MRKS (ARROW) DOLLARS and CENTS	EA	18.000	237
	677	6012		ELIM EXT PAV MRK & MRKS (WORD) DOLLARS and CENTS	EA	18.000	238
	680	6002	006	INSTALL HWY TRF SIG (ISOLATED) DOLLARS and CENTS	EA	3.000	239

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	680	6004	006	REMOVING TRAFFIC SIGNALS DOLLARS and CENTS	EA	3.000	240
	681	6001		TEMP TRAF SIGNALS DOLLARS and CENTS	EA	3.000	241
	682	6001		VEH SIG SEC (12")LED(GRN) DOLLARS and CENTS	EA	23.000	242
	682	6002		VEH SIG SEC (12")LED(GRN ARW) DOLLARS and CENTS	EA	9.000	243
	682	6003		VEH SIG SEC (12")LED(YEL) DOLLARS and CENTS	EA	23.000	244
	682	6004		VEH SIG SEC (12")LED(YEL ARW) DOLLARS and CENTS	EA	13.000	245
	682	6005		VEH SIG SEC (12")LED(RED) DOLLARS and CENTS	EA	23.000	246
	682	6006		VEH SIG SEC (12")LED(RED ARW) DOLLARS and CENTS	EA	8.000	247
	682	6018		PED SIG SEC (LED)(COUNTDOWN) DOLLARS and CENTS	EA	18.000	248
	682	6049		BACKPLATE W/REFL BRDR(4 SEC) DOLLARS and CENTS	EA	4.000	249
	682	6050		BACKPLATE W/REFL BRDR(5 SEC) DOLLARS and CENTS	EA	1.000	250
	682	6060		BACKPLATE W/REFL BRDR(3 SEC) DOLLARS and CENTS	EA	26.000	251

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	684	6009		TRF SIG CBL (TY A)(12 AWG)(4 CONDR) DOLLARS and CENTS	LF	3,018.000	252
	684	6012		TRF SIG CBL (TY A)(12 AWG)(7 CONDR) DOLLARS and CENTS	LF	7,032.000	253
	684	6080		TRF SIG CBL (TY C)(14 AWG)(2 CONDR) DOLLARS and CENTS	LF	2,955.000	254
	685	6005		RELOCT RDSD FLSH BCN AM (SOLAR PWRD) DOLLARS and CENTS	EA	6.000	255
	686	6031		INS TRF SIG PL AM(S)1 ARM(28')LUM DOLLARS and CENTS	EA	1.000	256
	686	6035		INS TRF SIG PL AM(S)1 ARM(32')LUM DOLLARS and CENTS	EA	1.000	257
	686	6043		INS TRF SIG PL AM(S)1 ARM(40')LUM DOLLARS and CENTS	EA	3.000	258
	686	6047		INS TRF SIG PL AM(S)1 ARM(44')LUM DOLLARS and CENTS	EA	3.000	259
	686	6051		INS TRF SIG PL AM(S)1 ARM(48')LUM DOLLARS and CENTS	EA	1.000	260
	686	6055		INS TRF SIG PL AM(S)1 ARM(50')LUM DOLLARS and CENTS	EA	1.000	261
	686	6059		INS TRF SIG PL AM(S)1 ARM(55')LUM DOLLARS and CENTS	EA	1.000	262
	686	6063		INS TRF SIG PL AM(S)1 ARM(60')LUM DOLLARS and CENTS	EA	1.000	263

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	687	6001		PED POLE ASSEMBLY DOLLARS and CENTS	EA	17.000	264
	688	6001		PED DETECT PUSH BUTTON (APS) DOLLARS and CENTS	EA	18.000	265
	688	6003		PED DETECTOR CONTROLLER UNIT DOLLARS and CENTS	EA	3.000	266
	690	6025		REPLACE OF SIGNAL HEAD ASSM DOLLARS and CENTS	EA	2.000	267
	730	6107		FULL - WIDTH MOWING DOLLARS and CENTS	CYC	16.000	268
	734	6002		LITTER REMOVAL DOLLARS and CENTS	CYC	49.000	269
	735	6001		DEBRIS REMOVAL (CNTR MEDIANS/ MAINLANES) DOLLARS and CENTS	CYC	49.000	270
	738	6003		CLEANING / SWEEPING (OUTSIDE MAIN LANE) DOLLARS and CENTS	CYC	49.000	271
	785	6016		BRIDGE JOINT REPAIR (TYPE A) DOLLARS and CENTS	LF	176.000	272
	786	6001		CARBON FIBER REINF POLYMER PROTEC-TION DOLLARS and CENTS	SF	441.000	273
	2001	6002		INSTL TIED CONCRETE EROSN CONTROL MATS DOLLARS and CENTS	SF	134,563.000	274

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	3076	6001		D-GR HMA TY-B PG64-22 DOLLARS and CENTS	TON	63,398.000	275
	3077	6034		SP MIXES SP-C SAC-B PG76-22 DOLLARS and CENTS	TON	23,919.000	276
	3077	6075		TACK COAT DOLLARS and CENTS	GAL	53,109.000	277
	4171	6001		INSTALL BRIDGE IDENTIFICATION NUM-BERS DOLLARS and CENTS	EA	4.000	278
	6001	6002		PORTABLE CHANGEABLE MESSAGE SIGN DOLLARS and CENTS	EA	2.000	279
	6158	6001		TMSP RADAR SPEED CONTROL MONITOR DOLLARS and CENTS	EA	2.000	280
	6185	6002	002	TMA (STATIONARY) DOLLARS and CENTS	DAY	159.000	281
	6185	6005	002	TMA (MOBILE OPERATION) DOLLARS and CENTS	DAY	303.000	282
	6292	6001		RVDS(PRESENCE DETECTION ONLY) DOLLARS and CENTS	EA	11.000	283
	6292	6002		RVDS(ADVANCE DETECTION ONLY) DOLLARS and CENTS	EA	6.000	284
	6306	6006		VIVDS TEMPORARY DOLLARS and CENTS	EA	3.000	285
	7186	6003		NGP (MAIN) (6" PLASTIC W/TW) (OPEN CUT) DOLLARS and CENTS	LF	69.000	286

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	7186	6004		NGP (MAIN) (4" PLASTIC W/TW) (OPEN CUT) DOLLARS and CENTS	LF	86.000	287
	7186	6009		NGP (MAIN)(8" PLASTIC W/TW)(OPEN CUT) DOLLARS and CENTS	LF	8,892.000	288
	7186	6021		NGP (GROUT ABANDONED MAIN)(4") DOLLARS and CENTS	LF	53.000	289
	7186	6022		NGP (GROUT ABANDONED MAIN)(6") DOLLARS and CENTS	LF	713.000	290
	7186	6023		NGP (GROUT ABANDONED MAIN)(8") DOLLARS and CENTS	LF	288.000	291
	7186	6025		NGP (REMOVE ABANDONED MAIN)(4") DOLLARS and CENTS	LF	143.000	292
	7186	6026		NGP (REMOVE ABANDONED MAIN)(6") DOLLARS and CENTS	LF	1,595.000	293
	7186	6027		NGP (REMOVE ABANDONED MAIN)(8") DOLLARS and CENTS	LF	3,815.000	294
	7186	6050		NGP(BORING)(CASING)(12" STEEL) DOLLARS and CENTS	LF	481.000	295
	7186	6051		NGP(BORING)(CASING)(8" STEEL) DOLLARS and CENTS	LF	189.000	296
	7186	6053		NGP(BORING)(8" PLASTIC W/TW) DOLLARS and CENTS	LF	1,472.000	297
	7186	6054		NGP(INSERT)(8" PLASTIC W/TW) DOLLARS and CENTS	LF	421.000	298

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	7186	6055		NGP(INSERT)(4" PLASTIC W/TW) DOLLARS and CENTS	LF	189.000	299
	7186	6058		NGP (BORING)(INSERT)(6" PLASTIC W/TW) DOLLARS and CENTS	LF	60.000	300
	7326	6001		TRENCH EXCAVATION SAFETY PROTEC-TION DOLLARS and CENTS	LF	1,213.000	301
	7326	6002		REMOVE SANITARY SEWER MAIN DOLLARS and CENTS	LF	1,385.000	302
	7326	6003		REMOVE SANITARY SEWER MANHOLE DOLLARS and CENTS	EA	10.000	303
	7326	6004		8" PVC SANITARY SEWER LINE (115 PSI) DOLLARS and CENTS	LF	294.000	304
	7326	6005		8" PVC SANITARY SEWER LINE (160 PSI) DOLLARS and CENTS	LF	696.000	305
	7326	6006		SANITARY SEWER LATERALS DOLLARS and CENTS	LF	48.000	306
	7326	6007		SANITARY SEWER TWO-WAY CLEANOUT DOLLARS and CENTS	EA	6.000	307
	7326	6008		SANITARY SEWER MANHOLE (0'-6')(5' DIA.) DOLLARS and CENTS	EA	8.000	308
	7326	6009		XTR DPTH MNHL (> 6')(5' DIA.)(VRTCL FT) DOLLARS and CENTS	VF	31.100	309
	7326	6010		8" CARRIER PIPE (PVC)(115 PSI) DOLLARS and CENTS	LF	227.000	310

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	7326	6011		8" CARRIER PIPE (PVC)(160 PSI) DOLLARS and CENTS	LF	106.000	311
	7326	6012		16" STEEL CASING (SEWER) DOLLARS and CENTS	LF	333.000	312
	7326	6013		JACKING, BORING OR TUNNELING PIPE DOLLARS and CENTS	LF	82.000	313
	7326	6014		CONC ENCASE, CRAD, SADD, AND COL-LARS DOLLARS and CENTS	CY	.300	314
	7326	6015		SEWER MAIN TELE INSP (POST-CONSTR) DOLLARS and CENTS	LF	1,323.000	315
	7330	6001		2" PVC D-2241 SDR-21 PIPE INSTL DOLLARS and CENTS	LF	289.000	316
	7330	6002		3" PVC D-2241 SDR-21 PIPE INSTL DOLLARS and CENTS	LF	4.000	317
	7330	6003		6" PVC C-900 DR-14 PIPE INSTL DOLLARS and CENTS	LF	256.000	318
	7330	6004		8" PVC C-900 DR-14 PIPE INSTL DOLLARS and CENTS	LF	737.000	319
	7330	6005		8" PVC C-900 DR-14 PIPE INSTL CRY PIPE DOLLARS and CENTS	LF	438.000	320
	7330	6006		12" PVC C-900 DR-14 PIPE INSTL DOLLARS and CENTS	LF	23,531.000	321
	7330	6007		12" PVC C-900 DR-14 PIPE INSTL (C PIPE) DOLLARS and CENTS	LF	2,296.000	322

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	7330	6008		SRVCE RELAY SHRT 1" TY "K" COPPER DOLLARS and CENTS	EA	32.000	323
	7330	6009		SRVCE RLY LNG 1" TY "K" CPPR INCL. SLV DOLLARS and CENTS	EA	58.000	324
	7330	6010		2" GATE VALVES DOLLARS and CENTS	EA	4.000	325
	7330	6011		3" GATE VALVES DOLLARS and CENTS	EA	1.000	326
	7330	6012		6" GATE VALVES DOLLARS and CENTS	EA	2.000	327
	7330	6013		8" GATE VALVES DOLLARS and CENTS	EA	9.000	328
	7330	6014		12" GATE VALVES DOLLARS and CENTS	EA	60.000	329
	7330	6016		1" AIR RELEASE ASSEMBLIES DOLLARS and CENTS	EA	9.000	330
	7330	6017		2" AIR RELEASE ASSEMBLIES DOLLARS and CENTS	EA	9.000	331
	7330	6018		FIRE HYDRANT ASSEMBLY DOLLARS and CENTS	EA	34.000	332
	7330	6019		GREY IRON AND DUCTILE-IRON FITTINGS DOLLARS and CENTS	TON	6.970	333
	7330	6020		WATER TIE-IN (COMP) (2") DOLLARS and CENTS	EA	1.000	334

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	7330	6021		WATER TIE-IN (COMP) (3") DOLLARS and CENTS	EA	1.000	335
	7330	6022		WATER TIE-IN (COMP) (6") DOLLARS and CENTS	EA	2.000	336
	7330	6023		WATER TIE-IN (COMP) (8") DOLLARS and CENTS	EA	6.000	337
	7330	6024		WATER TIE-IN (COMP) (12") DOLLARS and CENTS	EA	19.000	338
	7330	6025		JACKING, BORING OR TUNNELING PIPE DOLLARS and CENTS	LF	790.000	339
	7330	6026		16" STEEL CASING (WATER) DOLLARS and CENTS	LF	438.000	340
	7330	6027		20" STEEL CASING (WATER) DOLLARS and CENTS	LF	2,296.000	341
	7330	6028		CONC ENCSEMNT, CRADLES SDDLES & COLLARS DOLLARS and CENTS	CY	63.000	342
	7330	6029		GROUT ABANDONMENT WATER MAIN (12 IN) DOLLARS and CENTS	LF	411.000	343
	7330	6030		REMOVE EXISTING WATER LINES DOLLARS and CENTS	LF	35,477.000	344

CERTIFICATION OF INTEREST IN OTHER BID PROPOSALS FOR THIS WORK

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

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

_____ YES

_____ NO

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

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

DISCLOSURE OF LOBBYING ACTIVITIES

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

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

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

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

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

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

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

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

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

FEDERAL USE ONLY	Authorized for Local Reproduction Standard Form - LLL

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

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

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

DISCLOSURE OF LOBBYING ACTIVITIES

Approved by OMB

0348-0046

CONTINUATION SHEET

Reporting Entity: _____ Page _____ of _____

CONTRACTOR'S ASSURANCE

(Subcontracts-Federal Aid Projects)

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

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

ENGINEER SEAL

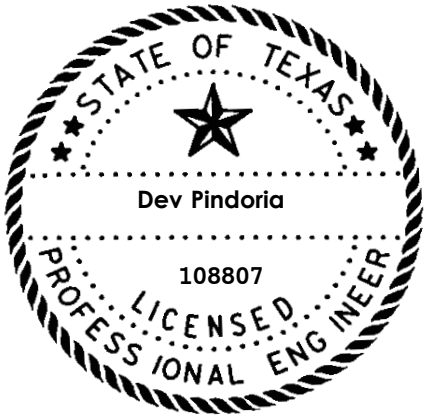
Control **0465-02-027, ETC.**

Project **STP 2023(954)MM, ETC.**

Highway **FM 1518**

County **BEXAR**

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



The seal appearing on this document was authorized by

Dev Pindoria, P.E.

APRIL 25, 2023

County: Bexar

Highway: FM 1518

**********GENERAL NOTES**********
2014 Specification Book

========== **Basis of Estimate** ==========

Item	Description	Rate/Area		Quant-Unit
168	Vegetative Watering	15.6 Gal/SY	409,692 SY	6,391.2 MG
247	FL BS (CIP)(TY D GR 1-2, OR 5) FINAL POS	36 yd/in	199,818 SY	44,404 CY
260	Lime (HYD, COM, or QK(SLRY))	100 lbs/SY-in (6% by wt.)	206,247 SY	4,950 Ton
310	Prime Coat (MC-30 or AE-P)	0.2 Gal/SY	193,377 SY	38,675 Gal
316	AGGR (TY-PB GR-4 SAC-B)	120 SY/CY	218,167 SY	1,818 CY
316	ASPH (AC-15P, AC-20-5TR, AC-20XP, AC10-2TR)	0.3 Gal/SY	218,167 SY	65,450 Gal
3077	Tack Coat	0.2 Gal/SY	265,567 SY	53,113 Gal
	- The Following Is For Information Only - Non Pay-			
166	Fertilizer	0.095 lbs/SY	408,421 SY	19.4 Ton

========== **Asphalt Concrete Pavement** ==========

Type	Location	Depth	Rate/Area		Quant-Tons
SP-C PG76-22	FM 1518/FM 78	2”	115 lbs/SY-in	207,954 SY	23,915 Ton
TY-B PG64-22	FM 1518	4”	110 lbs/SY-in	185,359 SY	40,779 Ton
TY-B PG64-22	FM 1518/FM 78	13.5”	110 lbs/SY-in	30,446 SY	22,606 Ton
TY-B PG64-22	FM 1518/FM 78	3.5”	110 lbs/SY-in	97 SY	19 Ton

--General--
The following State, District, Local and/or Utility Standards have been modified: MISC. CURB & SIDEWALK DETAILS (MOD), RW (MSE) DD (MOD), PDD(MOD), PJB(MOD), BBEB (MOD), BAS-A (MOD), BBND (MOD), BPBW (MOD).

Contact the Engineer when construction operations are within 400 feet of a signalized intersection to determine/verify the location of loop detectors, conduit, ground-boxes, etc. Repair or replace any signal equipment damaged by construction operations. The method of repair or replacement shall be pre-approved and inspected. Depending on the type and extent of the damage, the Engineer reserves the right to perform the repair or replacement work and the Contractor will be billed for this work.

Dale Picha: (210) 615-5810

Any materials removed and not reused and determined to be salvageable shall be stored within the project limits at an approved location or delivered undamaged to the storage yard as directed. Deface traffic signs so that they will not reappear in public as signs.

Any sign panels that are adjusted or removed and replaced, shall be done the same workday unless otherwise approved. This work shall be considered subsidiary to Item 502.

Notify the Engineer at least two weeks prior to a proposed traffic pattern change(s) that will require a revision to traffic signals.

Locate and reference all manholes and valves within the construction area with station and offset or GPS. Each manhole and valve shall be identified by its owner (City of Schertz, CPS, etc.). No roadwork will begin until this list has been submitted. All valves and manhole covers have to be accessible at all times, therefore; temp. CTB, material stockpiles, etc. cannot be placed over these valves or covers.

The Contractor has the option to adjust or construct all manholes and valves to final pavement elevations prior to the final mat of HMA or after final mat of HMA. If between the final elevation adjustment and the final mat of HMA, the manholes and valves are going to be exposed to traffic, place temporary asphalt around the manhole and valve to provide a +/- 50:1 taper. The cost of elevation adjustment and the concrete apron around the manhole and valve will be part of the manhole and valve work. The asphalt tapers are part of the HMA work.

Hurricane Evacuation

Hurricane Season is from June 1 thru November 30. As the closest metropolitan city inland from the Texas Coast, the City of San Antonio is a major shelter destination during mandatory hurricane evacuations. As such, planned work zone lane or road closures may be restricted and/or suspended during mandatory hurricane evacuation operations. The District will coordinate these restrictions at a minimum H-120 from any projected impact to the Texas Coast.

No time charges will be made if the Engineer determines that work on the project was impacted by the hurricane.

The Engineer may order changes in the Traffic Control Plan to accommodate evacuation traffic, and may suspend the work, all or in part, to ensure timely completion of this work. All work to implement changes in the Traffic Control Plan will be paid through existing bid prices or through Item 9.5, Force Account. However, the Department will not entertain any request for delay damages, loss of efficiency that may be attributed to the restriction or suspension of road or lane closures, or to changes in the Traffic Control Plan.

The Contractor should be aware that the "City Public Service" (CPS) will be consulted by the Engineer in matters concerning the execution of the work, materials and testing related to the

CPS work. As such, a CPS employee may be observing the construction and related operations as they progress.

If a sanitary sewer overflow (SSO) occurs:

1. Attempt to eliminate the source of the SSO.
2. Contain sewage from the SSO to the extent possible to prevent contamination of waterways.
3. Call City of Schertz at (210) 619-1819.

The Contractor should be aware that the City of Schertz will be consulted by the Engineer in matters concerning the execution of the joint bid Water and/or Sanitary work. This may include reviewing material submittals and testing related to this work, as well as inspection and observation of the actual work. As such, a City of Schertz employee may be reviewing submittals and test results as well as observing the construction and related operations as they progress.

Submit locate request for City of Schertz water and sewer to Paul Lopez, Public Works Supervisor at PLopez@schertz.com.

In accordance with the Underground Facility Damage Prevention Act (One Call Bill) the phone number for a utility locator is 811. It is the Contractor's responsibility to plan for utility locators as needed.

Underground utilities owned by the Texas Department of Transportation may be present within the Right-Of-Way. Call or email the TxDOT offices listed below for locates a minimum of 48 hours in advance of excavation. If city or town owned irrigation facilities are present, call the appropriate department of the local city or town a minimum of 48 hours in advance of excavation. The Contractor is liable for all damages incurred to the above-mentioned utilities when working without having the utilities located prior to excavation.

For signal and ITS locates call TransGuide at 210-731-5136 or email sat_its_locates@txdot.gov for ITS locates and signal.request@txdot.gov for signal locates.

Contractor questions on this project are to be addressed to the following individual(s):
Christen D. Longoria, PE (Area Engineer), Christen.Longoria@txdot.gov

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

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

County: Bexar

Highway: FM 1518

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

The Contractor must measure the vertical clearance at each structure after the final surface of the roadway is completed and provide the vertical clearance measurement to the Engineer.

--Item 5--
Taper ACP placed at curb inlets, traffic inlets and slotted drains.

A horizontal boom or equivalent equipment is required for construction in the vicinity of the CPS Energy electric lines to provide vertical clearance of equipment during construction. Contact CPS Energy Utility Coordination Group sixteen (16) week in anticipation of pole bracing. The estimated duration for pole bracing is 6 to 10 weeks (or longer if temporary construction easements are required) after invoice is paid. For de-energizing or sleeving of the overhead electrical lines depicted on the plans, please contact CPS Energy Utility Coordination Group sixteen (16) week in anticipation of needed de-energization. The estimated duration for de-energizing is approximately 4 to 6 weeks (after invoice is paid) but could vary on system scenario and back feed requirements. De-energizing may not be possible in all instances or may be restricted during specific periods of time due to load demand. Contractor will be reimbursed for the invoice cost for pole bracing and/or de-energizing or sleeving through force account.

Prevention of Migratory Bird Nesting

It is anticipated that migratory birds, a protected group of species, may try to nest on bridges, culverts, vegetation, or gravel substrate, at any time of the year. The preferred nesting season for migratory birds is from February 15 through October 1. When practicable, schedule construction operations outside of the preferred nesting season. Otherwise, nests containing migratory birds must be avoided and no work will be performed in the nesting areas until the young birds have fledged.

Structures

Bridge and culvert construction operations cannot begin until swallow nesting prevention is implemented, until after October 1 if it's determined that swallow nesting is actively occurring, or until it's determined swallow nests have been abandoned. If the State installed nesting deterrent on the bridges and culverts, maintain the existing nesting deterrent to prevent swallow nesting until October 1 or completion of the bridge and culvert work, whichever occurs earlier. If new nests are built and occupied after the beginning of the work, do not perform work that can interfere with or discourage swallows from returning to their nests. Prevention of swallow nesting can be performed by one of the following methods:

County: Bexar

Highway: FM 1518

1. By February 15 begin the removal of any existing mud nests and all other mud placed by swallows for the construction of nests on any portion of the bridge and culverts. The Engineer will inspect the bridges and culverts for nest building activity. If swallows begin nest building, scrape, or wash down all nest sites. Perform these activities daily unless the Engineer determines the need to do this work more frequently. Remove nests and mud through October 1 or until bridge and culvert construction operations are completed.

2. By February 15 place a nesting deterrent (which prevents access to the bridge and culvert by swallows) on the entire bridge (except deck and railing) and culverts. This work is subsidiary to the various bid items.

No extension of time or compensation payment will be granted for a delay or suspension of work caused by nesting swallows.

Provide a non-intrusive back-up alarm system on all heavy equipment used in close proximity to residential areas. This item is subsidiary to various bid items.

When a precast or cast-in-place concrete element is included in the plans, a precast concrete alternate may be submitted in accordance with "Standard Operating Procedure for Alternate Precast Proposal Submission" found online at https://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/publications/bridge.html#design. Acceptance or denial of an alternate is at the sole discretion of the Engineer. Impacts to the project schedule and any additional costs resulting from the use of alternates are the sole responsibility of the Contractor.

Excavation within 5 feet of an existing CPS Energy pole will require pole bracing. Contact CPS Energy utility coordination to request pole bracing (Customer Engineering 210-353-4050). The estimated duration for the pole bracing process is approximately 10 to 15 weeks.

--Item 6--
Show the stockpile lot and/or sub lot numbers on all tickets for all materials.

Steel Wrapped or Asbestos Utility Lines:

Existing steel wrapped natural gas and/or asbestos cement (AC) water lines that will no longer be in service are usually abandoned in place (AIP). However, if any of these lines have to be removed for whatever reason (in the way of other construction, to make tie-ins, etc.), comply with Item 6.

If removal of AC water lines is included in the construction contract, then notify the Engineer of proposed dates of removal of the AC water lines in accordance to Item 6. Excavate to the top of the AC water line to allow a separate contractor hired by the State to remove the AC water line. The excavation for the AC water line removal is subsidiary to the work that created the need for the removal (excavation for structures, roadway, a new line, tie-ins, etc.).

County: Bexar

Highway: FM 1518

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

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

--Item 7--
The project's total disturbed area is _87.41 AC_. The disturbed area in all project locations and Contractor project specific locations (PSL's), within 1/4 mile of the project limits, 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. Obtain any required authorization from the TCEQ for any PSL's on or off the ROW. When the total area disturbed on the project and PSL's within 1/4 mile of the project exceeds 5 acres, provide a copy of the Contractor NOI for PSL's to the Engineer (to the appropriate MS4 operator when the project is on an off-state system route).

Notify the Engineer of the disturbed acreage within one (1) mile of the project limits. Obtain authorization from the TCEQ for Contractor PSL's for construction support activities on or off ROW.

Roadway closures during the following key dates and/or special event are prohibited.
See the general notes under Item 502 for these dates.

--Item 8--
Working days will be computed and charged in accordance with Article 8.3.1.4: Standard work week.

A Special Provision to Item 8 for a delayed authorized date to begin work has been included in the contract. The reason for including the Special Provision is for material processing or contractor mobilization.

Create and maintain a _Critical Path Method (CPM)_ schedule.

The CPM schedule shall be created and maintained using software fully compatible with Primavera Project Planner version P6 Professional R15.2 .

Disincentive using road-user cost will be paid in accordance with special provision 008---006.

County: Bexar

Highway: FM 1518

The road-user cost liquidated damages shall be $_10,667_ per day.

Notes for Milestones

Substantial Completion of Work is defined in Special Provision to Item 8.

Milestone 1
See the traffic control plans (TCP) for a detailed description of the work included in Milestone 1.

The daily road-user cost for disincentive for Milestone 1 will be $_5,000_ per day.

The contractor will have _4_ working days for Substantial Completion of Work for Milestone 1.

Working day time charges for Milestone 1 will be computed and charged in accordance with Article 8.3.1.4 : Standard Work Week.

The time charges for the purpose of computing disincentive for Milestone 1 will begin when traffic is moved to the lane arrangement shown in the TCP for Milestone 1.

The time charges for the purpose of computing disincentive for Milestone 1 will end with Substantial Completion of Work for Milestone 1.

Failure of Substantial Completion of Work for Milestone 1 within the established number of working days shown above will result in the assessment of disincentives using the daily road-user costs shown above for each working day more than those allowed for Milestone 1.

--Item 9--
When approved, provide uniformed, off-duty law enforcement officers with marked vehicles during work that requires a lane closure. The officer in marked vehicles shall be located as approved to monitor or direct traffic during the closure. The method used to direct traffic at signalized intersections shall be as approved. Additional officers and vehicles may be provided when approved or directed.

Complete the daily tracking form provided by the department and submit invoices that agree with the tracking form for payment at the end of each month approved services were provided.

Show proof of certification by the Texas Commission on Law Enforcement Standards.

All law enforcement personnel used in Work Zone Traffic Control shall be trained for performing duties in work zones and are required to take “Safe and Effective Use of Law Enforcement Personnel in Work Zones” (Course #133119) which can be found online at the following site: www.nhi.fhwa.dot.gov

County: Bexar

Highway: FM 1518

Certificates of completion should be available to all who finish the course. These should be kept by the officers to substantiate completion when reporting to the work site.

Minimums, scheduling fees, etc. will not be paid; TxDOT will consider paying cancellation fees on a case-by-case basis.

--Item 100--

Trim and remove brush and trees within the stations noted in the plans and as needed for construction operations. Unless shown otherwise in the plans or a designated non-mow area, perform trimming or removal for areas to the ROW limits. Trim or remove to provide minimum of 5 ft. of horizontal clearance and 7 ft. of vertical clearance for the following: sidewalks, paths, guard fence, rails, signs, object markers, and structures. Trim to provide a minimum of 12 ft. vertical clearance under all trees.

Obtain approval for proposed method of tree and brush trimming and removal. Vertical flailing equipment is not allowed. Treat damaged or cut branches, roots and/or stumps of all oak trees with a commercial tree wound dressing. Disinfect all pruning tools with a solution of 70% alcohol before moving from one tree to another. Unless otherwise approved remove all resulting vegetative debris from the ROW within 24 hours. The Engineer can stop all construction operations if the dressing, cut and removal requirements are not followed.

Removal and disposal of existing abandoned utilities that were unable to be identified before letting required to support this project's construction shall be performed under the overall Preparing Right of Way. If you are uncertain whether the utility is active, contact the District Utility Section.

--Item 132--

Type C embankment material must be approved by the engineer before use on the project. If treated with calcium-based chemicals, furnish embankment with sulfate content less than 3000ppm. In any location where the Type C Embankment is within 5' of top of subgrade the sulfate content must be less than 3000ppm. Type C embankment must be free from vegetation or other objectionable material and meet the requirements of the Table below:

Table 1

Description	Percent Retained- Sieve				LL	PI	PI
	3"	3/8"	#4	#40	Max	Max	Min
Embankment (ORD COMP)(TY C)	0	-	30-75	50-85	50	20	6

--Item 162--

Furnish and place Bermuda (Cynodon dactylon) grass sod.

--Item 164--

Equipment manufactured for planting grain crops is acceptable for planting temporary cool season seeds, but not for planting the permanent seed mix.

County: Bexar

Highway: FM 1518

--Item 166--
Use a fertilizer with an analysis of 13-13-13 (50% of the total N must be sulfur coated urea) to apply 60 lbs of actual N per acre. This requires 460 lbs of 13-13-13 per acre or .095 lbs per SY of area.

--Item 168--
Apply vegetative watering as needed to supplement natural rainfall during the vegetation establishment period. Plan quantity of irrigation water is based on the application of a total of 1.3 gal of water each week for each sq. yd. of area that is sodded or seeded. Establishment time is estimated to be 12 weeks for both sod and permanent seed mixes. Temporary seeding will require less time for establishment. Provide a schedule and coordinate watering cycles and rates per cycle with the Engineer. Obtain approval if the quantity of water to be applied is expected to exceed the plan quantity. Adjust the amount of water applied with each cycle and the number of cycles each wk. according to actual site conditions. Drought or other conditions, as determined by the Engineer, may require the application of supplemental irrigation during hours other than normal working hours.

--Item 247--
There is no minimum PI requirement for this project.

--Item 302--
Previously tested aggregates found to contain excessive quantities of dust (more than 0.5 percent passing the No. 40 sieve) during precoating, stockpiling or hauling operations, may be rejected. Use Test Method Tex-200-F, Part I for testing.

--Item 316--
Asphalt season will be year-round but meet temperature limitations specified in the standard specifications for Item 316.

Ensure that the asphalt for precoating the aggregate and the asphalt used for the surface treatment will not result in a reaction that may adversely affect the bonding of the aggregate and asphalt during the surface treatment operation.

Do not add bag house fines in the production of precoated material.

Clean all concrete curbs, islands, medians, etc. that get coated with asphalt.

--Item 320--
Construct all longitudinal ACP joints adjacent to a travel lane with a joint maker device that will create a 3:1 to 6:1 taper. For placement of 2 inches or more, the device shall provide a maximum ½ inch vertical edge. Taper outside edges (next to the grass) or backfill (shoulder-up) the same day.

Provide a material transfer device capable of providing a continuous flow of material to the paver. The material transfer device will consist of a windrow elevator or better.

--Item 420--
Pier and Bent Concrete will be paid for as "Plans Quantity".

--Item 421--
Use an automated ticket that contains the same information as shown in the standard specification. Submit the ticket for approval prior to use. The concrete producer will contact the District Laboratory or the Engineer's Office (outside the San Antonio area) to inform TxDOT of scheduled structural concrete batching. The Engineer may suspend concrete operations if ticket information is incomplete/incorrect.

Entrained air is allowed for Class P and Class HES concrete only. Air content testing is waived for all classes of concrete.

Poly-fiber reinforced concrete may be used as an option, with the approval by the Engineer, for riprap, sidewalk, curb/gutter, and mow strip. Use a TxDOT approved manufacturer or producer for the poly-fiber. The poly-fibers shall be combined with the concrete in proportions as recommended by the manufacturer. A concrete mix design must be approved by the Engineer.

--Item 422--
For construction of approach slabs, longitudinal joints shall be placed on lane lines. Joints may be either a saw-cut crack control joint or a construction joint. Saw cut joints shall terminate 1'-0" before reaching the edge of the slab, must be saw cut as soon as possible after placement of concrete, and will be cut within 12 hours of concrete placement. Once sawing begins, it should be a continuous operation and should only be stopped if raveling occurs. Saw cut will be to a depth of 1.5" and filled with approved joint sealant.

--Item 423--
The backfill material for precast retaining walls shall be approved before placement. Build stockpile(s) in lifts not to exceed 2 feet and a minimum working face of not less than 10 feet, but not more than 20 feet.

Use the approved Mechanically Stabilized Earth (MSE) wall systems listed at:
http://www.txdot.gov/business/resources/approved-systems/mse-wall.html

When proprietary wall systems are used, a qualified representative of the retaining wall manufacturer must be available upon request during wall construction. As requested, or required the manufacturer's representative must be on site to assist with the initial stages of wall construction, provide training to the Contractor wall crew and ensure proper interpretation of MSE wall shop drawings and details. Specific attention must be given to nonstandard wall installation details. The Contractor's wall crew foreman must be on site for the duration of wall construction. Any change to the wall crew foreman may require additional training by the wall

supplier. The Contractor will ensure that the retaining walls are installed per the details presented in the construction drawings and as per the proprietary wall system requirements. The Engineer reserves the right to suspend wall construction activities due to any construction issue encountered.

Type DS material will be required on MSE walls in the area of the reinforcement mats.

--Item 425--
Vertical clearance over roadway at the following location(s) is(are) less than or equal to 20 feet. Provide Bars C and CH for the full length of the girder per the IGD standard.

- FM 78 Overpass at Aztec Way

--Item 462--
The following structures shall be pre-cast:
ALL CULVERTS.

--Item 465--
Concrete Class B invert shaping is required at all inlets, manholes and junction boxes to insure positive flow. The material and work performed for the placement of the inverts shall be considered subsidiary to this item.

--Item 500--
"Materials on Hand" payments will not be considered in determining percentages for mobilization payments.

--Item 502--
General

In addition to providing a Contractor's Responsible Person and a phone number for emergency contact, have an employee available to respond on the project for emergencies and for taking corrective measures within 2 hours or within a reasonable time frame as specified by the Engineer.

Treat the pavement drop-offs as shown in the TCP.

Avoid placing stockpiles, equipment, and other construction materials within the roadway's horizontal clear zone or at any location that will constitute a hazard and will endanger traffic. If a stockpile is placed within the clear zone, address in accordance with the TMUTCD.

If Nighttime work is required and work is not behind positive barrier then full Class 3 reflective gear is required to be worn by all workers, hard hat halos are required to be worn by the flaggers at flagging stations, TY III barricades are required to be spaced at 500 ft, and a mandatory night work meeting is required.

County: Bexar

Highway: FM 1518

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

Access to adjoining property must be maintained at all times.

Barricades, Signs, and Traffic Control Devices

When advanced warning flashing arrow panels and/or changeable message sign is specified, have one standby unit in good condition at the job site. Standby time shall be considered subsidiary to the bid item.

After written notification, the time frame is provided on the Form 599 to provide properly maintained signs and barricades before considered in non-compliance with this item.

Temporary Rumble Strips are to be used according to WZ (RS)-22.

Use 1 number of rumble strip arrays.

Moving an existing sign to a temporary location is subsidiary to Item 502. Installations with permanent supports at permanent locations will be paid for under the applicable bid item(s).

Cover permanent signs if not used. This is subsidiary to Item 502.

Lane and Ramp Closures and Detours

Notify the Engineer in writing 10 business days in advance of any temporary or permanent lane, ramp, connector, etc. closures/detours, restrictions to lane widths, alterations to vertical clearances, or modifications to radii. Any other modifications to the roadway that may adversely affect the mobility of oversized/overweight trucks also require 10 business days advance written notice to the Engineer. At least one lane must always remain open.

For closures not listed in the TCP; the lane closures are limited to between the hours of 9 AM to 4 PM , and at least one lane must remain open at all times.

At no time shall two consecutive intersecting roadways be closed at one time during construction.

At no time shall two consecutive ramps be closed at one time during construction or overlay operations.

Unless otherwise noted in the plans and/or as directed by the Engineer, daily lane closures shall be limited according to the following restrictions:

Nighttime: 9 PM to 5 AM.
(With uniformed off duty law enforcement officers)

Weekend closures when approved by the Engineer.

No lane closures will be permitted for the following dates and/or special events:
Between December 15 and January 1
Fiesta Week and Sales Tax Holidays (Bexar County Only)
Wednesday before Thanksgiving thru the Sunday after Thanksgiving
Saturday and Sunday before Memorial Day and Labor Day
Saturday or Sunday when July 4 falls on a Friday or Monday
Election days (Bexar County Only)
During major events at the AT&T Center (Spurs home games, Rodeo, concerts, etc.)
Alamodome, and/or Convention Center (Bexar County Only)
Easter Weekend: March 30-31, 2024; April 19-20, 2025; April 4-5, 2026; March 27-28, 2027

Traffic Signals

There are traffic signals at the intersection of FM 1518 at FM 78, FM 1518 at W. Schaefer Rd., FM 1518 at Lower Seguin Rd., and FM 1518 at IH 10. Always keep the signals in operation except when necessary for specific installation operations, including any modifications to existing signal heads to always maintain clear visibility. Adjustment of any signal head will be subsidiary to Item 502. When it is necessary for a signal to be turned off, or when left-turn lanes are closed, hire off duty police officers to control the traffic until the signals are back in satisfactory condition.

Moving or adjustment of traffic signal heads, VIVDS, and radar detection for the purpose of alignment with the shifting of lanes in conjunction with the traffic control plan will be subsidiary to various bid items.

Coordinate with the appropriate entity (City of San Antonio and City of Schertz) or TxDOT when left-turn lanes are closed and/or for signal timing revisions as necessary.

Hauling

The use of rubber-tired equipment will be required for moving dirt or other materials along or across pavement surfaces. Where the contractor desires to move any equipment not licensed for

operation on public highways, on or across pavement, they shall protect the pavement from damage as directed/approved by the Engineer.

Throughout construction operations, the Contractor will be required to conduct their hauling operations in a manner such that vehicles will not haul over previously recompacted subgrade or compacted base material, except in short sections for dumping manipulations.

The Contractor shall keep the roadway clean and free of dirt or other materials during hauling operations. If the Contractor does not maintain a clean roadway, they shall cease all construction operations, when directed by the Engineer, to clean the roadway to the satisfaction of the Engineer.

--Item 504--
For field office Type E Structure. Provide at least 1,200 sq. ft. of gross floor area in rooms 8 ft. high. Partition the floor area into at least 4 interconnected rooms with doors, 2 exterior doors, and at least 2 windows in each room. Provide at least 10 parking spaces for pull-through parking.

Enclose the field office, laboratory and the parking area as shown in 504.2.1.1 and provide security lighting.

Provide high speed internet service with WIFI signal and a laser jet printer/scanner/copier as directed.

Provide essential supplies, including: toilet paper, hand soap, paper towels, printing paper, potable water, and printer ink.

Provide a Type E Structure for a Concrete Field Laboratory with at least 200 sq. ft. of gross floor area in a room 8 ft. high, furnished with an exterior door and at least 2 windows. Provide required equipment for testing (moist cabinet, moist room, or water storage tank in accordance with Tex-498-A, Table 32 and Concrete Compression Testing Machine in accordance with Tex-498-A, Table 18). Provide associated calibration documents, as outlined in Tex-498-A, for all contractor provided testing equipment.

A Type D Structure (Asphalt Mix Control Laboratory) is required for all projects that do not have a previously approved laboratory structure for TxDOT's exclusive use. The structure will include high speed internet service with WIFI signal, one desk, two chairs, and one file cabinet.

All labs and offices will include cleaning at least once a week. The cleaning will include sweeping and mopping of floors, cleaning the toilet and lavatory, and emptying wastebaskets. Space heaters are not considered adequate heating.

--Item 506--
An Inspector will perform a regularly scheduled SWP3 inspection every 7 calendar days.

County: Bexar

Highway: FM 1518

Failure to address items noted on the SW3P inspection report within two report cycles may result in the Department stopping all construction operations, exclusive of time charges, or withholding that month's estimate until the SW3P deficiencies are corrected unless the Engineer determines that the area is too wet to correct SW3P deficiencies.

Failure to correctly maintain daily monitoring reports and submitting to TxDOT on a daily/weekly basis may result in the monthly estimate being withheld.

--Item 512--
More than one shape type of CTB may be furnished on a project, although no mixing of CTB shape types will be permitted along a continuous segment of CTB.

CTB reflectors will not be paid for directly but will be considered subsidiary to the barrier.

--Item 529--
Curb inlets and extensions are based on an exposed curb height of 7 inches. The roadway curb height and shape will be transitioned to the inlet's curb with a 40: 1 taper.

--Item 531--
The curb ramp locations shown in the plans have considered the geometric features of the intersection, traffic signals, and the pavement markings. If anything changes during construction, the location of curb ramps must be adjusted to ensure they meet TAS requirements.

--Item 540--
Guard fence posts placed in proposed and/or existing areas of riprap, sidewalks or other concrete shall have an 18 inch +/- (square or round) leave-out in the concrete as shown in the state standard for MBGF Mow Strip. After the posts are installed, fill the leave-outs with a Grout mixture as shown in the state standard for MBGF Mow Strip.

When connecting a Thrie-Beam to a concrete wingwall, bridge rail, CTB, etc., drill the holes for bolt placement using rotary or core type equipment. Use a core type drill when reinforcing steel is encountered. Do not use percussion or impact drilling. Repair damage to the concrete and spalls exceeding ½" from the edge of the hole.

--Item 545--
See the Crash Cushion Summary Sheet.

--Item 556--
Coarse Aggregate Grade 3 meeting requirements of Item 421, Table 4, is acceptable for Filter Material.

--Item 585--
Use Surface Test Type B, pay adjustment schedule 2 to evaluate ride quality of travel lanes.

County: Bexar

Highway: FM 1518

--Item 618--
It might be necessary to cut concrete for placement of conduit. Saw cut existing concrete, remove the concrete from the steel reinforcement (bars or fabric) and bend the steel to install the conduit. After the conduit has been placed, bend the steel back to its original position and back-fill the trench with an approved concrete. This work is subsidiary to this Item.
The conduit depth for illumination under the City of San Antonio streets is 36 inches.

--Item 628--
Make all arrangements for electrical service, and compliance with local standards and practices for proper installations.

--Item 644--
The wedge anchor system shown on State Standard Sheet SMD (TWT) is not allowed.

Triangular Slipbase Systems with set screws are not allowed.

--Item 666--
Use TY II markings (vs. an acrylic or epoxy) on asphalt surfaces as the sealer for the TY I markings, unless otherwise approved by the Engineer.

--Item 672--
Place all adhesive material directly from the heated dispenser to the pavement. Do not use portable or non-heated containers. Use adhesive of sufficient thickness so that when the marker is pressed into the adhesive, 1/8" or more adhesive will remain under 100% of the marker. The adhesive should extend not less than 1/2" but not more than 1 1/2" beyond the perimeter of the marker.

--Item 677--
Obtain approval before using the mechanical method for the elimination of existing thermoplastic pavement markings.

--Item 680--
Furnish and install all required materials and equipment necessary for the complete and operating traffic signal installation at the following intersections:
FM 1518 at FM 78, FM 1518 at W. Schaefer Rd., FM 1518 at Lower Seguin Rd., and FM 1518 at IH 10.

The locations shown on the plans for signal pole foundations, controller foundations, conduit and other items may be adjusted to better fit field conditions as approved.

Furnish and install a new Henke Enterprises or Mobotrex eight-phase NEMA TS2 Type 2 controller and cabinet, meeting the requirements of Departmental Materials Specifications DMS-11170. Provide detector panel toggle switches that additionally permit the user to disconnect the

detector. For both ground and pole-mount cabinets, provide cabinet configuration with 16 position load bay.

Deliver TS type 2 controller cabinet and assembly to the TxDOT San Antonio district signal shop for programming and testing two weeks in advance prior to contractor installing equipment in the field. Coordinate drop off and pick up with Mark Perez (210) 218-7430.
Connect all field wiring to the controller assembly into the polyphaser. The Signal Shop representative will assist in determining how the detection cables are to be connected, and will also program the controller for operation, hook up the malfunction management unit (MMU) or conflict monitor, detector units, and other equipment, and turn on the controller. Have a qualified technician on the project site to place the traffic signals in operation.

Once final punch list is complete, contractor is allowed to begin flashing signal operations. Signal shall flash for a minimum of 7 days prior to full operation, unless otherwise approved by the Engineer.

Use LED lamps from the prequalified material producer lists as shown on the Texas Department of Transportation (TxDOT) – Construction Division's (CST) material producer list. Category is "Roadway Illumination and Electrical Supplies." under item 610. No substitutions will be allowed for materials found on this list.

Demonstrate that the field wiring is properly installed. Install the electrical equipment in a neat and workmanlike manner.

Use the following wiring sequence when connecting signal sections to the cabinet:

Conductor No.	Base Color	Tracer Color	Signal Face
1	Black		Yellow Ball
2	White		Neutral
3	Red		Red Ball
4	Green		Green Ball
5	Orange		Yellow Arrow
6	Blue		Green Arrow
7	White	Black	Spare

All existing signal equipment with the exception of the signal controller and related equipment become the property of the Contractor. Deliver the controller and related equipment to the Signal

shop, located at 4615 NW Loop 410 (corner of IH 410 and Callaghan Road) in San Antonio, Texas or to the Area Office as directed.

Use qualified personnel to respond to and diagnose all trouble calls during the thirty-day test period. Repair any malfunction to Contractor-supplied signal equipment. Provide to the Engineer a local telephone number, not subject to frequent changes and available on a 24-hour basis, for reporting trouble calls. Response time to reported calls must be less than 2 hours. Make appropriate repairs within 24 hours. Place a logbook in the controller cabinet and keep a record of each trouble call reported. Notify the Engineer of each trouble call. Do not clear the error log in the conflict monitor or MMU during the thirty-day test period without approval.

Field verify the depths of the drill shafts to meet the minimum clearances specified in the plans before ordering materials.

--Item 682--
Pedestrian signals may be by a different manufacturer than the vehicle signal heads.

Cover all signal faces until placed in operation. This work is subsidiary to various bid items.

All mounting attachments shall be constructed of steel pipe and mounted as shown on the plans.

--Item 684--
Provide an extra 10’ for each cable terminating in the controller cabinet. All cables must be continuous without splices from terminal point to terminal point. All proposed signal cable must be #12 AWG stranded copper.

--Item 686 & 687--
Provide all signal poles from the same manufacturer. Pedestrian poles may be from a different manufacturer.

--Item 688--
The button placement must be coordinated with the concrete pad to access the button according to ADA and TAS. If any mounting modifications are needed (extensions, brackets, etc.) to meet ADA and TAS requirements the adjustment will be subsidiary to Item 688. The concrete pad (if required) will be paid separately.

The pedestrian push button must be wired with a 2/C#14 loop detector cable in lieu of a #12 A.W.G. XHHW wire.

Furnish and install new Polara Enterprises accessible pedestrian signals (APS) push buttons or approved equivalent.

County: Bexar

Highway: FM 1518

--Item 730--
Mow full-width and hand trim the right of way, including newly seeded or sodded areas, when vegetation reaches a height of 16" or when directed. Removal of brush sprouts growing within guardrail, concrete barriers or at other locations where mowing or hand trimming is done within the limits of construction is required and subsidiary to this item. Mowing may be required more often in newly sodded or seeded areas than in other parts of the project because of the supplemental irrigation these areas receive and the resulting weed growth. Coordinate mowing to avoid rutting or compaction of the soil when mowing where supplemental irrigation is being used. Use mowing equipment that will not adversely affect soil retention blankets or mulches that have been applied. Work performed under this item does not replace the mowing required when placing permanent seeding in an area that has established temporary seeding as described in Article 164.3, Construction.

--Item 734--
Perform Litter Removal once a month or as directed by the Engineer.

--Item 735--
Perform Debris Removal as directed by the Engineer.

--Item 738--
Perform Cleaning and Sweeping Highways once a month or as directed by the Engineer.

--Item 3076, 3077, 3079, 3080, 3081, & 3082 --

1. Table 10 in Item 3076 and Table 11in Item 3077, Hamburg Wheel Test Requirements tested in accordance with Tex-242-F are changed for PG 64-22 or lower and PG 70-22. Minimum number of passes at 12.55 mm Rut Depth, Tested at 50 degrees C will be 5,000 and 10,000 respectively.

2. Submit a copy of the Tex 233-F production charts on a weekly basis. At the end of the ACP work, provide all originals.

3. Crushing of aggregate for hot mix and immediate use for production of the mix is not allowed. Stockpile the aggregate until enough material is available for five days of production unless prior approval is provided

4. Hold a pre-paving meeting one month prior to the placement of the hot mix. The date and time of pre-paving meeting should be coordinated with the Engineer prior to scheduling.

5. Do not use diesel or solvents as asphalt release agents in production, transportation, or construction. A list of approved asphalt release agents is available from the District Laboratory.

6. No more than one hot mix lot will be open for any specific type of hot mix, unless authorized. After a lot is open and the Contractor gets approval to change plants, the previous lot will be closed, and a new lot will be opened. The numbering for the lots produced at the new plant will

start with No. 1. If allowed to switch back to the original or previous plant, the next lot from that plant will resume numbering sequentially from the last lot produced by that plant.

--Item 4171--
Install bridge identification numbers shown below for each of the following listed bridges in accordance with the special specification and San Antonio District Standard. Install the bridge identification number on two locations as shown on the plans, or as directed. For bridges in a two-way condition, install the bridge identification number on each outside beam on the upstream side of traffic. For bridges in a one-way condition, install the bridge identification number on each side, opposite corners on each outside beam. For culverts less than 5 ft. in height, install the bridge identification number on the headwall on upstream and downstream location. For culverts greater than 5 ft. in height, install the bridge identification number inside the first barrel on the upstream side of traffic and inside the last barrel on the opposite corner in the direction of traffic.

FM 78 at Cibolo Creek	NBI 15-015-0-0025-09-227
FM 1518 at Woman Hollering Creek	NBI 15-015-0-0465-02-194

--Item 6185--
5 shadow vehicles with TMA will be required for this project. The TMA's will be measured and paid for by the DAY for each TMA/TA set up and operational on the worksite. The contractor will be responsible for determining if one or more of these operations will be ongoing at the same time to determine the total number of TMA's needed for the project. See TMA and TA Summary sheet in the plans.

--Item 6292--
Radar presence detection device must utilize true-presence detection. Systems using locking algorithms to attempt presence detection will not be accepted. In addition, radar systems will not be allowed to use extensions/delays or place the controller on locking detection to aid in presence detection.

Radar presence detection device must be able to detect up to 10 lanes with a minimum offset of 6' and have at least 16 zones and channels per unit.

Radar presence detection device must be mounted on the same side of the intersection as the lanes it is set to detect.

Final placement of radar devices must be approved by the engineer.

Furnish and install new Wavetronix SmartSensor Matrix, or approved equivalent, for radar presence detectors and Wavetronix SmartSensor Advance, or approved equivalent, for radar advanced detection devices.

CONTROL : 0465-02-027, ETC
PROJECT : STP 2023(954)MM, ETC
HIGHWAY : FM 1518
COUNTY : BEXAR

TEXAS DEPARTMENT OF TRANSPORTATION

GOVERNING SPECIFICATIONS AND SPECIAL PROVISIONS

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

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

ITEMS 1 TO 9 INCL., GENERAL REQUIREMENTS AND COVENANTS
ITEM 100 PREPARING RIGHT OF WAY (103)
ITEM 104 REMOVING CONCRETE
ITEM 105 REMOVING TREATED AND UNTREATED BASE AND ASPHALT PAVEMENT
ITEM 110 EXCAVATION (132)
ITEM 132 EMBANKMENT (100)(160)(204)(210)(216)(260)(400)
ITEM 160 TOPSOIL (168)
ITEM 162 SODDING FOR EROSION CONTROL (166)(168)
ITEM 164 SEEDING FOR EROSION CONTROL (162)(166)(168)
ITEM 168 VEGETATIVE WATERING
ITEM 169 SOIL RETENTION BLANKETS
ITEM 247 FLEXIBLE BASE (105)(204)(210)(216)(520)
ITEM 260 LIME TREATMENT (ROAD-MIXED) (105)(132)(204)(210)(216) (247)(300)(310)(520)<3096>
ITEM 310 PRIME COAT (300)(316)<3096>
ITEM 316 SEAL COAT (210)(300)(302)(340)(520)<3096>
ITEM 400 EXCAVATION AND BACKFILL FOR STRUCTURES (110)(132)(401) (402)(403)(416)(420)(421)(423)
ITEM 401 FLOWABLE BACKFILL (421)
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)<458><556>
ITEM 425 PRECAST PRESTRESSED CONCRETE STRUCTURAL MEMBERS (409) (420)(421)(424)(426)(427)(434)(440)(442)(445)

ITEM 429 CONCRETE STRUCTURE REPAIR (421)(431)(440)(780)
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 (442)
ITEM 460 CORRUGATED METAL PIPE (400)(402)(403)(445)(467)(476)
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)(471)
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 504 FIELD OFFICE AND LABORATORY
ITEM 506 TEMPORARY EROSION, SEDIMENTATION, AND ENVIRONMENTAL CONTROLS (161)(432)(556)
ITEM 508 CONSTRUCTING DETOURS
ITEM 512 PORTABLE 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)<341>(360)(421)(440)<3076>
ITEM 531 SIDEWALKS (104)(360)(420)(421)(440)(530)
ITEM 540 METAL BEAM GUARD FENCE (421)(441)(445)<492>(529)
ITEM 542 REMOVING METAL BEAM GUARD FENCE
ITEM 544 GUARDRAIL END TREATMENTS
ITEM 545 CRASH CUSHION ATTENUATORS (421)
ITEM 560 MAILBOX ASSEMBLIES
ITEM 618 CONDUIT (400)(476)
ITEM 620 ELECTRICAL CONDUCTORS (610)(628)
ITEM 621 TRAY CABLE (620)
ITEM 624 GROUND BOXES (420)(421)(432)(440)(618)(620)
ITEM 628 ELECTRICAL SERVICES (441)(445)(449)(618)(620)(627)(656)
ITEM 636 SIGNS (643)
ITEM 644 SMALL ROADSIDE SIGN ASSEMBLIES (421)(440)(441)(442)(445)(636)(643)(656)
ITEM 658 DELINEATOR AND OBJECT MARKER ASSEMBLIES (445)
ITEM 662 WORK ZONE PAVEMENT MARKINGS (666)(668)(672)(677)
ITEM 666 RETROREFLECTORIZED PAVEMENT MARKINGS (316)(502)(662)(677)(678)<6438>
ITEM 672 RAISED PAVEMENT MARKERS (677)(678)
ITEM 677 ELIMINATING EXISTING PAVEMENT MARKINGS AND MARKERS (300)(302)(316)<3096>
ITEM 680 HIGHWAY TRAFFIC SIGNALS (416)(610)(618)(620)(624)(625)(627)(628)(636)(656)(682)(684)(686)(688)
ITEM 681 TEMPORARY TRAFFIC SIGNALS (416)(610)(618)(620)(621)(622)(624)(625)(627)(628)(636)(656)(680)(682)(684)(686)(687)

(688)
ITEM 682 VEHICLE AND PEDESTRIAN SIGNAL HEADS
ITEM 684 TRAFFIC SIGNAL CABLES
ITEM 685 ROADSIDE FLASHING BEACON ASSEMBLIES (441)(442)(445)(449)
(610)(618)(620)(621)(622)(624)(628)(656)(682)(684)(687)
ITEM 686 TRAFFIC SIGNAL POLE ASSEMBLIES (STEEL) (416)(421)(441)
(442)(445)(449)
ITEM 687 PEDESTAL POLE ASSEMBLIES (445)(449)(656)(682)
ITEM 688 PEDESTRIAN DETECTORS AND VEHICLE LOOP DETECTORS (618)
(624)(682)(684)
ITEM 690 MAINTENANCE OF TRAFFIC SIGNALS (416)(421)(476)(610)(618)
(620)(622)(624)(625)(627)(628)(636)(656)(680)(682)(684)
(685)(686)(687)(688)
ITEM 730 ROADSIDE MOWING
ITEM 734 LITTER REMOVAL
ITEM 735 DEBRIS REMOVAL (734)(738)
ITEM 738 CLEANING AND SWEEPING HIGHWAYS
ITEM 785 BRIDGE JOINT REPAIR OR REPLACEMENT (429)(438)(448)(449)
(454)
ITEM 786 CARBON FIBER REINFORCED POLYMER (CFRP) (429)

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

REQUIRED CONTRACT PROVISIONS, FEDERAL-AID CONSTRUCTION CONTRACTS
(FORM FHWA 1273)
WAGE RATES
SPECIAL PROVISION "NONDISCRIMINATION" (000---002)
SPECIAL PROVISION "CERTIFICATION OF NONDISCRIMINATION IN EMPLOYMENT"
(000---003)
SPECIAL PROVISION "NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO
ENSURE EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE
ORDER 11246" (000---004)
SPECIAL PROVISION "STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY
CONSTRUCTION CONTRACT SPECIFICATIONS" (000---005)
SPECIAL PROVISION "ONTHEJOB TRAINING PROGRAM" (000---006)
SPECIAL PROVISION "AMERICANS WITH DISABILITIES ACT CURB RAMP WORKSHOP
" (000---025)
SPECIAL PROVISION "CERTIFICATE OF INTERESTED PARTIES (FORM 1295)"
(000--1019)
SPECIAL PROVISION "SCHEDULE OF LIQUIDATED DAMAGES" (000--1243)
SPECIAL PROVISION "IMPORTANT NOTICE TO CONTRACTORS" (000--1380)
SPECIAL PROVISION "CARGO PREFERENCE ACT REQUIREMENTS IN FEDERAL AID
CONTRACTS" (000---241)
SPECIAL PROVISION "DISADVANTAGED BUSINESS ENTERPRISE IN FEDERALAID
CONTRACTS" (000---394)
SPECIAL PROVISION "NOTICE OF CONTRACTOR PERFORMANCE EVALUATIONS"
(000---659)
SPECIAL PROVISIONS TO ITEM 2 (002---009)(002---011)(002---013)
SPECIAL PROVISIONS TO ITEM 3 (003---011)(003---013)
SPECIAL PROVISIONS TO ITEM 5 (005---002)(005---003)

```
SPECIAL PROVISIONS TO ITEM     6  (006---012)(006---030)
SPECIAL PROVISIONS TO ITEM     7  (007---004)(007---008)(007---010)
                                  (007---011)
SPECIAL PROVISIONS TO ITEM     8  (008---003)(008---006)(008---030)
                                  (008---033)(008---054)
SPECIAL PROVISIONS TO ITEM     9  (009---010)(009---011)
SPECIAL PROVISION  TO ITEM   247  (247---003)
SPECIAL PROVISION  TO ITEM   300  (300---020)
SPECIAL PROVISION  TO ITEM   302  (302---003)
SPECIAL PROVISION  TO ITEM   316  (316---002)
SPECIAL PROVISION  TO ITEM   334  (334---004)
SPECIAL PROVISION  TO ITEM   340  (340---004)
SPECIAL PROVISION  TO ITEM   341  (341---004)
SPECIAL PROVISION  TO ITEM   342  (342---005)
SPECIAL PROVISION  TO ITEM   344  (344---005)
SPECIAL PROVISION  TO ITEM   347  (347---003)
SPECIAL PROVISION  TO ITEM   348  (348---004)
SPECIAL PROVISION  TO ITEM   360  (360---001)
SPECIAL PROVISION  TO ITEM   420  (420---001)
SPECIAL PROVISION  TO ITEM   421  (421---010)
SPECIAL PROVISION  TO ITEM   425  (425---001)
SPECIAL PROVISION  TO ITEM   426  (426---005)
SPECIAL PROVISION  TO ITEM   427  (427---003)
SPECIAL PROVISION  TO ITEM   434  (434---004)
SPECIAL PROVISION  TO ITEM   440  (440---004)
SPECIAL PROVISION  TO ITEM   441  (441---004)
SPECIAL PROVISION  TO ITEM   442  (442---001)
SPECIAL PROVISION  TO ITEM   446  (446---005)
SPECIAL PROVISION  TO ITEM   447  (447---001)
SPECIAL PROVISION  TO ITEM   448  (448---001)
SPECIAL PROVISION  TO ITEM   449  (449---002)
SPECIAL PROVISION  TO ITEM   450  (450---001)
SPECIAL PROVISION  TO ITEM   462  (462---002)
SPECIAL PROVISION  TO ITEM   464  (464---001)
SPECIAL PROVISION  TO ITEM   465  (465---001)
SPECIAL PROVISION  TO ITEM   502  (502---008)
SPECIAL PROVISION  TO ITEM   506  (506---005)
SPECIAL PROVISION  TO ITEM   520  (520---002)
SPECIAL PROVISION  TO ITEM   540  (540---001)
SPECIAL PROVISION  TO ITEM   636  (636---001)
SPECIAL PROVISION  TO ITEM   643  (643---001)
SPECIAL PROVISION  TO ITEM   656  (656---001)
SPECIAL PROVISION  TO ITEM   666  (666---007)
SPECIAL PROVISION  TO ITEM   680  (680---006)
SPECIAL PROVISION  TO SPECIAL SPECIFICATION ITEM  6185  (6185--002)


SPECIAL SPECIFICATIONS:
-----------------------

ITEM 2001 TIED-CONCRETE BLOCK EROSION CONTROL MAT
ITEM 3076 DENSE-GRADED HOT-MIX ASPHALT <300><301><316><320><340>
          <341><342><347><348><520><585><3079><3081><3082><3096>
ITEM 3077 SUPERPAVE MIXTURES <300><301><316><320><342><344><347>
```

<348><520><585><3079><3081><3082><3096>
ITEM 3079 PERMEABLE FRICTION COURSE (PFC) <300><301><320><342><520> <3096>
ITEM 3081 THIN OVERLAY MIXTURES (TOM) <300><301><320><342><520> <585><3096>
ITEM 3082 THIN BONDED FRICTION COURSES <210><300><301><320><342> <348><520><585><3079><3096>
ITEM 3096 ASPHALTS, OILS, AND EMULSIONS
ITEM 4171 INSTALL BRIDGE IDENTIFICATION NUMBERS <427>
ITEM 6001 PORTABLE CHANGEABLE MESSAGE SIGN
ITEM 6158 TRAILER MOUNTED SOLAR POWERED RADAR SPEED CONTROL MONITOR
ITEM 6185 TRUCK MOUNTED ATTENUATOR (TMA) AND TRAILER ATTENUATOR (TA)
ITEM 6292 RADAR VEHICLE DETECTION SYSTEMFOR SIGNALIZED INTERSECTION CONTROL
ITEM 6306 VIDEO IMAGING VEHICLE DETECTION SYSTEM
ITEM 6438 MOBILE RETROREFLECTIVITY DATA COLLECTION FOR PAVEMENT MARKINGS
ITEM 7186 NATURAL GAS PIPELINE <400><401><402><420>
ITEM 7326 SPECIAL SPECIFICATION XXXX SANITARY SEWER
ITEM 7330 SPECIAL SPECIFICATION 7330 WATER MAINS AND SERVICE LINES

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

Control **0465-02-027, ETC.**

Project **STP 2023(954)MM, ETC.**

Highway **FM 1518**

County **BEXAR**

DISADVANTAGED BUSINESS ENTERPRISE REQUIREMENTS

The following goal for disadvantaged business enterprises is established:

DBE
9.0%

Certification of DBE Goal Attainment

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

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

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

CHILD SUPPORT STATEMENT

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

CONFLICT OF INTEREST CERTIFICATION

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

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

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

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

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

E-VERIFY CERTIFICATION

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

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

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

Certification Regarding Disclosure of Public Information

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

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

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

By entering into Contract, the Contractor agrees to:

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

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

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

CERTIFICATION TO NOT BOYCOTT ISRAEL

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

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

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

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

CERTIFICATION TO NOT BOYCOTT ENERGY COMPANIES

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

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

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

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

CERTIFICATION TO NOT DISCRIMINATE AGAINST FIREARM ENTITIES OR FIREARM TRADE ASSOCIATIONS

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

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

This provision applies to a contract that:

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

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

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

PROHIBITION ON CERTAIN TELECOMMUNICATIONS EQUIPMENT OR SERVICES

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

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

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

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

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

REQUIRED CONTRACT PROVISIONS
FEDERAL-AID CONSTRUCTION CONTRACTS

I. GENERAL

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

6. Training and Promotion:

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

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

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

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

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

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

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

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

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

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

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

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

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

10. Assurances Required:

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

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

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

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

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

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

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

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

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

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

III. NONSEGREGATED FACILITIES

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

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

IV. DAVIS-BACON AND RELATED ACT PROVISIONS

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

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

1. Minimum wages (29 CFR 5.5)

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

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

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

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

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

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

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

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

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

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

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

2. Withholding (29 CFR 5.5)

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

3. Payrolls and basic records (29 CFR 5.5)

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

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

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

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

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

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

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

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

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

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

4. Apprentices and trainees (29 CFR 5.5)

a. Apprentices (programs of the USDOL).

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

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

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

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

b. Trainees (programs of the USDOL).

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

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

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

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

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

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

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

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

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

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

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

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

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

10. Certification of eligibility (29 CFR 5.5)

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

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

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

V. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT

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

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

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

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

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

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

VI. SUBLETTING OR ASSIGNING THE CONTRACT

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

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

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

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

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

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

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

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

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

VII. SAFETY: ACCIDENT PREVENTION

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

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

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

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

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

VIII. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

* * * * *

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

* * * * *

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

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

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

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

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

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

* * * * *

XI. CERTIFICATION REGARDING USE OF CONTRACT FUNDS FOR LOBBYING

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

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

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

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

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

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

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

XII. USE OF UNITED STATES-FLAG VESSELS:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Notes:

*Represents the USDOL wage decision.

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

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

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

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

01/06/2023

Special Provision to Item 000
Nondiscrimination

1. DESCRIPTION

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

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

2. DEFINITION OF TERMS

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

3. NONDISCRIMINATION PROVISIONS

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

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

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

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

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

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

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

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

Special Provision to Item 000
Certification of Nondiscrimination in Employment

1. GENERAL

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

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

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

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

Special Provision to Item 000

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

1. GENERAL

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

2. GOALS

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

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

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

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

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

3. SUBCONTRACTING

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

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

4. COVERED AREA

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

5. REPORTS

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

Table 1
Goals for Minority Participation

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

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

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

Special Provision to Item 000

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

1. GENERAL

1.1. As used in these specifications:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1. DESCRIPTION

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

2. TRAINEE ASSIGNMENT

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

3. PROGRAM REQUIREMENTS

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

4. REIMBURSEMENT

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

5. COMPLIANCE

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

Special Provision to Item 000
Americans with Disabilities Act Curb Ramp Workshop

Before starting work, schedule and attend a mandatory preconstruction Americans with Disabilities Act curb ramp workshop. The workshop will be administered by the Department, will be four hours or less, and will be held during normal working hours at an approved location in proximity to the project.

Supervisory personnel responsible for control of the work must attend the workshop.

The Department will provide workshop facilitators and facilities. No direct compensation will be made for fulfilling these requirements, as this workshop is considered subsidiary to the Items of the Contract.

Special Provision 000
Certificate of Interested Parties (Form 1295)

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

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

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

Special Provision 000
Important Notice to Contractors

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

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

Special Provision 000
Important Notice to Contractors

As of August 28, 2023, utilities within the project limits have not been cleared. The Department anticipates clearance by the dates listed below. Unless otherwise stated, clearance of these obstructions will be performed by their owners. Estimated clearance dates are not anticipated to interfere with the Contractor's operations. In the event the clearance dates are not met, requests for additional compensation or time will be made in accordance with the Standard Specifications.

The Contractor is invited to review the mapped information of obstructions on file with the Engineer.

UTILITY			
Utility Owner	**Approximate Location**	**Estimated Clearance Date**	**Effect on Construction**
Fiberlight	From Aztec Way to IH 10 WBFR	November 7, 2023	None
SCUC-ISD	From Elvira Ave to Ray Corbett Dr	January 1, 2024	None
Charter Spectrum	From Aztec Way to IH 10 WBFR	December 5, 2023	None
AT&T Texas	From Aztec Way to IH 10 WBFR	March 6, 2024	None
CPS Energy Electric (Pole Removal)	From Aztec Way to IH 10 WBFR	June 6, 2024	None
Canyon Regional Water Authority	At Lower Seguin Rd FM 1518 STA 238+48	March 2, 2024	None
Flint Hills Resources	South of Long Leaf Pkwy FM 1518 STA 269+95	November 1, 2023	None
Cibolo Creek Municipal Authority	Lisa Meadows FM 1518 STA 170+00	December 23, 2023	None

Special Provision 000

Cargo Preference Act Requirements in Federal Aid Contracts

1. DESCRIPTION

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

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

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

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

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

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

Special Provision to Item 000

Disadvantaged Business Enterprise in Federal-Aid Contracts

1. DESCRIPTION

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

2. DISADVANTAGED BUSINESS ENTERPRISE IN FEDERAL-AID CONTRACTS

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

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

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

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

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

2.2. **Definitions.**

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

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

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

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

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

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

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

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

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

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

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

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

2.3. **Contractor's Responsibilities.**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

CUF determinations are not subject to administrative appeal to DOT.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Special Provision 000
Notice of Contractor Performance Evaluations

1. GENERAL

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

2. DEFINITIONS

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

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

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

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

3. CONTRACTOR EVALUATIONS

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

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

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

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

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

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

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

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

4. DIVISION OVERSIGHT

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

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

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

5. PERFORMANCE REVIEW COMMITTEE

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

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

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

6. APPEALS PROCESS

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

Special Provision to Item 2
Instructions to Bidders

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

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

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

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

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

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

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

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

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

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

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

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

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

Special Provision to Item 2
Instructions to Bidders

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

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

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

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

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

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

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

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

The Department may recommend that the Commission:

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

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

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

Special Provision to Item 2
Instructions to Bidders

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

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

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

Special Provision to Item 3
Award and Execution Contract

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

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

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

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

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

Special Provision to Item 3
Award and Execution of Contract

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

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

Table 2
Insurance Requirements

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

Special Provision to Item 5
Control of the Work

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

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

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

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

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

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

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

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

Special Provision to Item 5
Control of the Work

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

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

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

Special Provision to Item 6
Control of Materials

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

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

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

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

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

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

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

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

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

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

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

The Department of State Health Services (DSHS), Asbestos Programs Branch, is responsible for administering the requirements of the National Emissions Standards for Hazardous Air Pollutants, 40 CFR Part 61, Subpart M and the Texas Asbestos Health Protection Rules (TAHPR). Based on EPA guidance and regulatory background information, bridges are considered to be a regulated “facility” under NESHAP. Therefore, federal standards for demolition and renovation apply.

The Department is required to notify the DSHS at least 10 working days (by postmarked date) before initiating demolition or renovation of each structure or load bearing member shown on the plans. If the actual demolition or renovation date is changed or delayed, notify the Engineer in writing of the revised dates in sufficient time to allow for the Department’s notification to DSHS to be postmarked at least 10 days in advance of the actual work.

Failure to provide the above information may require the temporary suspension of work under Article 8.4., “Temporary Suspension of Work or Working Day Charges,” due to reasons under the control of the Contractor. The Department retains the right to determine the actual advance notice needed for the change in date to address post office business days and staff availability.

10.3. Lead Abatement. Provide traffic control as shown on the plans, and coordinate and cooperate with the third party and the Department for managing or removing hazardous materials. Work for the traffic control shown on the plans and coordination work will not be paid for directly but will be subsidiary to pertinent Items.

Special Provision to Item 006
Control of Materials

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

Section 1.1, "Buy America," The section is removed and replaced by the following:

Comply with the latest provisions of Build America, Buy America Act (BABA Act) of the Bipartisan Infrastructure Law which restricts funds being made available from Federal financial assistance programs unless all the iron products, steel products, manufactured products, and construction materials used in the project are produced in the United States. Use steel or iron products, manufactured products, or construction materials produced in the United States except when:

- a waiver exists exempting the material from Buy America compliance
- the cost of materials, including delivery, does not exceed 0.1% of the total Contract cost or $2,500, whichever is greater,
- the Contract contains an alternate item for a foreign source product and the Contract is awarded based on the alternate item, or
- the materials are temporarily installed.

For construction materials submit a notarized original of TxDOT Construction Material Buy America Certification Form (Department Form 2806) with the proper attachments for verification of compliance.

Construction Materials are classified as an article, material, or supply—other than an item of primarily iron or steel; a manufactured product; cement and cementitious materials; aggregates such as stone, sand, or gravel; or aggregate binding agents or additives —that is or consists primarily of:

- Non-ferrous metals,
- plastic and polymer-based products (including polyvinylchloride, composite building materials, and polymers used in fiber optic cables),
- Glass (including optic glass)
- Lumber, or
- Drywall.

Details shown on the plans provide additional clarification on Buy America requirements for this project.

For steel or Iron materials submit a notarized original of the FORM D-9-USA-1 (Department Form 1818) with the proper attachments for verification of compliance. For Steel or Iron materials the manufacturing process includes any process that modifies the chemical content, physical shape or size, or final finish of a product. The manufacturing process begins with initial melting and mixing and continues through fabrication (cutting, drilling, welding, bending, etc.) and coating (paint, galvanizing, epoxy, etc.).

Article 4., "Sampling, Testing, and Inspection," is supplemented by the following:

Meet with the Engineer and choose either the Department or a Department-selected Commercial Lab (CL) for conducting the subset of project-level sampling and testing shown in Table 1, "Select Guide Schedule Sampling and Testing." Selection may be made on a test by test basis. CLs will meet the testing turnaround times shown (includes test time and time for travel and sampling and reporting) and in all cases issue test reports as soon as possible.

If the Contractor chooses a Department-selected CL for any Table 1 sampling and testing:

- notify the Engineer, District Lab, and the CL of project scheduling that may require CL testing;
- provide the Engineer, District Lab, and CL at least 24 hours' notice by phone or e-mail;
- reimburse the Department for CL Table 1 testing using the contract fee schedule for the CL (including mileage, travel, and stand ime) at the minimum guide schedule testing frequencies;
- reimburse the Department for CL Table 1 testing above the minimum guide schedule frequencies for retesting when minimum frequency testing results in failures to meet specification limits;
- agree with the Engineer and CL upon a policy regarding notification for testing services;
- give any cancellation notice to the Engineer, District Lab, and CL by phone or e-mail;
- reimburse the Department a $150 cancellation fee to cover technician time and mileage charges for previously scheduled work cancelled without adequate notice, which resulted in mobilization of technician and/or equipment by the CL; and
- all CL charges will be reimbursed to the Department by a deduction from the Contractor's monthly pay estimate.

If the CL does not meet the Table 1 turnaround times, testing charge to the Contractor will be reduced by 50% for the first late day and an additional 5% for each succeeding late day.

Approved CL project testing above the minimum testing frequencies in the Guide Schedule of Sampling and Testing, and not as the result of failing tests, will be paid by the Department.

Other project-level Guide Schedule sampling and testing not shown on Table 1 will be the responsibility of the Department.

Table 1
Select Guide Schedule Sampling and Testing (Note 1)

TxDOT Test	Test Description	Turn-Around Time (Calendar days)
SOILS/BASE		
Tex-101-E	Preparation of Soil and Flexible Base Materials for Testing (included in other tests)	
Tex-104-E	Liquid Limit of Soils (included in 106-E)	
Tex-105-E	Plastic Limit of Soils (included in 106-E)	
Tex-106-E	Calculating the Plasticity Index of Soils	7
Tex-110-E	Particle Size Analysis of Soils	6
Tex-113-E	Moisture-Density Relationship of Base Materials	7
Tex-114-E	Moisture-Density Relationship of Subgrade and Embankment Soil	7
Tex-115-E	Field Method for In-Place Density of Soils and Base Materials	2
Tex-116-E	Ball Mill Method for the Disintegration of Flexible Base Material	5
Tex-117-E, Part II	Triaxial Compression Tests For Disturbed Soils and Base Materials (Part II)	6
Tex-113-E **w/** Tex-117-E	Moisture-Density Relationship of Base Materials **with** Triaxial Compression Tests For Disturbed Soils and Base Materials (Part II)	10
Tex-140-E	Measuring Thickness of Pavement Layer	2
Tex-145-E	Determining Sulfate Content in Soils - Colorimetric Method	4
HOT MIX ASPHALT		
Tex-200-F	Sieve Analysis of Fine and Coarse Aggregate (dry, from ignition oven with known correction factors)	1 (Note 2)
Tex-203-F	Sand Equivalent Test	3
Tex-206-F, **w/** Tex-207-F, Part I, **w/** Tex-227-F	**(Lab-Molded Density of Production Mixture – Texas Gyratory)** Method of Compacting Test Specimens of Bituminous Mixtures **with** Density of Compacted Bituminous Mixtures, Part I - Bulk Specific Gravity of Compacted Bituminous Mixtures, **with** Theoretical Maximum Specific Gravity of Bituminous Mixtures	1 (Note 2)
Tex-207-F, Part I **&/or** Part VI	**(In-Place Air Voids of Roadway Cores)** Density of Compacted Bituminous Mixtures, Part I- Bulk Specific Gravity of Compacted Bituminous Mixtures **&/or** Part VI - Bulk Specific Gravity of Compacted Bituminous Mixtures Using the Vacuum Method	1 (Note 2)

Tex-207-F, Part V	Density of Compacted Bituminous Mixtures, Part V- Determining Mat Segregation using a Density-Testing Gauge	3
Tex-207-F, Part VII	Density of Compacted Bituminous Mixtures, Part VII - Determining Longitudinal Joint Density using a Density-Testing Gauge	4
Tex-212-F	Moisture Content of Bituminous Mixtures	3
Tex-217-F	Deleterious Material and Decantation Test for Coarse Aggregate	4
Tex-221-F	Sampling Aggregate for Bituminous Mixtures, Surface Treatments, and LRA (included in other tests)	
Tex-222-F	Sampling Bituminous Mixtures (included in other tests)	
Tex-224-F	Determination of Flakiness Index	3
Tex-226-F	Indirect Tensile Strength Test (production mix)	4
Tex-235-F	Determining Draindown Characteristics in Bituminous Materials	3
Tex-236-F (Correction Factors)	Asphalt Content from Asphalt Paving Mixtures by the Ignition Method (Determining Correction Factors)	4
Tex-236-F	Asphalt Content from Asphalt Paving Mixtures by the Ignition Method (Production Mixture)	1 (Note 2)
Tex-241-F **w/** Tex-207-F, Part I, **w/** Tex-227-F	**(Lab-Molded Density of Production Mixture – Superpave Gyratory)** Superpave Gyratory Compacting of Specimens of Bituminous Mixtures (production mixture) **with** Density of Compacted Bituminous Mixtures, Part I- Part I - Bulk Specific Gravity of Compacted Bituminous Mixtures, **with** Theoretical Maximum Specific Gravity of Bituminous Mixtures	1 (Note 2)
Tex-242-F	Hamburg Wheel-Tracking Test (production mix, molded samples)	3
Tex-244-F	Thermal Profile of Hot Mix Asphalt	1
Tex-246-F	Permeability of Water Flow of Hot Mix Asphalt	3
Tex-280-F	Flat and Elongated Particles	3
Tex-530-C	Effect of Water on Bituminous Paving Mixtures (production mix)	4
AGGREGATES		
Tex-400-A	Sampling Flexible Base, Stone, Gravel, Sand, and Mineral Aggregates	3
Tex-410-A	Abrasion of Coarse Aggregate Using the Los Angeles Machine	5
Tex-411-A	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate	12
Tex-461-A	Degradation of Coarse Aggregate by Micro-Deval Abrasion	5
CHEMICAL		
Tex-612-J	Acid Insoluble Residue for Fine Aggregate	4
GENERAL		
HMA Production Specialist [TxAPA – Level 1-A] ($/hr)		
HMA Roadway Specialist [TxAPA – Level 1-B] ($/hr)		
Technician Travel/Standby Time ($/hr)		
Per Diem ($/day – meals and lodging)		
Mileage Rate ($/mile from closest CL location)		

Note 1– Turn-Around Time includes test time and time for travel/sampling and reporting.
Note 2 – These tests require turn-around times meeting the governing specifications. Provide test results within the stated turn-around time. CL is allowed one additional day to provide the signed and sealed report.

Special Provision to Item 7
Legal Relations and Responsibilities

Item 7, "Legal Relations and Responsibilities," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 7.7.2., "Texas Pollutant Discharge Elimination System (TPDES) Permits and Storm Water Pollution Prevention Plans (SWP3)," is voided and replaced by the following:

7.2. Texas Pollution Discharge Elimination System (TPDES) Permits and Storm Water Pollution Prevention Plans (SWP3).

7.2.1. Projects with less than one acre of soil disturbance including required associated project specific locations (PSL's) per TPDES GP TXR 150000.

No posting or filing will be required for soil disturbances within the right of way. Adhere to the requirements of the SWP3.

7.2.2. Projects with one acre but less than five acres of soil disturbance including required associated PSL's per TPDES GP TXR 150000.

The Department will be considered a primary operator for Operational Control Over Plans and Specifications as defined in TPDES GP TXR 150000 for construction activity in the right of way. The Department will post a small site notice along with other requirements as defined in TPDES GP TXR 150000 as the entity of having operational control over plans and specifications for work shown on the plans in the right of way.

The Contractor will be considered a Primary Operator for Day-to-Day Operational Control as defined in TPDES GP TXR 150000 for construction activity in the right of way. In addition to the Department's actions, the Contractor will post a small site notice along with other requirements as defined in TPDES GP TXR 150000 as the entity of having day-to-day operational control of the work shown on the plans in the right of way. This is in addition to the Contractor being responsible for TPDES GP TXR 150000 requirements for on- right of way and off- right of way PSL's. Adhere to all requirements of the SWP3 as shown on the plans. The Contractor will be responsible for Implement the SWP3 for the project site in accordance with the plans and specifications, TPDES General Permit TXR150000, and as directed.

7.2.3. Projects with 5 acres or more of soil disturbance including required associated PSL's per TPDES GP TXR 150000.

The Department will be considered a primary operator for Operational Control Over Plans and Specifications as defined in TPDES GP TXR 150000 for construction activities in the right of way. The Department will post a large site notice, file a notice of intent (NOI), notice of change (NOC), if applicable, and a notice of termination (NOT) along with other requirements per TPDES GP TXR 150000 as the entity having operational control over plans and specifications for work shown on the plans in the right of way.

The Contractor will be considered a primary operator for Day-to-Day Operational Control as defined in TPDES GP TXR 150000 for construction activities in the right of way. In addition to the Department's actions, the Contractor shall file a NOI, NOC, if applicable, and NOT and post a large site notice along with other requirements as the entity of having day-to-day operational control of the work shown on the plans in the right of way. This is in addition to the Contractor

being responsible for TPDES GP TXR 150000 requirements for on- right of way and off- right of way PSL's. Adhere to all requirements of the SWP3 as shown on the plans.

Special Provision to Item 7
Legal Relations and Responsibilities

Item 7, "Legal Relations and Responsibilities" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 19.1., Minimum Wage Requirements for Federally Funded Contracts. The second paragraph is voided and replaced by the following:

Submit electronic payroll records to the Engineer using the Department's payroll system.

Section 19.2., Minimum Wage Requirements for State Funded Contracts. The second paragraph is voided and replaced by the following:

Submit electronic payroll records to the Engineer using the Department's payroll system.

Special Provision to Item 7
Legal Relations and Responsibilities

Item 7, "Legal Relations and Responsibilities," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 7.2.4., "Public Safety and Convenience." The first paragraph is deleted and replaced by the following.

Ensure the safety and convenience of the public and property as provided in the Contract and as directed. Keep existing roadways open to traffic or construct and maintain detours and temporary structures for safe public travel. Manage construction to minimize disruption to traffic. Maintain the roadway in a good and passable condition, including proper drainage and provide for ingress and egress to adjacent property.

If the construction of the project requires the closing of a highway, as directed, coordinate the closure with the Engineer and work to ensure all lanes and ramps possible are available during peak traffic periods before, during, and after significant traffic generator events to avoid any adverse economic impact on the municipalities during:

- dates or events as shown on the plans, and
- other dates as directed.

Special Provision to Item 007
Legal Relations and Responsibilities

Item 7, "Legal Relations and Responsibilities," of the Standard Specifications is amended with respect to the clauses cited below.

Section 2.6., "Barricades, Signs, and Traffic Handling," the first paragraph is voided and replaced by the following:

2.6. **Barricades, Signs, and Traffic Handling.** Comply with the requirements of Item 502 "Barricades, Signs, and Traffic Handling," and as directed. Provide traffic control devices that conform to the details shown on the plans, the TMUTCD, and the Department's Compliant Work Zone Traffic Control Device List maintained by the Traffic Safety Division. When authorized or directed, provide additional signs or traffic control devices not required by the plans.

Section 2.6.1., "Contractor Responsible Person and Alternative," is voided and replaced by the following:

2.6.1. **Contractor Responsible Person and Alternative.** Designate in writing, a Contractor's Responsible Person (CRP) and an alternate to be the representative of the Contractor who is responsible for taking or directing corrective measures regarding the traffic control. The CRP or alternate must be accessible by phone 24 hr. per day and able to respond when notified. The CRP and alternate must comply with the requirements of Section 2.6.5., "Training."

Section 2.6.2, "Flaggers," the first paragraph is voided and replaced by the following:

2.6.2. **Flaggers.** Designate in writing, a flagger instructor who will serve as a flagging supervisor and is responsible for training and assuring that all flaggers are qualified to perform flagging duties. Certify to the Engineer that all flaggers will be trained and make available upon request a list of flaggers trained to perform flagging duties.

Section 2.6.5, "Training," is voided and replaced by the following:

2.6.5. **Training.** Train workers involved with the traffic control using Department-approved training as shown on the "Traffic Control Training" Material Producer List.

Coordinate enrollment, pay associated fees, and successfully complete Department-approved training or Contractor-developed training. Training is valid for the period prescribed by the provider. Except for law enforcement personnel training, refresher training is required every 4 yr. from the date of completion unless otherwise specified by the course provider. The Engineer may require training at a frequency instead of the period prescribed based on the Department's needs. Training and associated fees will not be measured or paid for directly but are considered subsidiary to pertinent Items.

Certify to the Engineer that workers involved in traffic control and other work zone personnel have been trained and make available upon request a copy of the certification of completion to the Engineer. Ensure the following is included in the certification of completion:

- name of provider and course title,
- name of participant,
- date of completion, and
- date of expiration.

Where Contractor-developed training or a Department-approved training course does not produce a certification, maintain a log of attendees. Make the log available upon request. Ensure the log is legible and includes the following:

- printed name and signature of participant,
- name and title of trainer, and
- date of training.

2.6.5.1. **Contractor-developed Training.** Develop and deliver Contractor-developed training meeting the minimum requirements established by the Department. The outline for this training must be submitted to the Engineer for approval at the preconstruction meeting. The CRP or designated alternate may deliver the training instead of the Department-approved training. The work performed and materials furnished to develop and deliver the training will not be measured or paid for directly but will be considered subsidiary to pertinent Items.

2.6.5.1.1. **Flagger Training Minimum Requirements.** A Contractor's certified flagging instructor is permitted to train other flaggers.

2.6.5.1.2. **Optional Contractor-developed Training for Other Work Zone Personnel.** For other work zone personnel, the Contractor may provide training meeting the curriculum shown below instead of Department-approved training.

Minimum curriculum for Contractor-provided training is as follows:

Contractor-developed training must provide information on the use of personnel protection equipment, occupational hazards and health risks, and other pertinent topics related to traffic management. The type and amount of training will depend on the job duties and responsibilities. Develop training applicable to the work being performed. Develop training to include the following topics.

- The Life You Save May Be Your Own (or other similar company safety motto).
- Purpose of the training.
  - It's the Law.
  - To make work zones safer for workers and motorist.
  - To understand what is needed for traffic control.
  - To save lives including your own.
- Personal and Co-Worker Safety.
  - **High Visibility Safety Apparel.** Discuss compliant requirements; inspect regularly for fading and reduced reflective properties; if night operations are required, discuss the additional and appropriate required apparel in addition to special night work risks; if moving operations are underway, discuss appropriate safety measures specific to the situation and traffic control plan.
  - **Blind Areas.** A blind area is the area around a vehicle or piece of construction equipment not visible to the operators, either by line of sight or indirectly by mirrors. Discuss the "Circle of Safety" around equipment and vehicles; use of spotters; maintain eye contact with equipment operators; and use of hand signals.
  - **Runovers and Backovers.** Remain alert at all times; keep a safe distance from traffic; avoid turning your back to traffic and if you must then use a spotter; and stay behind protective barriers, whenever possible. Note: It is not safe to sit on or lean against a concrete barrier, these barriers can deflect four plus feet when struck by a vehicle.
  - Look out for each other, warn co-workers.
  - Be courteous to motorists.
  - Do not run across active roadways.
  - Workers must obey traffic laws and drive courteously while operating vehicles in the work zones.
  - Workers must be made aware of company distracted driving policies.
- **Night Time Operations.** Focus should be placed on projects with a nighttime element.

- **Traffic Control Training.** Basics of Traffic Control.
  - Identify work zone traffic control supervisor and other appropriate persons to report issues to when they arise.
  - Emphasize that work zone traffic control devices must be in clean and in undamaged condition. If devices have been hit but not damaged, put back in their correct place and report to traffic control supervisor. If devices have been damaged, replace with new one and report to traffic control supervisor. If devices are dirty, faded or have missing or damaged reflective tape clean or replace and report to traffic control supervisor. Show examples of non-acceptable device conditions. Discuss various types of traffic control devices to be used and where spacing requirements can be found.
  - **Channelizing Devices and Barricades with Slanted Stripes.** Stripes are to slant in the direction you want traffic to stay or move to; demonstrate this with a device.
  - **Traffic Queuing.** Workers must be made aware of traffic queuing and the dangers created by it. Workers must be instructed to immediately notify the traffic control supervisor and other supervisory personnel if traffic is queuing beyond advance warning sign and devices or construction limits.
  - **Signs.** Signs must be straight and not leaning. Report problems to the traffic control supervisor or other as designated for immediate repair. Covered signs must be fully covered. If covers are damaged or out of place, report to traffic control supervisor or other as designated.

Special Provision to Item 8
Prosecution and Progress

Item 8, "Prosecution and Progress" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 8.1., "Prosecution of Work." The first sentence of the first paragraph is voided and replaced by the following:

Begin work 90 calendar days after the authorization date to begin work. Do not begin work before or after this period unless authorized in writing by the Engineer.

Special Provision to Item 8
Prosecution and Progress

Item 8, "Prosecution and Progress" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

This item is supplemented by the following:

9. **Incentive Using Road-User Cost or Contract Administration Liquidated Damage Values and Disincentive Using Road-User Cost.** This special provision is for the application of incentives and disincentives as follows:

- incentives for early Contract completion using contract administration liquidated damage or substantial completion of work ahead of time using daily road-user cost values as basis and
- disincentives for late substantial completion of work using daily road-user costs.

Incentive provisions, based on contract administration liquidated damages, will apply when shown on the plans. Incentive provisions, based on road-user cost, will apply when shown on the plans. Disincentive provisions, based on road-user cost, will apply when road-user cost incentive provisions are shown on the plans. The disincentive provisions, based on road-user cost, will also apply when shown separately on the plans (without an associated road-user cost incentive). Definitions are as follows:

- Contract Completion - The final acceptance date (day) unless performance, establishment and maintenance periods occur. In the case of performance, establishment and maintenance periods, completion shall be considered when all work is complete and accepted except for performance, establishment and maintenance periods, with time computed to the suspension of time charges for the acceptance process.
- Substantial Completion of Work - The date (day) when all project work (or the work for a specified milestone or phase) requiring lane or shoulder closures or obstructions is completed, and traffic is following the lane arrangement as shown on the plans for the finished roadway (or the specified milestone or phase of work); all pavement construction and resurfacing are complete; and traffic control devices and pavement markings are in their final position (or as called for on the plans for the specified milestone of work). The Engineer may make an exception for permanent pavement markings provided the lack of markings does not cause a disruption to traffic flow or an unsafe condition for the traveling public, and work zone pavement markings are in place.

When A + B Bidding provisions are included in the Contract, the B working days bid will be considered as the time allowed for completion, contract or substantial as applicable. In addition, the plans will show either the number of working days or a specific date for the purposes of computing substantial completion incentives or disincentives.

Time charge adjustments will be made in accordance with the schedule required to meet Article 8.1, "Prosecution of Work" and Article 8.5, "Project Schedules," the proposal, and the plans. For Contracts with milestone dates, time charges for the completion incentives and disincentives will not be adjusted for weather, weekends, holidays, or other unforeseeable events not under the control or responsibility of the Department. However, time charges for completion incentives or disincentives may be adjusted by the Engineer when;

- work, under the control of the Department, such as extension of limits or changes in scope, change the actual duration of completion,

- delays occur due to unadjusted utilities or unclear right-or-way when clearance is not the responsibility of the Contractor, or
- catastrophic events occur, such as a declared state of emergency or natural disaster, if the event directly affects the Contractor's prosecution.

9.1. **Incentives.** When shown on the plans and in accordance with the Contract, the Department will pay an incentive for the early Contract completion or substantial completion of work under the number of working days stipulated in the Contract. The maximum number of working days used in computing the credit will be 30 days for each milestone and Contract completion incentive unless otherwise shown in the Contract. The amount of the credit will be added to money due or to become due to the Contractor.

9.1.1. **Early Contract Completion Incentive.** The incentive will be based on the difference between the actual early Contract completion days and the Contract completion days in the Contract. The difference will then be multiplied by the daily contract administration liquidated damage value shown in the proposal.

9.1.2. **Early Substantial Completion of Work Incentive.** The incentive will be based on the differences between the actual early substantial completion of work and the Contract days allowed to substantially complete the work (or the specified milestone or phase of work). The difference will then be multiplied by the daily road-user cost values specified for substantial Contract completion (or road-user cost specified for the corresponding milestone or phase of work).

9.2. **Disincentives for Failure to Substantially Complete Work on Time.** When shown on the plans and in accordance with the Contract, failure to substantially complete the work (or specified milestone or phase of work) within the established number of working days will result in the assessment of disincentives using the daily road-user cost shown on the plans for each working day in excess of those allowed. The road-user cost disincentive deductions will be in addition to any Contract administration liquidated damages, in accordance with Article 8.6, "Failure to Complete Work on Time." The amount of the disincentive will be deducted from money due or to become due to the Contractor. The road-user cost disincentives will be assessed not as a penalty, but for added expense incurred by the traveling public.

Special Provision to Item 8
Prosecution and Progress

Item 8, "Prosecution and Progress" of the Standard Specification is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 8.2., "Subcontracting," is supplemented by the following paragraph, which is added as paragraph six to this article:

The Contractor certifies by signing the Contract that the Contractor will not enter into any subcontract with a subcontractor that is not registered in the Department of Homeland Security's (DHS) E-Verify system. Require that all subcontractors working on the project register and require that all subcontractors remain active in the DHS E-Verify system until their work is complete on the project.

Special Provision to Item 8
Prosecution and Progress

Item 8, "Prosecution and Progress" of the Standard Specifications is amended with respect to the clause cited below. No other clauses or requirements of this Item are waived or changed.

Article 8.7.2., "Wrongful Default," is revised and replaced by the following:

If it is determined after the Contractor is declared in default, that the Contractor was not in default, the rights and obligations of all parties will be the same as if termination had been issued for the convenience of the public as provided in Article 8.8 "Termination of Contract."

Special Provision to Item 8
Prosecution and Progress

Item 8, "Prosecution and Progress" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 3., "Computation of Contract Time for Completion." The second paragraph is voided and replaced by the following:

The development of the conceptual time determination is intended to establish the number of working days on the Contract. Upon request, the Engineer will provide the conceptual time determination schedule to the Contractor for informational purposes only. The schedule assumes generic resources, production rates, sequences of construction, and average weather conditions based on historic data. Schedule labor, equipment, procurement of materials, subcontractor work, and all other necessary means to prosecute the work within the number of working days specified by the Contract.

Special Provision to Item 009
Measurement and Payment

Item 009 "Measurement and Payment" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 9.5., "PROGRESS PAYMENTS" is supplemented with the following:

It is the Department's desire to pay a Contractor for work through the last working day of the month; however, the use of early cut-off dates for monthly estimates and MOH is a project management practice to manage workload at the Area Office level. Approval for using early cut-off dates is at the District's discretion. The earliest cut-off date for estimates is the 25th of the month.

Article 9.6., "PAYMENT FOR MATERIAL ON HAND (MOH)" first paragraph is amended as follows:

If payment for MOH is desired, request compensation for the invoice cost of acceptable nonperishable materials that have not been used in the work before the request, and that have been delivered to the work location or are in acceptable storage places. Nonperishable materials are those that do not have a shelf life or whose characteristics do not materially change when exposed to the elements. Include only materials that have been sampled, tested, approved, or certified, and are ready for incorporation into the work. Only materials which are completely constructed or fabricated on the Contractor's order for a specific Contract and are so marked and on which an approved test report has been issued are eligible. Payment for MOH may include the following types of items: concrete traffic barrier, precast concrete box culverts, concrete piling, reinforced concrete pipe, and illumination poles. Any repairs required after fabricated materials have been approved for storage will require approval of the Engineer before being made and will be made at the Contractor's expense. Include only those materials and products, when cumulated under an individual item or similar bid items, that have an invoice cost of at least $1,000 in the request for MOH payment (e.g. For MOH eligibility, various sizes of conductor are considered similar bid items and may be cumulated to meet the threshold; for small roadside signs, the sign supports, mounting bolts, and the sign face is considered one bid item or similar bid items for more than one pay item for sign supports.) Requests for MOH are to be submitted at least two days before but not later than the estimate cutoff date unless otherwise agreed. If there is a need to request MOH after the established cut-off date, the district can make accommodation as the need arises. This needed accommodation is to be the exception, though, and not the rule.

Special Provision to Item 9
Measurement and Payment

Item 9, "Measurement and Payment" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 9.7.1.4.3., "Standby Equipment Costs," is voided and replaced by the following:

7.1.4.3. **Standby Equipment Costs.** Payment for standby equipment will be made in accordance with Section 9.7.1.4., "Equipment," except that the 15% markup will not be allowed and that:

Section 7.1.4.3.1., "Contractor-Owned Equipment," is voided and replaced by the following:

7.1.4.3.1. **Contractor-Owned Equipment**. For Contractor-owned equipment:

- Standby will be paid at 50% of the monthly Equipment Watch rate after the regional and age adjustment factors have been applied. Operating costs will not be allowed. Calculate the standby rate as follows.

  Standby rate = (FHWA hourly rate - operating costs) × 50%

- If an hourly rate is needed, divide the monthly *Equipment Watch* rate by 176.
- No more than 8 hr. of standby will be paid during a 24-hr. day period, nor more than 40 hr. per week.
- Standby costs will not be allowed during periods when the equipment would have otherwise been idle.

Special Provision to Item 247
Flexible Base

Item 247, "Flexible Base" of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Section 2.4., "Certification." This section is added.

Personnel certified by the Department-approved soils and base certification program must conduct all sampling, field testing, and laboratory testing required by the following:

- Section 2.1, "Aggregate,"
- Section 2.1.3.2, "Recycled Material (Including Crushed Concrete) Requirements,"
- Section 4.3, "Compaction," for measuring flexible base depth, and
- Section 4.3.2, "Density Control," for determining the roadway density and moisture content.

Supply the Engineer with a list of certified personnel and copies of their current certificates before laboratory and field testing is performed and when personnel changes are made. At any time during the project, the Engineer may perform production tests as deemed necessary in accordance with Item 5, "Control of the Work."

Section 2.5., "Reporting and Responsibilities." This section is added.

Use Department-provided templates to record and calculate all test data. Obtain the current version of the templates at http://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/forms/site-manager.html or from the Engineer. The Engineer and the Contractor will provide any available test results to the other party when requested. Record and electronically submit all test results and pertinent information on Department-provided templates.

Section 2.6., "Sampling." This section is added.

The Engineer will sample flexible base from stockpiles located at the production site or at the project location in accordance with Tex-400-A, Section 5.3. The Engineer will label the sample containers as "Engineer," "Contractor" or "Supplier," and "CST/M&P." Witness the sampling and take immediate possession of the sample containers labeled "Contractor" or "Supplier." The Engineer will maintain custody of the samples labeled "CST/M&P" until testing and reporting is completed.

Section 2.7., "Referee Testing." This section is added.

CST/M&P is the referee laboratory. The Contractor may request referee testing when the Engineer's test results fail to meet any of the material requirements listed in Table 1. Make the request via email within 5 working days after receiving test results from the Engineer. Submit test reports signed and sealed by a licensed professional engineer from a commercial laboratory listed on the Department's Material Producer List (MPL) of laboratories approved to perform compaction and triaxial compression testing located at http://ftp.dot.state.tx.us/pub/txdot-info/cmd/mpl/complabs.pdf. Submit completed test reports electronically on Department-provided templates in their original format. The referee laboratory will report test results to the Engineer within the allowable number of working days listed in Table 2 from the time the referee laboratory receives the samples. It is at the discretion of the Engineer or the referee laboratory to deny a referee request upon review of the test reports provided by the Contractor.

Table 2
Number of Allowable Working Days to Report Referee Test Results

Material Property	Test Method	Working Days
Gradation	Tex-110-E, Part I	5
Liquid Limit (Multi-Point Method)	Tex-104-E, Part I	5
Plasticity Index	Tex-106-E	5
Wet Ball Mill Value	Tex-116-E, Parts I and II	5
Wet Ball Mill, % Increase passing #40 sieve		
Compressive Strength[1]	Tex-117-E, Part II	6
Compressive Strength[2]	Tex-117-E	12

1. Moisture-Density curve provided by the District
2. Moisture-Density curve determined by the referee laboratory

Section 4.6., "Ride Quality." This section is voided and replaced by the following.

Measurement of ride quality only applies to the final travel lanes that receive a 1- or 2-course surface treatment for the final riding surface, unless otherwise shown on the plans. Measure the ride quality of the base course either before or after the application of the prime coat, as directed, and before placement of the surface treatment. Use a certified profiler operator from the Department's MPL. When requested, furnish the Engineer documentation for the person certified to operate the profiler.

Provide all profile data to the Engineer in electronic data files within 3 days of measuring the ride quality using the format specified in Tex-1001-S. The Engineer will use Department software to evaluate longitudinal profiles to determine areas requiring corrective action. Correct 0.1-mi.sections for each wheel path having an average international roughness index (IRI) value greater than 100 in. per mile to an IRI value of 100 in. per mile or less, unless otherwise shown on the plans.

Re-profile and correct sections that fail to maintain ride quality, as directed. Correct re-profiled sections until specification requirements are met, as approved. Perform this work at no additional expense to the Department.

Special Provision to Item 300
Asphalt, Oils, and Emulsions

Item 300, “Asphalt, Oils, and Emulsions” of the Standard Specifications is replaced by Special Specification 3096, “Asphalts, Oils, and Emulsions.” All Item 300 Special Provisions are no longer available, beginning with the April 2022 letting.

Special Provision to Item 302
Aggregates for Surface Treatments

Item 302, "Aggregates for Seal Coats," of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Section 2.1., "Aggregate." Tables 2 and 3 are voided and replaced by the following.

Table 2
Aggregate Gradation Requirements (Cumulative % Retained[1])

Sieve	Grade								
	1	2	3S[2]	3		4S[2]	4	5S[2]	5
				Non-Lightweight	Lightweight				
1"	-	-	-	-	-	-	-	-	-
7/8"	0–2	0	-	-	-	-	-	-	-
3/4"	20–35	0–2	0	0	0	-	-	-	-
5/8"	85–100	20–40	0–5	0–5	0–2	0	0	-	-
1/2"	-	80–100	55–85	20–40	10–25	0–5	0–5	0	0
3/8"	95–100	95–100	95–100	80–100	60–80	60–85	20–40	0–5	0–5
1/4"	-	-	-	95–100	95–100	-	-	65–85	-
#4	-	-	-	-	-	95–100	95–100	95–100	50–80
#8	99–100	99–100	99–100	98–100	98–100	98–100	98–100	98–100	98–100

1. Round test results to the nearest whole number.
2. Single-size gradation.

Table 3
Aggregate Quality Requirements

Property	Test Method	Requirement[1]	
		Minimum	Maximum
SAC	AQMP	As shown on the plans	
Deleterious Material[2], %	Tex-217-F, Part I	-	2.0
Decantation, %	Tex-406-A	-	1.5
Flakiness Index, %	Tex-224-F	-	17
Gradation	Tex-200-F, Part I	Table 2 Requirements	
Los Angeles Abrasion, %	Tex-410-A	-	35
Magnesium Sulfate Soundness, 5 Cycle, %	Tex-411-A	-	25
Micro-Deval Abrasion, %	Tex-461-A	Note 3	
Coarse Aggregate Angularity[4], 2 Crushed Faces, %	Tex-460-A, Part I	85	-
Additional Requirements for Lightweight Aggregate			
Dry Loose Unit Wt., lb./cu. ft.	Tex-404-A	35	60
Pressure Slaking, %	Tex-431-A	-	6.0
Freeze-Thaw Loss, %	Tex-432-A	-	10.0
Water Absorption, 24hr., %	Tex-433-A	-	12.0

1. Material requirements are listed below, unless otherwise shown on the plans.
2. Not required for lightweight aggregate.
3. Used to estimate the magnesium sulfate soundness loss in accordance with Section 2.1.1.
4. Only required for crushed gravel.

Section 2.1.1., "Micro-Deval Abrasion," is added.

The Engineer will perform a minimum of one Micro-Deval abrasion test in accordance with Tex-461-A for each coarse aggregate source per project that has a Rated Source Soundness Magnesium (RSSM) loss value greater than 15 as listed in the BRSQC. The Engineer may waive all Micro-Deval testing based on a satisfactory test history of the same aggregate source.

The Engineer will estimate the magnesium sulfate soundness loss for each coarse aggregate source, when tested, using the following formula.

$Mg_{est.} = (RSSM)(MD_{act.}/RSMD)$

where:
$Mg_{est.}$ = magnesium sulfate soundness loss
$MD_{act.}$ = actual Micro-Deval percent loss
RSMD = Rated Source Micro-Deval

When the estimated magnesium sulfate soundness loss is greater than the maximum magnesium sulfate soundness loss specified, the coarse aggregate source will not be allowed for use unless otherwise approved by the Engineer. The Engineer may require additional testing before granting approval.

Section 2.2., "Precoating." The third paragraph is voided and replaced by the following.

The Engineer retains the right to remove precoat material from aggregate samples in accordance with Tex-210-F, or as recommended by the Construction Division, and test the aggregate to verify compliance with Table 2 and Table 3 requirements. Gradation testing may be performed with precoat intact.

Section 2.3., "Sampling," is added.

Personnel who conduct sampling and witnessing of sampling must be certified by the Department-approved certification program. Supply the Engineer with a list of certified personnel and copies of their current certificates before beginning construction and when personnel changes are made. At any time during the project, the Engineer may perform production tests as deemed necessary in accordance with Item 5, "Control of the Work."

The Engineer will sample aggregate from stockpiles located at the production site, intermediate distribution site, or project location in accordance with Tex-221-F, Section 3.2.3. The Engineer will split each sample into 2 equal portions in accordance with Tex-200-F, Section 3.3, and label these portions "Engineer" and "Contractor" or "Supplier." Witness the sampling and splitting, and take immediate possession of the samples labeled "Contractor" or "Supplier".

Section 2.4., "Reporting and Responsibilities," is added.

The Engineer will provide test results to the Contractor and Supplier within 10 working days from the date the stockpile was sampled for sources listed on the Department's Bituminous Rated Source Quality Catalog (BRSQC), unless otherwise directed. The Engineer will provide test results for the LA Abrasion (Tex-410-A) and Magnesium Sulfate Soundness (Tex-411-A) tests within 30 calendar days for sources not listed on the BRSQC, or for sources not meeting the requirements of Section 2.1.1., "Micro-Deval Abrasion." The Engineer will report to the other party within 24 hours when any test result does not meet the requirements listed in Table 2 or Table 3.

Special Provision to Item 316
Seal Coat

Item 316, "Seal Coat" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 4.8, "Asphalt Placement" is supplemented by the following:

4.8.5. Collect all samples in accordance with Tex-500-C, "Sampling Bituminous Materials, Pre-Molded Joint Fillers, and Joint Sealers" from the distributor and with witness by the Engineer.

At least once per project, collect split samples of each binder grade and source used. The Engineer will submit one split sample to MTD for testing and retain the other split sample.

In addition, collect one sample of each binder grade and source used on the project for each production day. The Engineer will retain these samples.

The Engineer will keep all retained samples for one yr., for hot-applied binders and cutback asphalts; or for two mo., for emulsified asphalts. The Engineer may submit retained samples to MTD for testing as necessary or as requested by MTD.

Special Provision to Item 334
Hot-Mix Cold-Laid Asphalt Concrete Pavement

Item 334, "Hot-Mix Cold-Laid Asphalt Concrete Pavement," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed hereby.

Section 334.4.1.2., "Job-Mix Formula Approval." Table 5 is voided and replaced by the following:

Table 5
Laboratory Mixture Design Properties

Property	Test Method	Requirement
Target laboratory-molded density, %[1]	Tex-207-F	94.0 ± 1.5
Hveem stability, Min	Tex-208-F	35
Cantabro loss, %, Max	Tex-245-F	10
Hydrocarbon-volatile content, %, Max	Tex-213-F	0.6
Moisture content, %, Max[2]	Tex-212-F	1.0
Boil test, %, Max[3]	Tex-530-C	10

1. Unless otherwise shown on the plans.
2. Unless otherwise approved.
3. Limit may be increased or eliminated when approved.

Special Provision to Item 340
Dense-Graded Hot-Mix (Small Quantity)

Item 340, “Dense-Graded Hot-Mix (Small Quantity)” of the Standard Specifications is replaced by Special Specification 3076, “Dense-Graded Hot-Mix Asphalt,” Section 4.9.4., “Exempt Production.” All Item 340 Special Provisions and bid codes are no longer available, beginning with the February 2022 letting.

Special Provision to Item 341
Dense-Graded Hot-Mix Asphalt

Item 341, “Dense-Graded Hot-Mix Asphalt” of the Standard Specifications is replaced by Special Specification 3076, “Dense-Graded Hot-Mix Asphalt.” All Item 341 Special Provisions and bid codes are no longer available, beginning with the February 2020 letting.

Special Provision to Item 342
Permeable Friction Course (PFC)

Item 342, “Permeable Friction Course (PFC)” of the Standard Specifications is replaced by Special Specification 3079, “Permeable Friction Course.” All Item 342 Special Provisions and bid codes are no longer available, beginning with the April 2022 letting.

Special Provision to Item 344
Superpave Mixtures

Item 344, “Superpave Mixtures” of the Standard Specifications is replaced by Special Specification 3077, “Superpave Mixtures.” All Item 344 Special Provisions and bid codes are no longer available, beginning with the February 2020 letting.

Special Provision to Item 347
Thin Overlay Mixture (TOM)

Item 347, “Thin Overlay Mixture (TOM)” of the Standard Specifications is replaced by Special Specification 3081, “Thin Overlay Mixture (TOM). All Item 347 Special Provisions and bid codes are no longer available, beginning with the April 2022 letting.

Special Provision to Item 348
Thin Bonded Friction Courses

Item 348, “Thin Bonded Friction Courses” of the Standard Specifications is replaced by Special Specification 3082, “Thin Bonded Friction Courses.” All Item 348 Special Provisions and bid codes are no longer available, beginning with the April 2022 letting.

Special Provision to Item 360
Concrete Pavement

Item 360, "Concrete Pavement" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 360.2.1., "Materials," the third paragraph is voided and replaced by the following:

For continuously reinforced concrete pavements, use a coarse aggregate with a rated coefficient of thermal expansion of not more than 5.5×10^{-6} in./in./°F as listed in the Department's *Concrete Rated Source Quality Catalog*.

Section 360.4.8.3., "Surface Texture," the second paragraph is voided and replaced by the following:

A metal-tine texture finish is required unless otherwise shown on the plans. Provide transverse or longitudinal tining unless otherwise shown on the plans. Immediately following the carpet drag, apply a single coat of evaporation retardant, if needed, at the rate recommended by the manufacturer. Provide the metal-tine finish immediately after the concrete surface has set enough for consistent tining. Operate the metal-tine device to obtain grooves approximately 3/16 in. deep, with a minimum depth of 1/8 in., and approximately 1/12 in. wide. Do not overlap a previously tined area. Use manual methods to achieve similar results on ramps, small or irregular areas, and narrow width sections of pavements. Repair damage to the edge of the slab and joints immediately after texturing. Do not tine pavement that will be overlaid or that is scheduled for blanket diamond grinding or shot blasting.

Special Provision to Item 420
Concrete Substructure

Item 420, “Concrete Substructures” of the Standard Specifications is amended with respect to the clause cited below. No other clauses or requirements of this Item are waived or changed.

Article 420.6., “Payment.” The first paragraph is replaced by the following:

The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for the class of concrete and element identified and by the special designation when appropriate. This price is full compensation for furnishing, hauling, and mixing concrete materials; furnishing, bending, fabricating, splicing, welding and placing the required reinforcement; clips, blocks, metal spacers, ties, wire, or other materials used for fastening reinforcement in place; placing, finishing, and curing concrete; mass placement controls; applying ordinary surface finish; furnishing and placing drains, metal flashing strips, and expansion-joint material; excavation, subgrade preparation; and forms and falsework, equipment, labor, tools, and incidentals.

Special Provision to Item 421
Hydraulic Cement Concrete

Item 421, "Hydraulic Cement Concrete" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 421.2., "Materials," the second sentence of the first paragraph is voided and replaced by the following.

Provide aggregates from sources listed in the Department's Concrete Rated Source Quality Catalog (CRSQC).

Article 421.2.2., Supplementary Cementing Materials (SCM), is voided and replaced with the following.

Supplementary Cementing Materials (SCM).

- **Fly Ash**. Furnish fly ash, Modified fly ash (MFA), and Ground Bottom Ash (GBA) conforming to DMS-4610, "Fly Ash."
- **Slag Cement**. Furnish Slag Cement conforming to DMS-4620, "Slag Cement."
- **Silica Fume**. Furnish silica fume conforming to DMS-4630, "Silica Fume."
- **Metakaolin**. Furnish metakaolin conforming to DMS-4635, "Metakaolin."

Article 421.3.1.3., "Agitators and Truck and Stationary Mixers," the first paragraph is voided and replaced by the following.

Provide stationary and truck mixers capable of combining the ingredients of the concrete into a thoroughly mixed and uniform mass and capable of discharging the concrete so that the requirements of Tex-472-A are met.

Article 421.3.1.3., "Agitators and Truck and Stationary Mixers," is supplemented with the following.

Truck mixers with automated water and chemical admixture measurement and slump and slump flow monitoring equipment meeting the requirement of ASTM C 94 will be allowed. Provide data every 6 mo. substantiating the accuracy of slump, slump flow, temperature, water, and chemical admixture measurements. The slump measured by the automated system must be within 1 in. of the slump measured in accordance with Tex-415-A. The concrete temperature measured by the automated system must be within 1°F of concrete temperature measured in accordance with Tex-422-A. The Engineer will not use the automated measurements for acceptance.

Article 421.4.2, "Mix Design Proportioning," Table 8 is voided and replaced by the following.

Table 8
Concrete Classes

Class of Concrete	Design Strength,[1] Min f'_c (psi)	Max w/cm Ratio	Coarse Aggregate Grades[2,3,4]	Cement Types	Mix Design Options	Exceptions to Mix Design Options	General Usage[5]
A	3,000	0.60	1–4, 8	I, II, I/II, IL, IP, IS, IT, V	1, 2, 4, & 7	When the cementitious material content does not exceed 520 lb./cu. yd., any fly ash listed in the MPL may be used at a cement replacement of 20% to 50%.	Curb, gutter, curb & gutter, conc. retards, sidewalks, driveways, back-up walls, anchors, non-reinforced drilled shafts
B	2,000	0.60	2–7				Riprap, traffic signal controller foundations, small roadside signs, and anchors
C[6]	3,600	0.45	1–6	I, II, I/II, IP, IL, IS, IT, V	1–8		Drilled shafts, bridge substructure, traffic rail, culverts except top slab of direct traffic culverts, headwalls, wing walls, inlets, manholes, traffic barrier
E	3,000	0.50	2–5	I, II, I/II, IL, IP, IS, IT, V	1–8	When the cementitious material content does not exceed 520 lb./cu. yd., any fly ash listed in the MPL may be used at a cement replacement of 20% to 50%.	Seal concrete
F[6]	Note[7]	0.45	2–5	I, II, I/II, IP, IL, IS, IT, V			Railroad structures; occasionally for bridge piers, columns, bents, post-tension members
H[6]	Note[7]	0.45	3–6	I, II, I/II, III, IP, IL, IS, IT, V	1–4, 8	Mix design options 1-8 allowed for cast-in-place concrete and the following precast elements unless otherwise stated in the plans: ■ Bridge Deck Panels, ■ Retaining Wall Systems, ■ Coping, ■ Sound Walls, ■ Wall Columns, ■ Traffic Rail, ■ Traffic Barrier, ■ Long/Arch Span Culverts, and ■ precast concrete products included in Items 462, 464, and 465. Do not use Type III cement in mass placement concrete. Up to 20% of blended cement may be replaced with listed SCMs when Option 4 is used for precast concrete. Options 6, & 7 allowed for cast-in-place Class H concrete.	Precast concrete, post-tension members
S[6]	4,000	0.45	2–5	I, II, I/II, IP, IL, IS, IT, V	1–8		Bridge slabs, top slabs of direct traffic culverts, approach slabs
P	See Item 360, "Concrete Pavement."	0.50	2–3	I, II, I/II, IL, IP, IS, IT, V	1–8	When the cementitious material content does not exceed 520 lb./cu. yd., any fly ash listed in the MPL may be used at a cement replacement of 20% to 50%.	Concrete pavement

Class of Concrete	Design Strength,[1] Min f'_c (psi)	Max w/cm Ratio	Coarse Aggregate Grades[2,3,4]	Cement Types	Mix Design Options	Exceptions to Mix Design Options	General Usage[5]
CO[6]	4,600	0.40	6	I, II, I/II, IP, IL, IS, IT, V	1–8		Bridge deck concrete overlay
LMC[6]	4,000	0.40	6–8				Latex-modified concrete overlay
SS[6]	3,600	0.45	4–6		1-8	Use a minimum cementitious material content of 658 lb./cu. yd. of concrete. Limit the alkali loading to 4.0 lbs./cu. yd. or less when using option 7.	Slurry displacement shafts, underwater drilled shafts
K[6]	Note[7]	0.40	Note[7]	I, II, I/II, III IP, IL, IS, IT, V	1-8		Note[7]
HES	Note[7]	0.45	Note[7]	I, IL, II, I/II, III		Mix design options do not apply. 700 lb. of cementitious material per cubic yard limit does not apply.	Concrete pavement, concrete pavement repair
"X" (HPC) [6,8,9]	Note[10]	0.45	Note[10]	I, II, I/II, III IP, IL, IS, IT, V	1–4, & 8	Maximum fly ash replacement for Option 3 may be increased to 50%. Up to 20% of a blended cement may be replaced with listed SCMs for Option 4. Do not use Option 8 for precast concrete.	
"X" (SRC) [6,8,9]	Note[10]	0.45	Note[10]	I/II, II, IP, IL, IS, IT, V	1–4, & 7	When using fly ash, only use fly ashes allowed for SRC as listed in the Fly Ash MPL. Type III-MS may be used where allowed. Type I and Type III cements may be use when fly ashes allowed for SRC as listed in the Fly Ash MPL are used, and with a maximum w/cm of 0.40. Up to 20% of blended cement may be replaced with listed SCMs when Option 4 is used for precast concrete. Use Option 7 for precast concrete where allowed.	

1. Design strength must be attained within 56 days.
2. Do not use Grade 1 coarse aggregate except in massive foundations with 4 in. minimum clear spacing between reinforcing steel bars, unless otherwise permitted. Do not use Grade 1 aggregate in drilled shafts.
3. Use Grade 8 aggregate in extruded curbs unless otherwise approved.
4. Other grades of coarse aggregate maybe used in non-structural concrete classes when allowed by the Engineer.
5. For information only.
6. Structural concrete classes.
7. As shown on the plans or specified.
8. "X" denotes class of concrete shown on the plans or specified.
9. (HPC): High Performance Concrete, (SRC): Sulfate Resistant Concrete.
10. Same as class of concrete shown on the plans.

Article 421.4.2.2., "Aggregates," is supplemented by the following.

Use the following equation to determine if the aggregate combination meets the sand equivalency requirement when blending fine aggregate or using an intermediate aggregate:

$$\frac{(SE_1 \times P_1)+(SE_2 \times P_2)+(SE_{ia} \times P_{ia})}{100} \geq 80\%$$

where:
SE_1 = sand equivalency (%) of fine aggregate 1
SE_2 = sand equivalency (%) of fine aggregate 2
SE_{ia} = sand equivalency (%) of intermediate aggregate passing the 3/8 in. sieve
P_1 = percent by weight of fine aggregate 1 of the fine aggregate blend
P_2 = percent by weight of fine aggregate 2 of the fine aggregate blend
P_{ia} = percent by weight of intermediate aggregate passing the 3/8 in. sieve

Article 421.4.2.3., Chemical Admixtures," the second paragraph is voided and replaced with the following.

Use a 30% calcium nitrite solution when a corrosion-inhibiting admixture is required. Dose the admixture at the rate of gallons of admixture per cubic yard of concrete shown on the plans. Use set retarding admixtures, as needed, to control setting time to ensure concrete containing corrosion inhibiting admixtures remain workable for the entire duration of the concrete placement. Perform setting time testing and slump loss testing during trial batch testing.

Article 421.4.2.5., "Slump," the second paragraph is voided and not replaced. Table 9 is voided and replaced with below:

Table 9
Placement Slump Requirements

General Usage	Placement Slump Range,[1,2] in.
Walls (over 9 in. thick), caps, columns, piers	3 to 7
Bridge slabs, top slabs of direct traffic culverts, approach slabs, concrete overlays, latex-modified concrete for bridge deck overlays	3 to 6
Inlets, manholes, walls (less than 9 in. thick), bridge railing, culverts, concrete traffic barrier, concrete pavement (formed)	4 to 6
Precast concrete	4 to 9
Underwater concrete placements	6 to 8-1/2
Drilled shafts, slurry displaced and underwater drilled shafts	See Item 416, "Drilled Shaft Foundations."
Curb, gutter, curb and gutter, concrete retards, sidewalk, driveways, seal concrete, anchors, riprap, small roadside sign foundations, concrete pavement repair, concrete repair	As approved

1. Maximum slump values may be increase above these values shown using chemical admixtures, provided the admixture treated concrete has the same or lower water-to-cementitious ratio and does not exhibit segregation or excessive bleeding. Request approval to increase slump limits in advance for proper evaluation by the Engineer.
2. For fiber reinforced concrete, perform slump before addition of fibers.

Article 421.4.2.6., "Mix Design Options", is voided and replaced with the following.

Option 1. Replace cement with at least the minimum dosage listed in the Fly Ash MPL for the fly ash used in the mixture. Do not replace more than 50% of the cement with fly ash.

Option 2. Replace 35% to 50% of the cement with slag cement.

Option 3. Replace 35% to 50% of the cement with a combination of fly ash, slag cement, MFA, metakaolin, or at least 3% silica fume; however, no more than 35% may be fly ash, and no more than 10% may be silica fume.

Option 4. Use Type IP, Type IS, or Type IT cement as allowed in Table 8 for each class of concrete. Up to 10% of a Type IP, Type IS, or Type IT cement may be replaced with fly ash, slag cement, or silica fume. Use no more than 10% silica fume in the final cementitious material mixture if the Type IT cement contains silica fume, and silica fume is used to replace the cement.

Option 5. Option 5 is left intentionally blank.

Option 6. Use a lithium nitrate admixture at a minimum dosage determined by testing conducted in accordance with Tex-471-A. Before use of the mix, provide an annual certified test report signed and sealed by a licensed professional engineer, from a laboratory on the Department's MPL, certified by the Construction Division as being capable of testing according to Tex-471-A.

Option 7. Ensure the total alkali contribution from the cement in the concrete does not exceed 3.5 lb. per cubic yard of concrete when using hydraulic cement not containing SCMs calculated as follows:

$$\text{lb. alkali per cu. yd.} = \frac{(\text{lb. cement per cu. yd.}) \times (\%\ Na_2O \text{ equivalent in cement})}{100}$$

In the above calculation, use the maximum cement alkali content reported on the cement mill certificate.

Option 8. Use Table 10 when deviating from Options 1–3 or when required by the Fly Ash MPL. Perform required testing annually and submit results to the Engineer. Laboratories performing ASTM C1260, ASTM C1567, and ASTM C1293 testing must be listed on the Department's MPL. Before use of the mix, provide a certified test report signed and sealed by a licensed professional engineer demonstrating the proposed mixture conforms to the requirements of Table 10.

Provide a certified test report signed and sealed by a licensed professional engineer, when HPC is required, and less than 20% of the cement is replaced with SCMs, demonstrating ASTM C1202 test results indicate the permeability of the concrete is less than 1,500 coulombs tested immediately after either of the following curing schedules:

- Moisture cure specimens 56 days at 73°F.
- Moisture cure specimens 7 days at 73°F followed by 21 days at 100°F.

Table 10
Option 8 Testing and Mix Design Requirements

Scenario	ASTM C1260 Result		Testing Requirements for Mix Design Materials or Prescriptive Mix Design Options
	Mix Design Fine Aggregate	Mix Design Coarse Aggregate	
A	> 0.10%	> 0.10%	Determine the dosage of SCMs needed to limit the 14-day expansion of each aggregate[1] to 0.10% when tested individually in accordance with ASTM C1567.
B	≤ 0.10%	≤ 0.10%	Use the minimum replacement listed in the Fly Ash MPL, or When Option 8 is listed on the MPL, use a minimum of 40% fly ash with a maximum CaO[2] content of 25%, or Use any ternary combination which replaces 35% to 50% of cement.
	≤ 0.10%	ASTM C1293 1 yr. Expansion ≤ 0.04%	Use a minimum of 20% of any fly ash; or Use any ternary combination which replaces 20% to 50% of cement.
C	≤ 0.10%	> 0.10%	Determine the dosage of SCMs needed to limit the 14-day expansion of coarse and intermediate[1] aggregate to 0.10% when tested individually in accordance with ASTM C1567.
D	> 0.10%	≤ 0.10%	Use the minimum replacement listed in the Fly Ash MPL, or When Option 8 is listed on the MPL, use a minimum of 40% fly ash with a maximum CaO[2] content of 25%, or Use any ternary combination which replaces 35% to 50% of cement.
	> 0.10%	ASTM C1293 1 yr. Expansion ≤ 0.04%	Determine the dosage of SCMs needed to limit the 14-day expansion of each fine aggregate to 0.10% when individually tested in accordance with ASTM C1567.

1. Intermediate size aggregates will fall under the requirements of mix design coarse aggregate.
2. Average the CaO content from the previous ten values as listed on the test certificate.

Article 421.4.2.7., "Optimized Aggregate Gradation (OAG) Concrete," the first sentence of the first paragraph is voided and replaced by the following.

The gradations requirements in Table 4 and Table 6 do not apply when OAG concrete is specified or used by the Contractor unless otherwise shown on the plans.

The fineness modulus for fine aggregate listed in Table 5, does not apply when OAG Concrete is used,

Article 421.4.6.2., Delivering Concrete," the third paragraph is supplemented by the following.

When truck mixers are equipped with automated water or chemical admixture measurement and slump or slump flow monitoring equipment, the addition of water or chemical admixtures during transit is allowed. Reports generated by this equipment must be submitted to the Engineer daily.

Article 421.4.6.2., "Delivering Concrete," the fifth paragraph is voided and replaced with the following. Begin the discharge of concrete delivered in truck mixers within the times listed in Table 14. Concrete delivered after these times, and concrete that has not begun to discharge within these times will be rejected

Article 421.4.8.3., "Testing of Fresh Concrete," is voided and replaced with the following.

Testing Concrete. The Engineer, unless specified in other Items or shown on the plans, will test the fresh and hardened concrete in accordance with the following methods:

- Slump. Tex-415-A;
- Air Content. Tex-414-A or Tex-416-A;
- Temperature. Tex-422-A;
- Making and Curing Strength Specimens. Tex-447-A;
- Compressive Strength. Tex-418-A;
- Flexural Strength. Tex-448-A; and
- Maturity. Tex-426-A.

Flexural strength and maturity specimens will not be made unless specified in other items or shown on the plans.

Concrete with slump less than minimum required after all addition of water withheld will be rejected, unless otherwise allowed by the Engineer. Concrete with slump exceeding maximum allowed may be used at the contractor's option. If used, Engineer will make, test, and evaluate strength specimens as specified in Article 421.5., "Acceptance of Concrete." Acceptance of concrete not meeting air content or temperature requirements will be determined by Engineer. Fresh concrete exhibiting segregation and excessive bleeding will be rejected.

Article 421.4.8.3.1. "Job-Control Testing," is voided and not replaced.

Special Provision to Item 425
Precast Prestressed Concrete Structural Members

Item 425, "Precast Prestressed Concrete Structural Members" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 2.3., "Prestressing Steel." The first bullet is voided and replaced with the following.

- Seven-wire steel strand meeting DMS-4500, "Steel Strand, Uncoated Seven-Wire Low Relaxation for Prestressed Concrete."

Section 2.3., "Prestressing Steel." The second paragraph is voided and replaced with the following.

Use 7-wire steel strand produced by a prequalified manufacturer on the list in the Department MPL maintained by the Materials and Tests Division. The Department may take samples in accordance with Tex-710-I to verify compliance with specification requirements.

Special Provision to Item 426
Post-Tensioning

Item 426, "Post-Tensioning" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 2.1., "Prestressing Steel." The first bullet is voided and replaced with the following.

- Seven-wire steel strand meeting DMS-4500, "Steel Strand, Uncoated Seven-Wire Low Relaxation for Prestressed Concrete," or

Section 2.2., "Post-Tensioning System." The second bulleted item is voided and replaced with the following:

- Provide pre-packaged grouts in accordance with DMS-4670, "Grouts for Post-Tensioning." Do not use grouts that exceed the manufacturers' recommended shelf life or 6 mo. after date of manufacture, whichever is less.

Section 4.2., "Required Submittals." The section is voided and replaced with the following.

4.2. **Required Submittals.** Submit information required in this Section for post-tensioned elements, in addition to forming and falsework plans required by Item 420, "Concrete Substructures," and Item 424, "Precast Concrete Structural Members (Fabrication)." Include all necessary construction information in these submittals for cast-in-place and precast construction including, but not limited to the information required in this Section.

4.2.1. **Design Calculations**. Provide design procedures, coefficients, allowable stresses, tendon spacing, and clearances in accordance with the AASHTO LRFD *Bridge Design Specifications* and PTI/ASBI M50 unless otherwise shown on the plans. Submit enough calculations to support the proposed system and method of post-tensioning including friction loss diagrams. When the required jacking force for a particular type of tendon, duct, and configuration is furnished on the plans, design calculations are not required except to adjust for conditions different from those shown on the plans.

4.2.2. **Post-Tensioning Details**. Provide drawings with details that meet the requirements of PTI/ASBI M50 and this Specification.

4.2.3. **Grouting Plan**. Submit for approval written grouting procedures at least four weeks before the start of the element's construction. Include items required by PTI M55.

Include the names of people responsible for PT installation and grouting operations, with the foreman of each grouting crew certified as a PTI Level 2 Bonded PT Field Specialist and ASBI Certified Grouting Technician.

4.2.4. **Stressing Safety Plan**. Provide a plan to protect the public, workers, and Department personnel on and around the vicinity where post-tensioning operations are occurring.

Submit for approval, a detailed safety plan which identifies potential risk associated with post-tensioning operations, including but not limited to:

- tendon alignment,
- temporary shoring,
- ram operations, and
- stand anchorage.

Section 4.3., "Design Calculations." The section is voided and replaced with the following.

4.3. **Packaging, Storing, and Handling of Post-Tensioning Components**. Package, store, and handle post-tensioning steel, grout, duct, and other accessories in accordance with PTI/ASBI M50 and PTI M55 unless otherwise indicated. Acceptance and rejection criteria for strand will follow PTI/ASBI M50 and PTI M55.

The following exceptions apply:

- grout storage onsite will be limited to 30 days unless approval by the Engineer is given in advance of material delivery,
- install grout caps and ensure vents are closed at all times so that water and other contaminants cannot enter the duct before strand installation, and
- do not flush ducts at any time.

Section 4.4., "Packaging, Storing, and Handling of Post-Tensioning Components." The section is voided and replaced with the following.

4.4. **Duct and Prestressing Steel Installation for Post-Tensioning**. Follow PTI/ASBI M50 for duct and prestressing steel installation procedures and requirements unless otherwise specified. Verify that concrete strength requirements on the plans are met for stressing and staged loading of post-tensioned structural elements.

Stress the tendons within seven days of installing the strand in the ducts unless otherwise approved in advance. Follow the tensioning procedure noted in the approved post-tensioning details.

Section 4.5., "Duct and Prestressing Steel Installation for Post-Tensioning." The section is voided and replaced with the following.

4.5. **Grouting**. Grout in accordance with PTI M55.

Grout within 14 days of tendon stressing unless otherwise specified or approved. Obtain approval to extend the grouting time before stressing tendons.

Do not allow the grout temperature to exceed 85°F during mixing and pumping. Do not grout when the ambient temperature is below 35°F. Field-test the grout in accordance with Table 1 during grout installation. Perform field-testing by trained personnel at the Contractor's expense while witnessed by the Engineer. Pump at the lowest pressure possible that will maintain a continuous flow of grout.

Table1
Requirements for Field-Testing of Grout

Test	Frequency	Requirement
Schupak Pressure Bleed Test (ASTM C1741)	1 per day	Per DMS-4670
Fluidity test (Tex-437-A, Method 2)	2 every 2 hr. 2 min. per day	per DMS-4670
Compressive Strength test (3" × 6" cylinders)	1 per day	per DMS-4670
Mud Balance test (Tex-130-E, Part II)[1, 2]	2 per day	per PTI M55

1. Take one sample from the mixer and one sample from the farthest duct outlet.
2. Verify wet density is within the range established by the department.

Section 4.6., "Grouting." The section is voided and not replaced.

Article 5., "MEASUREMENT AND PAYMENT." The section is voided and replaced with the following.

5. **MEASUREMENT**

This Item will be measured by the each PT element or member. An element or member is defined by one of the following individual components.

- PT Cap

- PT Column
- PT Bent
- Other elements shown in the plans.

The PT may extend into other elements which is subsidiary to the main element being post-tensioned.

6. **PAYMENT**

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "PT" for the member type shown on the plans. This price is full compensation for submittals, mock-ups, prestressing steel, post-tensioning, ducts, grout fittings, grout, end anchorages, bearing plates, equipment, labor, materials, tools, and incidentals. Materials furnished for testing will not be paid for directly.

Post-tensioning of precast members, tensioned at a fabrication plant, will not be paid for directly but will be subsidiary to pertinent Items.

Special Provision to Item 427
Surface Finishes for Concrete

Item 427, "Surface Finishes for Concrete" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 427.2.1 "Coatings," is supplemented with the following:

Epoxy Waterproofing. Provide Type X Epoxy per DMS-6100 "Epoxies and Adhesives." Match color of coating with Federal Standard 595C color 35630, concrete gray, unless otherwise shown on the plans.

Article 427.4.2.2 "Application," is supplemented with the following:

Epoxy Waterproofing. Mix epoxy per manufacturer's instructions. Apply the coating on a dry surface at a maximum application rate of 100 sq. ft per gallon. Apply a thin uniform film of mixed epoxy to the substrate by the use of a short nap roller or brush. The epoxy may be sprayed following the thinning requirements of the manufacturer. No more than 15% reduction is permitted.

Match the color of the applied coating with the color standard shown on the plans. Apply when ambient temperature is between 50°F and 100°F.

Article 427.6 "Payment," the second paragraph is voided and replaced in its entirety with:

When a surface finish for concrete is specified as a pay item, the work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Adhesive Grout Finish," "Concrete Paint Finish," "Opaque Sealer Finish," "Silicone Resin Paint Finish," "Epoxy Waterproof Finish," or "Blast Finish." This price is full compensation for materials; cleaning and preparing surfaces; application of materials; and equipment, labor, tools, and incidentals.

Special Provision to Item 434
Bridge Bearings

Item 434, "Bridge Bearings" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 434.2.1., "Plain and Laminated Elastomeric Bearings," is voided and replaced with the following:

Manufacturers of plain and laminated elastomeric bearing pads must be approved in accordance with DMS-7365, "Qualification Procedure for Elastomeric Bridge Bearing Pad Manufacturers." The Materials and Tests Division (MTD) maintains a list of approved elastomeric bridge bearing pad manufacturers.

Manufacturers that produce laminated elastomeric bearings with a top steel plate or special components (steel guide bars and bottom plate) must comply with AASHTO's NTPEP Committee Work Plan for Evaluation of Plain and Laminated Elastomeric Bridge Bearing Manufacturers. DMS-7365 does not apply to manufacturers of bridge bearings where the laminated elastomeric bearing pad is a component of the completed bearing assembly.

Section 434.2.1.1., "Elastomer," is voided and replaced with the following:

Provide elastomer for bearings formulated from previously unvulcanized 100% virgin polychloroprene rubber polymers meeting the physical properties, heat resistance, and compression set requirements of AASHTO M 251, Table X1.1, unless otherwise shown on the plans. Do not provide bearings containing previously vulcanized synthetic rubber or other synthetic rubber-like polymers. Perform material tests on the finished product in accordance with the applicable test methods. Do not use standard laboratory test slabs for this purpose. Prepare test specimens from the finished product in accordance with ASTM D3183.

Obtain approval for each elastomer formulation before use on Department projects. Submit certified test results to MTD to prequalify and obtain approval of a particular formulation. Show actual test values obtained and the required values for the physical properties, heat resistance, and compression set of the elastomer when tested for compliance with the minimum requirements of AASHTO M 251, Table X1.1.

Forward samples (freight prepaid) to MTD, or their contracted testing laboratory when directed.

Submit only elastomer of the type or types to be supplied. Submit prequalification samples consisting of 2 finished bearing pads typical of the formulation and workmanship for Department projects. Submit 2 samples of each type when laminated and plain bearing pads are required. Laminated sample bearing pads may represent both plain bearing pads and laminated bearing pads for an elastomer formulation.

Plain sample bearing pads must measure 9 in. × 19 in. × 1 in. Laminated sample bearing pads must measure 9 in. × 14 in. × 1-1/2 in. with the following number of steel laminates:

- 50 durometer—3 steel laminates,
- 60 durometer—2 steel laminates, and
- 70 durometer—2 steel laminates.

Bond strength testing of laminated prequalification samples will be performed by the Department in accordance with Tex-601-J, Part I—"Bond Strength Test Method 1". The tested sample must achieve a minimum bond strength of 40 lbf/in. of width. Presence of chlorinated compounds (neoprene) in the elastomer will be verified by the Department in accordance with Tex-601-J, Part III—Chlorinated Compound Test Method 3.

Costs associated with testing elastomer formulations failing to conform to the requirements of this Item are borne by the bearing manufacturer. This cost will be assessed at the rate established by MTD at the time of testing.

Certify that the submitted samples are of the same basic elastomer formulation and of equivalent cure as the finished products to be furnished on Department projects.

Complete prequalification testing will be performed for each formulation at least once every 2 yr. and when necessary.

Section 434.2.1.2., "Steel Laminates," is voided and replaced with the following:

Provide steel laminates, for laminated bearing pads, of commercial grade steel strip or sheet with a thickness of 0.105 ±0.015 in.

Section 434.2.2.1.2., "Laminated Elastomeric Bearing Pad and Steel Plate," the first paragraph is amended to include the following sentence:

Bearing manufacturers that produce the laminated elastomeric bearing pad component of a sliding elastomeric bearing must comply with AASHTO's NTPEP Committee Work Plan for Evaluation of Plain and Laminated Elastomeric Bridge Bearing Manufacturers.

Section 434.3.1., "Plain and Laminated Elastomeric Bearings," is voided and replaced with the following:

Electronically submit shop drawings for the complete assembly before fabrication of laminated elastomeric bearings with or without steel top plates or special components in accordance with the plans and Item 441, "Steel Structures." Provide a bearing layout with the shop drawings.

Mold together components of a laminated bearing pad to form an integral unit free of voids or separations in the elastomer or between the elastomer and the steel laminates or plates, unless otherwise shown on the plans. Provide well-vulcanized elastomer between the laminates or plates and on the outer surfaces of the bearing pad that is uniform and integral and resists separation by mechanical means into separate, definite, well-defined elastomeric layers. Evidence of this layered construction, either at the outer surfaces or within the bearing pad, will be cause for rejection. Repair of damaged elastomer on sides of laminated bearing pads is not allowed for product acceptance. Repair of damaged elastomer on top or bottom surfaces of laminated bearing pads is allowed when approved.

Cover edges of steel laminates with 1/8 in. to 1/4 in. of elastomer except exposure of the laminates will be permitted at approved laminate restraining devices and around holes entirely enclosed in the finished structure. Position laminates within 1/8 in. of plan location.

Plain bearing pads may be molded individually, cut from previously molded strips or slabs molded to the full thickness of the finished bearing pads, or extruded and cut to length. The finish of cut surfaces must be ANSI 250, or smoother. The finished bearing pads must have no voids or separations detectable either at the bearing surfaces or within the bearing pad. Plain elastomeric bearing pads must be well vulcanized, uniform, and integral units of such construction that the bearing pad is incapable of being separated by any mechanical means into separate, definite, well-defined elastomeric layers. Evidence of layered construction either at the outer surfaces or within the bearing pad will be cause for rejection.

The permissible variation from the dimensions and configuration shown on the plans for both plain and laminated bearing pads will be as listed in AASHTO M 251, Table 2. Flash tolerance, finish, and appearance must meet the requirements of the latest edition of the Rubber Handbook published by the US Tire Manufacturer's Association, RMA F3 and T.063 for molded bearings, and RMA F2 for extruded bearings.

Perform required welding in accordance with Item 441, "Steel Structures." Manufacture guide bars, when required, so adjacent top and bottom bar surfaces are parallel to within 1/16 in. in the assembled position. The tolerance for diameter of anchor bolt holes is +1/8 in., −0. The maximum deviation for flatness of steel plates is 1/16 in. in any 24 in. or as shown on the plans.

Section 434.3.1.1., "Marking," the first paragraph is voided and replaced with the following:

Mark the bearing type on the surface of each bearing as shown on the plans. The marking must remain legible until placement in the structure. Permanently mark, in addition, laminated bearings with:

- manufacturer's name or trademark,
- lot number, and
- date of manufacture (month-year).

Section 434.3.1.2., "Testing and Acceptance," is voided and replaced with the following:

Perform testing, inspection, and acceptance of plain and laminated elastomeric bearing pads in accordance with DMS-7365, "Qualification Procedure for Elastomeric Bridge Bearing Pad Manufacturers."

For laminated elastomeric bearings with a steel top plate or special components (steel guide bars and bottom plate), apply a compression load of 2,250 psi or a stress approved by the Engineer to each bearing. Provide calibrated equipment per ASTM E4 for this compression testing. Each bearing will be acceptable if there is no visible evidence of bond failure or other damage and if the finished bearing meets other pertinent portions of this Item. Samples may be taken if the quality of production becomes questionable.

Section 434.3.2.2.1., "Lower Component," is voided and replaced with the following:

Manufacture one additional bearing lower component per project for testing purposes. Notify MTD, which will sample a bearing lower component at random from the lot, after bearings have been manufactured for a project. Forward selected samples (freight prepaid) to MTD, or to their contracted testing laboratory when directed. Lower component samples will be tested to the following:

- Tex-601-J, Part II—"Adhesion Test Method 2." Adhesion between the PTFE material and steel plate must meet a minimum 20 lb. per inch of width;
- Tex-601-J, Part III—"Chlorinated Compound Test Method 3." Laminated bearing pad elastomer must contain chlorinated compounds (neoprene); and
- PTFE physical properties in accordance with Table 1, with the exception of Melting Point Testing (ASTM D4894).

Costs associated with testing sliding elastomeric bearing lower component project samples failing to conform to these requirements are borne by the bearings manufacturer. This cost will be assessed at the rate established by Construction Division at the time of testing.

Section 434.3.3.2., "Testing and Acceptance." The last paragraph is voided.

Special Provision to Item 440
Reinforcement for Concrete

Item 440, "Standard Specification Title" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 440.2., "Materials" is supplemented with the following:

2.14. Provide zinc-coated, hot-dip galvanized Class I or II steel reinforcement conforming to ASTM A767, Grades 60 or 75 when shown on the plans and as allowed.

2.15. Provide continuously hot-dip galvanized reinforcement (CGR) conforming to ASTM A1094 steel reinforcement, Grades 60 or 75 when shown on the plans and as allowed.

Article 440.2.5., "Weldable Reinforcing Steel" is supplemented with the following:

All welding operations must be performed prior to hot-dip galvanizing.

Article 440.2.8., "Mechanical Couplers" is supplemented with the following:

Provide hot-dipped or mechanically galvanized couplers when splicing galvanized reinforcing or continuously galvanized reinforcing.

Article 440.2.11., "Low-Carbon, Chromium Reinforcing Steel." The first sentence is voided and replaced by the following:

Provide deformed steel bars conforming to ASTM A1035, Grade 100, Type CS when low-carbon, chromium reinforcing steel is required on the plans. Type CM will only be permitted if specified on the plans.

Article 440.3.1., "Bending" is supplemented with the following:

Do not bend hot-dip galvanized reinforcement. Only minor positioning adjustments are permitted.

Bending of continuously galvanized reinforcement is permitted after galvanizing.

Article 440.3.5, "Placing" the following will be added to paragraph four.

Use Class 1 or 1A supports with continuously galvanized reinforcing. Provide epoxy or plastic-coated tie wires and clips for use with epoxy coated reinforcing steel.

Article 440.3.6.3., "Repairing Coating" is supplemented with the following:

Repair damaged galvanized surfaces in accordance with Article 445.3.5.2. "Repair Processes."

Special Provision to Item 441
Steel Structures

Item 441, "Steel Structures" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 441.2.2., Approved Electrodes and Flux-Electrode Combinations," is voided and replaced with the following:

Use only electrodes and flux-electrode combinations conforming to AWS A5 specifications, and pertinent classifications for the applicable welding processes. When requested, submit a current Certificate of Conformance (COC) containing all test results as required by the applicable AWS A5 specification and welding code. Provide proof of Buy America compliance for welding consumables when requested. For bridge main member fabrication, submit the COC annually.

Section 441.2.3., "High-Strength Bolts," is revised and replaced by the following:

Use fasteners that meet Item 447, "Structural Bolting." Use galvanized fasteners on field connections of bridge members when ASTM F3125-Grade A325 bolts are specified, and steel is painted.

Section 441.3.1.5.1., "Plants," The second and third paragraphs are voided and replaced with the following:

Fabrication plants that produce the following non-bridge steel members must be approved in accordance with DMS-7380, "Steel Non-Bridge Member Fabrication Plant Qualification."

- Item 610, "Roadway Illumination Poles"
- Item 613, "High Mast Illumination Poles"
- Item 614, "High Mast Rings and Support Assemblies"
- Item 650, "Overhead Sign Support Structures"
- Item 654, "Sign Walkways"
- Item 686, "Traffic Signal Poles"
- Special Specification 6064, "Intelligent Transportation System (ITS) Poles."

The Materials and Tests Division (MTD) maintains a list of approved non-bridge fabrication plants on the Department MPL that produce these members.

Section 441.3.1.6.1., "Erection Drawings," the third paragraph is voided and replaced with the following:

Perform erection engineering evaluation of the structural adequacy and stability of constructing the bridge system for each step of the steel erection.

Section 441.3.1.5.3., "Nondestructive Testing (NDT)," is voided and replaced with the following:

Personnel performing NDT must be qualified in accordance with the applicable AWS code and the employer's Written Practice. Level III personnel who qualifies Level I and Level II technicians must be certified by ASNT for which the NDT Level III is qualified. In addition, NDT technicians must pass hands-on tests that MTD administers. This will remain current provided they continue to perform testing on Department materials as evidenced by test reports requiring their signature. A technician who fails any of the hands-on tests must wait 3 mo. or as approved otherwise before retesting. Qualification to perform NDT will be revoked when the technician's employment is terminated or when the technician goes 6 mo. without performing a test on a Department project. The technician must pass a new hands-on test to be re-certified. Testing of similar weld joints for non-Department projects may be considered by the Engineer instead of re-testing provided enough documentation is submitted with the signature of the project's Engineer. These requirements also apply to testing agencies, and individual third-party contractors.

Section 441.3.1.5.4., "Welding Procedure Specification Qualification Testing," is voided and replaced by the following:

For Fabricators qualified in accordance with DMS-7370, DMS-7380, or DMS-7395, laboratories performing procedure qualification testing for welding procedure specifications (WPSs) must be accredited by a nationally recognized agency that performs testing in accordance with ISO/International Electrotechnical Commission (IEC) 17025 in the mechanical field of testing.

Section 441.3.1.9., "Material Identification," is amended to include the following paragraph:

Low-stress stencil marks must have a radius instead of a sharp point. Acceptable stencils include dot, vibration, and rounded-V stencils. Label these stencils so that they are easily distinguishable from other stencils that are not low-stress.

Section 441.3.2.4.1., "Flange Tilt," the last sentence is voided and replaced with the following:

Minor jacking that does not deform the material will be permitted.

Section 441.3.2.5.3., "Magnetic Particle Testing," is voided and replaced with the following:

Use alternating current (AC) when using the yoke method unless otherwise approved. Welds may be further evaluated with half-wave rectified DC for subsurface indications. Centerline cracking may be detected with aluminum prod method when approved.

Section 441.3.5.8., "Hammering," is added to state the following:

Do not perform hammering on any portion of the member that causes the material to permanently deform. Avoid damage to the material by measures such as use of brass or aluminum hammers or by padding the area to be hammered.

Section 441.3.8.1., "Shop Painting," is amended to include with the following paragraph:

Measure the anchor profile after blast cleaning at random locations along the thermal cut surfaces. If specified anchor profile is not achieved over the entire flame cut surface, grind the edges and re-blast to achieve the required anchor pattern.

Section 441.3.9., "Handling and Storage of Materials," The second sentence of the second paragraph is replaced by the following:

Keep materials clean and avoid damaging of the applied coating.

Special Provision to Item 442
Metal for Structures

Item 442, "Metal for Structures" of the Standard Specifications is amended with respect to the clause cited below. No other clauses or requirements of this Item are waived or changed.

Section 442.2.1.3.3., "Fasteners." The first sentence of the first paragraph is replaced by the following:

Fasteners. Provide high-strength bolts that meet ASTM F3125-Grade A325 unless otherwise shown on the plans.

Section 442.2.1.3.3., "Fasteners." The third paragraph is deleted and not replaced.

Special Provision to Item 446
Field Cleaning and Painting Steel

For this project, Item 446, "Field Cleaning and Painting Steel," of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Section 446.4.1., "Qualification," the first and second paragraphs are voided and replaced by the following:

> Submit to the Engineer documentation verifying SSPC QP 1 or NACE NIICAP AS-1 certification for work requiring the removal or application of coatings. Additionally, submit to the Engineer documentation verifying SSPC QP 2 Cat A or NACE NIICAP AS-2 certification when work requires removal of coatings containing hazardous materials. Maintain certifications throughout the project. No work may be performed without current and active certifications unless otherwise shown on the plans. The Engineer may waive certification requirements for minor, touch-up repair work and coating steel members repaired in accordance with Item 784, "Steel Member Repair."
>
> The Engineer may waive certification requirements, when stated on the plans, for the purpose of qualification in either contractor certification program if the project has been accepted as a qualification project as part of the process for obtaining SSPC QP1 Cat A or NACE NIICAP AS-1 certification. Submit certification applications and proof of acceptance before beginning work or provide SSPC QP 7 certification when required on the plans.

Section 446.4.7.3.2., "Classes of Cleaning," is amended with the following:

> Prepare all surfaces of painted steel members subsequently exposed from structural operations, such as deck removal or steel repair, in accordance with this Item. Prevent loose or damaged paint from entering the environment.

Special Provision to Item 447
Structural Bolting

Item 447, "Structural Bolting" of the Standard Specifications is amended with respect to the clause cited below. No other clauses or requirements of this Item are waived or changed.

Article 447.2.2., "Bolt Assemblies." The first paragraph is replaced by the following:

Bolt Assemblies. Provide ASTM F3125 bolts and nuts and washers meeting the type, grade, and finish requirements in Table 1, unless otherwise shown in the plans.

Article 447.2.2., "Bolt Assemblies." The second paragraph is replaced by the following:

Use Grade A325 or Grade A490 Type 3 plain (uncoated) bolts for weathering steel as indicated and Grade A325 Type 1 galvanized bolts for coated steel, unless otherwise shown on the plans.

Article 447.2.2., "Bolt Assemblies." Table 1 is replaced by the following:

Table 1
ASTM Type, Finish, and Grade for Structural Bolts, Nuts, and Washers

	Bolt[1] Grade	Bolt Type	Bolt Finish	ASTM A563 Nut Grade and Finish	ASTM F436 Washer Type and Finish
Heavy-Hex Bolts[1]	A325	1	Galvanized	DH,[2] galvanized and lubricated	1; galvanized
	A325	3	Plain	C3 and DH3; plain	3; plain
	A490	3	Plain	DH3; plain	3; plain
Tension-Control Bolts[1]	F1852	1	Galvanized	DH,[2] galvanized and lubricated	1; galvanized
	F1852	3	Plain	C3 and DH3; plain	3; plain
	F2280	3	Plain	DH3; plain	3; plain

1. ASTM F3125 High Strength Structural Bolts
2. ASTM A194 Heavy Hex Grade 2H nuts may be substituted.

Article 447.2.6., "Fitup Bolts and Erection Pins." The first paragraph is replaced by the following:

Fitup Bolts and Erection Pins. Provide heavy-hex fitup bolts of the same diameter as the connection bolts. Do not use washer-type indicating devices for fitups. Do not reuse galvanized bolts or Grade A490 bolts that have been used as fitup bolts. Provide a sufficient number of erection or drift pins, 1/32 in. larger than the bolt diameter.

Article 447.4.3., "General." The second sentence of the third paragraph is replaced by the following:

Install hardened washers under both the nut and bolt head of Grade A490 bolts when the outer plies being fastened have a yield strength less than 40 ksi.

Article 447.4.3., "General." Table 2 is replaced by the following:

Table 2
Bolt Tension

Nominal Bolt Size, in.	Minimum Tension (kips)	
	Grade A325 Bolts	Grade A490 Bolts
½	12	15
5/8	19	24
¾	28	35
7/8	39	49
1	51	64
1-1/8	56	80
1-1/4	71	102
1-3/8	85	121
1-1/2	103	148

Article 447.4.5.2., "Install Bolts." The second paragraph is replaced by the following:

Fully tighten a minimum number of bolts as directed until the plies are in full contact if snugging does not bring the plies of the joint into full contact. Mark these bolts as fitup bolts. Use a non-galvanized Grade A325 bolt of the same diameter as a fitup bolt in connections requiring the use of galvanized Grade A325 bolts. Re-snug all remaining bolts.

Article 447.4.5.3., "Tension Bolts." The first paragraph is replaced by the following:

Tension Bolts. Loosen all fitup bolts after tensioning all the other bolts in the connection. Ungalvanized Grade A325 bolts used as fitup bolts may be reused in a connection using this type of bolt. Replace all galvanized bolts and Grade A490 bolts used as fitup bolts. Tension these remaining untensioned bolts in accordance with this paragraph. Ensure the element not turned by the wrench (bolt head or nut) does not rotate.

Article 447.4.5.4., "Bolt Reuse." The first paragraph is replaced by the following:

Bolt Reuse. Do not reuse Grade A490 or galvanized Grade A325 bolts. Ungalvanized Grade A325 bolts may be reused one time if the threads have not been damaged. Re-tensioning previously tensioned bolts loosened by the tensioning of adjacent bolts is not considered to be reuse.

Special Provision to Item 448
Structural Field Welding

Item 448, "Structural Field Welding" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 448.2., "Materials," the third paragraph is voided and replaced with the following:

Use only electrodes and flux-electrode combinations conforming to AWS A5 specifications and pertinent classifications for the applicable welding processes. When requested, submit a current Certificate of Conformance (COC) containing acceptable wording indicating Buy America compliance and all tests required by the applicable AWS specifications and welding codes. Tests must be conducted on electrodes of the same class, size, and brand; and manufactured by the same process and with the same materials as the electrodes to be furnished.

Special Provision to Item 449
Anchor Bolts

Item 449, "Anchor Bolts" of the Standard Specifications is amended with respect to the clause cited below. No other clauses or requirements of this Item are waived or changed.

Section 449.2.1., "Bolts and Nuts." Table 1 is replaced by the following:

Table 1
Bolt and Nut Standards

Specified Anchor Bolt Category	Bolt Standards	Nut Standards
Mild steel	ASTM A307 Gr. A, F1554 Gr. 36, or A36	ASTM A563
Medium-strength, mild steel	ASTM F1554 Gr. 55 with supplementary requirement S1	ASTM A194 Gr. 2 or A563 Gr. D or better
High-strength steel	ASTM F3125-Grade A325 or ASTM A449[1]	ASTM A194 or A563, heavy hex
Alloy steel	ASTM A193 Gr. B7 or F1554 Gr. 105	ASTM A194 Gr. 2H or A563 Gr. DH, heavy hex

1. **If headed bolts are specified, ASTM A449 bolts must be heavy hex head.**

Section 449.3.3.1,"Anchor Bolt Thread Lubricant Coating," The first sentence of the first paragraph is voided and replaced by the following.

Coat anchor bolt threads before installing nuts with an electrically conducting lubricant compound described in Section 449.3.3.2.1., "Definitions," for traffic signal poles, roadway illumination poles, high mast illumination poles, intelligent transportation system poles, overhead sign support structures, and steel electrical service supports.

Section 449.3.3.2,"Anchor Bolt Tightening Procedure," The first sentence of the first paragraph is voided and replaced by the following.

Tighten anchor bolts for traffic signal poles, shoe base and concrete traffic barrier base roadway illumination poles, high mast illumination poles, intelligent transportation system poles, and overhead sign support structures in accordance with this Section.

Special Provision to Item 450
Railing

Item 450, "Railing" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 450.3.1.2., "Fabrication," is supplemented with the following.

Fabrication plants that produce metal railing (steel and aluminum) must be approved in accordance with DMS-7395, "Metal Railing Fabrication Plant Qualification." This required approval does not include fabricators of chain link fence. The Materials and Tests Division maintains a MPL of approved fabrication plants of metal railing.

Permanently mark each metal railing post base plate, at a visible location when erected, with the fabrication plant's insignia or trademark. For fabricated rail panels, provide this permanent mark on one post base plate, per panel.

Special Provision to Item 462
Concrete Box Culverts and Drains

Item 462, "Concrete Box Culverts and Drains," of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Section 2.1., "General." The last paragraph is voided and replaced with the following:

Furnish material for precast formed and machine-made box culverts in accordance with DMS-7305, "Fabrication and Qualification Procedure for Multi-Project Fabrication Plants of Precast Concrete Drainage Structures."

Sections 2.2.2., "Formed Precast," and 2.2.3., "Machine-Made Precast," are voided and replaced by the following.

2.2.2 **Precast.** Precast formed and machine –made box culvert fabrication plants must be approved in accordance with DMS-7305, "Fabrication and Qualification Procedure for Multi-Project Fabrication Plants of Precast Concrete Drainage Structures." The Construction Division maintains a list of approved precast box culvert fabrication plants on the Department's MPL. Fabricate precast boxes in accordance with DMS-7305, "Fabrication and Qualification Procedure for Multi-Project Fabrication Plants of Precast Concrete Drainage Structures."

Sections 2.3.2., "Formed Precast," and 2.3.3., "Machine-Made Precast," are voided and replaced by the following.

2.3.2 **Precast.** Make, cure, and test compressive test specimens for precast formed and machine –made box culverts in accordance with DMS-7305, "Fabrication and Qualification Procedure for Multi-Project Fabrication Plants of Precast Concrete Drainage Structures.

Section 2.5., "Marking," the first paragraph is voided and replaced with the following.

Marking. Clearly mark each precast unit with the following:

- Name or trademark of fabricator and plant location;
- ASTM designation and product designation (when applicable);
- Date of manufacture,
- Box size,
- Minimum and maximum fill heights,
- Designation "TX" for precast units fabricated per DMS-7305,
- Fabricator's designated approval stamp for each approved unit,
- Designation "SR" for boxes meeting sulfate-resistant concrete plan requirements (when applicable), and
- Precast drainage structures used for jacking and boring (when applicable).

Section 2.6., "Tolerances." The section is voided and replaced with the following.

Ensure precast sections meet the permissible variations listed in ASTM C1577.

Ensure that the sides of a section at each end do not vary from being perpendicular to the top and bottom by more than 1/2 in. when measured diagonally between opposite interior corners. Deviations from this tolerance will be acceptable if the sections can be fitted at the plant and the joint opening at any point does not exceed 1 in. Use match-marks for proper installation on sections that have been accepted in this manner.

Ensure wall and slab thicknesses are not less than shown on the plans except for occasional deficiencies not greater than 3/16 in. or 5%, whichever is greater. If proper jointing is not affected, thicknesses in excess of plan requirements are acceptable.

Section 2.7., "Defects and Repair." The section is voided and replaced with the following:

Fine cracks on the surface of members that do not extend to the plane of the nearest reinforcement are acceptable unless the cracks are numerous and extensive. Repair cracks that extend into the plane of the reinforcing steel in accordance with the Department's Concrete Repair Manual. The Engineer may accept boxes with repairs that are sound, properly finished, and cured in conformance with pertinent specifications. Discontinue further production of precast sections until corrections are made and proper curing is provided when fine cracks on the surface indicate poor curing practices.

Repair precast boxes in accordance with DMS-7305, "Fabrication and Qualification Procedure for Multi-Project Fabrication Plants of Precast Concrete Drainage Structures."

Section 2.8., "Storage and Shipment." This section is voided and replaced with the following:

2.8 **Storage and Shipment.** Store precast sections on a level surface. Do not place any load on the sections until design strength is reached and curing is complete. Store and ship precast boxes in accordance with DMS-7305, "Fabrication and Qualification Production for Multi-Project Fabrication Plants of Precast Concrete Drainage Structures.

Special Provision to Item 464
Reinforced Concrete Pipe

Item 464, "Reinforced Concrete Pipe," of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Section 2.1., "Fabrication." The section is voided and replaced with the following.

Fabrication plants must be approved by the Materials and Tests Division in accordance with DMS-7305, "Fabrication and Qualification Procedure for Multi-Project Fabrication Plants of Precast Concrete Drainage Structures," before furnishing precast reinforced concrete pipe for Departmental projects. The Department's MPL has a list of approved reinforced concrete pipe plants.

Furnish material and fabricate reinforced concrete pipe in accordance with DMS-7305, "Fabrication and Qualification Procedure for Multi-Project Fabrication Plants of Precast Concrete Drainage Structures."

Section 2.3., "Marking." The first paragraph is voided and replaced with the following.

Furnish each section of reinforced concrete pipe marked with the following information specified in DMS-7305, "Fabrication and Qualification Procedure for Multi-Project Fabrication Plants of Precast Concrete Drainage Structures."

- Class or D-Load of pipe,
- ASTM designation,
- Date of manufacture,
- Pipe size,
- Name or trademark of fabricator and plant location,
- Designation "TX" for precast units fabricated per DMS-7305;
- Designated fabricator's approval stamp for each approved unit,
- Pipe to be used for jacking and boring (when applicable), and
- Designation "SR" for pipe meeting sulfate-resistant concrete plan requirements (when applicable).

Section 2.5., "Causes for Rejection." The section is voided and replaced with the following.

Individual sections of pipe may be rejected for any of the conditions stated in the Annex of DMS-7305, "Fabrication and Qualification Procedure for Multi-Project Fabrication Plants of Precast Concrete Drainage Structures."

Section 2.6., "Repairs." The section is voided and replaced with the following:

Make repairs, if necessary, as stated in the Annex of DMS-7305, "Fabrication and Qualification Procedure for Multi-Project Fabrication Plants of Precast Concrete Drainage Structures."

Special Provision to Item 465
Junction Boxes, Manholes, and Inlets

Item 465, "Junction Boxes, Manholes, and Inlets," of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Section 2.1., "Concrete," The section is voided and replaced with the following.

Furnish concrete per DMS-7305 for formed and machine-made precast junction boxes, manholes, and inlets. Furnish Class C concrete for cast-in-place junction boxes, manholes, and inlets unless otherwise shown on the plans.

Section 3.1., "Precast Junction Boxes, Manholes, and Inlets," The section is voided and replaced with the following.

Construct formed and machine-made precast junction boxes, manholes, and inlets in accordance with DMS-7305, "Fabrication and Qualification Procedure for Multi-Project Fabrication Plants of Precast Concrete Drainage Structures" and the Contract Plans, except as otherwise noted in this Item.

Multi-project fabrication plants as defined in Item 424 "Precast Concrete Structural Members (Fabrication)," that produce junction boxes, manholes, and inlets will be approved by the Materials and Tests Division in accordance with DMS-7305, "Fabrication and Qualification Procedure for Multi-Project Fabrication Plants of Precast Concrete Drainage Structures." The Department's MPL has a list of approved multi-project fabrication plants.

Section 3.1.1., "Lifting Holes," The section is voided and not replaced.

Section 3.1.2., "Marking." The section is voided and replaced with the following.

Marking. Clearly mark each precast junction box, manhole, and inlet unit with the following information:

- name or trademark of fabricator and plant location;
- product designation;
- ASTM designation (if applicable);
- date of manufacture;
- designation "TX" for precast units fabricated per DMS-7305;
- designated fabricator's approval stamp for each approved unit; and
- designation "SR" for product meeting sulfate-resistant concrete plan requirements (when applicable).

Special Provision to Item 502
Barricades, Signs and Traffic Handling

Item 502, "Barricades, Signs and Traffic Handling" of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Article 502.1., "Description," is supplemented by the following:

Temporary work-zone (TWZ) traffic control devices manufactured after December 31, 2019, must have been successfully tested to the crashworthiness requirements of the 2016 edition of the Manual for Assessing Safety Hardware (MASH). Such devices manufactured on or before this date and successfully tested to NCHRP Report 350 or the 2009 edition of MASH may continue to be used throughout their normal service lives. An exception to the manufacture date applies when, based on the project's date of letting, a category of MASH-2016 compliant TWZ traffic control devices are not approved, or are not self-certified after the December 31, 2019, date. In such case, devices that meet NCHRP-350 or MASH-2009 may be used regardless of the manufacture date.

Such TWZ traffic control devices include: portable sign supports, barricades, portable traffic barriers designated exclusively for use in temporary work zones, crash cushions designated exclusively for use in temporary work zones, longitudinal channelizers, truck and trailer mounted attenuators. Category I Devices (i.e., lightweight devices) such as cones, tubular markers and drums without lights or signs attached however, may be self-certified by the vendor or provider, with documentation provided to Department or as are shown on Department's Compliant Work Zone Traffic Control Device List.

Article 502.4., "Payment," is supplemented by the following:

Truck mounted attenuators and trailer attenuators will be paid for under Special Specification, "Truck Mounted Attenuator (TMA) and Trailer Attenuator (TA)." Portable Changeable Message Signs will be paid for under Special Specification, "Portable Changeable Message Sign." Portable Traffic Signals will be paid for under Special Specification, "Portable Traffic Signals."

Special Provision to Item 506

Temporary Erosion, Sedimentation, and Environmental Controls

Item 506, "Temporary Erosion, Sedimentation, and Environmental Controls," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 506.1., "Description." The second paragraph is voided and replaced by the following.

Contractor is considered primary operator to have day-to-day operational control as defined in TPDES GP TXR150000.

1.1. For projects with soil disturbance of less than 1 acre, no submittal to TCEQ will be required but Contractor will follow SWP3. For projects with soil disturbance of 1acre to less than 5 acres a small site notice will be posted at the site. For projects with soil disturbance of 5 acres or more a Notice of Intent (NOI) is required and a large site notice posted at site. Postings will be in accordance with TPDES GP TXR150000. Postings not associated with project specific locations will be in same location as Department's postings.

1.2. Notice of Intent (NOI). Submit a NOI, if applicable, with the TCEQ under the TPDES GP TXR150000 at least 7 days prior to commencement of construction activities at the project site. Provide a signed copy to the Engineer and any other MS4 operators at the time of submittal. The Department will submit their NOI prior to contractor submission and will provide a copy for Contractor's use in completing the Contractor's NOI form.

1.3. Notice of Change (NOC). Upon concurrence of the Engineer, submit a NOC, if applicable, to the TCEQ within 14 days of discovery of a change or revision to the NOI as required by the TPDES GP TXR150000. Provide a signed copy of the NOC to the Engineer and any other MS4 operators at the time of submittal.

1.4. Notice of Termination (NOT). Upon concurrence of the Engineer, submit a NOT, if applicable, to the TCEQ within 30 days of the Engineer's approval that 70% native background vegetative cover is met or equivalent permanent stabilization have been employed in accordance with the TPDES GP TXR 150000. Provide a signed copy of the NOT to the Engineer and any other MS4 operators at the time of submittal.

Section 506.3.1, "Contractor Responsible Person Environmental (CRPE) Qualifications and Responsibilities," is supplemented by the following:

3.1. Contractor Responsible Person Environmental (CRPE) Qualifications and Responsibilities. Provide and designate in writing at the preconstruction conference a CRPE and alternate CRPE who have overall responsibility for the storm water management program. The CRPE will implement stormwater and erosion control practices; will oversee and observe stormwater control measure monitoring and management; will monitor the project site daily and produce daily monitoring reports as long as there are BMPs in place or soil disturbing activities are evident to ensure compliance with the SWP3 and TPDES General Permit TXR150000. Daily monitor reports shall be maintained and made available upon request. During time suspensions when work is not occurring or on contract non-work days, daily inspections are not required unless a rain event has occurred. The CRPE will provide recommendations on how to improve the effectiveness of control measures. Attend the Department's preconstruction conference for the project. Ensure training is completed as identified in Section 506.3.3., "Training," by all applicable personnel before employees work on the project. Document and maintain and make available upon request, a list, signed by the CRPE, of all applicable Contractor and subcontractor employees who have completed the training. Include the employee's name, the training course name, and date the employee completed the training.

Section 506.3.3., "Training," is supplemented by the following:

Training is provided by the Department at no cost to the Contractor and is valid for 3 yr. from the date of completion. The Engineer may require the following training at a frequency less than 3 yr. based on environmental needs:

- "Environmental Management System: Awareness Training for the Contractor" (English and Spanish) (Approximate running time 20 min.), and
- "Storm Water: Environmental Requirements During Construction" (English and Spanish) (Approximate running time 20 min.).

The Contractor responsible person environmental (CRPE), alternate CRPE designated for emergencies, Contractor's superintendent, Contractor, and subcontractor lead personnel involved in soil disturbing or SWP3 activities must enroll in and complete the training listed below and maintain and make available upon request the certificate of completion. Training is provided by a third party and is valid for 3 yr. from the date shown on the Certificate of Completion. Coordinate enrollment as prescribed by the Department and pay associated fees for the following training:

- "Revegetation During Construction,"
- "Construction General Permit Compliance," and
- "Construction Stage Gate Checklist (CSGC)."

Training and associated fee will not be measured or paid for directly but are subsidiary to this Item.

Special Provision to Item 520
Weighing and Measuring Equipment

Item 520, "Weighing and Measuring Equipment" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 520.2., "Equipment." The third paragraph is voided and replaced by the following.

Calibrate truck scales using weights certified by the Texas Department of Agriculture (TDA) or an equivalent agency as approved. Provide a written calibration report from a scale mechanic for truck scale calibrations. Cease plant operations during the checking operation. Do not use inaccurate or inadequate scales. Bring performance errors as close to zero as practicable when adjusting equipment.

Article 520.2., "Equipment." The fourth paragraph is amended to include the following:

At the Contractors option, an electronic ticket delivery system (e-ticketing) may be used instead of printed tickets. The use of e-ticketing will require written approval of the Engineer. At a minimum, the approved system will:

- Provide electronic, real-time e-tickets meeting the requirements of the applicable bid items;
- Automatically generate e-tickets using software and hardware fully integrated with the automated scale system used to weigh the material, and be designed in such a way that data input cannot be altered by the Contractor or the Engineer;
- Provide the Engineer access to the e-ticketing data in real-time with a web-based or app-based system compatible with iOS;
- Provide offline capabilities to prevent data loss if power or connectivity is lost;
- Require both the Contractor and the Engineer to accept or reject the e-ticket and provide the ability to record the information required by the applicable bid items, as well as any comments. Record the time of the approval/rejection and include it in the summary spreadsheet described below. Provide each party the capability to edit their respective actions and any entered information;

The Contractor may discontinue use of the e-ticket system and provide printed tickets as needed to meet the requirements of the applicable bid items.

Special Provision to Item 540
Metal Beam Guard Fence

Item 540, "Metal Beam Guard Fence" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 540.4.7, "Measurement," is voided and replaced with the following:

> **Long Span System**. Measurement will be by each long span system, complete in place. Each long span system will be from the first CRT to the last CRT in the system.

Special Provision to Item 636
Signs

Item 636, "Signs" of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Section 636.3.1, "Fabrication." is deleted.

Section 636.3.1.2, "Sheeting Application." The last sentence of the fourth paragraph is voided and replaced by the following.

Do not splice sheeting or overlay films for signs fabricated with ink or with colored transparent films.

Special Provision to Item 643
Sign Identification Decals

Item 643, "Sign Identification Decals," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 2. "Materials." The sign identification decal design shown in Figure 1 and the description for each row in Table 1 are supplemented by the following.

Texas Department of Transportation												
C	**Fabrication Date**										**T**	**1**
J	F	M	A	M	J	J	A	S	O	N	D	**2**
	201		202		203		204		205			**3**
	0	1	2	3	4	5	6	7	8	9		**4**
Sheeting MFR - Substrate												
A	B	C	D	E	F	G	H	J	K	L	M	**5**
Film MFR												
A	B	C	D	E	F	G	H	J	K	L	M	**6**
Sheeting MFR - Legend												
A	B	C	D	E	F	G	H	J	K	L	M	**7**
Installation Date												
				0	1	2	3					**8**
	0	1	2	3	4	5	6	7	8	9		**9**
J	F	M	A	M	J	J	A	S	O	N	D	**10**
	201		202		203		204		205			**11**
	0	1	2	3	4	5	6	7	8	9		**12**
Name of Sign Fabricator **Physical Address** **City, State, Zip Code**												**13**

Figure 1
Decal Design (Row numbers explained in Table 1)

Table 1
Decal Description

Row Explanation
1 – Sign fabricator
2 – Month fabricated
3 – First 3 digits of year fabricated
4 – Last digit of year fabricated
5 – Manufacturer of the sheeting applied to the substrate
6 – Film (colored transparent or non-reflective black) manufacturer
7 – Manufacturer of the sheeting for the legend
8 – Tens digit of date installed
9 - Ones digit of date installed
10 – Month installed
11 – First 3 digits of year installed
12 – Last digit of year installed
13 – Name of sign fabricator and physical location of sign shop

Special Provision to Item 656
Foundations for Traffic Control Devices

Item 656, "Foundations for Traffic Control Devices" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 3. "Construction.," the first paragraph is supplemented by the following:

Ensure the top of the foundation and anchor bolts meet specified requirements in relation to the final grade.

Special Provision to Item 666
Retroreflectorized Pavement Markings

Item 666, "Retroreflectorized Pavement Markings," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 2.3., "Glass Traffic Beads." The first paragraph is voided and replaced by the following:

Furnish drop-on glass beads in accordance with DMS-8290, "Glass Traffic Beads," or as approved. Furnish a double-drop of Type II and Type III drop-on glass beads for longitudinal pavement markings where each type bead is applied separately in equal portions (by weight), unless otherwise approved. Apply the Type III beads before applying the Type II beads. Furnish Type II beads for work zone pavement markings and transverse markings or symbols.

Section 4.3.1., "Type I Markings.," is supplemented by the following:

4.3.1.3. Spot Striping. Perform spot striping on a callout basis with a minimum callout quantity as shown on the plans.

Section 4.3.2., "Type II Markings.," is supplemented by the following:

4.3.2.1. Spot Striping. Perform spot striping on a callout basis with a minimum callout quantity as shown on the plans.

Section 4.4., "Retroreflectivity Requirements.," is voided and replaced by the following.

Type I markings for Contracts totaling more than 20,000 ft. of pavement markings must meet the following minimum retroreflectivity values for all longitudinal edgeline, centerline or no passing barrier-line, and lane line markings when measured any time after 3 days, but not later than 10 days after application.

- White markings: 250 millicandelas per square meter per lux (mcd/m^2/lx)
- Yellow markings: 175 mcd/m^2/lx

Retroreflectivity requirements for Type I markings are not required for Contracts with less than 20,000 ft. of pavement markings or Contracts with callout work, unless otherwise shown on the plans.

Section 4.5., "Retroreflectivity Measurements.," is voided and replaced by the following:

Use a mobile retroreflectometer to measure retroreflectivity for Contracts totaling more than 50,000 ft. of pavement markings, unless otherwise shown on the plans. For Contracts with less than 50,000 ft. of pavement markings, mobile or portable retroreflectometers may be used at the Contractor's discretion. Coordinate with and obtain authorization from the Engineer before starting any retroreflectivity data collection.

Section 4.5.1., "Mobile Retroreflectometer Measurements." The last paragraph is voided and replaced by the following.

Restripe again at the Contractor's expense with a minimum of 0.060 in. (60 mils) of Type I marking material if the average of these measurements falls below the minimum retroreflectivity requirements. Take measurements every 0.1 miles a minimum of 10 days after this third application within that mile segment for that series of markings. If the markings do not meet minimum retroreflectivity after this third application, the Engineer may require removal of all existing markings, a new application as initially specified, and a repeat of the application process until minimum retroreflectivity requirements are met.

Section 4.5.2., "Portable Retroreflectometer Measurements." The first and second paragraphs are voided and replaced by the following.

Provide portable measurement averages for every 1.0 mile unless otherwise specified or approved. Take a minimum of 20 measurements for each 1-mi. section of roadway for each series of markings (e.g., edgeline, center skip line, each line of a double line) and direction of traffic flow when using a portable reflectometer. Measure each line in both directions for centerlines on two-way roadways (i.e., measure both double solid lines in both directions and measure all center skip lines in both directions). The spacing between each measurement must be at least 100 ft. The Engineer may decrease the mileage frequency for measurements if the previous measurements provide satisfactory results. The Engineer may require the original number of measurements if concerns arise.

Restripe at the Contractor's expense with a minimum of 0.060 in. (60 mils) of Type I marking material if the averages of these measurements fail. Take a minimum of 10 more measurements after 10 days of this second application within that mile segment for that series of markings. Restripe again at the Contractor's expense with a minimum of 0.060 in. (60 mils) of Type I marking material if the average of these measurements falls below the minimum retroreflectivity requirements. If the markings do not meet minimum retroreflectivity after this third application, the Engineer may require removal of all existing markings, a new application as initially specified, and a repeat of the application process until minimum retroreflectivity requirements are met.

Section 4.6. "Performance Period." The first sentence is voided and replaced by the following:

All longitudinal markings must meet the minimum retroreflectivity requirements within the time frame specified. All markings must meet all other performance requirements of this specification for at least 30 calendar days after installation.

Article 6. "Payment." The first two paragraphs are voided and replaced by the following.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Pavement Sealer" of the size specified; "Retroreflectorized Pavement Markings" of the type and color specified and the shape, width, size, and thickness (Type I markings only) specified, as applicable; "Retroreflectorized Pavement Markings with Retroreflective Requirements" of the types, colors, sizes, widths, and thicknesses specified; "Retroreflectorized Profile Pavement Markings" of the various types, colors, shapes, sizes, and widths specified; or "Reflectorized Pavement Marking (Call Out)" of the shape, width, size, and thickness (Type I markings only) specified, as applicable; or "Pavement Sealer (Call Out)" of the size specified.

This price is full compensation for materials, application of pavement markings, equipment, labor, tools, and incidentals.

Special Provision to Item 680
Highway Traffic Signals

Item 680, “Highway Traffic Signals” of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 680.3.1.1.2,”Conduit,” The fourth sentence of the first paragraph is voided and replaced by the following.

Seal the ends of each conduit with approved sealant, after all cables and conductors are installed.

Special Provision to Special Specification 6185
Truck Mounted Attenuator (TMA) and Trailer Attenuator (TA)

Item 6185, "Truck Mounted Attenuator (TMA) and Trailer Attenuator (TA)" of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Article 4. "Measurement", is voided and replaced by the following:

4.1. **Truck Mounted Attenuator/Trailer Attenuator (Stationary).** This Item will be measured by the day. TMA/TAs must be set up in a work area and operational before a calendar day can be considered measureable. A day will be measured for each TMA/TA set up and operational on the worksite.

4.2. **Truck Mounted Attenuator/Trailer Attenuator (Mobile Operation).** This Item will be measured by the hour or by the day. The time begins once the TMA/TA is ready for operation at the predetermined site and stops when notified by the Engineer. When measurement by the hour is specified, a minimum of 4 hr. will be paid each day for each operating TMA/TA used in a mobile operation. When measurement by the day is specified, a day will be measured for each TMA/TA set up and operational on the worksite.

Special Specification 2001
Tied-Concrete Block Erosion Control Mat

1. DESCRIPTION

Furnish all labor, materials, equipment, and incidentals required and perform all operations in connection with the installation of tied concrete erosion control mats in accordance with the lines, grades, design and dimensions shown on the plans.

The Contractor must submit to the Engineer all manufacturer's performance research results and calculations in support of the tied concrete block mat system. Calculations and shop drawings will be provided by the manufacturer for the means and methods necessary to place the mats in accordance with PART 2.A and in accordance with the plans. The shop drawings must indicate the size and location of mats and placement along with providing the details and how the mats are tied together and are to be moved.

The Contractor must furnish to the Engineer all manufacturers' specifications, literature, shop drawings for the installation of the mats, and any recommendations, if applicable, that are specifically related to this project.

2. MATERIALS

General - Tied concrete block mats must be manufactured or field fabricated from individual concrete blocks tied together with a high strength geogrid. Each block must be tapered, beveled and interlocked. Each block must incorporate interlocking surfaces or connections that prevent lateral displacement of the blocks within the mats when they are lifted for placement.

2.1. Materials - Cementitious Materials - Materials must conform to the following applicable ASTM specifications:

- Portland Cements - Specification C 150, for Portland Cement.
- Blended Cements - Specification C 595, for Blended Hydraulic Cements.
- Hydrated Lime Types - Specification C 207, for Hydrated Lime Types. Pozzolans - Specification C 618, for Fly Ash and Raw or Calcined Natural.
- Pozzolans for use in Portland Cement Concrete.

Aggregates must conform to the following ASTM specifications, except that grading requirements will not necessarily apply: Normal Weight - Specification C 33, for Concrete Aggregates.

2.2. Physical Requirements – The physical requirements should follow the items in Table 1.

2.3. Durability - The manufacturer must satisfy the purchaser by proven field performance that the concrete units have adequate durability even if they are to be subjected to a freeze-thaw environment.

2.4. Visual Inspection - All units must be sound and free of defects that would interfere with the proper placing of the unit or impair the strength or permanence of the construction. Surface cracks incidental to the usual methods of manufacture, or surface chipping resulting from customary methods of handling in shipment and delivery, will not be deemed grounds for rejection.

2.5. Sampling and Testing - The purchaser or his authorized representative will inspect the units upon delivery. Units missing more than 4 blocks per 80 square foot section will be deemed grounds for rejection. The tied concrete block mats must have one or more of the following nominal characteristics: Minimum open area of 10%. The tied concrete block mat must exhibit resistance to mild concentrations of acids, alkalis, and solvents.

2.6. Polypropylene Geogrid - Revetment mat must be constructed of high tenacity, low elongating, and continuous filament polypropylene fibers. Interlocking geogrid must have the following physical characteristics:

2.7. Mass/Unit Area ASTM D-5261 7.0 oz/yd2 240 g/m2 Aperture Size Measured 1.6 x 1.6 in. (40 x 40 mm) Wide Width Tensile Strength

2.8. Machine Direction (MD) ASTM D-6637 2,055 lb/ft 30 kN/m. Cross Machine Direction (CMD) ASTM D-6637 2,055 lb/ft 30 kN/m

2.9. Elongation at Break ASTM D-6637 6%. Tensile Strength @ 2%. Machine Direction (MD) ASTM D-6637 822 lb/ft 12 kN/m

2.10. Cross Machine Direction (CMD) ASTM D-6637 822 lb/ft 12 kN/m. Tensile Strength @ 5%. Machine Direction (MD) ASTM D-6637 1,640 lb/ft 24 kN/m

2.11. Cross Machine Direction (CMD) ASTM D-6637 1,640 lb/ft 24 kN/m

2.12. Tensile Modulus @ 2%. Machine Direction (MD) ASTM D-6637 41,100 lb/ft 600 kN/m. Cross Machine Direction (CMD) ASTM D-6637 41,100 lb/ft 600 kN/m

2.13. Tensile Modulus @ 5%. Machine Direction (MD) ASTM D-6637 32,900 lb/ft 480 kN/m. Cross Machine Direction (CMD) ASTM D-6637 32,900 lb/ft 480 kN/m

NOTE: Polypropylene geogrid will be determined by the manufacturer.

Tied concrete block mats are packaged in rolls. These are packaged with high strength lifting straps for moving material into place with an excavator.

Table1
Physical Requirements

Compressive Strength Net Area Min. psi (mPa)		Water Absorption Max. lb/ft3 (kg/m3)	
Avg. of 3 units	Individual Unit	Avg. of 3 units	Individual Unit
4,000 (27.6)	3,500 (24.)	10 (160)	12 (192)

3. CONSTRUCTION

3.1. Prior to placing the tied concrete block mats, prepare the sub grade as detailed on the plans. All subgrade surfaces prepared for placement of mats must be smooth and free of all rocks, stones, sticks, roots, other protrusions, or debris of any kind.

3.2. The prepared surface must provide a firm unyielding foundation for the mats with no sharp or abrupt changes or breaks in the grade.

3.3. Apply seed directly to the prepared soil prior to installation of the Tied Concrete Block Mat. Use seed per project specifications.

3.4. Install mats to the line and grade shown on the plans and according to the manufacturer's installation guidelines. The manufacturer will provide technical assistance during the slope preparation and installation of the tied concrete block mats as needed.

4. MEASUREMENT

This Item will be measured by the square foot as shown on the plan, complete in place.

5. PAYMENT

Payment for Tied Concrete Block Mat will include all labor, equipment and materials to complete the work as described.

Special Specification 3076
Dense-Graded Hot-Mix Asphalt

1. DESCRIPTION

Construct a hot-mix asphalt (HMA) pavement layer composed of a compacted, dense-graded mixture of aggregate and asphalt binder mixed hot in a mixing plant. Payment adjustments will apply to HMA placed under this specification unless the HMA is deemed exempt in accordance with Section 3076.4.9.4., "Exempt Production."

2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

Notify the Engineer of all material sources and before changing any material source or formulation. The Engineer will verify that the specification requirements are met when the Contractor makes a source or formulation change, and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time during the project to verify specification compliance in accordance with Item 6, "Control of Materials."

2.1. **Aggregate**. Furnish aggregates from sources that conform to the requirements shown in Table 1 and as specified in this Section. Aggregate requirements in this Section, including those shown in Table 1, may be modified or eliminated when shown on the plans. Additional aggregate requirements may be specified when shown on the plans. Provide aggregate stockpiles that meet the definitions in this Section for coarse, intermediate, or fine aggregate. Aggregate from reclaimed asphalt pavement (RAP) is not required to meet Table 1 requirements unless otherwise shown on the plans. Supply aggregates that meet the definitions in Tex-100-E for crushed gravel or crushed stone. The Engineer will designate the plant or the quarry as the sampling location. Provide samples from materials produced for the project. The Engineer will establish the Surface Aggregate Classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests listed in Table 1. Document all test results on the mixture design report. The Engineer may perform tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately. Determine aggregate gradations for mixture design and production testing based on the washed sieve analysis given in Tex-200-F, Part II.

2.1.1. **Coarse Aggregate**. Coarse aggregate stockpiles must have no more than 20% material passing the No. 8 sieve. Aggregates from sources listed in the Department's *Bituminous Rated Source Quality Catalog* (BRSQC) are preapproved for use. Use only the rated values for hot-mix listed in the BRSQC. Rated values for surface treatment (ST) do not apply to coarse aggregate sources used in hot-mix asphalt.

For sources not listed on the Department's BRSQC:

- build an individual stockpile for each material;
- request the Department test the stockpile for specification compliance; and
- once approved, do not add material to the stockpile unless otherwise approved.

Provide aggregate from non-listed sources only when tested by the Engineer and approved before use. Allow 30 calendar days for the Engineer to sample, test, and report results for non-listed sources.

Provide coarse aggregate with at least the minimum SAC shown on the plans. SAC requirements only apply to aggregates used on the surface of travel lanes. SAC requirements apply to aggregates used on surfaces other than travel lanes when shown on the plans. The SAC for sources on the Department's *Aggregate Quality Monitoring Program* (AQMP) (Tex-499-A) is listed in the BRSQC.

2.1.1.1. **Blending Class A and Class B Aggregates**. Class B aggregate meeting all other requirements in Table 1 may be blended with a Class A aggregate to meet requirements for Class A materials, unless otherwise shown on the plans. Ensure that at least 50% by weight, or volume if required, of the material retained on the No. 4 sieve comes from the Class A aggregate source when blending Class A and B aggregates to meet a Class A requirement unless otherwise shown on the plans. Blend by volume if the bulk specific gravities of the Class A and B aggregates differ by more than 0.300. Coarse aggregate from RAP and Recycled Asphalt Shingles (RAS) will be considered as Class B aggregate for blending purposes.

The Engineer may perform tests at any time during production, when the Contractor blends Class A and B aggregates to meet a Class A requirement, to ensure that at least 50% by weight, or volume if required, of the material retained on the No. 4 sieve comes from the Class A aggregate source. The Engineer will use the Department's mix design template, when electing to verify conformance, to calculate the percent of Class A aggregate retained on the No. 4 sieve by inputting the bin percentages shown from readouts in the control room at the time of production and stockpile gradations measured at the time of production. The Engineer may determine the gradations based on either washed or dry sieve analysis from samples obtained from individual aggregate cold feed bins or aggregate stockpiles. The Engineer may perform spot checks using the gradations supplied by the Contractor on the mixture design report as an input for the template; however, a failing spot check will require confirmation with a stockpile gradation determined by the Engineer.

2.1.1.2. **Micro-Deval Abrasion**. The Engineer will perform a minimum of one Micro-Deval abrasion test in accordance with Tex-461-A for each coarse aggregate source used in the mixture design that has a Rated Source Soundness Magnesium (RSSM) loss value greater than 15 as listed in the BRSQC. The Engineer will perform testing before the start of production and may perform additional testing at any time during production. The Engineer may obtain the coarse aggregate samples from each coarse aggregate source or may require the Contractor to obtain the samples. The Engineer may waive all Micro-Deval testing based on a satisfactory test history of the same aggregate source.

The Engineer will estimate the magnesium sulfate soundness loss for each coarse aggregate source, when tested, using the following formula:

$$Mg_{est.} = (RSSM)(MD_{act.}/RSMD)$$

where:
$Mg_{est.}$ = magnesium sulfate soundness loss
$MD_{act.}$ = actual Micro-Deval percent loss
RSMD = Rated Source Micro-Deval

When the estimated magnesium sulfate soundness loss is greater than the maximum magnesium sulfate soundness loss specified, the coarse aggregate source will not be allowed for use unless otherwise approved. The Engineer will consult the Soils and Aggregates Section of the Materials and Tests Division, and additional testing may be required before granting approval.

2.1.2. **Intermediate Aggregate**. Aggregates not meeting the definition of coarse or fine aggregate will be defined as intermediate aggregate. Supply intermediate aggregates, when used that are free from organic impurities. The Engineer may test the intermediate aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. Supply intermediate aggregate from coarse aggregate sources, when used that meet the requirements shown in Table 1 unless otherwise approved.

Test the stockpile if 10% or more of the stockpile is retained on the No. 4 sieve, and verify that it meets the requirements in Table 1 for crushed face count (Tex-460-A) and flat and elongated particles (Tex-280-F).

2.1.3. **Fine Aggregate**. Fine aggregates consist of manufactured sands, screenings, and field sands. Fine aggregate stockpiles must meet the gradation requirements in Table 2. Supply fine aggregates that are free from organic impurities. The Engineer may test the fine aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. Unless otherwise shown on the plans, up to 10% of the total aggregate may be field sand or other uncrushed fine aggregate. Use fine aggregate, with the exception of field sand, from coarse aggregate sources that meet the requirements shown in Table 1 unless otherwise approved.

Test the stockpile if 10% or more of the stockpile is retained on the No. 4 sieve and verify that it meets the requirements in Table 1 for crushed face count (Tex-460-A) and flat and elongated particles (Tex-280-F).

Table 1
Aggregate Quality Requirements

Property	Test Method	Requirement
Coarse Aggregate		
SAC	Tex-499-A (AQMP)	As shown on the plans
Deleterious material, %, Max	Tex-217-F, Part I	1.5
Decantation, %, Max	Tex-217-F, Part II	1.5
Micro-Deval abrasion, %	Tex-461-A	Note 1
Los Angeles abrasion, %, Max	Tex-410-A	40
Magnesium sulfate soundness, 5 cycles, %, Max	Tex-411-A	30
Crushed face count,[2] %, Min	Tex-460-A, Part I	85
Flat and elongated particles @ 5:1, %, Max	Tex-280-F	10
Fine Aggregate		
Linear shrinkage, %, Max	Tex-107-E	3
Sand equivalent, %, Min	Tex-203-F	45

1. Used to estimate the magnesium sulfate soundness loss in accordance with Section 3076.2.1.1.2., "Micro-Deval Abrasion."
2. Only applies to crushed gravel.

Table 2
Gradation Requirements for Fine Aggregate

Sieve Size	% Passing by Weight or Volume
3/8"	100
#8	70–100
#200	0–30

2.2. **Mineral Filler**. Mineral filler consists of finely divided mineral matter such as agricultural lime, crusher fines, hydrated lime, or fly ash. Mineral filler is allowed unless otherwise shown on the plans. Use no more than 2% hydrated lime or fly ash unless otherwise shown on the plans. Use no more than 1% hydrated lime if a substitute binder is used unless otherwise shown on the plans or allowed. Test all mineral fillers except hydrated lime and fly ash in accordance with Tex-107-E to ensure specification compliance. The plans may require or disallow specific mineral fillers. Provide mineral filler, when used, that:

- is sufficiently dry, free-flowing, and free from clumps and foreign matter as determined by the Engineer;
- does not exceed 3% linear shrinkage when tested in accordance with Tex-107-E; and
- meets the gradation requirements in Table 3, unless otherwise shown on the plans.

Table 3
Gradation Requirements for Mineral Filler

Sieve Size	% Passing by Weight or Volume
#8	100
#200	55–100

2.3. **Baghouse Fines**. Fines collected by the baghouse or other dust-collecting equipment may be reintroduced into the mixing drum.

2.4. **Asphalt Binder**. Furnish the type and grade of performance-graded (PG) asphalt specified on the plans.

2.5. **Tack Coat**. Furnish CSS-1H, SS-1H, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300, "Asphalts, Oils, and Emulsions." Specialized tack coat materials listed on the Department's MPL are allowed or required when shown on the plans. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

2.6. **Additives**. Use the type and rate of additive specified when shown on the plans. Additives that facilitate mixing, compaction, or improve the quality of the mixture are allowed when approved. Provide the Engineer with documentation such as the bill of lading showing the quantity of additives used in the project unless otherwise directed.

2.6.1. **Lime and Liquid Antistripping Agent**. When lime or a liquid antistripping agent is used, add in accordance with Item 301, "Asphalt Antistripping Agents." Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime into the drum.

2.6.2. **Warm Mix Asphalt (WMA)**. Warm Mix Asphalt (WMA) is defined as HMA that is produced within a target temperature discharge range of 215°F and 275°F using approved WMA additives or processes from the Department's MPL.

WMA is allowed for use on all projects and is required when shown on the plans. When WMA is required, the maximum placement or target discharge temperature for WMA will be set at a value below 275°F.

Department-approved WMA additives or processes may be used to facilitate mixing and compaction of HMA produced at target discharge temperatures above 275°F; however, such mixtures will not be defined as WMA.

2.6.3. **Compaction Aid.** Compaction Aid is defined as a chemical warm mix additive that is used to produce an asphalt mixture at a discharge temperature greater than 275°F.

Compaction Aid is allowed for use on all projects and is required when shown on the plans.

2.7. **Recycled Materials**. Use of RAP and RAS is permitted unless otherwise shown on the plans. Use of RAS is restricted to only intermediate and base mixes unless otherwise shown on the plans. Do not exceed the maximum allowable percentages of RAP and RAS shown in Table 4. The allowable percentages shown in Table 4 may be decreased or increased when shown on the plans. Determine the asphalt binder content and gradation of the RAP and RAS stockpiles for mixture design purposes in accordance with Tex-236-F, Part I. The Engineer may verify the asphalt binder content of the stockpiles at any time during production. Perform other tests on RAP and RAS when shown on the plans. Asphalt binder from RAP and RAS is designated as recycled asphalt binder. Calculate and ensure that the ratio of the recycled asphalt binder to total binder does not exceed the percentages shown in Table 5 during mixture design and HMA production when RAP or RAS is used. Use a separate cold feed bin for each stockpile of RAP and RAS during HMA production.

Surface, intermediate, and base mixes referenced in Tables 4 and 5 are defined as follows:

- **Surface**. The final HMA lift placed at the top of the pavement structure or placed directly below mixtures produced in accordance with Items 316, 342, 347, or 348;
- **Intermediate**. Mixtures placed below an HMA surface mix and less than or equal to 8.0 in. from the riding surface; and
- **Base**. Mixtures placed greater than 8.0 in. from the riding surface. Unless otherwise shown on the plans, mixtures used for bond breaker are defined as base mixtures.

2.7.1. **RAP**. RAP is salvaged, milled, pulverized, broken, or crushed asphalt pavement. Fractionated RAP is defined as a stockpile that contains RAP material with a minimum of 95.0% passing the 3/8-in. or 1/2-in. sieve, before burning in the ignition oven, unless otherwise approved. The Engineer may allow the Contractor to use an alternate to the 3/8-in. or 1/2-in. screen to fractionate the RAP.

Use of Contractor-owned RAP including HMA plant waste is permitted unless otherwise shown on the plans. Department-owned RAP stockpiles are available for the Contractor's use when the stockpile locations are shown on the plans. If Department-owned RAP is available for the Contractor's use, the Contractor may use Contractor-owned fractionated RAP and replace it with an equal quantity of Department-owned RAP. Department-owned RAP generated through required work on the Contract is available for the Contractor's use when shown on the plans. Perform any necessary tests to ensure Contractor- or Department-owned RAP is appropriate for use. The Department will not perform any tests or assume any liability for the quality of the Department-owned RAP unless otherwise shown on the plans. The Contractor will retain ownership of RAP generated on the project when shown on the plans.

Do not use Department- or Contractor-owned RAP contaminated with dirt or other objectionable materials. Do not use Department- or Contractor-owned RAP if the decantation value exceeds 5% and the plasticity index is greater than 8. Test the stockpiled RAP for decantation in accordance with Tex-406-A, Part I. Determine the plasticity index in accordance with Tex-106-E if the decantation value exceeds 5%. The decantation and plasticity index requirements do not apply to RAP samples with asphalt removed by extraction or ignition.

Do not intermingle Contractor-owned RAP stockpiles with Department-owned RAP stockpiles. Remove unused Contractor-owned RAP material from the project site upon completion of the project. Return unused Department-owned RAP to the designated stockpile location.

Table 4
Maximum Allowable Amounts of RAP[1]

Maximum Allowable Fractionated RAP (%)		
Surface	**Intermediate**	**Base**
15.0	25.0	30.0

1. Must also meet the recycled binder to total binder ratio shown in Table 5.

2.7.2. **RAS**. Use of post-manufactured RAS or post-consumer RAS (tear-offs) is not permitted in surface mixtures unless otherwise shown on the plans. RAS may be used in intermediate and base mixtures unless otherwise shown on the plans. Up to 3% RAS may be used separately or as a replacement for fractionated RAP in accordance with Table 4 and Table 5. RAS is defined as processed asphalt shingle material from manufacturing of asphalt roofing shingles or from re-roofing residential structures. Post-manufactured RAS is processed manufacturer's shingle scrap by-product. Post-consumer RAS is processed shingle scrap removed from residential structures. Comply with all regulatory requirements stipulated for RAS by the TCEQ. RAS may be used separately or in conjunction with RAP.

Process the RAS by ambient grinding or granulating such that 100% of the particles pass the 3/8 in. sieve when tested in accordance with Tex-200-F, Part I. Perform a sieve analysis on processed RAS material before extraction (or ignition) of the asphalt binder.

Add sand meeting the requirements of Table 1 and Table 2 or fine RAP to RAS stockpiles if needed to keep the processed material workable. Any stockpile that contains RAS will be considered a RAS stockpile and be limited to no more than 3.0% of the HMA mixture in accordance with Table 4.

Certify compliance of the RAS with DMS-11000, "Evaluating and Using Nonhazardous Recyclable Materials Guidelines." Treat RAS as an established nonhazardous recyclable material if it has not come into contact with any hazardous materials. Use RAS from shingle sources on the Department's MPL. Remove substantially all materials before use that are not part of the shingle, such as wood, paper, metal, plastic, and felt paper. Determine the deleterious content of RAS material for mixture design purposes in accordance with Tex-217-F, Part III. Do not use RAS if deleterious materials are more than 0.5% of the stockpiled RAS unless otherwise approved. Submit a sample for approval before submitting the mixture design. The Department will perform the testing for deleterious material of RAS to determine specification compliance.

2.8. **Substitute Binders**. Unless otherwise shown on the plans, the Contractor may use a substitute PG binder listed in Table 5 instead of the PG binder originally specified, if using recycled materials, and if the substitute PG binder and mixture made with the substitute PG binder meet the following:

- the substitute binder meets the specification requirements for the substitute binder grade in accordance with Section 300.2.10., "Performance-Graded Binders;" and
- the mixture has less than 10.0 mm of rutting on the Hamburg Wheel test (Tex-242-F) after the number of passes required for the originally specified binder. Use of substitute PG binders may only be allowed at the discretion of the Engineer if the Hamburg Wheel test results are between 10.0 mm and 12.5 mm.

Table 5
Allowable Substitute PG Binders and Maximum Recycled Binder Ratios

Originally Specified PG Binder	Allowable Substitute PG Binder for Surface Mixes	Allowable Substitute PG Binder for Intermediate and Base Mixes	Maximum Ratio of Recycled Binder[1] to Total Binder (%)		
			Surface	Intermediate	Base
76-22[4,5]	70-22	70-22	10.0	20.0	25.0
70-22[2,5]	N/A	64-22	10.0	20.0	25.0
64-22[2,3]	N/A	N/A	10.0	20.0	25.0
76-28[4,5]	70-28	70-28	10.0	20.0	25.0
70-28[2,5]	N/A	64-28	10.0	20.0	25.0
64-28[2,3]	N/A	N/A	10.0	20.0	25.0

1. Combined recycled binder from RAP and RAS. RAS is not permitted in surface mixtures unless otherwise shown on the plans.
2. Binder substitution is not allowed for surface mixtures.
3. Binder substitution is not allowed for intermediate and base mixtures.
4. Use no more than 10.0% recycled binder in surface mixtures when using this originally specified PG binder.
5. Use no more than 20.0% recycled binder when using this originally specified PG binder for intermediate mixtures. Use no more than 25.0% recycled binder when using this originally specified PG binder for base mixtures.

3. EQUIPMENT

Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement."

4. CONSTRUCTION

Produce, haul, place, and compact the specified paving mixture. In addition to tests required by the specification, Contractors may perform other QC tests as deemed necessary. At any time during the project, the Engineer may perform production and placement tests as deemed necessary in accordance with Item 5, "Control of the Work." Schedule and participate in a mandatory pre-paving meeting with the Engineer on or before the first day of paving unless otherwise shown on the plans.

4.1. **Certification**. Personnel certified by the Department-approved hot-mix asphalt certification program must conduct all mixture designs, sampling, and testing in accordance with Table 6. Supply the Engineer with a list of certified personnel and copies of their current certificates before beginning production and when personnel changes are made. Provide a mixture design developed and signed by a Level 2 certified specialist. Provide Level 1A certified specialists at the plant during production operations. Provide Level 1B certified specialists to conduct placement tests. Provide AGG101 certified specialists for aggregate testing.

Table 6
Test Methods, Test Responsibility, and Minimum Certification Levels

Test Description	Test Method	Contractor	Engineer	Level[1]
1. Aggregate and Recycled Material Testing				
Sampling	Tex-221-F	✓	✓	1A/AGG101
Dry sieve	Tex-200-F, Part I	✓	✓	1A/AGG101
Washed sieve	Tex-200-F, Part II	✓	✓	1A/AGG101
Deleterious material	Tex-217-F, Parts I & III	✓	✓	AGG101
Decantation	Tex-217-F, Part II	✓	✓	AGG101
Los Angeles abrasion	Tex-410-A		✓	TxDOT
Magnesium sulfate soundness	Tex-411-A		✓	TxDOT
Micro-Deval abrasion	Tex-461-A		✓	AGG101
Crushed face count	Tex-460-A	✓	✓	AGG101
Flat and elongated particles	Tex-280-F	✓	✓	AGG101
Linear shrinkage	Tex-107-E	✓	✓	AGG101
Sand equivalent	Tex-203-F	✓	✓	AGG101
Organic impurities	Tex-408-A	✓	✓	AGG101
2. Asphalt Binder & Tack Coat Sampling				
Asphalt binder sampling	Tex-500-C, Part II	✓	✓	1A/1B
Tack coat sampling	Tex-500-C, Part III	✓	✓	1A/1B
3. Mix Design & Verification				
Design and JMF changes	Tex-204-F	✓	✓	2
Mixing	Tex-205-F	✓	✓	2
Molding (TGC)	Tex-206-F	✓	✓	1A
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F, Parts I & VI	✓	✓	1A
Rice gravity	Tex-227-F, Part II	✓	✓	1A
Ignition oven correction factors[2]	Tex-236-F, Part II	✓	✓	2
Indirect tensile strength	Tex-226-F	✓	✓	1A
Hamburg Wheel test	Tex-242-F	✓	✓	1A
Boil test	Tex-530-C	✓	✓	1A
4. Production Testing				
Selecting production random numbers	Tex-225-F, Part I		✓	1A
Mixture sampling	Tex-222-F	✓	✓	1A/1B
Molding (TGC)	Tex-206-F	✓	✓	1A
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F, Parts I & VI	✓	✓	1A
Rice gravity	Tex-227-F, Part II	✓	✓	1A
Gradation & asphalt binder content[2]	Tex-236-F, Part I	✓	✓	1A
Control charts	Tex-233-F	✓	✓	1A
Moisture content	Tex-212-F, Part II	✓	✓	1A/AGG101
Hamburg Wheel test	Tex-242-F	✓	✓	1A
Micro-Deval abrasion	Tex-461-A		✓	AGG101
Boil test	Tex-530-C	✓	✓	1A
Abson recovery	Tex-211-F		✓	TxDOT
5. Placement Testing				
Selecting placement random numbers	Tex-225-F, Part II		✓	1B
Trimming roadway cores	Tex-251-F, Parts I & II	✓	✓	1A/1B
In-place air voids	Tex-207-F, Parts I & VI	✓	✓	1A
In-place density (nuclear method)	Tex-207-F, Part III	✓		1B
Establish rolling pattern	Tex-207-F, Part IV	✓		1B
Control charts	Tex-233-F	✓	✓	1A
Ride quality measurement	Tex-1001-S	✓	✓	Note 3
Segregation (density profile)	Tex-207-F, Part V	✓	✓	1B
Longitudinal joint density	Tex-207-F, Part VII	✓	✓	1B
Thermal profile	Tex-244-F	✓	✓	1B
Shear Bond Strength Test	Tex-249-F		✓	TxDOT

1. Level 1A, 1B, AGG101, and 2 are certification levels provided by the Hot Mix Asphalt Center certification program.
2. Refer to Section 3076.4.9.2.3., "Production Testing," for exceptions to using an ignition oven.
3. Profiler and operator are required to be certified at the Texas A&M Transportation Institute facility when Surface Test Type B is specified.

4.2. **Reporting and Responsibilities**. Use Department-provided templates to record and calculate all test data, including mixture design, production and placement QC/QA, control charts, thermal profiles, segregation density profiles, and longitudinal joint density. Obtain the current version of the templates at http://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/forms/site-manager.html or from the Engineer. The Engineer and the Contractor will provide any available test results to the other party when requested. The maximum allowable time for the Contractor and Engineer to exchange test data is as given in Table 7 unless otherwise approved. The Engineer and the Contractor will immediately report to the other party any test result that requires suspension of production or placement, a payment adjustment less than 1.000, or that fails to meet the specification requirements. Record and electronically submit all test results and pertinent information on Department-provided templates.

Subsequent sublots placed after test results are available to the Contractor, which require suspension of operations, may be considered unauthorized work. Unauthorized work will be accepted or rejected at the discretion of the Engineer in accordance with Article 5.3., "Conformity with Plans, Specifications, and Special Provisions."

Table 7
Reporting Schedule

Description	Reported By	Reported To	To Be Reported Within
Production Quality Control			
Gradation[1]	Contractor	Engineer	1 working day of completion of the sublot
Asphalt binder content[1]			
Laboratory-molded density[2]			
Moisture content[3]			
Boil test[3]			
Production Quality Assurance			
Gradation[3]	Engineer	Contractor	1 working day of completion of the sublot
Asphalt binder content[3]			
Laboratory-molded density[1]			
Hamburg Wheel test[4]			
Boil test[3]			
Binder tests[4]			
Placement Quality Control			
In-place air voids[2]	Contractor	Engineer	1 working day of completion of the lot
Segregation[1]			
Longitudinal joint density[1]			
Thermal profile[1]			
Placement Quality Assurance			
In-place air voids[1]	Engineer	Contractor	1 working day after receiving the trimmed cores[5]
Segregation[3]			1 working day of completion of the lot
Longitudinal joint density[3]			
Thermal profile[3]			
Aging ratio[4]			
Payment adjustment summary	Engineer	Contractor	2 working days of performing all required tests and receiving Contractor test data

1. These tests are required on every sublot.
2. Optional test. When performed on split samples, report the results as soon as they become available.
3. To be performed at the frequency specified in Table 16 or as shown on the plans.
4. To be reported as soon as the results become available.
5. 2 days are allowed if cores cannot be dried to constant weight within 1 day.

The Engineer will use the Department-provided template to calculate all payment adjustment factors for the lot. Sublot samples may be discarded after the Engineer and Contractor sign off on the payment adjustment summary documentation for the lot.

Use the procedures described in Tex-233-F to plot the results of all quality control (QC) and quality assurance (QA) testing. Update the control charts as soon as test results for each sublot become available. Make the control charts readily accessible at the field laboratory. The Engineer may suspend production for failure to update control charts.

4.3. **Quality Control Plan (QCP)**. Develop and follow the QCP in detail. Obtain approval for changes to the QCP made during the project. The Engineer may suspend operations if the Contractor fails to comply with the QCP.

Submit a written QCP before the mandatory pre-paving meeting. Receive approval of the QCP before beginning production. Include the following items in the QCP:

4.3.1. **Project Personnel**. For project personnel, include:

- a list of individuals responsible for QC with authority to take corrective action;
- current contact information for each individual listed; and
- current copies of certification documents for individuals performing specified QC functions.

4.3.2. **Material Delivery and Storage**. For material delivery and storage, include:

- the sequence of material processing, delivery, and minimum quantities to assure continuous plant operations;
- aggregate stockpiling procedures to avoid contamination and segregation;
- frequency, type, and timing of aggregate stockpile testing to assure conformance of material requirements before mixture production; and
- procedure for monitoring the quality and variability of asphalt binder.

4.3.3. **Production**. For production, include:

- loader operation procedures to avoid contamination in cold bins;
- procedures for calibrating and controlling cold feeds;
- procedures to eliminate debris or oversized material;
- procedures for adding and verifying rates of each applicable mixture component (e.g., aggregate, asphalt binder, RAP, RAS, lime, liquid antistrip, WMA);
- procedures for reporting job control test results; and
- procedures to avoid segregation and drain-down in the silo.

4.3.4. **Loading and Transporting**. For loading and transporting, include:

- type and application method for release agents; and
- truck loading procedures to avoid segregation.

4.3.5. **Placement and Compaction**. For placement and compaction, include:

- proposed agenda for mandatory pre-paving meeting, including date and location;
- proposed paving plan (e.g., paving widths, joint offsets, and lift thicknesses);
- type and application method for release agents in the paver and on rollers, shovels, lutes, and other utensils;
- procedures for the transfer of mixture into the paver, while avoiding segregation and preventing material spillage;
- process to balance production, delivery, paving, and compaction to achieve continuous placement operations and good ride quality;
- paver operations (e.g., operation of wings, height of mixture in auger chamber) to avoid physical and thermal segregation and other surface irregularities; and
- procedures to construct quality longitudinal and transverse joints.

4.4. **Mixture Design**.

4.4.1. **Design Requirements**. The Contractor will design the mixture using a Superpave Gyratory Compactor (SGC). A Texas Gyratory Compactor (TGC) may be used when shown on the plans. Use the dense-graded design procedure provided in Tex-204-F. Design the mixture to meet the requirements listed in Tables 1, 2, 3, 4, 5, 8, 9, and 10.

4.4.1.1. **Design Number of Gyrations (Ndesign) When The SGC Is Used**. Design the mixture at 50 gyrations (Ndesign). Use a target laboratory-molded density of 96.0% to design the mixture; however, adjustments can be made to the Ndesign value as noted in Table 9. The Ndesign level may be reduced to at least 35 gyrations at the Contractor's discretion.

Use an approved laboratory from the Department's MPL to perform the Hamburg Wheel test, and provide results with the mixture design, or provide the laboratory mixture and request that the Department perform the Hamburg Wheel test. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test results on the laboratory mixture design.

The Engineer will provide the mixture design when shown on the plans. The Contractor may submit a new mixture design at any time during the project. The Engineer will verify and approve all mixture designs (JMF1) before the Contractor can begin production.

Provide the Engineer with a mixture design report using the Department-provided template. Include the following items in the report:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- asphalt binder content and aggregate gradation of RAP and RAS stockpiles;
- the target laboratory-molded density (or Ndesign level when using the SGC);
- results of all applicable tests;
- the mixing and molding temperatures;
- the signature of the Level 2 person or persons that performed the design;
- the date the mixture design was performed; and
- a unique identification number for the mixture design.

Table 8
Master Gradation Limits (% Passing by Weight or Volume) and VMA Requirements

Sieve Size	B Fine Base	C Coarse Surface	D Fine Surface	F Fine Mixture
2"	–	–	–	–
1-1/2"	100.0[1]	–	–	–
1"	98.0–100.0	100.0[1]	–	–
3/4"	84.0–98.0	95.0–100.0	100.0[1]	–
1/2"	–	–	98.0–100.0	100.0[1]
3/8"	60.0–80.0	70.0–85.0	85.0–100.0	98.0–100.0
#4	40.0–60.0	43.0–63.0	50.0–70.0	70.0–90.0
#8	29.0–43.0	32.0–44.0	35.0–46.0	38.0–48.0
#30	13.0–28.0	14.0–28.0	15.0–29.0	12.0–27.0
#50	6.0–20.0	7.0–21.0	7.0–20.0	6.0–19.0
#200	2.0–7.0	2.0–7.0	2.0–7.0	2.0–7.0
Design VMA, % Minimum				
–	13.0	14.0	15.0	16.0
Production (Plant-Produced) VMA, % Minimum				
–	12.5	13.5	14.5	15.5

1. Defined as maximum sieve size. No tolerance allowed.

Table 9
Laboratory Mixture Design Properties

Mixture Property	Test Method	Requirement
Target laboratory-molded density, % (SGC)	Tex-207-F	96.0
Design gyrations (Ndesign for SGC)	Tex-241-F	50[1]
Indirect tensile strength (dry), psi	Tex-226-F	85–200[2]
Boil test[3]	Tex-530-C	–

1. Adjust within a range of 35–100 gyrations when shown on the plans or specification or when mutually agreed between the Engineer and Contractor.
2. The Engineer may allow the IDT strength to exceed 200 psi if the corresponding Hamburg Wheel rut depth is greater than 3.0 mm and less than 12.5 mm.
3. Used to establish baseline for comparison to production results. May be waived when approved.

Table 10
Hamburg Wheel Test Requirements

High-Temperature Binder Grade	Test Method	Minimum # of Passes @ 12.5 mm[1] Rut Depth, Tested @ 50°C
PG 64 or lower	Tex-242-F	10,000[2]
PG 70		15,000[3]
PG 76 or higher		20,000

1. When the rut depth at the required minimum number of passes is less than 3 mm, the Engineer may require the Contractor to increase the target laboratory-molded density (TGC) by 0.5% to no more than 97.5% or lower the Ndesign level (SGC) to at least 35 gyrations.
2. May be decreased to at least 5,000 passes when shown on the plans.
3. May be decreased to at least 10,000 passes when shown on the plans.

4.4.1.2. **Target Laboratory-Molded Density When The TGC Is Used**. Design the mixture at a 96.5% target laboratory-molded density. Increase the target laboratory-molded density to 97.0% or 97.5% at the Contractor's discretion or when shown on the plans or specification.

4.4.2. **Job-Mix Formula Approval**. The job-mix formula (JMF) is the combined aggregate gradation, target laboratory-molded density (or Ndesign level), and target asphalt percentage used to establish target values for hot-mix production. JMF1 is the original laboratory mixture design used to produce the trial batch. When WMA is used, JMF1 may be designed and submitted to the Engineer without including the WMA additive. When WMA is used, document the additive or process used and recommended rate on the JMF1 submittal. The Engineer and the Contractor will verify JMF1 based on plant-produced mixture from the trial batch unless otherwise approved. The Engineer may accept an existing mixture design previously used on a Department project and may waive the trial batch to verify JMF1. The Department may require the Contractor to reimburse the Department for verification tests if more than 2 trial batches per design are required.

4.4.2.1. **Contractor's Responsibilities**.

4.4.2.1.1. **Providing Gyratory Compactor**. Use a SGC calibrated in accordance with Tex-241-F to design the mixture in accordance with Tex-204-F, Part IV, for molding production samples. Locate the SGC, if used, at the Engineer's field laboratory and make the SGC available to the Engineer for use in molding production samples. Furnish a TGC calibrated in accordance with Tex-914-K when shown on the plans to design the mixture in accordance with Tex-204-F, Part I, for molding production samples.

4.4.2.1.2. **Gyratory Compactor Correlation Factors**. Use Tex-206-F, Part II, to perform a gyratory compactor correlation when the Engineer uses a different gyratory compactor. Apply the correlation factor to all subsequent production test results.

4.4.2.1.3. **Submitting JMF1**. Furnish a mix design report (JMF1) with representative samples of all component materials and request approval to produce the trial batch. Provide approximately 10,000 g of the design mixture if opting to have the Department perform the Hamburg Wheel test on the laboratory mixture, and request that the Department perform the test.

4.4.2.1.4. **Supplying Aggregates**. Provide approximately 40 lb. of each aggregate stockpile unless otherwise directed.

4.4.2.1.5. **Supplying Asphalt**. Provide at least 1 gal. of the asphalt material and enough quantities of any additives proposed for use.

4.4.2.1.6. **Ignition Oven Correction Factors**. Determine the aggregate and asphalt correction factors from the ignition oven in accordance with Tex-236-F, Part II. Provide correction factors that are not more than 12 months old. Provide the Engineer with split samples of the mixtures before the trial batch production, including all additives (except water), and blank samples used to determine the correction factors for the ignition oven used for QA testing during production. Correction factors established from a previously approved mixture design may be used for the current mixture design if the mixture design and ignition oven are the same as previously used, unless otherwise directed.

4.4.2.1.7. **Boil Test**. Perform the test and retain the tested sample from Tex-530-C until completion of the project or as directed. Use this sample for comparison purposes during production. The Engineer may waive the requirement for the boil test.

4.4.2.1.8. **Trial Batch Production**. Provide a plant-produced trial batch upon receiving conditional approval of JMF1 and authorization to produce a trial batch, including the WMA additive or process if applicable, for verification testing of JMF1 and development of JMF2. Produce a trial batch mixture that meets the requirements in Table 4, Table 5, and Table 11. The Engineer may accept test results from recent production of the same mixture instead of a new trial batch.

4.4.2.1.9. **Trial Batch Production Equipment**. Use only equipment and materials proposed for use on the project to produce the trial batch.

4.4.2.1.10. **Trial Batch Quantity**. Produce enough quantity of the trial batch to ensure that the mixture meets the specification requirements.

4.4.2.1.11. **Number of Trial Batches**. Produce trial batches as necessary to obtain a mixture that meets the specification requirements.

4.4.2.1.12. **Trial Batch Sampling**. Obtain a representative sample of the trial batch and split it into 3 equal portions in accordance with Tex-222-F. Label these portions as “Contractor,” “Engineer,” and “Referee.” Deliver samples to the appropriate laboratory as directed.

4.4.2.1.13. **Trial Batch Testing**. Test the trial batch to ensure the mixture produced using the proposed JMF1 meets the mixture requirements in Table 11. Ensure the trial batch mixture is also in compliance with the Hamburg Wheel requirement in Table 10. Use a Department-approved laboratory to perform the Hamburg Wheel test on the trial batch mixture or request that the Department perform the Hamburg Wheel test. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test results on the trial batch. Provide the Engineer with a copy of the trial batch test results.

4.4.2.1.14. **Development of JMF2**. Evaluate the trial batch test results after the Engineer grants full approval of JMF1 based on results from the trial batch, determine the optimum mixture proportions, and submit as JMF2. Adjust the asphalt binder content or gradation to achieve the specified target laboratory-molded density. The asphalt binder content established for JMF2 is not required to be within any tolerance of the optimum asphalt binder content established for JMF1; however, mixture produced using JMF2 must meet the voids in mineral aggregates (VMA) requirements for production shown in Table 8. If the optimum asphalt binder content for JMF2 is more than 0.5% lower than the optimum asphalt binder content for JMF1, the Engineer may perform or require the Contractor to perform Tex-226-F on Lot 1 production to confirm the indirect tensile strength does not exceed 200 psi. Verify that JMF2 meets the mixture requirements in Table 5.

4.4.2.1.15. **Mixture Production**. Use JMF2 to produce Lot 1 as described in Section 3076.4.9.3.1.1., “Lot 1 Placement,” after receiving approval for JMF2 and a passing result from the Department’s or a Department-approved

laboratory's Hamburg Wheel test on the trial batch. If desired, proceed to Lot 1 production, once JMF2 is approved, at the Contractor's risk without receiving the results from the Department's Hamburg Wheel test on the trial batch.

Notify the Engineer if electing to proceed without Hamburg Wheel test results from the trial batch. Note that the Engineer may require up to the entire sublot of any mixture failing the Hamburg Wheel test to be removed and replaced at the Contractor's expense.

4.4.2.1.16. **Development of JMF3**. Evaluate the test results from Lot 1, determine the optimum mixture proportions, and submit as JMF3 for use in Lot 2.

4.4.2.1.17. **JMF Adjustments**. If JMF adjustments are necessary to achieve the specified requirements, make the adjustments before beginning a new lot. The adjusted JMF must:

- be provided to the Engineer in writing before the start of a new lot;
- be numbered in sequence to the previous JMF;
- meet the mixture requirements in Table 4 and Table 5;
- meet the master gradation limits shown in Table 8; and
- be within the operational tolerances of JMF2 listed in Table 11.

4.4.2.1.18. **Requesting Referee Testing**. Use referee testing, if needed, in accordance with Section 3076.4.9.1., "Referee Testing," to resolve testing differences with the Engineer.

Table 11
Operational Tolerances

Description	Test Method	Allowable Difference Between Trial Batch and JMF1 Target	Allowable Difference from Current JMF Target	Allowable Difference between Contractor and Engineer[1]
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	Must be Within Master Grading Limits in Table 8	±5.0[2,3]	±5.0
Individual % retained for sieves smaller than #8 and larger than #200			±3.0[2,3]	±3.0
% passing the #200 sieve			±2.0[2,3]	±1.6
Asphalt binder content, %	Tex-236-F	±0.5	±0.3[3]	±0.3
Laboratory-molded density, %	Tex-207-F	±1.0	±1.0	±1.0
In-place air voids, %		N/A	N/A	±1.0
Laboratory-molded bulk specific gravity		N/A	N/A	±0.020
VMA, %, min	Tex-204-F	Note[4]	Note[4]	N/A
Theoretical maximum specific (Rice) gravity	Tex-227-F	N/A	N/A	±0.020

1. Contractor may request referee testing only when values exceed these tolerances.
2. When within these tolerances, mixture production gradations may fall outside the master grading limits; however, the % passing the #200 will be considered out of tolerance when outside the master grading limits.
3. Only applies to mixture produced for Lot 1 and higher.
4. Test and verify that Table 8 requirements are met.

4.4.2.2. **Engineer's Responsibilities**.

4.4.2.2.1. **Gyratory Compactor**. For SGC mixtures designed in accordance with Tex-204-F, Part IV, the Engineer will use a Department SGC, calibrated in accordance with Tex-241-F, to mold samples for laboratory mixture design verification. For molding trial batch and production specimens, the Engineer will use the Contractor-provided SGC at the field laboratory or provide and use a Department SGC at an alternate location. The Engineer will make the Contractor-provided SGC in the Department field laboratory available to the Contractor for molding verification samples.

For TGC mixtures designed in accordance with Tex-204-F, Part I, the Engineer will use a Department TGC, calibrated in accordance with Tex-914-K, to mold samples for trial batch and production testing. The Engineer will make the Department TGC and the Department field laboratory available to the Contractor for molding verification samples, if requested by the Contractor.

4.4.2.2.2. **Conditional Approval of JMF1 and Authorizing Trial Batch**. The Engineer will review and verify conformance of the following information within 2 working days of receipt:

- the Contractor's mix design report (JMF1);
- the Contractor-provided Hamburg Wheel test results;
- all required materials including aggregates, asphalt, additives, and recycled materials; and
- the mixture specifications.

The Engineer will grant the Contractor conditional approval of JMF1 if the information provided on the paper copy of JMF1 indicates that the Contractor's mixture design meets the specifications. When the Contractor does not provide Hamburg Wheel test results with laboratory mixture design, 10 working days are allowed for conditional approval of JMF1. The Engineer will base full approval of JMF1 on the test results on mixture from the trial batch.

Unless waived, the Engineer will determine the Micro-Deval abrasion loss in accordance with Section 3076.2.1.1.2., "Micro-Deval Abrasion." If the Engineer's test results are pending after two working days, conditional approval of JMF1 will still be granted within two working days of receiving JMF1. When the Engineer's test results become available, they will be used for specification compliance.

After conditionally approving JMF1, including either Contractor- or Department-supplied Hamburg Wheel test results, the Contractor is authorized to produce a trial batch.

4.4.2.2.3. **Hamburg Wheel Testing of JMF1**. If the Contractor requests the option to have the Department perform the Hamburg Wheel test on the laboratory mixture, the Engineer will mold samples in accordance with Tex-242-F to verify compliance with the Hamburg Wheel test requirement in Table 10.

4.4.2.2.4. **Ignition Oven Correction Factors**. The Engineer will use the split samples provided by the Contractor to determine the aggregate and asphalt correction factors for the ignition oven used for QA testing during production in accordance with Tex-236-F, Part II. Provide correction factors that are not more than 12 months old.

4.4.2.2.5. **Testing the Trial Batch**. Within 1 full working day, the Engineer will sample and test the trial batch to ensure that the mixture meets the requirements in Table 11. If the Contractor requests the option to have the Department perform the Hamburg Wheel test on the trial batch mixture, the Engineer will mold samples in accordance with Tex-242-F to verify compliance with the Hamburg Wheel test requirement in Table 10.

The Engineer will have the option to perform the following tests on the trial batch:

- Tex-226-F, to verify that the indirect tensile strength meets the requirement shown in Table 9; and
- Tex-530-C, to retain and use for comparison purposes during production.

4.4.2.2.6. **Full Approval of JMF1**. The Engineer will grant full approval of JMF1 and authorize the Contractor to proceed with developing JMF2 if the Engineer's results for the trial batch meet the requirements in Table 11. The Engineer will notify the Contractor that an additional trial batch is required if the trial batch does not meet these requirements.

4.4.2.2.7. **Approval of JMF2**. The Engineer will approve JMF2 within one working day if the mixture meets the requirements in Table 5 and the gradation meets the master grading limits shown in Table 8. The asphalt binder content established for JMF2 is not required to be within any tolerance of the optimum asphalt binder content established for JMF1; however, mixture produced using JMF2 must meet the VMA requirements shown in Table 8. If the optimum asphalt binder content for JMF2 is more than 0.5% lower than the optimum asphalt binder content for JMF1, the Engineer may perform or require the Contractor to perform Tex-226-F on Lot 1 production to confirm the indirect tensile strength does not exceed 200 psi.

4.4.2.2.8. **Approval of Lot 1 Production**. The Engineer will authorize the Contractor to proceed with Lot 1 production (using JMF2) as soon as a passing result is achieved from the Department's or a Department-approved laboratory's Hamburg Wheel test on the trial batch. The Contractor may proceed at its own risk with Lot 1 production without the results from the Hamburg Wheel test on the trial batch.

If the Department's or Department-approved laboratory's sample from the trial batch fails the Hamburg Wheel test, the Engineer will suspend production until further Hamburg Wheel tests meet the specified values. The Engineer may require up to the entire sublot of any mixture failing the Hamburg Wheel test be removed and replaced at the Contractor's expense.

4.4.2.2.9. **Approval of JMF3 and Subsequent JMF Changes**. JMF3 and subsequent JMF changes are approved if they meet the mixture requirements shown in Table 4, Table 5, and the master grading limits shown in Table 8, and are within the operational tolerances of JMF2 shown in Table 11.

4.5. **Production Operations**. Perform a new trial batch when the plant or plant location is changed. Take corrective action and receive approval to proceed after any production suspension for noncompliance to the specification. Submit a new mix design and perform a new trial batch when the asphalt binder content of:

- any RAP stockpile used in the mix is more than 0.5% higher than the value shown on the mixture design report; or
- RAS stockpile used in the mix is more than 2.0% higher than the value shown on the mixture design report.

4.5.1. **Storage and Heating of Materials**. Do not heat the asphalt binder above the temperatures specified in Item 300, "Asphalts, Oils, and Emulsions," or outside the manufacturer's recommended values. Provide the Engineer with daily records of asphalt binder and hot-mix asphalt discharge temperatures (in legible and discernible increments) in accordance with Item 320, "Equipment for Asphalt Concrete Pavement," unless otherwise directed. Do not store mixture for a period long enough to affect the quality of the mixture, nor in any case longer than 12 hr. unless otherwise approved.

4.5.2. **Mixing and Discharge of Materials**. Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not exceed the maximum production temperatures listed in Table 12 (or 275°F for WMA). The Department will not pay for or allow placement of any mixture produced above the maximum production temperatures listed in Table 12.

Table 12
Maximum Production Temperature

High-Temperature Binder Grade[1]	Maximum Production Temperature
PG 64	325˚F
PG 70	335˚F
PG 76	345˚F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.

Produce WMA within the target discharge temperature range of 215°F and 275°F when WMA is required. Take corrective action any time the discharge temperature of the WMA exceeds the target discharge range. The Engineer may suspend production operations if the Contractor's corrective action is not successful at controlling the production temperature within the target discharge range. Note that when WMA is produced, it may be necessary to adjust burners to ensure complete combustion such that no burner fuel residue remains in the mixture.

Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant. Determine the moisture content, if requested, by oven-drying in accordance with

Tex-212-F, Part II, and verify that the mixture contains no more than 0.2% of moisture by weight. Obtain the sample immediately after discharging the mixture into the truck, and perform the test promptly.

4.6. **Hauling Operations**. Clean all truck beds before use to ensure that mixture is not contaminated. Use a release agent shown on the Department's MPL to coat the inside bed of the truck when necessary.

Use equipment for hauling as defined in Section 3076.4.7.3.3., "Hauling Equipment." Use other hauling equipment only when allowed.

4.7. **Placement Operations**. Collect haul tickets from each load of mixture delivered to the project and provide the Department's copy to the Engineer approximately every hour, or as directed. Use a hand-held thermal camera or infrared thermometer, when a thermal imaging system is not used, to measure and record the internal temperature of the mixture as discharged from the truck or Material Transfer Device (MTD) before or as the mix enters the paver and an approximate station number or GPS coordinates on each ticket. Calculate the daily yield and cumulative yield for the specified lift and provide to the Engineer at the end of paving operations for each day unless otherwise directed. The Engineer may suspend production if the Contractor fails to produce and provide haul tickets and yield calculations by the end of paving operations for each day.

Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from pavement edges. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Offset longitudinal joints of successive courses of hot-mix by at least 6 in. Place mixture so that longitudinal joints on the surface course coincide with lane lines and are not placed in the wheel path, or as directed. Ensure that all finished surfaces will drain properly. Place the mixture at the rate or thickness shown on the plans. The Engineer will use the guidelines in Table 13 to determine the compacted lift thickness of each layer when multiple lifts are required. The thickness determined is based on the rate of 110 lb./sq. yd. for each inch of pavement unless otherwise shown on the plans.

Table 13
Compacted Lift Thickness and Required Core Height

Mixture Type	Compacted Lift Thickness Guidelines		Minimum Untrimmed Core Height (in.) Eligible for Testing
	Minimum (in.)	Maximum (in.)	
B	2.50	5.00	1.75
C	2.00	4.00	1.50
D	1.50	3.00	1.25
F	1.25	2.50	1.25

4.7.1. **Weather Conditions**.

4.7.1.1. **When Using a Thermal Imaging System**. Place mixture when the roadway surface is dry and the roadway surface temperature is at or above the temperatures listed in Table 14A. The Engineer may restrict the Contractor from paving surface mixtures if the ambient temperature is likely to drop below 32°F within 12 hr. of paving. Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. Provide output data from the thermal imaging system to demonstrate to the Engineer that no recurring severe thermal segregation exists in accordance with Section 3076.4.7.3.1.2., "Thermal Imaging System."

Table 14A
Minimum Pavement Surface Temperatures

High-Temperature Binder Grade[1]	Minimum Pavement Surface Temperatures (°F)	
	Subsurface Layers or Night Paving Operations	Surface Layers Placed in Daylight Operations
PG 64	35	40
PG 70	45[2]	50[2]
PG 76	45[2]	50[2]

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. Contractors may pave at temperatures 10°F lower than these values when a chemical WMA additive is used as a compaction aid in the mixture or when using WMA.

4.7.1.2. **When Not Using a Thermal Imaging System**. When using a thermal camera instead of the thermal imaging system, place mixture when the roadway surface temperature is at or above the temperatures listed in Table 14B unless otherwise approved or as shown on the plans. Measure the roadway surface temperature with a hand-held thermal camera or infrared thermometer. The Engineer may allow mixture placement to begin before the roadway surface reaches the required temperature if conditions are such that the roadway surface will reach the required temperature within 2 hr. of beginning placement operations. Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. The Engineer may restrict the Contractor from paving if the ambient temperature is likely to drop below 32°F within 12 hr. of paving.

Table 14B
Minimum Pavement Surface Temperatures

High-Temperature Binder Grade[1]	Minimum Pavement Surface Temperatures (°F)	
	Subsurface Layers or Night Paving Operations	Surface Layers Placed in Daylight Operations
PG 64	45	50
PG 70	55[2]	60[2]
PG 76	60[2]	60[2]

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. Contractors may pave at temperatures 10°F lower than these values when a chemical WMA additive is used as a compaction aid in the mixture, when using WMA, or utilizing a paving process with equipment that eliminates thermal segregation. In such cases, for each sublot and in the presence of the Engineer, use a hand-held thermal camera operated in accordance with Tex-244-F to demonstrate to the satisfaction of the Engineer that the uncompacted mat has no more than 10°F of thermal segregation.

4.7.2. **Tack Coat**.

4.7.2.1. **Application.** Clean the surface before placing the tack coat. The Engineer will set the rate between 0.04 and 0.10 gal. of residual asphalt per square yard of surface area. Apply a uniform tack coat at the specified rate unless otherwise directed. Apply the tack coat in a uniform manner to avoid streaks and other irregular patterns. Apply the tack coat to all surfaces that will come in contact with the subsequent HMA placement, unless otherwise directed. Allow adequate time for emulsion to break completely before placing any material. Prevent splattering of tack coat when placed adjacent to curb, gutter, and structures. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

4.7.2.2. **Sampling.** The Engineer will obtain at least one sample of the tack coat binder per project in accordance with Tex-500-C, Part III, and test it to verify compliance with Item 300, “Asphalts, Oils, and Emulsions.” The Engineer will notify the Contractor when the sampling will occur and will witness the collection of the sample from the asphalt distributor immediately before use.

For emulsions, the Engineer may test as often as necessary to ensure the residual of the emulsion is greater than or equal to the specification requirement in Item 300, “Asphalts, Oils, and Emulsions.”

4.7.3. **Lay-Down Operations**. Use the placement temperatures in Table 15 to establish the minimum placement temperature of the mixture delivered to the paver.

Table 15
Minimum Mixture Placement Temperature

High-Temperature Binder Grade[1]	Minimum Placement Temperature (Before Entering Paver)[2,3]
PG 64	260˚F
PG 70	270˚F
PG 76	280˚F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. Minimum placement temperatures may be reduced 10°F if using a chemical WMA additive as a compaction aid.
3. When using WMA, the minimum placement temperature is 215°F.

4.7.3.1. **Thermal Profile**. Use a hand-held thermal camera or a thermal imaging system to obtain a continuous thermal profile in accordance with Tex-244-F. Thermal profiles are not applicable in areas described in Section 3076.4.9.3.1.4., "Miscellaneous Areas."

4.7.3.1.1. **Thermal Segregation**.

4.7.3.1.1.1. **Moderate**. Any areas that have a temperature differential greater than 25°F, but not exceeding 50°F, are deemed as moderate thermal segregation.

4.7.3.1.1.2. **Severe**. Any areas that have a temperature differential greater than 50°F are deemed as severe thermal segregation.

4.7.3.1.2. **Thermal Imaging System**. Review the output results when a thermal imaging system is used, and provide the automated report described in Tex-244-F to the Engineer daily unless otherwise directed. Modify the paving process as necessary to eliminate any recurring (moderate or severe) thermal segregation identified by the thermal imaging system. The Engineer may suspend paving operations if the Contractor cannot successfully modify the paving process to eliminate recurring severe thermal segregation. Density profiles are not required and not applicable when using a thermal imaging system. Provide the Engineer with electronic copies of all daily data files that can be used with the thermal imaging system software to generate temperature profile plots daily or upon completion of the project or as requested by the Engineer.

4.7.3.1.3. **Thermal Camera**. When using a thermal camera instead of the thermal imaging system, take immediate corrective action to eliminate recurring moderate thermal segregation when a hand-held thermal camera is used. Evaluate areas with moderate thermal segregation by performing density profiles in accordance with Section 3076.4.9.3.3.2., "Segregation (Density Profile)." Provide the Engineer with the thermal profile of every sublot within one working day of the completion of each lot. When requested by the Engineer, provide the thermal images generated using the thermal camera. Report the results of each thermal profile in accordance with Section 3076.4.2., "Reporting and Responsibilities." The Engineer will use a hand-held thermal camera to obtain a thermal profile at least once per project. No production or placement payment adjustments greater than 1.000 will be paid for any sublot that contains severe thermal segregation. Suspend operations and take immediate corrective action to eliminate severe thermal segregation unless otherwise directed. Resume operations when the Engineer determines that subsequent production will meet the requirements of this Section. Evaluate areas with severe thermal segregation by performing density profiles in accordance with Section 3076.4.9.3.3.2., "Segregation (Density Profile)." Remove and replace the material in any areas that have both severe thermal segregation and a failing result for Segregation (Density Profile) unless otherwise directed. The sublot in question may receive a production and placement payment adjustment greater than 1.000, if applicable, when the defective material is successfully removed and replaced.

4.7.3.2. **Windrow Operations**. Operate windrow pickup equipment so that when hot-mix is placed in windrows, substantially all the mixture deposited on the roadbed is picked up and loaded into the paver.

4.7.3.3. **Hauling Equipment**. Use belly dumps, live bottom, or end dump trucks to haul and transfer mixture; however, with exception of paving miscellaneous areas, end dump trucks are only allowed when used in conjunction with an MTD with remixing capability or when a thermal imaging system is used unless otherwise allowed.

4.7.3.4. **Screed Heaters**. Turn off screed heaters to prevent overheating of the mat if the paver stops for more than 5 min. The Engineer may evaluate the suspect area in accordance with Section 3076.4.9.3.3.4., "Recovered Asphalt Dynamic Shear Rheometer (DSR)," if the screed heater remains on for more than 5 min. while the paver is stopped.

4.8. **Compaction**. Compact the pavement uniformly to contain between 3.8% and 8.5% in-place air voids. Take immediate corrective action to bring the operation within 3.8% and 8.5% when the in-place air voids exceed the range of these tolerances. The Engineer will allow paving to resume when the proposed corrective action is likely to yield between 3.8% and 8.5% in-place air voids.

Obtain cores in areas placed under Exempt Production, as directed, at locations determined by the Engineer. The Engineer may test these cores and suspend operations or require removal and replacement if the in-place air voids are less than 2.7% or more than 9.9%. Areas defined in Section 3076.4.9.3.1.4., "Miscellaneous Areas," are not subject to in-place air void determination.

Furnish the type, size, and number of rollers required for compaction as approved. Use additional rollers as required to remove any roller marks. Use only water or an approved release agent on rollers, tamps, and other compaction equipment unless otherwise directed.

Use the control strip method shown in Tex-207-F, Part IV, on the first day of production to establish the rolling pattern that will produce the desired in-place air voids unless otherwise directed.

Use tamps to thoroughly compact the edges of the pavement along curbs, headers, and similar structures and in locations that will not allow thorough compaction with rollers. The Engineer may require rolling with a trench roller on widened areas, in trenches, and in other limited areas.

Complete all compaction operations before the pavement temperature drops below 160°F unless otherwise allowed. The Engineer may allow compaction with a light finish roller operated in static mode for pavement temperatures below 160°F.

Allow the compacted pavement to cool to 160°F or lower before opening to traffic unless otherwise directed. Sprinkle the finished mat with water or limewater, when directed, to expedite opening the roadway to traffic.

4.9. **Acceptance Plan**. Payment adjustments for the material will be in accordance with Article 3076.6., "Payment."

Sample and test the hot-mix on a lot and sublot basis. Suspend production until test results or other information indicates to the satisfaction of the Engineer that the next material produced or placed will result in payment factors of at least 1.000, if the production payment factor given in Section 3076.6.1., "Production Payment Adjustment Factors," for two consecutive lots or the placement pay factor given in Section 3076.6.2., "Placement Payment Adjustment Factors," for two consecutive lots is below 1.000.

4.9.1. **Referee Testing**. The Materials and Tests Division is the referee laboratory. The Contractor may request referee testing if a "remove and replace" condition is determined based on the Engineer's test results, or if the differences between Contractor and Engineer test results exceed the maximum allowable difference shown in Table 11 and the differences cannot be resolved. The Contractor may also request referee testing if the Engineer's test results require suspension of production and the Contractor's test results are within specification limits. Make the request within five working days after receiving test results and cores from the Engineer. Referee tests will be performed only on the sublot in question and only for the particular tests in question. Allow 10 working days from the time the referee laboratory receives the samples for test results to

be reported. The Department may require the Contractor to reimburse the Department for referee tests if more than three referee tests per project are required and the Engineer's test results are closer to the referee test results than the Contractor's test results.

The Materials and Tests Division will determine the laboratory-molded density based on the molded specific gravity and the maximum theoretical specific gravity of the referee sample. The in-place air voids will be determined based on the bulk specific gravity of the cores, as determined by the referee laboratory and the Engineer's average maximum theoretical specific gravity for the lot. With the exception of "remove and replace" conditions, referee test results are final and will establish payment adjustment factors for the sublot in question. The Contractor may decline referee testing and accept the Engineer's test results when the placement payment adjustment factor for any sublot results in a "remove and replace" condition. Placement sublots subject to be removed and replaced will be further evaluated in accordance with Section 3076.6.2.2., "Placement Sublots Subject to Removal and Replacement."

4.9.2. **Production Acceptance**.

4.9.2.1. **Production Lot**. A production lot consists of four equal sublots. The default quantity for Lot 1 is 1,000 tons; however, when requested by the Contractor, the Engineer may increase the quantity for Lot 1 to no more than 4,000 tons. The Engineer will select subsequent lot sizes based on the anticipated daily production such that approximately three to four sublots are produced each day. The lot size will be between 1,000 tons and 4,000 tons. The Engineer may change the lot size before the Contractor begins any lot.

If the optimum asphalt binder content for JMF2 is more than 0.5% lower than the optimum asphalt binder content for JMF1, the Engineer may perform or require the Contractor to perform Tex-226-F on Lot 1 to confirm the indirect tensile strength does not exceed 200 psi. Take corrective action to bring the mixture within specification compliance if the indirect tensile strength exceeds 200 psi unless otherwise directed.

4.9.2.1.1. **Incomplete Production Lots**. If a lot is begun but cannot be completed, such as on the last day of production or in other circumstances deemed appropriate, the Engineer may close the lot. Adjust the payment for the incomplete lot in accordance with Section 3076.6.1., "Production Payment Adjustment Factors." Close all lots within five working days unless otherwise allowed.

4.9.2.2. **Production Sampling**.

4.9.2.2.1. **Mixture Sampling**. Obtain hot-mix samples from trucks at the plant in accordance with Tex-222-F. The sampler will split each sample into three equal portions in accordance with Tex-200-F and label these portions as "Contractor," "Engineer," and "Referee." The Engineer will perform or witness the sample splitting and take immediate possession of the samples labeled "Engineer" and "Referee." The Engineer will maintain the custody of the samples labeled "Engineer" and "Referee" until the Department's testing is completed.

4.9.2.2.1.1. **Random Sample**. At the beginning of the project, the Engineer will select random numbers for all production sublots. Determine sample locations in accordance with Tex-225-F. Take one sample for each sublot at the randomly selected location. The Engineer will perform or witness the sampling of production sublots.

4.9.2.2.1.2. **Blind Sample**. For one sublot per lot, the Engineer will obtain and test a "blind" sample instead of the random sample collected by the Contractor. Test either the "blind" or the random sample; however, referee testing (if applicable) will be based on a comparison of results from the "blind" sample. The location of the Engineer's "blind" sample will not be disclosed to the Contractor. The Engineer's "blind" sample may be randomly selected in accordance with Tex-225-F for any sublot or selected at the discretion of the Engineer. The Engineer will use the Contractor's split sample for sublots not sampled by the Engineer.

4.9.2.2.2. **Informational Shear Bond Strength Testing.** Select one random sublot from Lot 2 or higher for shear bond strength testing. Obtain full depth cores in accordance with Tex-249-F. Label the cores with the Control Section Job (CSJ), producer of the tack coat, mix type, shot rate, lot, and sublot number and provide to the

Engineer. The Engineer will ship the cores to the Materials and Tests Division or district laboratory for shear bond strength testing. Results from these tests will not be used for specification compliance.

4.9.2.2.3. **Asphalt Binder Sampling**. Obtain a 1-qt. sample of the asphalt binder witnessed by the Engineer for each lot of mixture produced. The Contractor will notify the Engineer when the sampling will occur. Obtain the sample at approximately the same time the mixture random sample is obtained. Sample from a port located immediately upstream from the mixing drum or pug mill and upstream from the introduction of any additives in accordance with Tex-500-C, Part II. Label the can with the corresponding lot and sublot numbers, producer, producer facility location, grade, district, date sampled, and project information including highway and CSJ. The Engineer will retain these samples for one year. The Engineer may also obtain independent samples. If obtaining an independent asphalt binder sample and upon request of the Contractor, the Engineer will split a sample of the asphalt binder with the Contractor.

At least once per project, the Engineer will collect split samples of each binder grade and source used. The Engineer will submit one split sample to MTD to verify compliance with Item 300, “Asphalts, Oils, and Emulsions” and will retain the other split sample for one year.

4.9.2.3. **Production Testing**. The Contractor and Engineer must perform production tests in accordance with Table 16. The Contractor has the option to verify the Engineer’s test results on split samples provided by the Engineer. Determine compliance with operational tolerances listed in Table 11 for all sublots.

Take immediate corrective action if the Engineer’s laboratory-molded density on any sublot is less than 95.0% or greater than 97.0% to bring the mixture within these tolerances. The Engineer may suspend operations if the Contractor’s corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

The Engineer may allow alternate methods for determining the asphalt binder content and aggregate gradation if the aggregate mineralogy is such that Tex-236-F, Part I does not yield reliable results. Provide evidence that results from Tex-236-F, Part I are not reliable before requesting permission to use an alternate method unless otherwise directed. Use the applicable test procedure as directed if an alternate test method is allowed.

Table 16
Production and Placement Testing Frequency

Description	Test Method	Minimum Contractor Testing Frequency	Minimum Engineer Testing Frequency
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	1 per sublot	1 per 12 sublots[1]
Individual % retained for sieves smaller than #8 and larger than #200			
% passing the #200 sieve			
Laboratory-molded density	Tex-207-F	N/A	1 per sublot[1]
Laboratory-molded bulk specific gravity			
In-place air voids			
VMA	Tex-204-F		
Segregation (density profile)[2]	Tex-207-F, Part V	1 per sublot	1 per project
Longitudinal joint density	Tex-207-F, Part VII		
Moisture content	Tex-212-F, Part II	When directed	
Theoretical maximum specific (Rice) gravity	Tex-227-F	N/A	1 per sublot[1]
Asphalt binder content	Tex-236-F	1 per sublot	1 per lot[1]
Hamburg Wheel test	Tex-242-F	N/A	1 per project
Recycled Asphalt Shingles (RAS)[3]	Tex-217-F, Part III	N/A	
Thermal profile[2]	Tex-244-F	1 per sublot	
Asphalt binder sampling and testing	Tex-500-C, Part II	1 per lot (sample only)[4]	
Tack coat sampling and testing	Tex-500-C, Part III	N/A	
Boil test[5]	Tex-530-C	1 per lot	
Shear Bond Strength Test[6]	Tex-249-F	1 per project (sample only)	

1. For production defined in Section 3076.4.9.4., "Exempt Production," the Engineer will test one per day if 100 tons or more are produced. For Exempt Production, no testing is required when less than 100 tons are produced.
2. Not required when a thermal imaging system is used.
3. Testing performed by the Materials and Tests Division or designated laboratory.
4. Obtain witnessed by the Engineer. The Engineer will retain these samples for one year.
5. The Engineer may reduce or waive the sampling and testing requirements based on a satisfactory test history.
6. Testing performed by the Materials and Tests Division or District for informational purposes only.

4.9.2.4. **Operational Tolerances**. Control the production process within the operational tolerances listed in Table 11. When production is suspended, the Engineer will allow production to resume when test results or other information indicates the next mixture produced will be within the operational tolerances.

4.9.2.4.1. **Gradation**. Suspend operation and take corrective action if any aggregate is retained on the maximum sieve size shown in Table 8. A sublot is defined as out of tolerance if either the Engineer's or the Contractor's test results are out of operational tolerance. Suspend production when test results for gradation exceed the operational tolerances in Table 11 for three consecutive sublots on the same sieve or four consecutive sublots on any sieve unless otherwise directed. The consecutive sublots may be from more than one lot.

4.9.2.4.2. **Asphalt Binder Content**. A sublot is defined as out of operational tolerance if either the Engineer's or the Contractor's test results exceed the values listed in Table 11. No production or placement payment adjustments greater than 1.000 will be paid for any sublot that is out of operational tolerance for asphalt binder content. Suspend production and shipment of the mixture if the Engineer's or the Contractor's asphalt binder content deviates from the current JMF by more than 0.5% for any sublot.

4.9.2.4.3. **Voids in Mineral Aggregates (VMA)**. The Engineer will determine the VMA for every sublot. For sublots when the Engineer does not determine asphalt binder content, the Engineer will use the asphalt binder content results from QC testing performed by the Contractor to determine VMA.

Take immediate corrective action if the VMA value for any sublot is less than the minimum VMA requirement for production listed in Table 8. Suspend production and shipment of the mixture if the Engineer's VMA results on two consecutive sublots are below the minimum VMA requirement for production listed in Table 8. No production or placement payment adjustments greater than 1.000 will be paid for any sublot that does not

meet the minimum VMA requirement for production listed in Table 8 based on the Engineer's VMA determination.

Suspend production and shipment of the mixture if the Engineer's VMA result is more than 0.5% below the minimum VMA requirement for production listed in Table 8. In addition to suspending production, the Engineer may require removal and replacement or may allow the sublot to be left in place without payment.

4.9.2.4.4. **Hamburg Wheel Test**. The Engineer may perform a Hamburg Wheel test at any time during production, including when the boil test indicates a change in quality from the materials submitted for JMF1. In addition to testing production samples, the Engineer may obtain cores and perform Hamburg Wheel tests on any areas of the roadway where rutting is observed. Suspend production until further Hamburg Wheel tests meet the specified values when the production or core samples fail the Hamburg Wheel test criteria in Table 10. Core samples, if taken, will be obtained from the center of the finished mat or other areas excluding the vehicle wheel paths. The Engineer may require up to the entire sublot of any mixture failing the Hamburg Wheel test to be removed and replaced at the Contractor's expense.

If the Department's or Department approved laboratory's Hamburg Wheel test results in a "remove and replace" condition, the Contractor may request that the Department confirm the results by re-testing the failing material. The Materials and Tests Division will perform the Hamburg Wheel tests and determine the final disposition of the material in question based on the Department's test results.

4.9.2.5. **Individual Loads of Hot-Mix**. The Engineer can reject individual truckloads of hot-mix. When a load of hot-mix is rejected for reasons other than temperature, contamination, or excessive uncoated particles, the Contractor may request that the rejected load be tested. Make this request within 4 hr. of rejection. The Engineer will sample and test the mixture. If test results are within the operational tolerances shown in Table 11, payment will be made for the load. If test results are not within operational tolerances, no payment will be made for the load.

4.9.3. **Placement Acceptance**.

4.9.3.1. **Placement Lot**. A placement lot consists of four placement sublots. A placement sublot consists of the area placed during a production sublot.

4.9.3.1.1. **Lot 1 Placement**. Placement payment adjustments greater than 1.000 for Lot 1 will be in accordance with Section 3076.6.2., "Placement Payment Adjustment Factors"; however, no placement adjustment less than 1.000 will be assessed for any sublot placed in Lot 1 when the in-place air voids are greater than or equal to 2.7% and less than or equal to 9.9%. Remove and replace any sublot with in-place air voids less than 2.7% or greater than 9.9%.

4.9.3.1.2. **Incomplete Placement Lots**. An incomplete placement lot consists of the area placed as described in Section 3076.4.9.2.1.1., "Incomplete Production Lots," excluding areas defined in Section 3076.4.9.3.1.4., "Miscellaneous Areas." Placement sampling is required if the random sample plan for production resulted in a sample being obtained from an incomplete production sublot.

4.9.3.1.3. **Shoulders, Ramps, Etc**. Shoulders, ramps, intersections, acceleration lanes, deceleration lanes, and turn lanes are subject to in-place air void determination and payment adjustments unless designated on the plans as not eligible for in-place air void determination. Intersections may be considered miscellaneous areas when determined by the Engineer.

4.9.3.1.4. **Miscellaneous Areas**. Miscellaneous areas include areas that typically involve significant handwork or discontinuous paving operations, such as temporary detours, driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. Temporary detours are subject to in-place air void determination when shown on the plans. Miscellaneous areas also include level-ups and thin overlays when the layer thickness specified on the plans is less than the minimum untrimmed core height eligible for testing shown in Table 13. The specified layer thickness is based on the rate of 110 lb./sq. yd. for each inch of

pavement unless another rate is shown on the plans. When "level up" is listed as part of the item bid description code, a payment adjustment factor of 1.000 will be assigned for all placement sublots as described in Article 3076.6, "Payment." Miscellaneous areas are not eligible for random placement sampling locations. Compact miscellaneous areas in accordance with Section 3076.4.8., "Compaction." Miscellaneous areas are not subject to in-place air void determination, thermal profiles testing, segregation (density profiles), or longitudinal joint density evaluations.

4.9.3.2. **Placement Sampling**. The Engineer will select random numbers for all placement sublots at the beginning of the project. The Engineer will provide the Contractor with the placement random numbers immediately after the sublot is completed. Mark the roadway location at the completion of each sublot and record the station number. Determine one random sample location for each placement sublot in accordance with Tex-225-F. Adjust the random sample location by no more than necessary to achieve a 2-ft. clearance if the location is within 2 ft. of a joint or pavement edge.

Shoulders, ramps, intersections, acceleration lanes, deceleration lanes, and turn lanes are always eligible for selection as a random sample location; however, if a random sample location falls on one of these areas and the area is designated on the plans as not subject to in-place air void determination, cores will not be taken for the sublot and a 1.000 pay factor will be assigned to that sublot.

Provide the equipment and means to obtain and trim roadway cores on site. On-site is defined as in close proximity to where the cores are taken. Obtain the cores within one working day of the time the placement sublot is completed unless otherwise approved. Obtain two 6-in. diameter cores side-by-side from within 1 ft. of the random location provided for the placement sublot. For Type D and Type F mixtures, 4-in. diameter cores are allowed. Mark the cores for identification, measure and record the untrimmed core height, and provide the information to the Engineer. The Engineer will witness the coring operation and measurement of the core thickness. Visually inspect each core and verify that the current paving layer is bonded to the underlying layer. Take corrective action if an adequate bond does not exist between the current and underlying layer to ensure that an adequate bond will be achieved during subsequent placement operations.

Trim the cores immediately after obtaining the cores from the roadway in accordance with Tex-251-F if the core heights meet the minimum untrimmed value listed in Table 13. Trim the cores on site in the presence of the Engineer. Use a permanent marker or paint pen to record the lot and sublot numbers on each core as well as the designation as Core A or B. The Engineer may require additional information to be marked on the core and may choose to sign or initial the core. The Engineer will take custody of the cores immediately after witnessing the trimming of the cores and will retain custody of the cores until the Department's testing is completed. Before turning the trimmed cores over to the Engineer, the Contractor may wrap the trimmed cores or secure them in a manner that will reduce the risk of possible damage occurring during transport by the Engineer. After testing, the Engineer will return the cores to the Contractor.

The Engineer may have the cores transported back to the Department's laboratory at the HMA plant via the Contractor's haul truck or other designated vehicle. In such cases where the cores will be out of the Engineer's possession during transport, the Engineer will use Department-provided security bags and the Roadway Core Custody protocol located at http://www.txdot.gov/business/specifications.htm to provide a secure means and process that protects the integrity of the cores during transport.

Decide whether to include the pair of cores in the air void determination for that sublot if the core height before trimming is less than the minimum untrimmed value shown in Table 13. Trim the cores as described above before delivering to the Engineer if electing to have the cores included in the air void determination. Deliver untrimmed cores to the Engineer and inform the Engineer of the decision to not have the cores included in air void determination if electing to not have the cores included in air void determination. The placement pay factor for the sublot will be 1.000 if cores will not be included in air void determination.

Instead of the Contractor trimming the cores on site immediately after coring, the Engineer and the Contractor may mutually agree to have the trimming operations performed at an alternate location such as a field laboratory or other similar location. In such cases, the Engineer will take possession of the cores

immediately after they are obtained from the roadway and will retain custody of the cores until testing is completed. Either the Department or Contractor representative may perform trimming of the cores. The Engineer will witness all trimming operations in cases where the Contractor representative performs the trimming operation.

Dry the core holes and tack the sides and bottom immediately after obtaining the cores. Fill the hole with the same type of mixture and properly compact the mixture. Repair core holes with other methods when approved.

4.9.3.3. **Placement Testing**. Perform placement tests in accordance with Table 16. After the Engineer returns the cores, the Contractor may test the cores to verify the Engineer's test results for in-place air voids. The allowable differences between the Contractor's and Engineer's test results are listed in Table 11.

4.9.3.3.1. **In-Place Air Voids**. The Engineer will measure in-place air voids in accordance with Tex-207-F and Tex-227-F. Before drying to a constant weight, cores may be pre-dried using a CoreDry or similar vacuum device to remove excess moisture. The Engineer will average the values obtained for all sublots in the production lot to determine the theoretical maximum specific gravity. The Engineer will use the average air void content for in-place air voids.

The Engineer will use the vacuum method to seal the core if required by Tex-207-F. The Engineer will use the test results from the unsealed core to determine the placement payment adjustment factor if the sealed core yields a higher specific gravity than the unsealed core. After determining the in-place air void content, the Engineer will return the cores and provide test results to the Contractor.

4.9.3.3.2. **Segregation (Density Profile)**. Test for segregation using density profiles in accordance with Tex-207-F, Part V when using a thermal camera insead of the thermal imaging system. Density profiles are not required and are not applicable when using a thermal imaging system. Density profiles are not applicable in areas described in Section 3076.4.9.3.1.4., "Miscellaneous Areas."

Perform a minimum of one density profile per sublot. Perform additional density profiles when any of the following conditions occur, unless otherwise approved:

- the paver stops due to lack of material being delivered to the paving operations and the temperature of the uncompacted mat before the initial break down rolling is less than the temperatures shown in Table 17;
- areas that are identified by either the Contractor or the Engineer with thermal segregation;,
- any visibly segregated areas that exist.

Table 17
Mimimum Uncompacted Mat Temperature Requiring a Segregation Profile

High-Temperature Binder Grade[1]	Minimum Temperature of the Uncompacted Mat Allowed Before Initial Break Down Rolling[2,3,4]
PG 64	<250˚F
PG 70	<260˚F
PG 76	<270˚F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. Segregation profiles are required in areas with moderate and severe thermal segregation as described in Section 3076.4.7.3.1.3.
3. Minimum uncompacted mat temperature requiring a segregation profile may be reduced 10°F if using a chemical WMA additive as a compaction aid.
4. When using WMA, the minimum uncompacted mat temperature requiring a segregation profile is 215°F.

Provide the Engineer with the density profile of every sublot in the lot within one working day of the completion of each lot. Report the results of each density profile in accordance with Section 3076.4.2., "Reporting and Responsibilities."

The density profile is considered failing if it exceeds the tolerances in Table 18. No production or placement payment adjustments greater than 1.000 will be paid for any sublot that contains a failing density profile. When a hand-held thermal camera is used instead of a thermal imaging system, the Engineer will measure the density profile at least once per project. The Engineer's density profile results will be used when available. The Engineer may require the Contractor to remove and replace the area in question if the area fails the density profile and has surface irregularities as defined in Section 3076.4.9.3.3.5., "Irregularities." The sublot in question may receive a production and placement payment adjustment greater than 1.000, if applicable, when the defective material is successfully removed and replaced.

Investigate density profile failures and take corrective actions during production and placement to eliminate the segregation. Suspend production if 2 consecutive density profiles fail unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

Table 18
Segregation (Density Profile) Acceptance Criteria

Mixture Type	Maximum Allowable Density Range (Highest to Lowest)	Maximum Allowable Density Range (Average to Lowest)
Type B	8.0 pcf	5.0 pcf
Type C, Type D & Type F	6.0 pcf	3.0 pcf

4.9.3.3.3. **Longitudinal Joint Density**.

4.9.3.3.3.1. **Informational Tests**. Perform joint density evaluations while establishing the rolling pattern and verify that the joint density is no more than 3.0 pcf below the density taken at or near the center of the mat. Adjust the rolling pattern, if needed, to achieve the desired joint density. Perform additional joint density evaluations, at least once per sublot, unless otherwise directed.

4.9.3.3.3.2. **Record Tests**. Perform a joint density evaluation for each sublot at each pavement edge that is or will become a longitudinal joint. Joint density evaluations are not applicable in areas described in Section 3076.4.9.3.1.4., "Miscellaneous Areas." Determine the joint density in accordance with Tex-207-F, Part VII. Record the joint density information and submit results on Department forms to the Engineer. The evaluation is considered failing if the joint density is more than 3.0 pcf below the density taken at the core random sample location and the correlated joint density is less than 90.0%. The Engineer will make independent joint density verification at least once per project and may make independent joint density verifications at the random sample locations. The Engineer's joint density test results will be used when available.

Provide the Engineer with the joint density of every sublot in the lot within one working day of the completion of each lot. Report the results of each joint density in accordance with Section 3076.4.2., "Reporting and Responsibilities."

Investigate joint density failures and take corrective actions during production and placement to improve the joint density. Suspend production if the evaluations on two consecutive sublots fail unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

4.9.3.3.4. **Recovered Asphalt Dynamic Shear Rheometer (DSR)**. The Engineer may take production samples or cores from suspect areas of the project to determine recovered asphalt properties. Asphalt binders with an aging ratio greater than 3.5 do not meet the requirements for recovered asphalt properties and may be deemed defective when tested and evaluated by the Materials and Tests Division. The aging ratio is the DSR value of the extracted binder divided by the DSR value of the original unaged binder. Obtain DSR values in accordance with AASHTO T 315 at the specified high temperature performance grade of the asphalt. The Engineer may require removal and replacement of the defective material at the Contractor's expense. The asphalt binder will be recovered for testing from production samples or cores in accordance with Tex-211-F.

4.9.3.3.5. **Irregularities**. Identify and correct irregularities including segregation, rutting, raveling, flushing, fat spots, mat slippage, irregular color, irregular texture, roller marks, tears, gouges, streaks, uncoated aggregate particles, or broken aggregate particles. The Engineer may also identify irregularities, and in such cases, the Engineer will promptly notify the Contractor. If the Engineer determines that the irregularity will adversely affect pavement performance, the Engineer may require the Contractor to remove and replace (at the Contractor's expense) areas of the pavement that contain irregularities. The Engineer may also require the Contractor to remove and replace (at the Contractor's expense) areas where the mixture does not bond to the existing pavement.

If irregularities are detected, the Engineer may require the Contractor to immediately suspend operations or may allow the Contractor to continue operations for no more than one day while the Contractor is taking appropriate corrective action.

4.9.4. **Exempt Production**. The Engineer may deem the mixture as exempt production for the following conditions:

- anticipated daily production is less than 500 tons;
- total production for the project is less than 5,000 tons;
- when mutually agreed between the Engineer and the Contractor; or
- when shown on the plans.

For exempt production, the Contractor is relieved of all production and placement sampling and testing requirements, except for coring operations when required by the Engineer. The production and placement pay factors are 1.000 if the specification requirements listed below are met, all other specification requirements are met, and the Engineer performs acceptance tests for production and placement listed in Table 16 when 100 tons or more per day are produced.

- produce, haul, place, and compact the mixture in compliance with the specification and as directed;
- control mixture production to yield a laboratory-molded density that is within ±1.0% of the target laboratory-molded density as tested by the Engineer;
- compact the mixture in accordance with Section 3076.4.8., "Compaction;" and
- when a thermal imaging system is not used, the Engineer may perform segregation (density profiles) and thermal profiles in accordance with the specification.

4.9.5. **Ride Quality**. Measure ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.

5. MEASUREMENT

5.1. **Dense Graded Hot-Mix Asphalt.** Hot mix will be measured by the ton of composite hot-mix, which includes asphalt, aggregate, and additives. Measure the weight on scales in accordance with Item 520, "Weighing and Measuring Equipment."

5.2. **Tack Coat.** Tack coat will be measured at the applied temperature by strapping the tank before and after road application and determining the net volume in gallons from the calibrated distributor. The Engineer will witness all strapping operations for volume determination. All tack, including emulsions, will be measured by the gallon applied.

The Engineer may allow the use of a metering device to determine asphalt volume used and application rate if the device is accurate within 1.5% of the strapped volume.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under Section 3076.5.1, "Measurement," will be paid for at the unit bid price for "Dense Graded Hot-Mix Asphalt" of the mixture type, SAC, and binder specified. These prices are full compensation for surface preparation, materials, placement, equipment, labor, tools, and incidentals.

The work performed and materials furnished in accordance with this Item and measured as provided under Article 3076.5.2, "Measurement," will be paid for at the unit bid price for "Tack Coat" of the tack coat provided. These prices are full compensation for materials, placement, equipment, labor, tools, and incidentals. Payment adjustments will be applied as determined in this Item; however, a payment adjustment factor of 1.000 will be assigned for all placement sublots for "level ups" only when "level up" is listed as part of the item bid description code. A payment adjustment factor of 1.000 will be assigned to all production and placement sublots when "exempt" is listed as part of the item bid description code, and all testing requirements are met.

Payment for each sublot, including applicable payment adjustments greater than 1.000, will only be paid for sublots when the Contractor supplies the Engineer with the required documentation for production and placement QC/QA, thermal profiles, segregation density profiles, and longitudinal joint densities in accordance with Section 3076.4.2., "Reporting and Responsibilities." When a thermal imaging system is used, documentation is not required for thermal profiles or segregation density profiles on individual sublots; however, the thermal imaging system automated reports described in Tex-244-F are required.

Trial batches will not be paid for unless they are included in pavement work approved by the Department.

Payment adjustment for ride quality will be determined in accordance with Item 585, "Ride Quality for Pavement Surfaces."

6.1. **Production Payment Adjustment Factors**. The production payment adjustment factor is based on the laboratory-molded density using the Engineer's test results. The bulk specific gravities of the samples from each sublot will be divided by the Engineer's maximum theoretical specific gravity for the sublot. The individual sample densities for the sublot will be averaged to determine the production payment adjustment factor in accordance with Table 19 for each sublot, using the deviation from the target laboratory-molded density defined in Table 9. The production payment adjustment factor for completed lots will be the average of the payment adjustment factors for the four sublots sampled within that lot.

Table 19
Production Payment Adjustment Factors for Laboratory-Molded Density[1]

Absolute Deviation from Target Laboratory-Molded Density	Production Payment Adjustment Factor (Target Laboratory-Molded Density)
0.0	1.050
0.1	1.050
0.2	1.050
0.3	1.044
0.4	1.038
0.5	1.031
0.6	1.025
0.7	1.019
0.8	1.013
0.9	1.006
1.0	1.000
1.1	0.965
1.2	0.930
1.3	0.895
1.4	0.860
1.5	0.825
1.6	0.790
1.7	0.755
1.8	0.720
> 1.8	Remove and replace

1. If the Engineer's laboratory-molded density on any sublot is less than 95.0% or greater than 98.0%, take immediate corrective action to bring the mixture within these tolerances. The Engineer may suspend operations if the Contractor's corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

6.1.1. **Payment for Incomplete Production Lots**. Production payment adjustments for incomplete lots, described under Section 3076.4.9.2.1.1., "Incomplete Production Lots," will be calculated using the average production payment factors from all sublots sampled.

A production payment factor of 1.000 will be assigned to any lot when the random sampling plan did not result in collection of any samples within the first sublot.

6.1.2. **Production Sublots Subject to Removal and Replacement**. If after referee testing, the laboratory-molded density for any sublot results in a "remove and replace" condition as listed in Table 19, the Engineer may require removal and replacement or may allow the sublot to be left in place without payment. The Engineer may also accept the sublot in accordance with Section 3076.5.3.1., "Acceptance of Defective or Unauthorized Work." Replacement material meeting the requirements of this Item will be paid for in accordance with this Section.

6.2. **Placement Payment Adjustment Factors**. The placement payment adjustment factor is based on in-place air voids using the Engineer's test results. The bulk specific gravities of the cores from each sublot will be divided by the Engineer's average maximum theoretical specific gravity for the lot. The individual core densities for the sublot will be averaged to determine the placement payment adjustment factor in accordance with Table 20 for each sublot that requires in-place air void measurement. A placement payment adjustment factor of 1.000 will be assigned to the entire sublot when the random sample location falls in an area designated on the plans as not subject to in-place air void determination. A placement payment adjustment factor of 1.000 will be assigned to quantities placed in areas described in Section 3076.4.9.3.1.4., "Miscellaneous Areas." The placement payment adjustment factor for completed lots will be the average of the placement payment adjustment factors for up to four sublots within that lot.

Table 20
Placement Payment Adjustment Factors for In-Place Air Voids

In-Place Air Voids	Placement Pay Adjustment Factor	In-Place Air Voids	Placement Pay Adjustment Factor
< 2.7	Remove and Replace	6.4	1.042
2.7	0.710	6.5	1.040
2.8	0.740	6.6	1.038
2.9	0.770	6.7	1.036
3.0	0.800	6.8	1.034
3.1	0.830	6.9	1.032
3.2	0.860	7.0	1.030
3.3	0.890	7.1	1.028
3.4	0.920	7.2	1.026
3.5	0.950	7.3	1.024
3.6	0.980	7.4	1.022
3.7	0.998	7.5	1.020
3.8	1.002	7.6	1.018
3.9	1.006	7.7	1.016
4.0	1.010	7.8	1.014
4.1	1.014	7.9	1.012
4.2	1.018	8.0	1.010
4.3	1.022	8.1	1.008
4.4	1.026	8.2	1.006
4.5	1.030	8.3	1.004
4.6	1.034	8.4	1.002
4.7	1.038	8.5	1.000
4.8	1.042	8.6	0.998
4.9	1.046	8.7	0.996
5.0	1.050	8.8	0.994
5.1	1.050	8.9	0.992
5.2	1.050	9.0	0.990
5.3	1.050	9.1	0.960
5.4	1.050	9.2	0.930
5.5	1.050	9.3	0.900
5.6	1.050	9.4	0.870
5.7	1.050	9.5	0.840
5.8	1.050	9.6	0.810
5.9	1.050	9.7	0.780
6.0	1.050	9.8	0.750
6.1	1.048	9.9	0.720
6.2	1.046	> 9.9	Remove and Replace
6.3	1.044		

6.2.1. **Payment for Incomplete Placement Lots**. Payment adjustments for incomplete placement lots described under Section 3076.4.9.3.1.2., "Incomplete Placement Lots," will be calculated using the average of the placement payment factors from all sublots sampled and sublots where the random location falls in an area designated on the plans as not eligible for in-place air void determination.

If the random sampling plan results in production samples, but not in placement samples, the random core location and placement adjustment factor for the sublot will be determined by applying the placement random number to the length of the sublot placed.

If the random sampling plan results in placement samples, but not in production samples, no placement adjustment factor will apply for that sublot placed.

A placement payment adjustment factor of 1.000 will be assigned to any lot when the random sampling plan did not result in collection of any production samples.

6.2.2. **Placement Sublots Subject to Removal and Replacement**. If after referee testing, the placement payment adjustment factor for any sublot results in a "remove and replace" condition as listed in Table 20, the Engineer will choose the location of two cores to be taken within 3 ft. of the original failing core location. The Contractor will obtain the cores in the presence of the Engineer. The Engineer will take immediate possession of the untrimmed cores and submit the untrimmed cores to the Materials and Tests Division, where they will be trimmed if necessary and tested for bulk specific gravity within 10 working days of receipt.

The bulk specific gravity of the cores from each sublot will be divided by the Engineer's average maximum theoretical specific gravity for the lot. The individual core densities for the sublot will be averaged to determine the new payment adjustment factor of the sublot in question. If the new payment adjustment factor is 0.700 or greater, the new payment adjustment factor will apply to that sublot. If the new payment adjustment factor is less than 0.700, no payment will be made for the sublot. Remove and replace the failing sublot, or the Engineer may allow the sublot to be left in place without payment. The Engineer may also accept the sublot in accordance with Section 3076.5.3.1., "Acceptance of Defective or Unauthorized Work." Replacement material meeting the requirements of this Item will be paid for in accordance with this Section.

6.3. **Total Adjusted Pay Calculation**. Total adjusted pay (TAP) will be based on the applicable payment adjustment factors for production and placement for each lot.

$TAP = (A+B)/2$

where:
A = Bid price × production lot quantity × average payment adjustment factor for the production lot
B = Bid price × placement lot quantity × average payment adjustment factor for the placement lot + (bid price × quantity placed in miscellaneous areas × 1.000)

Production lot quantity = Quantity actually placed - quantity left in place without payment

Placement lot quantity = Quantity actually placed - quantity left in place without payment - quantity placed in miscellaneous areas

Special Specification 3077
Superpave Mixtures

1. DESCRIPTION

Construct a hot-mix asphalt (HMA) pavement layer composed of a compacted, Superpave (SP) mixture of aggregate and asphalt binder mixed hot in a mixing plant. Payment adjustments will apply to HMA placed under this specification unless the HMA is deemed exempt in accordance with Section 3077.4.9.4., "Exempt Production."

2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

Notify the Engineer of all material sources and before changing any material source or formulation. The Engineer will verify that the specification requirements are met when the Contractor makes a source or formulation change and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time during the project to verify specification compliance in accordance with Item 6, "Control of Materials."

2.1. **Aggregate**. Furnish aggregates from sources that conform to the requirements shown in Table 1 and as specified in this Section. Aggregate requirements in this Section, including those shown in Table 1, may be modified or eliminated when shown on the plans. Additional aggregate requirements may be specified when shown on the plans. Provide aggregate stockpiles that meet the definitions in this Section for coarse, intermediate, or fine aggregate. Aggregate from reclaimed asphalt pavement (RAP) is not required to meet Table 1 requirements unless otherwise shown on the plans. Supply aggregates that meet the definitions in Tex-100-E for crushed gravel or crushed stone. The Engineer will designate the plant or the quarry as the sampling location. Provide samples from materials produced for the project. The Engineer will establish the Surface Aggregate Classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests listed in Table 1. Document all test results on the mixture design report. The Engineer may perform tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately. Determine aggregate gradations for mixture design and production testing based on the washed sieve analysis given in Tex-200-F, Part II.

2.1.1. **Coarse Aggregate**. Coarse aggregate stockpiles must have no more than 20% material passing the No. 8 sieve. Aggregates from sources listed in the Department's *Bituminous Rated Source Quality Catalog* (BRSQC) are preapproved for use. Use only the rated values for hot-mix listed in the BRSQC. Rated values for surface treatment (ST) do not apply to coarse aggregate sources used in hot-mix asphalt.

For sources not listed on the Department's BRSQC:

- build an individual stockpile for each material;
- request the Department test the stockpile for specification compliance; and
- once approved, do not add material to the stockpile unless otherwise approved.

Provide aggregate from non-listed sources only when tested by the Engineer and approved before use. Allow 30 calendar days for the Engineer to sample, test, and report results for non-listed sources.

Provide coarse aggregate with at least the minimum SAC shown on the plans. SAC requirements only apply to aggregates used on the surface of travel lanes. SAC requirements apply to aggregates used on surfaces other than travel lanes when shown on the plans. The SAC for sources on the Department's *Aggregate Quality Monitoring Program* (AQMP) (Tex-499-A) is listed in the BRSQC.

2.1.1.1. **Blending Class A and Class B Aggregates**. Class B aggregate meeting all other requirements in Table 1 may be blended with a Class A aggregate to meet requirements for Class A materials, unless otherwise shown on the plans. Ensure that at least 50% by weight, or volume if required, of the material retained on the No. 4 sieve comes from the Class A aggregate source when blending Class A and B aggregates to meet a Class A requirement unless otherwise shown on the plans. Blend by volume if the bulk specific gravities of the Class A and B aggregates differ by more than 0.300. Coarse aggregate from RAP and Recycled Asphalt Shingles (RAS) will be considered as Class B aggregate for blending purposes.

The Engineer may perform tests at any time during production, when the Contractor blends Class A and B aggregates to meet a Class A requirement, to ensure that at least 50% by weight, or volume if required, of the material retained on the No. 4 sieve comes from the Class A aggregate source. The Engineer will use the Department's mix design template, when electing to verify conformance, to calculate the percent of Class A aggregate retained on the No. 4 sieve by inputting the bin percentages shown from readouts in the control room at the time of production and stockpile gradations measured at the time of production. The Engineer may determine the gradations based on either washed or dry sieve analysis from samples obtained from individual aggregate cold feed bins or aggregate stockpiles. The Engineer may perform spot checks using the gradations supplied by the Contractor on the mixture design report as an input for the template; however, a failing spot check will require confirmation with a stockpile gradation determined by the Engineer.

2.1.1.2. **Micro-Deval Abrasion**. The Engineer will perform a minimum of one Micro-Deval abrasion test in accordance with Tex-461-A for each coarse aggregate source used in the mixture design that has a Rated Source Soundness Magnesium (RSSM) loss value greater than 15 as listed in the BRSQC. The Engineer will perform testing before the start of production and may perform additional testing at any time during production. The Engineer may obtain the coarse aggregate samples from each coarse aggregate source or may require the Contractor to obtain the samples. The Engineer may waive all Micro-Deval testing based on a satisfactory test history of the same aggregate source.

The Engineer will estimate the magnesium sulfate soundness loss for each coarse aggregate source, when tested, using the following formula:

$$Mg_{est.} = (RSSM)(MD_{act.}/RSMD)$$

where:
$Mg_{est.}$ = magnesium sulfate soundness loss
$MD_{act.}$ = actual Micro-Deval percent loss
RSMD = Rated Source Micro-Deval

When the estimated magnesium sulfate soundness loss is greater than the maximum magnesium sulfate soundness loss specified, the coarse aggregate source will not be allowed for use unless otherwise approved. The Engineer will consult the Soils and Aggregates Section of the Materials and Tests Division, and additional testing may be required before granting approval.

2.1.2. **Intermediate Aggregate**. Aggregates not meeting the definition of coarse or fine aggregate will be defined as intermediate aggregate. Supply intermediate aggregates, when used that are free from organic impurities. The Engineer may test the intermediate aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. Supply intermediate aggregate from coarse aggregate sources, when used that meet the requirements shown in Table 1 unless otherwise approved.

Test the stockpile if 10% or more of the stockpile is retained on the No. 4 sieve, and verify that it meets the requirements in Table 1 for crushed face count (Tex-460-A) and flat and elongated particles (Tex-280-F).

2.1.3. **Fine Aggregate**. Fine aggregates consist of manufactured sands, screenings, and field sands. Fine aggregate stockpiles must meet the gradation requirements in Table 2. Supply fine aggregates that are free from organic impurities. The Engineer may test the fine aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. Unless otherwise shown on the plans, up to 10% of the total aggregate may be field sand or other uncrushed fine aggregate. Use fine aggregate, with the exception of field sand, from coarse aggregate sources that meet the requirements shown in Table 1 unless otherwise approved.

Test the stockpile if 10% or more of the stockpile is retained on the No. 4 sieve and verify that it meets the requirements in Table 1 for crushed face count (Tex-460-A) and flat and elongated particles (Tex-280-F).

Table 1
Aggregate Quality Requirements

Property	Test Method	Requirement
Coarse Aggregate		
SAC	Tex-499-A (AQMP)	As shown on the plans
Deleterious material, %, Max	Tex-217-F, Part I	1.0
Decantation, %, Max	Tex-217-F, Part II	1.5
Micro-Deval abrasion, %	Tex-461-A	Note 1
Los Angeles abrasion, %, Max	Tex-410-A	35[2]
Magnesium sulfate soundness, 5 cycles, %, Max	Tex-411-A	25[3]
Crushed face count,[4] %, Min	Tex-460-A, Part I	85
Flat and elongated particles @ 5:1, %, Max	Tex-280-F	10
Fine Aggregate		
Linear shrinkage, %, Max	Tex-107-E	3
Sand equivalent, %, Min	Tex-203-F	45

1. Used to estimate the magnesium sulfate soundness loss in accordance with Section 3077.2.1.1.2., "Micro-Deval Abrasion."
2. For base mixtures defined in Section 3077.2.7., "Recycled Materials," the Los Angeles abrasion may be increased to a maximum of 40%.
3. For base mixtures defined in Section 3077.2.7., "Recycled Materials," the magnesium sulfate soundness, five cycles, may be increased to a maximum of 30%.
4. Only applies to crushed gravel.

Table 2
Gradation Requirements for Fine Aggregate

Sieve Size	% Passing by Weight or Volume
3/8"	100
#8	70–100
#200	0–30

2.2. **Mineral Filler**. Mineral filler consists of finely divided mineral matter such as agricultural lime, crusher fines, hydrated lime, or fly ash. Mineral filler is allowed unless otherwise shown on the plans. Use no more than 2% hydrated lime or fly ash unless otherwise shown on the plans. Use no more than 1% hydrated lime if a substitute binder is used unless otherwise shown on the plans or allowed. Test all mineral fillers except hydrated lime and fly ash in accordance with Tex-107-E to ensure specification compliance. The plans may require or disallow specific mineral fillers. Provide mineral filler, when used, that:

- is sufficiently dry, free-flowing, and free from clumps and foreign matter as determined by the Engineer;
- does not exceed 3% linear shrinkage when tested in accordance with Tex-107-E; and
- meets the gradation requirements in Table 3, unless otherwise shown on the plans.

Table 3
Gradation Requirements for Mineral Filler

Sieve Size	% Passing by Weight or Volume
#8	100
#200	55–100

2.3. **Baghouse Fines**. Fines collected by the baghouse or other dust-collecting equipment may be reintroduced into the mixing drum.

2.4. **Asphalt Binder**. Furnish the type and grade of performance-graded (PG) asphalt specified on the plans.

2.5. **Tack Coat**. Furnish CSS-1H, SS-1H, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300, "Asphalts, Oils, and Emulsions." Specialized tack coat materials listed on the Department's MPL are allowed or required when shown on the plans. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

2.6. **Additives**. Use the type and rate of additive specified when shown on the plans. Additives that facilitate mixing, compaction, or improve the quality of the mixture are allowed when approved. Provide the Engineer with documentation such as the bill of lading showing the quantity of additives used in the project unless otherwise directed.

2.6.1. **Lime and Liquid Antistripping Agent**. When lime or a liquid antistripping agent is used, add in accordance with Item 301, "Asphalt Antistripping Agents." Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime into the drum.

2.6.2. **Warm Mix Asphalt (WMA)**. Warm Mix Asphalt (WMA) is defined as HMA that is produced within a target temperature discharge range of 215°F and 275°F using approved WMA additives or processes from the Department's MPL.

WMA is allowed for use on all projects and is required when shown on the plans. When WMA is required, the maximum placement or target discharge temperature for WMA will be set at a value below 275°F.

Department-approved WMA additives or processes may be used to facilitate mixing and compaction of HMA produced at target discharge temperatures above 275°F; however, such mixtures will not be defined as WMA.

2.6.3. **Compaction Aid.** Compaction Aid is defined as a chemical warm mix additive that is used to produce an asphalt mixture at a discharge temperature greater than 275°F.

Compaction Aid is allowed for use on all projects and is required when shown on the plans.

2.7. **Recycled Materials**. Use of RAP and RAS is permitted unless otherwise shown on the plans. Use of RAS is restricted to only intermediate and base mixes unless otherwise shown on the plans. Do not exceed the maximum allowable percentages of RAP and RAS shown in Table 4. The allowable percentages shown in Table 4 may be decreased or increased when shown on the plans. Determine the asphalt binder content and gradation of the RAP and RAS stockpiles for mixture design purposes in accordance with Tex-236-F, Part I. The Engineer may verify the asphalt binder content of the stockpiles at any time during production. Perform other tests on RAP and RAS when shown on the plans. Asphalt binder from RAP and RAS is designated as recycled asphalt binder. Calculate and ensure that the ratio of the recycled asphalt binder to total binder does not exceed the percentages shown in Table 5 during mixture design and HMA production when RAP or RAS is used. Use a separate cold feed bin for each stockpile of RAP and RAS during HMA production.

Surface, intermediate, and base mixes referenced in Tables 4 and 5 are defined as follows:

- **Surface**. The final HMA lift placed at the top of the pavement structure or placed directly below mixtures produced in accordance with Items 316, 342, 347, or 348;
- **Intermediate**. Mixtures placed below an HMA surface mix and less than or equal to 8.0 in. from the riding surface; and
- **Base**. Mixtures placed greater than 8.0 in. from the riding surface. Unless otherwise shown on the plans, mixtures used for bond breaker are defined as base mixtures.

2.7.1. **RAP**. RAP is salvaged, milled, pulverized, broken, or crushed asphalt pavement. Fractionated RAP is defined as a stockpile that contains RAP material with a minimum of 95.0% passing the 3/8-in. or 1/2-in.

sieve, before burning in the ignition oven, unless otherwise approved. The Engineer may allow the Contractor to use an alternate to the 3/8-in. or 1/2-in. screen to fractionate the RAP.

Use of Contractor-owned RAP including HMA plant waste is permitted unless otherwise shown on the plans. Department-owned RAP stockpiles are available for the Contractor's use when the stockpile locations are shown on the plans. If Department-owned RAP is available for the Contractor's use, the Contractor may use Contractor-owned fractionated RAP and replace it with an equal quantity of Department-owned RAP. Department-owned RAP generated through required work on the Contract is available for the Contractor's use when shown on the plans. Perform any necessary tests to ensure Contractor- or Department-owned RAP is appropriate for use. The Department will not perform any tests or assume any liability for the quality of the Department-owned RAP unless otherwise shown on the plans. The Contractor will retain ownership of RAP generated on the project when shown on the plans.

Do not use Department- or Contractor-owned RAP contaminated with dirt or other objectionable materials. Do not use Department- or Contractor-owned RAP if the decantation value exceeds 5% and the plasticity index is greater than eight. Test the stockpiled RAP for decantation in accordance with Tex-406-A, Part I. Determine the plasticity index in accordance with Tex-106-E if the decantation value exceeds 5%. The decantation and plasticity index requirements do not apply to RAP samples with asphalt removed by extraction or ignition.

Do not intermingle Contractor-owned RAP stockpiles with Department-owned RAP stockpiles. Remove unused Contractor-owned RAP material from the project site upon completion of the project. Return unused Department-owned RAP to the designated stockpile location.

Table 4
Maximum Allowable Amounts of RAP[1]

Maximum Allowable Fractionated RAP (%)		
Surface	**Intermediate**	**Base**
20.0	30.0	35.0

1. Must also meet the recycled binder to total binder ratio shown in Table 5.

2.7.2. **RAS**. Use of post-manufactured RAS or post-consumer RAS (tear-offs) is not permitted in surface mixtures unless otherwise shown on the plans. RAS may be used in intermediate and base mixtures unless otherwise shown on the plans. Up to 3% RAS may be used separately or as a replacement for fractionated RAP in accordance with Table 4 and Table 5. RAS is defined as processed asphalt shingle material from manufacturing of asphalt roofing shingles or from re-roofing residential structures. Post-manufactured RAS is processed manufacturer's shingle scrap by-product. Post-consumer RAS is processed shingle scrap removed from residential structures. Comply with all regulatory requirements stipulated for RAS by the TCEQ. RAS may be used separately or in conjunction with RAP.

Process the RAS by ambient grinding or granulating such that 100% of the particles pass the 3/8 in. sieve when tested in accordance with Tex-200-F, Part I. Perform a sieve analysis on processed RAS material before extraction (or ignition) of the asphalt binder.

Add sand meeting the requirements of Table 1 and Table 2 or fine RAP to RAS stockpiles if needed to keep the processed material workable. Any stockpile that contains RAS will be considered a RAS stockpile and be limited to no more than 3.0% of the HMA mixture in accordance with Table 4.

Certify compliance of the RAS with DMS-11000, "Evaluating and Using Nonhazardous Recyclable Materials Guidelines." Treat RAS as an established nonhazardous recyclable material if it has not come into contact with any hazardous materials. Use RAS from shingle sources on the Department's MPL. Remove substantially all materials before use that are not part of the shingle, such as wood, paper, metal, plastic, and felt paper. Determine the deleterious content of RAS material for mixture design purposes in accordance with Tex-217-F, Part III. Do not use RAS if deleterious materials are more than 0.5% of the stockpiled RAS unless

otherwise approved. Submit a sample for approval before submitting the mixture design. The Department will perform the testing for deleterious material of RAS to determine specification compliance.

2.8. **Substitute Binders**. Unless otherwise shown on the plans, the Contractor may use a substitute PG binder listed in Table 5 instead of the PG binder originally specified if using recycled materials, and if the substitute PG binder and mixture made with the substitute PG binder meet the following:

- the substitute binder meets the specification requirements for the substitute binder grade in accordance with Section 300.2.10., "Performance-Graded Binders;" and
- the mixture has less than 10.0 mm of rutting on the Hamburg Wheel test (Tex-242-F) after the number of passes required for the originally specified binder. Use of substitute PG binders may only be allowed at the discretion of the Engineer if the Hamburg Wheel test results are between 10.0 mm and 12.5 mm.

Table 5
Allowable Substitute PG Binders and Maximum Recycled Binder Ratios

Originally Specified PG Binder	Allowable Substitute PG Binder for Surface Mixes	Allowable Substitute PG Binder for Intermediate and Base Mixes	Maximum Ratio of Recycled Binder[1] to Total Binder (%)		
			Surface	Intermediate	Base
76-22[4,5]	70-22	70-22	15.0	25.0	30.0
70-22[2,5]	N/A	64-22	15.0	25.0	30.0
64-22[2,3]	N/A	N/A	15.0	25.0	30.0
76-28[4,5]	70-28	70-28	15.0	25.0	30.0
70-28[2,5]	N/A	64-28	15.0	25.0	30.0
64-28[2,3]	N/A	N/A	15.0	25.0	30.0

1. Combined recycled binder from RAP and RAS. RAS is not permitted in surface mixtures unless otherwise shown on the plans.
2. Binder substitution is not allowed for surface mixtures.
3. Binder substitution is not allowed for intermediate and base mixtures.
4. Use no more than 15.0% recycled binder in surface mixtures when using this originally specified PG binder.
5. Use no more than 25.0% recycled binder when using this originally specified PG binder for intermediate mixtures. Use no more than 30.0% recycled binder when using this originally specified PG binder for base mixtures.

3. EQUIPMENT

Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement."

4. CONSTRUCTION

Produce, haul, place, and compact the specified paving mixture. In addition to tests required by the specification, Contractors may perform other QC tests as deemed necessary. At any time during the project, the Engineer may perform production and placement tests as deemed necessary in accordance with Item 5, "Control of the Work." Schedule and participate in a mandatory pre-paving meeting with the Engineer on or before the first day of paving unless otherwise shown on the plans.

4.1. **Certification**. Personnel certified by the Department-approved hot-mix asphalt certification program must conduct all mixture designs, sampling, and testing in accordance with Table 6. Supply the Engineer with a list of certified personnel and copies of their current certificates before beginning production and when personnel

changes are made. Provide a mixture design developed and signed by a Level 2 certified specialist. Provide Level 1A certified specialists at the plant during production operations. Provide Level 1B certified specialists to conduct placement tests. Provide AGG101 certified specialists for aggregate testing.

Table 6
Test Methods, Test Responsibility, and Minimum Certification Levels

Test Description	Test Method	Contractor	Engineer	Level[1]
1. Aggregate and Recycled Material Testing				
Sampling	Tex-221-F	✓	✓	1A/AGG101
Dry sieve	Tex-200-F, Part I	✓	✓	1A/AGG101
Washed sieve	Tex-200-F, Part II	✓	✓	1A/AGG101
Deleterious material	Tex-217-F, Parts I & III	✓	✓	AGG101
Decantation	Tex-217-F, Part II	✓	✓	AGG101
Los Angeles abrasion	Tex-410-A		✓	TxDOT
Magnesium sulfate soundness	Tex-411-A		✓	TxDOT
Micro-Deval abrasion	Tex-461-A		✓	AGG101
Crushed face count	Tex-460-A	✓	✓	AGG101
Flat and elongated particles	Tex-280-F	✓	✓	AGG101
Linear shrinkage	Tex-107-E	✓	✓	AGG101
Sand equivalent	Tex-203-F	✓	✓	AGG101
Bulk specific gravity	Tex-201-F	✓	✓	AGG101
Unit weight	Tex-404-A	✓	✓	AGG101
Organic impurities	Tex-408-A	✓	✓	AGG101
2. Asphalt Binder & Tack Coat Sampling				
Asphalt binder sampling	Tex-500-C, Part II	✓	✓	1A/1B
Tack coat sampling	Tex-500-C, Part III	✓	✓	1A/1B
3. Mix Design & Verification				
Design and JMF changes	Tex-204-F	✓	✓	2
Mixing	Tex-205-F	✓	✓	2
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F, Parts I & VI	✓	✓	1A
Rice gravity	Tex-227-F, Part II	✓	✓	1A
Ignition oven correction factors[2]	Tex-236-F, Part II	✓	✓	2
Indirect tensile strength	Tex-226-F	✓	✓	1A
Hamburg Wheel test	Tex-242-F	✓	✓	1A
Boil test	Tex-530-C	✓	✓	1A
4. Production Testing				
Selecting production random numbers	Tex-225-F, Part I		✓	1A
Mixture sampling	Tex-222-F	✓	✓	1A/1B
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F, Parts I & VI	✓	✓	1A
Rice gravity	Tex-227-F, Part II	✓	✓	1A
Gradation & asphalt binder content[2]	Tex-236-F, Part I	✓	✓	1A
Control charts	Tex-233-F	✓	✓	1A
Moisture content	Tex-212-F, Part II	✓	✓	1A/AGG101
Hamburg Wheel test	Tex-242-F	✓	✓	1A
Micro-Deval abrasion	Tex-461-A		✓	AGG101
Boil test	Tex-530-C	✓	✓	1A
Abson recovery	Tex-211-F		✓	TxDOT
5. Placement Testing				
Selecting placement random numbers	Tex-225-F, Part II		✓	1B
Trimming roadway cores	Tex-251-F, Parts I & II	✓	✓	1A/1B
In-place air voids	Tex-207-F, Parts I & VI	✓	✓	1A
In-place density (nuclear method)	Tex-207-F, Part III	✓		1B
Establish rolling pattern	Tex-207-F, Part IV	✓		1B
Control charts	Tex-233-F	✓	✓	1A
Ride quality measurement	Tex-1001-S	✓	✓	Note 3
Segregation (density profile)	Tex-207-F, Part V	✓	✓	1B
Longitudinal joint density	Tex-207-F, Part VII	✓	✓	1B
Thermal profile	Tex-244-F	✓	✓	1B
Shear Bond Strength Test	Tex-249-F		✓	TxDOT

1. Level 1A, 1B, AGG101, and 2 are certification levels provided by the Hot Mix Asphalt Center certification program.
2. Refer to Section 3077.4.9.2.3., "Production Testing," for exceptions to using an ignition oven.
3. Profiler and operator are required to be certified at the Texas A&M Transportation Institute facility when Surface Test Type B is specified.

4.2. **Reporting and Responsibilities**. Use Department-provided templates to record and calculate all test data, including mixture design, production and placement QC/QA, control charts, thermal profiles, segregation density profiles, and longitudinal joint density. Obtain the current version of the templates at http://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/forms/site-manager.html or from the Engineer. The Engineer and the Contractor will provide any available test results to the other party when requested. The maximum allowable time for the Contractor and Engineer to exchange test data is as given in Table 7 unless otherwise approved. The Engineer and the Contractor will immediately report to the other party any test result that requires suspension of production or placement, a payment adjustment less than 1.000, or that fails to meet the specification requirements. Record and electronically submit all test results and pertinent information on Department-provided templates.

Subsequent sublots placed after test results are available to the Contractor, which require suspension of operations, may be considered unauthorized work. Unauthorized work will be accepted or rejected at the discretion of the Engineer in accordance with Article 5.3., "Conformity with Plans, Specifications, and Special Provisions."

Table 7
Reporting Schedule

Description	Reported By	Reported To	To Be Reported Within
Production Quality Control			
Gradation[1]	Contractor	Engineer	1 working day of completion of the sublot
Asphalt binder content[1]			
Laboratory-molded density[2]			
Moisture content[3]			
Boil test[3]			
Production Quality Assurance			
Gradation[3]	Engineer	Contractor	1 working day of completion of the sublot
Asphalt binder content[3]			
Laboratory-molded density[1]			
Hamburg Wheel test[4]			
Boil test[3]			
Binder tests[4]			
Placement Quality Control			
In-place air voids[2]	Contractor	Engineer	1 working day of completion of the lot
Segregation[1]			
Longitudinal joint density[1]			
Thermal profile[1]			
Placement Quality Assurance			
In-place air voids[1]	Engineer	Contractor	1 working day after receiving the trimmed cores[5]
Segregation[3]			1 working day of completion of the lot
Longitudinal joint density[3]			
Thermal profile[3]			
Aging ratio[4]			
Payment adjustment summary	Engineer	Contractor	2 working days of performing all required tests and receiving Contractor test data

1. These tests are required on every sublot.
2. Optional test. When performed on split samples, report the results as soon as they become available.
3. To be performed at the frequency specified in Table 17 or as shown on the plans.
4. To be reported as soon as the results become available.
5. Two days are allowed if cores cannot be dried to constant weight within 1 day.

The Engineer will use the Department-provided template to calculate all payment adjustment factors for the lot. Sublot samples may be discarded after the Engineer and Contractor sign off on the payment adjustment summary documentation for the lot.

Use the procedures described in Tex-233-F to plot the results of all quality control (QC) and quality assurance (QA) testing. Update the control charts as soon as test results for each sublot become available.

Make the control charts readily accessible at the field laboratory. The Engineer may suspend production for failure to update control charts.

4.3. **Quality Control Plan (QCP)**. Develop and follow the QCP in detail. Obtain approval for changes to the QCP made during the project. The Engineer may suspend operations if the Contractor fails to comply with the QCP.

Submit a written QCP before the mandatory pre-paving meeting. Receive approval of the QCP before beginning production. Include the following items in the QCP:

4.3.1. **Project Personnel**. For project personnel, include:

- a list of individuals responsible for QC with authority to take corrective action;
- current contact information for each individual listed; and
- current copies of certification documents for individuals performing specified QC functions.

4.3.2. **Material Delivery and Storage**. For material delivery and storage, include:

- the sequence of material processing, delivery, and minimum quantities to assure continuous plant operations;
- aggregate stockpiling procedures to avoid contamination and segregation;
- frequency, type, and timing of aggregate stockpile testing to assure conformance of material requirements before mixture production; and
- procedure for monitoring the quality and variability of asphalt binder.

4.3.3. **Production**. For production, include:

- loader operation procedures to avoid contamination in cold bins;
- procedures for calibrating and controlling cold feeds;
- procedures to eliminate debris or oversized material;
- procedures for adding and verifying rates of each applicable mixture component (e.g., aggregate, asphalt binder, RAP, RAS, lime, liquid antistrip, WMA);
- procedures for reporting job control test results; and
- procedures to avoid segregation and drain-down in the silo.

4.3.4. **Loading and Transporting**. For loading and transporting, include:

- type and application method for release agents; and
- truck loading procedures to avoid segregation.

4.3.5. **Placement and Compaction**. For placement and compaction, include:

- proposed agenda for mandatory pre-paving meeting, including date and location;
- proposed paving plan (e.g., paving widths, joint offsets, and lift thicknesses);
- type and application method for release agents in the paver and on rollers, shovels, lutes, and other utensils;
- procedures for the transfer of mixture into the paver, while avoiding segregation and preventing material spillage;
- process to balance production, delivery, paving, and compaction to achieve continuous placement operations and good ride quality;
- paver operations (e.g., operation of wings, height of mixture in auger chamber) to avoid physical and thermal segregation and other surface irregularities; and
- procedures to construct quality longitudinal and transverse joints.

4.4. **Mixture Design**.

4.4.1. **Design Requirements**. Use the SP design procedure provided in Tex-204-F, unless otherwise shown on the plans. Design the mixture to meet the requirements listed in Tables 1, 2, 3, 4, 5, 8, 9, 10, and 11.

Design the mixture at 50 gyrations (Ndesign). Use a target laboratory-molded density of 96.0% to design the mixture; however, adjustments can be made to the Ndesign value as noted in Table 10. The Ndesign level may be reduced to at least 35 gyrations at the Contractor's discretion.

Use an approved laboratory from the Department's MPL to perform the Hamburg Wheel test and provide results with the mixture design, or provide the laboratory mixture and request that the Department perform the Hamburg Wheel test. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test results on the laboratory mixture design.

The Engineer will provide the mixture design when shown on the plans. The Contractor may submit a new mixture design at any time during the project. The Engineer will verify and approve all mixture designs (JMF1) before the Contractor can begin production.

The aggregate gradation may pass below or through the reference zone shown in Table 9 unless otherwise shown on the plans. Design a mixture with a gradation that has stone-on-stone contact and passes below the reference zone shown in Table 9 when shown on the plans. Verify stone-on-stone contact using the method given in the SP design procedure in Tex-204-F, Part IV.

Provide the Engineer with a mixture design report using the Department-provided template. Include the following items in the report:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- asphalt binder content and aggregate gradation of RAP and RAS stockpiles;
- the Ndesign level used;
- results of all applicable tests;
- the mixing and molding temperatures;
- the signature of the Level 2 person or persons that performed the design;
- the date the mixture design was performed; and
- a unique identification number for the mixture design.

Table 8
Master Gradation Limits (% Passing by Weight or Volume) and VMA Requirements

Sieve Size	SP-B Intermediate	SP-C Surface	SP-D Fine Mixture
2"	–	–	–
1-1/2"	100.0[1]	–	–
1"	98.0–100.0	100.0[1]	–
3/4"	90.0–100.0	98.0–100.0	100.0[1]
1/2"	Note[2]	90.0–100.0	98.0–100.0
3/8"	–	Note[2]	90.0–100.0
#4	23.0–90.0	28.0–90.0	32.0–90.0
#8	23.0–34.6	28.0–37.0	32.0–40.0
#16	2.0–28.3	2.0–31.6	2.0–37.6
#30	2.0–20.7	2.0–23.1	2.0–27.5
#50	2.0–13.7	2.0–15.5	2.0–18.7
#200	2.0–8.0	2.0–10.0	2.0–10.0
Design VMA, % Minimum			
–	14.0	15.0	16.0
Production (Plant-Produced) VMA, % Minimum			
–	13.5	14.5	15.5

1. Defined as maximum sieve size. No tolerance allowed.
2. Must retain at least 10% cumulative.

Table 9
Reference Zones (% Passing by Weight or Volume)

Sieve Size	SP-B Intermediate	SP-C Surface	SP-D Fine Mixture
2"	–	–	–
1-1/2"	–	–	–
1"	–	–	–
3/4"	–	–	–
1/2"	–	–	–
3/8"	–	–	–
#4	–	–	–
#8	34.6–34.6	39.1–39.1	47.2–47.2
#16	22.3–28.3	25.6–31.6	31.6–37.6
#30	16.7–20.7	19.1–23.1	23.5–27.5
#50	13.7–13.7	15.5–15.5	18.7–18.7
#200	–	–	–

Table 10
Laboratory Mixture Design Properties

Mixture Property	Test Method	Requirement
Target laboratory-molded density, %	Tex-207-F	96.0
Design gyrations (Ndesign)	Tex-241-F	50[1]
Indirect tensile strength (dry), psi	Tex-226-F	85–200[2]
Dust/asphalt binder ratio[3]	–	0.6–1.4
Boil test[4]	Tex-530-C	–

1. Adjust within a range of 35–100 gyrations when shown on the plans or specification or mutually agreed between the Engineer and Contractor.
2. The Engineer may allow the IDT strength to exceed 200 psi if the corresponding Hamburg Wheel rut depth is greater than 3.0 mm and less than 12.5 mm.
3. Defined as % passing #200 sieve divided by asphalt binder content.
4. Used to establish baseline for comparison to production results. May be waived when approved.

Table 11
Hamburg Wheel Test Requirements

High-Temperature Binder Grade	Test Method	Minimum # of Passes @ 12.5 mm[1] Rut Depth, Tested @ 50°C
PG 64 or lower	Tex-242-F	10,000[2]
PG 70		15,000[3]
PG 76 or higher		20,000

1. When the rut depth at the required minimum number of passes is less than 3 mm, the Engineer may require the Contractor to lower the Ndesign level to at least 35 gyrations.
2. May be decreased to at least 5,000 passes when shown on the plans.
3. May be decreased to at least 10,000 passes when shown on the plans.

4.4.2. **Job-Mix Formula Approval**. The job-mix formula (JMF) is the combined aggregate gradation, Ndesign level, and target asphalt percentage used to establish target values for hot-mix production. JMF1 is the original laboratory mixture design used to produce the trial batch. When WMA is used, JMF1 may be designed and submitted to the Engineer without including the WMA additive. When WMA is used, document the additive or process used and recommended rate on the JMF1 submittal. The Engineer and the Contractor will verify JMF1 based on plant-produced mixture from the trial batch unless otherwise approved. The Engineer may accept an existing mixture design previously used on a Department project and may waive the trial batch to verify JMF1. The Department may require the Contractor to reimburse the Department for verification tests if more than two trial batches per design are required.

4.4.2.1. **Contractor's Responsibilities**.

4.4.2.1.1. **Providing Superpave Gyratory Compactor (SGC)**. Furnish an SGC calibrated in accordance with Tex-241-F for molding production samples. Locate the SGC at the Engineer's field laboratory and make the SGC available to the Engineer for use in molding production samples.

4.4.2.1.2. **Gyratory Compactor Correlation Factors**. Use Tex-206-F, Part II, to perform a gyratory compactor correlation when the Engineer uses a different SGC. Apply the correlation factor to all subsequent production test results.

4.4.2.1.3. **Submitting JMF1**. Furnish a mix design report (JMF1) with representative samples of all component materials and request approval to produce the trial batch. Provide approximately 10,000 g of the design mixture if opting to have the Department perform the Hamburg Wheel test on the laboratory mixture, and request that the Department perform the test.

4.4.2.1.4. **Supplying Aggregates**. Provide approximately 40 lb. of each aggregate stockpile unless otherwise directed.

4.4.2.1.5. **Supplying Asphalt**. Provide at least 1 gal. of the asphalt material and enough quantities of any additives proposed for use.

4.4.2.1.6. **Ignition Oven Correction Factors**. Determine the aggregate and asphalt correction factors from the ignition oven in accordance with Tex-236-F, Part II. Provide correction factors that are not more than 12 months old. Provide the Engineer with split samples of the mixtures before the trial batch production, including all additives (except water), and blank samples used to determine the correction factors for the ignition oven used for QA testing during production. Correction factors established from a previously approved mixture design may be used for the current mixture design if the mixture design and ignition oven are the same as previously used, unless otherwise directed.

4.4.2.1.7. **Boil Test**. Perform the test and retain the tested sample from Tex-530-C until completion of the project or as directed. Use this sample for comparison purposes during production. The Engineer may waive the requirement for the boil test.

4.4.2.1.8. **Trial Batch Production**. Provide a plant-produced trial batch upon receiving conditional approval of JMF1 and authorization to produce a trial batch, including the WMA additive or process if applicable, for verification testing of JMF1 and development of JMF2. Produce a trial batch mixture that meets the requirements in Table 4, Table 5, and Table 12. The Engineer may accept test results from recent production of the same mixture instead of a new trial batch.

4.4.2.1.9. **Trial Batch Production Equipment**. Use only equipment and materials proposed for use on the project to produce the trial batch.

4.4.2.1.10. **Trial Batch Quantity**. Produce enough quantity of the trial batch to ensure that the mixture meets the specification requirements.

4.4.2.1.11. **Number of Trial Batches**. Produce trial batches as necessary to obtain a mixture that meets the specification requirements.

4.4.2.1.12. **Trial Batch Sampling**. Obtain a representative sample of the trial batch and split it into 3 equal portions in accordance with Tex-222-F. Label these portions as “Contractor,” “Engineer,” and “Referee.” Deliver samples to the appropriate laboratory as directed.

4.4.2.1.13. **Trial Batch Testing**. Test the trial batch to ensure the mixture produced using the proposed JMF1 meets the mixture requirements in Table 12. Ensure the trial batch mixture is also in compliance with the Hamburg Wheel-requirement in Table 11. Use a Department-approved laboratory to perform the Hamburg Wheel test on the trial batch mixture or request that the Department perform the Hamburg Wheel test.

The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test results on the trial batch. Provide the Engineer with a copy of the trial batch test results.

4.4.2.1.14. **Development of JMF2**. Evaluate the trial batch test results after the Engineer grants full approval of JMF1 based on results from the trial batch, determine the optimum mixture proportions, and submit as JMF2.

Adjust the asphalt binder content or gradation to achieve the specified target laboratory-molded density. The asphalt binder content established for JMF2 is not required to be within any tolerance of the optimum asphalt binder content established for JMF1; however, mixture produced using JMF2 must meet the voids in mineral aggregates (VMA) requirements for production shown in Table 8. If the optimum asphalt binder content for JMF2 is more than 0.5% lower than the optimum asphalt binder content for JMF1, the Engineer may perform or require the Contractor to perform Tex-226-F on Lot 1 production to confirm the indirect tensile strength does not exceed 200 psi. Verify that JMF2 meets the mixture requirements in Table 4 and Table 5.

4.4.2.1.15. **Mixture Production**. Use JMF2 to produce Lot 1 as described in Section 3077.4.9.3.1.1., "Lot 1 Placement," after receiving approval for JMF2 and a passing result from the Department's or a Department-approved laboratory's Hamburg Wheel test on the trial batch. If desired, proceed to Lot 1 production, once JMF2 is approved, at the Contractor's risk without receiving the results from the Department's Hamburg Wheel test on the trial batch.

Notify the Engineer if electing to proceed without Hamburg Wheel test results from the trial batch. Note that the Engineer may require up to the entire sublot of any mixture failing the Hamburg Wheel test to be removed and replaced at the Contractor's expense.

4.4.2.1.16. **Development of JMF3**. Evaluate the test results from Lot 1, determine the optimum mixture proportions, and submit as JMF3 for use in Lot 2.

4.4.2.1.17. **JMF Adjustments**. If JMF adjustments are necessary to achieve the specified requirements, make the adjustment before beginning a new lot. The adjusted JMF must:

- be provided to the Engineer in writing before the start of a new lot;
- be numbered in sequence to the previous JMF;
- meet the mixture requirements in Table 4 and Table 5;
- meet the master gradation limits shown in Table 8; and
- be within the operational tolerances of JMF2 listed in Table 12.

4.4.2.1.18. **Requesting Referee Testing**. Use referee testing, if needed, in accordance with Section 3077.4.9.1., "Referee Testing," to resolve testing differences with the Engineer.

Table 12
Operational Tolerances

Description	Test Method	Allowable Difference Between Trial Batch and JMF1 Target	Allowable Difference from Current JMF Target	Allowable Difference between Contractor and Engineer[1]
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	Must be Within Master Grading Limits in Table 8	±5.0[2,3]	±5.0
Individual % retained for sieves smaller than #8 and larger than #200			±3.0[2,3]	±3.0
% passing the #200 sieve			±2.0[2,3]	±1.6
Asphalt binder content, %	Tex-236-F	±0.5	±0.3[3]	±0.3
Dust/asphalt binder ratio[4]	–	Note 5	Note 5	N/A
Laboratory-molded density, %	Tex-207-F	±1.0	±1.0	±0.5
In-place air voids, %		N/A	N/A	±1.0
Laboratory-molded bulk specific gravity		N/A	N/A	±0.020
VMA, % min	Tex-204-F	Note 6	Note 6	N/A
Theoretical maximum specific (Rice) gravity	Tex-227-F	N/A	N/A	±0.020

1. Contractor may request referee testing only when values exceed these tolerances.
2. When within these tolerances, mixture production gradations may fall outside the master grading limits; however, the % passing the #200 will be considered out of tolerance when outside the master grading limits.
3. Only applies to mixture produced for Lot 1 and higher.
4. Defined as % passing #200 sieve divided by asphalt binder content.
5. Verify that Table 10 requirement is met.
6. Verify that Table 8 requirements are met.

4.4.2.2. **Engineer's Responsibilities**.

4.4.2.2.1. **Gyratory Compactor**. The Engineer will use a Department SGC, calibrated in accordance with Tex-241-F, to mold samples for laboratory mixture design verification. For molding trial batch and production specimens, the Engineer will use the Contractor-provided SGC at the field laboratory or provide and use a Department SGC at an alternate location. The Engineer will make the Contractor-provided SGC in the Department field laboratory available to the Contractor for molding verification samples.

4.4.2.2.2. **Conditional Approval of JMF1 and Authorizing Trial Batch**. The Engineer will review and verify conformance of the following information within two working days of receipt:

- the Contractor's mix design report (JMF1);
- the Contractor-provided Hamburg Wheel test results;
- all required materials including aggregates, asphalt, additives, and recycled materials; and
- the mixture specifications.

The Engineer will grant the Contractor conditional approval of JMF1 if the information provided on the paper copy of JMF1 indicates that the Contractor's mixture design meets the specifications. When the Contractor does not provide Hamburg Wheel test results with laboratory mixture design, 10 working days are allowed for conditional approval of JMF1. The Engineer will base full approval of JMF1 on the test results on mixture from the trial batch.

Unless waived, the Engineer will determine the Micro-Deval abrasion loss in accordance with Section 3077.2.1.1.2., "Micro-Deval Abrasion." If the Engineer's test results are pending after two working days, conditional approval of JMF1 will still be granted within 2 working days of receiving JMF1. When the Engineer's test results become available, they will be used for specification compliance.

After conditionally approving JMF1, including either Contractor- or Department-supplied Hamburg Wheel test results, the Contractor is authorized to produce a trial batch.

4.4.2.2.3. **Hamburg Wheel Testing of JMF1**. If the Contractor requests the option to have the Department perform the Hamburg Wheel test on the laboratory mixture, the Engineer will mold samples in accordance with Tex-242-F to verify compliance with the Hamburg Wheel test requirement in Table 11.

4.4.2.2.4. **Ignition Oven Correction Factors**. The Engineer will use the split samples provided by the Contractor to determine the aggregate and asphalt correction factors for the ignition oven used for QA testing during production in accordance with Tex-236-F, Part II. Provide correction factors that are not more than 12 months old.

4.4.2.2.5. **Testing the Trial Batch**. Within 1 full working day, the Engineer will sample and test the trial batch to ensure that the mixture meets the requirements in Table 12. If the Contractor requests the option to have the Department perform the Hamburg Wheel test on the trial batch mixture, the Engineer will mold samples in accordance with Tex-242-F to verify compliance with the Hamburg Wheel test requirement in Table 11.

The Engineer will have the option to perform the following tests on the trial batch:

- Tex-226-F, to verify that the indirect tensile strength meets the requirement shown in Table 10; and
- Tex-530-C, to retain and use for comparison purposes during production.

4.4.2.2.6. **Full Approval of JMF1**. The Engineer will grant full approval of JMF1 and authorize the Contractor to proceed with developing JMF2 if the Engineer's results for the trial batch meet the requirements in Table 12. The Engineer will notify the Contractor that an additional trial batch is required if the trial batch does not meet these requirements.

4.4.2.2.7. **Approval of JMF2**. The Engineer will approve JMF2 within one working day if the mixture meets the requirements in Table 5 and the gradation meets the master grading limits shown in Table 8. The asphalt binder content established for JMF2 is not required to be within any tolerance of the optimum asphalt binder content established for JMF1; however, mixture produced using JMF2 must meet the VMA requirements shown in Table 8. If the optimum asphalt binder content for JMF2 is more than 0.5% lower than the optimum asphalt binder content for JMF1, the Engineer may perform or require the Contractor to perform Tex-226-F on Lot 1 production to confirm the indirect tensile strength does not exceed 200 psi.

4.4.2.2.8. **Approval of Lot 1 Production**. The Engineer will authorize the Contractor to proceed with Lot 1 production (using JMF2) as soon as a passing result is achieved from the Department's or a Department-approved laboratory's Hamburg Wheel test on the trial batch. The Contractor may proceed at its own risk with Lot 1 production without the results from the Hamburg Wheel test on the trial batch.

If the Department's or Department-approved laboratory's sample from the trial batch fails the Hamburg Wheel test, the Engineer will suspend production until further Hamburg Wheel tests meet the specified values. The Engineer may require up to the entire sublot of any mixture failing the Hamburg Wheel test be removed and replaced at the Contractor's expense.

4.4.2.2.9. **Approval of JMF3 and Subsequent JMF Changes**. JMF3 and subsequent JMF changes are approved if they meet the mixture requirements shown in Table 4, Table 5, and the master grading limits shown in Table 8, and are within the operational tolerances of JMF2 shown in Table 12.

4.5. **Production Operations**. Perform a new trial batch when the plant or plant location is changed. Take corrective action and receive approval to proceed after any production suspension for noncompliance to the specification. Submit a new mix design and perform a new trial batch when the asphalt binder content of:

- any RAP stockpile used in the mix is more than 0.5% higher than the value shown on the mixture design report; or
- RAS stockpile used in the mix is more than 2.0% higher than the value shown on the mixture design report.

4.5.1. **Storage and Heating of Materials**. Do not heat the asphalt binder above the temperatures specified in Item 300, "Asphalts, Oils, and Emulsions," or outside the manufacturer's recommended values. Provide the Engineer with daily records of asphalt binder and hot-mix asphalt discharge temperatures (in legible and discernible increments) in accordance with Item 320, "Equipment for Asphalt Concrete Pavement," unless otherwise directed. Do not store mixture for a period long enough to affect the quality of the mixture, nor in any case longer than 12 hr. unless otherwise approved.

4.5.2. **Mixing and Discharge of Materials**. Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not exceed the maximum production temperatures listed in Table 13 (or 275°F for WMA). The Department will not pay for or allow placement of any mixture produced above the maximum production temperatures listed in Table 13.

Table 13
Maximum Production Temperature

High-Temperature Binder Grade[1]	Maximum Production Temperature
PG 64	325˚F
PG 70	335˚F
PG 76	345˚F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.

Produce WMA within the target discharge temperature range of 215°F and 275°F when WMA is required. Take corrective action any time the discharge temperature of the WMA exceeds the target discharge range. The Engineer may suspend production operations if the Contractor's corrective action is not successful at controlling the production temperature within the target discharge range. Note that when WMA is produced, it may be necessary to adjust burners to ensure complete combustion such that no burner fuel residue remains in the mixture.

Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant. Determine the moisture content, if requested, by oven-drying in accordance with Tex-212-F, Part II, and verify that the mixture contains no more than 0.2% of moisture by weight. Obtain the sample immediately after discharging the mixture into the truck, and perform the test promptly.

4.6. **Hauling Operations**. Clean all truck beds before use to ensure that mixture is not contaminated. Use a release agent shown on the Department's MPL to coat the inside bed of the truck when necessary.

Use equipment for hauling as defined in Section 3077.4.7.3.3., "Hauling Equipment." Use other hauling equipment only when allowed.

4.7. **Placement Operations**. Collect haul tickets from each load of mixture delivered to the project and provide the Department's copy to the Engineer approximately every hour or as directed. Use a hand-held thermal camera or infrared thermometer, when a thermal imaging system is not used, to measure and record the internal temperature of the mixture as discharged from the truck or Material Transfer Device (MTD) before or as the mix enters the paver and an approximate station number or GPS coordinates on each ticket. Calculate the daily yield and cumulative yield for the specified lift and provide to the Engineer at the end of paving operations for each day unless otherwise directed. The Engineer may suspend production if the Contractor fails to produce and provide haul tickets and yield calculations by the end of paving operations for each day.

Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from pavement edges. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Offset longitudinal joints of successive courses of hot-mix by at least 6 in. Place mixture so that longitudinal joints on the surface course coincide with lane lines and are not placed in the wheel path, or as directed. Ensure that all finished surfaces will drain properly. Place the

mixture at the rate or thickness shown on the plans. The Engineer will use the guidelines in Table 14 to determine the compacted lift thickness of each layer when multiple lifts are required. The thickness determined is based on the rate of 110 lb./sq. yd. for each inch of pavement unless otherwise shown on the plans.

Table 14
Compacted Lift Thickness and Required Core Height

Mixture Type	Compacted Lift Thickness Guidelines		Minimum Untrimmed Core Height (in.) Eligible for Testing
	Minimum (in.)	Maximum (in.)	
SP-B	2.50	4.0	2.00
SP-C	2.00	3.0	1.25
SP-D	1.25	2.0	1.25

4.7.1. **Weather Conditions**.

4.7.1.1. **When Using a Thermal Imaging System**. Place mixture when the roadway is dry and the roadway surface temperature is at or above the temperatures listed in Table 15A.The Engineer may restrict the Contractor from paving surface mixtures if the ambient temperature is likely to drop below 32°F within 12 hr. of paving. Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. Provide output data from the thermal imaging system to demonstrate to the Engineer that no recurring severe thermal segregation exists in accordance with Section 3077.4.7.3.1.2., "Thermal Imaging System."

Table 15A
Minimum Pavement Surface Temperatures

High-Temperature Binder Grade[1]	Minimum Pavement Surface Temperatures (°F)	
	Subsurface Layers or Night Paving Operations	Surface Layers Placed in Daylight Operations
PG 64	35	40
PG 70	45[2]	50[2]
PG 76	45[2]	50[2]

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. Contractors may pave at temperatures 10°F lower than these values when a chemical WMA additive is used as a compaction aid in the mixture or when using WMA.

4.7.1.2. **When Not Using a Thermal Imaging System**. When using a thermal camera instead of the thermal imaging system, place mixture when the roadway surface temperature is at or above the temperatures listed in Table 15B unless otherwise approved or as shown on the plans. Measure the roadway surface temperature with a hand-held thermal camera or infrared thermometer. The Engineer may allow mixture placement to begin before the roadway surface reaches the required temperature if conditions are such that the roadway surface will reach the required temperature within 2 hr. of beginning placement operations. Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. The Engineer may restrict the Contractor from paving if the ambient temperature is likely to drop below 32°F within 12 hr. of paving.

Table 15B
Minimum Pavement Surface Temperatures

High-Temperature Binder Grade[1]	Minimum Pavement Surface Temperatures (°F)	
	Subsurface Layers or Night Paving Operations	Surface Layers Placed in Daylight Operations
PG 64	45	50
PG 70	55[2]	60[2]
PG 76	60[2]	60[2]

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. Contractors may pave at temperatures 10°F lower than these values when a chemical WMA additive is used as a compaction aid in the mixture, when using WMA, or utilizing a paving process with equipment that eliminates thermal segregation. In such cases, for each sublot and in the presence of the Engineer, use a hand-held thermal camera operated in accordance with Tex-244-F to demonstrate to the satisfaction of the Engineer that the uncompacted mat has no more than 10°F of thermal segregation.

4.7.2. **Tack Coat**.

4.7.2.1. **Application.** Clean the surface before placing the tack coat. The Engineer will set the rate between 0.04 and 0.10 gal. of residual asphalt per square yard of surface area. Apply a uniform tack coat at the specified rate unless otherwise directed. Apply the tack coat in a uniform manner to avoid streaks and other irregular patterns. Apply the tack coat to all surfaces that will come in contact with the subsequent HMA placement, unless otherwise directed. Allow adequate time for emulsion to break completely before placing any material. Prevent splattering of tack coat when placed adjacent to curb, gutter, and structures. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

4.7.2.2. **Sampling.** The Engineer will obtain at least one sample of the tack coat binder per project in accordance with Tex-500-C, Part III, and test it to verify compliance with Item 300, "Asphalts, Oils, and Emulsions." The Engineer will notify the Contractor when the sampling will occur and will witness the collection of the sample from the asphalt distributor immediately before use.

For emulsions, the Engineer may test as often as necessary to ensure the residual of the emulsion is greater than or equal to the specification requirement in Item 300, "Asphalts, Oils, and Emulsions."

4.7.3. **Lay-Down Operations**. Use the placement temperatures in Table 16 to establish the minimum placement temperature of mixture delivered to the paver.

Table 16
Minimum Mixture Placement Temperature

High-Temperature Binder Grade[1]	Minimum Placement Temperature (Before Entering Paver)[2,3]
PG 64	260˚F
PG 70	270˚F
PG 76	280˚F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. Minimum placement temperatures may be reduced 10°F if using a chemical WMA additive as a compaction aid.
3. When using WMA, the minimum placement temperature is 215°F.

4.7.3.1. **Thermal Profile**. Use a hand-held thermal camera or a thermal imaging system to obtain a continuous thermal profile in accordance with Tex-244-F. Thermal profiles are not applicable in areas described in Section 3077.4.9.3.1.4., "Miscellaneous Areas."

4.7.3.1.1. **Thermal Segregation**.

4.7.3.1.1.1. **Moderate**. Any areas that have a temperature differential greater than 25°F, but not exceeding 50°F, are deemed as moderate thermal segregation.

4.7.3.1.1.2. **Severe**. Any areas that have a temperature differential greater than 50°F are deemed as severe thermal segregation.

4.7.3.1.2. **Thermal Imaging System**. Review the output results when a thermal imaging system is used, and provide the automated report described in Tex-244-F to the Engineer daily unless otherwise directed. Modify the paving process as necessary to eliminate any recurring (moderate or severe) thermal segregation identified by the thermal imaging system. The Engineer may suspend paving operations if the Contractor cannot successfully modify the paving process to eliminate recurring severe thermal segregation. Density profiles are not required and not applicable when using a thermal imaging system. Provide the Engineer with electronic copies of all daily data files that can be used with the thermal imaging system software to generate temperature profile plots daily or upon completion of the project or as requested by the Engineer.

4.7.3.1.3. **Thermal Camera**. When using a thermal camera instead of the thermal imaging system, take immediate corrective action to eliminate recurring moderate thermal segregation when a hand-held thermal camera is used. Evaluate areas with moderate thermal segregation by performing density profiles in accordance with Section 3077.4.9.3.3.2., "Segregation (Density Profile)." Provide the Engineer with the thermal profile of every sublot within one working day of the completion of each lot. When requested by the Engineer, provide the thermal images generated using the thermal camera. Report the results of each thermal profile in accordance with Section 3077.4.2., "Reporting and Responsibilities." The Engineer will use a hand-held thermal camera to obtain a thermal profile at least once per project. No production or placement payment adjustments greater than 1.000 will be paid for any sublot that contains severe thermal segregation. Suspend operations and take immediate corrective action to eliminate severe thermal segregation unless otherwise directed. Resume operations when the Engineer determines that subsequent production will meet the requirements of this Section. Evaluate areas with severe thermal segregation by performing density profiles in accordance with Section 3077.4.9.3.3.2., "Segregation (Density Profile)." Remove and replace the material in any areas that have both severe thermal segregation and a failing result for Segregation (Density Profile) unless otherwise directed. The sublot in question may receive a production and placement payment adjustment greater than 1.000, if applicable, when the defective material is successfully removed and replaced.

4.7.3.2. **Windrow Operations**. Operate windrow pickup equipment so that when hot-mix is placed in windrows, substantially all the mixture deposited on the roadbed is picked up and loaded into the paver.

4.7.3.3. **Hauling Equipment**. Use belly dumps, live bottom, or end dump trucks to haul and transfer mixture; however, with exception of paving miscellaneous areas, end dump trucks are only allowed when used in conjunction with an MTD with remixing capability or when a thermal imaging system is used unless otherwise allowed.

4.7.3.4. **Screed Heaters**. Turn off screed heaters to prevent overheating of the mat if the paver stops for more than 5 min. The Engineer may evaluate the suspect area in accordance with Section 3077.4.9.3.3.4., "Recovered Asphalt Dynamic Shear Rheometer (DSR)," if the screed heater remains on for more than 5 min. while the paver is stopped.

4.8. **Compaction**. Compact the pavement uniformly to contain between 3.7% and 7.5% in-place air voids. Take immediate corrective action to bring the operation within 3.7% and 7.5% when the in-place air voids exceed the range of these tolerances. The Engineer will allow paving to resume when the proposed corrective action is likely to yield between 3.7% and 7.5% in-place air voids.

Obtain cores in areas placed under Exempt Production, as directed, at locations determined by the Engineer. The Engineer may test these cores and suspend operations or require removal and replacement if the in-place air voids are less than 2.7% or more than 9.0%. Areas defined in Section 3077.4.9.3.1.4., "Miscellaneous Areas," are not subject to in-place air void determination.

Furnish the type, size, and number of rollers required for compaction as approved. Use additional rollers as required to remove any roller marks. Use only water or an approved release agent on rollers, tamps, and other compaction equipment unless otherwise directed.

Use the control strip method shown in Tex-207-F, Part IV, on the first day of production to establish the rolling pattern that will produce the desired in-place air voids unless otherwise directed.

Use tamps to thoroughly compact the edges of the pavement along curbs, headers, and similar structures and in locations that will not allow thorough compaction with rollers. The Engineer may require rolling with a trench roller on widened areas, in trenches, and in other limited areas.

Complete all compaction operations before the pavement temperature drops below 160°F unless otherwise allowed. The Engineer may allow compaction with a light finish roller operated in static mode for pavement temperatures below 160°F.

Allow the compacted pavement to cool to 160°F or lower before opening to traffic unless otherwise directed. Sprinkle the finished mat with water or limewater, when directed, to expedite opening the roadway to traffic.

4.9. **Acceptance Plan**. Payment adjustments for the material will be in accordance with Article 3077.6., "Payment."

Sample and test the hot-mix on a lot and sublot basis. Suspend production until test results or other information indicates to the satisfaction of the Engineer that the next material produced or placed will result in pay factors of at least 1.000 if the production pay factor given in Section 3077.6.1., "Production Payment Adjustment Factors," for two consecutive lots or the placement pay factor given in Section 3077.6.2., "Placement Payment Adjustment Factors," for two consecutive lots is below 1.000.

4.9.1. **Referee Testing**. The Materials and Tests Division is the referee laboratory. The Contractor may request referee testing if a "remove and replace" condition is determined based on the Engineer's test results, or if the differences between Contractor and Engineer test results exceed the maximum allowable difference shown in Table 12 and the differences cannot be resolved. The Contractor may also request referee testing if the Engineer's test results require suspension of production and the Contractor's test results are within specification limits. Make the request within 5 working days after receiving test results and cores from the Engineer. Referee tests will be performed only on the sublot in question and only for the particular tests in question. Allow 10 working days from the time the referee laboratory receives the samples for test results to be reported. The Department may require the Contractor to reimburse the Department for referee tests if more than three referee tests per project are required and the Engineer's test results are closer to the referee test results than the Contractor's test results.

The Materials and Tests Division will determine the laboratory-molded density based on the molded specific gravity and the maximum theoretical specific gravity of the referee sample. The in-place air voids will be determined based on the bulk specific gravity of the cores, as determined by the referee laboratory and the Engineer's average maximum theoretical specific gravity for the lot. With the exception of "remove and replace" conditions, referee test results are final and will establish payment adjustment factors for the sublot in question. The Contractor may decline referee testing and accept the Engineer's test results when the placement payment adjustment factor for any sublot results in a "remove and replace" condition. Placement sublots subject to be removed and replaced will be further evaluated in accordance with Section 3077.6.2.2., "Placement Sublots Subject to Removal and Replacement."

4.9.2. **Production Acceptance**.

4.9.2.1. **Production Lot**. A production lot consists of four equal sublots. The default quantity for Lot 1 is 1,000 tons; however, when requested by the Contractor, the Engineer may increase the quantity for Lot 1 to no more than 4,000 tons. The Engineer will select subsequent lot sizes based on the anticipated daily production such

that approximately three to four sublots are produced each day. The lot size will be between 1,000 tons and 4,000 tons. The Engineer may change the lot size before the Contractor begins any lot.

If the optimum asphalt binder content for JMF2 is more than 0.5% lower than the optimum asphalt binder content for JMF1, the Engineer may perform or require the Contractor to perform Tex-226-F on Lot 1 to confirm the indirect tensile strength does not exceed 200 psi. Take corrective action to bring the mixture within specification compliance if the indirect tensile strength exceeds 200 psi unless otherwise directed.

4.9.2.1.1. **Incomplete Production Lots**. If a lot is begun but cannot be completed, such as on the last day of production or in other circumstances deemed appropriate, the Engineer may close the lot. Adjust the payment for the incomplete lot in accordance with Section 3077.6.1., "Production Payment Adjustment Factors." Close all lots within five working days unless otherwise allowed.

4.9.2.2. **Production Sampling**.

4.9.2.2.1. **Mixture Sampling**. Obtain hot-mix samples from trucks at the plant in accordance with Tex-222-F. The sampler will split each sample into three equal portions in accordance with Tex-200-F and label these portions as "Contractor," "Engineer," and "Referee." The Engineer will perform or witness the sample splitting and take immediate possession of the samples labeled "Engineer" and "Referee." The Engineer will maintain the custody of the samples labeled "Engineer" and "Referee" until the Department's testing is completed.

4.9.2.2.1.1. **Random Sample**. At the beginning of the project, the Engineer will select random numbers for all production sublots. Determine sample locations in accordance with Tex-225-F. Take one sample for each sublot at the randomly selected location. The Engineer will perform or witness the sampling of production sublots.

4.9.2.2.1.2. **Blind Sample**. For one sublot per lot, the Engineer will obtain and test a "blind" sample instead of the random sample collected by the Contractor. Test either the "blind" or the random sample; however, referee testing (if applicable) will be based on a comparison of results from the "blind" sample. The location of the Engineer's "blind" sample will not be disclosed to the Contractor. The Engineer's "blind" sample may be randomly selected in accordance with Tex-225-F for any sublot or selected at the discretion of the Engineer. The Engineer will use the Contractor's split sample for sublots not sampled by the Engineer.

4.9.2.2.2. **Informational Shear Bond Strength Testing.** Select one random sublot from Lot 2 or higher for shear bond strength testing. Obtain full depth cores in accordance with Tex-249-F. Label the cores with the Control Section Job (CSJ), producer of the tack coat, mix type, shot rate, lot, and sublot number and provide to the Engineer. The Engineer will ship the cores to the Materials and Tests Division or district laboratory for shear bond strength testing. Results from these tests will not be used for specification compliance.

4.9.2.2.3. **Asphalt Binder Sampling**. Obtain a 1-qt. sample of the asphalt binder witnessed by the Engineer for each lot of mixture produced. The Contractor will notify the Engineer when the sampling will occur. Obtain the sample at approximately the same time the mixture random sample is obtained. Sample from a port located immediately upstream from the mixing drum or pug mill and upstream from the introduction of any additives in accordance with Tex-500-C, Part II. Label the can with the corresponding lot and sublot numbers, producer, producer facility location, grade, district, date sampled, and project information including highway and CSJ. The Engineer will retain these samples for one year. The Engineer may also obtain independent samples. If obtaining an independent asphalt binder sample and upon request of the Contractor, the Engineer will split a sample of the asphalt binder with the Contractor.

At least once per project, the Engineer will collect split samples of each binder grade and source used. The Engineer will submit one split sample to MTD to verify compliance with Item 300, "Asphalts, Oils, and Emulsions" and will retain the other split sample for one year.

4.9.2.3. **Production Testing**. The Contractor and Engineer must perform production tests in accordance with Table 17. The Contractor has the option to verify the Engineer's test results on split samples provided by the Engineer. Determine compliance with operational tolerances listed in Table 12 for all sublots.

Take immediate corrective action if the Engineer's laboratory-molded density on any sublot is less than 95.0% or greater than 97.0% to bring the mixture within these tolerances. The Engineer may suspend operations if the Contractor's corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

The Engineer may allow alternate methods for determining the asphalt binder content and aggregate gradation if the aggregate mineralogy is such that Tex-236-F, Part I does not yield reliable results. Provide evidence that results from Tex-236-F, Part I are not reliable before requesting permission to use an alternate method unless otherwise directed. Use the applicable test procedure as directed if an alternate test method is allowed.

Table 17
Production and Placement Testing Frequency

Description	Test Method	Minimum Contractor Testing Frequency	Minimum Engineer Testing Frequency
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	1 per sublot	1 per 12 sublots[1]
Individual % retained for sieves smaller than #8 and larger than #200			
% passing the #200 sieve			
Laboratory-molded density	Tex-207-F	N/A	1 per sublot[1]
Laboratory-molded bulk specific gravity			
In-place air voids			
VMA	Tex-204-F		
Segregation (density profile)	Tex-207-F, Part V	1 per sublot[2]	1 per project
Longitudinal joint density	Tex-207-F, Part VII		
Moisture content	Tex-212-F, Part II	When directed	
Theoretical maximum specific (Rice) gravity	Tex-227-F	N/A	1 per sublot[1]
Asphalt binder content	Tex-236-F	1 per sublot	1 per lot[1]
Hamburg Wheel test	Tex-242-F	N/A	1 per project
Recycled Asphalt Shingles (RAS)[3]	Tex-217-F, Part III	N/A	
Thermal profile	Tex-244-F	1 per sublot[2]	
Asphalt binder sampling and testing	Tex-500-C, Part II	1 per lot (sample only)[4]	
Tack coat sampling and testing	Tex-500-C, Part III	N/A	
Boil test[5]	Tex-530-C	1 per lot	
Shear Bond Strength Test[6]	Tex-249-F	1 per project (sample only)	

1. For production defined in Section 3077.4.9.4., "Exempt Production," the Engineer will test one per day if 100 tons or more are produced. For Exempt Production, no testing is required when less than 100 tons are produced.
2. To be performed in the presence of the Engineer, unless otherwise approved. Not required when a thermal imaging system is used.
3. Testing performed by the Materials and Tests Division or designated laboratory.
4. Obtain samples witnessed by the Engineer. The Engineer will retain these samples for one year.
5. The Engineer may reduce or waive the sampling and testing requirements based on a satisfactory test history.
6. Testing performed by the Materials and Tests Division or District for informational purposes only.

4.9.2.4. **Operational Tolerances**. Control the production process within the operational tolerances listed in Table 12. When production is suspended, the Engineer will allow production to resume when test results or other information indicates the next mixture produced will be within the operational tolerances.

4.9.2.4.1. **Gradation**. Suspend operation and take corrective action if any aggregate is retained on the maximum sieve size shown in Table 8. A sublot is defined as out of tolerance if either the Engineer's or the Contractor's test results are out of operational tolerance. Suspend production when test results for gradation exceed the operational tolerances in Table 12 for three consecutive sublots on the same sieve or four consecutive sublots on any sieve unless otherwise directed. The consecutive sublots may be from more than one lot.

4.9.2.4.2. **Asphalt Binder Content**. A sublot is defined as out of operational tolerance if either the Engineer's or the Contractor's test results exceed the values listed in Table 12. No production or placement payment

adjustments greater than 1.000 will be paid for any sublot that is out of operational tolerance for asphalt binder content. Suspend production and shipment of the mixture if the Engineer's or the Contractor's asphalt binder content deviates from the current JMF by more than 0.5% for any sublot.

4.9.2.4.3. **Voids in Mineral Aggregates (VMA)**. The Engineer will determine the VMA for every sublot. For sublots when the Engineer does not determine asphalt binder content, the Engineer will use the asphalt binder content results from QC testing performed by the Contractor to determine VMA.

Take immediate corrective action if the VMA value for any sublot is less than the minimum VMA requirement for production listed in Table 8. Suspend production and shipment of the mixture if the Engineer's VMA results on two consecutive sublots are below the minimum VMA requirement for production listed in Table 8. No production or placement payment adjustments greater than 1.000 will be paid for any sublot that does not meet the minimum VMA requirement for production listed in Table 8 based on the Engineer's VMA determination.

Suspend production and shipment of the mixture if the Engineer's VMA result is more than 0.5% below the minimum VMA requirement for production listed in Table 8. In addition to suspending production, the Engineer may require removal and replacement or may allow the sublot to be left in place without payment.

4.9.2.4.4. **Hamburg Wheel Test**. The Engineer may perform a Hamburg Wheel test at any time during production, including when the boil test indicates a change in quality from the materials submitted for JMF1. In addition to testing production samples, the Engineer may obtain cores and perform Hamburg Wheel tests on any areas of the roadway where rutting is observed. Suspend production until further Hamburg Wheel tests meet the specified values when the production or core samples fail the Hamburg Wheel test criteria in Table 11. Core samples, if taken, will be obtained from the center of the finished mat or other areas excluding the vehicle wheel paths. The Engineer may require up to the entire sublot of any mixture failing the Hamburg Wheel test to be removed and replaced at the Contractor's expense.

If the Department's or Department approved laboratory's Hamburg Wheel test results in a "remove and replace" condition, the Contractor may request that the Department confirm the results by re-testing the failing material. The Materials and Tests Division will perform the Hamburg Wheel tests and determine the final disposition of the material in question based on the Department's test results.

4.9.2.5. **Individual Loads of Hot-Mix**. The Engineer can reject individual truckloads of hot-mix. When a load of hot-mix is rejected for reasons other than temperature, contamination, or excessive uncoated particles, the Contractor may request that the rejected load be tested. Make this request within 4 hr. of rejection. The Engineer will sample and test the mixture. If test results are within the operational tolerances shown in Table 12, payment will be made for the load. If test results are not within operational tolerances, no payment will be made for the load.

4.9.3. **Placement Acceptance**.

4.9.3.1. **Placement Lot**. A placement lot consists of four placement sublots. A placement sublot consists of the area placed during a production sublot.

4.9.3.1.1. **Lot 1 Placement**. Placement payment adjustments greater than 1.000 for Lot 1 will be in accordance with Section 3077.6.2., "Placement Payment Adjustment Factors;" however, no placement adjustment less than 1.000 will be assessed for any sublot placed in Lot 1 when the in-place air voids are greater than or equal to 2.7% and less than or equal to 9.0%. Remove and replace any sublot with in-place air voids less than 2.7% or greater than 9.0%.

4.9.3.1.2. **Incomplete Placement Lots**. An incomplete placement lot consists of the area placed as described in Section 3077.4.9.2.1.1., "Incomplete Production Lot," excluding areas defined in Section 3077.4.9.3.1.4., "Miscellaneous Areas." Placement sampling is required if the random sample plan for production resulted in a sample being obtained from an incomplete production sublot.

4.9.3.1.3. **Shoulders, Ramps, Etc**. Shoulders, ramps, intersections, acceleration lanes, deceleration lanes, and turn lanes are subject to in-place air void determination and payment adjustments unless designated on the plans as not eligible for in-place air void determination. Intersections may be considered miscellaneous areas when determined by the Engineer.

4.9.3.1.4. **Miscellaneous Areas**. Miscellaneous areas include areas that typically involve significant handwork or discontinuous paving operations, such as temporary detours, driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. Temporary detours are subject to in-place air void determination when shown on the plans. Miscellaneous areas also include level-ups and thin overlays when the layer thickness specified on the plans is less than the minimum untrimmed core height eligible for testing shown in Table 14. The specified layer thickness is based on the rate of 110 lb./sq. yd. for each inch of pavement unless another rate is shown on the plans. When "level up" is listed as part of the item bid description code, a payment adjustment factor of 1.000 will be assigned for all placement sublots as described in Article3077.6, "Payment." Miscellaneous areas are not eligible for random placement sampling locations. Compact miscellaneous areas in accordance with Section 3077.4.8., "Compaction." Miscellaneous areas are not subject to in-place air void determination, thermal profiles testing, segregation (density profiles), or longitudinal joint density evaluations.

4.9.3.2. **Placement Sampling**. The Engineer will select random numbers for all placement sublots at the beginning of the project. The Engineer will provide the Contractor with the placement random numbers immediately after the sublot is completed. Mark the roadway location at the completion of each sublot and record the station number. Determine one random sample location for each placement sublot in accordance with Tex-225-F. Adjust the random sample location by no more than necessary to achieve a 2-ft. clearance if the location is within 2 ft. of a joint or pavement edge.

Shoulders, ramps, intersections, acceleration lanes, deceleration lanes, and turn lanes are always eligible for selection as a random sample location; however, if a random sample location falls on one of these areas and the area is designated on the plans as not subject to in-place air void determination, cores will not be taken for the sublot and a 1.000 pay factor will be assigned to that sublot.

Provide the equipment and means to obtain and trim roadway cores on-site. On-site is defined as in close proximity to where the cores are taken. Obtain the cores within one working day of the time the placement sublot is completed unless otherwise approved. Obtain two 6-in. diameter cores side-by-side from within 1 ft. of the random location provided for the placement sublot. For SP-C and SP-D mixtures, 4-in. diameter cores are allowed. Mark the cores for identification, measure and record the untrimmed core height, and provide the information to the Engineer. The Engineer will witness the coring operation and measurement of the core thickness. Visually inspect each core and verify that the current paving layer is bonded to the underlying layer. Take corrective action if an adequate bond does not exist between the current and underlying layer to ensure that an adequate bond will be achieved during subsequent placement operations.

Trim the cores immediately after obtaining the cores from the roadway in accordance with Tex-251-F if the core heights meet the minimum untrimmed value listed in Table 14. Trim the cores on-site in the presence of the Engineer. Use a permanent marker or paint pen to record the lot and sublot numbers on each core as well as the designation as Core A or B. The Engineer may require additional information to be marked on the core and may choose to sign or initial the core. The Engineer will take custody of the cores immediately after witnessing the trimming of the coresand will retain custody of the cores until the Department's testing is completed. Before turning the trimmed cores over to the Engineer, the Contractor may wrap the trimmed cores or secure them in a manner that will reduce the risk of possible damage occurring during transport by the Engineer. After testing, the Engineer will return the cores to the Contractor.

The Engineer may have the cores transported back to the Department's laboratory at the HMA plant via the Contractor's haul truck or other designated vehicle. In such cases where the cores will be out of the Engineer's possession during transport, the Engineer will use Department-provided security bags and the Roadway Core Custody protocol located at http://www.txdot.gov/business/specifications.htm to provide a secure means and process that protects the integrity of the cores during transport.

Decide whether to include the pair of cores in the air void determination for that sublot if the core height before trimming is less than the minimum untrimmed value shown in Table 14. Trim the cores as described above before delivering to the Engineer if electing to have the cores included in the air void determination. Deliver untrimmed cores to the Engineer and inform the Engineer of the decision to not have the cores included in air void determination if electing to not have the cores included in air void determination. The placement pay factor for the sublot will be 1.000 if cores will not be included in air void determination.

Instead of the Contractor trimming the cores on-site immediately after coring, the Engineer and the Contractor may mutually agree to have the trimming operations performed at an alternate location such as a field laboratory or other similar location. In such cases, the Engineer will take possession of the cores immediately after they are obtained from the roadway and will retain custody of the cores until testing is completed. Either the Department or Contractor representative may perform trimming of the cores. The Engineer will witness all trimming operations in cases where the Contractor representative performs the trimming operation.

Dry the core holes and tack the sides and bottom immediately after obtaining the cores. Fill the hole with the same type of mixture and properly compact the mixture. Repair core holes with other methods when approved.

4.9.3.3. **Placement Testing**. Perform placement tests in accordance with Table 17. After the Engineer returns the cores, the Contractor may test the cores to verify the Engineer's test results for in-place air voids. The allowable differences between the Contractor's and Engineer's test results are listed in Table 12.

4.9.3.3.1. **In-Place Air Voids**. The Engineer will measure in-place air voids in accordance with Tex-207-F and Tex-227-F. Before drying to a constant weight, cores may be pre-dried using a CoreDry or similar vacuum device to remove excess moisture. The Engineer will average the values obtained for all sublots in the production lot to determine the theoretical maximum specific gravity. The Engineer will use the average air void content for in-place air voids.

The Engineer will use the vacuum method to seal the core if required by Tex-207-F. The Engineer will use the test results from the unsealed core to determine the placement payment adjustment factor if the sealed core yields a higher specific gravity than the unsealed core. After determining the in-place air void content, the Engineer will return the cores and provide test results to the Contractor.

4.9.3.3.2. **Segregation (Density Profile**). Test for segregation using density profiles in accordance with Tex-207-F, Part V when using a thermal camera instead of the thermal imaging system. Density profiles are not required and are not applicable when using a thermal imaging system. Density profiles are not applicable in areas described in Section 3077.4.9.3.1.4., "Miscellaneous Areas."

Perform a minimum of one density profile per sublot. Perform additional density profiles when any of the following conditions occur, unless otherwise approved:

- the paver stops due to lack of material being delivered to the paving operations and the temperature of the uncompacted mat before the initial break down rolling is less than the temperatures shown in Table 18;
- areas that are identified by either the Contractor or the Engineer with thermal segregation;
- any visibly segregated areas that exist.

Table 18
Minimum Uncompacted Mat Temperature Requiring a Segregation Profile

High-Temperature Binder Grade[1]	Minimum Temperature of the Uncompacted Mat Allowed Before Initial Break Down Rolling[2,3,4]
PG 64	<250˚F
PG 70	<260˚F
PG 76	<270˚F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. Segregation profiles are required in areas with moderate and severe thermal segregation as described in Section 3077.4.7.3.1.3.
3. Minimum uncompacted mat temperature requiring a segregation profile may be reduced 10°F if using a chemical WMA additive as a compaction aid.
4. When using WMA, the minimum uncompacted mat temperature requiring a segregation profile is 215°F.

Provide the Engineer with the density profile of every sublot in the lot within one working day of the completion of each lot. Report the results of each density profile in accordance with Section 3077.4.2., "Reporting and Responsibilities."

The density profile is considered failing if it exceeds the tolerances in Table 19. No production or placement payment adjustments greater than 1.000 will be paid for any sublot that contains a failing density profile. When a hand-held thermal camera is used instead of a thermal imaging system, the Engineer will measure the density profile at least once per project. The Engineer's density profile results will be used when available. The Engineer may require the Contractor to remove and replace the area in question if the area fails the density profile and has surface irregularities as defined in Section 3077.4.9.3.3.5., "Irregularities." The sublot in question may receive a production and placement payment adjustment greater than 1.000, if applicable, when the defective material is successfully removed and replaced.

Investigate density profile failures and take corrective actions during production and placement to eliminate the segregation. Suspend production if two consecutive density profiles fail unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

Table 19
Segregation (Density Profile) Acceptance Criteria

Mixture Type	Maximum Allowable Density Range (Highest to Lowest)	Maximum Allowable Density Range (Average to Lowest)
SP-B	8.0 pcf	5.0 pcf
SP-C & SP-D	6.0 pcf	3.0 pcf

4.9.3.3.3. **Longitudinal Joint Density**.

4.9.3.3.3.1. **Informational Tests**. Perform joint density evaluations while establishing the rolling pattern and verify that the joint density is no more than 3.0 pcf below the density taken at or near the center of the mat. Adjust the rolling pattern, if needed, to achieve the desired joint density. Perform additional joint density evaluations at least once per sublot unless otherwise directed.

4.9.3.3.3.2. **Record Tests**. Perform a joint density evaluation for each sublot at each pavement edge that is or will become a longitudinal joint. Joint density evaluations are not applicable in areas described in Section 3077.4.9.3.1.4., "Miscellaneous Areas." Determine the joint density in accordance with Tex-207-F, Part VII. Record the joint density information and submit results on Department forms to the Engineer. The evaluation is considered failing if the joint density is more than 3.0 pcf below the density taken at the core random sample location and the correlated joint density is less than 90.0%. The Engineer will make independent joint density verification at least once per project and may make independent joint density

verifications at the random sample locations. The Engineer's joint density test results will be used when available.

Provide the Engineer with the joint density of every sublot in the lot within one working day of the completion of each lot. Report the results of each joint density in accordance with Section 3077.4.2., "Reporting and Responsibilities."

Investigate joint density failures and take corrective actions during production and placement to improve the joint density. Suspend production if the evaluations on two consecutive sublots fail unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

4.9.3.3.4. **Recovered Asphalt Dynamic Shear Rheometer (DSR)**. The Engineer may take production samples or cores from suspect areas of the project to determine recovered asphalt properties. Asphalt binders with an aging ratio greater than 3.5 do not meet the requirements for recovered asphalt properties and may be deemed defective when tested and evaluated by the Materials and Tests Division. The aging ratio is the DSR value of the extracted binder divided by the DSR value of the original unaged binder. Obtain DSR values in accordance with AASHTO T 315 at the specified high temperature performance grade of the asphalt. The Engineer may require removal and replacement of the defective material at the Contractor's expense. The asphalt binder will be recovered for testing from production samples or cores in accordance with Tex-211-F.

4.9.3.3.5. **Irregularities**. Identify and correct irregularities including segregation, rutting, raveling, flushing, fat spots, mat slippage, irregular color, irregular texture, roller marks, tears, gouges, streaks, uncoated aggregate particles, or broken aggregate particles. The Engineer may also identify irregularities, and in such cases, the Engineer will promptly notify the Contractor. If the Engineer determines that the irregularity will adversely affect pavement performance, the Engineer may require the Contractor to remove and replace (at the Contractor's expense) areas of the pavement that contain irregularities. The Engineer may also require the Contractor to remove and replace (at the Contractor's expense) areas where the mixture does not bond to the existing pavement.

If irregularities are detected, the Engineer may require the Contractor to immediately suspend operations or may allow the Contractor to continue operations for no more than one day while the Contractor is taking appropriate corrective action.

4.9.4. **Exempt Production**. The Engineer may deem the mixture as exempt production for the following conditions:

- anticipated daily production is less than 500 tons;
- total production for the project is less than 5,000 tons;
- when mutually agreed between the Engineer and the Contractor; or
- when shown on the plans.

For exempt production, the Contractor is relieved of all production and placement QC/QA sampling and testing requirements, except for coring operations when required by the Engineer. The production and placement pay factors are 1.000 if the specification requirements listed below are met, all other specification requirements are met, and the Engineer performs acceptance tests for production and placement listed in Table 17 when 100 tons or more per day are produced:

- produce, haul, place, and compact the mixture in compliance with the specification and as directed;
- control mixture production to yield a laboratory-molded density that is within ±1.0% of the target laboratory-molded density as tested by the Engineer;
- compact the mixture in accordance with Section 3077.4.8., "Compaction"; and
- when a thermal imaging system is not used, the Engineer may perform segregation (density profiles) and thermal profiles in accordance with the specification.

4.9.5. **Ride Quality**. Measure ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.

5. MEASUREMENT

5.1. **Superpave Mixtures.** Hot mix will be measured by the ton of composite hot-mix, which includes asphalt, aggregate, and additives. Measure the weight on scales in accordance with Item 520, "Weighing and Measuring Equipment."

5.2. **Tack Coat.** Tack coat will be measured at the applied temperature by strapping the tank before and after road application and determining the net volume in gallons from the calibrated distributor. The Engineer will witness all strapping operations for volume determination. All tack, including emulsions, will be measure by the gallon applied.

The Engineer may allow the use of a metering device to determine the asphalt volume used and application rate if the device is accurate within 1.5% of the strapped volume.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under Article 3077.5.1, "Measurement," will be paid for at the unit bid price for "Superpave Mixtures" of the mixture type, SAC, and binder specified. These prices are full compensation for surface preparation, materials, placement, equipment, labor, tools, and incidentals.

The work performed and materials furnished in accordance with this Item and measured as provided under Article 3077.5.2, "Measurement," will be paid for at the unit bid price for "Tack Coat" of the tack coat provided. These prices are full compensation for materials, placement, equipment, labor, tools, and incidentals. Payment adjustments will be applied as determined in this Item; however, a payment adjustment factor of 1.000 will be assigned for all placement sublots for "level ups" only when "level up" is listed as part of the item bid description code. A payment adjustment factor of 1.000 will be assigned to all production and placement sublots when "exempt" is listed as part of the item bid description code, and all testing requirements are met.

Payment for each sublot, including applicable payment adjustments greater than 1.000, will only be paid for sublots when the Contractor supplies the Engineer with the required documentation for production and placement QC/QA, thermal profiles, segregation density profiles, and longitudinal joint densities in accordance with Section 3077.4.2., "Reporting and Responsibilities." When a thermal imaging system is used, documentation is not required for thermal profiles or segregation density profiles on individual sublots; however, the thermal imaging system automated reports described in Tex-244-F are required.

Trial batches will not be paid for unless they are included in pavement work approved by the Department.

Payment adjustment for ride quality will be determined in accordance with Item 585, "Ride Quality for Pavement Surfaces."

6.1. **Production Payment Adjustment Factors**. The production payment adjustment factor is based on the laboratory-molded density using the Engineer's test results. The bulk specific gravities of the samples from each sublot will be divided by the Engineer's maximum theoretical specific gravity for the sublot. The individual sample densities for the sublot will be averaged to determine the production payment adjustment factor in accordance with Table 20 for each sublot using the deviation from the target laboratory-molded density defined in Table 10. The production payment adjustment factor for completed lots will be the average of the payment adjustment factors for the four sublots sampled within that lot.

Table 20
Production Payment Adjustment Factors for Laboratory-Molded Density[1]

Absolute Deviation from Target Laboratory-Molded Density	Production Payment Adjustment Factor (Target Laboratory-Molded Density)
0.0	1.075
0.1	1.075
0.2	1.075
0.3	1.066
0.4	1.057
0.5	1.047
0.6	1.038
0.7	1.029
0.8	1.019
0.9	1.010
1.0	1.000
1.1	0.900
1.2	0.800
1.3	0.700
> 1.3	Remove and replace

1. If the Engineer's laboratory-molded density on any sublot is less than 95.0% or greater than 97.0%, take immediate corrective action to bring the mixture within these tolerances. The Engineer may suspend operations if the Contractor's corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

6.1.1. **Payment for Incomplete Production Lots**. Production payment adjustments for incomplete lots, described under Section 3077.4.9.2.1.1., "Incomplete Production Lots," will be calculated using the average production pay factors from all sublots sampled.

A production payment factor of 1.000 will be assigned to any lot when the random sampling plan did not result in collection of any samples within the first sublot.

6.1.2. **Production Sublots Subject to Removal and Replacement**. If after referee testing, the laboratory-molded density for any sublot results in a "remove and replace" condition as listed in Table 20, the Engineer may require removal and replacement or may allow the sublot to be left in place without payment. The Engineer may also accept the sublot in accordance with Section 3077.5.3.1., "Acceptance of Defective or Unauthorized Work." Replacement material meeting the requirements of this Item will be paid for in accordance with this Section.

6.2. **Placement Payment Adjustment Factors**. The placement payment adjustment factor is based on in-place air voids using the Engineer's test results. The bulk specific gravities of the cores from each sublot will be divided by the Engineer's average maximum theoretical specific gravity for the lot. The individual core densities for the sublot will be averaged to determine the placement payment adjustment factor in accordance with Table 21 for each sublot that requires in-place air void measurement. A placement payment adjustment factor of 1.000 will be assigned to the entire sublot when the random sample location falls in an area designated on the plans as not subject to in-place air void determination. A placement payment adjustment factor of 1.000 will be assigned to quantities placed in areas described in Section 3077.4.9.3.1.4., "Miscellaneous Areas." The placement payment adjustment factor for completed lots will be the average of the placement payment adjustment factors for up to four sublots within that lot.

Table 21
Placement Payment Adjustment Factors for In-Place Air Voids

In-Place Air Voids	Placement Payment Adjustment Factor	In-Place Air Voids	Placement Payment Adjustment Factor
< 2.7	Remove and Replace	5.9	1.048
2.7	0.710	6.0	1.045
2.8	0.740	6.1	1.042
2.9	0.770	6.2	1.039
3.0	0.800	6.3	1.036
3.1	0.830	6.4	1.033
3.2	0.860	6.5	1.030
3.3	0.890	6.6	1.027
3.4	0.920	6.7	1.024
3.5	0.950	6.8	1.021
3.6	0.980	6.9	1.018
3.7	1.000	7.0	1.015
3.8	1.015	7.1	1.012
3.9	1.030	7.2	1.009
4.0	1.045	7.3	1.006
4.1	1.060	7.4	1.003
4.2	1.075	7.5	1.000
4.3	1.075	7.6	0.980
4.4	1.075	7.7	0.960
4.5	1.075	7.8	0.940
4.6	1.075	7.9	0.920
4.7	1.075	8.0	0.900
4.8	1.075	8.1	0.880
4.9	1.075	8.2	0.860
5.0	1.075	8.3	0.840
5.1	1.072	8.4	0.820
5.2	1.069	8.5	0.800
5.3	1.066	8.6	0.780
5.4	1.063	8.7	0.760
5.5	1.060	8.8	0.740
5.6	1.057	8.9	0.720
5.7	1.054	9.0	0.700
5.8	1.051	> 9.0	Remove and Replace

6.2.1. **Payment for Incomplete Placement Lots**. Payment adjustments for incomplete placement lots described under Section 3077.4.9.3.1.2., "Incomplete Placement Lots," will be calculated using the average of the placement pay factors from all sublots sampled and sublots where the random location falls in an area designated on the plans as not eligible for in-place air void determination.

If the random sampling plan results in production samples, but not in placement samples, the random core location and placement adjustment factor for the sublot will be determined by applying the placement random number to the length of the sublot placed.

If the random sampling plan results in placement samples, but not in production samples, no placement adjustment factor will apply for that sublot placed.

A placement payment adjustment factor of 1.000 will be assigned to any lot when the random sampling plan did not result in collection of any production samples.

6.2.2. **Placement Sublots Subject to Removal and Replacement**. If after referee testing, the placement payment adjustment factor for any sublot results in a "remove and replace" condition as listed in Table 21, the Engineer will choose the location of two cores to be taken within 3 ft. of the original failing core location. The Contractor will obtain the cores in the presence of the Engineer. The Engineer will take immediate possession of the untrimmed cores and submit the untrimmed cores to the Materials and Tests Division,

where they will be trimmed, if necessary, and tested for bulk specific gravity within 10 working days of receipt.

The bulk specific gravity of the cores from each sublot will be divided by the Engineer's average maximum theoretical specific gravity for the lot. The individual core densities for the sublot will be averaged to determine the new payment adjustment factor of the sublot in question. If the new payment adjustment factor is 0.700 or greater, the new payment adjustment factor will apply to that sublot. If the new payment adjustment factor is less than 0.700, no payment will be made for the sublot. Remove and replace the failing sublot, or the Engineer may allow the sublot to be left in place without payment. The Engineer may also accept the sublot in accordance with Section 3077.5.3.1., "Acceptance of Defective or Unauthorized Work." Replacement material meeting the requirements of this Item will be paid for in accordance with this Section.

6.3. **Total Adjusted Pay Calculation**. Total adjusted pay (TAP) will be based on the applicable payment adjustment factors for production and placement for each lot.

TAP = (A+B)/2

where:
A = Bid price × production lot quantity × average payment adjustment factor for the production lot
B = Bid price × placement lot quantity × average payment adjustment factor for the placement lot + (bid price × quantity placed in miscellaneous areas × 1.000)

Production lot quantity = Quantity actually placed - quantity left in place without payment

Placement lot quantity = Quantity actually placed - quantity left in place without payment - quantity placed in miscellaneous areas

Special Specification 3079
Permeable Friction Course

1. DESCRIPTION

Construct a hot-mix asphalt (HMA) surface course composed of a compacted permeable mixture of aggregate, asphalt binder, and additives mixed hot in a mixing plant.

2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

Notify the Engineer of all material sources and before changing any material source or formulation. The Engineer will verify that the specification requirements are met when the Contractor makes a source or formulation change, and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time during the project to verify specification compliance in accordance with Item 6, "Control of Materials."

2.1. **Aggregate.** Furnish aggregates from sources that conform to the requirements in accordance with Table 1 and as specified in this Section. Aggregate requirements in this Section, including those shown in Table 1, may be modified or eliminated when shown on the plans. Additional aggregate requirements may be specified when shown on the plans. Provide aggregate stockpiles that meet the definitions in this Section for coarse aggregate. Do not use intermediate or fine aggregate in permeable friction course (PFC) mixtures. Supply aggregates that meet the definitions in Tex-100-E for crushed gravel or crushed stone. The Engineer will designate the plant or the quarry as the sampling location. Provide samples from materials produced for the project. The Engineer will establish the Surface Aggregate Classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests in accordance with Table 1. Document all test results on the mixture design report. The Engineer may perform tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately. Determine aggregate gradations for mixture design and production testing based on the washed sieve analysis given in Tex-200-F, Part II.

2.1.1. **Coarse Aggregate.** Coarse aggregate stockpiles must have no more than 20% material passing the No. 8 sieve. Aggregates from sources listed in the Department's *Bituminous Rated Source Quality Catalog* (BRSQC) are preapproved for use. Use only the rated values for hot-mix listed in the BRSQC. Rated values for surface treatment (ST) do not apply to coarse aggregate sources used in hot-mix asphalt.

For sources not listed on the Department's BRSQC:

- build an individual stockpile for each material;
- request the Department test the stockpile for specification compliance;
- approved only when tested by the Engineer;
- once approved, do not add material to the stockpile unless otherwise approved; and
- allow 30 calendar days for the Engineer to sample, test, and report results.

Provide coarse aggregate with at least the minimum SAC shown on the plans. SAC requirements only apply to aggregates used on the surface of travel lanes, unless otherwise shown on the plans. SAC requirements apply to aggregates used on surfaces other than travel lanes when shown on the plans. The SAC for sources on the Department's *Aggregate Quality Monitoring Program* (AQMP) (Tex-499-A) is listed in the BRSQC.

2.1.1.1. **Blending Class A and Class B Aggregates.** To prevent crushing of the Class B aggregate when blending, Class B aggregate may be blended with a Class A aggregate to meet requirements for Class A materials if the Department's BRSQC rated source soundness magnesium (RSSM) rating for the Class B aggregate is less than the Class A aggregate or if the RSSM rating for the Class B aggregate is less than or equal to 10%. Use the rated values for hot mix asphaltic concrete (HMAC) published in the BRSQC. When blending Class A and B aggregates to meet a Class A requirement, ensure that at least 50% by weight, or volume if required, of all the aggregates used in the mixture design retained on the No. 4 sieve comes from the Class A aggregate source, unless otherwise shown on the plans. Blend by volume if the bulk specific gravities of the Class A and B aggregates differ by more than 0.300. Class B aggregate may be disallowed when shown on the plans.

The Engineer may perform tests at any time during production, when the Contractor blends Class A and B aggregates to meet a Class A requirement, to ensure that at least 50% by weight, or volume if required, of the material retained on the No. 4 sieve comes from the Class A aggregate source. The Engineer will use the Department's mix design template, when electing to verify conformance, to calculate the percent of Class A aggregate retained on the No. 4 sieve by inputting the bin percentages shown from readouts in the control room at the time of production and stockpile gradations measured at the time of production. The Engineer may determine the gradations based on either washed or dry sieve analysis from samples obtained from individual aggregate cold feed bins or aggregate stockpiles. The Engineer may perform spot checks using the gradations supplied by the Contractor on the mixture design report as an input for the template; however, a failing spot check will require confirmation with a stockpile gradation determined by the Engineer.

2.1.1.2. **Micro-Deval Abrasion.** The Engineer will perform a minimum of one Micro-Deval abrasion test in accordance with Tex-461-A for each coarse aggregate source used in the mixture design that has a Rated Source Soundness Magnesium (RSSM) loss value greater than 10 as listed in the BRSQC, unless otherwise directed. The Engineer will perform testing before the start of production and may perform additional testing at any time during production. The Engineer may obtain the coarse aggregate samples from each coarse aggregate source or may require the Contractor to obtain the samples. The Engineer may waive all Micro-Deval testing based on a satisfactory test history of the same aggregate source.

The Engineer will estimate the magnesium sulfate soundness loss for each coarse aggregate source, when tested, using the following formula:

$$Mg_{est.} = (RSSM)(MD_{act.}/RSMD)$$

where:
$Mg_{est.}$ = magnesium sulfate soundness loss
RSSM = Rated Source Soundness Magnesium
$MD_{act.}$ = actual Micro-Deval percent loss
RSMD = Rated Source Micro-Deval

When the estimated magnesium sulfate soundness loss is greater than the maximum magnesium sulfate soundness loss specified, the coarse aggregate source will not be allowed for use unless otherwise approved. The Engineer will consult the Soils and Aggregates Section of the Materials and Tests Division, and additional testing may be required before granting approval.

Table 1
Coarse Aggregate Quality Requirements

Property	Test Method	Requirement
SAC	Tex-499-A (AQMP)	As shown on the plans
Deleterious material, %, Max	Tex-217-F, Part I	1.0
Decantation, %, Max	Tex-217-F, Part II	1.5
Micro-Deval abrasion, %	Tex-461-A	Note [1]
Los Angeles abrasion, %, Max	Tex-410-A	30
Magnesium sulfate soundness, 5 cycles, %, Max	Tex-411-A	20
Crushed face count,[2] %, Min	Tex-460-A, Part I	95
Flat and elongated particles @ 5:1, %, Max	Tex-280-F	10

1. Used to estimate the magnesium sulfate soundness loss in accordance with Section 3079.2.1.1.2., "Micro-Deval Abrasion."
2. Only applies to crushed gravel.

2.2. **Baghouse Fines.** Fines collected by the baghouse or other dust-collecting equipment may be reintroduced into the mixing drum.

2.3. **Asphalt Binder.** Furnish the type and grade of binder specified on the plans that meets the requirements of Item 300, "Asphalts, Oils, and Emulsions."

2.3.1. **Performance-Graded (PG) Binder.** Provide an asphalt binder with a high-temperature grade of PG 76 and low-temperature grade as shown on the plans in accordance with Section 300.2.10., "Performance-Graded Binders," when PG binder is specified.

2.3.2. **Asphalt-Rubber (A-R) Binder.** Provide A-R binder that meets the Type I or Type II requirements of Section 300.2.9., "Asphalt-Rubber Binders," when A-R is specified unless otherwise shown on the plans. Use at least 15.0% by weight of Crumb Rubber Modifier (CRM) that meets the Grade B or Grade C requirements of Section 300.2.7., "Crumb Rubber Modifier," unless otherwise shown on the plans. Provide the Engineer the A-R binder blend design with the mix design (JMF1) submittal. Provide the Engineer with documentation such as the bill of lading showing the quantity of CRM used in the project unless otherwise directed.

2.4. **Tack Coat.** Furnish CSS-1H, SS-1H, EBL, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300, "Asphalts, Oils, and Emulsions." Specialized tack coat materials listed on the Department's Tracking Resistant Asphalt Interlayer (TRAIL) MPL may be allowed or required when shown on the plans. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

2.5. **Additives.** Provide the Engineer with documentation such as the bill of lading showing the quantity of additives used in the project unless otherwise directed.

2.5.1. **Fibers.** Provide cellulose or mineral fibers when PG binder is specified. Do not use fibers when A-R binder is specified. Submit written certification to the Engineer that the fibers proposed for use meet the requirements of DMS-9204, "Fiber Additives for Bituminous Mixtures." Fibers may be pre-blended into the binder at the asphalt supply terminal unless otherwise shown on the plans.

2.5.2. **Lime Mineral Filler.** Add lime as mineral filler at a rate of 1.0% by weight of the total dry aggregate in accordance with Item 301, "Asphalt Antistripping Agents," unless otherwise shown on the plans or waived by the Engineer based on Hamburg Wheel test results. Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime into the drum.

2.5.3. **Lime and Liquid Antistripping Agent.** When lime or a liquid antistripping agent is used, add in accordance with Item 301, "Asphalt Antistripping Agents." Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime into the drum. When the plans require lime to be added as an antistripping agent, lime added as mineral filler will count towards the total quantity of lime specified.

2.5.4. **Compaction Aid.** Compaction aid is defined as a Department-approved chemical warm mix additive denoted as "chemical additive" on the Department's materials producer list (MPL) that is used to facilitate mixing and compaction of HMA.

Compaction aid is allowed for use on all projects. Compaction aid is required when shown on the plans or as required in Section 3079.4.7.1., "Weather Conditions."

Warm mix foaming processes, denoted as "foaming process" on the Department-approved MPL, may be used to facilitate mixing and compaction of HMA; however warm mix foaming processes are not defined as a Compaction aid.

2.6. **Recycled Materials.** Recycled materials are not allowed for use.

3. EQUIPMENT

Provide required or necessary equipment in accordance with Item 320, “Equipment for Asphalt Concrete Pavement.” When A-R binder is specified, equip the hot-mix plant with an in-line viscosity-measuring device located between the blending unit and the mixing drum. Provide a means to calibrate the asphalt mass flow meter on-site when a meter is used.

4. CONSTRUCTION

Produce, haul, place, and compact the specified paving mixture. In addition to tests required by the specification, Contractors may perform other QC tests as deemed necessary. At any time during the project, the Engineer may perform production and placement tests as deemed necessary in accordance with Item 5, “Control of the Work.” Schedule and participate in a mandatory pre-paving meeting with the Engineer on or before the first day of paving unless otherwise shown on the plans.

4.1. **Certification.** Personnel certified by the Department-approved hot-mix asphalt certification program must conduct all mixture designs, sampling, and testing in accordance with Table 2. Supply the Engineer with a list of certified personnel and copies of their current certificates before beginning production and when personnel changes are made. Provide a mixture design developed and signed by a Level 2 certified specialist. Provide Level 1A certified specialists at the plant during production operations. Provide Level 1B certified specialists to conduct placement tests. Provide Level AGG101 certified specialists for aggregate testing.

Table 2
Test Methods, Test Responsibility, and Minimum Certification Levels

Test Description	Test Method	Contractor	Engineer	Level[1]
1. Aggregate Testing				
Sampling	Tex-221-F	✓	✓	1A/AGG101
Dry sieve	Tex-200-F, Part I	✓	✓	1A/AGG101
Washed sieve	Tex-200-F, Part II	✓	✓	1A/AGG101
Deleterious material	Tex-217-F, Parts I & III	✓	✓	AGG101
Decantation	Tex-217-F, Part II	✓	✓	AGG101
Los Angeles abrasion	Tex-410-A		✓	Department
Magnesium sulfate soundness	Tex-411-A		✓	Department
Micro-Deval abrasion	Tex-461-A		✓	AGG101
Crushed face count	Tex-460-A	✓	✓	AGG101
Flat and elongated particles	Tex-280-F	✓	✓	AGG101
2. Asphalt Binder & Tack Coat Sampling				
Asphalt binder sampling	Tex-500-C, Part II	✓	✓	1A/1B
Tack coat sampling	Tex-500-C, Part III	✓	✓	1A/1B
3. Mix Design & Verification				
Design and JMF changes	Tex-204-F	✓	✓	2
Mixing	Tex-205-F	✓	✓	2
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F, Parts I, VI, & VIII	✓	✓	1A
Rice gravity	Tex-227-F, Part II	✓	✓	1A
Ignition oven correction factors[2]	Tex-236-F, Part II	✓	✓	2
Drain-down	Tex-235-F	✓	✓	1A
Hamburg Wheel test	Tex-242-F	✓	✓	1A
Boil test[4]	Tex-530-C	✓	✓	1A
Cantabro loss	Tex-245-F	✓	✓	1A
4. Production Testing				
Control charts	Tex-233-F	✓	✓	1A
Mixture sampling	Tex-222-F	✓	✓	1A/1B
Gradation & asphalt binder content[2]	Tex-236-F, Part I	✓	✓	1A
Moisture content	Tex-212-F, Part II	✓	✓	1A/AGG101
Micro-Deval abrasion	Tex-461-A		✓	AGG101
Drain-down	Tex-235-F	✓	✓	1A
Boil test[4]	Tex-530-C	✓	✓	1A
Abson recovery	Tex-211-F		✓	Department
5. Placement Testing				
Control charts	Tex-233-F	✓	✓	1A
Ride quality measurement	Tex-1001-S	✓	✓	Note 3
Thermal profile	Tex-244-F	✓	✓	1B
Water flow test	Tex-246-F	✓	✓	1B
Shear bond strength test	Tex-249-F		✓	Department

1. Level 1A, 1B, AGG101, and 2 are certification levels provided by the Hot Mix Asphalt Center certification program.
2. Refer to Section 3079.4.9.2.3., "Production Testing," for exceptions to using an ignition oven.
3. Profiler and operator are required to be certified at the Texas A&M Transportation Institute facility when Surface Test Type B is specified.
4. When shown on the plans.

4.2. **Reporting and Responsibilities**. Use Department-provided templates to record and calculate all test data, including mixture design, production and placement tests, control charts, and thermal profiles. Obtain the current version of the templates at https://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/forms/site-manager.html or from the Engineer. The Engineer and the Contractor will provide any available test results to the other party when requested. The maximum allowable time for the Contractor and Engineer to exchange test data is given in Table 3. The Engineer and the Contractor will immediately report to the other party any test result that requires suspension of production or placement or that fails to meet the specification requirements. Record and electronically submit all test results and pertinent information on Department-provided templates.

Subsequent sublots placed after test results are available to the Contractor, which require suspension of operations, may be considered unauthorized work. Unauthorized work will be accepted or rejected at the discretion of the Engineer in accordance with Article 5.3., "Conformity with Plans, Specifications, and Special Provisions."

Table 3
Reporting Schedule

Description	Reported By	Reported To	To Be Reported Within
Production Quality Control			
Gradation[1]	Contractor	Engineer	1 working day of completion of the sublot
Asphalt binder content[1]			
Laboratory-molded density[1]			
Moisture content[2]			
Drain-down[1]			
Boil test[4]			
Production Quality Assurance			
Gradation[2]	Engineer	Contractor	1 working day of completion of the sublot
Asphalt binder content[2]			
Laboratory-molded density[2]			
Hamburg Wheel test[3]			
Boil test[4]			
Drain-down[2]			
Binder tests[3]			
Placement Quality Control			
Thermal profile[1]	Contractor	Engineer	1 working day of completion of the lot
Water flow[1]			
Placement Quality Assurance			
Thermal profile[2]	Engineer	Contractor	1 working day of completion of the lot
Aging ratio[3]			
Water flow[2]			

1. These tests are required on every sublot.
2. To be performed at the frequency in accordance with Table 9 or as shown on the plans.
3. To be reported as soon as the results become available.
4. When shown on the plans

Use the procedures described in Tex-233-F to plot the results of all production and placement testing, when directed. Update the control charts as soon as test results for each sublot become available. Make the control charts readily accessible at the field laboratory. The Engineer may suspend production for failure to update control charts.

4.3. **Quality Control Plan (QCP).** Develop and follow the QCP in detail. Obtain approval for changes to the QCP made during the project. The Engineer may suspend operations if the Contractor fails to comply with the QCP.

Submit a written QCP before the mandatory pre-paving meeting when directed. Receive approval of the QCP before pre-paving meeting. Include the following items in the QCP:

4.3.1. **Project Personnel.** For project personnel, include:

- a list of individuals responsible for QC with authority to take corrective action;
- current contact information for each individual listed; and

- current copies of certification documents for individuals performing specified QC functions.

4.3.2. **Material Delivery and Storage.** For material delivery and storage, include:

- the sequence of material processing, delivery, and minimum quantities to assure continuous plant operations;
- aggregate stockpiling procedures to avoid contamination and segregation;
- frequency, type, and timing of aggregate stockpile testing to assure conformance of material requirements before mixture production; and
- procedure for monitoring the quality and variability of asphalt binder.

4.3.3. **Production.** For production, include:

- loader operation procedures to avoid contamination in cold bins;
- procedures for calibrating and controlling cold feeds;
- procedures to eliminate debris or oversized material;
- procedures for adding and verifying rates of each applicable mixture component (e.g., aggregate, asphalt binder, lime, liquid antistrip, compaction aid, foaming process, fibers);
- procedures for reporting job control test results; and
- procedures to avoid segregation and drain-down in the silo.

4.3.4. **Loading and Transporting.** For loading and transporting, include:

- type and application method for release agents; and
- truck loading procedures to avoid segregation.

4.3.5. **Placement and Compaction.** For placement and compaction, include:

- proposed agenda for mandatory pre-paving meeting, including date and location;
- proposed paving plan (e.g., production rate, paving widths, joint offsets, and lift thicknesses);
- type and application method for release agents in the paver and on rollers, shovels, lutes, and other utensils;
- procedures for the transfer of mixture into the paver, while avoiding physical and thermal segregation and preventing material spillage;
- process to balance production, delivery, paving, and compaction to achieve continuous placement operations and good ride quality;
- paver operations (e.g., speed, operation of wings, height of mixture in auger chamber) to avoid physical and thermal segregation and other surface irregularities; and
- procedures to construct quality longitudinal and transverse joints.

4.4. **Mixture Design.**

4.4.1. **Design Requirements.** Use the PFC design procedure provided in Tex-204-F, unless otherwise shown on the plans. Design the mixture to meet the requirements in accordance with Tables 1, 4, 5, and 6. Use a Superpave Gyratory Compactor (SGC) at 50 gyrations as the design number of gyrations (Ndesign).

The Engineer will provide the mixture design when shown on the plans. The Contractor may submit a new mixture design at any time during the project. The Engineer will verify and approve all mixture designs (JMF1) before the Contractor can begin production.

Provide the Engineer with a mixture design report using the Department-provided template. Include the following items in the report:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- results of all applicable tests;
- the mixing and molding temperatures;
- the signature of the Level 2 person or persons that performed the design;

- the date the mixture design was performed; and
- a unique identification number for the mixture design.

Table 4
Master Gradation Limits (% Passing by Weight or Volume)

Sieve Size	PG 76 Mixtures		A-R Mixtures		Test Procedure
	Fine (PFC-F)	Coarse (PFC-C)	Fine (PFCR-F)	Coarse (PFCR-C)	
3/4"	–	100.0[1]	100.0[1]	100.0[1]	Tex-200-F
1/2"	100.0[1]	80.0–100.0	95.0–100.0	80.0–100.0	
3/8"	95.0–100.0	35.0–60.0	50.0–80.0	35.0–60.0	
#4	20.0–55.0	1.0–20.0	0.0–8.0	0.0–20.0	
#8	1.0–10.0	1.0–10.0	0.0–4.0	0.0–10.0	
#200	1.0–4.0	1.0–4.0	0.0–4.0	0.0–4.0	

1. Defined as maximum sieve size. No tolerance allowed.

Table 5
Mixture Design Properties

Mix Property	PG 76 Mixtures		A-R Mixtures		Test Procedure
	Fine (PFC-F) Requirements	Coarse (PFC-C) Requirements	Fine (PFCR-F) Requirements	Coarse (PFCR-C) Requirements	
Design gyrations (Ndesign)	50	50	50	50	Tex-241-F
Lab-molded density, %	78.0 Max	82.0 Max	82.0 Max	82.0 Max	Tex-207-F
Asphalt Binder Content, %	6.0–7.0	6.0–7.0	8.0–10.0	7.0–9.0	--
Hamburg Wheel test,[1] passes at 12.5 mm rut depth	10,000 Min[2]	Note 3	Note 3	Note 3	Tex-242-F
Drain-down, %	0.10 Max	0.10 Max	0.10 Max	0.10 Max	Tex-235-F
Fiber content, % by wt. of total PG 76 mixture	0.20–0.50	0.20–0.50	–	–	Calculated
Lime content, % by wt. of total aggregate	1.0[4]	1.0[4]	–	–	Calculated
CRM content, % by wt. of A-R binder	–	–	15.0 Min	15.0 Min	Calculated
Boil test[5]	–	–	–	–	Tex-530-C
Cantabro loss, %	20.0 Max	20.0 Max	20.0 Max	20.0 Max	Tex-245-F

1. Mold test specimens to Ndesign at the optimum asphalt binder content.
2. May be decreased when shown on the plans.
3. No specification value is required unless otherwise shown on the plans.
4. Unless otherwise shown on the plans or waived by the Engineer based on Hamburg Wheel results.
5. When shown on the plans. Used to establish baseline for comparison to production results.

4.4.2. **Job-Mix Formula Approval.** The job-mix formula (JMF) is the combined aggregate gradation, Ndesign level, and target asphalt percentage used to establish target values for hot-mix production. JMF1 is the original laboratory mixture design used to produce the trial batch. When a compaction aid or foaming process is used, JMF1 may be designed and submitted to the Engineer without including the compaction aid or foaming process. When a compaction aid or foaming process is used, document the compaction aid or foaming process used and recommended rate on the JMF1 submittal. The Engineer and the Contractor will verify JMF1 based on plant-produced mixture from the trial batch unless otherwise approved. The Engineer may accept an existing mixture design previously used on a Department project and may waive the trial batch to verify JMF1. The Department may require the Contractor to reimburse the Department for verification tests if more than two trial batches per design are required.

4.4.2.1. **Contractor's Responsibilities.**

4.4.2.1.1. **Providing Gyratory Compactor.** Furnish an SGC calibrated in accordance with Tex-241-F for molding production samples. Locate the SGC at the Engineer's field laboratory or make the SGC available to the Engineer for use in molding production samples.

4.4.2.1.2. **Gyratory Compactor Correlation Factors.** Use Tex-206-F, Part II, to perform a gyratory compactor correlation when the Engineer uses a different SGC. Apply the correlation factor to all subsequent production test results.

4.4.2.1.3. **Submitting JMF1.** Furnish a mix design report (JMF1) with representative samples of all component materials and request approval to produce the trial batch. Provide an additional 25 lb. of the design mixture if opting to have the Department perform the Hamburg Wheel test on the laboratory mixture when required in accordance with Table 5, and request that the Department perform the test.

4.4.2.1.4. **Supplying Aggregates.** Provide approximately 40 lb. of each aggregate stockpile unless otherwise directed.

4.4.2.1.5. **Supplying Asphalt.** Provide at least 1 gal. of the asphalt material and enough quantities of any additives proposed for use.

4.4.2.1.6. **Ignition Oven Correction Factors.** Determine the aggregate and asphalt correction factors from the ignition oven in accordance with Tex-236-F, Part II. Provide correction factors that are not more than 12 mo. old. Note that the asphalt content correction factor takes into account the percent fibers in the mixture so that the fibers are excluded from the binder content determination. Provide the Engineer with split samples of the mixtures before the trial batch production, including all additives (except water), and blank samples used to determine the correction factors for the ignition oven used for quality assurance (QA) testing during production. Correction factors established from a previously approved mixture design may be used for the current mixture design if the mixture design and ignition oven are the same as previously used and the correction factors are not more than 12 mo. old, unless otherwise directed.

4.4.2.1.7. **Boil Test.** When shown on the plans, perform the test and retain the tested sample from Tex-530-C until completion of the project or as directed. Use this sample for comparison purposes during production. Add lime or liquid antistripping agent, as directed, if signs of stripping exist.

4.4.2.1.8. **Trial Batch Production.** Provide a plant-produced trial batch upon receiving conditional approval of JMF1 and authorization to produce a trial batch including the compaction aid or foaming process, if applicable, for verification testing of JMF1 and development of JMF2. Produce a trial batch mixture that meets the requirements in accordance with Table 6. The Engineer may accept test results from recent production of the same mixture instead of a new trial batch.

4.4.2.1.9. **Trial Batch Production Equipment.** Use only equipment and materials proposed for use on the project to produce the trial batch. Provide documentation to verify the calibration or accuracy of the asphalt mass flow meter to measure the binder content. Verify that asphalt mass flow meter meets the requirements of 0.4% accuracy, when required, in accordance with Item 520, "Weighing and Measuring Equipment." The Engineer may require that the accuracy of the mass flow meter be verified based on quantities used.

4.4.2.1.10. **Trial Batch Quantity.** Produce enough quantity of the trial batch to ensure that the mixture meets the specification requirements.

4.4.2.1.11. **Number of Trial Batches.** Produce trial batches as necessary to obtain a mixture that meets the specification requirements.

4.4.2.1.12. **Trial Batch Sampling.** Obtain a representative sample of the trial batch and split it into three equal portions in accordance with Tex-222-F. Label these portions as "Contractor," "Engineer," and "Referee." Deliver samples to the appropriate laboratory as directed.

4.4.2.1.13. **Trial Batch Testing.** Test the trial batch to ensure the mixture produced using the proposed JMF1 meets the mixture requirements in accordance with Table 6. Ensure the trial batch mixture is also in compliance with the requirements in accordance with Table 5. Use a Department-approved laboratory listed on the MPL to perform

the Hamburg Wheel test on the trial batch mixture or request that the Department perform the Hamburg Wheel test. Provide an additional 25 lb. of the trial batch mixture if opting to have the Department perform the Hamburg Wheel test, if applicable, and request that the Department perform the test. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test results on the trial batch. Provide the Engineer with a copy of the trial batch test results.

4.4.2.1.14. **Development of JMF2.** Evaluate the trial batch test results, determine the target mixture proportions, and submit as JMF2 after the Engineer grants full approval of JMF1 based on results from the trial batch. The mixture produced using JMF2 must meet the requirements in accordance with Tables 4 and 5. Verify that JMF2 meets the operational tolerances in accordance with Table 6.

4.4.2.1.15. **Mixture Production.** Use JMF2 to produce Lot 1 after receiving approval for JMF2.

4.4.2.1.16. **Development of JMF3.** Evaluate the test results from Lot 1, determine the optimum mixture proportions, and submit as JMF3 for use in Lot 2.

4.4.2.1.17. **JMF Adjustments.** If JMF adjustments are necessary to achieve the specified requirements, make the adjustments before beginning a new lot. The adjusted JMF must:

- be provided to the Engineer in writing before the start of a new lot;
- be numbered in sequence to the previous JMF;
- meet the master gradation limits in accordance with Table 4; and
- be within the operational tolerances of JMF2 in accordance with Table 6.

4.4.2.1.18. **Requesting Referee Testing.** Use referee testing, if needed, in accordance with Section 3079.4.9.1., "Referee Testing," to resolve testing differences with the Engineer.

Table 6
Operational Tolerances

Test Description	Test Method	Allowable Difference between JMF2 and JMF1 Target[1]	Allowable Difference from Current JMF and JMF2[2]	Allowable Difference between Contractor and Engineer[3]
Individual % retained for sieve sized larger than #200	Tex-200-F	Must be Within Master Grading Limits in accordance with Table 4	±3.0[4]	±5.0[4]
% passing the #200 sieve				±2.0[4]
Laboratory-molded density, %	Tex-207-F, Part VIII	±1.0	±1.0	±1.0
Asphalt binder content, %	Tex-236-F, Part I[5]	±0.3[6,7]	±0.3[4,6,7]	±0.3[6,7]
Drain-down, %	Tex-235-F	Note 8	Note 8	N/A
Boil test	Tex-530-C	Note 9	Note 9	N/A

1. JMF1 is the approved laboratory mixture design used for producing the trial batch. JMF2 is the approved mixture design developed from the trial batch used to produce Lot 1.
2. Current JMF is JMF3 or higher. JMF3 is the approved mixture design used to produce Lot 2.
3. Contractor may request referee testing only when values exceed these tolerances.
4. Only applies to mixture produced for Lot 1 and higher. Aggregate gradation is not allowed to be outside the limits shown in Table 4.
5. Ensure the binder content determination excludes fibers.
6. May be obtained from asphalt mass flow meter readouts as determined by the Engineer.
7. Binder content is not allowed to be outside the limits in accordance with Table 5.
8. Verify that Table 5 requirements are met.
9. When shown on the plans.

4.4.2.2. **Engineer's Responsibilities.**

4.4.2.2.1. **Superpave Gyratory Compactor.** The Engineer will use a Department SGC calibrated in accordance with Tex-241-F to mold samples for laboratory mixture design verification. For molding trial batch and production specimens, the Engineer will use the Contractor-provided SGC at the

field laboratory or provide and use a Department SGC at an alternate location.

4.4.2.2.2. **Conditional Approval of JMF1 and Authorizing Trial Batch.** The Engineer will review and verify conformance of the following information within two working days of receipt:

- the Contractor's mix design report (JMF1);
- the Contractor-provided Hamburg Wheel test results;
- all required materials including aggregates, asphalt, and additives; and
- the mixture specifications.

The Engineer will grant the Contractor conditional approval of JMF1 if the information provided on the paper copy of JMF1 indicates that the Contractor's mixture design meets the specifications. When the Contractor does not provide Hamburg Wheel test with laboratory mixture design, 10 working days are allowed for conditional approval of JMF1. The Engineer will base full approval of JMF1 on the test results on mixture from the trial batch.

Unless waived, the Engineer will determine the Micro-Deval abrasion loss in accordance with Section 3079.2.1.1.2., "Micro-Deval Abrasion." If the Engineer's test results are pending after two working days, conditional approval of JMF1 will still be granted within two working days of receiving JMF1. When the Engineer's test results become available, they will be used for specification compliance.

The Contractor is authorized to produce a trial batch after the Engineer grants conditional approval of JMF1.

4.4.2.2.3. **Hamburg Wheel Testing.** At the Contractor's request, the Department will perform the Hamburg Wheel test on the laboratory mixture in accordance with Tex-242-F to verify compliance with the Hamburg Wheel test requirement in accordance with Table 5. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test results on the laboratory mixture design.

4.4.2.2.4. **Ignition Oven Correction Factors.** The Engineer will use the split samples provided by the Contractor to determine the aggregate and asphalt correction factors for the ignition oven used for QA testing during production in accordance with Tex-236-F, Part II. Provide correction factors that are not more than 12 mo. old. The Engineer will verify that the asphalt content correction factor takes into account the percent fibers in the mixture so that the fibers are excluded from the binder content determination.

4.4.2.2.5. **Testing the Trial Batch.** Within one full working day, the Engineer will sample and test the trial batch to ensure that the mixture meets the requirements in accordance with Table 6. If the Contractor requests the option to have the Department perform the Hamburg Wheel test on the trial batch mixture, the Engineer will mold samples in accordance with Tex-242-F to verify compliance with the Hamburg Wheel test requirement in accordance with Table 5.

The Engineer will have the option to perform Tex-530-C on the trial batch when shown on the plans. These results may be retained and used for comparison purposes during production.

4.4.2.2.6. **Full Approval of JMF1.** The Engineer will grant full approval of JMF1 and authorize the Contractor to proceed with developing JMF2 if the Engineer's results for the trial batch meet the requirements in accordance with Table 5.

The Engineer will notify the Contractor that an additional trial batch is required if the trial batch does not meet these requirements.

4.4.2.2.7. **Approval of JMF2.** The Engineer will approve JMF2 within one working day if the mixture meets the requirements in accordance with Tables 4, 5, and 6.

4.4.2.2.8. **Approval of Lot 1 Production.** The Engineer will authorize the Contractor to proceed with Lot 1 production (using JMF2).

4.4.2.2.9. **Approval of JMF3 and Subsequent JMF Changes.** JMF3 and subsequent JMF changes are approved if they meet the master grading limits in accordance with Table 4, the asphalt binder content in accordance with Table 5, and are within the operational tolerances of JMF2 in accordance with Table 6.

4.4.2.2.10. **Binder Content Adjustments.** For JMF2 and above, the Engineer may require the Contractor to adjust the target binder content by no more than 0.3% from the current JMF.

4.5. **Production Operations.** Perform a new trial batch when the plant or plant location is changed. Take corrective action and receive approval to proceed after any production suspension for noncompliance to the specification.

4.5.1. **Storage and Heating of Materials.** Do not heat the asphalt binder above the temperatures specified in Item 300, "Asphalts, Oils, and Emulsions," or outside the manufacturer's recommended values. Provide the Engineer with daily records of asphalt binder and hot-mix asphalt discharge temperatures (in legible and discernible increments) in accordance with Item 320, "Equipment for Asphalt Concrete Pavement," unless otherwise directed. Do not store mixture for a period long enough to affect the quality of the mixture, nor in any case longer than 12 hr. unless otherwise approved.

4.5.2. **Mixing and Discharge of Materials.** Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not exceed the maximum production temperatures in accordance with Table 7. The Department will not pay for or allow placement of any mixture produced above the maximum production temperatures in accordance with Table 7.

Table 7
Maximum Production Temperature

High-Temperature Binder Grade[1]	Maximum Production Temperature
PG 76	345˚F
A-R Binder	345˚F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.

Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant. Determine the moisture content, if requested, by oven-drying in accordance with Tex-212-F, Part II, and verify that the mixture contains no more than 0.2% of moisture by weight. Obtain the sample immediately after discharging the mixture into the truck and perform the test promptly.

4.6. **Hauling Operations.** Clean all truck beds before use to ensure that mixture is not contaminated. Use a release agent, when necessary, shown on the Department's MPL to coat the inside bed of the truck. Do not use diesel or any release agent not shown on the Department's MPL.

Use equipment for hauling as defined in Section 3079.4.7.3.3., "Hauling Equipment." Use other hauling equipment only when allowed.

4.7. **Placement Operations.** Collect haul tickets from each load of mixture delivered to the project and provide the Department's copy to the Engineer approximately every hour or as directed. Use a hand-held thermal camera or infrared thermometer, when a thermal imaging system is not used, to measure and record the internal temperature of the mixture as discharged from the truck or Material Transfer Device (MTD) before or as the mix enters the paver and an approximate station number or GPS coordinates on each ticket. Calculate the daily yield and cumulative yield for the specified lift and provide to the Engineer at the end of paving operations for each day unless otherwise directed. The Engineer may suspend production if the Contractor fails to produce and provide haul tickets and yield calculations by the end of paving operations for each day.

Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from

pavement edges. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Offset longitudinal joints of successive courses of hot-mix by at least 6 in. Place mixture so that longitudinal joints on the surface course coincide within 6-in. of lane lines and are not placed in the wheel path, or as directed. Ensure that all finished surfaces will drain properly.

4.7.1. **Weather Conditions.**

4.7.1.1. **When Using a Thermal Imaging System.** The Contractor may pave any time the roadway is dry and the roadway surface temperature is at least 60°F unless otherwise approved or as shown on the plans; however, the Engineer may restrict the Contractor from paving if the ambient temperature is likely to drop below 32°F within 12 hr. of paving. Place mixtures when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. Provide output data from the thermal imaging system to demonstrate to the Engineer that no recurring severe thermal segregation exists in accordance with Section 3079.4.7.3.1.2., "Thermal Imaging System."

Produce mixture with a target discharge temperature higher than 300°F and with a compaction aid to facilitate compaction when the air temperature is 70°F and falling.

4.7.1.1.1. **When Not Using a Thermal Imaging System.** When using a thermal camera instead of the thermal imaging system, place mixture when the roadway surface temperature is at or above 70°F unless otherwise approved or as shown on the plans. Measure the roadway surface temperature with a hand-held thermal camera or infrared thermometer. Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. The Engineer may restrict the Contractor from paving if the air temperature is 60°F and falling.

Produce mixture with a target discharge temperature higher than 300°F and with a compaction aid to facilitate compaction when the air temperature is 70°F and falling.

4.7.2. **Tack Coat.**

4.7.2.1. **Application.** Clean the surface before placing the tack coat. The Engineer will set the rate between 0.04 and 0.10 gal. of residual asphalt per square yard of surface area. Apply a uniform tack coat at the specified rate unless otherwise directed. Apply the tack coat in a uniform manner to avoid streaks and other irregular patterns. Apply adequate overlap of the tack coat in the longitudinal direction during the placement of the mat to ensure bond of adjacent PFC mats, unless otherwise directed. Unless otherwise directed, avoid tacking the vertical faces of adjacent PFC mats in the longitudinal direction to avoid restricting lateral drainage. Apply tack coat to all transverse joints. Allow adequate time for emulsion to break completely before placing any material. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

4.7.2.2. **Sampling.** The Engineer will obtain at least one sample of the tack coat binder per project in accordance with Tex-500-C, Part III, and test it to verify compliance with Item 300, "Asphalts, Oils, and Emulsions." The Engineer will notify the Contractor when the sampling will occur and will witness the collection of the sample from the asphalt distributor immediately before use. Label the can with the corresponding lot and sublot numbers, producer, producer facility, grade, district, date sampled, and project information including highway and CSJ. For emulsions, the Engineer may test as often as necessary to ensure the residual of the emulsion is greater than or equal to the specification requirement in Item 300, "Asphalts, Oils, and Emulsions."

4.7.3. **Lay-Down Operations.** Use the placement temperature in accordance with Table 8 to establish the minimum placement temperature of the mixture delivered to the paving operation.

Table 8
Minimum Mixture Placement Temperature

High-Temperature Binder Grade[1]	Minimum Placement Temperature (Before Entering Paving Operation)[2,3]
PG 76	280˚F
A-R Binder	280˚F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. The mixture temperature must be measured using a hand-held thermal camera or infrared thermometer nearest to the point of entry of the paving operation.
3. Minimum placement temperatures may be reduced 10°F if using a compaction aid.

4.7.3.1. **Thermal Profile.** Use a hand-held thermal camera or a thermal imaging system to obtain a continuous thermal profile in accordance with Tex-244-F. Thermal profiles are not applicable in areas described in Section 3079.4.9.3.2., "Miscellaneous Areas."

4.7.3.1.1. **Thermal Segregation.**

4.7.3.1.1.1. **Moderate.** Any areas that have a temperature differential greater than 25°F, but not exceeding 50°F.

4.7.3.1.1.2. **Severe.** Any areas that have a temperature differential greater than 50°F.

4.7.3.1.2. **Thermal Imaging System.** Review the output results when a thermal imaging system is used, and provide the report described in Tex-244-F to the Engineer daily. Modify the paving process as necessary to eliminate any recurring (moderate or severe) thermal segregation identified by the thermal imaging system.

The Engineer may suspend subsequent paving operations if the Contractor cannot successfully modify the paving process to eliminate recurring severe or moderate thermal segregation.

Provide the Engineer with electronic copies of all daily data files that can be used with the thermal imaging system software to generate temperature profile plots daily or as requested by the Engineer.

4.7.3.1.2.1. **Thermal Camera.** When using a thermal camera instead of the thermal imaging system, take immediate corrective action to eliminate recurring moderate thermal segregation when a hand-held thermal camera is used. Provide the Engineer with the thermal profile of every sublot within one working day of the completion of each lot. When requested by the Engineer, provide the electronic files generated using the thermal camera. Report the results of each thermal profile in accordance with Section 3079.4.2., "Reporting and Responsibilities." The Engineer will use a hand-held thermal camera to obtain a thermal profile at least once per project. Suspend operations and take immediate corrective action to eliminate severe thermal segregation unless otherwise directed. Resume operations when the Engineer determines that subsequent production will meet the requirements of this Section.

4.7.3.2. **Windrow Operations.** Operate windrow pickup equipment so that when hot-mix is placed in windrows, substantially all the mixture deposited on the roadbed is picked up and loaded into the paver.

4.7.3.3. **Hauling Equipment.** Use belly dumps, live bottom, or end dump trucks to haul and transfer mixture; however, with exception of paving miscellaneous areas, end dump trucks are only allowed when used in conjunction with an MTD with remixing capability or when a thermal imaging system is used unless otherwise allowed.

4.7.3.4. **Screed Heaters.** Turn off screed heaters to prevent overheating of the mat if the paver stops for more than 5 min. The Engineer may evaluate the suspect area in accordance with Section 3079.4.9.3.3., "Recovered Asphalt Dynamic Shear Rheometer (DSR)," if the screed heater remains on for more than 5 min. while the paver is stopped.

4.8. **Compaction.** Roll the freshly placed PFC with as many steel-wheeled rollers as necessary, operated in static mode, to seat the mixture without excessive breakage of the aggregate and to provide a smooth surface and uniform texture. Do not use pneumatic rollers. Moisten the roller drums thoroughly with a soap and water solution to prevent adhesion. Use only water or an approved release agent on rollers, tamps, and

other compaction equipment unless otherwise directed.

Use Tex-246-F to test and verify that the compacted mixture has adequate permeability. Measure the water flow once per sublot at locations directed by the Engineer. The water flow rate must be less than 20 sec. Investigate the cause of the water flow rate test failures and take corrective actions during production and placement to ensure the water flow rate is less than 20 sec. Suspend production if two consecutive water flow rate tests fail unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

Complete all compaction operations before the pavement temperature drops below 180°F unless otherwise allowed. The Engineer may allow compaction with a light finish roller operated in static mode for pavement temperatures below 180°F.

Allow the compacted pavement to cool to 160°F or lower before opening to traffic unless otherwise directed. Sprinkle the finished mat with water or limewater, when directed, to expedite opening the roadway to traffic.

4.9. **Acceptance Plan.** Sample and test the hot-mix on a lot and sublot basis.

4.9.3. **Referee Testing.** The Materials and Tests Division is the referee laboratory. The Contractor may request referee testing if the differences between Contractor and Engineer test results exceed the operational tolerances in accordance with Table 6 and the differences cannot be resolved. The Contractor may also request referee testing if the Engineer's test results require suspension of production and the Contractor's test results are within specification limits. Make the request within five working days after receiving test results and cores from the Engineer. Referee tests will be performed only on the sublot in question and only for the particular tests in question. Allow 10 working days from the time the referee laboratory receives the samples for test results to be reported. The Department may require the Contractor to reimburse the Department for referee tests if more than three referee tests per project are required and the Engineer's test results are closer to the referee test results than the Contractor's test results.

4.9.4. **Production Acceptance**.

4.9.4.1. **Production Lot.** A production lot consists of four equal sublots. The default quantity for Lot 1 is 1,000 ton; however, when requested by the Contractor, the Engineer may increase the quantity for Lot 1 to no more than 2,000 ton. The Engineer will select subsequent lot sizes based on the anticipated daily production such that approximately three to four sublots are produced each day. The lot size will be between 1,000 ton and 4,000 ton. The Engineer may change the lot size before the Contractor begins any lot.

4.9.4.1.1. **Incomplete Production Lots.** If a lot is begun but cannot be completed, such as on the last day of production or in other circumstances deemed appropriate, the Engineer may close the lot. Close all lots within five working days unless otherwise allowed.

4.9.4.2. **Production Sampling**.

4.9.4.2.1. **Mixture Sampling.** Obtain hot-mix samples from trucks at the plant in accordance with Tex-222-F. The sampler will split each sample into three equal portions in accordance with Tex-200-F and label these portions as "Contractor," "Engineer," and "Referee." The Engineer will perform or witness the sample splitting and take immediate possession of the samples labeled "Engineer" and "Referee." The Engineer will maintain the custody of the samples labeled "Engineer" and "Referee" until the Department's testing is completed.

4.9.4.2.1.1. **Random Sample.** At the beginning of the project, the Engineer will select random numbers for all production sublots. Determine sample locations in accordance with Tex-225-F. Take one sample for each sublot at the randomly selected location. The Engineer will perform or witness the sampling of production sublots.

4.9.4.2.1.2. **Blind Sample.** For one sublot per lot, the Engineer will obtain and test a "blind" sample instead of the random sample collected by the Contractor. Test either the "blind" or the random sample; however, referee testing (if applicable) will be based on a comparison of results from the "blind" sample. The location of the Engineer's "blind" sample will not be disclosed to the Contractor. The Engineer's "blind" sample may be randomly selected in accordance with Tex-225-F for any sublot or selected at the discretion of the Engineer. The

Engineer will use the Contractor's split sample for sublots not sampled by the Engineer.

4.9.4.2.2. **Informational Shear Bond Strength Testing.** Select one random sublot from Lot 2 or higher for shear bond strength testing. Obtain full depth cores in accordance with Tex-249-F. Label the cores with the Control Section Job (CSJ), producer of the tack coat, mix type, shot rate, lot, and sublot number and provide to the Engineer. The Engineer will ship the cores to the Materials and Tests Division or district laboratory for shear bond strength testing. Results from these tests will not be used for specification compliance.

4.9.4.2.3. **Informational Hamburg and Overlay Testing.** Select one random sublot from Lot 2 or higher for Hamburg and Overlay testing during the first week of production. Obtain and provide the Engineer with approximately 90 lb. of mixture, sampled in accordance with Tex-222-F, in sealed containers, boxes, or bags labeled with the Control-Section-Job (CSJ), mixture type, lot, and sublot number. The Engineer will ship the mixture to the Materials and Tests Division for Hamburg and Overlay testing. Results from these tests will not be used for specification compliance.

4.9.4.2.4. **Asphalt Binder Sampling.** Obtain a 1 qt. (1 gal. for A-R binder) sample of the asphalt binder witness by the Engineer for each lot of mixture produced. The Contractor will notify the Engineer when the sampling will occur. Obtain the sample at approximately the same time the mixture random sample is obtained. Sample from a port located immediately upstream from the mixing drum or pug mill and upstream from the introduction of any additives in accordance with Tex-500-C, Part II. Label the can with the corresponding lot and sublot numbers, producer, producer facility, grade, district, date sampled, and project information including highway and CSJ. The Engineer will retain these samples for one year. The Engineer may also obtain independent samples. If obtaining an independent asphalt binder sample and upon request of the Contractor, the Engineer will split a sample of the asphalt binder with the Contractor

At least once per project, the Engineer will collect split samples of each binder grade and source used. The Engineer will submit one split sample to the Materials and Tests Division to verify compliance with Item 300, "Asphalts, Oils, and Emulsions" and will retain the other split sample for one year.

4.9.4.3. **Production Testing.** The Contractor and Engineer must perform production tests in accordance with Table 9. The Contractor has the option to verify the Engineer's test results on split samples provided by the Engineer. Determine compliance with operational tolerances in accordance with Table 6 for all sublots.

At any time during production, the Engineer may require the Contractor to verify the following based on quantities used:

- lime content (within ±0.1% of JMF), when PG binder is specified;
- fiber content (within ±0.03% of JMF), when PG binder is specified; and
- CRM content (within ±1.5% of JMF), when A-R binder is specified.

Maintain the in-line measuring device when A-R binder is specified to verify the A-R binder viscosity between 2,500 and 4,000 centipoise at 350°F unless otherwise approved. Record A-R binder viscosity at least once per hour and provide the Engineer with a daily summary unless otherwise directed.

If the aggregate mineralogy is such that Tex-236-F, Part I does not yield reliable results, the Engineer may allow alternate methods for determining the asphalt content and aggregate gradation. The Engineer will require the Contractor to provide evidence that results from Tex-236-F, Part I are not reliable before permitting an alternate method unless otherwise allowed. Use the applicable test procedure as directed if an alternate test method is allowed.

Table 9
Production and Placement Testing Frequency

Description	Test Method	Minimum Contractor Testing Frequency	Minimum Engineer Testing Frequency
Individual % retained for sieve sized larger than #200 % passing the #200 sieve	Tex-200-F	1 per sublot	1 per 12 sublots
Laboratory-molded density, %	Tex-207-F, Part VIII	1 per sublot	1 per lot
Asphalt binder content[1], %	Tex-236-F, Part I[2]	1 per sublot	1 per lot
Drain-down, %	Tex-235-F	1 per sublot	1 per 12 sublots
Boil test[3]	Tex-530-C	1 per project	1 per project
Moisture content	Tex-212-F, Part II	When directed	1 per project
Cantabro loss, %	Tex-245-F	1 per project (sample only)	1 per project
Overlay test	Tex-248-F	1 per project (sample only)	1 per project[4,9]
Hamburg Wheel test	Tex-242-F	1 per project (sample only)	1 per project[4,9]
Water flow test	Tex-246-F	1 per sublot	1 per project
Asphalt binder sampling	Tex-500-C, Part II	1 per lot (sample only)[5]	1 per project
Tack coat sampling and testing	Tex-500-C, Part III	N/A	1 per project
Thermal profile	Tex-244-F	1 per sublot,[6,7,8]	1 per project[7]

1. May be obtained from t mass flow meter readouts as determined by the Engineer.
2. Ensure the binder content determination excludes fibers.
3. When shown on the plans.
4. Testing performed by the Materials and Tests Division on sample obtained from Lot 2 or higher.
5. Obtain samples witness by the Engineer. The Engineer will retain these samples for one year.
6. To be performed in the presence of the Engineer when using the thermal camera, unless otherwise approved.
7. Not required when a thermal imaging system is used.
8. When using the thermal imaging system, the test report must include the temperature measurements taken in accordance with Tex-244-F.
9. Testing performed by the Materials and Tests Division for informational purposes only.

4.9.4.4. **Operational Tolerances.** Control the production process within the operational tolerances in accordance with Table 6. Suspend production and placement operations when production or placement test results exceed the tolerances in accordance with Table 6 unless otherwise allowed. When production is suspended, the Engineer will allow production to resume when test results or other information indicates the next mixture produced will be within the operational tolerances.

4.9.4.5. **Individual Loads of Hot-Mix.** The Engineer can reject individual truckloads of hot-mix. When a load of hot-mix is rejected for reasons other than temperature, contamination, or excessive uncoated particles, the Contractor may request that the rejected load be tested. Make this request within 4 hr. of rejection. The Engineer will sample and test the mixture. If test results are within the operational tolerances in accordance with Table 6, payment will be made for the load. If test results are not within operational tolerances, no payment will be made for the load.

4.9.5. **Placement Acceptance.**

4.9.5.1. **Placement Lot.** A placement lot consists of four placement sublots. A placement sublot consists of the area placed during a production sublot.

4.9.5.2. **Miscellaneous Areas.** Miscellaneous areas include areas that typically involve significant handwork or discontinuous paving operations such as driveways, mailbox turnouts, crossovers, gores, spot level-up

areas, and other similar areas. The specified layer thickness is based on the rate of 90 lb. per square yard for each inch of pavement unless another rate is shown on the plans. Miscellaneous areas are not subject to thermal profiles testing.

4.9.5.3. **Recovered Asphalt Dynamic Shear Rheometer (DSR).** The Engineer may take production samples or cores from suspect areas of the project to determine recovered asphalt properties. Asphalt binders with an aging ratio greater than 3.5 do not meet the requirements for recovered asphalt properties and may be deemed defective when tested and evaluated by the Materials and Tests Division. The aging ratio is the DSR value of the extracted binder divided by the DSR value of the original unaged binder. Obtain DSR values in accordance with AASHTO T 315 at the specified high temperature performance grade of the asphalt. The Engineer may require removal and replacement of the defective material at the Contractor's expense. The asphalt binder will be recovered for testing from production samples or cores in accordance with Tex-211-F.

4.9.5.4. **Irregularities.** Identify and correct irregularities, including segregation, rutting, raveling, flushing, fat spots, mat slippage, irregular color, irregular texture, roller marks, tears, gouges, streaks, uncoated aggregate particles, or broken aggregate particles. The Engineer may also identify irregularities, and in such cases, the Engineer will promptly notify the Contractor. If the Engineer determines that the irregularity will adversely affect pavement performance, the Engineer may require the Contractor to remove and replace (at the Contractor's expense) areas of the pavement that contain irregularities. The Engineer may also require the Contractor to remove and replace (at the Contractor's expense) areas where the mixture does not bond to the existing pavement.

If irregularities are detected, the Engineer may require the Contractor to immediately suspend operations or may allow the Contractor to continue operations for no more than one day while the Contractor is taking appropriate corrective action.

4.9.6. **Exempt Production.** When the anticipated daily production is less than 100 ton, all QC and QA sampling and testing are waived. The Engineer may deem the mixture as exempt production for the following conditions:

- anticipated daily production is more than 100 ton but less than 250 ton;
- total production for the project is less than 2,500 ton;
- when mutually agreed between the Engineer and the Contractor; or
- when shown on the plans.

For exempt production, the Contractor is relieved of all production and placement sampling and testing requirements. All other specification requirements apply, and the Engineer will perform acceptance tests for production and placement in accordance with Table 9.

For exempt production:

- produce, haul, place, and compact the mixture as directed by the Engineer; and
- control mixture production to yield a laboratory-molded density that is within ±1.0% of the target density as tested by the Engineer.

4.9.7. **Ride Quality.** Measure ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.

5. MEASUREMENT

5.1. **PFC Hot-Mix Asphalt.** Permeable friction course (PFC) hot-mix will be measured by the ton of composite mixture which includes asphalt, aggregate, and additives. Measure the weight on scales in accordance with Item 520, "Weighing and Measuring Equipment.

5.2. **Tack Coat.** Tack coat will be measured at the applied temperature by strapping the tank before and after road application and determining the net volume in gallons from the calibrated distributor. The Engineer will witness all strapping operations for volume determination. All tack, including emulsions, will be measured by the gallon applied.

The Engineer may allow the use of a metering device to determine asphalt volume used and application rate if the device is accurate to within 1.5% of the strapped volume.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under Section 3079.5.1., "PFC Hot-Mix Asphalt," will be paid for at the unit bid price for "Permeable friction course Hot Mix Asphalt" of the mixture type, SAC, and binder specified. These prices are full compensation for surface preparation, materials, placement, equipment, labor, tools, and incidentals.

The work performed and materials furnished in accordance with this Item and measured as provided under Section 3079.5.2., "Tack Coat," will be paid for at the unit bid price for "Tack Coat" of the tack coat provided. These prices are full compensation for materials, placement, equipment, labor, tools, and incidentals.

Trial batches will not be paid for unless they are included in pavement work approved by the Department.

Payment adjustment for ride quality will be determined in accordance with Item 585, "Ride Quality for Pavement Surfaces."

Special Specification 3081
Thin Overlay Mixtures

1. DESCRIPTION

Construct a thin surface course composed of a compacted mixture of aggregate and asphalt binder mixed hot in a mixing plant. Produce a thin overlay mixture (TOM) with a minimum lift thickness of 1/2 in. for a Type F mixture and 3/4 in. for a Type C mixture.

2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

Notify the Engineer of all material sources and before changing any material source or formulation. The Engineer will verify that the specification requirements are met when the Contractor makes a source or formulation change, and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time during the project to verify specification compliance in accordance with Item 6, "Control of Materials."

2.1. **Aggregate.** Furnish aggregates from sources that conform to the requirements in accordance with Table 1 and as specified in this Section. Aggregate requirements in this Section, including those shown in Table 1, may be modified or eliminated when shown on the plans. Additional aggregate requirements may be specified when shown on the plans. Provide aggregate stockpiles that meet the definitions in this Section for coarse, intermediate, or fine aggregate. Do not use reclaimed asphalt pavement (RAP) or recycled asphalt shingles (RAS). Supply aggregates that meet the definitions in accordance with Tex-100-E for crushed gravel or crushed stone. The Engineer will designate the plant or the quarry as the sampling location. Provide samples from materials produced for the project. The Engineer will establish the Surface Aggregate Classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests in accordance with Table 1. Document all test results on the mixture design report. The Engineer may perform tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately. Determine aggregate gradations for mixture design and production testing based on the washed sieve analysis in accordance with Tex-200-F, Part II.

2.1.1. **Coarse Aggregate.** Coarse aggregate stockpiles must have no more than 20% material passing the No. 8 sieve. Aggregates from sources listed in the Department's *Bituminous Rated Source Quality Catalog* (BRSQC) are preapproved for use. Use only the rated values for hot-mix listed in the BRSQC. Rated values for surface treatment (ST) do not apply to coarse aggregate sources used in hot-mix asphalt.

For sources not listed on the Department's BRSQC:

- build an individual stockpile for each material;
- request the Department test the stockpile for specification compliance;
- approved only when tested by the Engineer;
- once approved, do not add material to the stockpile unless otherwise approved; and
- allow 30 calendar days for the Engineer to sample, test, and report results.

2.1.1.1. **Blending Class A and Class B Aggregates.** Class B aggregate meeting all other requirements in blending Class A and B aggregates to meet a Class A requirement, ensure that at least 50% by weight, or volume if required, of all aggregates used in the mixture design retained on the No. 8 sieve comes from the Class A

aggregate source, unless otherwise shown on the plans. Blend by volume if the bulk specific gravities of the Class A and B aggregates differ by more than 0.300. Class B aggregate may be disallowed when shown on the plans.

The Engineer may perform tests at any time during production, when the Contractor blends Class A and B aggregates to meet a Class A requirement, to ensure that at least 50% by weight, or volume if required, of the material retained on the No. 8 sieve comes from the Class A aggregate source. The Engineer will use the Department's mix design template, when electing to verify conformance, to calculate the percent of Class A aggregate retained on the No. 8 sieve by inputting the bin percentages shown from readouts in the control room at the time of production and stockpile gradations measured at the time of production. The Engineer may determine the gradations based on either washed or dry sieve analysis from samples obtained from individual aggregate cold feed bins or aggregate stockpiles. The Engineer may perform spot checks using the gradations supplied by the Contractor on the mixture design report as an input for the template; however, a failing spot check will require confirmation with a stockpile gradation determined by the Engineer.

2.1.1.2. **Micro-Deval Abrasion.** The Engineer will perform a minimum of one Micro-Deval abrasion test in accordance with Tex-461-A for each coarse aggregate source used in the mixture design that has a Rated Source Soundness Magnesium (RSSM) loss value greater than 15 as listed in the BRSQC, unless otherwise directed. The Engineer will perform testing before the start of production and may perform additional testing at any time during production. The Engineer may obtain the coarse aggregate samples from each coarse aggregate source or may require the Contractor to obtain the samples. The Engineer may waive all Micro-Deval testing based on a satisfactory test history of the same aggregate source.

The Engineer will estimate the magnesium sulfate soundness loss for each coarse aggregate source, when tested, using the following formula:

$$Mg_{est.} = (RSSM)(MD_{act.}/RSMD)$$

where:
Mg_{est} = magnesium sulfate soundness loss
$RSSM$ = Rated Source Soundness Magnesium
MD_{act} = actual Micro-Deval percent loss
$RSMD$ = Rated Source Micro-Deval

When the estimated magnesium sulfate soundness loss is greater than the maximum magnesium sulfate soundness loss specified, the coarse aggregate source will not be allowed for use unless otherwise approved. The Engineer will consult the Soils and Aggregates Section of the Materials and Tests Division, and additional testing may be required before granting approval.

2.1.2. **Intermediate Aggregate.** Aggregates not meeting the definition of coarse or fine aggregate will be defined as intermediate aggregate. Supply intermediate aggregates, when used that are free from organic impurities. The Engineer may test the intermediate aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. Supply intermediate aggregate from coarse aggregate sources, when used that meet the requirements in accordance with Table 1 unless otherwise approved.

If 10% or more of the stockpile is retained on the No. 4 sieve, verify that it meets the requirements in accordance with Table 1 for crushed face count (Tex-460-A) and flat and elongated particles (Tex-280-F).

2.1.3. **Fine Aggregate.** Fine aggregates consist of manufactured sands and screenings. Natural sands are not allowed in any mixture. Fine aggregate stockpiles must meet the fine aggregate properties in accordance with Table 1 and the gradation requirements in accordance with Table 2. Supply fine aggregates that are free from organic impurities. The Engineer may test the fine aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. Use fine aggregate from coarse aggregate sources that meet the requirements in accordance with Table 1 unless otherwise approved.

If 10% or more of the stockpile is retained on the No. 4 sieve, verify that it meets the requirements in accordance with Table 1 for crushed face count (Tex-460-A) and flat and elongated particles (Tex-280-F).

Table 1
Aggregate Quality Requirements

Property	Test Method	Requirement
Coarse Aggregate		
SAC	Tex-499-A	A[1]
Deleterious material, %, Max	Tex-217-F, Part I	1.5
Decantation, %, Max	Tex-217-F, Part II	1.5
Micro-Deval abrasion, %	Tex-461-A	Note [2]
Los Angeles abrasion, %, Max	Tex-410-A	30
Magnesium sulfate soundness, 5 cycles, %, Max	Tex-411-A	20
Crushed face count,[3] %, Min	Tex-460-A, Part I	95
Flat and elongated particles @ 5:1, %, Max	Tex-280-F	10
Fine Aggregate		
Linear shrinkage, %, Max	Tex-107-E	3
Sand equivalent, %, Min	Tex-203-F	45

1. Surface Aggregate Classification of "A" is required unless otherwise shown on the plans.
2. Used to estimate the magnesium sulfate soundness loss in accordance with Section 3081.2.1.1.2., "Micro-Deval Abrasion."
3. Only applies to crushed gravel.

Table 2
Gradation Requirements for Fine Aggregate

Sieve Size	% Passing by Weight or Volume
3/8"	100
#8	70–100
#200	0–30

2.2. **Mineral Filler.** Mineral filler consists of finely divided mineral matter such as agricultural lime, crusher fines, or hydrated lime. Mineral filler is allowed unless otherwise shown on the plans. Fly ash is not permitted unless otherwise shown on the plans. Use no more than 2% hydrated lime unless otherwise shown on the plans. Test all mineral fillers except hydrated lime and fly ash in accordance with Tex-107-E to ensure specification compliance. The plans may require or disallow specific mineral fillers. Provide mineral filler, when used, that:

- is sufficiently dry, free-flowing, and free from clumps and foreign matter as determined by the Engineer;
- does not exceed 3% linear shrinkage when tested in accordance with Tex-107-E; and
- meets the gradation requirements in Table 3, unless otherwise shown on the plans.

Table 3
Gradation Requirements for Mineral Filler

Sieve Size	% Passing by Weight or Volume
#8	100
#200	55–100

2.3. **Baghouse Fines.** Fines collected by the baghouse or other dust-collecting equipment may be reintroduced into the mixing drum.

2.4. **Asphalt Binder.** Furnish performance-graded (PG) asphalt binder with a high temperature grade of PG 76 unless otherwise shown in the plans and a low temperature grade as shown on the plans, in accordance with Section 300.2.10., "Performance-Graded Binders."

2.5. **Tack Coat.** Furnish CSS-1H, SS-1H, EBL, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300, "Asphalts, Oils, and Emulsions." Specialized tack coat materials listed on the Department's Tracking Resistant Asphalt Interlayer (TRAIL) MPL may be allowed or required when shown on the plans. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

2.6. **Additives.** Provide the Engineer with documentation such as the bill of lading showing the quantity of additives used in the project unless otherwise directed.

2.6.1. **Lime and Liquid Antistripping Agent.** When lime or a liquid antistripping agent is used, add in accordance with Item 301, "Asphalt Antistripping Agents." Use no more than 1% hydrated lime when using crushed gravel. Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime into the drum.

2.6.2. **Compaction Aid.** Compaction Aid is defined as a department-approved chemical warm mix additive denoted as "chemical additive" on the Department's materials producer list (MPL) that is used to facilitate mixing and compaction of HMA.

Compaction Aid is allowed for use on all projects. Compaction aid is required when shown on the plans or as required in Section 3081.4.7.1., "Weather Conditions."

Warm mix foaming processes, denoted as "foaming process" on the Department-approved MPL, may be used to facilitate mixing and compaction of HMA; however warm mix foaming processes are not defined as a Compaction Aid.

2.7. **Recycled Materials.** Recycled materials are not allowed for use.

3. EQUIPMENT

Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement."

4. CONSTRUCTION

Produce, haul, place, and compact the specified paving mixture. In addition to tests required by the specification, Contractors may perform other QC tests as deemed necessary. At any time during the project, the Engineer may perform production and placement tests as deemed necessary in accordance with Item 5, "Control of the Work." Schedule and participate in a mandatory pre-paving meeting with the Engineer on or before the first day of paving unless otherwise shown on the plans.

4.1. **Certification.** Personnel certified by the Department-approved hot-mix asphalt certification program must conduct all mixture designs, sampling, and testing in accordance with Table 4. Supply the Engineer with a list of certified personnel and copies of their current certificates before beginning production and when personnel changes are made. Provide a mixture design developed and signed by a Level 2 certified specialist. Provide Level 1A certified specialists at the plant during production operations. Provide Level 1B certified specialists to conduct placement tests. Provide AGG101 certified specialists for aggregate testing.

Table 4
Test Methods, Test Responsibility, and Minimum Certification Levels

Test Description	Test Method	Contractor	Engineer	Level[1]
1. Aggregate Testing				
Sampling	Tex-221-F	✓	✓	1A/AGG101
Dry sieve	Tex-200-F, Part I	✓	✓	1A/AGG101
Washed sieve	Tex-200-F, Part II	✓	✓	1A/AGG101
Deleterious material	Tex-217-F, Part I	✓	✓	AGG101
Decantation	Tex-217-F, Part II	✓	✓	AGG101
Los Angeles abrasion	Tex-410-A		✓	Department
Magnesium sulfate soundness	Tex-411-A		✓	Department
Micro-Deval abrasion	Tex-461-A		✓	AGG101
Crushed face count	Tex-460-A	✓	✓	AGG101
Flat and elongated particles	Tex-280-F	✓	✓	AGG101
Sand equivalent	Tex-203-F	✓	✓	AGG101
Organic impurities	Tex-408-A	✓	✓	AGG101
Methylene blue test	Tex-252-F		✓	Department
2. Asphalt Binder & Tack Coat Sampling				
Asphalt binder sampling	Tex-500-C, Part II	✓	✓	1A/1B
Tack coat sampling	Tex-500-C, Part III	✓	✓	1A/1B
3. Mix Design & Verification				
Design and JMF changes	Tex-204-F	✓	✓	2
Mixing	Tex-205-F	✓	✓	2
Molding (TGC)	Tex-206-F	✓	✓	1A
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F, Parts I & VI	✓	✓	1A
Rice gravity	Tex-227-F, Part II	✓	✓	1A
Drain-down	Tex-235-F	✓	✓	1A
Ignition oven correction factors[2]	Tex-236-F, Part II	✓	✓	2
Indirect tensile strength	Tex-226-F	✓	✓	1A
Overlay test	Tex-248-F		✓	Department
Hamburg Wheel test	Tex-242-F	✓	✓	1A
Boil test[4]	Tex-530-C	✓	✓	1A
4. Production Testing				
Selecting production random numbers	Tex-225-F, Part I		✓	1A
Mixture sampling	Tex-222-F	✓	✓	1A/1B
Molding (TGC)	Tex-206-F	✓	✓	1A
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F, Parts I & VI	✓	✓	1A
Rice gravity	Tex-227-F, Part II	✓	✓	1A
Gradation & asphalt binder content[2]	Tex-236-F, Part I	✓	✓	1A
Drain-down	Tex-235-F	✓	✓	1A
Control charts	Tex-233-F	✓	✓	1A
Moisture content	Tex-212-F, Part II	✓	✓	1A/AGG101
Hamburg Wheel test	Tex-242-F	✓	✓	1A
Overlay test	Tex-248-F	✓	✓	Department
Micro-Deval abrasion	Tex-461-A		✓	AGG101
Boil test[4]	Tex-530-C	✓	✓	1A
Absorn recovery	Tex-211-F		✓	Department
5. Placement Testing				
Establish rolling pattern	Tex-207-F, Part IV	✓		1B
In-place density (nuclear method)	Tex-207-F, Part III	✓		1B
Control charts	Tex-233-F	✓	✓	1A
Ride quality measurement	Tex-1001-S	✓	✓	Note 3
Thermal profile	Tex-244-F	✓	✓	1B
Water flow test	Tex-246-F	✓	✓	1B

1. Level 1A, 1B, AGG101, and 2 are certification levels provided by the Hot Mix Asphalt Center certification program.
2. Refer to Section 3081.4.9.2.3., "Production Testing," for exceptions to using an ignition oven.
3. Profiler and operator are required to be certified at the Texas A&M Transportation Institute facility when Surface Test Type B is specified.
4. When shown on the plans.

4.2. **Reporting and Responsibilities.** Use Department-provided templates to record and calculate all test data, including mixture design, production and placement QC/QA, control charts, and thermal profiles. Obtain the current version of the templates at https://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/forms/site-manager.html or from the Engineer. The Engineer and the Contractor will provide any available test results to the other party when requested. The maximum allowable time for the Contractor and Engineer to exchange test data is as given in Table 5 unless otherwise approved. The Engineer and the Contractor will immediately report to the other party any test result that requires suspension of production or placement or that fails to meet the specification requirements. Record and electronically submit all test results and pertinent information on Department-provided templates.

Subsequent sublots placed after test results are available to the Contractor, which require suspension of operations, may be considered unauthorized work. Unauthorized work will be accepted or rejected at the discretion of the Engineer in accordance with Section 5.3., "Conformity with Plans, Specifications, and Special Provisions."

Table 5
Reporting Schedule

Description	Reported By	Reported To	To Be Reported Within
Production Quality Control			
Gradation[1]	Contractor	Engineer	1 working day of completion of the sublot
Asphalt binder content[1]			
Laboratory-molded density[2]			
Moisture content[3]			
Boil test[5]			
Production Quality Assurance			
Gradation[3]	Engineer	Contractor	1 working day of completion of the sublot
Asphalt binder content[3]			
Laboratory-molded density[1]			
Hamburg Wheel test[4]			
Overlay test[4]			
Boil test[5]			
Binder tests[4]			
Placement Quality Control			
Thermal profile[1]	Contractor	Engineer	1 working day of completion of the lot
Water flow[1]			
Placement Quality Assurance			
Thermal profile[3]	Engineer	Contractor	1 working day of completion of the lot
Aging ratio[4]			
Water flow			

1. These tests are required on every sublot.
2. Optional test. When performed on split samples, report the results as soon as they become available.
3. To be performed at the frequency specified and in accordance with Table 13 or as shown on the plans.
4. To be reported as soon as the results become available.
5. When shown on the plans.

Use the procedures described in Tex-233-F to plot the results of all quality control (QC) and quality assurance (QA) testing. Update the control charts as soon as test results for each sublot become available. Make the control charts readily accessible at the field laboratory. The Engineer may suspend production for failure to update control charts.

4.3. **Quality Control Plan (QCP).** Develop and follow the QCP in detail. Obtain approval for changes to the QCP made during the project. The Engineer may suspend operations if the Contractor fails to comply with the QCP.

Submit a written QCP before the mandatory pre-paving meeting. Receive approval of the QCP before pre-paving meeting. Include the following items in the QCP:

4.3.1. **Project Personnel**. For project personnel, include:

- a list of individuals responsible for QC with authority to take corrective action;
- current contact information for each individual listed; and
- current copies of certification documents for individuals performing specified QC functions.

4.3.2. **Material Delivery and Storage.** For material delivery and storage, include:

- the sequence of material processing, delivery, and minimum quantities to assure continuous plant operations;
- aggregate stockpiling procedures to avoid contamination and segregation;
- frequency, type, and timing of aggregate stockpile testing to assure conformance of material requirements before mixture production; and
- procedure for monitoring the quality and variability of asphalt binder.

4.3.3. **Production.** For production, include:

- loader operation procedures to avoid contamination in cold bins;
- procedures for calibrating and controlling cold feeds;
- procedures to eliminate debris or oversized material;
- procedures for adding and verifying rates of each applicable mixture component (e.g., aggregate, asphalt binder, lime, liquid antistrip, compaction aid, foaming process);
- procedures for reporting job control test results; and
- procedures to avoid segregation and drain-down in the silo.

4.3.4. **Loading and Transporting.** For loading and transporting, include:

- type and application method for release agents; and
- truck loading procedures to avoid segregation.

4.3.5. **Placement and Compaction.** For placement and compaction, include:

- proposed agenda for mandatory pre-paving meeting, including date and location;
- proposed paving plan (e.g., production rate, paving widths, joint offsets, and lift thicknesses);
- type and application method for release agents in the paver and on rollers, shovels, lutes, and other utensils;
- procedures for the transfer of mixture into the paver, while avoiding physical and thermal segregation and preventing material spillage;
- process to balance production, delivery, paving, and compaction to achieve continuous placement operations and good ride quality;
- paver operations (e.g., speed, operation of wings, height of mixture in auger chamber) to avoid physical and thermal segregation and other surface irregularities; and
- procedures to construct quality longitudinal and transverse joints.

4.4. **Mixture Design.**

4.4.1. **Design Requirements.** The Contractor may design the mixture using a Texas Gyratory Compactor (TGC) or a Superpave Gyratory Compactor (SGC) unless otherwise shown on the plans. Use the typical weight design example given in Tex-204-F, Part I, when using a TGC. Use the Superpave mixture design procedure provided in Tex-204-F, Part IV, when using a SGC. Design the mixture to meet the requirements in accordance with Tables 1, 2, 3, 6, and 7.

4.4.1.1. **Target Laboratory-Molded Density When the TGC Is Used.** Design the mixture at a 97.5% target laboratory-molded density or in accordance with Table 7.

4.4.1.2. **Design Number of Gyrations (Ndesign) When the SGC Is Used.** Design the mixture at 50 gyrations (Ndesign). Use a target laboratory-molded density of 96.0% to design the mixture; however, adjustments can be made to the Ndesign value as noted in Table 7. The Ndesign level may be reduced to no less than 35 gyrations at the Contractor's discretion.

Use an approved laboratory from the Department's MPL to perform the Hamburg Wheel test, and the Department will perform the Overlay test and provide results with the mixture design, or provide the laboratory mixture and request that the Department perform the Hamburg Wheel test and Overlay test. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test and Overlay test results on the laboratory mixture design.

The Engineer will provide the mixture design when shown on the plans. The Contractor may submit a new mixture design at any time during the project. The Engineer will verify and approve all mixture designs (JMF1) before the Contractor can begin production.

Provide the Engineer with a mixture design report using the Department-provided template. Include the following items in the report:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- the target laboratory-molded density (or Ndesign level when using the SGC);
- results of all applicable tests;
- the mixing and molding temperatures;
- the signature of the Level 2 person or persons that performed the design;
- the date the mixture design was performed; and
- a unique identification number for the mixture design.

Table 6
Master Gradation Limits (% Passing by Weight or Volume) and Volumetric Requirements

Sieve Size	Coarse (TOM-C)	Fine (TOM-F)
1/2"	100.0[1]	100.0[1]
3/8"	95.0–100.0	98.0–100.0
#4	40.0–60.0	70.0–95.0
#8	17.0–27.0	40.0–65.0
#16	5.0–27.0	20.0–45.0
#30	5.0–27.0	10.0–35.0
#50	5.0–27.0	10.0–20.0
#200	5.0–9.0	2.0–12.0
Asphalt Binder Content,[2] % Min		
-	6.0	6.5
Design VMA,[3] % Min		
-	16.0	16.5
Production (Plant-Produced) VMA,[3] % Min		
-	15.5	16.0

1. Defined as maximum sieve size. No tolerance allowed.
2. Unless otherwise shown on the plans or approved by the Engineer.
3. Voids in Mineral Aggregates (VMA).

Table 7
Mixture Design Properties

Mixture Property	Test Method	Requirement
Target laboratory-molded density, % (TGC)	Tex-207-F	97.5[1]
Design gyrations (Ndesign for SGC)	Tex-241-F	50[2]
Hamburg Wheel test, passes at 12.5 mm rut depth for PG 76 mixtures	Tex-242-F	20,000 Min
Overlay test, Critical Fracture Energy, lb.-in/sq. in	Tex-248-F	1.5 Min
Overlay test, Crack Progression Rate	Tex-248-F	0.40 Max
Drain-down, %	Tex-235-F	0.20 Max

1. Unless otherwise shown on the plans or approved by the Engineer. Laboratory-molded density requirement using the TGC may be waived when approved by the Engineer.

2. May be adjusted within the range of 35–100 gyrations when shown on the plans or specification or when mutually agreed between the Engineer and Contractor. Laboratory-molded density requirement using the SGC may be waived when approved by the Engineer.

4.4.1 **Job-Mix Formula Approval.** The job-mix formula (JMF) is the combined aggregate gradation, target laboratory-molded density (or Ndesign level), and target asphalt percentage used to establish target values for hot-mix production. JMF1 is the original laboratory mixture design used to produce the trial batch. When a compaction aid or foaming process is used, JMF1 may be designed and submitted to the Engineer without including the compaction aid or foaming process. When a compaction aid or foaming process is used, document the compaction aid or foaming process used and recommended rate on the JMF1 submittal. The Engineer and the Contractor will verify JMF1 based on plant-produced mixture from the trial batch unless otherwise approved. The Engineer may accept an existing mixture design previously used on a Department project and may waive the trial batch to verify JMF1. The Department may require the Contractor to reimburse the Department for verification tests if more than two trial batches per design are required.

4.4.2.1. **Contractor's Responsibilities.**

4.4.2.1.1. **Providing Gyratory Compactor.** Use a TGC calibrated in accordance with Tex-914-K when electing or required to design the mixture in accordance with Tex-204-F, Part I, for molding production samples. Furnish an SGC calibrated in accordance with Tex-241-F when electing or required to design the mixture in accordance with Tex-204-F, Part IV, for molding production samples. Locate the SGC if used, at the Engineer's field laboratory or make the SGC available to the Engineer for use in molding production samples.

4.4.2.1.2. **Gyratory Compactor Correlation Factors.** Use Tex-206-F, Part II, to perform a gyratory compactor correlation when the Engineer uses a different gyratory compactor. Apply the correlation factor to all subsequent production test results.

4.4.2.1.3. **Submitting JMF1.** Furnish a mix design report (JMF1) with representative samples of all component materials and request approval to produce the trial batch. Provide approximately 25 lb. of the design mixture if opting to have the Department perform the Hamburg Wheel test on the laboratory mixture, and request that the Department perform the test. Provide approximately 60 lb. of the design mixture to perform the Overlay test.

4.4.2.1.4. **Supplying Aggregates.** Provide approximately 40 lb. of each aggregate stockpile unless otherwise directed.

4.4.2.1.5. **Supplying Asphalt.** Provide at least 1 gal. of the asphalt material and enough quantities of any additives proposed for use.

4.4.2.1.6. **Ignition Oven Correction Factors.** Determine the aggregate and asphalt correction factors from the ignition oven in accordance with Tex-236-F, Part II. Provide correction factors that are not more than 12 mo. old. Provide the Engineer with split samples of the mixtures before the trial batch production, including all additives (except water), and blank samples used to determine the correction factors for the ignition oven used for QA testing during production. Correction factors established from a previously approved mixture design may be used for the current mixture design if the mixture design and ignition oven are the same as previously used and the correction factors are not more than 12 mo. old, unless otherwise directed.

4.4.2.1.7. **Boil Test.** When shown on the plans, perform the test and retain the tested sample from Tex-530-C until completion of the project or as directed. Use this sample for comparison purposes during production.

4.4.2.1.8. **Trial Batch Production.** Provide a plant-produced trial batch upon receiving conditional approval of JMF1 and authorization to produce a trial batch, including the compaction aid or foaming process, if applicable, for verification testing of JMF1 and development of JMF2. Produce a trial batch mixture that meets the requirements in accordance with Table 8. The Engineer may accept test results from recent production of the same mixture instead of a new trial batch.

4.4.2.1.9. **Trial Batch Production Equipment.** Use only equipment and materials proposed for use on the project to produce the trial batch.

4.4.2.1.10. **Trial Batch Quantity.** Produce enough quantity of the trial batch to ensure that the mixture meets the specification requirements.

4.4.2.1.11. **Number of Trial Batches.** Produce trial batches as necessary to obtain a mixture that meets the specification requirements.

4.4.2.1.12. **Trial Batch Sampling.** Obtain a representative sample of the trial batch and split it into three equal portions in accordance with Tex-222-F. Label these portions as "Contractor," "Engineer," and "Referee." Deliver samples to the appropriate laboratory as directed.

4.4.2.1.13. **Trial Batch Testing.** Test the trial batch to ensure the mixture produced using the proposed JMF1 meets the mixture requirements in accordance with Table 8. Ensure the trial batch mixture is also in compliance with the requirements in accordance with Tables 6 and 7. Use a Department-approved laboratory listed on the MPL to perform the Hamburg Wheel test on the trial batch mixture or request that the Department perform the Hamburg Wheel test. Provide approximately 25 lb. of the trial batch mixture if opting to have the Department perform the Hamburg Wheel test, and request that the Department perform the test. Obtain and provide approximately 60 lb. of trial batch mixture in sealed containers, boxes, or bags labeled with the CSJ, mixture type, lot, and sublot number in accordance with Tex-222-F for the Overlay test. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test and Overlay test results on the trial batch. Provide the Engineer with a copy of the trial batch test results.

4.4.2.1.14. **Development of JMF2.** Evaluate the trial batch test results after the Engineer grants full approval of JMF1 based on results from the trial batch, determine the optimum mixture proportions, and submit as JMF2. Adjust the asphalt binder content or gradation to achieve the specified target laboratory-molded density. The mixture produced using JMF2 must meet the requirements in accordance with Tables 6 and 7. Verify that JMF2 meets the operation tolerances of JMF1 in accordance with Table 8.

4.4.2.1.15. **Mixture Production.** Use JMF2 to produce Lot 1 after receiving approval for JMF2 and a passing result from the Department's or a Department-approved laboratory's Hamburg Wheel test and the Department's Overlay test on the trial batch. If desired, proceed to Lot 1 production, once JMF2 is approved, at the Contractor's risk without receiving the results from either the Department's Hamburg Wheel test or Overlay test on the trial batch.

Notify the Engineer if electing to proceed without Hamburg Wheel test and Overlay test results from the trial batch. Note that the Engineer may require up to the entire sublot of any mixture failing the Hamburg Wheel test or Overlay test to be removed and replaced at the Contractor's expense.

4.4.2.1.16. **Development of JMF3.** Evaluate the test results from Lot 1, determine the optimum mixture proportions, and submit as JMF3 for use in Lot 2.

4.4.2.1.17. **JMF Adjustments.** If JMF adjustments are necessary to achieve the specified requirements, make the adjustments before beginning a new lot. The adjusted JMF must:

- be provided to the Engineer in writing before the start of a new lot;
- be numbered in sequence to the previous JMF;
- meet the master gradation limits in accordance with Table 6; and
- be within the operational tolerances of JMF2 in accordance with Table 8.

4.4.2.1.18. **Requesting Referee Testing.** Use referee testing, if needed, in accordance with Section 3081.4.9.1., "Referee Testing," to resolve testing differences with the Engineer.

Table 8
Operational Tolerances

Description	Test Method	Allowable Difference between JMF2 and JMF1 Target[1]	Allowable Difference from Current JMF and JMF2[2]	Allowable Difference between Contractor and Engineer[3]
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	Must be Within Master Grading Limits in accordance with Table 6	±3.0[4,5]	±5.0
Individual % retained for sieves smaller than #8 and larger than #200			±3.0[4,5]	±3.0
% passing the #200 sieve			±2.0[4,5]	±1.6
Asphalt binder content, %[6]	Tex-236-F	±0.3	±0.3[5]	±0.3
Laboratory-molded density, %	Tex-207-F	±1.0	±1.0	±1.0
Laboratory-molded bulk specific gravity		N/A	N/A	±0.020
VMA, % Min	Tex-204-F	Note 7	Note 7	N/A
Theoretical Max specific (Rice) gravity	Tex-227-F	N/A	N/A	±0.020
Drain-down, %	Tex-235-F	Note 8	Note 8	N/A

1. JMF1 is the approved laboratory mixture design used for producing the trial batch. JMF2 is the approved mixture design developed from the trial batch used to produce Lot 1.
2. Current JMF is JMF3 or higher. JMF3 is the approved mix design used to produce Lot 2.
3. Contractor may request referee testing only when values exceed these tolerances.
4. When within these tolerances, mixture production gradations may fall outside the master grading limits; however, the % passing the #200 will be considered out of tolerance when outside the master grading limits.
5. Only applies to mixture produced for Lot 1 and higher.
6. Binder content is not allowed to be outside the limits in accordance with Table 6. May be obtained from asphalt meter readouts as determined by the Engineer.
7. Verify that Table 6 requirements are met.
8. Verify that Table 7 requirements are met.

4.4.2.2. **Engineer's Responsibilities.**

4.4.2.2.1. **Gyratory Compactor.** For mixtures designed in accordance with Tex-204-F, Part I, the Engineer will use a Department TGC, calibrated in accordance with Tex-914-K, to mold samples for trial batch and production testing.

For mixtures designed in accordance with Tex-204-F, Part IV, the Engineer will use a Department SGC, calibrated in accordance with Tex-241-F, to mold samples for laboratory mixture design verification. For molding trial batch and production specimens, the Engineer will use the Contractor-provided SGC at the field laboratory or provide and use a Department SGC at an alternate location.

4.4.2.2.2. **Conditional Approval of JMF1 and Authorizing Trial Batch.** The Engineer will review and verify conformance of the following information within two working days of receipt:

- the Contractor's mix design report (JMF1);
- the Department-provided Overlay test results;
- the Contractor-provided Hamburg Wheel test results;
- all required materials including aggregates, asphalt, and additives; and
- the mixture specifications.

The Engineer will grant the Contractor conditional approval of JMF1 if the information provided on the paper copy of JMF1 indicates that the Contractor's mixture design meets the specifications. When the Contractor does not provide Hamburg Wheel test and department provided Overlay test results with laboratory mixture design, 10 working days are allowed for conditional approval of JMF1. The Engineer will base full approval of JMF1 on test results on mixture from the trial batch.

Unless waived, the Engineer will determine the Micro-Deval abrasion loss in accordance with

Section 3081.2.1.1., "Micro-Deval Abrasion." If the Engineer's test results are pending after two working days, conditional approval of JMF1 will still be granted within two working days of receiving JMF1. When the Engineer's test results become available, they will be used for specification compliance.

The Contractor is authorized to produce a trial batch after the Engineer grants conditional approval of JMF1.

4.4.2.2.3. **Hamburg Wheel and Overlay Testing of JMF1.** If the Contractor requests the option to have the Department perform the Hamburg Wheel test on the laboratory mixture, the Engineer will mold samples in accordance with Tex-242-F to verify compliance with the Hamburg Wheel test requirement in Table 7. The Engineer will perform the Overlay test and mold samples in accordance with Tex-248-F to verify compliance with the Overlay test requirements in Table 7. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel and Overlay test results on the laboratory mixture design.

4.4.2.2.4. **Ignition Oven Correction Factors.** The Engineer will use the split samples provided by the Contractor to determine the aggregate and asphalt correction factors for the ignition oven used for QA testing during production in accordance with Tex-236-F, Part II. Provide correction factors that are not more than 12 mo. old.

4.4.2.2.5. **Testing the Trial Batch.** Within one full working day, the Engineer will sample and test the trial batch to ensure that the mixture meets the requirements in accordance with Table 8. The Engineer will mold samples in accordance with Tex-242-F if the Contractor requests the option to have the Department perform the Hamburg Wheel test on the trial batch mixture to verify compliance with Hamburg Wheel test requirements in Table 7. The Engineer will mold samples for the Overlay test in accordance with Tex-248-F to verify compliance with the Overlay test requirement in Table 7.

The Engineer will have the option to perform Tex-530-C on the trial batch when shown on the plans. These results may be retained and used for comparison purposes during production.

4.4.2.2.6. **Full Approval of JMF1.** The Engineer will grant full approval of JMF1 and authorize the Contractor to proceed with developing JMF2 if the Engineer's results for the trial batch meet the requirements in accordance with Tables 6 and 7. The Engineer will notify the Contractor that an additional trial batch is required if the trial batch does not meet these requirements.

4.4.2.2.7. **Approval of JMF2.** The Engineer will approve JMF2 within one working day if the mixture meets the requirements in accordance with Table 6, 7, and 8.

4.4.2.2.8. **Approval of Lot 1 Production.** The Engineer will authorize the Contractor to proceed with Lot 1 production (using JMF2) as soon as a passing result is achieved from the Department's or a Department-approved laboratory's Hamburg Wheel test and the Department's Overlay test on the trial batch. The Contractor may proceed at its own risk with Lot 1 production without the results from the Hamburg Wheel test or Overlay test on the trial batch.

If the Department's or Department-approved laboratory's sample from the trial batch fails the Hamburg Wheel test or Overlay test, the Engineer will suspend production until further Hamburg Wheel tests or Overlay tests meet the specified values. The Engineer may require up to the entire sublot of any mixture failing the Hamburg Wheel test or Overlay test to be removed and replaced at the Contractor's expense.

4.4.2.2.9. **Approval of JMF3 and Subsequent JMF Changes.** JMF3 and subsequent JMF changes are approved if they meet the master grading limits and asphalt binder content shown in Table 6 and are within the operational tolerances of JMF2 shown in accordance with Table 8.

4.5. **Production Operations.** Perform a new trial batch when the plant or plant location is changed. Take corrective action and receive approval to proceed after any production suspension for noncompliance to the specification.

4.5.1. **Storage and Heating of Materials.** Do not heat the asphalt binder above the temperatures specified in Item 300, "Asphalts, Oils, and Emulsions," or outside the manufacturer's recommended values. Provide the Engineer with daily records of asphalt binder and hot-mix asphalt discharge temperatures (in legible and discernible increments) in accordance with Item 320, "Equipment for Asphalt Concrete Pavement," unless otherwise directed. Do not store mixture for a period long enough to affect the quality of the mixture, nor in any case longer than 12 hr. unless otherwise approved.

4.5.2. **Mixing and Discharge of Materials.** Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not exceed the maximum production temperatures in accordance with Table 9. The Department will not pay for or allow placement of any mixture produced above the maximum production temperatures listed in Table 9.

Table 9
Maximum Production Temperature

High-Temperature Binder Grade[1]	Max Production Temperature
PG 76	345˚F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.

Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant. Determine the moisture content, if requested, by oven-drying in accordance with Tex-212-F, Part II, and verify that the mixture contains no more than 0.2% of moisture by weight. Obtain the sample immediately after discharging the mixture into the truck and perform the test promptly.

4.6. **Hauling Operations.** Clean all truck beds before use to ensure that mixture is not contaminated. Use a release agent shown on the Department's MPL to coat the inside bed of the truck when necessary. Do not use diesel or any release agent not shown on the Department's MPL.

Use equipment for hauling as defined in Section 3081.4.7.3.3., "Hauling Equipment." Use other hauling equipment only when allowed.

4.7. **Placement Operations.** Collect haul tickets from each load of mixture delivered to the project and provide the Department's copy to the Engineer approximately every hour, or as directed. Use a hand-held thermal camera or infrared thermometer, when a thermal imaging system is not used, to measure and record the internal temperature of the mixture as discharged from the truck or Material Transfer Device (MTD) before or as the mix enters the paver and an approximate station number or GPS coordinates on each ticket. Calculate the daily yield and cumulative yield for the specified lift and provide to the Engineer at the end of paving operations for each day unless otherwise directed. The Engineer may suspend production if the Contractor fails to produce and provide haul tickets and yield calculations by the end of paving operations for each day.

Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from pavement edges. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Place mixture so that longitudinal joints on the surface course coincide within 6-in. of lane lines and are not placed in the wheel path, or as directed, and offset longitudinal joints of successive courses of hot-mix by at least 6-in. Ensure that all finished surfaces will drain properly. Place the mixture at the rate or thickness shown on the plans. The Engineer will use the guidelines in Table 10 to determine the compacted lift thickness. The thickness determined is based on the rate of 110–115 lb. per square inch. for each inch of pavement unless otherwise shown on the plans.

Table 10
Compacted Lift Thickness

Mixture Type	Compacted Lift Thickness[1]	
	Min (in.)	Max (in.)
TOM-C	0.75	1.25
TOM-F	0.5	1.00

1. Compacted target lift thickness will be specified on the plans.

4.7.1. **Weather Conditions.**

4.7.1.1. **When Using a Thermal Imaging System.** The Contractor may pave any time the roadway is dry and the roadway surface temperature is at least 60°F unless otherwise approved or as shown on the plans; however, the Engineer may restrict the Contractor from paving surface mixtures if the ambient temperature is likely to drop below 32°F within 12 hr. of paving. Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. Provide output data from the thermal imaging system to demonstrate to the Engineer that no recurring severe thermal segregation exists in accordance with Section 3081.4.7.3.1.2., "Thermal Imaging System."

Produce mixture with a target discharge temperature higher than 300°F and with a compaction aid to facilitate compaction when the air temperature is 70°F and falling

4.7.1.2. **When Not Using a Thermal Imaging System.** When using a thermal camera instead the thermal imaging system, place mixture when the roadway surface temperature is at or above 70°F unless otherwise approved or as shown on the plans. Measure the roadway surface temperature with a hand-held thermal camera or infrared thermometer. Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. The Engineer may restrict the Contractor from paving if the air temperature is 70°F and falling.

Produce mixture with a target discharge temperature higher than 300°F and with a compaction aid to facilitate compaction when the air temperature is 70°F and falling.

4.7.2. **Tack Coat.**

4.7.2.1. **Application.** Clean the surface before placing the tack coat. The Engineer will set the rate between 0.04 and 0.10 gal. of residual asphalt per square yard of surface area, unless otherwise specified on the plans. Apply a uniform tack coat at the specified rate unless otherwise directed. Apply the tack coat in a uniform manner to avoid streaks and other irregular patterns. Apply the tack coat to all surfaces that will come in contact with the subsequent HMA placement unless otherwise directed. Apply adequate overlap of the tack coat in the longitudinal direction during placement of the mat to ensure bond of adjacent mats, unless otherwise directed. Allow adequate time for emulsion to break completely before placing any material. Prevent splattering of tack coat when placed adjacent to curb, gutter, and structures. The Engineer may suspend paving operations until there is adequate coverage. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

4.7.2.2. **Sampling.** The Engineer will obtain at least one sample of the tack coat binder per project in accordance with Tex-500-C, Part III, and test it to verify compliance with Item 300, "Asphalts, Oils, and Emulsions." The Engineer will notify the Contractor when the sampling will occur and will witness the collection of the sample from the asphalt distributor immediately before use. Label the can with the corresponding lot and sublot numbers, producer, producer facility, grade, district, date sampled, and project information including highway and CSJ. For emulsions, the Engineer may test as often as necessary to ensure the residual of the emulsion is greater than or equal to the specification requirement in Item 300, "Asphalts, Oils, and Emulsions."

4.7.3. **Lay-Down Operations.** Use the placement temperatures in accordance with Table 11 to establish the minimum placement temperature of mixture delivered to the paving operation.

Table 11
Minimum Mixture Placement Temperature

High-Temperature Binder Grade[1]	Min Placement Temperature (Before Entering Paving Operation)2,3
PG 76	280°F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. The mixture temperature must be measured using a hand-held thermal camera or infrared thermometer nearest to the point of entry of the paving operation.
3. Minimum placement temperatures may be reduced 10°F if using a compaction aid.

4.7.3.1. **Thermal Profile.** Use a hand-held thermal camera or a thermal imaging system to obtain a continuous thermal profile in accordance with Tex-244-F.

4.7.3.1.1. **Thermal Segregation.**

4.7.3.1.1.1. **Moderate.** Any areas that have a temperature differential greater than 25°F, but not exceeding 50°F.

4.7.3.1.1.2. **Severe.** Any areas that have a temperature differential greater than 50°F.

4.7.3.1.2. **Thermal Imaging System.** Review the output results when a thermal imaging system is used, and provide the report described in accordance with Tex-244-F to the Engineer daily. Modify the paving process as necessary to eliminate any recurring (moderate or severe) thermal segregation identified by the thermal imaging system.

The Engineer may suspend subsequent paving operations if the Contractor cannot successfully modify the paving process to eliminate recurring severe or moderate thermal segregation.

Provide the Engineer with electronic copies of all daily data files that can be used with the thermal imaging system software to generate temperature profile plots daily or as requested by the Engineer.

4.7.3.1.3. **Thermal Camera.** When using a thermal camera instead of the thermal imaging system, take immediate corrective action to eliminate recurring moderate thermal segregation when a hand-held thermal camera is used. Evaluate areas with moderate thermal segregation by performing water flow testing in accordance with Tex-246-F and verify the water flow is greater than 120 sec. Provide the Engineer with the thermal profile of every sublot within one working day of the completion of each lot. When requested by the Engineer, provide the electronic files generated using the thermal camera. Report the results of each thermal profile in accordance with Section 3081.4.2., "Reporting and Responsibilities." The Engineer will use a hand-held thermal camera to obtain a thermal profile at least once per project, unless the thermal imaging system is used. Suspend operations and take immediate corrective action to eliminate severe thermal segregation unless otherwise directed. Resume operations when the Engineer determines that subsequent production will meet the requirements of this Section. Evaluate areas with severe thermal segregation by performing water flow testing in accordance with Tex-246-F and verify the water flow is greater than 120 sec. Remove and replace the material in any areas that have both severe thermal segregation and a failing result for water flow test unless otherwise directed.

4.7.3.2. **Windrow Operations.** Operate windrow pickup equipment so that when hot-mix is placed in windrows, substantially all the mixture deposited on the roadbed is picked up and loaded into the paver.

4.7.3.3. **Hauling Equipment.** Use belly dumps, live bottom, or end dump trucks to haul and transfer mixture. End dump trucks are only allowed when used in conjunction with an MTD with remixing capability unless otherwise allowed.

4.7.3.4. **Screed Heaters.** Turn off screed heaters to prevent overheating of the mat if the paver stops for more than 5 min. The Engineer may evaluate the suspect area in accordance with Section 3081.4.9.3.1.1., "Recovered Asphalt Dynamic Shear Rheometer (DSR)," if the screed heater remains on for more than 5 min. while the paver is stopped.

4.8. **Compaction.** Roll the freshly placed mixture with as many steel-wheeled rollers as necessary to ensure adequate compaction without excessive breakage of the aggregate and to provide a smooth surface and uniform texture. Operate each roller in static mode for TOM-F mixtures only. Do not use pneumatic-tire rollers. Use the control strip method given in accordance with Tex-207-F, Part IV, to establish the rolling pattern. Thoroughly moisten the roller drums with a soap and water solution to prevent adhesion. Use only water or an approved release agent on rollers, tamps, and other compaction equipment unless otherwise directed.

Use tamps to thoroughly compact the edges of the pavement along curbs, headers, and similar structures and in locations that will not allow thorough compaction with rollers. The Engineer may require rolling with a trench roller on widened areas, in trenches, and in other limited areas.

Use Tex-246-F to measure water flow to verify the mixture is adequately compacted. Measure the water flow once per sublot at locations directed by the Engineer. Take additional water flow measurements when the minimum temperature of the uncompacted mat is below the temperature requirements in accordance with Table 12.

Table 12
Minimum Uncompacted Mat Temperature Requiring Additional Water Flow Measurements

High-Temperature Binder Grade[1]	Min Temperature of the Uncompacted Mat Allowed Before Initial Break Down Rolling[2,3]
PG 76	<270˚F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. The surface of the uncompacted mat must be measured using a hand-held thermometer or infrared thermometer.
3. Minimum uncompacted mat temperature requiring a water flow measurement may be reduced 10°F if using a compaction aid.

Use Tex-246-F to measure water flow to verify the mixture is adequately compacted at confined longitudinal joints as directed by the Engineer.

The water flow rate should be greater than 120 sec. Investigate the cause of the water flow rate test failures and take corrective actions during production and placement to ensure the water flow rate is greater than 120 sec. Suspend production if two consecutive water flow rate tests fail unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

Complete all compaction operations before the pavement temperature drops below 180°F unless otherwise allowed. The Engineer may allow compaction with a light finish roller operated in static mode for pavement temperatures below 180°F when approved.

Allow the compacted pavement to cool to 160°F or lower before opening to traffic unless otherwise directed. Sprinkle the finished mat with water or limewater, when directed, to expedite opening the roadway to traffic.

4.9. **Acceptance Plan.** Sample and test the hot-mix asphalt on a lot and sublot basis.

4.9.1. **Referee Testing.** The Materials and Tests Division is the referee laboratory. The Contractor may request referee testing if the differences between Contractor and Engineer test results exceed the maximum allowable difference in accordance with Table 8 and the differences cannot be resolved. The Contractor may also request referee testing if the Engineer's test results require suspension of production and the Contractor's test results are within specification limits. Make the request within five working days after receiving test results from the Engineer. Referee tests will be performed only on the sublot in question and only for the particular tests in question. Allow 10 working days from the time the referee laboratory receives the samples for test results to be reported. The Department may require the Contractor to reimburse the Department for referee tests if more than three referee tests per project are required and the Engineer's test results are closer to the referee test results than the Contractor's test results.

The Materials and Tests Division will determine the laboratory-molded density based on the molded specific gravity and the maximum theoretical specific gravity of the referee sample.

4.9.2. **Production Acceptance.**

4.9.2.1. **Production Lot.** A production lot consists of four equal sublots. The default quantity for Lot 1 is 500 ton; however, when requested by the Contractor, the Engineer may increase the quantity for Lot 1 to no more than 2,000 ton. The Engineer will select subsequent lot sizes based on the anticipated daily production such that approximately three to four sublots are produced each day. The lot size will be between 500 ton and 2,000 ton. The Engineer may change the lot size before the Contractor begins any lot.

4.9.2.1.1. **Incomplete Production Lots.** If a lot is begun but cannot be completed, such as on the last day of production or in other circumstances deemed appropriate, the Engineer may close the lot. Close all lots within five working days unless otherwise allowed.

4.9.2.2. **Production Sampling.**

4.9.2.2.1. **Mixture Sampling.** Obtain hot-mix samples from trucks at the plant in accordance with Tex-222-F. The sampler will split each sample into three equal portions in accordance with Tex-200-F and label these portions as "Contractor," "Engineer," and "Referee." The Engineer will perform or witness the sample splitting and take immediate possession of the samples labeled "Engineer" and "Referee." The Engineer will maintain the custody of the samples labeled "Engineer" and "Referee" until the Department's testing is completed.

4.9.2.2.1.1. **Random Sample.** At the beginning of the project, the Engineer will select random numbers for all production sublots. Determine sample locations in accordance with Tex-225-F. Take one sample for each sublot at the randomly selected location. The Engineer will perform or witness the sampling of production sublots.

4.9.2.2.1.2. **Blind Sample.** For one sublot per lot, the Engineer will obtain and test a "blind" sample instead of the random sample collected by the Contractor. Test either the "blind" or the random sample; however, referee testing (if applicable) will be based on a comparison of results from the "blind" sample. The location of the Engineer's "blind" sample will not be disclosed to the Contractor. The Engineer's "blind" sample may be randomly selected in accordance with Tex-225-F for any sublot or selected at the discretion of the Engineer. The Engineer will use the Contractor's split sample for sublots not sampled by the Engineer.

4.9.2.2.2. **Informational Methylene Blue Testing.** During the project and at random, obtain and provide the Engineer with approximately 50 lb. of each fine aggregate and approximately 20 lb. of all mineral fillers used to produce the mixture. Label the samples with the Control Section Job (CSJ), mixture type, and approximate lot and sublot number corresponding to when the sample was taken. The Engineer will ship the samples to the Materials and Tests Division for Methylene Blue testing in accordance with Tex-252-F. Results from these tests will not be used for specification compliance.

4.9.2.2.3. **Asphalt Binder Sampling.** Obtain a 1-qt. sample of the asphalt binder witnessed by the Engineer for each lot of mixture produced. The Contractor will notify the Engineer when the sampling will occur. Obtain the sample at approximately the same time the mixture random sample is obtained. Sample from a port located immediately upstream from the mixing drum or pug mill and upstream from the introduction of any additives in accordance with Tex-500-C, Part II. Label the can with the corresponding lot and sublot numbers, producer, producer facility location, grade, district, date sampled, and project information including highway and CSJ. The Engineer will retain these samples for one year. The Engineer may also obtain independent samples. If obtaining an independent asphalt binder sample and upon request of the Contractor, the Engineer will split a sample of the asphalt binder with the Contractor.

At least once per project, the Engineer will collect split samples of each binder grade and source used. The Engineer will submit one split sample to the Materials and Tests Division to verify compliance with Item 300, "Asphalts, Oils, and Emulsions," and will retain the other split sample for 1 yr.

4.9.2.3. **Production Testing.** The Contractor and Engineer must perform production tests in accordance with Table 13. The Contractor has the option to verify the Engineer's test results on split samples provided by the Engineer. Determine compliance with operational tolerances listed in accordance with Table 8 for all sublots. Take immediate corrective action if the Engineer's laboratory-molded density on any sublot is less than 95.0% or greater than 98.0% when using the SGC or less than 96.5% or greater than 98.5% when using the TGC, to bring

the mixture within these tolerances. The Engineer may suspend operations if the Contractor's corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

The Engineer may allow alternate methods for determining the asphalt binder content and aggregate gradation if the aggregate mineralogy is such that Tex-236-F, Part I does not yield reliable results. Provide evidence that results from Tex-236-F, Part I are not reliable before requesting permission to use an alternate method unless otherwise directed. Use the applicable test procedure as directed if an alternate test method is allowed.

Table 13
Production and Placement Testing Frequency

Description	Test Method	Min Contractor Testing	Min Engineer Testing
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	1 per sublot	1 per 12 sublots[1]
Individual % retained for sieves smaller than #8 and larger than #200			
% passing the #200 sieve			
Laboratory-molded density	Tex-207-F	N/A	1 per sublot[1]
Laboratory-molded bulk specific gravity			
VMA	Tex-204-F		
Moisture content	Tex-212-F, Part II	When directed	
Theoretical maximum specific (Rice) gravity	Tex-227-F, Part II	N/A	1 per sublot[1]
Asphalt binder content[2]	Tex-236-F, Part I	1 per sublot	1 per lot[1]
Overlay test[3]	Tex-248-F	N/A	1 per project
Hamburg Wheel test	Tex-242-F	N/A	1 per project
Thermal profile	Tex-244-F	1 per sublot[4,5,6]	1 per project[5]
Asphalt binder sampling and testing	Tex-500-C, Part II	1 per lot (sample only)[7]	1 per project
Tack coat sampling and testing	Tex-500-C, Part III	N/A	1 per project
Boil test[8]	Tex-530-C	1 per sublot[9]	1 per project
Water flow	Tex-246-F		
Methylene blue test[10]	Tex-252-F	1 per project (sample only)	

1. For production defined in Section 3081.4.9.4., "Exempt Production," the Engineer will test one per day if 100 ton or more are produced. For Exempt Production, no testing is required with less than 100 ton are produced.
2. May be obtained from asphalt flow meter readout as determined by the Engineer.
3. Testing performed by the Materials and Tests Division on sample obtained from Lot 2 or higher.
4. To be performed in the presence of the Engineer when a thermal camera is used, unless otherwise approved.
5. Not required when a thermal imaging system is used.
6. When using the thermal imaging system, the test report must include the temperature measurements taken in accordance with Tex-244-F.
7. Obtain samples witnessed by the Engineer. The Engineer will retain these samples for 1 yr.
8. When shown on the plans.
9. To be performed in the presence of the Engineer, unless otherwise directed.
10. Testing performed by the Materials and Tests Division for informational purposes only.

4.9.2.4. **Operational Tolerances.** Control the production process within the operational tolerances in accordance with Table 8. When production is suspended, the Engineer will allow production to resume when test results or other information indicates the next mixture produced will be within the operational tolerances.

4.9.2.4.1. **Gradation.** Suspend operation and take corrective action if any aggregate is retained on the maximum sieve size in accordance with Table 6. A sublot is defined as out of tolerance if either the Engineer's or the Contractor's test results are out of operational tolerance. Suspend production when test results for gradation exceed the operational tolerances in accordance with Table 8 for three consecutive sublots on the same sieve or four consecutive sublots on any sieve unless otherwise directed. The consecutive sublots may be from more than one lot.

4.9.2.4.2. **Asphalt Binder Content.** A sublot is defined as out of operational tolerance if either the Engineer's or the Contractor's test results exceed the values in accordance with Table 8. Suspend production when two or

more sublots within a lot are out of operational tolerance or below the minimum asphalt binder content specified in accordance with Table 6 unless otherwise directed. Suspend production and shipment of mixture if the Engineer's or Contractor's asphalt binder content deviates from the current JMF by more than 0.5% for any sublot or is less than the minimum asphalt content allowed in accordance with Table 6.

4.9.2.4.3. **Voids in Mineral Aggregates (VMA).** The Engineer will determine the VMA for every sublot. For sublots when the Engineer does not determine asphalt binder content, the Engineer will use the asphalt binder content results from QC testing performed by the Contractor to determine VMA.

Take immediate corrective action if the VMA value for any sublot is less than the minimum VMA requirement for production in accordance with Table 6. Suspend production and shipment of the mixture if the Engineer's VMA results on two consecutive sublots are below the minimum VMA requirement for production in accordance with Table 6.

Suspend production and shipment of the mixture if the Engineer's VMA result is more than 0.5% below the minimum VMA requirement for production in accordance with Table 6. In addition to suspending production, the Engineer may require removal and replacement or may allow the sublot to be left in place without payment.

4.9.2.4.4. **Hamburg Wheel.** The Engineer may perform a Hamburg Wheel on plant produced mixture at any time during production. In addition to testing production samples, the Engineer may obtain cores and perform the Hamburg Wheel test on any area of the roadway where rutting is observed. Suspend production until further Hamburg Wheel meet the specified values when the production or core samples fail to meet the Hamburg Wheel criteria in accordance with Table 7. Core samples, if taken, will be obtained from the center of the finished mat or other areas excluding the vehicle wheel paths. The Engineer may require up to the entire sublot of any mixture failing the Hamburg Wheel to be removed and replaced at the Contractor's expense.

If the Department's or Department-approved laboratory's Hamburg Wheel test results in a "remove and replace" condition, the Contractor may request that the Department confirm the results by re-testing the failing material. The Materials and Tests Division will perform the Hamburg Wheel and determine the final disposition of the material in question based on the Department's test results.

4.9.2.5. **Individual Loads of Hot-Mix.** The Engineer can reject individual truckloads of hot-mix. When a load of hot-mix is rejected for reasons other than temperature, contamination, or excessive uncoated particles, the Contractor may request that the rejected load be tested. Make this request within 4 hr. of rejection. The Engineer will sample and test the mixture. If test results are within the operational tolerances in accordance with Table 8, payment will be made for the load. If test results are not within operational tolerances, no payment will be made for the load.

4.9.3. **Placement Acceptance.**

4.9.3.1. **Placement Lot.** A placement lot consists of four placement sublots. A placement sublot consists of the area placed during a production sublot.

4.9.3.1.1. **Recovered Asphalt Dynamic Shear Rheometer (DSR).** The Engineer may take production samples or cores from suspect areas of the project to determine recovered asphalt properties. Asphalt binders with an aging ratio greater than 3.5 do not meet the requirements for recovered asphalt properties and may be deemed defective when tested and evaluated by the Materials and Tests Division. The aging ratio is the DSR value of the extracted binder divided by the DSR value of the original unaged binder. Obtain DSR values in accordance with AASHTO T 315 at the specified high temperature performance grade of the asphalt. The Engineer may require removal and replacement of the defective material at the Contractor's expense. The asphalt binder will be recovered for testing from production samples or cores in accordance with Tex-211-F.

4.9.3.1.2. **Irregularities.** Identify and correct irregularities including segregation, rutting, raveling, flushing, fat spots, mat slippage, irregular color, irregular texture, roller marks, tears, gouges, streaks, uncoated aggregate particles, or broken aggregate particles. The Engineer may also identify irregularities, and in such cases, the Engineer will promptly notify the Contractor. The Engineer may require the Contractor to remove and replace (at the

Contractor's expense) areas of the pavement that contain irregularities if the Engineer determines that the irregularity will adversely affect pavement performance. The Engineer may also require the Contractor to remove and replace (at the Contractor's expense) areas where the mixture does not bond to the existing pavement.

The Engineer may require the Contractor to immediately suspend operations if irregularities are detected or may allow the Contractor to continue operations for no more than one day while the Contractor is taking appropriate corrective action.

4.9.4. **Exempt Production.** When the anticipated daily production is less than 100 ton, all QC and QA sampling and testing are waived. The Engineer may deem the mixture as exempt production for the following conditions:

- anticipated daily production is more than 100 ton but less than 250 ton;
- total production for the project is less than 2,500 ton;
- when mutually agreed between the Engineer and the Contractor; or
- when shown on the plans.

For exempt production, the Contractor is relieved of all production and placement sampling and testing requirements. All other specification requirements apply, and the Engineer will perform acceptance tests for production and placement in accordance with Table 13.

For exempt production:

- produce, haul, place, and compact the mixture as directed by the Engineer; and
- control mixture production to yield a laboratory-molded density that is within ±1.0% of the target density as tested by the Engineer.

4.9.5. **Ride Quality.** Measure ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.

5. MEASUREMENT

5.1. **TOM Hot-Mix Asphalt.** TOM hot-mix will be measured by the ton of composite mixture, which includes asphalt, aggregate, and additives. Measure the weight on scales in accordance with Item 520, "Weighing and Measuring Equipment."

5.2. **Tack Coat.** Tack coat will be measured at the applied temperature by strapping the tank before and after road application and determining the net volume in gallons from the calibrated distributor. The Engineer will witness all strapping operations for volume determination. All tack, including emulsions, will be measured by the gallon applied.

The Engineer may allow the use of a metering device to determine asphalt volume used and application rate if the device is accurate within 1.5% of the strapped volume.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under Section 3081.5.1., "TOM Hot-Mix Asphalt," will be paid for at the unit bid price for "Thin Overlay Mixture" of the mixture type, SAC, and binder specified. These prices are full compensation for surface preparation, removing pavement marking and markers, materials, placement, equipment, labor, tools, and incidentals.

The work performed and materials furnished in accordance with this Item and measured as provided under Section 3081.5.2., "Tack Coat," will be paid for at the unit bid price for "Tack Coat" of the tack coat provided. These prices are full compensation for materials, placement, equipment, labor, tools, and incidentals.

Trial batches will not be paid for unless they are included in pavement work approved by the Department.

Payment adjustment for ride quality will be determined in accordance with Item 585, "Ride Quality for Pavement Surfaces."

Special Specification 3082
Thin Bonded Friction Courses

1. DESCRIPTION

Construct a hot-mix asphalt (HMA) surface course composed of a warm spray-applied polymer modified emulsion membrane followed immediately with a compacted permeable mixture of aggregate, asphalt binder, and additives mixed hot in a mixing plant.

2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

Notify the Engineer of all material sources and before changing any material source or formulation. The Engineer will verify that the specification requirements are met when the Contractor makes a source or formulation change, and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time during the project to verify specification compliance in accordance with Item 6, "Control of Materials."

2.1. **Aggregate.** Furnish aggregates from sources that conform to the requirements shown in Table 1 and as specified in this Section. Aggregate requirements in this Section, including those shown in Table 1, may be modified or eliminated when shown on the plans. Additional aggregate requirements may be specified when shown on the plans. Provide aggregate stockpiles that meet the definitions in this Section for coarse or fine aggregate. Do not use intermediate or fine aggregate in PFC mixtures. Supply aggregates that meet the definitions in Tex-100-E for crushed gravel or crushed stone. The Engineer will designate the plant or the quarry as the sampling location. Provide samples from materials produced for the project. The Engineer will establish the Surface Aggregate Classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests listed in accordance with Table 1. Document all test results on the mixture design report. The Engineer may perform tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately. Determine aggregate gradations for mixture design and production testing based on the washed sieve analysis given in Tex-200-F, Part II.

2.1.1. **Coarse Aggregate.** Coarse aggregate stockpiles must have no more than 20% material passing the No. 8 sieve. Aggregates from sources listed in the Department's *Bituminous Rated Source Quality Catalog* (BRSQC) are preapproved for use. Use only the rated values for hot-mix listed in the BRSQC. Rated values for surface treatment (ST) do not apply to coarse aggregate sources used in hot-mix asphalt.

For sources not listed on the Department's BRSQC:

- build an individual stockpile for each material;
- request the Department test the stockpile for specification compliance;
- approved only when tested by the Engineer;
- once approved, do not add material to the stockpile unless otherwise approved; and
- allow 30 calendar days for the Engineer to sample, test, and report results.

Provide coarse aggregate with at least the minimum SAC shown on the plans. SAC requirements only apply to aggregates used on the surface of travel lanes, unless otherwise shown on the plans. SAC requirements apply to aggregates used on surfaces other than travel lanes when shown on the plans. The SAC for sources on the Department's *Aggregate Quality Monitoring Program* (AQMP) (Tex-499-A) is listed in the BRSQC.

2.1.1.1. **Blending Class A and Class B Aggregates.** To prevent crushing of the Class B aggregate when blending, Class B aggregate may be blended with a Class A aggregate to meet requirements for Class A materials if the Department's BRSQC rated source soundness magnesium (RSSM) rating for the Class B aggregate is less than the Class A aggregate or if the RSSM rating for the Class B aggregate is less than or equal to 10%. Use the rated values for hot mix asphaltic concrete (HMAC) published in the BRSQC. When blending Class A and B aggregates to meet a Class A requirement, ensure that at least 50% by weight, or volume if required, of all the aggregates used in the mixture design retained on the No. 4 sieve comes from the Class A aggregate source, unless otherwise shown on the plans. Blend by volume if the bulk specific gravities of the Class A and B aggregates differ by more than 0.300. Class B aggregate may be disallowed when shown on the plans.

The Engineer may perform tests at any time during production, when the Contractor blends Class A and B aggregates to meet a Class A requirement, to ensure that at least 50% by weight, or volume if required, of the material retained on the No. 4 sieve comes from the Class A aggregate source. The Engineer will use the Department's mix design template, when electing to verify conformance, to calculate the percent of Class A aggregate retained on the No. 4 sieve by inputting the bin percentages shown from readouts in the control room at the time of production and stockpile gradations measured at the time of production. The Engineer may determine the gradations based on either washed or dry sieve analysis from samples obtained from individual aggregate cold feed bins or aggregate stockpiles. The Engineer may perform spot checks using the gradations supplied by the Contractor on the mixture design report as an input for the template; however, a failing spot check will require confirmation with a stockpile gradation determined by the Engineer.

2.1.1.2. **Micro-Deval Abrasion.** The Engineer will perform a minimum of one Micro-Deval abrasion test in accordance with Tex-461-A for each coarse aggregate source used in the mixture design that has a Rated Source Soundness Magnesium (RSSM) loss value greater than 15 as listed in the BRSQC, unless otherwise directed. The Engineer will perform testing before the start of production and may perform additional testing at any time during production. The Engineer may obtain the coarse aggregate samples from each coarse aggregate source or may require the Contractor to obtain the samples. The Engineer may waive all Micro-Deval testing based on a satisfactory test history of the same aggregate source.

The Engineer will estimate the magnesium sulfate soundness loss for each coarse aggregate source, when tested, using the following formula:

$Mg_{est.} = (RSSM)(MD_{act.}/RSMD)$

where:
$Mg_{est.}$ = magnesium sulfate soundness loss
$RSSM$ = Rated Source Soundness Magnesium
$MD_{act.}$ = actual Micro-Deval percent loss
$RSMD$ = Rated Source Micro-Deval

When the estimated magnesium sulfate soundness loss is greater than the maximum magnesium sulfate soundness loss specified, the coarse aggregate source will not be allowed for use unless otherwise approved. The Engineer will consult the Soils and Aggregates Section of the Materials and Tests Division, and additional testing may be required before granting approval.

2.1.2. **Fine Aggregate.** Fine aggregates consist of manufactured sands and screenings. Fine aggregate stockpiles must meet the fine aggregate properties in accordance with Table 1 and the gradation requirements in accordance with Table 2. Supply fine aggregates that are free from organic impurities. The Engineer may test the fine aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. Do not use field sand or other uncrushed fine aggregate. Use fine aggregate from coarse aggregate sources that meet the requirements shown in accordance with Table 1 unless otherwise approved.

Table 1
Coarse Aggregate Quality Requirements

Property	Test Method	Requirement
SAC	Tex-499-A (AQMP)	As shown on the plans
Deleterious material, %, Max	Tex-217-F, Part I	1.0
Decantation, %, Max	Tex-217-F, Part II	1.5
Micro-Deval abrasion, %	Tex-461-A	Note [1]
Los Angeles abrasion, %, Max	Tex-410-A	30
Magnesium sulfate soundness, 5 cycles, %, Max	Tex-411-A	20
Crushed face count[2], %, Min	Tex-460-A, Part I	95
Flat and elongated particles @ 5:1, %, Max	Tex-280-F	10
Fine Aggregate Properties		
Sand Equivalent, %, Min	Tex-203-F	45
Methylene Blue, mg/g, Max	Tex-252-F	10.0

1. Used to estimate the magnesium sulfate soundness loss in accordance with section 3082.2.1.1.2., "Micro-Deval Abrasion."
2. Only applies to crushed gravel.

Table 2
Gradation Requirements for Fine Aggregate

Sieve Size	% Passing by Weight or Volume
3/8"	100
#8	70–100
#200	0–30

2.2. **Mineral Filler.** Mineral filler consists of finely divided mineral matter such as agricultural lime, crusher fines, or hydrated lime. Fly ash is not allowed unless otherwise shown on the plans. Mineral filler is allowed unless otherwise shown on the plans. Use no more than 2% hydrated lime, unless otherwise shown on the plans. Test all mineral fillers except hydrated lime and fly ash in accordance with Tex-252-F to ensure specification compliance. The plans may require or disallow specific mineral fillers. Provide mineral filler, when used, that:

- is sufficiently dry, free-flowing, and free from clumps and foreign matter as determined by the Engineer;
- does not exceed 3% linear shrinkage when tested in accordance with Tex-107-E; and
- meets the gradation requirements in accordance with Table 3, unless otherwise shown on the plans.

Table 3
Gradation Requirements for Mineral Filler

Sieve Size	% Passing by Weight or Volume
#8	100
#200	55–100

2.3. **Baghouse Fines.** Fines collected by the baghouse or other dust-collecting equipment may be reintroduced into the mixing drum.

2.4. **Asphalt Binder.** Furnish the type and grade of binder specified on the plans that meets the requirements of Item 300, "Asphalts, Oils, and Emulsions."

2.4.1. **Performance-Graded (PG) Binder.** Provide an asphalt binder with a high-temperature grade of PG 76 and low-temperature grade as shown on the plans in accordance with Section 300.2.10., "Performance-Graded Binders," when PG binder is specified.

2.4.2. **Asphalt-Rubber (A-R) Binder.** Provide A-R binder that meets the Type I or Type II requirements of Section 300.2.9., "Asphalt-Rubber Binders," when A-R is specified unless otherwise shown on the plans. Use at least 15.0% by weight of Crumb Rubber Modifier (CRM) that meets the Grade B or Grade C requirements of Section 300.2.7., "Crumb Rubber Modifier," unless otherwise shown on the plans. Provide the Engineer the A-R binder blend design with the mix design (JMF1) submittal. Provide the Engineer with documentation such as the bill of lading showing the quantity of CRM used in the project unless otherwise directed.

2.5. **Membrane.** Provide a smooth and homogeneous polymer modified emulsion meeting the requirements in accordance with Table 4.

Table 4
Polymer Modified Emulsion Requirements

Test on Emulsion	Test Method	Min	Max
Viscosity @ 77°F, SSF	T 72	20	100
Storage Stability,[1] %	T 59		1
Demulsibility (for anionic emulsions), 35 mL of 0.02 N CaCl2, %	T 59	55	
Demulsibility (for cationic emulsions), 35 mL 0.8% Sodium dioctyl sulfosuccinate, %	T 59	55	
Sieve Test,[2] %	T 59		0.05
Distillation Test:[3] Residue by distillation, % by wt. Oil portion of distillate, % by vol.	T 59	63	0.5
Test on Residue from Distillation	**Test Method**	**Min**	**Max**
Elastic Recovery @ 50°F, 50 mm/min., %	Tex-539-C	60	
Penetration @ 77°F, 100 g, 5 sec, 0.1 mm	T 49	100	150

1. After standing undisturbed for 24 hr., the surface must be smooth, must not exhibit a white or milky colored substance, and must be a homogeneous color throughout.
2. May be required by the Engineer only when the emulsion cannot be easily applied in the field.
3. The temperature on the lower thermometer should be brought slowly to 350°F ±10°F and maintained at this temperature for 20 min. The total distillation should be complete in 60 ±5 min. from the first application of heat.

2.6. **Additives.** Provide the Engineer with documentation such as the bill of lading showing the quantity of additives used in the project unless otherwise directed.

2.6.1. **Fibers.** Provide cellulose or mineral fibers when PG binder is specified. Do not use fibers when A-R binder is specified. Submit written certification to the Engineer that the fibers proposed for use meet the requirements of DMS-9204, "Fiber Additives for Bituminous Mixtures." Fibers may be pre-blended into the binder at the asphalt supply terminal unless otherwise shown on the plans.

2.6.2. **Lime Mineral Filler.** Add lime as mineral filler at a rate of 1.0% by weight of the total dry aggregate in accordance with Item 301, "Asphalt Antistripping Agents," unless otherwise shown on the plans or waived by the Engineer based on Hamburg Wheel test results. Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime into the drum.

2.6.3. **Lime and Liquid Antistripping Agent.** When lime or a liquid antistripping agent is used, add in accordance with Item 301, "Asphalt Antistripping Agents." Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime into the drum. Lime added as mineral filler will count towards the total quantity of lime specified when the plans require lime to be added as an antistripping agent.

2.6.4. **Compaction Aid.** Compaction Aid is defined as a Department-approved chemical warm mix additive denoted as "chemical additive" on the Department's material producer list (MPL) that is used to facilitate mixing and compaction of HMA.

Compaction aid is allowed for use on all projects. Compaction aid is required when shown on the plans or as required in Section 3082.4.7.1., "Weather Conditions."

Warm mix foaming processes, denoted as "foaming process" on the Department-approved MPL, may be used to facilitate mixing and compaction of HMA; however warm mix processes are not defined as a Compaction Aid.

2.7. **Recycled Materials.** Recycled materials are not allowed for use.

3. EQUIPMENT

Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement." When A-R binder is specified, equip the hot-mix plant with an in-line viscosity-measuring device located between the blending unit and the mixing drum. Provide a means to calibrate the asphalt mass flow meter on-site when a meter is used.

3.1. **Placement Equipment.** Provide a paver that meets all the requirements listed below.

3.1.1. **Paver.** Furnish a paver that will spray the membrane, apply the PFC mixture, and level the surface of the mat in a single pass. Configure the paver so that the mixture is placed no more than 5 sec. after the membrane is applied. Ensure the paver does not support the weight of any portion of hauling equipment other than the connection. Provide loading equipment that does not transmit vibrations or other motions to the paver that adversely affects the finished pavement quality. Equip the paver with an automatic dual longitudinal-grade control system and an automatic transverse-grade control system.

3.1.1.1. **Tractor Unit.** Supply a tractor unit that can push or propel vehicles, dumping directly into the finishing machine to obtain the desired lines and grades to eliminate any hand finishing. Equip the unit with a hitch to maintain contact between the hauling equipment's rear wheels and the finishing machine's pusher rollers while mixture is unloaded.

3.1.1.2. **Membrane Storage Tank and Distribution System.** Equip the paver with an insulated storage tank with a minimum capacity of 900 gal. Provide a metered mechanical pressure sprayer on the paver to apply a uniform membrane at the specified rate. Locate the spray bar on the paver so that the membrane is applied immediately in front of the screed unit. Provide a read-out device on the paver to monitor the membrane application rate.

Furnish a volumetric calibration and strap stick for the tank in accordance with Tex-922-K, Part I, unless otherwise directed. Calibrate the tank within the previous 5 yr. of the date first used on the project. The Engineer may verify calibration accuracy in accordance with Tex-922-K, Part II.

3.1.1.3. **Screed.** Provide a variable width vibratory screed that meets Item 320, "Equipment for Asphalt Concrete Pavement."

3.1.2. **Material Transfer Device (MTD).** Provide the specified type of MTD when shown on the plans. Ensure MTDs provide a continuous, uniform mixture flow to the asphalt paver.

3.1.3. **Rollers.** Provide steel-wheel rollers meeting the requirements of Item 210, "Rolling," except provide rollers weighing a minimum of 10 ton for each roller required. Operate rollers in static (non-vibrating) mode unless otherwise allowed.

4. CONSTRUCTION

Produce, haul, place, and compact the specified paving mixture. In addition to tests required by the specification, Contractors may perform other QC tests as deemed necessary. At any time during the project, the Engineer may perform production and placement tests as deemed necessary in accordance with Item 5, "Control of the Work." Schedule and participate in a mandatory pre-paving meeting with the Engineer on or before the first day of paving unless otherwise shown on the plans.

4.1. **Certification.** Personnel certified by the Department-approved hot-mix asphalt certification program must conduct all mixture designs, sampling, and testing in accordance with Table 5. Supply the Engineer with a list of certified personnel and copies of their current certificates before beginning production and when personnel changes are made. Provide a mixture design developed and signed by a Level 2 certified specialist. Provide Level 1A certified specialists at the plant during production operations. Provide Level 1B certified specialists to conduct placement tests. Provide AGG101 certified specialists for aggregate testing.

Table 5

Test Methods, Test Responsibility, and Minimum Certification Levels

Test Description	Test Method	Contractor	Engineer	Level[1]
1. Aggregate Testing				
Sampling	Tex-221-F	✓	✓	1A/AGG101
Dry sieve	Tex-200-F, Part I	✓	✓	1A/AGG101
Washed sieve	Tex-200-F, Part II	✓	✓	1A/AGG101
Deleterious material	Tex-217-F, Parts I & III	✓	✓	AGG101
Decantation	Tex-217-F, Part II	✓	✓	AGG101
Los Angeles abrasion	Tex-410-A		✓	Department
Magnesium sulfate soundness	Tex-411-A		✓	Department
Micro-Deval abrasion	Tex-461-A		✓	AGG101
Crushed face count	Tex-460-A	✓	✓	AGG101
Flat and elongated particles	Tex-280-F	✓	✓	AGG101
Methylene blue test	Tex-252-F		✓	Department
2. Asphalt Binder & Tack Coat Sampling				
Asphalt binder sampling	Tex-500-C, Part II	✓	✓	1A/1B
Membrane sampling	Tex-500-C, Part III	✓	✓	1A/1B
3. Mix Design & Verification				
Design and JMF changes	Tex-204-F	✓	✓	2
Mixing	Tex-205-F	✓	✓	2
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F, Parts I, VI, & VIII	✓	✓	1A
Rice gravity	Tex-227-F, Part II	✓	✓	1A
Ignition oven correction factors[2]	Tex-236-F, Part II	✓	✓	2
Drain-down	Tex-235-F	✓	✓	1A
Hamburg Wheel test	Tex-242-F	✓	✓	1A
Boil test[4]	Tex-530-C	✓	✓	1A
Cantabro loss	Tex-245-F	✓	✓	1A
4. Production Testing				
Control charts	Tex-233-F	✓	✓	1A
Mixture sampling	Tex-222-F	✓	✓	1A/1B
Gradation & asphalt binder content[2]	Tex-236-F, Part I	✓	✓	1A
Moisture content	Tex-212-F, Part II	✓	✓	1A/AGG101
Micro-Deval abrasion	Tex-461-A		✓	AGG101
Drain-down	Tex-235-F	✓	✓	1A
Boil test[4]	Tex-530-C	✓	✓	1A
Abson recovery	Tex-211-F		✓	Department
5. Placement Testing				
Control charts	Tex-233-F	✓	✓	1A
Ride quality measurement	Tex-1001-S	✓	✓	Note 3
Thermal profile	Tex-244-F	✓	✓	1B
Water flow test	Tex-246-F	✓	✓	1B

1. Level 1A, 1B, AGG101, and 2 are certification levels provided by the Hot Mix Asphalt Center certification program.
2. Refer to Section 3082.4.5., "Production Operations," for exceptions to using an ignition oven.
3. Profiler and operator are required to be certified at the Texas A&M Transportation Institute facility when Surface Test Type B is specified.
4. When shown on the plans.

4.2. **Reporting and Responsibilities.** Use Department-provided templates to record and calculate all test data, including mixture design, production and placement tests, control charts, and thermal profiles. Obtain the current version of the templates at https://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/forms/site-manager.html or from the Engineer. The Engineer and the Contractor will provide any available test results to the other party when requested. The Contractor and Engineer must exchange test data within the maximum allowable time in accordance with Table 6 unless otherwise approved. The Engineer and the

Contractor will immediately report to the other party any test result that requires suspension of production or placement or that fails to meet the specification requirements. Record and electronically submit all test results and pertinent information on Department-provided templates.

Subsequent sublots placed after test results are available to the Contractor, which require suspension of operations, may be considered unauthorized work. Unauthorized work will be accepted or rejected at the discretion of the Engineer in accordance with Section 5.3., "Conformity with Plans, Specifications, and Special Provisions."

Table 6
Reporting Schedule

Description	Reported By	Reported To	To Be Reported Within
Production Quality Control			
Gradation[1]	Contractor	Engineer	1 working day of completion of the sublot
Asphalt binder content[1]			
Laboratory-molded density[1]			
Moisture content[2]			
Drain-down[1]			
Boil test[4]			
Production Quality Assurance			
Gradation[2]	Engineer	Contractor	1 working day of completion of the sublot
Asphalt binder content[2]			
Laboratory-molded density[2]			
Hamburg Wheel test[3]			
Boil test[4]			
Drain-down[2]			
Binder tests[3]			
Placement Quality Control			
Thermal profile[1]	Contractor	Engineer	1 working day of completion of the lot
Water flow[1]			
Membrane application rate[2]			
Placement Quality Assurance			
Thermal profile[2]	Engineer	Contractor	1 working day of completion of the lot
Aging ratio[3]			
Water flow[2]			
Membrane application rate[2]			

1. These tests are required on every sublot.
2. To be performed at the frequency in accordance with Table 14 or as shown on the plans.
3. To be reported as soon as the results become available.
4. When shown on the plans

Use the procedures described in Tex-233-F, when directed, to plot the results of all production and placement testing. Update the control charts as soon as test results for each sublot become available. Make the control charts readily accessible at the field laboratory. The Engineer may suspend production for failure to update control charts.

4.3. **Quality Control Plan (QCP).** Develop and follow the QCP in detail. Obtain approval for changes to the QCP made during the project. The Engineer may suspend operations if the Contractor fails to comply with the QCP.

Submit a written QCP before the mandatory pre-paving meeting, when directed. Receive approval of the QCP before pre-paving meeting. Include the following items in the QCP:

4.3.1. **Project Personnel.** For project personnel, include:

- a list of individuals responsible for QC with authority to take corrective action;
- current contact information for each individual listed; and
- current copies of certification documents for individuals performing specified QC functions.

4.3.2. **Material Delivery and Storage.** For material delivery and storage, include:

- the sequence of material processing, delivery, and minimum quantities to assure continuous plant

operations;

- aggregate stockpiling procedures to avoid contamination and segregation;
- frequency, type, and timing of aggregate stockpile testing to assure conformance of material requirements before mixture production; and
- procedure for monitoring the quality and variability of asphalt binder.

4.3.3. **Production.** For production, include:

- loader operation procedures to avoid contamination in cold bins;
- procedures for calibrating and controlling cold feeds;
- procedures to eliminate debris or oversized material;
- procedures for adding and verifying rates of each applicable mixture component (e.g., aggregate, asphalt binder, lime, liquid antistrip, compaction aid, foaming process, fibers);
- procedures for reporting job control test results; and
- procedures to avoid segregation and drain-down in the silo.

4.3.4. **Loading and Transporting.** For loading and transporting, include:

- type and application method for release agents; and
- truck loading procedures to avoid segregation.

4.3.5. **Placement and Compaction.** For placement and compaction, include:

- proposed agenda for mandatory pre-paving meeting, including date and location;
- proposed paving plan (e.g., production rate, paving widths, joint offsets, and lift thicknesses);
- type and application method for release agents in the paver and on rollers, shovels, lutes, and other utensils;
- procedures for the transfer of mixture into the paver while avoiding physical and thermal segregation and preventing material spillage;
- process to balance production, delivery, paving, and compaction to achieve continuous placement operations and good ride quality;
- paver operations (e.g., speed, operation of wings, height of mixture in auger chamber) to avoid physical and thermal segregation and other surface irregularities; and
- procedures to construct quality longitudinal and transverse joints.

4.4. **Mixture Design.**

4.4.1. **Design Requirements.** Use the design procedure provided in Tex-204-F, unless otherwise shown on the plans. Design the mixture to meet the requirements in accordance with Tables 1, 2, 3, 7, 8, and 9. Use a Superpave Gyratory Compactor (SGC) at 50 gyrations as the design number of gyrations (Ndesign).

The Engineer will provide the mixture design when shown on the plans. The Contractor may submit a new mixture design at any time during the project. The Engineer will verify and approve all mixture designs (JMF1) before the Contractor can begin production.

Provide the Engineer with a mixture design report using the Department-provided template. Include the following items in the report:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- the membrane application rate based on design volumetrics;
- results of all applicable tests;
- the mixing and molding temperatures;
- the signature of the Level 2 person or persons that performed the design;
- the date the mixture design was performed; and
- a unique identification number for the mixture design.

Table 7
Master Gradation Limits (% Passing by Weight or Volume)
and Laboratory Mixture Design Properties

Sieve Size	Permeable Friction Course		Thin Bonded Friction Course		
	Fine (PFC-F)	Coarse (PFC-C and PFCR-C)	Type A	Type B	Type C
3/4"	–	100.0[1]	–	–	100[1]
1/2"	100.0[1]	80.0–100.0	–	100[1]	75–100
3/8"	95.0–100.0	35.0–60.0	100[1]	75–100	55–80
#4	20.0–55.0	1.0–20.0	35–55	22–36	22–36
#8	1.0–10.0	1.0–10.0	19–30	19–30	19–30
#16	–	–	14–25	14–24	14–24
#50	–	–	7–14	7–14	7–14
#200	1.0–4.0	1.0–4.0	4–6	4–6	4–6

1. Defined as maximum sieve size. No tolerance allowed.

Table 8
Mixture Design Properties

Mixture Property	Test Method	PG 76 Mixtures		A-R Mixtures	Thin Bonded Friction Course		
		Fine (PFC-F)	Coarse (PFC-C)	Coarse (PFCR-C)	Type A	Type B	Type C
Asphalt binder content, %	–	6.0–7.0	6.0–7.0	7.0–9.0	5.0–5.8	4.8–5.6	4.8–5.6
Film thickness, microns	–	–	–	–	9.0 Min	9.0 Min	9.0 Min
Design gyrations (Ndesign)	Tex-241-F	50	50	50	50	50	50
Laboratory-molded density, %	Tex-207-F	78.0 Max	82.0 Max	82.0 Max	92.0 Max	92.0 Max	92.0 Max
Hamburg Wheel test,[1] passes at 12.5 mm rut depth	Tex-242-F	10,000 Min	Note 2	Note 2	Note 2	Note 2	Note 2
Drain-down, %	Tex-235-F	0.10 Max	0.10 Max	0.10 Max	0.10 Max	0.10 Max	0.10 Max
Fiber content, % by wt. of total PG 76 mixture	Calculated	0.20–0.50	0.20-0.50	–	–	–	–
Lime content, % by wt. of total aggregate	Calculated	1.0[3]	1.0[3]	–	Note 4	Note 4	Note 4
CRM content, % by wt. of A-R binder	Calculated	–	–	15.0 Min	–	–	–
Boil test[5]	Tex-530-C	–	–	–	–	–	–
Cantabro loss, %	Tex-245-F	20.0 Max	20.0 Max	20.0 Max	20.0 Max	20.0 Max	20.0 Max

1. Mold test specimens to Ndesign at the optimum asphalt binder content.
2. No specification value is required unless otherwise shown on the plans.
3. Unless otherwise shown on the plans or waived by the Engineer based on Hamburg Wheel results.
4. Lime may be required when shown on the plans.
5. When shown on the plans. Used to establish baseline for comparison to production results.

4.4.2. **Job-Mix Formula Approval.** The job-mix formula (JMF) is the combined aggregate gradation, Ndesign level, and target asphalt percentage used to establish target values for hot-mix production. JMF1 is the original laboratory mixture design used to produce the trial batch. When a compaction aid or foaming process is used, JMF1 may be designed and submitted to the Engineer without including the compaction aid or foaming process. When a compaction aid or foaming process is used, document the compaction aid or foaming process used and recommended rate on the JMF1 submittal. The Engineer and the Contractor will verify JMF1 based on plant-produced mixture from the trial batch unless otherwise approved. The Engineer may accept an existing mixture design previously used on a Department project and may waive the trial batch to verify JMF1. The Department may require the Contractor to reimburse the Department for verification tests if more than two trial batches per design are required.

4.4.2.1. **Contractor's Responsibilities.**

4.4.2.1.1. **Providing Superpave Gyratory Compactor.** Furnish an SGC calibrated in accordance with Tex-241-F for molding production samples. Locate the SGC at the Engineer's field laboratory or make the SGC available to the Engineer for use in molding production samples.

4.4.2.1.2. **Gyratory Compactor Correlation Factors.** Use Tex-206-F, Part II, to perform a gyratory compactor

correlation when the Engineer uses a different SGC. Apply the correlation factor to all subsequent production test results.

4.4.2.1.3. **Submitting JMF1.** Furnish a mix design report (JMF1) with representative samples of all component materials and request approval to produce the trial batch. Provide an additional 25 lb. of the design mixture if opting to have the Department perform the Hamburg Wheel test on the laboratory mixture when required in accordance with Table 8, and request that the Department perform the test.

4.4.2.1.4. **Supplying Aggregates.** Provide approximately 40 lb. of each aggregate stockpile unless otherwise directed.

4.4.2.1.5. **Supplying Asphalt.** Provide at least 1 gal. of the asphalt material and enough quantities of any additives proposed for use.

4.4.2.1.6. **Ignition Oven Correction Factors.** Determine the aggregate and asphalt correction factors from the ignition oven in accordance with Tex-236-F, Part II. Provide correction factors that are not more than 12 mo. old. Note that the asphalt content correction factor takes into account the percent fibers in the mixture so that the fibers are excluded from the binder content determination. Provide the Engineer with split samples of the mixtures before the trial batch production, including all additives (except water), and blank samples used to determine the correction factors for the ignition oven used for quality assurance testing during production. Correction factors established from a previously approved mixture design may be used for the current mixture design if the mixture design and ignition oven are the same as previously used and the correction factors are not more than 12 mo. old, unless otherwise directed.

4.4.2.1.7. **Boil Test.** When shown on the plans, perform the test and retain the tested sample from Tex-530-C until completion of the project or as directed. Use this sample for comparison purposes during production. Add lime or liquid antistripping agent as directed if signs of stripping exist.

4.4.2.1.8. **Trial Batch Production.** Provide a plant-produced trial batch upon receiving conditional approval of JMF1 and authorization to produce a trial batch, including the compaction aid or foaming process, if applicable, for verification testing of JMF1 and development of JMF2. Produce a trial batch mixture that meets the requirements in accordance with Table 9. The Engineer may accept test results from recent production of the same mixture instead of a new trial batch.

4.4.2.1.9. **Trial Batch Production Equipment.** Use only equipment and materials proposed for use on the project to produce the trial batch. Provide documentation to verify the calibration or accuracy of the asphalt mass flow meter to measure the binder content. Verify that asphalt mass flow meter meets the requirements of 0.4 % accuracy, when required, in accordance with Item 520, "Weighing and Measuring Equipment." The Engineer may require that the accuracy of the mass flow meter be verified based on quantities used.

4.4.2.1.10. **Trial Batch Quantity.** Produce enough quantity of the trial batch to ensure that the mixture meets the specification requirements.

4.4.2.1.11. **Number of Trial Batches.** Produce trial batches as necessary to obtain a mixture that meets the specification requirements.

4.4.2.1.12. **Trial Batch Sampling.** Obtain a representative sample of the trial batch and split it into three equal portions in accordance with Tex-222-F. Label these portions as "Contractor," "Engineer," and "Referee." Deliver samples to the appropriate laboratory as directed.

4.4.2.1.13. **Trial Batch Testing.** Test the trial batch to ensure the mixture produced using the proposed JMF1 meets the mixture requirements in accordance with Table 9. Ensure the trial batch mixture is also in compliance with the requirements in accordance with Tables 7 and 8. Use a Department-approved laboratory listed on the MPL to perform the Hamburg Wheel test on the trial batch mixture or request that the Department perform the Hamburg Wheel test. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test results on the trial batch. Provide the Engineer with a copy of the trial batch test results.

4.4.2.1.14. **Development of JMF2.** Evaluate the trial batch test results, determine the target mixture proportions, and

submit as JMF2 after the Engineer grants full approval of JMF1 based on results from the trial batch. Verify that JMF2 meets the mixture requirements in accordance with Table 9.

4.4.2.1.15. **Mixture Production.** After receiving approval for JMF2, use JMF2 to produce Lot 1.

4.4.2.1.16. **Development of JMF3.** Evaluate the test results from Lot 1, determine the optimum mixture proportions, and submit as JMF3 for use in Lot 2.

4.4.2.1.17. **JMF Adjustments.** If JMF adjustments are necessary to achieve the specified requirements, make the adjustments before beginning a new lot. The adjusted JMF must:

- be provided to the Engineer in writing before the start of a new lot;
- be numbered in sequence to the previous JMF;
- meet the master gradation limits in accordance with Table 7
- meet the binder content limits in accordance with Table 8; and
- be within the operational tolerances of JMF2 in accordance with Table 9.

4.4.2.1.18. **Requesting Referee Testing.** Use referee testing, if needed, in accordance with Section 3082.4.9.1., "Referee Testing," to resolve testing differences with the Engineer.

Table 9
Operational Tolerances

Test Description	Test Method	Allowable Difference between JMF2 and JMF1 Target[1]	Allowable Difference from Current JMF and JMF2[2]	Allowable Difference between Contractor and Engineer[3]
Individual % retained for sieve sized larger than #200	Tex-200-F	Must be Within Master Grading Limits in accordance with Table 7	±3.0[4]	±5.0[4]
% passing the #200 sieve			±2.0[4]	±3.0[4]
Laboratory-molded density, %	Tex-207-F, Part VIII	±1.0	±1.0	±1.0
Asphalt binder content, %	Tex-236-F, Part I[5]	±0.3[6,7]	±0.3[4,6,7]	±0.3[6,7]
Drain-down, %	Tex-235-F	Note 8	Note 8	N/A
Boil test	Tex-530-C	Note 9	Note 9	N/A
Membrane application rate	Tex-247-F	±0.02	±0.02	N/A

1. JMF1 is the approved laboratory mixture design used for producing the trial batch. JMF2 is the approved mixture design developed from the trial batch used to produce Lot 1.
2. Current JMF is JMF3 or higher. JMF3 is the approved mixture design used to produce Lot 2.
3. Contractor may request referee testing only when values exceed these tolerances.
4. Only applies to mixture produced for Lot 1 and higher. Aggregate gradation is not allowed to be outside the limits in accordance with Table 7.
5. Ensure the binder content determination excludes fibers.
6. May be obtained from asphalt mass flow meter readouts as determined by the Engineer.
7. Binder content is not allowed to be outside the limits shown in Table 8.
8. Verify that Table 8 requirements are met.
9. When shown on the plans.

4.4.2.2. **Engineer's Responsibilities.**

4.4.2.2.1. **Superpave Gyratory Compactor.** The Engineer will use a Department SGC calibrated in accordance with Tex-241-F to mold samples for laboratory mixture design verification. For molding trial batch and production specimens, the Engineer will use the Contractor-provided SGC at the field laboratory or provide and use a Department SGC at an alternate location.

4.4.2.2.2. **Conditional Approval of JMF1 and Authorizing Trial Batch.** The Engineer will review and verify conformance of the following information within two working days of receipt:

- the Contractor's mix design report (JMF1);
- the Contractor-provided Hamburg Wheel test results, if applicable;
- all required materials including aggregates, asphalt, and additives; and
- the mixture specifications.

The Engineer will grant the Contractor conditional approval of JMF1 if the information provided on the paper copy of JMF1 indicates that the Contractor's mixture design meets the specifications. When the Contractor does not provide Hamburg Wheel test with laboratory mixture design, 10 working days are allowed for conditional approval of JMF1. The Engineer will base full approval of JMF1 on the test results on mixture from the trial batch.

Unless waived, the Engineer will determine the Micro-Deval abrasion loss in accordance with

Section 3082.2.1.1.2., "Micro-Deval Abrasion." If the Engineer's test results are pending after two working days, conditional approval of JMF1 will still be granted within two working days of receiving JMF1. When the Engineer's test results become available, they will be used for specification compliance.

The Contractor is authorized to produce a trial batch after the Engineer grants conditional approval of JMF1.

4.4.2.2.3. **Hamburg Wheel Testing.** At the Contractor's request, the Department will perform the Hamburg Wheel test on the laboratory mixture in accordance with Tex-242-F to verify compliance with the Hamburg Wheel test requirement in accordance with Table 8. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel results on the laboratory mixture design.

4.4.2.2.4. **Ignition Oven Correction Factors.** The Engineer will use the split samples provided by the Contractor to determine the aggregate and asphalt correction factors for the ignition oven used for quality assurance testing during production in accordance with Tex-236-F, Part II. Provide correction factors that are not more than 12 mo. old. The Engineer will verify that the asphalt content correction factor takes into account the percent fibers in the mixture so that the fibers are excluded from the binder content determination.

4.4.2.2.5. **Testing the Trial Batch.** The Engineer will sample and test the trial batch within one full working day to ensure that the mixture meets the requirements in accordance with Table 9. If the Contractor requests the option to have the Department perform the Hamburg Wheel test on the trial batch mixture, the Engineer will mold samples in accordance with Tex-242-F to verify compliance with the Hamburg Wheel test requirement in accordance with Table 8.

The Engineer will have the option to perform Tex-530-C on the trial batch when shown on the plans. These results may be retained and used for comparison purposes during production.

4.4.2.2.6. **Full Approval of JMF1.** The Engineer will grant full approval of JMF1 and authorize the Contractor to proceed with developing JMF2 if the Engineer's results for the trial batch meet the requirements in accordance with Tables 7 and 8.

The Engineer will notify the Contractor that an additional trial batch is required if the trial batch does not meet these requirements.

4.4.2.2.7. **Approval of JMF2.** The Engineer will approve JMF2 within one working day if the mixture meets the requirements in accordance with Tables 7, 8, and 9.

4.4.2.2.8. **Approval of Lot 1 Production.** The Engineer will authorize the Contractor to proceed with Lot 1 production (using JMF2).

4.4.2.2.9. **Approval of JMF3 and Subsequent JMF Changes.** JMF3 and subsequent JMF changes are approved if they meet the master grading and asphalt binder content shown in accordance with Tables 7 and 8 and are within the operational tolerances of JMF2 in accordance with Table 9.

4.4.2.2.10. **Binder Content Adjustments.** For JMF2 and above, the Engineer may require the Contractor to adjust the target binder content by no more than 0.3% from the current JMF.

4.5. **Production Operations.** Perform a new trial batch when the plant or plant location is changed. Take corrective action and receive approval to proceed after any production suspension for noncompliance to the specification.

4.5.1. **Storage and Heating of Materials.** Do not heat the asphalt binder above the temperatures specified in Item 300, "Asphalts, Oils, and Emulsions," or outside the manufacturer's recommended values. Provide the Engineer with daily records of asphalt binder and hot-mix asphalt discharge temperatures (in legible and discernible increments) in accordance with Item 320, "Equipment for Asphalt Concrete Pavement," unless otherwise directed. Do not store mixture for a period long enough to affect the quality of the mixture, nor in any case longer than 12 hr. unless otherwise approved.

4.5.2. **Mixing and Discharge of Materials.** Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not exceed the maximum production temperatures in accordance with Table 10. The Department will not pay for or allow placement of any mixture produced above the maximum production temperatures in accordance with Table 10.

Table 10
Maximum Production Temperature

High-Temperature Binder Grade[1]	Max Production Temperature
PG 76	345˚F
A-R Binder	345˚F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.

Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant. Determine the moisture content, if requested, by oven-drying in accordance with Tex-212-F, Part II, and verify that the mixture contains no more than 0.2% of moisture by weight. Obtain the sample immediately after discharging the mixture into the truck and perform the test promptly.

4.6. **Hauling Operations.** Clean all truck beds before use to ensure that mixture is not contaminated. Use a release agent shown on the Department's MPL to coat the inside bed of the truck when necessary. Do not use diesel or any release agent not shown on the Department's MPL.

Use equipment for hauling as defined in Section 3082.4.7.3.2., "Hauling Equipment." Use other hauling equipment only when allowed.

4.7. **Placement Operations.** Collect haul tickets from each load of mixture delivered to the project and provide the Department's copy to the Engineer approximately every hour, or as directed. Use a hand-held thermal camera or infrared thermometer, when a thermal imaging system is not used, to measure and record the internal temperature of the mixture as discharged from the truck or Material Transfer Device (MTD) before or as the mix enters the paver and an approximate station number or GPS coordinates on each ticket. Calculate the daily yield and cumulative yield for the specified lift and provide to the Engineer at the end of paving operations for each day unless otherwise directed. The Engineer may suspend production if the Contractor fails to produce and provide haul tickets and yield calculations by the end of paving operations for each day.

Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from pavement edges. Do not allow any loose mixture onto the prepared surface before application of the membrane. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Offset longitudinal joints of successive courses of hot-mix by at least 6 in. Place mixture so that longitudinal joints on the surface course coincide within 6-in. of lane lines and are not placed in the wheel path, or as directed, and offset longitudinal joints of successive courses of hot-mix by at least 6-in. Ensure that all finished surfaces will drain properly.

4.7.1. **Weather Conditions.**

4.7.1.1. **When Using a Thermal Imaging System.** The Contractor may pave any time the roadway is dry and the roadway surface temperature is at least 60°F unless otherwise approved or as shown on the plans; however, the Engineer may restrict the Contractor from paving if the ambient temperature is likely to drop below 32°F within 12 hr. of paving. Place mixtures when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. Provide output data from the thermal imaging system to demonstrate to the Engineer that no recurring severe thermal segregation exists in accordance with Section 3082.4.7.3.1.2., "Thermal Imaging System."

Produce mixture with a target discharge temperature higher than 300°F and with a compaction aid to facilitate compaction when the air temperature is 70°F and falling.

4.7.1.2. **When Not Using a Thermal Imaging System.** When using a thermal camera instead of the thermal imaging system, place mixture when the roadway surface temperature is at or above 70°F unless otherwise approved or as shown on the plans. Measure the roadway surface temperature with a hand-held thermal camera or infrared thermometer. Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. The Engineer may restrict the Contractor from paving if the air temperature is 60°F and falling.

Produce mixture with a target discharge temperature higher than 300°F and with a compaction aid to facilitate compaction when the air temperature is 70°F and falling.

4.7.2. **Application of Membrane.** Apply the membrane at the rates in accordance with Table 11 unless otherwise directed. Spray the membrane using a metered mechanical pressure spray bar at a temperature of 140°F to 180°F. Monitor the membrane application rate and make adjustments to the rate when directed. Verify that the spray bar is capable of applying the membrane at a uniform rate across the entire paving width. Apply adequate overlap of the tack coat in the longitudinal direction during placement of the mat to ensure bond of adjacent mats, unless otherwise directed. Unless otherwise directed, avoid tacking the vertical faces of adjacent PFC mats in the longitudinal direction to avoid restricting lateral drainage. Apply tack coat to all transverse joints. Do not let the wheels or other parts of the paving machine contact the freshly applied membrane. Do not dilute the membrane at the terminal, in the field, or at any other location before use. Do not allow any loose mixture onto the prepared surface before application of the membrane.

Table 11
Membrane Application Rate Limits, (Gal. per square yard)

Mix Type	Lift Thickness	Membrane Rate
Permeable Friction Course	1-1/2 in.	0.30–0.33
	1-1/4 in.	0.27–0.30
	1 in.	0.25–0.28
	3/4 in.	0.22–0.25
Thin Bonded Friction Course	3/4 in.	0.17–0.27
	5/8 in.	0.16–0.24
	1/2 in.	0.14–0.20

4.7.2.1. **Non-uniform Application of Membrane**. Stop application if it is not uniform due to streaking, ridging, pooling, or flowing off the roadway surface. Verify equipment condition including plugged nozzles on the spray bar, operating procedures, application temperature, and material properties. Determine and correct the cause of non-uniform application.

4.7.2.2. **Test Strips.** The Engineer may perform independent tests to confirm Contractor compliance and may require testing differences or failing results to be resolved before resuming production.

The Engineer may cease operations and require construction of test strips at the Contractor's expense if any of the following occurs:

- non-uniformity of application continues after corrective action;
- in three consecutive shots, application rate differs by more than 0.03 gal. per square yard from the rate

directed; or

- any shot differs by more than 0.05 gal. per square yard from the rate directed.

The Engineer will approve the test strip location. The Engineer may require additional test strips until the membrane application meets specification requirements.

4.7.3. **Lay-Down Operations.** Use the placement temperature in accordance with Table 12 to establish the minimum placement temperature of the mixture delivered to the paving operation.

Table 12
Min Mixture Placement Temperature

High-Temperature Binder Grade[1]	Min Placement Temperature (Before Entering Paving Operation)[2,3]
PG 76	280˚F
A-R Binder	280˚F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. The mixture temperature must be measured using a hand-held thermal camera or infrared thermometer nearest to the point of entry of the paving operation.
3. Minimum placement temperatures may be reduced 10°F if using a compaction aid.

4.7.3.1. **Thermal Profile.** Use a hand-held thermal camera or a thermal imaging system to obtain a continuous thermal profile in accordance with Tex-244-F. Thermal profiles are not applicable in areas described in Section 3082.4.9.8., "Miscellaneous Areas."

4.7.3.1.1. **Thermal Segregation.**

4.7.3.1.1.1. **Moderate.** Any areas that have a temperature differential greater than 25°F, but not exceeding 50°F.

4.7.3.1.1.2. **Severe.** Any areas that have a temperature differential greater than 50°F.

4.7.3.1.2. **Thermal Imaging System.** Review the output results when a thermal imaging system is used, and provide the report described in Tex-244-F to the Engineer daily unless otherwise directed. Modify the paving process as necessary to eliminate any recurring (moderate or severe) thermal segregation identified by the thermal imaging system.

The Engineer may suspend subsequent paving operations if the Contractor cannot successfully modify the paving process to eliminate recurring severe or moderate thermal segregation.

Provide the Engineer with electronic copies of all daily data files that can be used with the thermal imaging system software to generate temperature profile plots daily or as requested by the Engineer.

4.7.3.1.3. **Thermal Camera.** When using the thermal camera instead of the thermal imaging system, take immediate corrective action to eliminate recurring moderate thermal segregation when a hand-held thermal camera is used. Provide the Engineer with the thermal profile of every sublot within one working day of the completion of each lot. When requested by the Engineer, provide the electronic files generated using the thermal camera. Report the results of each thermal profile in accordance with Section 3082.4.2., "Reporting and Responsibilities." The Engineer will use a hand-held thermal camera to obtain a thermal profile at least once per project unless the thermal imaging system is used. Suspend operations and take immediate corrective action to eliminate severe thermal segregation unless otherwise directed. Resume operations when the Engineer determines that subsequent production will meet the requirements of this Section.

4.7.3.2. **Hauling Equipment.** Use live bottom or end dump trucks to haul and transfer mixture; however, with exception of paving miscellaneous areas, end dump trucks are only allowed when used in conjunction with an MTD with remixing capability or when a thermal imaging system is used unless otherwise allowed.

4.7.3.3. **Screed Heaters.** Turn off screed heaters to prevent overheating of the mat if the paver stops for more than 5 min. The Engineer may evaluate the suspect area in accordance with Section 3082.4.9.9., "Recovered

Asphalt Dynamic Shear Rheometer (DSR)," if the screed heater remains on for more than 5 min. while the paver is stopped.

4.8. **Compaction.** Roll the freshly placed mixture with as many steel-wheeled rollers as necessary, operated in static mode, to seat the mixture without excessive breakage of the aggregate and to provide a smooth surface and uniform texture. Do not use pneumatic rollers. Use the control strip method given in Tex-207-F, Part IV, to establish the rolling pattern. Moisten the roller drums thoroughly with a soap and water solution to prevent adhesion. Use only water or an approved release agent on rollers, tamps, and other compaction equipment unless otherwise directed.

For PFC mixtures, use Tex-246-F to test and verify that the compacted mixture has adequate permeability. Measure the water flow once per sublot at locations directed by the Engineer. The water flow rate should be less than 20 sec. Investigate the cause of the water flow rate test failures and take corrective actions during production and placement to ensure the water flow rate is less than 20 sec. Suspend production if two consecutive water flow rate tests fail unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

Complete all compaction operations before the pavement temperature drops below 180°F unless otherwise allowed. The Engineer may allow compaction with a light finish roller operated in static mode for pavement temperatures below 180°F.

Allow the compacted pavement to cool to 160°F or lower before opening to traffic unless otherwise directed. Sprinkle the finished mat with water or limewater, when directed, to expedite opening the roadway to traffic.

4.9. **Acceptance Plan.** Sample and test the hot-mix on a lot and sublot basis.

4.9.1. **Referee Testing.** The Materials and Tests Division is the referee laboratory. The Contractor may request referee testing if the differences between Contractor and Engineer test results exceed the operational tolerances in accordance with Table 9 and the differences cannot be resolved. The Contractor may also request referee testing if the Engineer's test results require suspension of production and the Contractor's test results are within specification limits. Make the request within five working days after receiving test results and cores from the Engineer. Referee tests will be performed only on the sublot in question and only for the particular tests in question. Allow 10 working days from the time the referee laboratory receives the samples for test results to be reported. The Department may require the Contractor to reimburse the Department for referee tests if more than three referee tests per project are required and the Engineer's test results are closer to the referee test results than the Contractor's test results.

4.9.2. **Production Acceptance.**

4.9.2.1. **Production Lot.** A production lot consists of four equal sublots. The default quantity for Lot 1 is 1,000 ton; however, when requested by the Contractor, the Engineer may increase the quantity for Lot 1 to no more than 2,000 ton. The Engineer will select subsequent lot sizes based on the anticipated daily production such that approximately three to four sublots are produced each day. The lot size will be between 1,000 ton and 4,000 ton. The Engineer may change the lot size before the Contractor begins any lot.

4.9.2.1.1. **Incomplete Production Lots.** If a lot is begun but cannot be completed, such as on the last day of production or in other circumstances deemed appropriate, the Engineer may close the lot. Close all lots within five working days unless otherwise allowed.

4.9.2.2. **Production Sampling.**

4.9.2.2.1. **Mixture Sampling.** Obtain hot-mix samples from trucks at the plant in accordance with Tex-222-F. The sampler will split each sample into three equal portions in accordance with Tex-200-F and label these portions as "Contractor," "Engineer," and "Referee." The Engineer will perform or witness the sample splitting and take immediate possession of the samples labeled "Engineer" and "Referee." The Engineer will maintain the custody of the samples labeled "Engineer" and "Referee" until the Department's testing is completed.

4.9.2.2.1.1. **Random Sample.** At the beginning of the project, the Engineer will select random numbers for all production sublots. Determine sample locations in accordance with Tex-225-F. Take one sample for each sublot at the randomly selected location. The Engineer will perform or witness the sampling of production sublots.

4.9.2.2.1.2. **Blind Sample.** For one sublot per lot, the Engineer will obtain and test a "blind" sample instead of the random sample collected by the Contractor. Test either the "blind" or the random sample; however, referee testing (if applicable) will be based on a comparison of results from the "blind" sample. The location of the Engineer's "blind" sample will not be disclosed to the Contractor. The Engineer's "blind" sample may be randomly selected in accordance with Tex-225-F for any sublot or selected at the discretion of the Engineer. The Engineer will use the Contractor's split sample for sublots not sampled by the Engineer.

4.9.2.2.2. **Informational Hamburg and Overlay Testing.** Select one random sublot from Lot 2 or higher for Hamburg and Overlay testing during the first week of production. Obtain and provide the Engineer with approximately 90 lb. of mixture, sampled in accordance with Tex-222-F, in sealed containers, boxes, or bags labeled with the Control-Section-Job (CSJ), mixture type, lot, and sublot number. The Engineer will ship the mixture to the Materials and Tests Division for Hamburg and Overlay testing. Results from these tests will not be used for specification compliance.

4.9.2.2.3. **Asphalt Binder Sampling**. Obtain a 1-qt. (1 gal. for A-R binder) sample of the asphalt binder witness by the Engineer for each lot of mixture produced. The Contractor will notify the Engineer when the sampling will occur. Obtain the sample at approximately the same time the mixture random sample is obtained. Sample from a port located immediately upstream from the mixing drum or pug mill and upstream from the introduction of any additives in accordance with Tex-500-C, Part II. Label the can with the corresponding lot and sublot numbers, producer, producer facility, grade, district, date sampled, and project information including highway and CSJ. The Engineer will retain these samples for one year. The Engineer may also obtain independent samples. If obtaining an independent asphalt binder sample and upon request of the Contractor, the Engineer will split a sample of the asphalt binder with the Contractor.

At least once per project, the Engineer will collect split samples of each binder grade and source used. The Engineer will submit one split sample to the Materials and Tests Division to verify compliance with Item 300, "Asphalts, Oils, and Emulsions" and will retain the other split sample for 1 yr.

4.9.2.3. **Membrane Sampling.** The Engineer will obtain a 1-qt. sample of the polymer modified emulsion for each lot of mixture produced in accordance with Tex-500-C, Part III. The Engineer will notify the Contractor when the sampling will occur and will witness the collection of the sample. Obtain the sample at approximately the same time the mixture random sample is obtained. Label the can with the corresponding lot and sublot numbers, producer, producer facility, grade, district, date sampled, and project information including highway and CSJ. The Engineer will retain theses samples for two months.

At least once per project, the Engineer will collect split samples of the polymer modified emulsion. The Engineer will submit one split sample to the Materials and Tests Division to verify compliance with Item 300, "Asphalts, Oils, and Emulsions" and will retain the other split sample for two months. The Engineer may test as often as necessary to ensure the residual of the emulsion is greater than or equal to the specification requirement in Item 300, "Asphalts, Oils, and Emulsions."

4.9.2. **Production Testing.** The Contractor and Engineer must perform production tests in accordance with Table 13. The Contractor has the option to verify the Engineer's test results on split samples provided by the Engineer. Determine compliance with operational tolerances in accordance with Table 9 for all sublots.

At any time during production, the Engineer may require the Contractor to verify the following based on quantities used:

- lime content (within ±0.1% of JMF), when PG binder is specified;
- fiber content (within ±0.03% of JMF), when PG binder is specified; and
- CRM content (within ±1.5% of JMF), when A-R binder is specified.

Maintain the in-line measuring device when A-R binder is specified to verify the A-R binder viscosity between

2,500 and 4,000 centipoise at 350°F unless otherwise approved. Record A-R binder viscosity at least once per hour and provide the Engineer with a daily summary unless otherwise directed.

If the aggregate mineralogy is such that Tex-236-F Part I does not yield reliable results, the Engineer may allow alternate methods for determining the asphalt content and aggregate gradation. The Engineer will require the Contractor to provide evidence that results from Tex-236-F, Part I are not reliable before permitting an alternate method unless otherwise allowed. Use the applicable test procedure as directed if an alternate test method is allowed.

Table 13
Production and Placement Testing Frequency

Description	Test Method	Min Contractor Testing Frequency	Min Engineer Testing Frequency
Individual % retained for sieve sized larger than #200	Tex-200-F	1 per sublot	1 per 12 sublots
% passing the #200 sieve			
Laboratory-molded density, %	Tex-207-F, Part VIII	1 per sublot	1 per lot
Asphalt binder content[1], %	Tex-236-F, Part I[2]	1 per sublot	1 per lot
Drain-down, %	Tex-235-F	1 per sublot	1 per 12 sublots
Boil test[3]	Tex-530-C	1 per project	1 per project
Membrane application rate	Tex-247-F	1 per lot	1 per 12 sublots
Moisture content	Tex-212-F, Part II	When directed	1 per project
Cantabro loss, %	Tex-245-F	1 per project (sample only)	1 per project
Overlay test	Tex-248-F	1 per project (sample only) [10]	1 per project[4]
Hamburg Wheel test	Tex-242-F	1 per project (sample only)[10]	1 per project[4]
Water flow test[5]	Tex-246-F	1 per sublot	1 per project
Asphalt binder sampling	Tex-500-C, Part II	1 per lot (sample only)[6]	1 per project
Membrane sampling and testing	Tex-500-C, Part III	N/A	1 per project
Thermal profile	Tex-244-F	1 per sublot[7,8,9]	1 per project[8]

1. May be obtained from asphalt mass flow meter readouts as determined by the Engineer.
2. Ensure the binder content determination excludes fibers.
3. When shown on the plans.
4. When required according to mixture type and requirements in accordance with Table 8.
5. Only required for PFC mixtures.
6. Obtain samples witness by the Engineer. The Engineer will retain these samples for 1 yr.
7. To be performed in the presence of the Engineer when using the thermal camera, unless otherwise approved.
8. Not required when a thermal imaging system is used.
9. When using the thermal imaging system, the test report must include the temperature measurements taken in accordance with Tex-244-F.
10. Testing performed by the Materials and Tests Division for informational purposes only.

4.9.3. **Operational Tolerances.** Control the production process within the operational tolerances in accordance with Table 9. Suspend production and placement operations when production or placement test results exceed the tolerances in accordance with Table 9 unless otherwise allowed. The Engineer will allow suspended production to resume when test results or other information indicates the next mixture produced will be within the operational tolerances.

4.9.4. **Individual Loads of Hot-Mix**. The Engineer can reject individual truckloads of hot-mix. When a load of hot-mix is rejected for reasons other than temperature, contamination, or excessive uncoated particles, the Contractor may request that the rejected load be tested. Make this request within 4 hr. of rejection. The Engineer will sample and test the mixture. If test results are within the operational tolerances in accordance with Table 9 , payment will be made for the load. If test results are not within operational tolerances, no payment will be made for the load.

4.9.5. **Placement Acceptance.**

4.9.6. **Placement Lot.** A placement lot consists of four placement sublots. A placement sublot consists of the area placed during a production sublot.

4.9.7. **Miscellaneous Areas.** Miscellaneous areas include areas that typically involve significant handwork or discontinuous paving operations such as driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. The specified layer thickness is based on the rate of 90 lb. per square yard for each inch of pavement unless another rate is shown on the plans. Miscellaneous areas are not subject to thermal profiles testing.

4.9.8. **Recovered Asphalt Dynamic Shear Rheometer (DSR).** The Engineer may take production samples or cores from suspect areas of the project to determine recovered asphalt properties. Asphalt binders with an aging ratio greater than 3.5 do not meet the requirements for recovered asphalt properties and may be deemed defective when tested and evaluated by the Materials and Tests Division. The aging ratio is the DSR value of the extracted binder divided by the DSR value of the original unaged binder. Obtain DSR values in accordance with AASHTO T 315 at the specified high temperature performance grade of the asphalt. The Engineer may require removal and replacement of the defective material at the Contractor's expense. The asphalt binder will be recovered for testing from production samples or cores in accordance with Tex-211-F.

4.9.9. **Irregularities.** Identify and correct irregularities including segregation, rutting, raveling, flushing, fat spots, mat slippage, irregular color, irregular texture, roller marks, tears, gouges, streaks, uncoated aggregate particles, or broken aggregate particles. The Engineer may also identify irregularities, and in such cases, the Engineer will promptly notify the Contractor. If the Engineer determines that the irregularity will adversely affect pavement performance, the Engineer may require the Contractor to remove and replace (at the Contractor's expense) areas of the pavement that contain irregularities. The Engineer may also require the Contractor to remove and replace (at the Contractor's expense) areas where the mixture does not bond to the existing pavement.

If irregularities are detected, the Engineer may require the Contractor to immediately suspend operations or may allow the Contractor to continue operations for no more than one day while the Contractor is taking appropriate corrective action.

4.9.10. **Exempt Production.** When the anticipated daily production is less than 100 ton, all QC and QA sampling and testing are waived. The Engineer may deem the mixture as exempt production for the following conditions:

- anticipated daily production is more than 100 ton but less than 250 ton;
- total production for the project is less than 2,500 ton;
- when mutually agreed between the Engineer and the Contractor; or
- when shown on the plans.

For exempt production, the Contractor is relieved of all production and placement sampling and testing requirements. All other specification requirements apply, and the Engineer will perform acceptance tests for production and placement in accordance with Table 13.
For exempt production:

- produce, haul, place, and compact the mixture as directed by the Engineer; and
- control mixture production to yield a laboratory-molded density that is within ±1.0% of the target density as tested by the Engineer.

4.9.11. **Ride Quality**. Measure ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.

5. MEASUREMENT

5.1. **PFC Hot-Mix Asphalt.** Permeable friction course (PFC) hot-mix will be measured by the ton of composite mixture, which includes asphalt, aggregate, and additives. Measure the weight on scales in accordance with Item 520, "Weighing and Measuring Equipment."

5.2. **TBFC Hot-Mix Asphalt.** Thin bonded friction course (TBFC) hot-mix will be measured by the ton of composite mixture, which includes asphalt, aggregate, and additives. Measure the weight on scales in accordance with Item 520, "Weighing and Measuring Equipment."

5.3. **Membrane.** Membrane material will be measured by volume. Membrane material will be measured at the applied temperature by strapping the tank before and after road application and determining the net volume in gallons from the distributor's calibrated strap stick. The Engineer will witness all operations for volume determination. All membrane will be measured by the gallon applied, in the accepted membrane.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under Section 3082.5.1., "PFC Hot-Mix Asphalt," will be paid for at the unit bid price for "Permeable friction course" of the mixture type, SAC, and binder specified. These prices are full compensation for surface preparation, removing pavement marking and markers, materials, placement, equipment, labor, tools, and incidentals.

The work performed and materials furnished in accordance with this Item and measured as provided under Section 3082.5.2., "TBFC Hot-Mix Asphalt," will be paid for at the unit bid price for "Thin bonded friction course" of the mixture type, SAC, and binder specified. These prices are full compensation for surface preparation, removing pavement marking and markers, materials, placement, equipment, labor, tools, and incidentals.

The work performed and materials furnished in accordance with this Item and measured as provided under Section 3082.5.3., "Membrane," will be paid for at the unit bid price for "Membrane" of the membrane material provided. These prices are full compensation for materials, placement, equipment, labor, tools, and incidentals.

Trial batches will not be paid for unless they are included in pavement work approved by the Department.

Payment adjustment for ride quality will be determined in accordance with Item 585, "Ride Quality for Pavement Surfaces."

Special Specification 3096
Asphalts, Oils, and Emulsions

1. DESCRIPTION

Provide asphalt cements, cutback and emulsified asphalts, performance-graded asphalt binders, and other miscellaneous asphalt materials as specified on the plans.

2. MATERIALS

Provide asphalt materials that meet the stated requirements when tested in conformance with the referenced Department, AASHTO, and ASTM test methods. Use asphalt containing recycled materials only if the recycled components meet the requirements of Article 6.9., "Recycled Materials." Provide asphalt materials that the Department has preapproved for use in accordance with Tex-545-C, "Asphalt Binder Quality Program."

Inform the Department of all additives or modifiers included in the asphalt binder as part of the facility quality plan, as required by Tex-545-C, "Asphalt Binder Quality Program," and provide that information to Department personnel. The Department reserves the right to prohibit the use of any asphalt additive or modifier.

Limit the use of polyphosphoric acid to no more than 0.5% by weight of the asphalt binder.

The use of re-refined engine oil bottoms is prohibited.

Acronyms used in this Item are defined in Table 1.

Table1
Acronyms

Acronym	Definition
Test Procedure Designations	
Tex	Department
T or R	AASHTO
D	ASTM
Polymer Modifier Designations	
P	polymer-modified
SBR or L	styrene-butadiene rubber (latex)
SBS	styrene-butadiene-styrene block co-polymer
TR	tire rubber (from ambient temperature grinding of truck and passenger tires)
AC	asphalt cement
AE	asphalt emulsion
AE-P	asphalt emulsion prime
A-R	asphalt-rubber
C	cationic
EAP&T	emulsified asphalt prime and tack
EBL	emulsified bonding layer
FDR	full depth reclamation
H-suffix	harder residue (lower penetration)
HF	high float
HY	high yield
MC	medium-curing
MS	medium-setting
PCE	prime, cure, and erosion control
PG	performance grade
RC	rapid-curing
RS	rapid-setting
S-suffix	stockpile usage
SCM	special cutback material
SS	slow-setting
SY	standard yield
TRAIL	tracking resistant asphalt interlayer

2.1. **Asphalt Cement**. Provide asphalt cement that is homogeneous, water-free, and nonfoaming when heated to 347°F, and meets the requirements in Table 2.

Table 2
Asphalt Cement

Property	Test Procedure	Viscosity Grade									
		AC-0.6		AC-1.5		AC-3		AC-5		AC-10	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity	T 202										
140°F, poise		40	80	100	200	250	350	400	600	800	1,200
275°F, poise		0.4	–	0.7	–	1.1	–	1.4	–	1.9	–
Penetration, 77°F, 100g, 5 sec.	T 49	350	–	250	–	210	–	135	–	85	–
Flash point, C.O.C., °F	T 48	425	–	425	–	425	–	425	–	450	–
Solubility in trichloroethylene, %	T 44	99.0	–	99.0	–	99.0	–	99.0	–	99.0	–
Spot test	Tex-509-C	Neg.		Neg.		Neg.		Neg.		Neg.	
Tests on residue from RTFOT:	T 240										
Viscosity, 140°F, poise	T 202	–	180	–	450	–	900	–	1,500	–	3,000
Ductility,[1] 77°F 5 cm/min., cm	T 51	100	–	100	–	100	–	100	–	100	–

1. If AC-0.6 or AC-1.5 ductility at 77°F is less than 100 cm, material is acceptable if ductility at 60°F is more than 100 cm.

2.2. **Polymer-Modified Asphalt Cement**. Provide polymer-modified asphalt cement that is smooth, homogeneous, and meets the requirements Table 3. Supply samples of the base asphalt cement and polymer additives if requested.

Table 3
Polymer-Modified Asphalt Cement

Property	Test Procedure	Polymer-Modified Viscosity Grade											
		AC-12-5TR		NT-HA[1]		AC-15P		AC-20XP		AC-10-2TR		AC-20-5TR	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Polymer		TR		–		SBS		SBS		TR		TR	
Polymer content, % (solids basis)	Tex-533-C or Tex-553-C	5.0	–	–	–	3.0	–	–	–	2.0	–	5.0	–
Dynamic shear, G*/sinδ, 82°C, 10 rad/s, kPa	T 315			1.0	–								
Dynamic shear, G*/sinδ, 64°C, 10 rad/s, kPa	T 315	–	–	–	–	–	–	1.0	–	–	–	1.0	–
Dynamic shear, G*/sinδ, 58°C, 10 rad/s, kPa	T 315	1.0	–	–	–	–	–	–	–	1.0	–	–	–
Viscosity 140°F, poise 275°F, poise	 T 202 T 202	 1,200	 –	 –	 4,000	 1,500 –	 – 8.0	 2,000 –	 – –	 1,000 –	 – 8.0	 2,000 –	 – 10.0
Penetration, 77°F, 100 g, 5 sec.	T 49	110	150	–	25	100	150	75	115	95	130	75	115
Ductility, 5cm/min., 39.2°F, cm	T 51					–	–	–	–	–	–	–	–
Elastic recovery, 50°F, %	Tex-539-C	55	–			55	–	55	–	30	–	55	–
Softening point, °F	T 53	113	–	170	–	–	–	120	–	110	–	120	–
Polymer separation, 5 hr.	Tex-540-C	None				None		None		None		None	
Flash point, C.O.C., °F	T 48	425	–	425	–	425	–	425	–	425	–	425	–
Tests on residue from RTFOT aging and pressure aging:	T 240 and R 28												
Creep stiffness S, -18°C, MPa m-value, -18°C	T 313	 – 0.300	 300 –	 – –	 – –	 – 0.300	 300 –	 – 0.300	 300 –	 – 0.300	 300 –	 – 0.300	 300 –

1. Non-Tracking Hot Applied Tack Coat - TRAIL product

2.3. **Cutback Asphalt**. Provide cutback asphalt that meets the requirements of Tables 4, 5, and 6, for the specified type and grade. Supply samples of the base asphalt cement and polymer additives if requested.

Table 4
Rapid-Curing Cutback Asphalt

Property	Test Procedure	Type–Grade					
		RC-250		RC-800		RC-3000	
		Min	Max	Min	Max	Min	Max
Kinematic viscosity, 140°F, cSt	T 201	250	400	800	1,600	3,000	6,000
Water, %	D95	–	0.2	–	0.2	–	0.2
Flash point, T.O.C., °F	T 79	80	–	80	–	80	–
Distillation test:	T 78						
Distillate, percentage by volume of total distillate to 680°F							
to 437°F		40	75	35	70	20	55
to 500°F		65	90	55	85	45	75
to 600°F		85	–	80	–	70	–
Residue from distillation, volume %		70	–	75	–	82	–
Tests on distillation residue:							
Viscosity, 140°F, poise	T 202	600	2,400	600	2,400	600	2,400
Ductility, 5 cm/min., 77°F, cm	T 51	100	–	100	–	100	–
Solubility in trichloroethylene, %	T 44	99.0	–	99.0	–	99.0	–
Spot test	Tex-509-C	Neg.		Neg.		Neg.	

Table 5
Medium-Curing Cutback Asphalt

Property	Test Procedure	Type–Grade							
		MC-30		MC-250		MC-800		MC-3000	
		Min	Max	Min	Max	Min	Max	Min	Max
Kinematic viscosity, 140°F, cSt	T 201	30	60	250	500	800	1,600	3,000	6,000
Water, %	D95	–	0.2	–	0.2	–	0.2	–	0.2
Flash point, T.O.C., °F	T 79	95	–	122	–	140	–	149	–
Distillation test:	T 78								
Distillate, percentage by volume of total distillate to 680°F									
to 437°F		–	35	–	20	–	–	–	–
to 500°F		30	75	5	55	–	40	–	15
to 600°F		75	95	60	90	45	85	15	75
Residue from distillation, volume %		50	–	67	–	75	–	80	–
Tests on distillation residue:									
Viscosity, 140°F, poise	T 202	300	1,200	300	1,200	300	1,200	300	1,200
Ductility, 5 cm/min., 77°F, cm	T 51	100	–	100	–	100	–	100	–
Solubility in trichloroethylene, %	T 44	99.0	–	99.0	–	99.0	–	99.0	–
Spot test	Tex-509-C	Neg.		Neg.		Neg.		Neg.	

Table 6
Special-Use Cutback Asphalt

Property	Test Procedure	Type–Grade					
		MC-2400L		SCM I		SCM II	
		Min	Max	Min	Max	Min	Max
Kinematic viscosity, 140°F, cSt	T 201	2,400	4,800	500	1,000	1,000	2,000
Water, %	D95	–	0.2	–	0.2	–	0.2
Flash point, T.O.C., °F	T 79	150	–	175	–	175	–
Distillation test:	T 78						
Distillate, percentage by volume of total distillate to 680°F							
to 437°F		–	–	–	–	–	–
to 500°F		–	35	–	0.5	–	0.5
to 600°F		35	80	20	60	15	50
Residue from distillation, volume %		78	–	76	–	82	–
Tests on distillation residue:							
Polymer		SBR		–		–	
Polymer content, % (solids basis)	Tex-533-C	2.0	–	–	–	–	–
Penetration, 100 g, 5 sec., 77°F	T 49	150	300	180	–	180	–
Ductility, 5 cm/min., 39.2°F, cm	T 51	50	–	–	–	–	–
Solubility in trichloroethylene, %	T 44	99.0	–	99.0	–	99.0	–

2.4. **Emulsified Asphalt**. Provide emulsified asphalt that is homogeneous, does not separate after thorough mixing, and meets the requirements for the specified type and grade in Tables 7, 8, 9, 10, and 10A-C.

Table 7
Emulsified Asphalt

Property	Test Procedure	Type–Grade									
		Rapid-Setting		Medium-Setting				Slow-Setting			
		HFRS-2		MS-2		AES-300		SS-1		SS-1H	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72										
77°F, sec.		–	–	–	–	75	400	20	100	20	100
122°F, sec.		150	400	100	300	–	–	–	–	–	–
Sieve test, %	T 59	–	0.1	–	0.1	–	0.1	–	0.1	–	0.1
Miscibility	T 59	–		–		–		Pass		Pass	
Cement mixing, %	T 59	–	–	–	–	–	–	–	2.0	–	2.0
Coating ability and water resistance:	T 59										
Dry aggregate/after spray		–		–		Good/Fair		–		–	
Wet aggregate/after spray		–		–		Fair/Fair		–		–	
Demulsibility, 35 mL of 0.02 N $CaCl_2$, %	T 59	50	–	–	30	–	–	–	–	–	–
Storage stability, 1 day, %	T 59	–	1	–	1	–	1	–	1	–	1
Freezing test, 3 cycles[1]	T 59	–		Pass		–		Pass		Pass	
Distillation test:	T 59										
Residue by distillation, % by wt.		65	–	65	–	65	–	60	–	60	–
Oil distillate, % by volume of emulsion		–	0.5	–	0.5	–	5	–	0.5	–	0.5
Tests on residue from distillation:											
Penetration, 77°F, 100 g, 5 sec.	T 49	100	140	120	160	300	–	120	160	70	100
Solubility in trichloroethylene, %	T 44	97.5	–	97.5	–	97.5	–	97.5	–	97.5	–
Ductility, 77°F, 5 cm/min., cm	T 51	100	–	100	–	–	–	100	–	80	–
Float test, 140°F, sec.	T 50	1,200	–	–	–	1,200	–	–	–	–	–

1. Applies only when the Engineer designates material for winter use.

Table 8
Cationic Emulsified Asphalt

Property	Test Procedure	Type–Grade											
		Rapid-Setting				Medium-Setting				Slow-Setting			
		CRS-2		CRS-2H		CMS-2		CMS-2S		CSS-1		CSS-1H	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72												
77°F, sec.		–	–	–	–	–	–	–	–	20	100	20	100
122°F, sec.		150	400	150	400	100	300	100	300	–	–	–	–
Sieve test, %	T 59	–	0.1	–	0.1	–	0.1	–	0.1	–	0.1	–	0.1
Cement mixing, %	T 59	–	–	–	–	–	–	–	–	–	2.0	–	2.0
Coating ability and water resistance:	T 59												
Dry aggregate/after spray		–		–		Good/Fair		Good/Fair		–		–	
Wet aggregate/after spray		–		–		Fair/Fair		Fair/Fair		–		–	
Demulsibility, 35 mL of 0.8% Sodium dioctyl sulfosuccinate, %	T 59	70	–	70	–	–	–	–	–	–	–	–	–
Storage stability, 1 day, %	T 59	–	1	–	1	–	1	–	1	–	1	–	1
Particle charge	T 59	Positive		Positive		Positive		Positive		Positive		Positive	
Distillation test:													
Residue by distillation, % by wt.	T 59	65	–	65	–	65	–	65	–	60	–	60	–
Oil distillate, % by volume of emulsion		–	0.5	–	0.5	–	7	–	5	–	0.5	–	0.5
Tests on residue from distillation:													
Penetration, 77°F, 100 g, 5 sec.	T 49	120	160	70	110	120	200	300	–	120	160	70	110
Solubility in trichloroethylene, %	T 44	97.5	–	97.5	–	97.5	–	97.5	–	97.5	–	97.5	–
Ductility, 77°F, 5 cm/min., cm	T 51	100	–	80	–	100	–		–	100	–	80	–

Table 9
Polymer-Modified Emulsified Asphalt

Property	Test Procedure	Type–Grade									
		Rapid-Setting		Medium-Setting				Slow-Setting			
		HFRS-2P		AES-150P		AES-300P		AES-300S		SS-1P	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72										
77°F, sec.		–	–	75	400	75	400	75	400	30	100
122°F, sec.		150	400					–	–	–	–
Sieve test, %	T 59	–	0.1	–	0.1	–	0.1	–	0.1	–	0.1
Miscibility	T 59	–		–		–		–		Pass	
Coating ability and water resistance:											
Dry aggregate/after spray	T 59	–		Good/Fair		Good/Fair		Good/Fair		–	
Wet aggregate/after spray		–		Fair/Fair		Fair/Fair		Fair/Fair		–	
Demulsibility, 35 mL of 0.02 N $CaCl_2$, %	T 59	50	–	–	–	–	–	–	–	–	–
Storage stability, 1 day, %	T 59	–	1	–	1	–	1	–	1	–	1
Breaking index, g	Tex-542-C	–	–								
Distillation test:[1]	T 59										
Residue by distillation, % by wt.		65	–	65	–	65	–	65	–	60	–
Oil distillate, % by volume of emulsion		–	0.5	–	3	–	5	–	7	–	0.5
Tests on residue from distillation:											
Polymer content, wt. % (solids basis)	Tex-533-C	3.0	–	–	–	–	–	–	–	3.0	–
Penetration, 77°F, 100 g, 5 sec.	T 49	90	140	150	300	300	–	300	–	100	140
Solubility in trichloroethylene, %	T 44	97.0	–	97.0	–	97.0	–	97.0	–	97.0	–
Viscosity, 140°F, poise	T 202	1,500	–	–	–	–	–	–	–	1,300	–
Float test, 140°F, sec	T 50	1,200	–	1,200	–	1,200	–	1,200	–	–	–
Ductility,[2] 39.2°F, 5 cm/min., cm	T 51	50	–	–	–	–	–	–	–	50	–
Elastic recovery,2 50°F, %	Tex-539-C	55	–	–	–	–	–	–	–	–	–
Tests on RTFO curing of distillation residue	T 240										
Elastic recovery, 50°F, %	Tex-536-C	–	–	50	–	50	–	30	–	–	–

1. Exception to T 59: Bring the temperature on the lower thermometer slowly to 350°F ±10°F. Maintain at this temperature for 20 min. Complete total distillation in 60 min. (±5 min.) from the first application of heat.
2. HFRS-2P must meet one of either the ductility or elastic recovery requirements.

Table 10
Polymer-Modified Cationic Emulsified Asphalt

Property	Test Procedure	Type–Grade											
		Rapid-Setting						Medium-Setting				Slow-Setting	
		CRS-2P		CHFRS-2P		CRS-2TR		CMS-1P[3]		CMS-2P[3]		CSS 1P	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72												
77°F, sec.		–	–	–	–	–	–	10	100	–	–	20	100
122°F, sec.		150	400	100	400	150	500	–	–	50	400	–	–
Sieve test, %	T 59	–	0.1	–	0.1	–	0.1	–	0.1	–	0.1	–	0.1
Demulsibility, 35 ml of 0.8% sodium dioctyl sulfosuccinate, %	T 59	70	–	60	–	40	–	–	–	–	–	–	–
Storage stability, 1 day, %	T 59	–	1	–	1	–	1	–	1	–	1	–	1
Breaking index, g	Tex-542-C	–	–	–	–	–	–	–	–	–	–	–	–
Particle charge	T 59	Positive		Positive		Positive		Positive		Positive		Positive	
Distillation test[1]:	T 59												
Residue by distillation, % by weight		65	–	65	–	65	–	30	–	60	–	62	–
Oil distillate, % by volume of emulsion		–	0.5	–	0.5	–	3	–	0.5	–	0.5	–	0.5
Tests on residue from distillation:													
Polymer content, wt. % (solids basis)	Tex-533-C	3.0	–	3.0	–	5.0[7]	–	–	–	–	–	3.0	–
Penetration, 77°F, 100 g, 5 sec.	T 49	90	150	80	130	90	150	30	–	30	–	55	90
Viscosity, 140°F, poise	T 202	1,300	–	1,300	–	1,000	–	–	–	–	–	–	–
Solubility in trichloroethylene, %	T44	97.0	–	95.0	–	98	–	–	–	–	–	97.0	–
Softening point, °F	T 53	–	–	–	–	–	–	–	–	–	–	135	–
Ductility, 77°F, 5 cm/min., cm	T 51	–	–	–	–	40	–	–	–	–	–	70	–
Float test, 140°F, sec.	T 50	–	–	1,800	–	–	–	–	–	–	–	–	–
Ductility,[2] 39.2°F, 5 cm/min., cm	T 51	50	–	–	–	–	–	–	–	–	–	–	–
Elastic recovery,[2] 50°F, %	Tex-539-C	55	–	55	–	–	–	–	–	–	–	–	–
Tests on residue from evaporative recovery:	R 78, Procedure B												
Nonrecoverable creep compliance of residue, 3.2 kPa, 52°C, kPa-[1]	T 350	–	–	–	–	–	–	–	2.0	–	4.0	–	–
Tests on rejuvenating agent:													
Viscosity, 140°F, cSt	T 201	–	–	–	–	–	–	50	175	50	175	–	–
Flash point, C.O.C., °F	T 48	–	–	–	–	–	–	380	–	380	–	–	–
Saturates, % by weight	D 2007	–	–	–	–	–	–	–	30	–	30	–	–
Solubility in n-pentane, % by weight	D 2007	–	–	–	–	–	–	99	–	99	–	–	–
Tests on rejuvenating agent after RTFO	T 240												
Weight Change, %		–	–	–	–	–	–	–	6.5	–	6.5	–	–
Viscosity Ratio		–	–	–	–	–	–	–	3.0	–	3.0	–	–
Tests on latex[4]:													
Tensile strength, die C dumbbell, psi	D 412[5]	–	–	–	–	–	–	800	–	800	–	–	–
Change in mass after immersion in rejuvenating agent, %	D 471	–	–	–	–	–	–	–	40[6]	–	40[6]	–	–

1. Exception to T 59: Bring the temperature on the lower thermometer slowly to 350°F (±0°F). Maintain at this temperature for 20 min. Complete total distillation in 60 min. (±5 min.) from the first application of heat.
2. CRS-2P must meet one of either the ductility or elastic recovery requirements.
3. With all precertification samples of CMS-1P or CMS-2P, submit certified test reports showing that the rejuvenating agent and latex meet the stated requirements. Submit samples of these raw materials if requested by the Engineer.
4. Preparation of latex specimens: use any substrate and recovery method which produces specimens of uniform dimensions and which delivers enough material to achieve desired residual thickness.
5. Cut samples for tensile strength determination using a crosshead speed of 20 in. per minute.
6. Specimen must remain intact after exposure and removal of excess rejuvenating agent.
7. Modifier type is tire rubber.

Table 10A
Non-Tracking Tack Coat Emulsion[1]

Property	Test Procedure	NT-HRE		NT-RRE		NT-SRE	
		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77º F, sec.	T 72	15	–	15	–	10	100
Storage stability, 1 Day, %	T 59	–	1	–	1	–	1
Settlement, 5-day, %	T 59	–	5	–	5	–	5
Sieve test, %	T 59	–	0.30	–	0.30	–	0.1
Distillation test:[2]	T 59						
Residue by distillation, % by wt.		50	–	58	–	50	–
Oil distillate, by volume of emulsion		–	1.0	–	1.0	–	1.0
Test on residue from distillation:							
Penetration, 77ºF, 100 g, 5 sec.	T 49	–	20	15	45	40	90
Solubility in trichloroethylene, %	T 44	97.5	–	97.5	–	97.5	–
Softening point, ºF	T 53	150	–	–	–	–	–
Dynamic shear, G*/sin(δ), 82°C, 10 rad/s, kPa	T 315	1.0	–	–	–	–	–

1. Due to the hardness of the residue, these emulsions should be heated to 120-140°F before thoroughly mixing as the emulsion is being prepared for testing.
2. Exception to T 59: Bring the temperature on the lower thermometer slowly to 350ºF ± 10ºF. Maintain at this temperature for 20 min. Complete total distillation in 60 ± 5 min. from first application of heat.

Table10B
Spray Applied Underseal Membrane Polymer-Modified Emulsions (EBL)

Property	Test Procedure	Min	Max
Viscosity @ 77°F, SSF	T 72	20	100
Storage Stability[1], %	T 59	–	1
Demulsibility[2] Anionic emulsions – 35 mL of 0.02 N CaCl2, % Cationic emulsions – 35 mL of 0.8% sodium dioctyl sulfosuccinate, %	T 59	55	–
Sieve Test[3], %	T 59	–	0.05
Distillation Test[4]	T 59		
Residue by distillation, % by wt.		63	
Oil portion of distillate, % by vol.			0.5
Test on Residue from Distillation			
Elastic Recovery @ 50°F, 50 mm/min., %	Tex-539-C	60	–
Penetration @ 77°F, 100 g, 5 sec., 0.1 mm	T 49	80	130

1. After standing undisturbed for 24 hr., the surface must be smooth, must not exhibit a white or milky colored substance, and must be a homogeneous color throughout.
2. Material must meet demulsibility test for emulsions.
3. May be required by the Engineer only when the emulsion cannot be easily applied in the field.
4. The temperature on the lower thermometer should be brought slowly to 350°F ± 10°F and maintained at this temperature for 20 min. The total distillation should be completed in 60 ± 5 min. from the first application of heat.

Table 10C
Full-Depth Reclamation Emulsion (FDR EM)

Property	Test Procedure	Standard Yield (SY)		High Yield (HY)	
		Min	Max	Min	Max
Sieve test, %	T 59	–	0.1	–	0.1
Viscosity Saybolt Furol @ 77°F, sec.	T 59	20	100	20	100
Distillation test[1]:	T 59				
Residue by distillation, % by wt.		60	–	63	–
Oil portion of distillate, % by vol.		–	0.5	–	0.5
Test on residue from distillation:	T 49				
Penetration @ 77°F, dmm		55	95	120	–
Test on rejuvenating agent:					
BWOA, %[2]	***	–	–	2	–
Viscosity @ 140°F, cSt	T 201	–	–	50	175
Flash Point, COC, °F	T 48	–	–	380	–
Solubility in n-pentane, % by wt.	D2007	–	–	99	–

1. The temperature on the lower thermometer should be brought slowly to 350°F ±10°F and maintained at this temperature for 20 min. The total distillation should be completed in 60 ± 5 min. from the first application of heat.
2. BWOA = By weight of asphalt. Provide a manufacturer's certificate of analysis (COA) with the percent of rejuvenator added.

2.5. **Specialty Emulsions.** Provide specialty emulsion that is either asphalt-based or resin-based and meets the requirements of Table 11 or Table 11A.

Table 11
Specialty Emulsions

Property	Test Procedure	Type–Grade					
		Medium-Setting				Slow-Setting	
		AE-P		EAP&T		PCE[1]	
		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72						
77°F, sec.		–	–	–	–	10	100
122°F, sec.		15	150	–	–	–	–
Sieve test, %	T 59	–	0.1	–	0.1	–	0.1
Miscibility[2]	T 59	–		Pass		Pass	
Demulsibility, 35 mL of 0.10 N $CaCl^2$, %	T 59	–	70	–	–	–	–
Storage stability, 1 day, %	T 59	–	1	–	1	–	–
Particle size,[5] % by volume < 2.5 μm	Tex-238-F[3]	–	–	90	–	90	–
Asphalt emulsion distillation to 500°F followed by Cutback asphalt distillation of residue to 680°F:	T 59 & T 78						
Residue after both distillations, % by wt.		40	–	–	–	–	–
Total oil distillate from both distillations, % by volume of emulsion		25	40	–	–	–	–
Residue by distillation, % by wt.	T 59	–	–	60	–	–	–
Residue by evaporation,[4] % by wt.	T 59	–	–	–	–	60	–
Tests on residue after all distillations:							
Viscosity, 140°F, poise	T 202	–	–	800	–	–	–
Kinematic viscosity,[5] 140°F, cSt	T 201	–	–	–	–	100	350
Flash point C.O.C., °F	T 48	–	–	–	–	400	–
Solubility in trichloroethylene, %	T 44	97.5	–	–	–	–	–
Float test, 122°F, sec.	T 50	50	200	–	–	–	–

1. Supply with each shipment of PCE:
   - a copy of a lab report from an approved analytical lab, signed by a lab official, indicating the PCE formulation does not meet any characteristics of a Resource Conservation Recovery Act (RCRA) hazardous waste;
   - a certification from the producer that the formulation supplied does not differ from the one tested and that no listed RCRA hazardous wastes or Polychlorinated Biphenyls (PCBs) have been mixed with the product; and
   - a Safety Data Sheet.
2. Exception to T 59: In dilution, use 350 mL of distilled or deionized water and a 1,000-mL beaker.
3. Use Tex-238-F, beginning at "Particle Size Analysis by Laser Diffraction," with distilled or deionized water as a medium and no dispersant, or use another approved method.
4. Exception to T 59: Leave sample in the oven until foaming ceases, then cool and weigh.
5. PCE must meet either the kinematic viscosity requirement or the particle size requirement.

Table 11A
Hard Residue Surface Sealant

Property	Test Procedure	Min	Max
Viscosity, Krebs unit, 77ºF, Krebs units	D 562	45	75
Softening point, ºF	Tex-505-C[1]	250	–
Uniformity	D 2939	Pass[2]	
Resistance to heat	D 2939	Pass[3]	
Resistance to water	D 2939	Pass[4]	
Wet flow, mm	D 2939	–	0
Resistance to Kerosene (optional)[5]	D 2939	Pass[6]	
Ultraviolet exposure, UVA-340, 0.77 W/m^2, 50°C chamber, 8 hr. UV lamp, 5 min. spray, 3 hr. 55 min. condensation, 1,000 hr. total exposure[7]	G 154	Pass[8]	
Abrasion loss, 1.6 mm thickness, liquid only, %	ISSA TB-100	–	1.0
Residue by evaporation, % by weight	D 2939	33	–
Tests on residue from evaporation: Penetration, 77ºF, 100 g, 5 sec. Flash point, Cleveland open cup, °F	 T 49 T 48	 15 500	 30
Tests on base asphalt before emulsification Solubility in trichloroethylene, %	 T 44	 98	 –

1. Cure the emulsion in the softening point ring in a 200°F ± 5°F oven for 2 hr.
2. Product must be homogenous and show no separation or coagulation that cannot be overcome by moderate stirring.
3. No sagging or slippage of film beyond the initial reference line.
4. No blistering or re-emulsification.
5. Recommended for airport applications or where fuel resistance is desired.
6. No absorption of Kerosene into the clay tile past the sealer film. Note sealer surface condition and loss of adhesion.
7. Other exposure cycles with similar levels of irradiation and conditions may be used with Department approval.
8. No cracking, chipping, surface distortion, or loss of adhesion. No color fading or lightening.

2.6. **Recycling Agent**. Recycling agent and emulsified recycling agent must meet the requirements in Table 12. Additionally, recycling agent and residue from emulsified recycling agent, when added in the specified proportions to the recycled asphalt, must meet the properties specified on the plans.

Table 12
Recycling Agent and Emulsified Recycling Agent

Property	Test Procedure	Recycling Agent		Emulsified Recycling Agent (ARA-1)		Polymer Modified Emulsified Recycling Agent (ARA-1P)	
		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol, 77°F, sec.	T 72	–	–	15	100	15	110
Sieve test, %	T 59	–	–	–	0.1	–	0.1
Miscibility[1]	T 59	–		No coagulation			
Residue by evaporation,[2] % by wt.	T 59	–	–	60	–	–	–
Distillation test: Residue by distillation, % by wt. Oil distillate, % by volume of emulsion	T 59					 60 –	 65 2
Penetration of Distillation Residue at 39.2°F, 100 g, 5 sec.	T 49					110	190
Tests on recycling agent or residue from evaporation: Flash point, C.O.C., °F Kinematic viscosity, 140°F, cSt 275°F, cSt	 T 48 T 201	 400 75 –	 – 200 10.0	 400 75 –	 – 200 10.0	 400	 –

1. Exception to T 59: Use 0.02 N CaCl2 solution in place of water.
2. Exception to T 59: Maintain sample at 300°F until foaming ceases, then cool and weigh.

2.7. **Crumb Rubber Modifier**. Crumb rubber modifier (CRM) consists of automobile and truck tires processed by ambient temperature grinding.

CRM must be:

- free from contaminants including fabric, metal, and mineral and other nonrubber substances;
- free-flowing; and
- nonfoaming when added to hot asphalt binder.

Ensure rubber gradation meets the requirements of the grades in Table 13 when tested in accordance with Tex-200-F, Part I, using a 50-g sample.

Table 13
CRM Gradations

Sieve Size (% Passing)	Grade A		Grade B		Grade C		Grade D	Grade E
	Min	Max	Min	Max	Min	Max		
#8	100	–	–	–	–	–	As shown on the plans	As approved
#10	95	100	100	–	–	–		
#16	–	–	70	100	100	–		
#30	–	–	25	60	90	100		
#40	–	–	–	–	45	100		
#50	0	10	–	–	–	–		
#200	–	–	0	5	–	–		

2.8. **Crack Sealer**. Provide polymer-modified asphalt-emulsion crack sealer meeting the requirements of Table 14. Provide rubber-asphalt crack sealer meeting the requirements of Table 15.

Table 14
Polymer-Modified Asphalt-Emulsion Crack Sealer

Property	Test Procedure	Min	Max
Rotational viscosity, 77°F, cP	D 2196, Method A	10,000	25,000
Sieve test, %	T 59	–	0.1
Storage stability, 1 day, %	T 59	–	1
Evaporation Residue by evaporation, % by wt.	Tex-543-C	65	–
Tests on residue from evaporation: Penetration, 77°F, 100 g, 5 sec. Softening point, °F Ductility, 39.2°F, 5 cm/min., cm	 T 49 T 53 T 51	 35 140 100	 75 – –

Table 15
Rubber-Asphalt Crack Sealer

Property	Test Procedure	Class A		Class B	
		Min	Max	Min	Max
CRM content, Grade A or B, % by wt.	Tex-544-C	22	26	–	–
CRM content, Grade B, % by wt.	Tex-544-C	–	–	13	17
Virgin rubber content,[1] % by wt.		–	–	2	–
Flash point,[2] C.O.C., °F	T 48	400	–	400	–
Penetration,[3] 77°F, 150 g, 5 sec.	T 49	30	50	30	50
Penetration,[3] 32°F, 200 g, 60 sec.	T 49	12	–	12	–
Softening point, °F	T 53	–	–	170	–
Bond Test, non-immersed, 0.5 in specimen, 50% extension, 20°F[4]	D5329	–		Pass	

1. Provide certification that the Min % virgin rubber was added.
2. Agitate the sealing compound with a 3/8- to 1/2 in. (9.5- to 12.7 mm) wide, square-end metal spatula to bring the material on the bottom of the cup to the surface (i.e., turn the material over) before passing the test flame over the cup. Start at one side of the thermometer, move around to the other, and then return to the starting point using 8 to 10 rapid circular strokes. Accomplish agitation in 3 to 4 sec. Pass the test flame over the cup immediately after stirring is completed.
3. Exception to T 49: Substitute the cone specified in D 217 for the penetration needle.
4. Allow no crack in the crack sealing materials or break in the bond between the sealer and the mortar blocks over 1/4 in. deep for any specimen after completion of the test.

2.9. **Asphalt-Rubber Binders**. Provide asphalt-rubber (A-R) binders that are mixtures of asphalt binder and CRM, which have been reacted at elevated temperatures. Provide A-R binders meeting D6114 and containing a minimum of 15% CRM by weight. Provide Types I or II, containing CRM Grade C, for use in hot-mixed aggregate mixtures. Provide Types II or III, containing CRM Grade B, for use in surface treatment binder. Ensure binder properties meet the requirements of Table 16.

Table 16
A-R Binders

Property	Test Procedure	Binder Type					
		Type I		Type II		Type III	
		Min	Max	Min	Max	Min	Max
Apparent viscosity, 347°F, cP	D2196, Method A	1,500	5,000	1,500	5,000	1,500	5,000
Penetration, 77°F, 100 g, 5 sec.	T 49	25	75	25	75	50	100
Penetration, 39.2°F, 200 g, 60 sec.	T 49	10	–	15	–	25	–
Softening point, °F	T 53	135	–	130	–	125	–
Resilience, 77°F, %	D5329	25	–	20	–	10	–
Flash point, C.O.C., °F	T 48	450	–	450	–	450	–
Tests on residue from Thin-Film Oven Test: Retained penetration ratio, 39.2°F, 200 g, 60 sec., % of original	T 179 T 49	75	–	75	–	75	–

2.10. **Performance-Graded Binders**. Provide PG binders that are smooth and homogeneous, show no separation when tested in accordance with Tex-540-C, and meet the requirements of Table 17.

Separation testing is not required if:

- a modifier is introduced separately at the mix plant either by injection in the asphalt line or mixer,
- the binder is blended on site in continuously agitated tanks, or
- binder acceptance is based on field samples taken from an in-line sampling port at the hot-mix plant after the addition of modifiers.

Table 17
Performance-Graded Binders

Property and Test Method	Performance Grade																		
	PG 58			PG 64				PG 70				PG 76				PG 82			
	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	
Average 7-day max pavement design temperature, °C[1]	58			64				70				76				82			
Min pavement design temperature, °C[1]	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	
Original Binder																			
Flash point, T 48, Min, °C	230																		
Viscosity, T 316[2, 3]: Max, 3.0 Pa·s, test temperature, °C	135																		
Dynamic shear, T 315[4]: G*/sin(δ), Min, 1.00 kPa, Max, 2.00 kPa[7], Test temperature @ 10 rad/sec., °C	58			64				70				76				82			
Elastic recovery, D6084, 50°F, % Min[8]	–	–	30	–	–	30	50	–	30	50	60	30	50	60	70	50	60	70	
Rolling Thin-Film Oven (Tex-506-C)																			
Mass change, T 240, Max, %	1.0																		
Dynamic shear, T 315: G*/sin(δ), Min, 2.20 kPa, Max, 5.00 kPa[7], Test temperature @ 10 rad/sec., °C	58			64				70				76				82			
MSCR, T350, Recovery, 0.1 kPa, High Temperature, % Min[8]	–	–	20	–	–	20	30	–	20	30	40	20	30	40	50	30	40	50	
Pressure Aging Vessel (PAV) Residue (R 28)																			
PAV aging temperature, °C	100																		
Dynamic shear, T 315: G*sin(δ), Max, 5,000 kPa Test temperature @ 10 rad/sec., °C	25	22	19	28	25	22	19	28	25	22	19	28	25	22	19	28	25	22	
Creep stiffness, T 313[5, 6]: *S*, max, 300 MPa, *m*-value, Min, 0.300 Test temperature @ 60 sec., °C	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	
Direct tension, T 314[6]: Failure strain, min, 1.0% Test temperature @ 1.0 mm/min., °C	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	

1. Pavement temperatures are estimated from air temperatures and using an algorithm contained in a Department-supplied computer program, may be provided by the Department, or by following the procedures outlined in AASHTO MP 2 and PP 28.
2. This requirement may be waived at the Department's discretion if the supplier warrants that the asphalt binder can be adequately pumped, mixed, and compacted at temperatures that meet all applicable safety, environmental, and constructability requirements. At test temperatures where the binder is a Newtonian fluid, any suitable standard means of viscosity measurement may be used, including capillary (T 201 or T 202) or rotational viscometry (T 316).
3. Viscosity at 135°C is an indicator of mixing and compaction temperatures that can be expected in the lab and field. High values may indicate high mixing and compaction temperatures. Additionally, significant variation can occur from batch to batch. Contractors should be aware that variation could significantly impact their mixing and compaction operations. Contractors are therefore responsible for addressing any constructability issues that may arise.
4. For quality control of unmodified asphalt binder production, measurement of the viscosity of the original asphalt binder may be substituted for dynamic shear measurements of G*/sin(δ) at test temperatures where the asphalt is a Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary (T 201 or T 202) or rotational viscometry (T 316).
5. Silicone beam molds, as described in AASHTO TP 1-93, are acceptable for use.
6. If creep stiffness is below 300 MPa, direct tension test is not required. If creep stiffness is between 300 and 600 MPa, the direct tension failure strain requirement can be used instead of the creep stiffness requirement. The m value requirement must be satisfied in both cases.
7. Maximum values for unaged and RTFO aged dynamic shear apply only to materials used as substitute binders, as described in Item 340, "Dense-Graded Hot-Mix Asphalt (Small Quantity)", Item 341, "Dense-Graded Hot-Mix Asphalt, and Item 344, "Superpave Mixtures."
8. Elastic Recovery (ASTM D6084) is not required unless MSCR (AASHTO T 350) is less than the minimum % recovery. Elastic Recovery must be used for the acceptance criteria in this instance.

3. EQUIPMENT

Provide all equipment necessary to transport, store, sample, heat, apply, and incorporate asphalts, oils, and emulsions.

4. CONSTRUCTION

Typical Material Use. Use materials shown in Table 18, unless otherwise determined by the Engineer.

Table18
Typical Material Use

Material Application	Typically Used Materials
Hot-mixed, hot-laid asphalt mixtures	PG binders, A-R binders Types I and II
Surface treatment	AC-5, AC-10, AC-15P, AC-20XP, AC-10-2TR, AC-20-5TR, HFRS-2, MS-2, CRS-2, CRS-2H, CRS-2TR, CMS-2P HFRS-2P, CRS-2P, CHFRS-2P, A-R binders Types II and III
Surface treatment (cool weather)	AC12-5TR, RC-250, RC-800, RC-3000, MC-250, MC-800, MC-3000, MC-2400L, CMS-2P
Precoating	AC-5, AC-10, PG 64-22, SS-1, SS-1H, CSS-1, CSS-1H
Tack coat	PG Binders, SS-1H, CSS-1H, EAP&T, TRAIL, EBL
Fog seal	SS-1, SS-1H, CSS-1, CSS-1H, CMS-1P
Hot-mixed, cold-laid asphalt mixtures	AC-0.6, AC-1.5, AC-3, AES-300, AES-300P, CMS-2, CMS-2S
Patching mix	MC-800, SCM I, SCM II, AES-300S
Recycling	AC-0.6, AC-1.5, AC-3, AES-150P, AES-300P, recycling agent, emulsified recycling agent
Crack sealing	SS-1P, polymer mod AE crack sealant, rubber asphalt crack sealers (Class A, Class B)
Microsurfacing	CSS-1P
Prime	MC-30, AE-P, EAP&T, PCE
Curing membrane	SS-1, SS-1H, CSS-1, CSS-1H, PCE
Erosion control	SS-1, SS-1H, CSS-1, CSS-1H, PCE
FDR -Foaming	PG 64-22, FDR EM-SY, FDR EM-HY

4.1. **Storage and Application Temperatures**. Use storage and application temperatures in accordance with Table 19. Store and apply materials at the lowest temperature yielding satisfactory results. Follow the manufacturer's instructions for any agitation requirements in storage. Manufacturer's instructions regarding recommended application and storage temperatures supersede those of Table 19.

Table19
Storage and Application Temperatures

Type-Grade	Application		Storage Max (°F)
	Recommended Range (°F)	Max Allowable (°F)	
AC-0.6, AC-1.5, AC-3	200–300	350	350
AC-5, AC-10	275–350	350	350
AC-15P, AC-20-5TR, AC12-5TR and AC10-2TR	300–375	375	360
RC-250	125–180	200	200
RC-800	170–230	260	260
RC-3000	215–275	285	285
MC-30, AE-P	70–150	175	175
MC-250	125–210	240	240
MC-800, SCM I, SCM II	175–260	275	275
MC-3000, MC-2400L	225–275	290	290
HFRS-2, MS-2, CRS-2, CRS-2H, HFRS-2P, CRS-2P, CMS-2, CMS-2S, AES-300, AES-300S, AES-150P, AES-300P, CRS-2TR	120–160	180	180
SS-1, SS-1H, CSS-1, CSS-1H, PCE, EAP&T, SS-1P, RS-1P, CRS-1P, CSS-1P, recycling agent, emulsified recycling agent, polymer mod AE crack sealant	50–130	140	140
PG binders	275–350	350	350
Rubber asphalt crack sealers (Class A, Class B)	350–375	400	–
A-R binders Types I, II, and III	325–425	425	425

5. MEASUREMENT AND PAYMENT

The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly but is subsidiary or is included in payment for other pertinent Items.

Special Specification 4171
Install Bridge Identification Numbers

1. DESCRIPTION

This item will govern for the installation of bridge identification numbers on bridge structures in accordance with this specification, project plans, or as directed.

2. MATERIALS

Furnish materials that conform to the pertinent requirement of the following items:

- stencil ink, black 11 oz., spray can (lead, CFC, and CFHC free). Black spray will be waterproof, weather resistance and dry instantly on all surfaces, without smearing, smudging or rippling and
- brass stencil, 3 in., numbers and letters, adjustable interlocking stencil, set content 92 piece numbers and letters, legend height 3 in., symbol height 3 in. Stencils must be industrial grade and interlocking.

3. WORK METHODS

Install bridge identification numbers according to the requirements shown on the plans, and the following:

Clean the surface thoroughly before applying the painted structure number including removal of existing structure number by chemical cleaning, or by water blasting according to Item 427, if required.

4. MEASUREMENT

This Item will be measured by each bridge identification number installed.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Installing Bridge Identification Numbers." This price must be full compensation for removing existing bridge identification numbers, cleaning and preparing surfaces, and furnishing all materials, equipment, labor and incidentals necessary to complete the work.

Special Specification 6001
Portable Changeable Message Sign

1. DESCRIPTION

Furnish, operate, and maintain portable trailer mounted changeable message sign (PCMS) units.

2. MATERIALS

Furnish new or used material in accordance with the requirements of this Item and the details shown on the plans. Provide a self-contained PCMS unit with the following:

- Sign controller
- Changeable Message Sign
- Trailer
- Power source

Paint the exterior surfaces of the power supply housing, supports, trailer, and sign with Federal Orange No. 22246 or Federal Yellow No. 13538 of Federal Standard 595C, except paint the sign face assembly flat black.

2.1. **Sign Controller**. Provide a controller with permanent storage of a minimum of 75 pre-programmed messages. Provide an external input device for random programming and storage of a minimum of 75 additional messages. Provide a controller capable of displaying up to 3 messages sequentially. Provide a controller with adjustable display rates. Enclose sign controller equipment in a lockable enclosure.

2.2. **Changeable Message Sign**. Provide a sign capable of being elevated to at least 7 ft. above the roadway surface from the bottom of the sign. Provide a sign capable of being rotated 360° and secured against movement in any position.

Provide a sign with 3 separate lines of text and 8 characters per line minimum. Provide a minimum 18 in. character height. Provide a 5 × 7 character pixel matrix. Provide a message legibility distance of 600 ft. for nighttime conditions and 800 ft. for normal daylight conditions. Provide for manual and automatic dimming light sources.

The following are descriptions for 3 screen types of PCMS:

- **Character Modular Matrix**. This screen type comprises of character blocks.
- **Continuous Line Matrix**. This screen type uses proportionally spaced fonts for each line of text.
- **Full Matrix**. This screen type uses proportionally spaced fonts, varies the height of characters, and displays simple graphics on the entire sign.

2.3. **Trailer**. Provide a 2 wheel trailer with square top fenders, 4 leveling jacks, and trailer lights. Do not exceed an overall trailer width of 96 in. Shock mount the electronics and sign assembly.

2.4. **Power Source**. Provide a diesel generator, solar powered power source, or both. Provide a backup power source as necessary.

2.5. **Cellular Telephone**. When shown on the plans, provide a cellular telephone connection to communicate with the PCMS unit remotely.

3. CONSTRUCTION

Place or relocate PCMS units as shown on the plans or as directed. The plans will show the number of PCMS units needed, for how many days, and for which construction phases.

Maintain the PCMS units in good working condition. Repair damaged or malfunctioning PCMS units as soon as possible. PCMS units will remain the property of the Contractor.

4. MEASUREMENT

This Item will be measured by each PCMS or by the day used. All PCMS units must be set up on a work area and operational before a calendar day can be considered measurable. When measurement by the day is specified, a day will be measured for each PCMS set up and operational on the worksite.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Portable Changeable Message Sign." This price is full compensation for PCMS units; set up; relocating; removing; replacement parts; batteries (when required); fuel, oil, and oil filters (when required); cellular telephone charges (when required); software; and equipment, materials, tools, labor, and incidentals.

Special Specification 6158
Trailer Mounted Solar Powered Radar Speed Control Monitor

1. DESCRIPTION

Provide, maintain and remove upon completion of work, trailer mounted solar powered radar speed control monitors as shown on the plans or as directed.

2. EQUIPMENT

Provide a trailer mounted solar powered radar speed detection radar unit with light emitting diode (LED) display panel. Unit must be used by the Contractor to alert motorists of work zone speeds and excessive speed for their safety and that of the Contractor's and Department's personnel. Any unit furnished under this specification must be in good working condition.

Use equipment in accordance with the manufacturer's directions.

2.1. **Batteries.** Provide unit equipped with a minimum of two, heavy duty, deep cycle batteries which will power the unit 24 hr. a day for a minimum of 12 days without the assistance of the solar panels.

2.2. **Battery Regulator and Recharging System.** Provide unit equipped with an internal controller that regulates the amount of current delivered to the batteries and prevents overcharging. The manufacturer's standard charger must also be provided to recharge the batteries from a standard 120 VAC source.

2.3. **Solar Panels.** Provide unit equipped with solar panels which generates sufficient power to enable the system to continually recharge the batteries.

2.4. **Radar Device.** Ensure unit is equipped with the manufacturer's radar device that measures speed in miles per hour.

Provide radar device that detects speeds of oncoming vehicles only from a minimum distance of one-quarter mile.

Provide radar that detects speeds from 10 to 99 mph.

Provide radar that can operate in ambient temperatures from -22 to 140ºF (-30 to 60ºC).

Provide radar device that detects speeds in the stationary mode.

2.5. **Display Panel.** Provide a display panel that contains LED technology which displays oncoming vehicle speeds in miles per hour from 10 to 99 mph.

Provide a display panel that consists of two characters, each a minimum of 18 in. in height. Provide a display that is amber in color and visible from a minimum of 600 ft.

Provide a display panel that is equipped with a photocell that automatically adjusts the display for day and night operation.

Provide a display panel that is equipped to alert motorist when they are traveling over the posted speed, either by flashing the traveling speed, changing the display color, or by "blanking" out the display.

Provide a display panel that is equipped with an operator-set high speed cutoff feature.

2.6. **Trailer Requirements.** Provide a trailer unit that is equipped with a heavy duty, all steel unitized or electrically welded, tubular or C-channel frames.

Ensure that the rear of the trailer is equipped with a red tail lamp, a red stop lamp, a turn indicator, and a red reflector on each side at the same level and as widely spaced laterally as practicable.

Provide a trailer that is equipped with a siren and strobe light that will alert workers of an oncoming speeding vehicle.

3. WORK METHODS

The unit provided must meet or exceed all federal and state safety, health, lighting and noise regulations and standards in effect and applicable to equipment furnished at the time of manufacture.

4. MEASUREMENT

This Item will be measured by each trailer mounted solar powered speed control monitor, furnished, installed, and made fully operational.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Trailer Mounted Solar Assisted and Battery Powered Radar Speed Control Monitor." This price is full compensation for trailer mounted solar assisted and battery powered radar speed control monitor unit; set up; relocating; removing; replacement parts; solar panels, batteries (when required); and equipment, materials, tools, labor and incidentals.

Special Specification 6185

Truck Mounted Attenuator (TMA) and Trailer Attenuator (TA)

1. DESCRIPTION

Furnish, operate, maintain and remove upon completion of work, Truck Mounted Attenuator (TMA) or Trailer Attenuator (TA).

2. MATERIALS

Furnish, operate and maintain new or used TMAs or TAs. Assure used attenuators are in good working condition and are approved for use. A list of approved TMA/TA units can be found in the Department's Compliant Work Zone Traffic Control Devices List. The host vehicle for the TMA and TA must weigh a minimum of 19,000 lbs. Host vehicles may be ballasted to achieve the required weight. Any weight added to the host vehicle must be properly attached or contained within it so that it does not present a hazard and that proper energy dissipation occurs if the attenuator is impacted from behind by a large truck. The weight of a TA will not be considered in the weight of the host vehicle but the weight of a TMA may be included in the weight of the host vehicle. Upon request, provide either a manufacturer's curb weight or a certified scales weight ticket to the Engineer.

3. CONSTRUCTION

Place or relocate TMA/TAs as shown on the plans or as directed. The plans will show the number of TMA/TAs needed, for how many days or hours, and for which construction phases.

Maintain the TMA/TAs in good working condition. Replace damaged TMA/TAs as soon as possible.

4. MEASUREMENT

4.1. **Truck Mounted Attenuator/Trailer Attenuator (Stationary).** This Item will be measured by the each or by the day. TMA/TAs must be set up in a work area and operational before a calendar day can be considered measurable. When measurement by the day is specified, a day will be measured for each TMA/TA set up and operational on the worksite.

4.2. **Truck Mounted Attenuator/Trailer Attenuator (Mobile Operation).** This Item will be measured by the hour. The time begins once the TMA/TA is ready for operation at the predetermined site and stops when notified by the Engineer. A minimum of 4 hr. will be paid each day for each operating TMA/TA used in a mobile operation.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Truck Mounted Attenuators/Trailer Attenuators (Stationary)," or "Truck Mounted Attenuators/Trailer Attenuators (Mobile Operation)." This price is full compensation for furnishing TMA/TA: set up; relocating; removing; operating; fuel; and equipment, materials, tools, labor, and incidentals.

Special Specification 6292

Radar Vehicle Detection System for Signalized Intersection Control

1. DESCRIPTION

Furnish, install, relocate, or remove radar vehicle detection systems (RVDS) of the specified devices at signalized intersections to provide the required zones of detection as shown on the plans, or as directed.

2. MATERIALS

2.1. **General**. Except as allowed for relocation of RVDS equipment, ensure all equipment and component parts are new in accordance with Section 1.0 through Section 6.0 of Division Specification TO-8000, "Radar Vehicle Detection System." and in an operable condition at time of delivery and installation.

The Traffic Management Section of the Traffic Operations Division (TRF-TM) maintains the Prequalified Products Master List (QPL) of all RVDS conforming to the requirements of this Specification. New materials appearing on the QPL for TO-8000 require no further sampling and testing before use unless deemed necessary by the Project Engineer or TRF-TM. Provide prequalified RVDSs from the Division's QPL.

Ensure all RVDS serving the same detection purpose within the project are from the same manufacturer. RVDS devices are classified by their functional requirements. The functional requirements are for radar presence detection devices (RPDD) and radar advance detection devices (RADD). The RVDS system classifications are RVDS (RPDD Only), RVDS (RADD Only)" and "RVDS (RPDD and RADD).

Provide each RVDS sensor with a mounting bracket designed to mount directly to a pole, mast-arm, or other structure. Ensure bracket is designed such that the sensor can be tilted both vertically and horizontally for alignment and then locked into place after proper alignment is achieved. All hardware must be designed to support the load of the RVDS sensor and mounting bracket.

2.2. **Configuration**. Ensure the RVDS will provide vehicle detection as required on the plans, or as directed.

Ensure the RVDS does not require tuning or recalibration to maintain performance once initial calibration and configuration is complete. RVDS must not require cleaning or adjustment to maintain performance.

RVDS must self-recover from power failure once power is restored.

2.3. **Cabling**. Provide appropriate length of all cables necessary to complete the work (of making the RVDS fully operational) at each installation site.

2.4. **Software**. Ensure the RVDS manufacturer includes all software required to configure and monitor operation of RVDS field equipment locally and remotely. RVDS software must be a stable production release.

Software must allow the user to configure, operate, exercise, diagnose, and read current status of all RVDS features and functions using a laptop computer.

Software must include the ability to save a local copy of RVDS field device configurations, and load saved configurations to RVDS field devices.

Ensure all licenses required for operation and use of software are included at no additional cost.

Software updates must be provided at no additional cost during the warranty period.

2.5. **Electrical**. All conductors supplying the equipment must meet National Electrical Code® (NEC) requirements.

Ensure equipment is designed to protect personnel from exposure to high voltage during installation, operation, and maintenance.

2.6. **Mechanical**. Ensure that all parts are fabricated from corrosion resistant materials, such as plastic, stainless steel, aluminum, or brass.

Ensure that all screws, nuts, and locking washers are corrosion resistant. Do not use self-tapping screws.

Ensure equipment is clearly and permanently marked with manufacturer name or trademark, part number, date of manufacture, and serial number.

Ensure RVDS is modular in design for ease of field replacement and maintenance. Provide a sensor that will minimize weight and wind loading when mounted on a traffic signal pole or mast arm.

All printed circuit boards (PCB) must have conformal coating.

2.7. **Environmental.** RVDS sensor must be able to withstand the maximum wind load based on the Department's basic wind velocity zone map standard without any damage or loosening from structure.

The RVDS enclosure must conform to criteria set forth in the NEMA 250 Standard for Type 4X enclosures.

The RVDS must meet all NEMA TS2 environmental requirements for temperature, humidity, transients, vibration, and shock.

2.8. **Connectors and Harnesses.** Ensure all conductors are properly color coded and identified.

Ensure cable connector design prohibits improper connections. Cable connector pins are plated to improve conductivity and resist corrosion.

Connections for both data and power must be made to the RVDS sensor using waterproof, quick disconnect connectors. Pigtails from the sensor to a waterproof junction box (NEMA 4) or an approved waterproof connector must be allowed for splicing. The pigtails must not be shorter than 3 ft. unless otherwise shown on the plans.

3. CONSTRUCTION

3.1. **System Installation**. Install RVDS system devices according to the manufacturer's recommendations to provide properly functioning detection as required. This will include the installation of sensors on signal poles or mast-arms, controller interface modules, power and surge protection panels, cabling and all associated equipment, software, serial and Ethernet communication ports, connectors and hardware required to setup and operate. Ensure that the supplier of the RVDS provides competent on-site support representative during installation to supervise installation and testing of the RVDS. Ensure the radar sensor locations are optimal for system operation and operate as required. Maintain safe construction practices during equipment installation.

Ensure installation and configuration of software on Department computers is included with the RVDS.

Use care to prevent damage to any support structures. Any equipment or structure damaged or lost must be replaced by the Contractor (with items approved by the Engineer) at no cost to the Department.

3.2. **Mechanical Components.** Ensure that all fasteners, including bolts, nuts, and washers with a diameter less than 5/8 in. are Type 316 or 304 stainless steel and meet the requirements of ASTM F593 and ASTM F594 for corrosion resistance. Ensure that all bolts and nuts 5/8 in. and over in diameter are galvanized and meet the requirements of ASTM A307. Separate dissimilar metals with an inert dielectric material.

3.3. **Wiring.** Install all wiring and electrical work supplying power to the equipment in a neat workmanlike manner. Supply and install all wiring necessary to interconnect RVDS sensors to the traffic signal cabinet and incidentals necessary to complete the work. Furnish and install any additional required wiring at no additional cost to the Department.

Wiring must be cut to proper length prior to installation. Provide cable slack for ease of removal and replacement. All cable slack must be neatly laced with lacing or straps in the bottom of the cabinet. Ensure cables are secured with clamps.

3.4. **Grounding.** Ensure all RVDS components, cabinets, and supports are grounded in accordance with the NEC and manufacturer recommendations.

3.5. **Relocation of RVDS 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 RVDS 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 equipment that fails inspection to the Department.

Prior to removal of existing RVDS 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 relocation. Remove existing RVDS field equipment as shown on the plans only when authorized by the Engineer.

Use care to prevent damage to any support structures. Any equipment or structure damaged or lost must be replaced by the Contractor (with items approved by the Engineer) at no cost to the Department.

Make all arrangements for connection to 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, latest edition.

3.6. **Removal of RVDS Field Equipment.** Perform the removal 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 removal.

Disconnect and isolate any existing electrical supply prior to removal of existing field equipment.

Use care to prevent damage to any support structures. Any equipment or structure damaged or lost must be replaced by the Contractor (with items approved by the Engineer) at no cost to the Department.

All materials not designated for reuse or retention by the Department will become the property of the Contractor and be removed from the project site at the Contractor's expense. Deliver items to be retained by the Department to a location shown on the plans or general notes. The Contractor is fully responsible for any removed equipment until released by the Engineer.

3.7. **Documentation**. Provide electronic copy operation and maintenance manuals, along with a copy of all product documentation on electronic media. Include the following documentation:

- Complete and accurate schematic diagrams,

- Complete installation procedures,
- Manufacturer's specifications (functional, electrical, mechanical, and environmental),
- Complete maintenance and trouble-shooting procedures, and
- Explanation of product operation.
- Warranty as specified in Section 3.8.

The RVDS must pass testing to ensure functionality and reliability prior to delivery. These include functional tests for internal subassemblies, a 24 hr. minimum unit level burn-in test, and a unit functionality test. Provide test results and supporting documentation, including serial number tested, must be submitted for each RVDS. If requested, manufacturing data per serial number must be provided for each RVDS.

Unless deemed unnecessary by the Project Engineer or TRF-TM, Provide certification from an independent laboratory demonstrating compliance with NEMA TS2 environmental requirements for temperature, humidity, transients, vibration, and shock.

Unless deemed unnecessary by the Project Engineer or TRF-TM, Provide third party enclosure test results demonstrating the sensor enclosure meets Type 4X criteria.

Unless deemed unnecessary by the Project Engineer or TRF-TM, Provide evidence of RVDS manufacturer's quality assurance program, including proof that the manufacturer of the RVDS is either ISO 9001 certified or other quality management system programs for manufacturing RVDS.

3.8. **Warranty**. Ensure that the detection system has a manufacturer's warranty covering defects for a minimum of 5 years from the date of final acceptance. In addition to the terms required by Article 8 of TO-8000, Ensure the warranty includes providing replacements, within 10 calendar days of notification, for defective parts and equipment during the warranty period at no cost to the Department.

3.9. **Training and Support**. Provide manufacturer approved end user training to the Department and their representatives. Training must include instruction on system configuration, operation, and maintenance. Provide training for a minimum of 10 Department-designated representatives up to 8 hs., including both class and field training.

Ensure that the detection system manufacturer will provide product support for a minimum of 5 years from the date of final acceptance.

4. TESTING

Perform the following tests on equipment and systems unless otherwise shown on the plans. The Department may witness all the tests.

4.1. **Stand-Alone Test.** Conduct a Stand-Alone Test for each unit after installation. The test must exercise all stand-alone (non-network) functional operations and verify that RVDS is placing detector contact closure to assigned detector channels in the traffic signal controller assembly. Notify the Engineer 5 working days before conducting this test.

4.2. **Consequences of Test Failure.** If a unit fails a test, provide a new unit and then repeat the test until successfully completed.

4.3. **Final Acceptance Test.** Conduct a Final Acceptance Test on the complete functional system. Demonstrate all control, monitoring, and communication requirements and operate the system for 30 days. The Engineer will furnish a Letter of Approval stating the first day of the Final Acceptance Test.

4.4. **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.

4.5. **Relocation**

4.5.1. **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. 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. Rejected test procedures must be resubmitted 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 RVDS field equipment. Test all functional operations of the equipment in the presence of representatives of the Contractor and the Department. Ensure that both representatives sign the test report indicating that the equipment has passed or failed each function. Once removed, the equipment becomes the responsibility of the Contractor until accepted by the Department. Compare test data prior to removal and after installation. The performance test results after relocation must be equal to or better than the test results prior to removal. Repair or replace those components within the system that failed after relocation but passed prior to removal.

4.5.2. **Post-Test.** Testing of the RVDS field equipment is to relieve the Contractor of system maintenance. The Contractor will be relieved of the responsibility for system maintenance in accordance with Item 7, “Legal Relations and Responsibilities” after a successful test period. The Contractor will not be required to pay for electrical energy consumed by the system.

After all existing RVDS field equipment has been installed, conduct approved continuity, stand alone, and performance tests. Furnish test data forms containing the sequence of tests including all the data taken as well as quantitative results for all tests. Submit the test data forms to the Engineer at least 30 days prior to the day the tests are to begin. Obtain Engineer’s approval of test procedures prior to submission of equipment for tests. Send at least 1 copy of the data forms to the Engineer.

Conduct an approved stand-alone test of the equipment installation at the field sites. At a minimum, exercise all stand-alone (non-network) functional operations of the field equipment with all 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 RVDS 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 and deliver a report to the Engineer. Describe the nature of the failure and the corrective action needed. If the failure is the result of improper installation or damage during reinstallation, reinstall or replace the unit and repeat the test until the unit passes successfully, at no additional cost to the Department or extension of the Contract period.

5. MEASUREMENT

New RVDS furnished and installed by the Contractor will be measured by each approach to the signalized intersection.

RVDS furnished by the Department for the Contractor to install only will be measured by each approach to the signalized intersection.

Existing RVDS to be relocated or removed will be measured by each sensor relocated or removed.

6. PAYMENT

6.1. **Furnish and Install.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit bid price for "RVDS (Presence Detection Only)", "RVDS (Advance Detection Only)" and "RVDS (Presence and Advance Detection)."

This price is full compensation for furnishing, installing, configuring, integrating, and testing the completed installation including RVDS equipment, voltage converters or injectors, cables, connectors, associated equipment, and mounting hardware; and for all labor, tools, equipment, any required equipment modifications for electrical service, documentation, testing, training, software, warranty and incidentals necessary to complete the work.

6.2. **Install Only.** The work performed and materials furnished in accordance with this Item will be paid for at the unit bid price for "RVDS (Presence Detection Only) (Install Only)", "RVDS (Advance Detection Only) (Install Only)" and "RVDS (Presence and Advance Detection) (Install Only)."

This price is full compensation for making fully operational a radar vehicle detection system furnished by the Department; installing, configuring, integrating, and testing the completed installation including RVDS equipment, voltage converters or injectors, cables, connectors, associated equipment, and mounting hardware; and for all labor, tools, equipment, any required equipment modifications for electrical service, documentation, testing, training, software, and incidentals necessary to complete the work.

6.3. **Relocate.** The work performed and materials furnished in accordance with this Item will be paid for at the unit bid price for "Relocate RVDS." This price is full compensation for relocating and making fully operational existing RVDS field equipment; furnishing and installing additional cables or connectors; for testing, delivery and storage of components designated for salvage or reuse; and all testing, training, software, equipment, any required equipment modifications for electrical service, labor, materials, tools, and incidentals necessary to complete the work.

6.4. **Remove.** The work performed and materials furnished in accordance with this Item will be paid for at the unit bid price for "Remove RVDS." This price is full compensation for removing existing RVDS equipment; removal of cables and connectors; for testing, delivery and storage of components designated for salvage; and all testing training, software, equipment, labor, materials, tools, and incidentals necessary to complete the work.

6.5. **Communication Cable.** All communication cables necessary to make the RVDS fully operational will be subsidiary to this Item.

Special Specification 6306
Video Imaging Vehicle Detection System

1. DESCRIPTION

Furnish, install, relocate, or remove video imaging vehicle detection system (VIVDS) at locations shown on the plans, or as directed. Use VIVDS listed on the Department's Prequalified Products List.

2. MATERIALS

2.1. **General**. Furnish, assemble, and install only new materials except as allowed for relocation of VIVDS equipment. Ensure all VIVDS within the project are from the same manufacturer.

VIVDS must analyze video images and produce vehicle detector outputs that can serve as inputs to a traffic signal controller. Provide VIVDS field equipment that is compatible with existing infrastructure and software located in the Department's Traffic Management Control Centers across the state as directed. VIVDS must meet Department TSS Protocol requirements when integration with Traffic Management Center software or systems is shown on the plans.

VIVDS equipment must include the following:

- Camera and mounting hardware (fixed or variable focal length; infrared; or 360° "fish-eye"),
- VIVDS processor,
- Cabinet control unit and associated devices required for system integration, and
- Data, power, and communication cable, connectors, and assemblies.

The VIVDS must use one or more cameras and video processing equipment to accurately provide detector calls for the intersection, approach, or roadway segment where they are installed, and provide detection as shown on the plans. A single camera placed per manufacturer recommendations must be capable of monitoring and detecting 5 lanes of traffic simultaneously.

Ensure the system is designed and constructed with subassemblies, circuits, cards, and modules to maximize standardization and commonality.

Ensure field replaceable parts are accessible for inspection and maintenance. Provide test points for checking essential voltages and waveforms.

VIVDS devices must self-recover from power failure once power is restored.

2.2. **Configuration and Management**. Ensure that the VIVDS allows local and remote configuration and monitoring. The VIVDS must allow the user to fully configure the system and place detection zones using a mouse, monitor, and keyboard (or keypad) connected to the VIVDS. Provide each VIVDS with all associated equipment required to configure and operate the system in a field environment including a video monitor, mouse, keyboard (or keypad), software, and interface cables as applicable. The VIVDS must also support local configuration and monitoring using a laptop computer, but must not require a computer for local configuration, monitoring, and operation.

Ensure that the system can display detection zones and detection activations overlaid on live video from VIVDS cameras.

Ensure that the VIVDS allows a user to edit previously defined configuration parameters, including size, placement, and sensitivity of detection zones.

Ensure that the VIVDS retains its programming in nonvolatile memory. Ensure that the detection system configuration settings can be saved to a computer and restored from a saved file locally and remotely. The system must allow stored configurations to be modified for fine-tuning and optimization. The VIVDS must continue to detect vehicles and operate normally while configuration and detection zone modifications are made.

Ensure the VIVDS does not require adjustment or recalibration to maintain performance once initial calibration and configuration is complete.

2.3. **Detection Zones**. The VIVDS must allow a user to configure detection zones using a graphical user interface (GUI) superimposed on a video image of the roadway. Ensure detection zones can be placed anywhere within a camera field of view. Ensure VIVDS detection zones can detect vehicle presence and collect traffic data, such as traffic counts.

Detection zones must appear as lines or polygons in the field of view. The system must allow a minimum of 8 detection zones per field of view. VIVDS detection zones must be able to provide detection equivalent to a 6 ft. by 6 ft. loop. Ensure zones can be sized, shaped, and overlapped to accurately detect vehicles at the locations shown on the plans.

The system must allow zones to be configured with directionality, delay, extension, and logic functions including “AND” and “OR.” If each detection zone provides a unique output to the signal controller and the controller includes logical functions, then the VIVDS is not required to support logic functions.

Ensure zones displayed on a monitor provide a visual indication when vehicles are detected during configuration and operation.

2.4. **Detection.** VIVDS processor must compensate for minor camera movement. Movement up to 2% of field of view at 400 ft. must not produce a false detection.

Ensure VIVDS processor operates regardless of whether monitoring equipment is connected. If monitoring equipment is connected to the processor unit, vehicle detections are displayed real-time as they occur.

VIVDS must simultaneously detect vehicles in all lanes. VIVDS must be able to accurately detect approaching and departing vehicles in multiple lanes. VIVDS is configurable for which direction of travel to detect. Ensure vehicles traveling in any direction other than the configured direction of travel (e.g., cross-street and wrong-way traffic) do not activate a call to the controller.

Ensure a constant call is placed on outputs associated with zones or cameras that are in an error state or failed. Ensure a constant call is placed on assigned outputs whenever the system is unable to provide accurate detection.

2.5. **Accuracy.** Ensure VIVDS individual lane accuracy for vehicle presence detection is within 5% of actual.

2.6. **Camera.** Use color or thermal cameras that are provided as part of an engineered system by the VIVDS processor manufacturer or approved for use by the VIVDS processor manufacturer. Ensure that analog cameras provide NTSC composite video with a minimum resolution of at least 480 TVL.

Cameras must produce useable video suitable for detection in low light. Cameras with day and night modes must automatically and seamlessly transition between modes without producing vehicle detection errors such as false calls and missed calls. Nighttime monochrome operation must produce feature resolvable video with luminance as low as 0.1 lux. Nighttime color operation must produce feature resolvable video with luminance as low as 1.0 lux.

Cameras must produce resolvable features in the video with luminance as high as 10,000 lux.

Visual spectrum cameras must include automatic electronic shutter and iris control based on average scene luminance.

Variable focal length lenses must be adjustable from 6 mm to 34 mm.

Processed images produced by the VIVDS must use a standard encoding format such as H.264 or MJPEG unless otherwise shown on the plans.

2.6.1. **Thermal cameras.** Thermal imaging cameras must use a long-life, uncooled vanadium oxide microbolometer thermal detector with a spectral range of 7.5 to 13.5 µm.

Ensure analog video is compliant with National Television System Committee (NTSC) Standard and has a minimum NTSC array format of 320 x 240 with a 76,800 pixel effective resolution.

2.6.2. **Camera enclosure.** Camera and lens assembly must be housed in an enclosure designed for outdoor use. The housing must be light in color to limit solar heating and prolong equipment life. Enclosure, including cable connections, must be waterproof and dust tight with a NEMA Type 4 rating.

Ensure enclosures for visual spectrum cameras include a sunshield. Sunshield must protrude beyond the front edge of the enclosure and divert water away from the camera's field of view. Ensure the sunshield overhang is adjustable. Any plastics used in the construction of the enclosure must include ultraviolet inhibitors.

Ensure the enclosure allows the camera horizon to be rotated in the field during installation. Ensure camera focus and zoom can be adjusted, if necessary, without entering the camera enclosure.

The camera enclosure must be provided with mounting bracket designed to mount directly to a pole, mast-arm, or other structure. Ensure the bracket allows the camera to be panned and tilted for alignment and then locked into place once properly positioned.

The camera enclosure with camera and lens installed must weigh 10 lb. or less.

Camera housing must include a means to prevent the formation of ice or condensation. If camera housing includes a heater, wiper, or other electronically controlled mechanism, such mechanism does not interfere with the camera operation or video signal.

2.7. **Video Processor**. Ensure the VIVDS includes a machine vision processor that provides video analysis, presence detection, and interfaces for inputs and outputs. VIVDS must provide data collection features, including storage and reporting of collected vehicle detection data, when shown on the plans.

VIVDS must be able to interface with the traffic controller unit (CU) via the detector rack, SDLC, or another detector interface described in NEMA TS2-2016, unless otherwise shown on the plans. Solid state detection outputs must meet the requirements of NEMA TS2-2016, 6.5.2.26.

Each VIVDS detector rack card must have a minimum of 4 detector outputs. The system must be able to provide a total of 24 detection outputs. Ensure each zone and output is user definable, and previously saved zones can be redefined.

The system must be capable of functioning as a detector BIU using an RS-485 SDLC connector. TS2 Type 1 VIVDS must include indicators that display detector output status for verification of calls.

Analog video inputs must use BNC connectors or be routed through existing loop inputs using connections designed for that purpose. Analog video outputs must use BNC or RCA connectors. Use of external cable connections to create a combined video output is not allowed.

Ensure processor includes provisions to view video image in the field and remotely.

VIVDS processors installed in the traffic controller cabinet must utilize digital video or accommodate asynchronous, synchronous, and line-locked analog video as part of a complete system engineered by the VIVDS manufacturer.

2.8. **Camera Interface Panel**. Supply the VIVDS with a camera interface panel as required by the manufacturer that provides a cabinet connection point between field wiring from VIVDS cameras and VIVDS equipment in the cabinet. The interface panel must be provided by the VIVDS manufacturer as part of a complete engineered system. The panel must include terminal facilities and surge suppression for all conductors used to connect VIVDS field equipment, including camera power and communications. Interface panels for analog cameras must include a 10 amp breaker or blade type fuses and a power terminal strip with a minimum of eight (8) 8/32 binder head screws for camera power connections. The panel must also have, as a minimum, four (4) coax protectors (EDCO CX06 or equivalent). Additional lightning and transient protection will be allowed. All components that reside on the panel must be Department approved. For cameras utilizing POE the interface panel must consist of surge protection meeting GR 1089 standards.

Ensure interface panel is capable of being mounted on the side walls of the controller cabinet. Video connections must be isolated from earth ground.

2.9. **Cabling**. Supply the VIVDS with connector cables of the appropriate length for each installation site. Connector cables must include all conductors necessary for power, video, and communication. All cabling used must meet the minimum recommended specifications of the VIVDS manufacturer.

Ensure the power and data cable connectors are IP 67 to protect against intrusion of solids and water. External connectors must be quick disconnect and keyed to prevent improper connections. All wiring must be color coded and marked appropriately. Ensure all conductors that interface with the connector are encased in a single jacket.

Fiber optic cable, if used, must meet the requirements of Special Specification Item Intelligent Transportation System (ITS) Fiber Optic Cable.

If coaxial cable is used, it must be low loss, 75 ohm, precision video cable suited for outdoor installation and approved by the VIVDS manufacturer.

RS-485 and RS-232 communication cable must meet the requirements of Special Specification 6004 Networking Intelligent Transportation System (ITS) Communications Cable.

2.10. **Communication**. Ensure that the VIVDS includes a minimum of one serial or Ethernet communications interface.

Ensure serial interfaces and connectors conform to Telecommunications Industry Association (TIA)-232 standards. Ensure that the serial ports support data rates up to 115200 bps; error detection utilizing parity bits (i.e., none, even, and odd); and stop bits (1 or 2).

Ensure that wired Ethernet interfaces provide a 10/100 Base TX connection. Verify that all unshielded twisted pair/shielded twisted pair network cables and connectors comply with TIA-568.

Ensure wireless communications are secure and that wireless devices are Federal Communications Commission (FCC) certified. Ensure that the FCC identification number is displayed on an external label and that all detection system devices operate within their FCC frequency allocation.

Ensure the system can be configured and monitored via one or more communications interface. Ensure that all communication addresses are user programmable.

2.11. **Software**. Ensure the VIVDS manufacturer includes all software required to configure and monitor operation of VIVDS field equipment locally and remotely. VIVDS software must be a stable production release approved by the Department's Traffic Operations Division.

Ensure VIVDS computer software includes a GUI that displays all configured lanes and provides visual representation of all detected vehicles. Server software must be designed to run on the Windows Server operating system (Windows Server 2012 or newer). Client workstation software must be designed to run on Microsoft Windows 7 Professional and newer.

VIVDS software must allow the user to program, operate, exercise, diagnose, and read status of all VIVDS features and functions using a laptop computer.

VIVDS computer software must be able to communicate with VIVDS field devices using TCP/IP and serial connections. The software must provide for local and remote configuration and monitoring, including display of detection zone activations on live video and modification of existing detection zone layouts.

System software must provide the user complete control over the configuration process for VIVDS devices and allow the user to load new firmware into non-volatile memory of VIVDS field devices locally and over any supported communication channel including TCP/IP networks.

The system software must include the ability to retrieve and store data collected by VIVDS field devices.

Ensure all licenses required for operation and use of software are included at no additional cost.

Software updates must be provided at no additional cost during the warranty period.

2.12. **Mechanical**. VIVDS detector card rack units must comply with dimensions specified in NEMA TS2-2016, 6.5.2.2.2.

Ensure that all parts are fabricated from corrosion resistant materials, such as plastic, stainless steel, aluminum, or brass.

Ensure that all screws, nuts, and locking washers are stainless steel. Do not use self-tapping screws.

Ensure equipment is clearly and permanently marked with manufacturer name or trademark and part number as well as date of manufacture or serial number.

Ensure VIVDS is modular in design for ease of field replacement and maintenance.

All printed circuit boards must have conformal coating to protect against moisture and fungus.

2.13. **Electrical**. Ensure equipment is designed to protect personnel from exposure to high voltage during installation, operation, and maintenance. Ensure all connections include the manufacturer recommend surge protective device (SPD). SPDs must not interfere with the performance of the VIVDS. VIVDS electrical design must be modular.

Ensure the VIVDS operates on nominal 120 V_{AC}. A power converter must be provided for devices that do not operate on nominal 120 V_{AC}. Camera sensors must operate between 12 V_{DC} and 28 V_{DC}.

2.14. **Environmental.** All VIVDS devices must operate properly during and after being subjected to the environmental testing procedures described in NEMA TS2, Section 2. VIVDS cameras must be able to withstand the maximum wind load defined in the Department's basic wind velocity zone map standard without any damage or loosening from structure.

2.15. **Connectors and Harnesses.** External connections exposed to the outdoor environment must be made with weatherproof connectors. Connectors must be keyed to ensure correct alignment and mating.

Ensure all conductors are properly color coded and identified. Ensure that every conductive contact surface or pin is gold-plated or made of a noncorrosive, nonrusting, conductive metal.

RS-485 and RS-232 communication cables must:

- be shielded, twisted pair cable with a drain wire,
- have a nominal capacitance conductor to conductor @ 1Khz ≥ 26pF/ ft.,
- have nominal conductor DC resistance @ 68°F ≤ 15 ohms/1,000 ft.,
- be one continuous run with no splices, and
- be terminated only on the two farthest ends of the cable.

2.16. **Documentation**. Provide hardcopy operation and maintenance manuals, along with a copy of all product documentation on electronic media. Include the following documentation for all system devices and software:

- operator manuals,
- installation manuals with installation procedures,
- maintenance and troubleshooting procedures, and
- manufacturer's specifications (functional, electrical, mechanical, and environmental).

Provide certification from an independent laboratory demonstrating compliance with NEMA TS2 environmental requirements for temperature, humidity, transients, vibration, and shock.

Provide certification that VIVDS electronic equipment meets FCC Class B requirements for electromagnetic interference and emissions.

Ensure the VIVDS system manufacturer has a quality assurance program for manufacturing VIVDS as described in this specification. Manufacturer of the VIVDS must be ISO 9001 certified, or provide a copy of the company quality manual for review.

The VIVDS must pass testing to ensure functionality and reliability before delivery. Test results and supporting documentation, including serial number tested, must be submitted for each VIVDS. If requested, manufacturing data per serial number must be provided for each VIVDS.

2.17. **Warranty**. Warrant the equipment against defects or failure in design, materials, and workmanship for a minimum of 5 yr. or in accordance with the manufacturer's standard warranty if that warranty period is greater. The start date of the manufacturer's standard warranty will begin after the equipment has successfully passed all tests contained in the final acceptance test plan. Any VIVDS 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 per the manufacturer's published specifications. Assign, to the Department, all manufacturer's normal warranties or guarantees on all electronic, electrical, and mechanical equipment, materials, technical data, and products furnished for and installed on the project.

Malfunctioning equipment must be repaired or replaced at the Contractor's expense before completion of the final acceptance test plan. Furnish replacement parts for all equipment within 10 days of notification of failure by the Department.

During the warranty period, technical support must be available via telephone within 4 hr. of the time a call is made by a user, and this support must be available from factory certified personnel.

2.18. **Training**. Conduct a training class for a minimum of 8 hr., unless otherwise directed, for up to 10 representatives designated by the Department on installation, configuration, operation, testing, maintenance, troubleshooting, and repair. Submit a training session agenda, a complete set of training material, the names and qualifications of proposed instructors, and proposed training location for approval at least 30 days before the training. Conduct training within the local area unless otherwise directed. Provide 1 copy of course material for each attendee. Ensure that training includes:

- "Hands-on" operation of system software and equipment;
- explanation of all system commands, their function and usage; and
- system "troubleshooting," operation, and maintenance.

3. CONSTRUCTION

3.1. **System Installation**. Install VIVDS devices and configure detection zones and settings as shown on the plans, in accordance with the manufacturer's recommendations, and as directed. Provide configuration file backups, including detector placement, names, communication settings, and output assignments. Completion of the work must present a neat, workmanlike, and finished appearance.

VIVDS installer must be certified by VIVDS manufacturer in proper installation setup and procedures. VIVDS integrator must be certified by the manufacturer for training end users in the maintenance, configuration, and operation of VIVDS.

Ensure VIVDS detector rack cards are properly installed and seated in the controller cabinet detector rack and use the card edge connector to obtain power and provide outputs. Rewiring the backplane or any other cabinet panel for the system is not permitted except for power and grounding for camera interface panels, wiring from the video camera sensor to the loop detector panel for the video signal inputs, as applicable, and wiring to obtain power for the VIVDS cameras.

Mount and aim cameras in a manner that eliminates as much environmentally generated glare as possible.

All wiring must be cut to proper length before assembly. Provide cable service loops. All cable slack must be neatly laced and placed in the bottom of the cabinet. Ensure cables are secured with clamps. Ensure cables between the controller cabinet and VIVDS cameras are continuous with no splices.

Provisions must be made for installation and configuration of software on Department computers.

3.2. **Temporary Use.** When shown on the plans, the VIVDS equipment must be used to provide vehicle detection on a temporary basis. When the permanent vehicle detection system and related equipment are installed and made operational, the VIVDS equipment must be carefully removed and delivered to the location shown on the plans.

3.3. **Mechanical Components.** Ensure that all fasteners, including bolts, nuts, and washers with a diameter less than 5/8 in. are Type 316 or 304 stainless steel and meet the requirements of ASTM F593 and ASTM F594 for corrosion resistance. Ensure that all bolts and nuts 5/8 in. and over in diameter are galvanized and meet the requirements of ASTM A307. Separate dissimilar metals with an inert dielectric material.

3.4. **Wiring.** All wiring and electrical work supplying the equipment must meet the requirements of the most current version of the National Electrical Code (NEC). Supply and install all wiring necessary to interconnect VIVDS cameras to the controller cabinet and incidentals necessary to complete the work. If additional cables are required, the Contractor must furnish and install them at no additional cost to the Department. Provide conductors at least the minimum size indicated on the plans and insulated for 600 V.

Cables must be cut to proper length before assembly. Provide cable slack for ease of removal and replacement. All cable slack must be neatly laced with lacing or straps in the bottom of the cabinet. Ensure cables are secured with clamps and include service loops.

3.5. **Electrical Service.** The Contractor is responsible for checking the local electrical service to determine if a modification is needed for the equipment.

3.6. **Grounding.** Ensure all VIVDS devices and supports are grounded in accordance with the NEC and manufacturer recommendations.

3.7. **Relocation of VIVDS 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 VIVDS field equipment with a representative from the Department and document any evidence of damage before removal. Conduct a pre-removal test in accordance with the testing requirements contained in this Item to document operational functionality. Remove and deliver equipment that fails inspection to the Department.

Before removal of existing VIVDS 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 VIVDS field equipment as shown on the plans only when authorized by the Engineer.

Use care to prevent damage to any support structures. Any equipment or structure damaged or lost must be replaced by the Contractor (with items approved by the Engineer) at no cost to the Department.

Make all arrangements for connection to power and communications including any permits required for the work to be done under the Contract. Provide conductors 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.

3.8. **Removal of VIVDS Field Equipment.** Perform the removal 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 removal.

Disconnect and isolate any existing electrical power supply before removal of existing field equipment.

Use care to prevent damage to any support structures. Any equipment or structure damaged or lost must be replaced by the Contractor (with items approved by the Engineer) at no cost to the Department.

All materials not designated for reuse or retention by the Department will become the property of the Contractor and be removed from the project site at the Contractor's expense. Deliver items to be retained by the Department to a location shown on the plans or general notes. The Contractor is fully responsible for any removed equipment until released by the Engineer.

3.9. **Contractor Experience Requirements.** Contractor or designated subcontractor must meet the following experience requirements:

3.9.1. **Minimum Experience.** Three years of continuous existence offering services in the installation of VIVDS.

3.9.2. **Completed Projects.** Three completed projects where personnel installed, tested, and integrated VIVDS field equipment. The completed installations must have been in continuous satisfactory operation for a minimum of 1 yr.

3.9.3. **Equipment Experience**. One project (may be 1 of the 3 projects in the preceding paragraph) in which the personnel worked in cooperation with technical representatives of the equipment supplier to perform installation, integration, or acceptance testing of the work. The Contractor will not be required to furnish equipment on this project from the same supplier who was referenced in the qualification documentation.

Submit the names, addresses, and telephone numbers of the references that can be contacted to verify the experience requirements given above.

4. TESTING

Ensure that the following tests are performed on equipment and systems unless otherwise shown on the plans. The Department may witness all the tests.

4.1. **Test Procedures Documentation.** Provide an electronic copy of the test procedures and blank data forms 60 days before testing for each test required on this project. Include the sequence of the tests in the

procedures. The Engineer will approve test procedures before submission of equipment for tests. Conduct all tests in accordance with the approved test procedures.

Record test data on the data forms as well as quantitative results. Ensure the data forms are signed by an authorized representative (company official) of the equipment manufacturer.

4.2. **Design Approval Test.** Ensure that the VIVDS has successfully completed a Design Approval Test that confirms compliance with the environmental requirements of this specification.

Provide a certification and test report from an independent testing laboratory as evidence of a successfully completed Design Approval Test. Ensure that the testing by this laboratory is performed in accordance with the requirements of this specification.

4.3. **Demonstration Test.** Conduct a Demonstration Test on applicable equipment at an approved Contractor facility. Notify the Engineer 10 working days before conducting this testing. Perform the following tests:

4.3.1. **Examination of Product.** Examine each unit carefully to verify that the materials, design, construction, markings, and workmanship comply with the requirements of this specification.

4.3.2. **Continuity Tests.** Check the wiring to determine conformance with the requirements this specification.

4.3.3. **Operational Test.** Operate each unit for at least 15 min. to permit equipment temperature stabilization and observation of a sufficient number of performance characteristics to ensure compliance with this specification.

4.4. **Stand-Alone Test.** Conduct a Stand-Alone Test for each unit after installation. The test must exercise all stand-alone (non-network) functional operations. Notify the Engineer 5 working days before conducting this test.

4.4.1. **Performance Test.** Ensure the VIVDS meets functional performance requirements of Section 2.55 using the following methods:

Verify presence detection accuracy at installed field sites by comparing sample data collected from the detection system with ground truth data collected by human observation. Collect samples and ground truth data for each detection zone for a minimum of 5 minutes during a peak period and 5 minutes during an off-peak period. Ensure the sample period for each zone includes a minimum of 3 vehicles. Perform tests in the presence of the Engineer.

Recorded video of all cameras showing vehicle detections during a 24 hr. period at each intersection must be provided within 30 days upon request. This video must allow verification of proper camera placement, field of view, focus, detection zone placement, and operation.

4.5. **System Integration Test.** Conduct a System Integration Test on the complete functional system. Demonstrate all control and monitor functions for each system component and operate the system for 72 hr.. Supply 2 copies of the System Operations manual before the System Integration Test. Notify the Engineer 10 working days before conducting this testing. The Department may witness all the tests. Conduct a System Integration Test on the complete functional system. Demonstrate all control and monitor functions for each system component for 72 hr. Supply 2 copies of the System Operations manual before the System Integration Test. Notify the Engineer 10 working days before conducting this testing.

4.6. **Consequences of Test Failure.** If a unit fails a test, submit a report describing the nature of the failure and the actions taken to remedy the situation 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 enough cause for rejection of the unit.

If a failure pattern develops in similar units within the system, implement corrective measures, including modification or replacement of units, to all similar units within the system as directed. Perform the corrective measures without additional cost or extension of the contract period.

4.7. **Final Acceptance Test.** Conduct a Final Acceptance Test on the complete functional system. Demonstrate all control, monitor, and communication requirements and operate the system for 90 days. The Engineer will furnish a Letter of Approval stating the first day of the Final Acceptance Test. The completion of the Final Acceptance Test occurs when system downtime due to mechanical, electrical, or other malfunctions to equipment furnished or installed does not exceed 72 hr. and any individual points of failure identified during the test period have operated free of defects.

4.8. **Consequences of Final Acceptance Test Failure.** If a defect within the system is detected during the Final Acceptance Test, document and correct the source of failure. Once corrective measures are taken, monitor the point of failure until a consecutive 30-day period free of defects is achieved.

If after completion of the initial test period, the system downtime exceeds 72 hr. or individual points of failure have not operated for 30 consecutive days free of defects, extend the test period by an amount of time equal to the greater of the downtime more than 72 hr. or the number of days required to complete the performance requirement of the individual point of failure.

4.9. **Relocation and Removal**

4.9.1. **Pre-Test.** Tests may include, but are not limited to, physical inspection of the unit and cable assemblies. Include the sequence of the tests in the procedures along with acceptance thresholds. Contractor to resubmit, if necessary, rejected test procedures for final approval within 10 days. Review time is calendar days. Conduct all tests in accordance with the approved test procedures.

Conduct basic functionality testing before removal of VIVDS 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 before removal and test data after installation. 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 that failed after relocation, but passed before removal.

4.9.2. **Post-Test.** Testing of the VIVDS field equipment is for 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 VIVDS field equipment has been installed, conduct approved continuity, stand alone, and performance tests. Furnish test data forms containing the sequence of tests including all the data taken as well as quantitative results for all tests. Submit the test data forms to the Engineer at least 30 days 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.

Conduct an approved stand-alone test of the equipment installation at the field sites. At a minimum, exercise all stand-alone (non-network) functional operations of the field equipment installed per the plans as directed. 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 before all tests to permit the Engineer or his representative to observe each test.

The Department will conduct approved VIVDS field equipment system tests on the field equipment with the central equipment. The tests will, as a minimum, exercise remote control functions and confirm communication with field equipment.

If any unit fails to pass a test, prepare a report and deliver it to the Engineer. Describe the nature of the failure and the corrective action needed. If the failure is the result of improper installation or damage during reinstallation, reinstall or replace the unit and repeat the test until the unit passes successfully, at no additional cost to the Department or extension of the Contract period.

5. MEASUREMENT

The VIVDS will be measured as each major system component furnished, installed, relocated, made fully operational, and tested or removed in accordance with this Special Specification or as directed.

The VIVDS communication cable will be measured by the foot of the appropriate media type furnished, installed, made fully operational, and tested in accordance with this Specification, other referenced Special Specifications, or as directed.

When the VIVDS is used on a temporary basis, the VIVDS will be measured as each system furnished, installed, made fully operational, including reconfiguration and removal if required by the plans, and tested in accordance with this Special Specification or as directed.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal unless modified by Article 9.2., “Plans Quantity Measurement.” Additional measurements or calculations will be made if adjustments of quantities are required.

When recorded, video is required. It will be paid for by each camera recorded.

6. PAYMENT

6.1. **Furnish and Install.** The work performed, materials, and all accompanying software furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "VIVDS Processor System," "VIVDS Camera Assembly" of the various types, "VIVDS Central Control Software," "VIVDS Temporary," "VIVDS Cabling," and “VIVDS Video Recording.” These prices are full compensation for furnishing, configuring, placing, and testing all materials and equipment, and for all tools, labor, equipment, hardware, operational software packages, supplies, support, personnel training, shop drawings, documentation, and incidentals.

These prices include all interfaces required for the field and remote communications links along with any associated peripheral equipment, including cables; all associated mounting hardware and associated field equipment; and incidentals required for a complete and fully functional video imaging vehicle detection system.

6.2. **Install Only.** The work performed and materials furnished in accordance with this Item will be paid for at the unit bid price for "VIVDS Processor System (Install Only)," "VIVDS Camera Assembly (Install Only)," "VIVDS Temporary (Install Only)," and "VIVDS Cabling (Install Only)." This price is full compensation for installing, configuring, integrating, and testing the completed installation, including VIVDS equipment, voltage converters or injectors, cables, connectors, associated equipment, and mounting hardware; and for all labor, tools, equipment, documentation, testing, training, software, and incidentals necessary to complete the work.

6.3. **Relocate.** The work performed and materials furnished in accordance with this Item will be paid for at the unit bid price for "VIVDS Processor System (Relocate)," "VIVDS Camera Assembly (Relocate)," "VIVDS Temporary (Relocate)," and "VIVDS Cabling (Relocate)." This price is full compensation for relocating and making fully operational existing equipment; furnishing and installing additional cables or connectors; testing, delivery, and storage of components designated for salvage or reuse; and all labor, tools, equipment and incidentals necessary to complete the work.

6.4. **Remove.** The work performed and materials furnished in accordance with this Item will be paid for at the unit bid price for "VIVDS Processor System (Remove)," "VIVDS Camera Assembly (Remove)," "VIVDS Temporary (Remove)," and "VIVDS Cabling (Remove)." This price is full compensation for removing existing

equipment as shown on the plans; testing, delivery, and storage of components designated for salvage; and all labor, materials, tools, equipment, and incidentals necessary to complete the work.

Special Specification 6438

Mobile Retroreflectivity Data Collection for Pavement Markings

1. DESCRIPTION

Furnish mobile retroreflectivity data collection (MRDC) for pavement markings on roadways as shown on the plans or as designated by the Engineer. Conduct MRDC on dry pavement only. Provider is defined as the Contractor or Subcontractor who collects the MRDC data.

2. EQUIPMENT AND PERSONNEL

2.1. **Mobile Retroreflectometer**. Provide a self-propelled, mobile retroreflectometer certified by the Texas A&M Transportation Institute (TTI) Mobile Retroreflectometer Certification Program.

2.2. **Portable Retroreflectometer**. Provide a portable retroreflectometer that uses 30-meter geometry meeting the requirements described in ASTM E 1710. Maintain, service, and calibrate all portable retroreflectometers according to the manufacturer's instructions.

2.3. **Operating Personnel for Mobile Retroreflectometer**. Provide all personnel required to operate the mobile retroreflectometer and portable retroreflectometer. Ensure MRDC system operator has a current certification from the TTI Mobile Retroreflectometer Certification Program to conduct MRDC with the certified mobile retroreflectometer provided.

2.4. **Additional Personnel**. Provide any other personnel necessary to compile, evaluate, and submit MRDC.

2.5. **Safety Equipment**. Supply and operate all required safety equipment to perform this service.

3. MRDC DOCUMENTATION AND TESTING

Document all MRDC by county and roadway or as directed by the Engineer. Submit all data to the Department and to the TTI Mobile Retroreflectometer Certification Program no later than three working days after the day the data is collected. Submit all raw data collected in addition to all other data submitted. Provide data files in Microsoft Excel format or a format approved by the Engineer. Provide measurement notification and field tests as specified. Verification and referee testing may be conducted at the Department's discretion.

3.1. **Preliminary Documentation Sample**. Submit a sample data file, video, and map of MRDC data in the required format 10 working days before beginning any work. The format must meet specification and be approved by the Engineer before any work may begin.

3.2. **Initial Documentation Review and Approval**. The Department will review documentation submitted for the first day of MRDC, and if it does not meet specification requirements, will not allow further MRDC until deficiencies are corrected. The Department will inform the Provider no later than three working days after submittal if the first day of MRDC does not meet specification requirements. Time charges will continue unless otherwise directed by the Engineer.

3.3. **Data File**. Provide data files with the following:

- date;
- district number;

- county;
- Project CSJ number;
- name of mobile retroreflectometer operator;
- route number with reference markers or other reference information provided by the Engineer to indicate the location of beginning and end data collection points on that roadway;
- cardinal direction;
- line type (single solid, single broken, double solid, etc.);
- line color;
- file name corresponding to video;
- data for each centerline listed separately;
- average reading taken for each 0.1-mi. interval (or interval designated by the Engineer);
- accurate GPS coordinates (within 20 ft.) for each interval;
- color-coding for each interval indicating passing or failing, unless otherwise directed by the Engineer (passing and failing thresholds provided by the Engineer);
- graphical representation of the MRDC (y-axis showing retroreflectivity and x-axis showing intervals) corresponding with each data file;
- distance in miles driven while measuring the pavement markings;
- event codes (pre-approved by the Engineer) indicating problems with measurement;
- portable retroreflectometer field check average reading and corresponding mobile average reading for that interval when applicable; and
- upper validation threshold (may be included separately with the raw data but must be clearly identified with the data collected using that threshold).

3.4. **Map**. Provide a map in an electronic format approved by the Engineer with each MRDC submission that includes the following information:

- date;
- district number;
- county;
- color-coded 1-mi. intervals (or interval length designated by the Engineer) for passing and failing retroreflectivity values or retroreflectivity threshold values provided by the Engineer; and
- percentage of passing and failing intervals, if required by the Engineer.

3.5. **Video**. Provide a high-quality DVD or electronic video file with the following information:

- date and corresponding data file name on label;
- district number;
- county;
- route number with reference markers or other designated reference information to indicate the location of beginning and end collection points on that roadway; and
- retroreflectivity values presented on the same screen with the following information:
  - date;
  - location;
  - starting and ending mileage;
  - total miles;
  - retroreflectivity readings; and
  - upper validation thresholds (may be included separately with the raw data but must be clearly identified with the data collected using that threshold).

3.6. **Field Comparison Checks with a Portable Retroreflectometer**. Take a set of field comparison readings with the portable retroreflectometer at least once every 4 hr. while conducting MRDC or at the frequency designated by the Engineer. Take a minimum of 20 readings, spread out over the interval measured. List the average portable retroreflectometer reading next to the mobile average reading for that interval with the

reported MRDC data. Request approval from the Engineer to take field comparison readings on a separate roadway, when measuring a roadway where portable retroreflectometer readings are difficult to take. Take the off-location field comparison readings at no additional cost. Submit the portable retroreflectometer printout of all the readings taken for the field comparison check with the corresponding MRDC data submitted. The mobile average reading must be within ±15% of the portable average reading. The Engineer may require new MRDC for some or all of the pavement markings measured in a 4-hr. interval before a field comparison check not meeting the ±15% range. Provide the new MRDC at no extra cost to the Department. The Engineer may take readings with a Department portable retroreflectometer to ensure accuracy at any time. The Department's Materials and Tests Division (MTD) will take comparison readings and serve as the referee if there is a significant difference between the Engineer's portable readings and the Provider's mobile and handheld readings. For best results, take field comparison readings on a fairly flat and straight roadway when possible.

3.7. **Periodic Field Checks at Pre-Measured Locations**. When requested by the Engineer, measure with the mobile unit and report to the Engineer immediately after measurement the average retroreflectivity values for a designated pre-measured test location. The Engineer will have taken measurements at the test location within 10 days of the test. The test location will not include pavement markings less than 30 days old. If the measured averages do not fall within ±15% of the pre-measured averages, further calibration and comparison measurements may be required before any further MRDC. Submit the results of the field check with the MRDC report for that day.

3.8. **Measurement Notification**. Provide notification via email to Mobileretro@tamu.edu with a carbon copy to the Engineer a minimum of 24 hr. before mobile retroreflectivity data collection to allow for scheduling verification testing when needed.

3.9. **Verification Testing.** The Engineer or a third party may perform retroreflectivity verification testing within seven days of the Provider's retroreflectivity readings. The Provider-submitted retroreflectivity data will be compared to the verification test data to determine acceptability of the Provider's mobile retroreflectometer data. Comparison of the data will result in one of the two scenarios below:

- Provider's Data is Validated – if the difference between Provider's and Engineer-third party data is 20% or less, then the Provider's data is validated. The Provider's data will be used for acceptance.

- Provider's Data is not Validated – if the difference between Provider's and Engineer-third party data is more than 20%, then the Provider's data is not validated. The Engineer-third party data will be used for acceptance and the Provider will be required to take corrective action before additional Provider data collection and may require re-certification of the mobile retroreflectometer. If the Engineer determines that the Provider's data might be correct then, referee testing may be requested by the Engineer.

3.10. **Referee Testing.** MTD will perform referee testing using portable retroreflectometers to determine if the markings need to be restriped to meet the required retroreflectivity level. The referee test results will be final. Referee testing will be conducted on the verification test sections using the method for portable retroreflectometers specified in Item 666, "Reflectorized Pavement Markings."

4. FINAL REPORT

Submit a final report in the format specified by the Engineer to the Department's Traffic Engineering representative within one calendar week after the service is complete. The final report must contain a list of all problems encountered (pre-approved event codes) and the locations where problems occurred during MRDC.

5. MEASUREMENT

When mobile retroreflectivity data collection for pavement markings is specified on the plans to be a pay item, measurement will be by the mile driven while measuring pavement markings.

6. PAYMENT

Unless otherwise specified on the plans, the work performed, materials furnished, equipment, labor, tools, and incidentals will not be paid for directly, but will be considered subsidiary to bid items of the Contract. When mobile retroreflectivity data collection for pavement markings is specified on the plans to be a pay item, the work performed in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Mobile Retroreflectivity Data Collection." This price is full compensation for providing summaries of readings to the Engineer, equipment calibration and prequalification, equipment, labor, tools, and incidentals.

Special Specification 7186
Natural Gas Pipeline

1. DESCRIPTION

Obtain all natural gas pipeline materials from a designated CPS ENERGY Center (a municipal agency of the City of San Antonio), transporting and unloading the CPS ENERGY furnished materials at the project site; and for furnishing all other materials, tools, supplies, labor and equipment necessary for a complete natural gas pipeline in conformance with the details shown on the plans, this Item and as directed by the Engineer. The Engineer will consult with CPS ENERGY in matters concerning the execution of the work, materials, inspection, and testing related to the CPS ENERGY Gas Distribution System.

2. GENERAL

Responsible for the construction of complete facilities, conforming in all respects with the details shown on the plans and as covered by this Item including the design standards.

No gas service may be cut/turned-off after 2:30 PM each day. All gas services cut/turned-off during the day must be restored before 4:00 PM that same day. All work must be coordinated with the Engineer and CPS ENERGY.

Locate all existing gas facilities as needed for the construction and installation of new gas facilities. Upon request, the Engineer will provide copies of the appropriate CPS ENERGY gas maps to facilitate locating activities for the existing facilities at the project site; however, the Engineer and CPS ENERGY do not guarantee the accuracy of such gas facilities map information. Use conventional pipe locating equipment and techniques in conjunction with information from the maps to determine the actual location of existing gas facilities and be liable for any damages to existing gas facilities and any other utilities that are incurred by construction activities.

While this Item and the details shown on the plans are intended to be full and complete, the Contractor is considered bound by customary good construction practice whether referred to specifically or not.

Contractor used for the gas pipeline work must have performed utility gas pipeline work within the past (3) three years of similar technical scope and magnitude as the services to be performed under this contract. With their bid, Contractor must provide evidence of qualifications in this regard and of any licenses, permits or registrations possessed that pertain to the services or are required in the specifications. Contractor may contact CPS Energy prior to the letting of this project to determine if their previous experience meets this requirement.

The Contractor must have a program complying with 49 CFR Part 199, "Control of Drug Use in Natural Gas, Liquified Natural Gas, and Hazardous Liquid Pipeline Operations" and 49 CFR Part 40, "Procedures for Transportation Workplace Drug and Alcohol Testing Programs" to test employees for the presence of prohibited drugs as prescribed and to provide an employee assistance program. The Contractor agrees to provide CPS Energy with an affidavit prior to the date of execution of the Contract which states that Contractor and its employees have complied with all applicable laws, statutes, and regulations pertaining to ensuring a drug free workplace including, but not limited to, the requirements of Part 199 and Part 40. Furthermore, the Contractor agrees to allow CPS Energy Human Resources personnel periodic on-site access to Contractor's records documenting compliance with Part 199 and Part 40. Contractor will provide the name and contact person for the agency or consortium used by the Contractor to comply with this requirement prior to the date of execution of the Contract.

The Contractor agrees to provide CPS Energy with an affidavit prior to the date of execution of the contract which states that Contractor and its employees have complied with all applicable laws, statutes, and regulations pertaining to ensuring a drug free workplace including, but not limited to, the requirements of 49 CFR as amended by the Research and Special Programs Administration (RSPA).

CPS Energy requires the following to verify Contractor and Sub-Contractor compliance with all applicable laws, statutes and regulations pertaining to the qualification of pipeline personnel including, but not limited to the applicable requirements of 49 CFR Part 192 – Subpart N -"Qualification of Pipeline Personnel" as adopted by the Railroad Commission of Texas (RCC) within the Pipeline Safety Rules.

- A Notarized Affidavit that states the company placing the bid and its sub-contractors are in compliance with 49 CFR 192 and RRC Pipeline Safety Rules pertaining to the qualification of pipeline personnel.
- A current copy of its Operator Qualification Plan, unless currently on file, and approval of its plan by a CPS Energy Gas Operation's Representative. A copy of CPS Energy Covered Tasks Regulated by 49 CFR Part 192.
- Current listing of employees and qualifications.

The Contractor must submit a copy of SMWBA Form 101 to CPS Energy prior to date of execution of the contract.

Prospective Contractors bidding on the Project must submit to CPS Energy through the Texas Department of Transportation (the Department) a properly executed Certificate of Insurance from its insurance agent or carrier of such insurance coverages as required and set forth in the Project Contract Documents prior to award of the contract. Failure to provide proof of insurance will result in the Department's Contractor not being approved for award of the CPS Energy utility work on the Project.

3. REFERENCES

Attention should be directed to the follow Items:

- Item 9, "Measurement and Payment;"
- Item 400, "Excavation and Backfill for Structures;"
- Item 401, "Flowable Backfill;"
- Item 402, "Trench Excavation Protection;" and
- Item 420, "Concrete Substructures."

4. MATERIALS

CPS ENERGY will provide all natural gas pipe (steel and/or plastic), couplings, valves, valve boxes,

stop cocks, anodeless risers, miscellaneous fittings, pipe tracer wire, and any other natural gas pipeline materials necessary to complete the work. These materials will be provided by CPS ENERGY at no cost to the Contractor. Notify the Engineer 10 days prior to scheduling the pick-up of these materials.

All other materials, tools, supplies, equipment, etc., necessary to complete the work will be furnished by the Contractor.

When the materials stored at the CPS ENERGY Centers are issued, they become the Contractor's responsibility. A transfer-of-inventory will be signed as a written record of the materials provided. The Contractor, the Department and CPS ENERGY will jointly inspect and inventory the materials for quantity and quality at the time of loading at the CPS ENERGY Center and will sign the inventory list. After this transfer, the Contractor will be responsible for CPS ENERGY's delivered costs for any materials that have to be replaced due to loss or damage beyond use during the project. “Damaged Beyond Use” will be determined by the Engineer.

Load the materials at one or more CPS ENERGY Centers in San Antonio and transport and unload at the work area. All materials are to be unloaded (not dropped) with proper equipment to prevent damage.

Deliver the materials along the right of way in such a manner as to not cause interference to driveways, streets, other construction operations, sidewalks, etc. Prevent dirt or debris from entering into the pipe, couplings, fittings, etc.

Upon completion of the gas work, promptly return excess or salvaged materials furnished or owned by CPS ENERGY to the designated CPS ENERGY Centers.

5. CONSTRUCTION METHODS

5.1. Excavation. Excavation (trenching) required to complete the pipeline installation will have sufficient width to allow installation of piping and valves at depths specified on the plans and/or the design standards shown at the end of this Item. Blasting to perform the excavation is not allowed. In cases where shrubbery and trees that are labeled to remain are encountered in any location where in the opinion of the Engineer the use of ditching/trenching equipment may result in unnecessary damage, the Engineer may require the trench to be excavated by hand.

5.2. Dust Suppression. Whenever trenching activities create significant quantities of dust or other undesirable emissions into the atmosphere, take action to reduce these emissions, as determined by the Engineer.

5.3. Boring. At the locations shown on the plans, the pipe installation is accomplished with a boring operation using the following methods.

The use of guided or directional boring equipment is acceptable if the Contractor demonstrates such equipment is capable of installing the pipe along a controlled and constant horizontal and vertical alignment. Insure that the pipe is not damaged as it is pulled or otherwise inserted into the bored hole. The bored hole must be at least 1 nominal pipe size larger than the pipe to be installed (i.e. a 4 in. pipe requires at least a 6 in. bored hole). When the bored hole is known to have significant deflections, the bored hole must then be at least 2 nominal pipe sizes larger than the gas pipe.

When boring equipment is used to install plastic pipe, a fusible link will be used between the pull head and the pipe at all times to prevent damage during the pull-back operation. The fusible link should be at least 2 ft. in length and be a section of pipe that is 1 nominal pipe size smaller that the pipe being installed.

The Engineer will inspect the fusible link and the leading edge of the installed pipe for any significant gouges or scrapes in the outside wall of the pipe or excessive change in length of the fusible link. If damages to the fusible link or pipe are found, remove and replace all damaged pipe, and reimburse CPS ENERGY for the cost of the damaged pipe (including CPS ENERGY inventory and handling expenses).

When boring equipment is used to install steel pipe, the Engineer is to inspect the installed pipe for any significant gouges or scrapes in the protective coating on the outside wall of the pipe. If damages to the coating are found and are caused by the Contractor, the Contractor will repair all of the damaged coating at no additional cost

Whenever service lines are planned for installation along a section of gas main that is being installed with guided or directional boring equipment, excavate at least 1 service tap location to provide an intermediate

inspection hole prior to pulling the pipe into the bored hole. The intermediate inspection hole is to be located near the middle of the directional bored section. If several service line connections are planned along the route, the Engineer must approve the location of the service tap that is excavated for the intermediate inspection hole before the pipe insertion process.

Mains and service lines that are installed by guided or directional boring equipment must not be installed at depths greater than 7 ft. unless one of the following conditions applies:

- The plans specifically require installation depths in excess of 7 ft.
- Installation depths in excess of 7 ft. are necessary to achieve acceptable clearance between the pipe and another utility or structure while maintaining the minimum burial depth requirements for the pipe.
- The Engineer's prior approval for such installation when the conditions described above exist are not applicable.
- When guided or directional boring equipment is used to install gas distribution facilities, additional compensation due to extra depth of cover will not apply.
- The method of gas service replacement by insertion involves sliding a new polyethylene pipe of smaller diameter into the existing pipe. This is an acceptable method of installation provided the ends of the existing steel pipe are reamed and fitted with bushings for the pipe to be inserted without damage, and a shrink sleeve is applied to keep components in place and prevent damage thereafter. In order to reduce stress on the service line being inserted from the main, the horizontal distance between the end point of the new service alignment and the point of insertion should be at least, twice the perpendicular distance between the lines.Tracer wires will be inserted through the existing service along with the new pipe.
- An electrical continuity test will be conducted by the Contractor on each installed tracer wire to verify that the wire has not been “shorted” against the existing steel service during the installation procedure.

5.4. Temporary Bridges. When the trench is excavated where it is necessary to have a passageway across/lower the trench, provide safe, temporary bridges or provide other safe means of crossing the trench as approved by the Engineer.

No streets, alleys or driveways are to be blocked at night, except with the Engineer's prior approval. Trenches/holes left open during

5.5. Protection of Pipe Ends. Keep the pipeline installation clean. At the end of each day's work and at any other times that the ends of the installed pipe are left unattended, the pipe ends must be securely closed to prevent the entrance of water, animals, trash or any other obstructions, and not opened until work is resumed.

If there is an obstruction in a portion of the lines, remove all foreign matter if it is in the lines. The work necessary to assure that foreign matter is not present and/or to remove the foreign matter if it is present is included in the installation cost of the line.

5.6. Welding. All welding is in accordance with API Standard 1104, 18th Edition, dated September, 1994 (or the latest edition), as outlined herein, as shown on the plans, and/or as directed/approved by the Engineer.

5.6.1. Welds are to be made with the “shielded metal-arc” process. All welding equipment and materials such as welding rods will be furnished by the Contractor. Brand of welding rods proposed must be approved by the Engineer prior to use.

5.6.2. Where determined by the Engineer to be necessary, back-welding or inside-welding of all tube turns, ells, etc., in the pipeline is to be performed as part of the required work.

5.6.3. All welds to be made with not less than 3 beads. The second or “Hot Pass Bead” should be run on the full circumference of the pipe as soon as practical where the Hot Pass or second bead is run before the Stringer Bead has cooled.

5.6.4. Prior to being allowed to weld, each welder must qualify in accordance with Section 3.0 of API Standard 1104 and must pass the tests listed in paragraph 3.4 of this Standard. Conduct, or make arrangement

5.6.5. Each welder will be assigned a specific number and it will be the welder's responsibility to affix his/her number with a crayon next to each weld for future identification. Steel die stamping is not be used.

5.6.6. Welding inspection is in accordance with Section 5.1 of API Standard 1104. Test all welds with soap suds while the line is subjected to an internal air pressure of 90 PSI prior to field coating the joints.

5.6.7. Pin holes, leaks, cold laps, rivers, undercutting or any other defects occurring in any weld, are to be repaired by cutting out the entire weld and completely rewelding. Whenever it becomes necessary to remove a weld from the completed line, replacement is made by welding into the line a pup joint having a minimum length of 10 ft.

5.7. Coating of Pipe. Coating materials for coating field joints and for repairing damaged or defective coating will be furnished by CPS ENERGY.

5.7.1. If the pipe furnished by CPS ENERGY is coated and wrapped pipe, the Contractor will be responsible for coating all field joints and repairing damaged and defective coating on the pipe regardless of the nature, extent or cause of damage or defect. However, if the pipe provided had a damaged or defective coating of such magnitude as to require an extra charge to properly coat, first refer this matter to the Engineer and not proceed until authorization to do so has been obtained.

5.7.2. For coating field joints of pipes coated with TGF-3 coal tar enamel, the coating on the pipe must be cut back a distance of 8 to 12 in. from the joint. The edge of the enamel and felt wrapping is to be feathered at these points to assure a firm bond between the original coating and the field coating. After the joints are welded and tested, and the welds cleaned and brushed, the bare ends of the pipe are to be thoroughly cleaned, then immediately given a hand-brushed coat of primer to dry surfaces. Exercise care to prevent primer from being applied too heavily, especially at the base of the welds; any runs or sags which have dried or dead primer must be scraped off and the pipe reprimed. After the tape primer has dried to a tacky consistency, apply cold wrap tape with a 30% overlap, taking care not to create any voids between the pipe and tape coating. No primer or coating will be applied to wet or damp pipe.

5.7.3. All repairs to damaged coating which exceeds 2 sq. in. will be made by breaking out the old coating, scraping the pipe to bare metal, feathering the edges to assure a firm bond and repriming. After the primer has dried to a tacky consistency, apply cold wrap tape taking care not to create any voids between the pipe and the tape coating. For repairs less than 2 sq. in., the pipe does not have to be scraped to bare metal and primed; however, the good enamel around the damaged portion is to be feathered before the cold wrap is applied.

5.7.4. Repairs to Fusion Bonded Epoxy (F.B.E.) and/or Powercrete coated pipe may include the following additional repair procedures.

For pinhole and small area repair, the pipe surface and small area holidays where repairs by the patching stick method are approved by the Engineer and is a recommended procedure by the coating manufacturer, the original coated surface must be thoroughly cleaned and lightly abraded with sandpaper. Patching stick material is to be compatible with the F.B.E. epoxy coating system and is to be material normally supplied by the manufacturer of the F.B.E. coating system.

It is to be applied by heating the clean pipe surface until the patching stick begins to melt when it is rubbed over the heated area. Continue heating the coated surface while applying the patching stick like a brazing

rod. Build a small puddle of melted compound to obtain a minimum thickness of 0.025 in. Continue heating until the compound flows out smoothly. In all instances the manufacturer's recommendations for the use of the patching stick are to be followed.

An alternate method, for repairs to small area holidays, is liquid epoxy. The material for patching is to be 100% solids catalytically cured epoxy coating normally supplied by the manufacturer of the F.B.E. coating system. The original coated surface must be thoroughly cleaned and lightly abraded with sandpaper. All dust is to be wiped off before applying the patch coating. This type of repair coating is to be applied by spatula, brush, roller, or spray to attain a uniform minimum thickness of 0.025 in. and is to overlap the surrounding undamaged coating by at least 1 in. The patch coating is not to be applied when pipe temperatures are below 50ºF unless provisions are made for complete heat curing, using methods and temperatures in accordance with procedures recommended by the patch coating manufacturer.

At the option of the Engineer, completely cured coating repairs are to be inspected with the Contractor's holiday detector. A patch-coated area is to be allowed to cure prior to handling as per manufacturer's specifications. Supply necessary equipment to complete repairs to manufacturer's guidelines.

For large area repair, where repairs are approved by the Engineer, the following procedures are to be followed. The pipe is to be cleaned to remove all dirt, scale, rust, damaged of disbonded coating and other foreign material. Areas repaired before surface oxidation or rusting occurs may be prepared by hand sanding, power tool grinding, or surface oxidation or other approved and suitable means. Areas repaired after surface oxidation or rusting occurs are to be cleaned using abrasive blasting prior to coating repairs. The edges of the original coating are to be “feathered out” around the area to be coated and all dust wiped off before applying the patch coating.

The material for patch coating must be 100% catalytically cured epoxy coating supplied by the manufacturer of the F.B.E. coating system. This type of repair coating is to be applied by spatula, brush, roller or spray to attain a uniform minimum thickness of 0.025 in. or as recommended by the manufacturer. The patch compound is to overlap the surrounding undamaged coating by at least 1 in. A patch-coated area is to be allowed to cure prior to handling as per manufacturer's specifications. At the option of the Engineer, completely cured coating repairs are to be inspected with the Contractor's holiday detector. Supply necessary equipment to complete repairs to manufacturer's guidelines.

For coating field joints on fusion bonded epoxy coated pipe, heat shrink sleeves may be employed when approved by the Engineer. Heat shrink sleeves are to be the heat shrinkable wraparound sleeves with either a specially formulated mastic sealant or a solvent free, 2 component liquid epoxy primer designed to prevent corrosion of joints on buried pipelines.

Apply sleeves in compliance with manufacturer's recommendations. In addition, for field joints within bores, heat shrink sleeves may also be employed when approved by the Engineer, provided the sleeves are manufactured for this application. Sleeves for this application are to consist of a combination of the following components: a specially designed wraparound heat shrinkable sleeve, a high shear strength thermoplastic hot melt adhesive, a solvent free, 2 component epoxy, a specially designed wear cone, and optional clamping belts. Supply necessary equipment to install sleeves in accordance to manufacturer's recommendations. This may include, but not be limited to, high intensity gas torches and abrasive blast equipment for pipe surface preparation.

After the field joints have been coated and immediately before the pipe is lowered into the ditch, the entire coating will be tested to locate breaks or pinholes and other flaws in the coating with an approved holiday detector in good working condition capable of producing the testing voltage in pulsating cycles at very low amperage. The voltage used is not to exceed 14,000 volts for pipe coatings of 0.094 in. For fusion bonded epoxy coated pipe, the coating is to be checked for holidays using a dry-type holiday detector. The holiday detector is to be set at 150 volts per mil thickness of coating. All defective places will be plainly marked immediately. Furnish the holiday detector, and check the coating for holidays in the presence of the Engineer.

5.7.5. Compression type couplings, valves, welded fittings, etc., will receive a cold applied mastic after the pipe is in the trench and has been tested for leaks. A plastic wrap supplied by CPS ENERGY will be installed over the mastic to protect the coating during backfilling.

5.7.6. Handling coated pipe is to be accomplished only with suitable equipment to prevent damage to the coating. The coated pipe is to be placed on skids alongside the trench until it is to be welded and lowered into the trench. The skids are to be of sufficient width or padded with sand bags or resilient pads to prevent the skid edges from cutting the coating and wrapping. The skids are to be arranged to permit the coated pipe to bear on the full width of the skid.

5.7.7. Coated and wrapped pipe is to be carefully handled with wide rubber, leather, composition, or canvas slings or belts containing no protruding rivets or belts that may damage the coating. Wire rope, tongs, chains, hooks, and bare cables must not come into contact with the coating. Coated pipe is not to be handled when the temperature is low enough to cause cracking of the enamel.

5.8. Plastic Gas Pipe. Handle the pipe only with suitable equipment to prevent damage to the pipe such as fracture, kinking, deep gouges or cuts. The pipe is not to be subjected to abuse by dropping, throwing or dragging except over smooth non-scratching terrain or surface.

Install an insulated copper tracer wire furnished by CPS ENERGY with all pipe for the purpose of locating the pipe after backfilling. This wire is to be installed with 2 to 6 in. of separation from the pipe.

Fuse pipe joints in accordance with requirements of 49 CFR Part 192, “Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards”, Paragraphs of 192. 281, 192. 283, 192. 285, 192, and 287.

Prior to starting production fusing, each employee that will be making fusion joints must qualify according to 49 CFR Part 192, Paragraph 285. Conduct, or make arrangements for the qualification tests. The qualifying tests are to be conducted in the presence of the Engineer.

Furnish all specialty tools and equipment required to handle, install, butt fuse and squeeze-off the pipe. Insure all specialty tools and equipment are specifically designed for use on plastic piping systems and are in good working condition. The Engineer may inspect all specialty tools and equipment and may disallow the use of any specialty tools or equipment that are not specifically designed for use on high density polyethylene (plastic) piping systems or are deemed to not be in good working condition. CPS ENERGY routinely uses the Steve Vick & Mark II Coil Trailer for handling large diameter coiled pipe, McElroy equipment for making butt fusions on plastic pipe and Mustang Squeeze-off tools for stopping the flow of gas in existing plastic piping systems. Provide copies of the manufacturer's literature for all comparable equipment from other manufacturers and at the discretion of the Engineer, comparable equipment from other manufacturers may be approved.

All pipe joints are to be soap bubble tested with the line having between 90 and 120 PSIG internal pressure. The test is to be made in the presence of the Engineer.

5.9. Cathodic Protection. Install packaged anodes, insulating joints and insulating flange sets as provided for by this Item and/or as shown on the plans. Welding machines are not be used to test insulation or otherwise be grounded across insulating devices. Insulation will be checked by the Engineer and declared acceptable only after testing establishes satisfactory performance.

5.10. Installation and Backfill. All stumps and roots found in the trench are to be cut and removed where they will not come in contact with the pipe. All loose rocks, stones, blocks, heavy clods, tree limbs, etc., which may damage or prevent proper installation of the pipe are to be removed before the pipe is installed. The pipe will not be lowered into the trench until it has been inspected and approved by the Engineer.

The trench is to be excavated a minimum of 4 in. deeper than the proposed pipe depth so that a commercial sand approved by the Engineer can be placed in the trench before the pipe is installed. The sand placed in

the trench to cushion the pipe is to be leveled and tamped so that the weight of the pipe is evenly distributed on the sand cushion.

Unless the plans or the Engineer requires flowable backfill, backfilling must be conducted in a manner where the trench will be neatly and uniformly backfilled and compacted. Exercise care to prevent hand shovels and tampers from damaging the pipe. Provide 6 in. of sand backfill around and over the pipe to form a protective cushion between the pipe and the materials and equipment used for backfilling. After the pipe has a 6 in. minimum cover of sand, the remaining backfill may contain rocks and gravel, except that large rocks in excess of 4 in. in diameter, width or length, will not be used.

When crossing drainage ditches and minor streams, furnish and install all materials necessary for bank reinforcement. The backfill is to be properly maintained until the work has been completed and accepted. No reimbursement will be made for repairing of backfill due to floods and/or other conditions occurring before final acceptance.

Control the excavation and backfilling operation to have a minimum quantity of open trench commensurate with good construction practices. Any surplus material not used for backfilling is to be disposed of properly. Attain the minimum specified cover for the gas piping.

Backfill in public and private thoroughfares must be properly compacted to ninety-five per cent (95%) density to prevent settlement or damage to other buried utilities. CPS ENERGY will strictly enforce this requirement through random visual inspection and the use of standard compaction evaluation methods. The Contractor will not use soil from the right of way except from the spoil bank. The Contractor will dispose of any surplus soil. The Contractor will provide density testing reports to ensure proper compaction when the city, county or state entity having jurisdiction over the project requests such tests.

5.11. Final Piping Connections, Tie-Ins and Purging. Make all connections of new gas lines to existing gas lines. This includes all necessary preparations for tie-ins and purging for all sections of gas lines installed. Weld short stop fittings and other necessary fittings on existing steel gas lines that will be used by CPS ENERGY to control the flow of gas into the new gas lines. CPS ENERGY will control the flow of gas on all operative gas facilities while the Contractor is making final piping connections and/or tie-ins.

CPS ENERGY will purge the new gas mains, and the Contractor will purge all new and/or existing service lines that have been tied to the new gas mains or otherwise adjusted.

Furnish all necessary equipment and instrumentation that is required to insure that the final tie-in welds and/or fusions between new and existing gas facilities are performed in a safe manner. Such equipment and instrumentation may include pneumatic air movers, combustible gas indicators (CGI's), oxygen monitors, self-contained breathing apparatus and fire retardant clothing for construction personnel, and fire extinguishers.

5.12. Clean-Up. As soon as backfill is completed on a section of pipeline, clean the right of way, remove and transport all surplus CPS ENERGY issued materials to the designated CPS ENERGY Center(s). Dispose of all refuse such as brush, broken skids, rock, etc. The earth on both sides of the trench which has been disturbed during the construction of the gas line is to be leveled, and the entire area left in a condition satisfactory to the Engineer.

5.13. Gas Facility Access Cover Adjustments. Install CPS Energy provided riser ring(s) on gas facility access cover assembly in order to raise existing access cover to the same elevation as final grade. Adjustment, excavation, demolition of concrete, and/or replacement of existing gas facility access cover assembly may be necessary if final grade is below existing grade. Any concrete used for gas facility access cover adjustments must have a minimum compressive strength of 2,000 psi. Adjust all gas facility access covers as directed by authorized CPS Energy personnel. The contractor will be responsible for damage to other appurtenances and/or structures whether CPS Energy owned or not, and perform the adjustment in accordance with the paving contractor's schedule.

6. TESTS

6.1. Radiographic Inspection. Applies when radiographic inspection is specified by this Item, by the plans, or CPS Energy Cover Tasks Regulated by 49 CFR Part 192.

6.1.1. Standards and Codes. The latest editions of the following documents apply when required:

- Department of Transportation, 49 CFR Part 192, "Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards."
- Recommended Practice No. SNT-TC-1A, Supplement A "Radiographic Testing Method."
- ANSI B31. 8, "Gas Transmission and Distribution Piping Systems."
- ASME Code Section V, "Nondestructive Examination."
- United States Nuclear Regulatory Commission, Title 10, Chapter 1, CFR - Energy and other federal, state and local regulations for protection against radiation hazards.

6.1.2. Radiographic Procedure. Perform all radiographic inspections in accordance with Section 8.2 of API Standard 1104. The Contractor is to provide a copy of the written procedure to the Engineer for acceptance.

6.1.3. Personnel Qualifications. Radiographic certification will be through a qualification and certification program that incorporates the requirements of Recommended Practice No. SNT-TC-1A, Supplement A in accordance with Section 8.7 of API Standard 1104.

6.1.4. Equipment and Material. Furnish all equipment and materials necessary for the performance of the radiographic inspection. The materials and equipment include all film and supplies for the processing, film identification, recording, filing and storage. Provide all barriers, warning systems, film badges, documentation and records necessary for the protection and personnel monitoring of every person near a radiation source.

6.1.5. Production Radiography Procedures. Notify the Engineer if any welds fail to meet the radiographic inspection. All welds or welded joints that are repaired or replaced are to be radiographed again.

6.1.6. Film Identification Procedure. Film identification is in accordance with Section 8. 6 of API Standard 1104. The method of identification will be as approved by the Engineer prior to the start of radiographic inspection.

6.1.7. Radiographic Reports and File. Furnish the Engineer a report for each calendar day the unit is on the project. All radiographs made are to be delivered to the Engineer and become the property of CPS ENERGY.

6.2. Pressure Testing. Demonstrate to the satisfaction of the Engineer, by performing a pressure test, that the mains and/or services installed do not leak and will operate safely at the desired maximum allowable operating pressure. Pressure tests will be performed to verify satisfactory workmanship and the strength of materials. To the extent practical, the test is to be conducted to the entire pipeline to minimize the number of untested tie-in connections. All joints used to tie-in a test segment of pipeline after the test are to be soap bubble tested at not less than its operating pressure. Repair any leaks or failures which are revealed by the test.

Furnish all supervision, labor, materials and equipment to perform the pressure test, including but not limited to, pumps, compressors, pigs, test instrumentation and water. Pressure test requirements will be as indicated on the plans. The requirements indicate the minimum and maximum test pressure, test fluid and test duration, as appropriate.

Conduct the test in accordance with the applicable requirements of 49 CFR Part 192 and take all necessary safety precautions to protect construction personnel and the general public during the test. Obtain all permits necessary to conduct the test except for the Railroad Commission of Texas test water discharge permit that is required for a hydrostatic pressure test.

6.2.1. Standard Air Test. Gas mains and services to be operated at pressures of 60 PSIG or less. This test will be indicated in the gas plan sheets without a test duration period. The test pressure is to be a minimum of 90 PSIG and a maximum of 120 PSIG. The test duration is to be sufficient to ensure discovery of all leaks. At the minimum, each weld, butt fusion and any other fitting and connection is to be soap bubble tested at the specified test pressure. The test pressure is to be measured with a dial type gauge and monitored during the course of the test to detect leakage. Upon completion of the test, furnish the Engineer with a written statement to indicate successful completion of the test. Pending acceptance of the test by the Engineer, the Engineer must also sign the statement.

6.2.2. High Pressure Test. When the plans specify a test pressure greater than 90 PSIG or if a specific test duration period is specified, the following applies.

6.2.2.1. Prior to initiating any work required for a High Pressure Test, hold a pre-test meeting with the Engineer to discuss all aspects of plans for conducting the High Pressure Test. The key points of discussion for hydrostatic pressure tests will include the following: 1) optimum direction and injection rate for filling the pipe section with water while minimizing air entrapment; 2) optimum direction and discharge location for safely and completely draining the pipe section; 3) the type, quantity and condition of pipeline pigs; 4) installation and use of temporary pig launchers and/or receivers; 5) capacities of water pumping equipment; 6) pressurization procedures; 7) written test documentation; 8) limitations on refilling and/or discharging test water during the pressure test without invalidating the test and causing the test to be restarted; 9) test water stabilization period after filling the pipe section; 10) appropriate procedures for dewatering the pipe section to minimize the quantity of water that remains in the pipe; 11) any other aspects of High Pressure Test.

The test medium may be either air or water as shown on the plans. A hydrostatic test is to be conducted in general conformance with API Recommended Practice (RP) 1110. Conduct air tests in conformance with API RP 1110 with regard to safety and instrumentation.

6.2.2.2. All filling and pressurization procedures are subject to the approval of the Engineer. When a hydrostatic test is performed, fill the pipeline in a manner that no air is entrapped, making use of pipeline pigs as necessary. Furnish all pipeline pigging equipment, including appropriate styles and types of pipeline pigs and temporary pig traps and launchers. The Engineer will inspect all pigging equipment, and the equipment is to be acceptable to the Engineer prior to use. Allow a suitable time for temperature stabilization of the test fluid.

The stabilization period is to be a minimum of 24 hr. after the filling operation is complete for a hydrostatic test or, for an air test, 8 hr. after the pipeline is pressurized to the minimum test pressure. The stabilization period may be reduced by the Engineer for short sections such as offsets, etc.

6.2.2.3. Note each significant step or event during the filling, pressurization and testing operation and comments are to be added for any incidents which may affect the results of the test. Where the specified test duration is 2 hr. or less deadweight pressure, pipe temperature and ambient temperature measurements are to be recorded at 15 min. intervals. For tests whose duration is greater than 2 hr, these measurements are to be recorded at 30 min. intervals.

6.2.2.4. Upon completion of the test, obtain the approval of the Engineer prior to depressurizing the pipeline. Depressurize, de-water, clean and dry the pipeline to the satisfaction of the Engineer. Dispose water in the manner required by (if any) permits.

6.2.3. Test Records. Submit to the Engineer all documentation associated with all the tests, including a completed Form I, “Hydrostatic Test Record and Certification” of Appendix I, API RP 1110, (or substantially similar documentation), testing logs and all recorder charts. All documentation is to be labeled to identify the pipeline section that was tested, signed, and dated by the Contractor. Provide written confirmation to indicate successful completion of the test for the Engineer's approval.

6.3. Pipeline Availability (Test Period). The gas main installation including the backfill will not receive final acceptance until all gas main construction has been completed and the main has been in satisfactory operation. This date will be established by the Engineer in writing. If it is determined by the Engineer that adjustments, repairs, replacements or other correction measures are needed, promptly perform the

correction or replacement and retesting work necessary at contractor's expense including all work damaged by the correction or replacement of the defective work. Upon completion of the gas work, all subsequent test periods will be at the discretion of the Engineer.

7. MEASUREMENT

Measurement of completed and accepted work as described herein is as follows:

7.1. New service stubs for 1/2 in. through 4 in. diameter pipes placed in an open trench will be measured as each location shown on the plans and as directed by the Engineer. A service stub connected to the gas main located along the same side of the street as the property being serviced is referred to as a short side service stub. A service stub connected to the gas main located along the opposite side of the street from the property being serviced is referred to as a long side service stub. The following conditions apply for service stubs:

7.1.1. Service stubs installed from an existing gas main to 1 ft. inside property line for short side or long side service.

7.1.2. Service stubs installed from a new gas main to 1 ft. inside property line for short side or long side service.

7.2. Re-running and lowering service lines for 1/2 in. through 4 in. diameter pipes will be measured as each location shown on the plans and as directed by the Engineer. The conditions for service lines shown in Sections 6.(1)(a) and (b) will apply for re-running and lowering service lines.

7.3. Extending, connecting and pump testing an existing service line for 1/2 in. through 4 in. diameter pipe to anew gas main will be measured as each location shown on the plans and as directed by the Engineer.

7.4. Shortening, connecting and pump testing an existing service line for 1/2 in. through 4 in. diameter pipe to anew gas main will be measured as each location shown on the plans and as directed by the Engineer.

7.5. When there is a need for a new welded steel service tee or a steel ball valve to be welded, the new welded steel service tee or the steel ball valve will be measured for the welding required to install each fitting for a 1-1/4 in. steel tee or a 2 in. or 4 in. steel ball valve. In most instances, the existing service tee and/or valve will be utilized when re-running a service line off an existing steel gas main.

7.6. Uncovering and capping service lines at the gas main will be measured as each location shown on the plans and as directed by the Engineer.

7.7. Installing a gas main of the size and type shown on the plans in an open trench will be measured by the foot along the top of the trench.

7.8. Installing a gas main of the size and type shown on the plans in a joint trench will be measured by the foot along the top of the trench.

7.9. Installing a steel pipe casing for a service line or a gas main of the size shown on the plans in an open trench will be measured by the foot along the top of the trench. The size of the steel pipe casing will be larger than the size of the service line or gas main, such as, using 2 in. casing for a 3/4 in. pipe, 3 in. casing for 1 in. or1-1/4 in. pipe, 4 in. casing for a 2 in. pipe, etc. This does not include the pipe installed in the casing.

7.10. Boring for a service line or a steel pipe casing of the size specified on the plans will be measured by the foot of pipe installed in the bore. The size of the steel pipe casing will be larger than the size of the service line or gas main to be installed.

7.11. Installing a service line or gas main of the type and size shown on the plans into a previously installed casing will be measured by the foot of pipe installed in the casing. The size of the pipe will be a 3/4 in. pipe into a 2 in. casing, a 1 in. or 1-1/4 in. pipe into a 3 in. casing, a 2 in. pipe into a 4 in. casing, a 4 in. pipe into a 6 in.

casing, a 6 in. pipe into a 8 in. casing, a 8 in. pipe into a 12 in. casing, a 12 in. pipe into a 16 in. casing or a 16 in. pipe into a 20 in. casing.

7.12. Flowable backfill will be measured in accordance with Item 401, "Flowable Backfill," for the locations shown on the plans and locations directed by the Engineer.

7.13. Trench excavation protection will be measured in accordance with Item 402, "Trench Excavation Protection," for the locations shown on the plans and locations directed by the Engineer.

7.14. Excavation and backfill (except flowable backfill) and the work for cutting and restoring pavement will be measured in accordance with Item 400, "Excavation and Backfill for Structures." The sand used as part of the backfill will be considered subsidiary to this Item. All testing of the gas main installations will not be measured for payment but is to be considered subsidiary to the various natural gas pipeline pay items.

7.15. Mobilization (Equipment and Materials) will be measured in accordance with "NGP Mobilization," for one time mobilization to and from the job site. Any additional mobilization requested by CPS Energy that requires an extra charge for mobilization, first refer this matter to the Engineer and do not proceed until authorization to do so has been obtained, in which event the provisions of Item 9, "Measurement and Payment," will be used to pay for this work.

7.16. The 12 in. and larger stopple fittings and the work for stopping the flow of gas will be measured in accordance with "NGP Stopple". The cost of the fitting(s) used as part of the line stop will be included this Item and provided by the contractor.

7.17. Adjustment of a gas facility access cover to final/proposed grade will be measured as each location shown on the plans and as directed by the Engineer.

7.18. Reinforced concrete will be measured in accordance with Item 420, "Concrete Substructures" for the locations shown on the plans and locations directed by the Engineer.

8. PAYMENT

The work performed and materials furnished for the installation of the natural gas pipeline in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for the Items of work hereinafter described. These prices will be full compensation for hauling all CPS ENERGY furnished materials, preparation, excavation and backfill, for shaping and fine-grading the trench, for placing and connecting pipes, for coating the steel pipe, for installing all necessary fittings, for building and painting risers, for meter set-ups, furnishing materials not provided by CPS ENERGY, for all testing, disposition of surplus material and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

8.1. Payment for new service stubs for 1/2 in. through 4 in. diameter pipe placed in an open trench will be at the unit price bid for "Natural Gas Pipeline (New Short or Long Service)(Existing Main to Property Line)" and "Natural Gas Pipeline (New Short or Long Service) (New Main to Property Line)", complete in place.

8.2. Payment for re-running and lowering service lines for 1/2 in. through 4 in. diameter pipe placed in an open trench will be at the unit price bid for "Natural Gas Pipeline (Short or Long Service)(Existing Main to Property Line)", "Natural Gas Pipeline (Short or Long Service)(Existing Main to Meter)" "Natural Gas Pipeline (Short or Long Service)(New Main to Property Line)" and "Natural Gas Pipeline (Short or Long Service)(New Main to Meter)", complete in place. Removal of existing service lines will be subsidiary to this Item.

8.3. Payment for extending and connecting a service line for 1/2 in. through 4 in. diameter pipe to a new gas main will be at the unit price bid for "Natural Gas Pipeline (Service)(Extend to New Main)", complete in place.

8.4. Payment for shortening and connecting a service line for 1/2 in. through 4 in. diameter pipe to a new gas main will be at the unit price bid for “Natural Gas Pipeline (Service)(Shorten to New Main)”, complete in place.

8.5. Payment for the welding required to install each fitting for a 1-1/4 in. steel tee or a 2 in. or 4 in. steel gate valve will be at the unit price bid for “Natural Gas Pipeline (Service)(Welded Fitting)(Tee)” or “Natural Gas Pipeline (Service)(Welded Fitting)(Valve)”, complete in place.

8.6. Payment for uncovering and capping an existing service line at the gas main will be at the unit price bid for “Natural Gas Pipeline (Capping Service at Main)”, complete in place.

8.7. Payment for installing a new gas main will be at the unit price bid for “Natural Gas Pipeline (Main)” of the type and size specified on the plans, complete in place. This includes the placement of a tracer wire in the trench when plastic pipe is specified.

8.8. Payment for installing a new gas main in a joint trench with another utlity will be at the unit price bid for “Natural Gas Pipeline (Joint Trench)” of the type and size specified on the plans, complete in place. This work includes appurtenances, additional padding, and the placement of a tracer wire in the trench when plastic pipe is specified.

8.9. Payment for installing steel pipe casing in an open trench for a service line or gas main will be at the unit price bid for “Natural Gas Pipeline (Casing)” of the type and size specified on the plans, complete in place. This work includes the installation of casing vent pipes, insulators and end seals.

8.10. Payment for boring the installation of a service line or a casing for a service line or a gas main will be at the unit price bid for “Natural Gas Pipeline (Boring)” of the type and size specified on the plans, complete in place.

8.11. Payment for inserting a service line or a gas main inside a casing will be at the unit price bid for “Natural Gas Pipeline (Insert)” of the type and size specified on the plans, complete in place.

8.12. Payment for flowable backfill used to backfill the trench will be at the unit price bid for “Flowable Backfill” under Item 401, “Flowable Backfill” by the cubic yard.

8.13. Payment for trench excavation protection will be at the unit price bid for “(Trench Excavation Protection)” under Item 402, “Trench Excavation Protection.”

8.14. Payment for excavation and cutting and restoring pavement will be at the unit price bid under Item 400, “Excavation and Backfill for Structures.”

8.15. Payment for mobilization will be at the lump sum price bid for “(Gas Construction Contractor Mobilization)” under “NGP Mobilization.”

8.16. Payment for stopping gas flow on 12 in. diameter or larger pipelines will be at the unit price bid for “(Stoppling)” under “NGP Stopple.”

8.17. Payment for adjusting a gas facility access cover to final/proposed grade will be at the unit price bid for “Adjust Gas Facility Access Cover”, complete in place. Excavation, demolition, or replacement of concrete pad for gas facility access cover assembly will be subsidiary to item “Adjust Gas Facility Access Cover” as deemed necessary by authorized CPS Energy personnel.

Testing the natural gas pipeline for leakage, including all labor, materials and equipment necessary to perform the tests, will not be paid for directly but is to be subsidiary to the various natural gas pipeline pay items.

8.18. Payment for reinforced concrete will be at the unit price bid for “CL A Conc (Misc)” under Item 420, “Concrete Substructures” by the square yard.

Special Specification 7326
Sanitary Sewer

1. DESCRIPTION

1.1. **Scope of work.** Provide and install complete sanitary sewer construction and adjustments as shown on the plans or as directed, as described herein, in compliance with the Department's Utility Accommodation Policy (UAP)(Title 43, T.A.C., Sections 21.31—21.55) or as directed.

Reference Specifications of the American Society for Testing and Materials (ASTM), American Water Works Association (AWWA) and American National Standards Institute (ANSI) will mean the latest standard in effect on the date of the proposal.

1.2. **Definitions.**

1.2.1. **Sanitary Sewer Main.** Sanitary sewer main is defined as that portion of the sanitary sewer system which collects the wastewater from the service laterals, including stub outs from the nearest manhole, to the point of final destination.

1.2.2. **Sanitary Sewer Force Main.** Sanitary sewer force main is defined as that portion of the sanitary sewer system which moves wastewater under pressure using a lift station to the point of final destination.

1.2.3. **Service Lateral.** Service lateral is defined as that portion of the sanitary sewer system beginning at a customer property line or other establishment property line which is the point of origin of the wastewater being carried by the system to the sanitary sewer main, including the connection into the sanitary sewer main system.

1.2.4. **Point Repair.** Point repair is defined as the repair of a small length of pipe section of an existing sewer line which has deteriorated due to settlement or corrosion, or is falling, missing, crushed or broken, or has offset joints. Point repairs are to be completed before rehabilitation by trenchless methods between two adjacent manholes is initiated.

1.2.5. **Rehabilitation.** Rehabilitation is defined as the rehabilitation of existing sanitary sewer mains by an approved trenchless method including Cured-In-Place-Pipe (CIPP) method or by sliplining with Centrifugally Cast Fiberglass Pipe (ASTM D 3262) or by sliplining with hollow Core I-Beam construction closed profile PVC pipe (ASTM D F794).

1.2.6. **Cured-In-Place-Pipe.** This method consists of inverting a resin-impregnated flexible sewn felt tube into the original conduit by use of hydrostatic head. The resin is cured by circulating hot water within the tube. The CIPP must be continuous and tight fitting. The work must be completed with the Department's schedule. Contractors may, when appropriate, elect to use any material that is considered to be equal (i.e., a product that has structural physical properties that are equal or greater than those of the specified products), however, submittal to the design Engineer is required no later than 10 days before bid opening.

1.2.7. **Television Inspection.** Television inspection is defined as televising and videotaping of sewer lines utilizing a color, closed-circuit television inspection unit to determine the condition of the lines.

Television inspection is part of the acceptance requirements for new sewer lines. All new sewer mains must not carry flow until the Engineer and Inspector approve and accept the mains for service.

1.2.8. **Cleaning Manholes and Mains.** Cleaning manholes and mains is defined as cleaning of existing sanitary sewer manholes and mains to facilitate the TV inspection and rehabilitation of the sanitary sewer mains.

The designated sanitary sewer manhole sections and the manholes themselves should be cleaned using mechanical, hydraulically propelled, or high velocity sewer cleaning equipment. Debris generated by the cleaning process should be removed from the manhole, transported and disposed of.

1.2.9. **Bypass Pumping.** Bypass pumping is defined as the installation of pumping equipment and temporary piping for the purpose of redirecting sewage flow to prevent interference with the rehabilitation of the sanitary sewer manholes and mains as well as providing reliable sewer service to the buildings being served.

1.2.10. **Pipe Bursting or Crushing Replacement Process.** The pipe bursting or crushing process is defined as the reconstruction of existing sanitary sewers by the simultaneous insertion (breaking and expanding the old pipe) of liner pipe within the bore of the existing pipe. The pipe bursting or crushing process involves the rehabilitation of deteriorated gravity sewer pipe by installing new pipe material within the enlarged bore created by the use of using static, hydraulic, or pneumatic hammer “moling” device, suitably sized to break the existing pipe or by using a modified boring “knife” with a flared plug that crushes the existing sewer pipe. Forward progress of the “mole” or the “knife” may be aided by hydraulic equipment or other apparatus. Replacement pipe is either pulled or pushed into the bore. Sewer services are reconnected to the new pipe through small excavations from the surface. Sewage flows from the upstream line and from the services are pumped as required to prevent overflows and provide continual service. All excavations required for reconnecting and pumping service flows, entry pits, exit pits, obstruction removal, point repairs, among others, are to be kept to a minimum, and all damage to surface and underground features, facilities, utilities, and improvements are to be repaired.

1.2.11. **Sliplining.** Sliplining is accomplished by pulling or pushing liner pipe into existing sewers by use of mechanical or hydraulic equipment. Once in place, liner pipe is allowed time to normalize and is then cut to fit between the manholes. Manhole inverts and benches are re-worked and re-shaped. Existing sewers remain in operation during the slip lining process, with sewage flow diverted around operations in progress.

1.2.12. **Grouting of Sewer Mains.** This Item must govern the grouting of existing sewer mains with a diameter of larger than 4 in. for the purposes of abandonment underneath roadways, paved areas, and at other designated locations. The location of this work is as shown on the Contract document plans and as encountered in the field during construction. The Contractor must, unless otherwise specified, furnish all labor, materials, equipment, tools and all other appurtenances necessary to abandon sewer lines segments in place by filling them with flowable cementitious low-strength grout including plugs, bulkheads, excavation, and backfill at locations as required to completely fill the line to be abandoned in place to protect against future collapse of the line.

2. MATERIALS

All materials furnished for this project must be new. A manufacturer’s certificate of compliance will be acceptable for quality control.

2.1. **Sanitary Sewer Pipe.** Materials for sanitary sewer pipe may be either rigid or flexible unless a specific type of pipe is called for on the plans. All pipe not listed will be subject to pre-approval by the Engineer.

2.1.1. **Rigid Pipe.** Ductile iron pipe will, for the purpose of this Specification, be known as rigid pipe.

2.1.2. **Flexible Pipe.** Pipe consisting of materials other than those listed above.

Any flexible pipe with a deflection of the inside diameter greater than 5% after 30 days of installation as determined by a mandrel test, will not be accepted.

Unless directed otherwise by the Engineer, a "GO, NO-GO" deflection testing mandrel, built as shown on the plans and in accordance with 30 TAC § 217, must be furnished at the Contractor's expense and must be used in testing pipe deflection for acceptance. Refer to “Air and Deflection Testing,” section of this Specification for more information about mandrel deflection testing.

The working room for flexible pipe must be at least 6 in.

Pipe stiffness is to be in accordance with ASTM 3034 SDR 26 (115 psi) or ASTM 2241 SDR 26 (160 psi).

At waterline crossings and where water and sewer mains are parallel and separation distance cannot be achieved as per 30 TAC§ 217.53, use extra stiff pipe SDR 26 PVC (ASTM D 2241-09) with a pressure rating of at least 150 psi. This will include all lateral piping as well.

All sanitary sewer piping must pass the low-pressure test, as described in 30 TAC § 217.57.

2.1.3. **Concrete Pipe.** Concrete pipe must not be used.

2.1.4. **Asbestos-Cement (AC) Pipe.** AC pipe must not be used. For any work requiring the removal of AC pipe, the Contractor must comply with the requirements of Item 6 of the Department's *Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges.* Excavate to the top of the AC water line to allow a separate Contractor hired by the State to remove the AC water line. The excavation for the AC water line removal is subsidiary to the work that created the need for the removal (excavation for structures, roadway, a new line, tie-ins, etc.). The third-party Contractor must remove whole sections of AC pipe.

2.1.5. **Fiberglass Reinforced Pipe, For Large Diameter Gravity Sanitary Sewer.** This Item will govern the designing, fabricating, furnishing, installing, and joining of large dimeter (18 in. or greater) fiberglass sewer piping for gravity-flow conveyance of wastewater. The pipe size, centerline alignment, and grades are presented in the project drawings. All materials and construction must be in accordance with the TCEQ rules to include: Design Criteria for Sewerage systems 30 TAC 217.1, 30 TAC 217.2, 30 TAC 217.3, and 30 TAC 217.13, or any revision thereto as applicable.

The work to be performed in this section includes design calculations, detailing, and fabrication of FRP for the conveyance of raw sanitary sewage. Pipe design calculations will be required for open-trench and tunneling installation methods. All pipes must be manufactured specifically for this project and no pipe should be furnished from stock unless approved by the owner.

2.1.5.1. **Performance and Design Criteria.** Design in accordance with ASTM D 3262 including the appendix and subsequent Specifications. Depths must comply with requirement of ASTM D 3681. Design pipe for service loads that include external groundwater and earth loads, jacking or pushing loads, allowable jacking or pushing capacity must not exceed 40% of the ultimate compressive strength or the maximum allowable compressive strength recommended by the manufacturer, whichever is less, and traffic loads.

Design is to be conducted under the supervision of a Professional Engineer licensed in the State of Texas, who must seal and sign the design. Standard lay length of 20 ft., except for special fittings or closure pieces, is necessary to comply with the plans.

Design of pipe is to include the determination of design pressures up to 25 psi, stresses, external loads, pressure class (PN), and pipe stiffness class (SN).

SN that satisfies design requirement on the plans, or not less than 115 psi when used in direct bury operations.

All lines must be able to withstand a high-velocity cleaning with a water jet capable of producing at least a volume of 50 gpm with a pressure of 1,500 psi at the nozzle. Install a gauge to indicate working pressure on the discharge of high-pressure water pumps. The jet angle of the outlet must be no greater than 30° relative to the pipe axis. A video of pipe before and after line cleaning must be submitted of all installed lines. No delamination should occur.

In no case should pipe be installed deeper than its design allows.

Pipe markings must meet the minimum requirements of ASTM 3236. Minimum pipe markings must be as follows:

- manufacturer;
- manufacturer number (identifies factory, location, date manufactured, shift and sequence);
- nominal diameter;
- beam load;
- laying length; and
- ASTM designation.

2.1.5.2. **Gaskets.** Supply from approved gasket manufacturer in accordance with ASTM F 477 and suitable for service intended. Affix gaskets to pipe by means of suitable adhesive or install in a manner to prevent gasket from rolling out of pre-cut groove in pipe or sleeve coupling.

Provide the following gaskets in potentially contaminated areas:

- petroleum (diesel, gasoline)—Viton; and
- other contaminants—manufacturer recommendation.

2.1.5.3. **Fittings.** All bends exceeding a 2° horizontal or vertical deflection must consist of a manufacturer fabricated fitting meeting the same requirements as the pipe material. Provide tolerance of laying length of fittings to ±2 in. Use only manufactured fittings. Flanges, elbows, reducers, tees, wyes, laterals, and other fittings must be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glass-fiber reinforced overlays. For pipe diameters 18 in. or larger, lateral openings 6 in. or greater in size must be made using insert a-tee conforming to ASTM D 3034 service connections, approved by Engineer.

2.1.5.4. **Couplings.** Unless otherwise specified, the pipe must be field connected with fiberglass sleeve couplings that use elastomeric sealing gaskets as the sole means to maintain joint water tightness. Elastomeric sealing gaskets should be recommended by the manufacturer for application with sanitary sewage. Chemical grout, epoxy grout, or internal repair boots will not be accepted as long-term watertight seals. The joints must meet the performance requirements of ASTM D 4161.

2.1.5.5. **Structure Conditions.** Provide an FRP water stop flange (wall pipe) or raised rib for watertight connection to a concrete cast-in-place structure or manhole.

2.1.5.6. **Dimensional Tolerances.**

- Inside diameter pipe must not vary more than 1/8 in. from the nominal inside diameter.
- Roundness: The difference between the major and minor outside diameters must not exceed 0.1% of the nominal outside or 1/4 in., whichever is less.
- Wall thickness: Provide minimum single point thickness at least 98% of stated design thickness.
- End squareness: Provide pipe ends square to pipe axis with maximum tolerance of 1/8 in.
- Fittings: Provide tolerance of angle of elbow and angle between main and leg of wye or tee to ±2 degree. Provide tolerance of laying length of fitting to ±2 in.

2.1.6. **PSM Polyvinyl Chloride Pipe.** Polyvinyl Chloride (PVC) pipe must be made from class 12454-B materials as prescribed in ASTM D 1784. For pipes 4 in. to 15 in. in diameter PSM pipe, fittings, and joints must be in accordance with ASTM D 3034, with elastomeric gasket joints meeting ASTM D 3212, or ASTM D 2241 and ASTM D 3139 where applicable, with the exception that solvent cement joints must not be used. All pipe that is 18 in. to 36 in. in diameter must meet requirements of ASTM F 679.

2.1.7. **PVC Pressure Pipe and Force Mains.** Pipe must be made from Class 12454-A or 12454-B, as defined in ASTM D 1784-11. All pipe, fittings, and joints must meet or exceed the requirements of ASTM D 2241-09, with the exception that solvent cement joints must not be used. The pressure rating, size, and pressure class must be as shown on the Contract documents. Pipe must have an integral bell and gasket seal with the locked-in type gasket reinforced with a steel band or other rigid material in accordance with ASTM F 477-10.

The joint must be in accordance with the requirements of ASTM D 3139-98(2011). All required joint restraints must be approved by the Engineer before the work being accepted. Pressure pipe or force mains are required to have modified grade 5 material used as bedding. Pipes also must be hydrostatically tested at a minimum 100 psi after their construction to ensure proper construction.

2.1.8. **High Density Polyethylene Pipe.** High Density Polyethylene Pipe (HDPE) and fittings must be made of high density extra high molecular weight (EHMW) polyethylene with a standard thermoplastic material designation code of PE3408 and with a cell classification of 345464E per ASTM D 3350. The molecular weight category will be extra high (250,000 to 1,500,000) as per the Gel Permeation Chromatography determination procedure with a typical value of 300,000 to 330,000. The pipe must be manufactured in accordance with ASTM F 714 or ASTM D 3035.

All HDPE piping must have identifiable green striping (dual) every 120 degrees. The pipe must be gray in color and must meet the Utility Location and Coordination Council, “Uniform Color Code,” for sewer lines per APWA/ULCC Standards Committee.

The pipe and fittings must have product traceability. The manufacturer must include a print line on the pipe. This must notate the manufacturer’s name, date of manufacture, the lot and supplier of raw material, plant location, and production shift. The ASTM standard must also appear as ASTM F 714 with the material designation as PE3408.

The polyethylene pipe manufacturer must provide certification that the stress regression testing has been performed on the specific product. The said certification must include a stress life curve per ASTM D 2837. The stress regression testing must have been performed in accordance with ASTM D 2837, and the manufacturer must provide a product supplying a minimum Hydrostatic Design Basis (HDB) of 1,600 psi as determined by ASTM D 2837.

The material must be listed by the Plastics Pipe Institute (PPI), a division of The Society of the Plastics Industry in PPI TR-4. The pipe material must have a HDB of 1,600 psi at 73 degrees and 800 psi at 140 degrees. The PPI listing must be in the name of the pipe manufacturer and testing and validation of samples of the pipe manufacturer’s production pipe must be based upon ASTM D 2837 and PPI TR-3.

The manufacturer’s certification must state that the pipe was manufactured from one specific resin in compliance with these Specifications. The certificate must state the specific resin used and its source.

HDPE pipe manufactured from materials meeting the Specifications of this section must have an Environmental Stress Crack Resistance (ESCR) of no failures in 10,000 hrs. (ESCR: FO>10,000) when tested in accordance with ASTM F 1248.

Pipe and fittings must be manufactured from material meeting the requirements of this section. Pipe supplied under this Specification must have a nominal iron pipe size (IPS) outside diameter unless otherwise specified. The Dimension Ration (DR) and pressure rating of the pipe at 73° must be as shown on the drawings.

Both pipe and fittings must carry the same pressure rating. All fittings must be pressure rated to match the system piping to which they are joined. At the point of fusion, the outside diameter and minimum wall thickness of the fitting must match the outside diameter and minimum wall thickness Specifications of ASTM F 714 for the same size pipe. Fittings must be manufactured by the manufacturer of the pipe. Ells, tees, and wyes must be manufactured by mitered fabrication.

Clamps and Gaskets: Clamps must be stainless steel, including bolts and lugs, as manufactured by JCM Industries Type 108 or equal. Furnish full circle, universal clamp couplings with at least 3/16 in. thick neoprene, grid-type gasket. Select clamps to fit outside diameter of pipe. Use minimum clamp length of 30 in. for replacement pipes outside diameter (O.D.) of 10.75 in. (10 in. nominal) or greater and 18 in. for replacement pipe O.D. less than 10.75 in.

Terminal sections pipe that are joined within the insertion pit must be connected with a full circle pipe repair clamp. The butt gap between pipe ends must not exceed 1/2 in.

Force Mains: Where applicable, solid wall pipe for sanitary sewer force mains must have a minimum working pressure rating of 150 psi and an inside diameter equal to or greater than the nominal pipe size indicated on the drawings.

For force mains or pressure rated fittings, all fittings must be de-rated according to the manufacturer's written Specifications, and clearly labeled on the fittings as such. For direct bury or insertion lining, fittings must be fully pressure rated. All fittings must have a quality control label as approved by the manufacturer.

HDPE is related to pipe bursting or pipe crushing for sanitary sewer or related pipeline rehabilitation.

Yard piping: DR 9 only, no more than two splices, and must use long inserts for connections.

Heat fusion joining systems: Pipe and fittings must be thermal butt fusion, saddle fusion, or socket fusion according to manufacturer recommended procedures.

2.1.9. **Mechanical or Compression Joints.** Mechanical or compression joints, concrete jointing collars, or non-reinforced rubber adaptors must not be used unless as approved by the Engineer.

2.1.10. **Ductile Iron Pipe and Fittings.** Ductile iron pipe must be centrifugally cast of 60-42-10 iron and must conform to the requirements of the latest revision of ANSI A21.51 and AWWA C151-09. Ductile iron pipe may be "thickness designed" in accordance with requirements of the latest revision of ANSI A21.50 and AWWA C150-08. Thickness design should be based on standard laying conditions 4 or 5 in conformance with conditions at the site. Fittings for ductile iron pipe must not have less than the thickness, class, or pressure rating specified for ductile iron pipe. Fittings must be furnished with all necessary glands, gaskets, bolts, etc. as may be required to complete the joints.

Rubber gasket joints for mechanical joints or push on type joints must be in accordance with ANSI A21 and AWWA C111-12.

All ductile iron pipe and fittings used for sewer applications must have the interior lined with a non-corrosive lining material consisting of polyurethane, ceramic epoxy, or calcium aluminate. The lining material should be applied per the manufacturer's written instructions and at thicknesses recommended by the pipe manufacturer for sewer applications. The type and brand of interior lining should be clearly marked on the outside of the pipe and fittings. Only one type and brand of lining should be used for pipe on a project.

Where ductile iron pipe is to be installed in a casing, the pipe should be thoroughly cleaned down to the coal-tar enamel pipe coating by approved methods. Where damaged, a prime coat, compatible to the polyvinyl tape to be used, should then be applied to the pipe. Following the application of the prime coat, the pipe must be wrapped with Scotchrap, Trantex V-10 polyvinyl tape, or other approved equal product. The tape must not be applied until the prime coat is completely dry. The tape must be spirally and tightly wrapped on each section of the pipe with a 50% lap. The wrap must be made to the bell on the bell end and to a point 6 in. from the spigot end. The joint must be protected with tape 6 in. in width on pipe 12 in. or less in size and with tape 8 in. in width on pipe greater than 12 in. in size.

Ductile iron pipe to be installed in a trench must be protected in the following manner. Each pipe joint must be covered with a 4-mil thick polyethylene sleeve that is 2 ft. longer than the pipe joint. The sleeve must cover the full length of the pipe joint, lap over 1 ft. on each end of the adjoining pipe joints, and be secured with a minimum of two circumferential turns of pressure sensitive polyvinyl tape. Excess material should be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe, and held in place by means of pieces of pressure sensitive tape at approximately 5 ft. intervals. After assembling the joint, the polywrap tube from the previously installed pipe must be pulled over the joint and secured by the Contractor. The polywrap tube from the new joint must be pulled over the first tube and secured by the Contractor to provide a double seal.

Cast iron and ductile iron fittings and valves must be completely wrapped in 8 mil thick polyethylene film with at least a 1 ft. overlap on each end and appropriately taped. Laps must cover joints with adjoining pipe joints or fittings when installed. Also, the fire hydrant barrel, from the surface to the valve, must be wrapped as specified herein.

Any damaged areas in the polyethylene film must be repaired by covering the area with a sheet of polyethylene film large enough to lap over the damaged area 1 ft. at least in any direction and appropriately taped. Extreme care should be taken at service tap locations to ensure that the tape extends beyond the corporation and onto the service line pipe by at least 1 ft.

Before placing pipe in the trench, a cushion of approved materials must be placed in the trench as required herein. Backfill material must be carefully placed on the pipe to avoid any damage to the polyethylene sleeve.

The Contractor should use care to protect and preserve the polyethylene wrap around ductile iron water mains when installing service corporations. The required method is to wrap pipe tape around the pipe over the polywrap in the area to be tapped. The tap is to be made through the tape and polywrap. It is not necessary to remove and replace poly wrap. All exposed pipe, the corporation, and the first 3 ft. of the service must be wrapped and taped to achieve a complete seal. In addition, a sand envelope must extend over and around the connection to a depth of 8 in. above the main.

2.1.10.1. **Polyethylene Wrapping Material.** Polyethylene wrapping material must be used to encapsulate all ductile and cast-iron fittings. Polyethylene wrapping for ductile and cast-iron fittings must consist of a 4-mil tubular section of cross-laminated high-density polyethylene, which has a high dielectric and tensile strength, for use in insulating cast iron and ductile iron pipe from the electrolytic action encountered in highly active soils. All iron pipe, fittings, and accessories must be wrapped with edges overlapped and taped securely with duct tape to provide a continuous wrap to prevent contact between the pipe and the surrounding backfill. Repair all punctures with duct tape to restore the continuous protection before backfilling.

Polyethylene wrapping is to consist of opaque cross-laminated high-density polyethylene sheet continuously thermally bonded to form a tubular section. The tubes may be supplied in bulk length on rolls or in individual pre-cut lengths. See Table 1 for size and length chart, in accordance with AWWA C-105 (Table 1) for minimum requirements. When supplied in specific pipe lengths, the tubes are to contain at least 4 ft. over the actual pipe length to allow for overlap.

The polyvinyl sheet of film for the tubular wrapping is to be of virgin resins meeting raw and physical properties of ASTM D 1248 and AWWA C-105, latest edition. The material is to be 4 mil cross-laminated high-density polyethylene of uniform film thickness and be free of imperfections such as pin holes, etc., after being thermally seamed into tubular form. The finished product must have a nominal thickness of 4 mils, with tolerances of minus 10%.

The material is to have no volatile constituents, the loss of which may affect ductility. The material is also to have the following properties:

- Mechanical: The polyethylene film is to have a tensile strength per latest ASTM D 882 test of 6300 psi min. The film is to have an elongation of not less than 100% of the test strip per latest ASTM D 882 test. The film is to have an impact resistance 800-gram min per (ASTM D 1709 Method B). The film is to have a propagation tear resistance of 250 gf minimum in machine and transverse direction (ASTM D 1922).
- Dielectric: The film is to have a dielectric strength of 800 volts per mil thickness per ASTM D 149.

Inspection and Certification by Manufacturer:

- Quality control and inspection: The manufacturer must establish the necessary quality control and inspection practice to ensure compliance with this standard.

- Manufacturer's statement: The manufacturer must provide a sworn statement on each lot purchased that the inspection and all applicable material requirements of Article 2 have been met and that all results comply with the requirements of this standard.
- Freedom from defects: All polyethylene film must be clean, sound, and without defects that could impair service.

The polyethylene film supplied should be clearly marked, at a minimum of every 2 ft. along its length, containing the following information:

- manufacturer's name or trademark,
- year of manufacturer,
- ANSI and AWWA C-105A21.5,
- minimum film thickness and material type,
- applicable range of nominal pipe diameter sizes, and
- warning-corrosion protection-repair any damage.

The City of Schertz may, at no cost to the Contractor, subject random testing by an independent laboratory for compliance with this Specification. Any visible defect of failure to meet the quality standards herein will be grounds for rejecting the entire order.

Table 1
4 mil Polyethylene Wrapping Materials

Size (in.) & Length (All sizes lay flat size)	
Pipe Size (in.)	**Product Size Width (in.) x Length**
4, 6 & 8	20 x 200/500
8, 10 & 12	27 x 200/500
16 & 18	37 x 200/500
20	41 x 200/500
24	54 x 200/500
30	67 x 140/500
36	81 x 120/500
48	95 x 100/500
54	108 x 100/500

2.1.11. **Concrete Steel Cylinder Pipe.** Concrete Steel Cylinder Pipe must not be used.

2.1.12. **Pipe Testing.** All sanitary sewer pipe and fittings produced within the jurisdiction of the City of Schertz must be tested by City of Schertz-approved laboratory method at the source of supply. All shipments of pipe not so tested must be accompanied by a certificate of compliance to these Specifications prepared by an independent testing laboratory and signed by a Texas licensed Professional Engineer.

2.1.13. **Steel Casing Pipe.** Steel casing pipe must be in accordance with ASTM A 134 with at least a thickness of 3/8 in.; actual thickness should be as shown on the plans.

2.1.14. **Stainless Steel Casing Spacer and Insulators.** This section covers casing spacers for use in wastewater collection. Casing spacers are used to facilitate installing a sewer pipe inside a casing pipe or tunnel. Casing spacers should consist of two or more segments of circular steel that bolt together, forming a shell around the carrier pipes. Casing spacers should protect the carrier pipe and any protective coating or wrapping from damage during the installation, and properly support and electrically isolate the carrier pipes within the casing or tunnel. On occasion, multiple carrier pipes may be installed in one casing or tunnel.

2.1.14.1. **General Requirements.** Casing spacers should be 8 in. long for carrier pipes up to 16 in. diameter and 12 in. long for larger carrier pipe sizes. Manufacturer's approval in writing must be required for installations

exceeding 300 ft. in length, carrier pipes in excess of 48 in. diameter, or multiple carrier pipes in one casing or tunnel.

Casing spacers must have at least 14-gauge type 304 stainless steel band and 10-gauge steel riser when required. The band, risers, and connecting studs must be welded and cleaned at the factory before the application of a fluidized bed fusion bonded PVC coating.

The fluidized bed fusion-bonded PVC coating must be between 10-16 mils thickness. The PVC coating must provide good resistance to acids and alkalize and excellent resistance under ASTM B 117 salt spray tests. The coating must have at least 1380 volts/mil per ASTM D 149-61 short time 0.010" test and a Durometer-shore A@ (10 sec) of 80 per ASTM D 1706-61T. Epoxy coatings are not an acceptable alternative.

The spacers must have a flexible PVC liner of 0.09 in. thickness with Durometer “A” 85-90 hardness and at least 58,000-volt dielectric strength (60,000 V minimum surge test.) Moisture absorption must not exceed 1%.

The runners must be of high-pressure molded glass reinforced polyester with a minimum compressive strength of 18,000 psi per ASTM D 695, flexural strength of 25,300 psi per ASTM D 790, tensile strength of 17,600 psi per ASTM D 638, and Rockwell hardness (M) of 90 per ASTM D 785. The riser should be designed and fabricated to place the runner (skid) in full contact with the inside surface of the casing pipe. This evenly distributes the load force to all support members. The ends of all runners must be shaped to resist hanging or sticking inside casing during installation of the carrier pipe. Polyethylene runners are not acceptable.

Runners should be at least 1 in. in width and at least 7 in. long for carrier pipes up to 16 in., and at least 2 in. in width and 11 in. long for larger carrier pipes. Bolts on runners are not acceptable. The runners should be attached to the band or riser by 3/8 the wearing surface on the runner. The recess should be filled with a corrosion inhibiting filler. There must be 4 runners per casing spacer for carrier pipes up to 12 in. diameter, 6 runners for 14 in. through 36 in., and 8 or more runners for carrier pipes over 36 in. diameter. Number of bottom runners should be multiples of 2. Number of top runners should be multiples of 2.

Stainless steel casing spacers must be furnished with stainless steel studs, nuts, and washers.

Casing spacers must have ample riser height to limit vertical movement of the carrier pipe in the casing. At least 1 in. to 2 in. clearance should be provided between the top runner and the ID of the casing or tunnel.

Continuous operating temperatures for the PVC coated casing spacers should not exceed 150°F. Stainless steel casing should be used in applications where continuous operating temperatures exceed 150° F.

Unless noted otherwise, casing spacers must be required on all carrier pipes installed in casing or tunnel applications.

2.1.14.2. **Quality Assurance.** All casing spacers are to be manufactured in accordance with NACE International Recommend Practice RP 0286 (Isolation Spacers). Each casing spacer must be manufactured in the USA at a facility that has a Registered ISO 9002 Quality Management System or be in the process of achieving this certification by March 2005. Non-compliance to this registered commercial quality system requirement by March 2005 will result in removal of the manufacturer’s product from approved manufacturers.

If on receipt of casing spacers they are found to be non-compliant, the manufacturer must replace the defective casing spacer with a casing spacer that meets the City of Schertz’s specifications, at no charge to City of Schertz.

If City of Schertz audits, product inspection and performance data review in accordance with these Specifications determine excessive casing spacer noncompliance, the manufacturer will be subject to removal by the Products Standard Committee. Copy of the current ISO 9002 registration (or written documentation of being “in the process of achieving ISO registration,” before March 2005) must be provided with material submittal.

2.1.15. **Water Main Crossings.** Gravity or force main sewers constructed in the vicinity of water mains must be in accordance with the “Criteria for Domestic Wastewater Systems,” 30 TAC 217.53, as adopted by The Texas Commission on Environmental Quality, latest revision.

2.2. **Manholes.** This Item should govern the construction of standard sanitary sewer manholes complete and the materials therein, including manhole rings and covers. All material and construction work must be in accordance with current TCEQ rules to include “Design Criteria for Sewage Systems” (30 TCEQ § 217). All constructed manholes must be watertight and equipped with pre-tested and approved low leakage frames and lids. Sewer manhole ring and cover castings must meet the current requirements of American Association of State Highway and Transportation Officials (AASHTO) Designation M306-10.

For new concrete manholes, all concrete manhole components (cast-in-place or precast manhole base, precast risers, precast cone sections, cast-in-place or precast flat tops, and concrete “throat rings” as applicable) for new manholes must be in conformance with the applicable requirements of ASTM Designation C 478, except as modified in this Specification.

All concrete grout used for patching or other similar fill-in work must be of non-shrink type made with the Komponent® admixture specified above, or approved alternate, in conformance with the manufacturer’s recommended formulation with Portland cement, fine aggregate, water, and water reducer to produce a compressive strength of approximately 4,800 psi within 7 days and 7,250 psi within 28 days at a 70ºF baseline temperature.

Unless otherwise shown on the Contract documents or approved by the Engineer, standard sanitary sewer manholes should be constructed with influent and effluent piping less than or equal to 24 in. in diameter with precast, reinforced concrete manhole sections. A standard sanitary sewer manhole must be a single entrance cylindrical structure, with at least an internal diameter of 4 ft. between the cone and base sections. The base of the structure must include the load bearing portion beneath and exterior of the structure, invert channels, and the fill or bench portions adjacent to the lower sewer pipes within the structure. The maximum vertical height of the diameter adjustment section or cone must be 36 in. Adjustment or “throat rings” may be used for final elevation adjustment of the manhole ring and cover. Concrete encasement of the manhole’s ring must be as shown on the plans. Specifically, they must attach the ring and cover to the diameter adjustment section or cone. Manholes which differ from the above description must be identified as “Manhole Structures" or “Doghouse Manholes.”

An internal drop manhole must be required when sewer lines enter a manhole more than 24 in. above the manhole invert, while an external drop manhole must be provided for a sewer entering a manhole more than 30 in. above the invert. Both conditions must require prior approval by the Engineer.

2.2.1. **Manhole Structures.** Cast in place concrete structures or pre-cast concrete structures, as shown on the plans, must be installed where any pipe intercepted is larger than 24 in. in diameter. All material and construction work must be in accordance with TCEQ rules to include: “Design Criteria for Sewerage Systems” (30 TAC § 217), or any revisions thereto as applicable. All structures must be watertight and coated with a City of Schertz-approved sewer coating.

2.2.2. **Doghouse Manholes.** Material for manholes must be as shown on the plans. All material and construction work must be in accordance with current TCEQ rules to include: “Design Criteria for Sewage Systems” (30 TCEQ § 217). All constructed manholes must be watertight and equipped with pre-tested and approved low leakage frames and lids. Sewer manhole ring and cover castings must meet the current requirements of AASHTO Designation M306-10.

The intent of the doghouse manhole is to construct the base of the manhole, cast in place, on existing sewer mains, to keep the main active during construction and reduce the time needed for bypass pumping. A section with a “doghouse” is to be installed on the base, unless otherwise shown on the construction documents, and remaining sections of manhole to be installed. All requirements of standard manholes are applicable to doghouse manholes. Testing requirements within the EARZ are the same as those for standard manholes, as described in the Specifications and the construction documents.

2.2.3. **Precast Reinforced Concrete Manhole Sections.** Precast reinforced concrete manhole sections must be in accordance with ASTM Designation C 478-12a.

2.2.4. **Manhole Ring and Cover.** The manhole ring and cover must be of ductile iron or gray cast iron construction. The cover must be solid with no vent or pick holes; hinged with underlying special hinge area leakage protection; the cover secured with four stainless steel bolts; and must have a recessed "pick bar" for cover opening. Cam lock type covers will not be allowed. Approved City of Schertz manufacturers have previously completed required inflow leakage shop testing and have met a maximum allowable leakage rate criterion of 1 gal. per minute at 12 in. of water submergence above the manhole cover. Rings and covers must be furnished from the City of Schertz approved manufacturers list with the specified features.

All covers must have the words "CITY OF SCHERTZ Sanitary Sewer" cast thereon. Ring and cover must have the specified foundry's name, part number, country of origin preceded by "Made in" (example: MADE IN USA) in compliance with the country-of-origin law of 1984, and production date (example: mm/dd/yy) for tracking purposes. Each casting must be marked with DI (ductile iron) and ASTM A 536 or A 536-80-55-06 or CI (cast iron) and ASTM A 48, Class 35B to verify the materials used. Castings without proper markings will be rejected.

Four bolts of 1/2 in. diameter x 13 thread pitch must be used to secure the cover. Bolts must be of stainless steel, grade 304 or better. The top of the cover must have a recessed area around each bolt assembly to accommodate the washer diameter and thickness and bolt head height so that the bolting assembly does not exceed the top of the manhole cover. Where cover bolts directly thread into the underlying cast iron frame, the bolt threads must be thoroughly coated with Nikal Jet Lube product, as manufactured by CSW Industrials Company or approved alternate before insertion to avoid subsequent "seize up" from dissimilar metals. If such bolts are removed for any purpose, the threads must be recoated. Stainless steel bolts that are threaded into stainless steel nuts within recessed slots in the underlying frame optionally do not require an anti-seize coating of the bolt threads.

2.2.5. **"Throat Rings."** "Throat rings" must be made of either HDPE or reinforced concrete and have a maximum thickness of 2 in. The internal diameter must match that of the ring and cover's opening. Concrete must be in accordance with the provisions of Concrete (Class "A"), Item No. 421, "Hydraulic Cement Concrete." If concrete "throat rings" are to be used, they must be used in conjunction with a UV stabilized polyethylene liner for the purpose of providing an infiltration or inflow (I/I) barrier. The I/I barrier must be as manufactured by Strike Tool Products of Cannon Falls, MN and must meet the following ASTM standards: ASTM D 790 for flexural properties; ASTM D 1505 for density; ASTM D 1238 for melt flow index; ASTM D 638 for tensile strength at yield (50mm/mm); ASTM D 790 for flexural modulus; ASTM D 648 for heat deflection temperature at IGEPAL; and ASTM D 693 for EsCR, 100% IGEPAL/10% IGEPAL. A minimum of two and a maximum of six "throat rings" may be used at each adjusted manhole. "Throat rings" are limited to a minimum of two and a maximum of four rings for new manhole construction.

2.2.6. **Bitumastic Joint Sealant.** To be applied between cones, risers, adjustment rings, flat tops, and between the ductile or gray cast iron ring (frame) and the uppermost adjustment ring or flat top: RAM-NEK, as manufactured by Henry, Inc.; Kent Seal, as manufactured by Hamilton Kent, Inc.; Encapseal, as manufactured by Miller Pipeline Corporation; or approved alternate.

2.2.7. **Interior Coating.** All manholes must be watertight and coated with a City of Schertz-approved sewer coating. Before coating, all manholes must be vacuum tested, and approved. For new and rehabilitated manholes, apply a combination of both products with the cementitious coating first, followed by the epoxy coating.

2.3. **Glass-Fiber Reinforced Polyester (FRP) Manholes.** This Item must govern the construction of FRP sanitary sewer manholes, and the materials therein, including manhole ring and covers. All material and construction work must be in accordance with current TCEQ rules to include: "Design Criteria for Sewage Systems" (30 TCEQ § 217), or any revisions thereto as applicable. All constructed FRP manholes must be watertight. Sewer manhole ring and cover castings, "throat rings", and miscellaneous specifications and details must meet the current requirements of AASHTO Designation M306-10 and "Manholes" section of this Specification.

All manholes must be watertight. Glass-Fiber Reinforced Polyester Manholes must be a one-piece monolithic designed unit constructed of glass-fiber reinforced, supplier-certified, unsaturated isophthalic polyester resin containing chemically enhanced silica to improve corrosion resistance, strength, and overall performance. FRP manholes must be manufactured in strict accordance with ASTM D 3753- 12.

For a UV inhibitor, the resin on the exterior surface of the manhole must have gray pigment added for at least a thickness of 0.125 in.

Manholes must be a circular cylinder, reduced at the top to a circular manway not smaller than 30 in. (inside diameter). Manholes must also be produced in whole foot increments of length ±2 in. Nominal inside diameter must be 48 in. Tolerance on the inside diameter must be ±1%. The minimum wall thickness for all FRP manholes (all depths) must be 0.50 in. Unless otherwise shown on the Contract documents or approved by the Engineer, standard sanitary sewer FRP manholes must be constructed on influent or effluent pipes less than 24 in. in diameter. The maximum vertical height of the diameter adjustment section or cone must be 36 in.

The manway reducer must provide a bearing surface on which a standard ring and cover may be supported and adjusted to grade. The reducer must be joined to the barrel section at the factory with resin and glass fiber reinforcement, thus providing the required monolithic design to prevent infiltration or exfiltration through the manhole.

Manholes must be manufactured in one class of load rating. This class must be AASHTO H-20 wheel load.

Several methods exist that may be used to connect primary and secondary lines to manholes, and these must be performed per the Engineer's request. The most common of these methods include: installation of SDR PVC sewer pipe stub-outs to the manhole, Kor-N-Seal boots, or Insert-a-Tee fittings in the manhole wall. Installation of SDR PVC sewer pipe must be performed by sanding, priming, and using resin fiber-reinforced hand lay-up. The resin and fiberglass must be the same type and grade as used in the fabrication of the fiberglass manhole. Kor-N-Seal boots may be installed by the manhole manufacturer using fiberglass reinforced pipe stub-out for Kor-N-Seal boot sealing surface. Insert-a-Tee fittings maybe installed only with the approval of the Engineer, and must be installed per the manufacturers' instructions.

Manholes are required to have a resin fiber-reinforced bottom. Deeper manholes (> 6 ft.) may require at least two 1 1/2 in. deep x 3 1/2 in. wide stiffening ribs, completely enclosed with resin fiber-reinforcement. All fiberglass manholes with a fiberglass bottom must have at least a 3 in. anti-flotation ring. Manhole bottoms must be at least 1/2 in. thick.

All manholes must be marked in letters at least 1 in. in height with the manufacturer's name or trademark, manufacturer's factory location, manufacturer's serial number, manhole length, ASTM designation, and installation assist marks (vertical lines 90 degrees apart at base of manhole).

Manhole ring and covers must be as described in these Specifications for new manholes.

Mortar must be composed of 1 part Portland Cement, 2 parts sand, and enough potable water to produce a working mixture.

All membrane curing compound must be in accordance with DMS-4650, "Hydraulic Cement Concrete Curing Materials and Evaporation Retardants."

2.4. **Existing Manhole Adjustments.** This Item will govern the adjustment of all existing manholes, to include the replacing of existing manhole covers and rings regardless of type shown on the Contract documents and in accordance with these Specifications or as directed. All material and construction work must be in accordance with current TCEQ rules to include: "Design Criteria for Sewage Systems" (30 TCEQ § 217), or any revision thereto as applicable. All manholes must be watertight and coated with a City of Schertz-approved sewer coating. The context of this Specification is limited to replacing the existing manhole ring and covers and adjusting the final elevation of the manhole by the maximum or minimum number of "throat rings."

All manholes requiring adjustments beyond the maximum or minimum number of “throat rings” (described herein) will be subject to reconstruction under the “Existing Manhole Reconstruction” section.

2.4.1. **Manhole Rings and Covers (if replaced).** As described in this Specification.

2.4.2. **Concrete “Throat Rings” (if needed).** As described in this Specification, including infiltration or inflow barrier.

2.4.3. **Bitumastic Joint Sealant.** As described in this Specification.

2.5. **Reconstruction of Existing Manholes.** This Item will consist of the reconstruction of all existing manholes, all types and sizes, to include the replacement of manhole ring and covers, the cones, manhole sections required regardless of type shown on the Contract documents and in accordance with these Specifications. All material and construction work must be in accordance with current TCEQ rules to include: “Design Criteria for Sewage Systems” (30 TCEQ § 217). All reconstructed manholes must be watertight and coated with a City of Schertz-approved sewer coating. Existing monolithic manholes are not to be reconstructed, but fully replaced with a new manhole in accordance with this Specification.

Materials used in manhole reconstruction (concrete, precast reinforced concrete manhole sections, grout, manhole ring and cover, “throat rings,” bitumastic joint sealant, and interior coating) must be per the requirements for new manholes described in this Section.

2.6. **Existing Manhole Adjustments.** This Item will govern the adjustment of all existing manholes, to include the replacing of existing manhole covers and rings regardless of type shown on the Contract documents and in accordance with these Specifications or as directed. All material and construction work must be in accordance with current TCEQ rules to include: “Design Criteria for Sewage Systems” (30 TCEQ § 217), or any revision thereto as applicable. All manholes must be watertight and coated with a City of Schertz-approved sewer coating. The context of this Specification is limited to adjusting the final elevation of the manhole by the maximum or minimum number of “throat rings”. Manhole rings and covers must be in accordance with these Specifications. Sewer manhole ring and cover castings must meet the current requirements of the AASHTO Designation M306-10. All manholes requiring adjustments beyond the maximum or minimum number of “throat rings” (described herein), will be subject to the requirements of “Existing Manhole Reconstruction.”

Manhole ring and covers must be replaced with new ring and covers under this Item. Concrete “throat rings” with liners, joint sealant, and other materials described under manholes in this Specification must be used as necessary to adjust the manholes.

2.7. **Reconstruction of Existing Manholes.** This Item will consist of the reconstruction of all existing manholes, all types and sizes, to include the replacement of manhole ring and covers, the cones, manhole sections required regardless of type shown in the Contract documents and in conformity with the provisions of these Specifications. All material and construction work must be in accordance with current TCEQ rules to include: Design Criteria for Sewage Systems (30 TCEQ § 217). All reconstructed manholes must be watertight and coated with a City of Schertz-approved sewer coating. Sewer manhole ring and cover castings must meet the current requirements of AASHTO Designation M306-10. Existing Monolithic Manholes are not to be reconstructed, but fully replaced.

Manhole ring and covers, cover gaskets, concrete “throat rings” with liners, joint sealant, interior coating, and other materials described under manholes in this Specification must be used as necessary in the reconstruction of existing manholes Item.

2.8. **Sanitary Sewer System Cleaning.** The Contractor must furnish all labor, equipment, and materials necessary for cleaning the sanitary sewer system, including the removal of all debris, solids, sand, grease, grit, rock, etc. from the sewer mains, manholes, or structures to facilitate television inspection.

2.8.1. **Preparation.** The Contractor must only use the type of cleaning identified in Article 4 of this Specification for “Cleaning Manholes and Mains” to perform the necessary removal of all material which must not create

hazards to health, property, affect downstream treatment plant processes, or damage to the sanitary sewer system.

2.9. **Concrete.** All concrete is to meet the requirements of Item 421, “Hydraulic Cement Concrete.” Unless otherwise shown on the plans or required by this Specification, all concrete must be Class A.

2.10. **Mortar.** Mortar must be composed of 1 part Portland Cement, 2 parts sand and enough water to produce a workable mixture. When used to plaster manholes, it may be composed of 1 part cement to 3 parts sand. Lime up to 10% may be used. It must have a consistency such that it can be easily handled and spread.

2.11. **Reinforcing Steel.** Reinforcing steel and the placing thereof is in accordance with the Specification, except where welded wire is as shown on the plans, the material must be welded wire flat sheets meeting ASTM A-185. Welded wire rolls must not be used.

2.12. **Cement Stabilized Backfill.** Cement stabilized backfill is to be in accordance with Item 400, “Excavation and Backfill for Structures.”

2.13. **Flowable Backfill.** When indicated on the plans, the trench is to be backfilled to the dimensions shown with flowable backfill. The flowable backfill with fly ash must be Mix Design Type B in accordance with Item 401, “Flowable Backfill,” or an acceptable mix as approved.

2.14. **Grout.** When shown on the plans for various applications, the grout is to be a cements, sand, and water mixture as approved. It must have a consistency such that it will flow into and completely fill all voids.

2.15. **Sewer Main Television Inspection.** The Contractor must furnish all labor, materials, equipment, and incidentals to provide the televising and a NASSCO-(PACP) standard video, recorded in MPEG-1 format and written to DVD video of sewer lines and manholes utilizing a color, closed-circuit television inspection unit to determine their condition. The video should include an inclinometer, visible on the video being viewed, noting the slope of the main being televised.

After completion of the work specified on the Contract documents, and before placement of the final course of asphalt or other final surface, the newly constructed or rehabilitated sanitary sewer main must be televised immediately upon cleaning. Televising must be observed by the Inspector or Engineer and Contractor, as the camera is run through the system. Any abnormalities such as, but not limited to, misaligned joints, cracked or defected pipe, rolled gaskets, must be repaired by the Contractor solely at his expense. Sections requiring repair must be re-televised to verify condition of repair. No additional compensation will be provided for all needed repairs, re-cleaning, or re-televising efforts.

The Contractor must provide a DVD and log of the televised system for review and approval by the Inspector. If the Contractor provides a DVD of such poor quality that it cannot be properly evaluated, the Contractor must re-televise as necessary and provide a DVD of good quality at no additional cost to City of Schertz. If the Contractor cannot provide a DVD of such good quality that can be reviewed by City of Schertz, City of Schertz may elect to televise the line at the Contractor's expense.

The television unit must also have the capability of displaying in color, on DVD, pipe inspection observations such as pipe defects, sags, points of root intrusion, offset joints, service connection locations, and any other relevant physical attributes. Each DVD must be permanently labeled with the following:

- project name,
- date of television inspection,
- station to station location and size of sanitary sewer,
- street or easement location,
- name of Contractor,
- Date DVD submitted,
- DVD number, and
- City of Schertz Inspector name.

The Contractor must provide a line diagram area sketch and written log for each completed segment of DVD sewer main describing the section being televised, flow and camera direction, position of service connections, description and location of failures, pipe condition, weather conditions, and other significant observations.

The television inspection equipment must have an accurate footage counter which displays on the monitor the exact distance of the camera from the center of the starting manhole. A camera with rotating and panning lens capabilities is required. The camera height should be centered in the conduit being televised. The speed of the camera through the conduit must not exceed 40 ft. per minute. The produced video must also have an inclinometer that displays the slope of the sewer main being televised.

The Contractor will be required to have all materials, equipment, and labor force necessary to complete all videotaping on the jobsite before isolating the sewer manhole segment and beginning videotaping operations.

Television inspection must be done one section between two manholes at a time. Also, the flow in the section being televised must be bypassed if the line is in service and the flow exceeds 25% of the internal pipe diameter. When the depth of flow at the upstream manhole of the manhole section being worked is above the maximum allowable for television inspection, the flow can be reduced to allowable levels by performing bypass pumping, as approved by the Inspector.

The Contractor will not be allowed to float the camera. There may be occasions during the televised inspection of a manhole section when the camera will be unable to pass an obstruction. At that time, and before proceeding, the Contractor must contact the Inspector. If the length of sewer line cannot be televised because of obstructions, the Contractor must clean the system as is necessary. If, in the opinion of the Inspector, the obstruction is attributed to a collapsed main or pipe deflection, televising must be suspended, payment must be made based on the actual televised length, and the remaining televising of the sewer line will be continued upon successful correction of the blockage by the Contractor at his expense. No additional payment will be made for additional setups required due to obstructions encountered during televising.

No lateral connections should be made to the sanitary sewer main at the 12 o'clock position. All lateral connections should clearly indicate which side of the sanitary sewer main in which it was installed.

The Contractor is solely responsible for any damage of sewer mains as a direct result of televising operations. Any repair will also be the responsibility of the Contractor.

The methods used for securing passage of the camera is at the discretion of the Contractor, and as approved by the Inspector.

No sanitary sewer main televising effort will commence until all pertinent permits or required approvals have been obtained by City of Schertz.

No separate or additional payment will be made for any excavation, man entry, or any other method which may be required to retrieve video equipment that may have been hung up, destroyed, or lost during the operation.

2.16. **Air Release Assemblies for Wastewater.** Valves furnished under this Specification must conform to ANSI and NSF Standard 60 for direct additives and ANSI and NSF Standard 61 for indirect additives. Cast iron valve body and cover must be in accordance with ASTM A 48-35 or ASTM A 126 class B. Non-metallic valve body must be fabricated from fiberglass reinforced nylon. Inlet sizes through 2 in. must be screwed National Pipe Thread Tapered (NPT). Pipe sizes 3" and above must have flanged inlets (125# ASNSI B 16.1). A protective hood or cowl must be installed on the outlet of flange-bodied valves.

Metallic internal seat trim float arm and pivot pin must be stainless steel type 303, 304, or 316. Metallic floats must be stainless steel ASTM A 240. Other stainless steel metal internal parts must be stainless steel ASTM A 240 or ASTM A 276.

Non-metallic floats must be foamed polyethylene with stainless steel type 316 fasteners.

Valves requiring internal seats or orifice buttons must be Buna-N rubber compounded for water service. For valves requiring cover gaskets, the cover gasket must be composition type, equal to Armstrong CS-231, Garlock 3000, or Lexide NK-511. If an O-Ring is used to seal the cover, it must be on NSF 61 certified rubber. Cover bolts must be alloy steel. Rolling seals must be furnished for non-metallic valves 2" and below.

Valve body must have a test pressure rating of 300 psi and working pressure rating of 150 psi.

The air release valve should be designed to vent accumulated air automatically. The outlet orifice must be properly sized to facilitate valve operation at pressures up to 150 psi. The air release valve must be simple-lever, compound-lever, ball and orifice, or rolling seal depending upon volume requirements and the design of the valve.

The air and vacuum valve should be designed with the inlet and outlet of equal cross-sectional area where applicable. The valve must be capable or automatically allowing large quantities of air to be exhausted during the filling cycle and also capable of automatically allowing air to re-enter the system to prevent a negative pressure at water column separation or during the draining cycle. The float must be guided to minimize premature closure by air and to provide proper alignment for normal closure by floating on the water surface.

Combination air and vacuum relief valves should provide for both automatic air release under system pressure and to allow air movement during filling or draining operations, or water column separation. The combination valve may be housed in a single casting. The housing must be designed to incorporate conventional or kinetic flow principles to properly vent the air without premature closure. Flange sizes (4 in. and larger) may be furnished in a dual housing. When dual casings are used a bronze manual isolation valve must be installed if indicated by the manufacturer. This will allow the air release valve to be serviced when the system is under pressure. Field service of the valve may also be performed by closing the isolation valve between the air valve and the pipe connection.

The City of Schertz may, at no cost to the manufacturer, subject random valves to testing by an independent laboratory for compliance with these standards. Any visible defect or failures to meet the quality standards herein will be grounds for rejecting the entire order.

The manufacturers must provide certification that products furnished under this Specification are manufactured in an ISO 9001 certified facility or documentation from an accredited facility that ISO 9001 certification is in process.

2.17. **Point Repairs & Obstruction Removals.** Repair of sanitary sewer lines by replacing short lengths of failed pipe with new pipe. Repair of service laterals located within the utility easement or street right of way, when replacing short lengths of failed pipe with new pipe. Obstruction removal by remote device or excavation. Use pipe material for repairs in accordance with “Sanitary Sewer Pipe” of this Specification. If point repair is located at a service connection, use a full-bodied fitting for the service connection. No field fabrication of fittings allowed. For joining to existing pipe, use flexible adapters secured with 1/2 in. stainless steel bands, as manufactured by Fernco, or approved equal. All flexible adapters must be concrete encased to prevent movement or breakage of the steel bands.

2.18. **Rehabilitation of Sanitary Sewer by Cured-In-Place Pipe (CIPP) (Hot Water or Steam Cured).** This Specification includes requirements to rehabilitate existing sanitary sewers by the installation of a resin-impregnated flexible tube, which is formed to the original conduit. The lining is inserted via an existing manhole or other access and, depending on the system selected, is installed using one of the following insertion methods:

- Water inversion—where the lining is inverted under the pressure of water and cured by circulating hot water.
- Winched insertion—where the lining is winched into place and inflated against the sewer wall by either a removable bladder inverted into the lining under the pressure of water or a pre-positioned bladder, which is simply inflated. Curing is accomplished using circulated hot water.

- Air inversion—where the lining is inverted under the pressure of air and cured by introducing steam.

2.18.1. **Tube.** The tube must consist of one or more layers of absorbent needled felt fabric or an equivalent non-woven or woven material, or a combination thereof which meets the requirements of ASTM F 1216 or ASTM F 1743, Section 5. The tube must be constructed to withstand installation pressures and curing temperatures, have enough strength to bridge missing pipe, and stretch to fit irregular pipe sections.

The impregnated tube must have a uniform and homogenous thickness that when compressed at installation pressures must meet or exceed the design thickness.

The tube must be sized that, when installed, must tightly fit the internal circumference and length of the original pipe. Allowance should be made for circumferential stretching during inversion.

The outside layer of the tube (before wet out) must be coated with an impermeable, flexible membrane that must contain the resin and facilitate monitoring of resin saturation during the resin impregnation (wet out) procedure.

The tube must be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. No material should be included in the tube that may cause delamination in the cured CIPP. No dry or unsaturated layers should be evident.

The wall color of the interior pipe surface of CIPP after installation should be a light reflective color so that a clear detailed examination with closed-circuit television inspection equipment may be made.

Seams in the tube must be stronger than the un-seamed felt and meet the requirements of ASTM D 5813.

The outside of the tube must be marked for distance at regular intervals along its entire length, not to exceed 5 ft. Such markings must include the manufacturer's name or identifying symbol. The tubes must be manufactured in the USA.

2.18.2. **Resin.** The resin system must be a corrosion-resistant polyester, vinyl ester, or epoxy and catalyst system. When properly cured, the tube composite meets the requirements of ASTM F 1216, ASTM F 1743 and ASTM F 2019, the physical properties herein, and those that are to be used in the design of the CIPP for this project. The resin must produce CIPP that must comply with the structural and chemical resistance requirements of this Specification.

2.18.3. **Structural Requirements.** The CIPP must be designed as per ASTM F 1216, Appendix X1. The CIPP design should assume no bonding to the original pipe wall.

The Contractor must have performed long-term testing for flexural creep of the CIPP pipe material installed by his company. Such testing results are to be used to determine the long-term, time-dependent flexural modulus to be used in the product design. This is a performance test of the materials (tube and resin) and general workmanship of the installation and curing. A percentage of the instantaneous flexural modulus value (as measured by ASTM D 790 testing) must be used in design calculations for external buckling. The percentage, or the long- term creep retention value used, must be verified by this testing. Values in excess of 50% will not be applied unless substantiated by qualified third party test data. The materials used for the Contracted project must be of a quality equal to or better than the materials used in the long-term test with respect to the initial flexural modulus used in design.

The layers of the cured CIPP must be uniformly bonded. It must not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly, or the probe or knife blade moves freely between the layers. If separation of the layers occurs during testing of field samples, new samples must be cut from the work. Any reoccurrence may cause rejection of the work.

The CIPP must be classified as conforming to the following minimum structural properties for a cured composite:

- modulus of elasticity (per ASTM D 790-short term): 250,000 psi,
- flexural strength (per ASTM D 790): 4,500 psi,
- compressive strength (per ASTM D 695): 6,500 psi, and
- Tensile strength (per ASTM D 638): 3,500 psi.

The required structural wall thickness must be based as a minimum on the physical properties listed above, the design equations in ASTM F 1216, Appendix X1 (as referenced by ASTM F 2019), and the following design parameters:

- pipe condition: fully deteriorated,
- minimum design safety factor: 2.0,
- percentage ovality of original pipe: 2.0%,
- soil density: 120 lbs. per cf,
- traffic loads: HS-20-44 per AASHTO highway loading,
- soil modulus: 500 psi,
- Groundwater depth must be ground surface at a minimum or the elevation of the 100-year floodplain water surface, whichever is greater, to account for all reasonable anticipated future loadings,
- long term flexural modulus retention: 50%,
- soil depth: maximum distance in feet measured between the crown of the pipe and the highest point of soil cover over the length of continuous CIPP section, and
- The liner must be designed for a minimum fifty-year service life under continuous loading conditions.

Contractor must submit design calculations in accordance with ASTM F1216 that substantiate the CIPP wall thickness for each continuous length of CIPP installed. The required CIPP wall thickness must be uniform from CIPP start point to CIPP finish point with no deviation in thickness.

2.19. **By-Pass Pumping—Small Diameter Sanitary Sewers.** The work covered by this Item consists of bypass pumping operations for existing sanitary sewers less than 24 in. in diameter to temporarily reroute sanitary sewer flows to prevent a sanitary sewage overflow (SSO) and to provide adequate and reliable sanitary sewer flow at all times during construction, while the tasked scope of work is executed. The work also covered in this Item is for the use of inflatable and mechanical pipe plugs. The use of inflatable or mechanical plugs in the water and sewer industry is the standard method to temporarily plug a pipe where permanent flow control devices are not available or are not operating as designed. An inherent danger exists with all inflatable products. If any conditions with this equipment exist that may jeopardize the safety of workers or others, do not use it.

This Item includes all requirements for implementing a temporary pumping system for the purpose of diverting sanitary sewage flow around any construction-related activity to an approved reintroduction point within the sanitary sewer system. The Contractor must minimize the health, safety, and regulatory risks by taking all reasonable measures to avoid an SSO. Therefore, City of Schertz requires the Contractor to manage the flow of wastewater in a planned and proactive manner. Contractor will be fully responsible for all damages and costs related to the installation, modification of existing manholes or structures, operation, and maintenance of Contractor's bypass pumping operations including damages, clean up, fines, penalties, and other related costs.

Bypass pumping systems must be stationary systems consisting of portable pumps, piping, and appurtenances unless a "pump and haul" bypass system is accepted by City of Schertz. Pump and haul bypass systems can use a relay system of vacuum trucks using a pump and haul approach to bypass sewage flows. Where pump and haul bypass systems are allowed the Contractor may elect to submit using a pump and haul bypass system for these locations or to use a stationary bypass system. All bypass systems must comply with all the requirements of this section unless specifically noted otherwise.

The Contractor will be responsible for the design of the bypass pumping plan and system. Contractor's bypass pumping system design must be developed based upon the requirements of the Contract Documents.

The bypass system must meet the requirements of all codes and regulatory agencies with jurisdiction

Pump and haul bypass systems must not be allowed within the Edwards Aquifer Recharge Zone (EARZ) or for larger sanitary sewers with significant sewage bypass flows. Contractor must provide for temporary measures to convey sewage flows and avoid sewage spills should a storm event occur that generates sanitary sewer flows in excess of Contractor's bypass pumping system.

2.19.1. **Submittals.** All submittals must be in conformance with owner's requirements and must be acknowledged by owner before delivery.

For all projects requiring bypass pumping, the Contractor must prepare and submit a Bypass Pumping Plan (BPP). The BPP must be submitted at least two weeks before commencing any portion of the proposed scope of work and must be acknowledged by City of Schertz before beginning work. The BPP must be signed and sealed by a Professional Engineer licensed in the State of Texas (Contractor's Engineer).

Contractor must submit manufacturer's product data, instructions, recommendations, shop drawings, and necessary certifications for the proposed BPP to be reviewed and acknowledged.

The following must be submitted as part of the BPP:

- A cover letter containing the following information:
  - the project name and job number;
  - the name and address of the Contractor;
  - contact information of the Contractor's project manager, superintendent, foreman or supervisor, safety professional, etc.;
  - a description and location of the planned bypass pumping work to be performed; and
  - include data for stationery and pump and haul bypass systems as applicable.
- Emergency (24/7) contact information for the bypass pumping Sub-Contractor, if applicable. Make sure to include the name, cell phone number, and title of the persons onsite responsible for the bypass pumping operation.
- The name, phone number, title, signature, and PE seal of the Contractor's Engineer preparing the BPP.
- Copies of permits or other documents showing the Contractor has obtained all clearances necessary for installation and operation of the BPP.
- If Contractor elects to use a combination of stationary bypass pumping and pump and haul for his bypass system, Contractor's BPP must identify the quantity of flows that will be pumped and pumped and hauled for each type of bypass system along with the points where flows will be removed and reintroduced into the sanitary sewer system.
- Certificate of compliance that the BPP complies with all City of Schertz and regulatory requirements and that all components have been designed by a Professional Engineer licensed in the State of Texas. The Contractor's Engineer must review all components of the submitted BPP for adequacy to the Contractor's selected design flow conditions and ensure that all bypass pumping system components are of adequate size, strength, and meet the reliability criteria specified herein.
- A description of the maximum amount of sanitary sewer flows to be bypassed by the Contractor's bypass pumping system and how the flow conditions must be monitored during system operations (including all flow measurement devices, calculations, equipment, or other sources of how data was obtained). If the bypass plan is not based on the maximum wet weather flow in the sanitary sewer, this description must include an explanation for how the Contractor plans to monitor the weather for potential flows exceeding his bypass system capacity and how he must avoid having to bypass during wet weather events exceeding his bypass system capacity.

- Descriptions of all proposed bypass pumping components to be used. If applicable, describe all different bypass pumping phases. Include bypass pumps sizes and capacity, as well as the sizes and capacity of the suction or discharge piping. The description should also include manholes or structures depths and sizes that will be used during the bypass pumping operation, sanitary sewer plugging method, type of plugs to be used, and flowmeter installation locations, etc. Contractor must provide City of Schertz with adequate prior notification to allow City of Schertz to witness installation and removal of all plugs.
- The date and time the bypass pumping is expected to begin and be completed. Indicate if bypass pumping will take place outside normal work hours, which are between 8 A.M. to 5 P.M. Mondays through Fridays (except for City of Schertz observed holidays). Contractor must reimburse City of Schertz for the overtime costs required by his bypass pumping testing outside of City of Schertz normal work hours.
- The pump curves, showing operating range. This must include the proposed system curve, addressing the pump operation in relation to the suction or discharge piping's alignment with respect to restriction or elevations.
- Suction and discharge piping materials and capacity to be used for the bypass pumping operation, including the materials for any bends and valves that will be used.
- A sketch showing the location of the pumps and the route of the suction, and discharge piping. If Contractor elects to use locations outside of the easements obtained by City of Schertz, Contractor will be solely responsible for obtaining the required easements and written documentation required for use of these locations. The sketch should be dimensioned and all-inclusive, showing all City of Schertz manhole numbers that will be used for suction and discharge operations. If any other structure will be used for suction or discharge operations, then the nearest manholes should be labeled. The sketch should include the name of any streets or major intersection in the area. All features possibly affected by the alignment of the BPP's components (driveways, vehicular traffic, residential or commercial dwellings due to noise) should likewise be addressed. For pump and haul systems, the sketch should show the location of all system components along with the staging areas, haul routes, and an explanation of the expected cycle time of all aspects of the operation.
- Clear photographs of the manholes interior that will be used for the bypass pumping operation, including pole camera photographs of pipes where plugs must be installed. All photographs must be labeled with the manhole number, date, and intended use of the manhole by the Contractor's BPP.
- A traffic control plan that pertains solely to the bypass pumping operations. This may differ than the project's traffic control plan for the overall scope of work. The traffic control plan should include all required permits including street cut permits. Contractor must maintain pedestrian and vehicular traffic and comply with ADA regulations for access to all residential and commercial property unless written approval is otherwise obtained from the property owner allowing for reduced access.
- An emergency plan detailing procedures to be followed in the event any portion of the bypass operation fails and causes either surcharging or an actual SSO. Contractor is herein advised that:
    - The existing sanitary sewer system may surcharge during certain storm events. The Contractor's BPP must recognize this potential and accommodate it with enough bypass capacity, restoration of flow through the sanitary sewer system, or other measures acceptable to City of Schertz during these flow events. These measures must be included in the submitted BPP.
    - The Contractor's BPP cannot cause any excess surcharging (beyond that normally occurring within the existing sanitary sewer system at that flow event) that results in damage or SSOs.
    - Any damage or SSOs during bypass pumping operations resulting from Contractor's bypass system will be deemed a failure of BPP, and the Contractor must re-propose an improvement to their BPP for review and acknowledgment. A sanitary sewer surcharge is herein defined as any flows entering the manhole or structure (above the crown of the pipe). Excessive sanitary sewer surcharges are higher than normally occurring levels of surcharge levels resulting from the Contractor's BPP that result in damage or SSOs. Contractor will be fully responsible for all

damages and costs related to the installation, operation, and maintenance of Contractor's bypass pumping operations including damages, clean up, fines, penalties, and other related costs.
    - Contractor to include minimum equipment on hand for implementing and emergency plan. (i.e., spare pump, emergency power source.)
- Where bypass piping is installed within the floodplain of waterways subject to flooding, the Contractor must submit an anchorage plan and calculations to ensure that piping is properly anchored. The pipe must be capable of remaining in place during a 100-year storm event. Anchorage plan and calculations must be designed and sealed by a Professional Engineer licensed in the State of Texas (Contractor's Engineer). This must be the same PE that sealed the BPP Certificate of Compliance.
- For pump and haul system, submit copy of Hauler's Transporter Registration as issued by TCEQ under 30 TAC Chapter 312, Subchapter G.
- For pump and haul system, submit information on licensed disposal site to be used by the Contractor
- Submit the checklist found at the end of this document confirming that all Items required by this section are included in the BPP submittal.

2.19.2. **Equipment & Materials.** The Contractor must provide all necessary pumping equipment, piping, and all other necessary appurtenances to maintain adequate and reliable sanitary sewer flow in the sanitary sewer system (including any temporary manholes) at all times during construction for stationary pumping and pump and haul bypass pumping systems. All materials, equipment, etc., must be in good condition, and should not have visible damage such as cracks, holes, foreign material, blisters, etc.

Plugs must be selected and installed according to the size of the line to be plugged. Plugs must be adequately secured and anchored to prevent plug movement or escape into the adjoining sanitary sewers should the plug fail. An additional plug (for each size of plug used) must be onsite and ready to be installed in the event a plug fails or becomes dislodged. Plugs must be visually examined by the Inspector or Engineer for defects that might lead to failure before being installed. Contractor must immediately locate and remove any plug that has shifted its position, slipped within the pipe, dislodged, moved, or otherwise provided an indication that its suitability for use in plugging may be suspect or compromised. Contractor must notify City of Schertz of any plug that has provided an indication that its suitability for use in plugging may be suspect or compromised and allow City of Schertz to observe plug removal and replacement. It is also imperative that the Contractor notify the Inspector at the completion of the work to verify that all plugs have been removed from the system.

- The Contractor must provide all necessary equipment, plugs, hoses, gauges, and necessary appurtenances to install the plug, maintain the plug during use and remove the plug at completion.
- All plugs must be in good condition, and must not have visible damage such as cracks, holes, tears, cuts, punctures, abrasions, loose or damaged fittings, cracks in castings and excessive wear.
- All plugs 15 in. and larger must have an air release valve for rupture protection.
- If the plug is damaged, it must be immediately removed from the jobsite.
- Contractor must be aware of the limitations associated with plugs.

Stationary bypass pumping systems must consist of:

- HDPE is the preferred pipe material for all bypass piping. HDPE must be used when bypass discharge pipe will be going through streams, storm water culverts, the Edward's Aquifer Recharge Zone, or environmentally sensitive areas. At other locations, not within the Edward's Aquifer Recharge Zone, flexible discharge hose that is in good condition and does not leak, may be allowed subject to it acceptably passing testing.
- HDPE pipe must be assembled and joined using couplings, flanges, or fusion welding to avoid joint leakage.
- HDPE fusion welding must be performed by personnel certified as fusion technicians by the manufacturer of HDPE pipe or fusing equipment. City of Schertz must examine welds before use in BPP operation.
- BPP must indicate the proposed DR of the pipe to be used.

- Rigid suction hose that is in good condition and does not leak may be allowed for withdrawal of flows from the suction point into the bypass pumps. Pipe material other than HDPE must be submitted to City of Schertz for approval. Neither “irrigation type” pipe nor glued PVC pipe must be permitted.
- Any hoses or pipes that leak must be removed and replaced with non-leaking hoses or pipes.
- Pumps must be fully automatic self-priming units that do not require the use of foot valves or vacuum pumps to prime the system. No electric pumps must be allowed; all pumps must be diesel powered. Contractor must provide suitable spill control and containment measures to avoid environmental contamination by pumps, fuels, or lubricants. All pumps must be open impeller solids handling type pumps, capable of passing at least 3 in. diameter solids. Contractor must have one backup pump, equal in capacity to the largest pump in the system, connected into the bypass pumping system, and ready for operation in case any of the primary pumps fail. The backup pump must not be used in Contractor’s calculations for determining the pumping capacity requirements for the stated flow conditions above. Sound-attenuated pump enclosures must be required on all projects where the bypass pumps are located within 50 ft. of any residence, business, park, or other presence of people. Contractor must provide enough sound attention measures to comply with City of San Antonio noise limitation requirements.

Pump and haul bypass pumping systems must use good-quality vacuum trucks, equipment, and materials from manufacturers commonly engaged in the manufacture, service, and repair of these types of sanitary sewer service trucks and equipment. All equipment must be designed and manufactured for sanitary sewer service, must function acceptably, be reliable, and free from leaks or other deleterious environmental impacts. All equipment proposed for use in pump and haul bypass pumping must have been maintained per the manufacture’s recommendations. Equipment service records must be made available at City of Schertz request. Any hoses or pipes that leak must be removed and replaced with non-leaking hoses or pipes.

2.20. **Bypass Pumping-Large Diameter Sanitary Sewers.** The work covered by this Item consists of bypass pumping operations for existing sanitary sewers 24 in. and larger in diameter to temporarily reroute sanitary sewer flows to prevent a SSO and to provide adequate and reliable sanitary sewer flow at all times during construction, while the tasked scope of work is executed. The work also covered in this Item is for the use of inflatable and mechanical pipe plugs. The use of inflatable or mechanical plugs in the water and sewer industry is the standard method to temporarily plug a pipe where permanent flow control devices are not available or are not operating as designed. An inherent danger exists with all inflatable products. If any conditions with this equipment exist that may jeopardize the safety of workers or others, do not use it.

This Item includes all requirements for implementing a temporary pumping system for the purpose of diverting sanitary sewage flow around any construction-related activity to an approved reintroduction point within the sanitary sewer system. The Contractor must minimize the health, safety, and regulatory risks by taking all reasonable measures to avoid an SSO. Therefore, City of Schertz requires the Contractor to manage the flow of wastewater in a planned and proactive manner. Contractor will be fully responsible for all damages and costs related to the installation, modification of existing manhole or structures, operation, and maintenance of Contractor’s bypass pumping operations including damages, clean up, fines, penalties, and other related costs.

Bypass pumping systems must be stationary systems consisting of portable pumps, piping, and appurtenances unless a flow diversion bypass system is allowed on the BPP sheet. Flow diversion bypass systems can use temporary gravity sewers (installed and removed by Contractor) to divert flows into an existing manhole identified in the BPP sheet. Where flow diversion bypass systems are allowed, the Contractor may elect to submit using a flow diversion bypass system for these locations or to use a stationary bypass system. All bypass systems must comply with all the requirements of this section unless specifically noted otherwise.

The Contractor will be responsible for the design of Contractor’s BPP and system. Contractor’s bypass pumping system design must be developed based upon the data and requirements of the Contract Documents. The bypass system must meet the requirements of all codes and regulatory agencies with

jurisdiction. City of Schertz will furnish data on the BPP sheet which must include average daily flows and maximum peak flows.

Contractor may rely upon the data provided in the Contract documents for designing Contractor's bypass pumping system. Contractor must provide for temporary measures to convey sewage flows and avoid sewage spills should a storm event occur that generates sanitary sewer flows in excess of Contractor's bypass pumping system. Contractor to include an emergency response plan in submittals. Plan should include measures for handling excess flows due to storm events. Plan needs to include additional emergency equipment, diversion plans, and what measures will be taken to handle excess flows.

2.20.1. **Submittals.** All submittals must be in conformance with owner's requirements and must be acknowledged by owner before delivery.

For all projects requiring bypass pumping, the Contractor must prepare and submit a BPP. The BPP must be submitted at least two weeks before commencing any portion of the proposed scope of work and must be acknowledged and accepted by City of Schertz before beginning work. The BPP must be signed and sealed by a Professional Engineer licensed in the State of Texas (Contractor's Engineer).

Contractor must submit manufacturer's product data, instructions, recommendations, shop drawings, and necessary certifications for the proposed BPP to be reviewed and acknowledged.

The following must be submitted as part of the BPP:

- A cover letter containing the following information:
  - the project name and job number,
  - the name and address of the Contractor,
  - contact information of the Contractor's project manager, superintendent, foreman or supervisor, safety professional, etc.,
  - a description and location of the planned bypass pumping work to be performed, and
  - include data for stationery and flow diversion bypass systems as applicable.
- Emergency (24/7) contact information for the bypass pumping sub-Contractor, if applicable. Make sure to include the name, cell phone number, and title of the persons' onsite responsible for the bypass pumping operation.
- The name, phone number, title, signature, and PE seal of the Contractor's Engineer preparing the BPP.
- Copies of permits or other documents showing the Contractor has obtained all clearances necessary for installation and operation of the BPP.
- If flow diversion to existing sewers is proposed by Contractor, all diversion flows must be contained within pipes, and use of excavated trenches is not allowable for diverting sanitary sewer flows.
- If Contractor elects to use a combination of stationary bypass pumping and flow diversion for his bypass system, Contractor's BPP must identify the quantity of flows that will be pumped and flows diverted for each type of bypass system along with the points where flows must be removed and reintroduced into the sanitary sewer system.
- Certificate of compliance that the BPP complies with all City of Schertz and regulatory requirements and that all components have been designed by a Professional Engineer licensed in the State of Texas. The Contractor's Engineer must review all components of the submitted BPP for adequacy to the Contractor's selected design flow conditions and ensure that all bypass pumping system components are of adequate size, strength, and meet the reliability criteria specified herein.
- A description of the maximum amount of sanitary sewer flows to be bypassed by the Contractor's bypass pumping system and how the flow conditions must be monitored during system operations (including all flow measurement devices, calculations, equipment, or other sources of how data was obtained). If the bypass plan is not based on the maximum wet weather flow in the sanitary sewer, this description must include an explanation for how the Contractor plans to monitor the weather for potential

flows exceeding his bypass system capacity and how he must avoid having to bypass during wet weather events exceeding his bypass system capacity.

- Descriptions of all proposed bypass pumping components to be used. If applicable, describe all different bypass pumping phases. Include bypass pumps sizes and capacity, as well as the sizes and capacity of the suction or discharge piping. The description must also include manholes and structures depths and sizes that will be used during the bypass pumping operation, sanitary sewer plugging method and type of plugs to be used, flowmeter installation locations, etc. Where plugs greater than 24 in. are required, submit a plug use plan (PUP) according to the requirements of Special Provision to this section. Contractor must provide City of Schertz with adequate prior notification to allow City of Schertz to witness installation and removal of all plugs.
- Description of procedure for locating and recovering any lost plug using the required radio transmitter and receiver system.
- Description of minimum equipment on hand should an emergency plan be implemented, i.e., spare pump, emergency generator.
- The date and time the bypass pumping is expected to begin and be completed. Indicate if bypass pumping will take place outside normal work hours which are between 8 A.M. to 5 P.M. Mondays through Fridays (except for City of Schertz observed holidays).
- The pump curves, showing operating range. This must include the proposed system curve, addressing the pump operation in relation to the suction or discharge piping's alignment with respect to restriction or elevations.
- Suction, discharge, and diversion piping materials and capacity are to be used for the bypass pumping operation, including the materials for any bends and valves that will be used.
- A sketch showing the location of the pumps and the route of the suction, discharge, and diversion piping. If Contractor elects to use locations outside of the easements obtained by City of Schertz or locations that are not indicated for use on the BPP plan sheet, Contractor will be solely responsible for obtaining the required easements and written documentation required for use of these locations, and a copy must be provided to City of Schertz before Contractor's use. A sketch detailing proposed restoration of the suction and discharge points if the Contractor proposed to make openings in the existing pipes or structures.
- If different than shown in Contract documents, the new sketch must be dimensioned and all-inclusive showing all City of Schertz manhole numbers that will be used for suction and discharge operations. If any other structure must be used for suction or discharge operations, then the nearest manholes must be labeled. The sketch must include the name of any streets or major intersection in the area. All features possibly affected by the alignment of the BPP's components (driveways, vehicular traffic, residential or commercial dwellings (due to noise) must likewise be addressed.
- Clear photographs of the manholes interior that will be used for the bypass pumping operation, including pole camera photographs of pipes where plugs will be installed. All photographs must be labeled with the manhole number, date, and intended use of the manhole by the Contractor's BPP.
- A traffic control plan that pertains solely to the bypass pumping operations. This may differ than the project's traffic control plan for the overall scope of work. The traffic control plan must include all required permits including street cut permits. Contractor must maintain pedestrian and vehicular traffic and comply with ADA regulations for access to all residential and commercial property unless written approval is otherwise obtained from the property owner allowing for reduced access.
- An emergency plan detailing procedures to be followed in the event any portion of the bypass operation fails and causes either surcharging or an actual SSO. Contractor is herein advised that:
    - The existing sanitary sewer system may surcharge during certain storm events. The Contractor's BPP must recognize this potential and accommodate it with enough bypass capacity, restoration of flow through the sanitary sewer system, or other measures acceptable to City of Schertz during these flow events. These measures must be included in the submitted BPP.

- The Contractor's BPP cannot cause any excess surcharging (beyond that normally occurring within the existing sanitary sewer system at that flow event) that results in damage or SSOs.
- Any damage or SSOs during bypass pumping operations resulting from Contractor's bypass system must be deemed a failure of BPP, and the Contractor must re-propose an improvement to their BPP for review and acknowledgment. A sanitary sewer surcharge is herein defined as any flows entering the manhole or structure (above the crown of the pipe). Excessive sanitary sewer surcharges are higher than normally occurring levels of surcharge levels resulting from the Contractor's BPP that result in damage or SSOs. Contractor will be fully responsible for all damages and costs related to the installation, operation, and maintenance of Contractor's bypass pumping operations including damages, clean up, fines, penalties, and other related costs.

■ Where bypass piping is installed within the floodplain of waterways subject to flooding, the Contractor must submit an anchorage plan and calculations to ensure that piping is properly anchored. The pipe must be capable of remaining in place during a 100-year storm event. Anchorage plan and calculations must be designed and sealed by a Professional Engineer licensed in the State of Texas (Contractor's Engineer). This must be the same PE that sealed the BPP certificate of compliance.

■ Submit the checklist found at the end of this document, confirming that all Items required by this section are included in the BPP submittal.

For all projects requiring the use of pipe plugs on pipes, the Contractor must furnish a submittal containing manufacturer's product data, instructions, recommendations, and a project PUP. The PUP must be submitted at least two weeks before commencing any portion of the proposed scope of work.

The following must be submitted with the PUP:

■ A cover letter containing the following information:
- the project name and job number,
- the name and address of the Contractor,
- contact information of the Contractor's project manager, superintendent, foreman or supervisor, safety professional, etc.
- emergency (24/7) contact information for the staff responsible for operating and maintaining the plug.
- Include the name, phone number, email address and the persons' onsite who is responsible for the project.
- The name and contact information for the PUP preparer.

■ Plug plan that must show where on the project site the Contractor intends to use pipe plugs, including the following information:
- manhole numbers,
- the upstream and downstream pipe diameters and pipe materials,
- pipe slopes, pipe depth,
- pipe flow direction,
- known peak or surcharge flow data,
- types of plugs to be used,
- types of restraint used, and
- type of radio transmitting device.

■ Provide calculations of the maximum anticipated head pressure on the plug and the resultant tensile force required to restrain the plug before plug inflation and during plug removal. Provide calculations of the required inflation pressure of the plug. Calculations must be sealed and signed by a Professional Engineer licensed in the State of Texas in civil or mechanical engineering.

■ Detail the plug selection for each installation including given conditions, pipe size, and anticipated pressure requirements. Include in this plan whether sleeves will be used.

- Provide an inspection form detailing manufacturer's recommendations for plug inspection of plug condition before and after use; form to be signed by Contractor staff responsible for plug installation before and after plug installation.
- Provide a monitoring plan for observing the plug inflation pressure gauge and hoses. Monitoring must be for 24 hr. per day during the plug use duration. Provide a written response plan for when the plug loses pressure. Provide a plug retrieval plan.
- Provide means and methods for anchoring, support, and bracing appropriate for anticipated operating pressure conditions. Size restraint (cable or chain) based on calculated loads using a safety factor of 4. Provide multiple tie-off locations for chain or wire cable restraint. Rope of any kind is not an acceptable material for plug restraint.
- Provide manufacturer's literature on proper plug use and safety precautions, including available on-line training.

2.20.2. **Equipment and Materials.** The Contractor must provide all necessary pumping equipment, piping, and all other necessary appurtenances to maintain adequate and reliable sanitary sewer flow in the sanitary sewer system (including any temporary manholes) at all times during construction for stationary pumping and flow diversion bypass pumping systems. All materials, equipment, etc., must be in good condition, and should not have visible damage such as cracks, holes, foreign material, blisters, etc.

Plugs must be selected and installed according to the size of the line to be plugged. Plugs must be adequately secured and anchored to prevent plug movement or escape into the adjoining sanitary sewers should the plug fail. All plugs must be equipped with a radio transmitter that will be used to locate any plug that has escaped in the adjacent system. The radio transmitter must be designed for the environment that it will be installed. The Contractor must also provide and keep onsite the matching radio receiver that will be used to locate any plug that is lost in the adjacent system.

An additional plug (for each size of plug used) must be onsite and ready to be installed in the event a plug fails or becomes dislodged. Plugs must be reviewed by the Inspector or Engineer for defects that might lead to failure before being installed. Contractor must immediately locate and remove any plug that has shifted its position, slipped within the pipe, dislodged, moved, or otherwise provided an indication that its suitability for use in plugging may be suspect or compromised. Contractor must notify City of Schertz of any plug that has provided an indication that its suitability for use in plugging may be suspect or compromised and allow City of Schertz to observe plug removal and replacement. It is also imperative that the Contractor notify the Inspector at the completion of the work to verify that all plugs have been removed from the system.

- The Contractor must provide all necessary equipment, plugs, hoses, gauges, and necessary appurtenances to install the plug, maintain the plug during use, and remove the plug at completion.
- All plugs must be in good condition, and must not have visible damage such as cracks, holes, tears, cuts, punctures, abrasions, loose or damaged fittings, cracks in castings, and excessive wear.
- All plugs 15 in. and larger must have an air release valve for rupture protection.
- All plugs 24 in. in diameter and larger must be equipped with a radio transmitter locating device that is activated by the plug losing air pressure. The locating transmitter device must be effective to a depth of 65 ft. and have a battery life of 1,000 hr. when operated in pulse mode after activation.
- All plugs 24 in. in diameter and larger must have a protective sleeve.
- If the plug is damaged, do not use the plug and remove it from the jobsite.
- Contractor must be aware of the limitations associated with plugs.

Stationary bypass pumping systems must consist of:

- HDPE is the required pipe material for all bypass piping. HDPE must be used when bypass discharge pipe will be going through streams, storm water culverts, the Edward's Aquifer Recharge Zone, environmentally sensitive areas, and all other locations.

- HDPE pipe must be assembled and joined using couplings, flanges, or fusion welding to avoid joint leakage. City of Schertz must be notified in enough time to allow them to inspect the pipe joints during assembly. City of Schertz must be notified at least 48 hr. in advance of all fusing and joining operations
- HDPE fusion welding must be performed by personnel certified as fusion technicians by the manufacturer of HDPE pipe or fusing equipment. City of Schertz must examine welds before use in BPP operation.
- BPP must indicate the proposed DR of the pipe to be used.
- Any hoses or pipes that leak must be removed and replaced with non-leaking hoses or pipes.
- Neither "irrigation type" pipe nor glued PVC pipe will be permitted.
- Disinfect and drain the entire BPP system in conformance with approved submittal.
- Pumps must be fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps to prime the system. No electric pumps will be allowed; all pumps must be diesel powered.
- Contractor must provide suitable spill control and containment measures to avoid environmental contamination by pumps, fuels, or lubricants. All pumps must be open-impeller, solids-handling type pumps, capable of passing at least 3 in. diameter solids. Contractor must have one backup pump, equal in capacity to the largest pump in the system, connected into the bypass pumping system, and ready for operation in case any of the primary pumps fail. The backup pump must not be used in Contractor's calculations for determining the pumping capacity requirements for the stated flow conditions above. Sound-attenuated pump enclosures must be required on all projects where the bypass pumps are located within 50 ft. of any residence, business, park, or other presence of people. Contractor must provide enough sound attenuation measures to comply with City of San Antonio noise limitation requirements.

2.21. **Reconstruction of Sanitary Sewer by Pipe Bursting Replacement Process.** The pipe bursting process involves the replacement of deteriorated gravity sewer pipe by installing a new sanitary sewer pipe within the burst or enlarged excavation of the existing sewer created using a static, hydraulic, or pneumatic hammer bursting head device, suitably sized to break the existing sewer main. Forward progress of the bursting head is aided by hydraulic equipment or other apparatus. The new replacement pipe is attached to the back of the bursting head and is pulled into the excavation during the bursting process. The Contractor must provide equipment, planning, and job execution necessary to accomplish the work in an efficient manner and consistent with the objectives of these Specifications, including preventing damage to existing infrastructure, maintaining pedestrian and vehicular access, and providing continual sewer service to customers.

2.21.1. **High Density Polyethylene Pipe (HDPE).** HDPE related to pipe bursting or pipe crushing for a sanitary sewer or related pipeline rehabilitation:

Solid wall HDPE pipe that is in accordance with ASTM F 714 and ASTM requirements stated herein. HDPE pipe must further be required to have a minimum pipe stiffness of 46 psi for 12 in. to 48 in. diameter pipe and 115 psi for 8 in. to 10 in. diameters as required by City of Schertz and TCEQ.

2.21.2. **Pipe Manufacturer.** All pipe and fittings must be HDPE and made of virgin material. No re-work except that obtained from the manufacturer's own production of the same formulation must be used. The liner material must be manufactured from a high density, high molecular weight polyethylene compound which is in accordance with ASTM D 1248 and meets the requirements for Type III, Class C, Grade P-34, Category 5, and has a PPI rating of PE 3408.

The pipe produced from this resin must have a minimum cell classification of 345434C (inner wall must be light in color) under ASTM D 3350. A higher number cell classification limit which gives a desirable higher primary property, per ASTM D 3350, may also be accepted by the Engineer at no extra cost to City of Schertz. The value for the hydrostatic design basis must not be less than 1600 psi (11.03 MPA) per ASTM D 2837. Pipe must have ultraviolet protection.

2.21.3. **Pipe Color and Quality.** For television inspection purposes, the polyethylene pipe must have light-colored interior achieved with a homogenous, light-colored material throughout or with a fully bonded light-colored

interior liner meeting Specifications indicated above. All pipe must be free of visible cracks, holes, foreign material, foreign inclusions, blisters, or other deleterious or injurious faults or defects. Pipe and fittings must be as uniform as commercially practical in color, opacity, density, and other physical properties.

For interior-lined pipe, the liner must be at least 10 mils thick and co-extruded. The bond between the layers must be strong and uniform. It must not be possible to separate the two layers with a probe or point of a knife blade so that the layers separate cleanly at any point, nor must separation of the bond occur, between layers, during testing performed under the requirements of this Specification.

2.21.4. **Pipe Diameter.** Polyethylene plastic pipe must meet the applicable requirements of ASTM F 714 polyethylene (PE) plastic pipe (SDR-PR) based on outside diameter, ASTM D 1248, and ASTM D 3550. Internal diameter of the pipe as shown on the plans must be the minimum allowable pipe size.

2.21.5. **Pipe Dimension Ratios.** The minimum wall thickness of the polyethylene pipe must meet the following requirements in Table 2 as based on the deepest portion of a particular pipe pull, typically between manholes:

Table 2
Minimum Pipe Wall Thickness

Depth of Cover (ft.)	Minimum SDR of Pipe
0—16.0	19
>16.1	17

Wall thickness must be as shown on the plans and must be in conformance with the manufacturer.

2.21.6. **Force Mains.** Where applicable, solid wall pipe for sanitary sewer force mains must have at least a working pressure rating of 150 psi, and an inside diameter equal to or greater than the nominal pipe size as shown on the Drawings.

2.21.7. **Augering Pipe.** HDPE pipe is not approved in applications requiring auguring of sewer pipe.

2.21.8. **Pipe Marking.** Each standard and non-standard length of pipe or fitting must be clearly marked with pipe size, pipe class, production code, material designation, and other relevant identifying information.

2.21.9. **Pipe Inspections.** The Engineer reserves the right to inspect pipes or witness pipe manufacturing. Such inspection must in no way relieve the manufacturer of the responsibilities to provide products that comply with the applicable standards and these Specifications. Should the Engineer wish to witness the manufacture of specific pipes, the manufacturer must provide the Engineer with adequate notice of when and where the production of those specific pipes will take place. Approval of the products or tests is not implied by the Engineer's decision not to inspect the manufacturing, testing, or finished pipes.

2.21.10. **Acceptable Manufacturer.** Vendors must have approval through City of Schertz standards committee before product use and must meet all requirements set forth in this Specification.

2.22. **Sliplining.** Sliplining sanitary sewer pipe is accomplished by pulling or pushing liner pipe into existing sewers by use of mechanical or hydraulic equipment. Once in place, liner pipe is allowed time to normalize and is then cut to fit between manholes. Annular spaces between liners and existing sewers are sealed at each manhole. Manhole inverts and benches are reworked and reshaped. Existing sewers remain in operation during slip lining process, with sewage flow diverted around operations in progress.

2.22.1. **Manufacturers.** Liner pipe systems must be fiberglass reinforced plastic (FRP) or T-Lock Liner concrete pipe, as approved by the City of Schertz.

Acceptable manufacturer for FRP liner pipe must conform to the current Standard Material Specifications accepted by City of Schertz.

Acceptable manufacturer for Amer-Plate T-Lock pipe: Ameron Protective Linings.

2.22.2. **FRP Liner Pipe and Fittings.** Pipe, joint and fitting; ASTM D 3262 Type 1, Liner 2, Grade 3.

FRP Liner Pipe: Reinforced plastic mortar pipe manufactured by centrifugal casting process resulting in dense, nonporous, corrosion-resistant, consistent, composite structure. Minimum Stiffness: 72 psi, measured in accordance with ASTM D 2412. Use with a stiffness of 72 psi where specified or shown on the drawings.

Resin Systems: Thermosetting polyester epoxy resin, with or without filler, meeting ASTM D 3262.

Reinforcing Glass Fibers: Commercial-grade E-type glass filaments, with binder and sizing compatible with impregnating resins.

Filler: Sand with at least 98% silica content, and maximum moisture content of 0.2%.

Joints: Low-profile FRP jacking bell-and-spigot joints or flush bell and spigot joints, with elastomeric sealing gaskets for watertight joints meeting ASTM D 4161.

Dimensions and Tolerances:

- Pipe outside diameters and tolerances: In accordance with ASTM D 3262, cast iron pipe equivalent outside diameters, and Table 3 below.
- When possible, supply pipe in nominal lengths of 20 ft. Where radius curves in existing pipe or limitations in entry pit dimensions restrict pipe length, shorter lengths may be used. Engineer must first approve of all proposed pipe joints that are shorter than 20 ft.
- FRP pipe minimum outside diameters and minimum wall thickness as shown in Table 3:
- Fabricate pipe ends square to pipe axis plus or minus 0.25 in., or plus or minus 0.5% of nominal diameter, whichever is greater.
- Flanges, elbows, reducers, tees, wyes, and other fittings: capable of withstanding operating conditions.
- Fabrication: contact-molded or manufactured from mitered sections of pipe joined by glass-fiber-reinforces overlays.

Table 3
FRP Diameter and Thickness

Minimum Existing Sewer Nominal Diameter	Minimum Wall Liner O.D.	Minimum Wall Thickness 46 psi Stiffness	Thickness 72 psi Stiffness
(in.)	(in.)	(in.)	(in.)
21	19.50	0.42	0.48
24	21.60	0.46	0.53
30	25.80	0.54	0.63
36	32.00	0.66	0.77
42	38.30	0.78	0.91
48	44.50	0.90	1.05
54	50.80	1.02	1.19
60	57.10	1.14	1.33

Table 3
FRP Diameter and Thickness

Minimum Existing Sewer Nominal Diameter	Minimum Wall Liner O.D.	Minimum Wall Thickness 46 psi Stiffness	Thickness 72 psi Stiffness
66	62.90	1.26	1.47
72	69.20	1.38	1.61
78	75.40	1.50	1.75

2.22.3. **Liner Pipe Seals at Manholes.** Sealer for annular spaced between liner pipes and host sewers at manholes: Oakum strips soaked in Scotchseal 5600 as manufactured by 3M Corporation or approved equal.

Non-shrink grout: strong seal's QSR patching material or approved equal.

2.22.4. **Clamps and Gaskets.** Clamps: stainless steel, including bolts and lugs, as manufactured by JCM Industries, Type 108, or equal. Furnish full circle, universal clamp couplings with at least 3/16 in. thick neoprene grid-type gaskets. Select clamps to fit outside diameter of liner pipe as follows in Table 4.

Table 4
Clamp Length

Liner Pipe O.D. (in.)	Minimum Clamp Length (in.)
7.125	15
8.625	18
10.750 or greater	30

2.22.5. **Bedding Material.** Make point repair and remove obstructions, such as roots, rocks, and other debris, before installing liner pipe. Comply with excavation, trenching, and backfill requirements of this Specification.

2.23. **Sliplining Grout.** Slip-lining grout is installed in the annular space between the sliplining pipe and the host sewer. Completely fill the annular space without deflecting the pipe. Test grout equipment and procedures in conformance with approved submittals. Perform testing on the first pipeline segment to be grouted. Testing must be performed under observation by the Inspector. If the grout does not totally fill the annular space, adjust the procedure or the mix, and rerun the test on the first pipeline segment.

2.23.1. **Manufacturers and Application.** The applicator of the grout mix must be certified by the grout mix manufacturer and approved by the City of Schertz Engineer. The certified applicator must be regularly engaged in the placement of grout, including completion of pipeline grouting installations with at least 1,000 cu. yd. in the past 3 yr.

2.23.2. **Materials.**

2.23.2.1. **Cement.** In accordance with ASTM C 150. Pozzolans and other cementitious materials are permitted.

2.23.2.2. **Fly Ash.** In accordance with ASTM C 618; either Type C or Type F must be used.

2.23.2.3. **Sand.** If provided, in accordance with ASTM C 144, except as modified in Table 5 below:

Table 5
Sand Gradation

U.S. Standard	% Passing
Sieve Size	**By Weight**
No. 16	100
No. 30	60—85
No. 50	10—35
No. 100	5—25
No. 200	0—10

2.23.2.4. **Water.** Use potable water free from deleterious amounts of alkali, acid, and organic materials which would adversely affect the setting time or strength of the sliplining grout.

2.23.2.5. **Admixtures.** Admixtures should be selected by the sliplining grout manufacturer to meet performance requirements, improve pumpability, control set time and reduce segregation.

2.23.2.5.1. **Compressive Strength.** The grout must have at least a penetration resistance of 100 psi in 24 hr. when tested in accordance with ASTM C 403 and at least a compressive strength of 300 psi in 28 days when tested in accordance with ASTM C 495 or C 109.

2.23.2.5.2. **Performance Requirements.** The Contractor must submit the proposed grout mixes, methods, plans and criteria of the grouting operations. The grouting system must have enough gauges, monitoring devices, and should be tested to determine the effectiveness of the grouting operation and to ensure compliance with the liner pipe Specifications and design parameters.

2.23.2.5.3. **Mix Designs.** One or more mixes must be developed to completely fill the annular space based, but not restricted to, the following requirements:

- size of annular void,
- void (size) of the surround soil,
- absence or presence of groundwater,
- enough strength and durability to prevent movement of the line pipe,
- provide adequate retardation, and
- provide less than 1% shrinkage by volume.

2.23.2.5.4. **Density and Viscosity.** The Contractor must design a grout mix with a density to prevent floating of the liner pipe. The apparent viscosity must not exceed 20 sec. in accordance with ASTM C 939 unless otherwise approved by the City of Schertz Engineer.

2.24. **Bedding and Backfill.** Backfilling for sanitary sewers is divided into three separate zones:

- bedding: the material in trench bottom in direct contact with the bottom of the pipe,
- initial backfill: the backfill zone extending from the surface of the bedding to a point 1 ft. above the top of the pipe, and
- secondary backfill: the backfill zone extending from the initial backfill surface to the top of the trench. Materials and placement for each of the zones must be as described herein.

2.24.1. **Bedding.**

2.24.1.1. **Stable Material.** Existing stable material present during excavation including:

- trench bottom free of water, muck, and debris;
- rock in boulder, ledge, or coarse gravel (particle size not larger than 1 3/4 in.) formations;

- coarse sand and gravels with maximum particle size of 1 3/4 in., various graded sands and gravels containing small percentages of fines, generally granular and non-cohesive either wet or dry; and
- Fine sands and clayey gravels; fine sand, sand-clay mixtures, clay, and gravel-clay mixtures.

2.24.1.2. **Unstable Material.** Existing unstable materials are: silt, muck, trash, or debris in the trench bottom bearing level; rock, in ledge or boulder, or coarse gravel (minimum particle size larger than 1 3/4 in.) formations.

2.24.1.3. **Bedding Material.** The existing material at the bearing level must be removed and replaced to at least a depth of 6 in. or 18 of the outside diameter of the pipe, whichever is greater, with bedding material. The bedding material must extend up the sides of the pipe enough to embed the lower quadrant of the pipe. The bedding material must be composed of well-graded, crushed stone or gravel conforming to the requirements of Table 6 unless modified by the Engineer in writing.

Table 6
Gravel Gradation

Sewer Gravel	% **Passing 1-1/2 in. sieve**
100	
Passing 1 in. sieve	95—100
Passing 1/2 in. sieve	25—60
Passing No. 4 sieve	0—10
Passing No. 8 sieve	0—5

2.24.2. **Over-Excavation.** Where the trench bottom has been over-excavated beyond the limits as defined in the Specification due to removal of unstable material, the pipe must be concrete-encased. Encasement must extend from the trench wall to trench wall and be at least 6 in. above the top of pipe. No separate pay Item.

2.24.3. **Reduced Excavation.** Where the trench bottom is not excavated in accordance with the Specification due to rock or other hard under lying materials, then the pipe must be concrete encased. No separate pay Item.

2.24.4. **Consolidating Backfill Material.** The initial bedding material must be consolidated to assure it is incorporated from the bottom of the trench up to the pipe centerline. A hand-held vibrator, commonly used for concrete work, can be used for this purpose. The vibrator must be inserted every 3 ft. on each side of the pipe.

2.24.5. **Initial Backfill.** Initial backfill is defined as backfill with a thickness in its compacted state from the surface of the bedding to a point 1 ft. above the top of the pipe.

Initial backfill must consist of gravel which conforms to the requirements for bedding material.

2.24.6. **Secondary Backfill.** Secondary backfill is defined as backfill from 1 ft. above the top of the pipe to the top of the trench or bottom of pavement section. Secondary backfill must be constructed as shown on the plans in the construction documents.

Secondary backfill must generally consist of materials removed from the trench and must be free of brush, debris, and trash. Rock or stones with a dimension larger than 6 in. at the largest dimension must be sifted out and removed before the material is used in the secondary backfilling zone. Secondary backfill material must be primarily composed of compactible soil materials.

2.25. **Grouting of Sewer Mains.**

2.25.1. **Submittals.**

- Proposed mix design report for grout
- Submit manufacturers data for proposed plugs and detail of bulkhead

- Technical information for equipment and operations procedures including projected injection rate, grout pressure, method of controlling grout pressure, bulkhead and vent design, and number of stages of grout application.
- Submit project specific plan for abandonment at least 15 days before commencing grouting activities, describe proposed sequence, access points and other information pertinent for completion of work.

2.25.2. **Materials.**

- Cement-based grout or flowable fill with self-leveling and non-shrink characteristics.
- Unconfined compressive strength: At least 100 psi at 56 days as determined based on average of three tests for same placement. Present at least three acceptable strength tests for proposed mix design in mix design report.

2.26. **Remove Existing Sewer Lines.** All materials designated to be removed must become the property of the Contractor and must be disposed of in an approved and permitted disposal site.

3. CONSTRUCTION

3.1. **Excavation.** Excavation as required to complete the work as outlined herein must be performed in accordance with Item 400, “Excavation and Backfill for Structures.”

3.1.1. **Trench Excavation Protection.** Excavation greater than 5 ft. in depth is to be protected as specified in Item 402, “Trench Excavation Protection,” or Item 403, “Temporary Special Shoring.”

3.1.2. Trench Excavation Protection must be applied to all protections and shoring for excavations where the width of a trench or excavation is not greater than 15 ft. (measure at the bottom of the excavation). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 ft. or less (measure at the bottom of the excavation), the excavation is also considered to be a trench. All required shoring for jacking, boring and receiving pits will be paid under Section 3.1.1. “Trench Excavation Protection.” In addition, “Trench Excavation Protection” must not be limited to these applications but may be used whenever deemed expedient and proper to ensuing work.

3.1.3. **Trenches.** Trench walls must be vertical. The practice of undercutting at the bottom or flaring at the top must not be permitted except where it is justified for safety or at the Engineer’s or Inspector’s direction. In special cases where trench flaring is required, the trench walls must remain vertical to a depth of at least 1 ft. above the top of the pipe.

The trench bottom must be square or slightly curved to the shape of the trenching machine cutters. The trench must be accurately graded along its entire length to provide uniform bearing and support for each section of pipe installed upon the bedding material. Bell holes and depressions for joints must be dug after the trench bottom has been graded and bedding installed. The pipe must rest upon the new bedding material for its full length.

Where over-excavation occurs and when not as directed, the under-cut trench must be restored to grade at no cost to City of Schertz by replacement with a material conforming to the requirements of the bedding material or a material approved by the Engineer.

3.2. **Width of Trench.** Minimum Width of Trench. The minimum width of pipe trenches, measured at the crown of the pipe, must be not less than 12 in. greater than the exterior diameter of the pipe, exclusive of bells. The minimum base width of such trench must be not less than 12 in. greater than the exterior diameter of the pipe, exclusive of special structures or connections. Such minimum width must be exclusive of trench supports and not greater than the width at the top of the trench.

Maximum Width of Trench. The maximum allowable width of trench for pipelines measured at the top of the pipe must be the outside diameter of the pipe (exclusive of bells or collars) plus 24 in. A trench wider than the

outside diameter plus 24 in. may be used without special bedding if the Contractor, at his expense, furnishes pipe of the required strength to carry additional trench load. Such modifications must be submitted to the Inspector and approved in writing. Whenever such maximum allowable width of trench is exceeded, except as provided for in the Contract documents, or by written approval of the Engineer, the Contractor, at his expense, must encase the pipe in concrete from trench wall to trench wall, or with other approved pipe bedding material. Any excavation wider than this maximum width or subsequent surface or paving work, will be done at the Contractor's expense.

3.2.1. **Classification of Excavated Materials.** No classification of excavated materials will be made. Excavation and trench work is to include the removal and subsequent handling of all materials excavated in accordance with Item 400.

3.2.2. **Grade of Trench Bottom.** The trench is to be over-excavated to a depth of 6 in. below the grade line established for the bottom of the pipe, regardless of the type of pipe. The grade line of the pipe is to be met by the addition of a layer of approved bedding material as directed.

3.2.3. **Excavation Below Grade.** Any part of the bottom of the trench excavated below the limits specified in Section 3.2.2., "Grade of Trench Bottom," is to be corrected with approved material and compacted as directed. Should excessive over-excavation occur, except at bell holes, the grade is to be restored in accordance with the methods described in Section 3.2.4., "Unstable Conditions at Grade," at no cost to the Department.

3.2.4. **Unstable Conditions at Grade.** Where the bottom of the trench at grade is found to be unstable or to include ashes, cinders, any type of refuse, vegetable or other organic material, or large pieces of fragments or inorganic materials which, in the judgment of the Engineer should be removed, the Contractor is to excavate and remove such unsuitable material to a depth at least 6 in. below the pipe. Before the pipe is laid, the grade is to be restored by backfilling with an approved material in layers of 3 in. before compaction. The layers are to be slightly moistened and thoroughly compacted to provide a uniform and continuous bearing and support for the pipe at every point between bell or collar holes. The finished grade is to be accurately graded to provide uniform bearing and support for each section of pipe at every point along its entire length except for the portions of the pipe sections where it is necessary to excavate for bell holes and for the proper seating of pipe joints.

3.2.5. **Caution in Excavation.** The Contractor is to proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures and utilities may be determined whether shown on the plans or not. Machine excavation is not permitted closer than 12 in. on either side of other existing underground utilities. The Contractor is to be responsible for the repair of such structures and utilities when broken or damaged. He is also to be responsible for adjusting alignment and trench grades with reference to such structures to obtain specified clearance for the sewer main construction.

Whenever the Engineer determines that it is necessary to explore and excavate to determine the location of existing underground structures and utilities, the Contractor is to make explorations and excavations for such purposes at his expense.

3.2.6. **Backfill Material Derived from Excavation.** Any excess excavated material not used after all fill requirements have been met must become the responsibility of the Contractor. The Contractor must dispose of it by hauling and wasting outside the limits of the rights of way or easements of this project and of public thoroughfares and water courses, in conformity with pertinent city, county, state, and federal codes and ordinances and in a manner meeting the approval of the Engineer.

3.2.7. **Trench Surface Restoration.** The surface of the backfilled trench must be restored to match the previous existing conditions. This must include final grading, placement of topsoil and seeding, placement of sod (such as at homes or businesses that had maintained grass), or other unprepared and prepared surfaces.

Trenches in alleys actively being used by vehicles (such as trash pickup, vehicle parking, etc.) must be restored by grading and compacting to 98% or higher with at least 4 in. of flex base materials for the entire width of the alley. Asphaltic materials must have a compaction density of 95%. Alleys not actively used by

vehicles must be graded and compacted to 98% or higher from the top of the initial backfill to the bottom of the pavement section, then spread grass seed for entire width of the alley.

Trenches in paved streets must be covered with a temporary all-weather surface to allow for vehicular traffic until the final asphalt and concrete paving is complete. This surface must be at least 4 in. compacted and rolled asphaltic black base, either hot-mix or cold-mix applied. It is the Contractor's responsibility to maintain this surface until the final street restoration is complete. Temporary street striping may also be required. This surface must be removed before final asphalting.

All street work must be done in conformance with the latest Department Specifications. Included in this requirement is replacement of any curbs or sidewalks damaged or removed during the construction.

No separate payment for the surface restoration is permitted. The cost for this work must be included in the appropriate bid Item.

3.2.8. **Pavement.** The Contractor is to remove pavement and surfaces as a part of the trench excavation. The removal of pavement and surfaces and their restoration is to be based on the minimum trench widths as specified, plus 6 in. either side or as otherwise provided herein. The Contractor is to use such methods as sawing, drilling, or chipping to assure the breaking of the pavement along straight lines.

If the Contractor removes or damages pavement or surfaces beyond the limits specified above, such pavement and surfaces are to be restored at the expense of the Contractor.

Where water line construction necessitates cutting through existing streets outside the limits of new street construction, said streets are to be replaced in kind as directed. Where, in the opinion of the Engineer, it is necessary to maintain traffic across a trench, the Contractor is to install temporary metal bridges as necessary to facilitate the movement of traffic.

The street surface adjacent to the trench is to be kept free of surplus spoil. Construction materials are to be placed at locations that must minimize interference with the traveling public.

3.2.9. **Concrete Sidewalks, Driveways, Etc.** All concrete sidewalks, driveways, etc., are to be cut with a concrete saw. When transverse expansion or "dummy" joints are encountered, the concrete is to be removed to the nearest transverse joint on each side of the trench and restored. The depth of cut is to be such that upon removal of the concrete, the sides of the cut are to be straight and square.

Existing reinforcing wire fabric or bars are to be cut and removed to permit completion of trench excavation, pipe laying, and backfill operations. When the backfill operations have been completed, the existing reinforcement is to be replaced in its original position and satisfactorily spliced before the replacement of concrete over the new trench alignment.

Transverse expansion joints are to be made by a jointing tool, or other means acceptable, and are to match in depth and thickness in the existing transverse joints.

Expansion joint material is to be provided where new construction abuts the existing curb or driveway if the Engineer deems it necessary.

Concrete is to be spaded, tamped, and thoroughly compacted until mortar entirely covers the surface and has a monolithic finish. The top surface is to be floated, troweled, and finished to match the existing concrete surface.

Immediately after finishing, the concrete surface is to be protected by a membrane compound curing agent, or by wetted cotton or burlap mats. Either method is to be subject to approval.

3.2.10. **Dewatering.** Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding areas.

The Contractor must not allow water to accumulate in excavations or at subgrade level. Remove water to prevent softening of foundation bottoms and soil changes detrimental to stability of subgrades and foundations. Provide and maintain dewatering system components necessary to convey water from excavations.

Convey water removed from excavation and rainwater to collecting or runoff areas away from buildings and other structures. Establish and maintain temporary drainage ditches and other diversion outside excavation limits. Do not use trench excavations as temporary drainage ditches.

Dewatering devices must be provided by the Contractor with filters to prevent the removal of fines from the soil. Should the pumping system draw fines from the soil, the Engineer must order immediate shutdown, and remedial measures must be the responsibility of the Contractor.

Upon completion of the dewatering work, the Contractor must remove all equipment and leave the construction area in a neat, clean, condition that is acceptable to the owner.

The Contractor must maintain ground water table at least 12 in. below the finished excavation subgrade.

Performances of the dewatering system for lowering ground water should be measured by observation wells on piezometers installed in conjunction with the dewatering system, and these must be documented at least daily. The Contractor must maintain a log of these readings and submit them to the owner.

No direct payment will be made for costs associated with dewatering. All costs in connection therewith should be included in the applicable Contract price for the Item to which the work pertains.

3.2.11. **Bedding and Backfill.**

3.2.11.1. **General.** Trenches must not be backfilled until the construction structures or appurtenances, as installed, conform to the requirements specified. Where specified, only the secondary backfilling may incorporate excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel, soft shale, or other approved materials, and free from large clods of earth or stones. Where pipe is specially coated, sleeve wrapped, or tape wrapped for protection against corrosion, care should be taken not to damage the coating, sleeve wrap, or tape wrap.

Where a trench has been improperly backfilled, or where settlement occurs, the identified section must be excavated to a depth and length 50 ft. beyond the failed area, then refilled and compacted to the grade and compaction level required. The use of sand backfill must not be allowed. All compaction within the secondary backfill zone will be such that the apparent dry density of each layer must not be less than 98% from the top of the initial backfill to the bottom of pavement section. The pavement (asphalt) section must have 95% compaction density with a maximum dry density at ±2% optimum moisture content as determined by tests on samples as outlined in the latest provisions of TxDOT testing method Tex-113-E or most applicable approved equal provisions, unless otherwise shown on the Contract documents. At the time of compaction, the water content must be at optimum moisture content, ±2% points.

3.2.11.2. **Initial Backfill.** Before laying the pipe, the normal or select bedding material must be shaped to conform to the outside diameter of the pipe as shown on the plans. Bedding material must be consolidated to assure it is incorporated from the bottom of the trench up to the pipe centerline. A hand-held vibrator, commonly used for concrete work, can be used for this purpose. The vibrator must be inserted every 3 ft. on each side of the pipe.

For sewer lines up to 24 in. in diameter, initial backfill material must be placed in two lifts above the bedding material the pipe is set on. The first lift must be spread uniformly and simultaneously on each side and under the bottom quadrant of the pipe to the midpoint or spring line of the pipe. Consolidate the initial backfill material as specified for bedding.

Placement of the first lift of initial backfill must be subject to inspection and approval before placement of second lift, which must extend from the spring line of the pipe to at least 1 ft. above the top of the pipe. The second lift must be evenly spread in a similar manner as the first lift.

For diameters 24 in. and larger, initial backfill material must be evenly and simultaneously spread alongside, under the lower quadrant of the pipe and over the pipe in 12 in. lifts to a point enough to at least 1 ft. above the top of the pipe. Consolidate the initial backfill material as specified for bedding.

3.2.11.3. **Secondary Backfill.** The secondary backfill material must be placed in maximum 12 in. loose lifts or as directed by the Design Engineer or Inspector.

3.3. **Pipe Installation.**

3.3.1. **General.** All sanitary sewer mains must be constructed in accordance with the Specifications herein outlined and in conformity with the required lines and grades, as shown on the plans and as directed. Successful passage of the air and mandrel test (for flexible pipe, 30 days after installation), as described under TCEQ criteria, must be required for the acceptance of the mains.

3.3.2. **Water Main Crossings.** Where gravity or force main sewers are constructed in the vicinity of water mains, the requirements of the TCEQ 30 TAC 217.53 must be met.

3.3.3. **Pipe Installation.** The Inspector must inspect all pipe before it is placed in the trench and must reject any sections found to be damaged or defective to a degree that would affect the structural integrity of the pipe. Rejected pipe must be immediately removed from the site of the work and replaced with new acceptable pipe. The Contractor must commence installation of the pipe at the downstream end of the sanitary sewer line and proceed nonstop in a forward upstream direction. No pipe should be laid within 10 ft. of any point where excavation is in progress. Pipe installation should precede upgrade with the bell pointing in the upstream direction of flow. Pipe must be lowered into the trench without disturbing the prepared foundation or the trench sides. The drilling of lifting holes in the field must not be permitted. Pipe must be installed by means of a concentric pressure being applied to the pipe with a mechanical pipe puller. Pulling or pushing a joint of pipe in place by using a crane, bulldozer, or backhoe must not be permitted. Pipe must be “pulled home” in a straight line with all parts of the pipe on line and grade at all times. No side movement or up and down movement of the pipe must be permitted during or after the pulling operation. Should coupled joints of pipe be out of line or off grade, they must be removed one joint at a time in the presence of the Inspector and brought to the proper line and grade. The lifting or moving of several joints of coupled pipe at one time to close a partially open joint or to fine grade under laid joints of pipe must not be permitted. Also, Contractor must ensure that all existing or proposed manholes or structures must remain visible and accessible at all times. No manhole or structure covers must be covered by pavement, equipment, or other obstructions other than a removable, temporary lid provided for safety. Inspector must suspend all work until this requirement is met without any valid claims of costs or schedule delays.

3.3.4. **Laser Beams.** The use of laser beams for vertical control must be required, provided the Contractor makes available to the Inspector, when requested, a level and rod of enough sensitivity to accurately determine differences in elevation between points 300 ft. apart with one instrument set-up. Contractor must provide a written summary to the Inspector of all elevations that all installed, repaired, or replaced sewer main enter and exit at the manhole or structure.

No pipe should be installed in tunnels except as shown on the plans, or with the permission of the Engineer. If the Contractor finds it necessary to install pipe in tunnels not shown on the plans, he must submit to the Engineer, before commencement of work, a detailed outline of procedures, methods, or use of materials depending on existing soil conditions.

No horizontal or vertical curves must be permitted in conformance with appropriate regulatory agency requirements.

Before leaving the work unattended, the upper ends of all pipelines must be securely closed with a tight-fitting plug or closure. The interior of laid pipe must be kept free from dirt, silt, gravel, or foreign material at all times. All pipes in place must be approved before backfilling.

When replacing an existing system in place, Contractor must maintain screens to prevent the entrance of construction debris into the sewer system.

3.3.5. **Sanitary Sewer Laterals.** Sanitary sewer laterals, fittings, and appurtenances must conform to these Specifications and must be installed by the Contractor as specified herein, or as directed by the Construction Inspector or the Engineer as shown on the plans. Where the lateral is within the Edwards Aquifer Recharge Zone then it must be installed as shown on the plans.

3.3.5.1. **Designation of Lateral.** A sewer pipe located between the sanitary sewer main and the customer's premise, is designated as a "sanitary sewer lateral."

3.3.5.2. **Lateral Installation.** All service line installations must be performed in accordance with this Specification. For sanitary sewer mains that are 12 in. in diameter or smaller, all laterals must be connected using the appropriate size tee or wye placed in line with the main line. For mains larger than 12 in., insert a tee in accordance with ASTM 3034-88 or approved or equal may be used. Where waterline crossings with sanitary sewer laterals are less than the regulated separation distances, all lateral piping must be SDR-26 PVC pipe (ASTM D 2241-09) with a pressure rating of 150 psi.

Connection to the customer's end of the lateral must be performed using a flexible coupling, or pre-approved equal. All flexible couplings must be concrete encased to prevent movement or breakage of the steel bands. All cleanouts at jobsites must have installed an approved heavy duty sanitary sewer cap.

Cutting, excavation, and backfill must be as specified herein.

3.3.6. **Fiberglass Reinforced Pipe for Large Diameter Gravity Sanitary Sewer Installation.** All sanitary sewer mains must be constructed in accordance with the Specification herein outlined and in accordance with the required lines, grades, and details as shown on the Contract documents and as directed.

3.3.6.1. **Quality Control.** All project pipes must be provided by a single manufacturer. Only the pipe and fittings that will be installed during a single workday will be allowed to be stored within the barricaded work area. Pipe manufacturing operations must be performed under the control of the manufacturer. All pipe furnished must be in accordance with this Specification and ASTM D 3262.

3.3.6.2. **Delivery of Materials.** Provide adequate stulling during transport to prevent damage to the pipe, fittings, and appurtenances in conformance with manufacturer's recommendations.

3.3.6.3. **Storage Requirements.** Gravity pipe must be stored and handled in conformance with the manufacturer's guidelines or Engineer's recommendations.

All products must be stored above the ground up on platforms, pallets, skids, or other supports supplied by the Contractor and approved by City of Schertz. Products must be kept free from dirt and other foreign matter.

All products must be stored to permit ready access for identification and inspection by the Inspector.

If new pipe and fittings become damaged before or during installation, they must be repaired as recommended by the manufacturer or replaced as required by the Engineer at the Contractor's expense, before proceeding further. Deliver, store, and handle other materials as required to prevent damage.

Pipe laid directly on the ground must be placed on an area free of loose stones or sharp objects in conformance with manufacturer's recommendations and approved by the City of Schertz.

3.3.6.4. **Pipe Handling.** The Contractor must abide by the required handling techniques specified by the Manufacturer.

The Contractor must provide suitable quantities of all lifting equipment to handle the pipe. In no case must any equipment be used that is not rated to handle the intended loading or conditions of use to which it will be subjected, or which will damage or gouge the pipe.

Dragging or dropping the pipe must not be allowed.

Haul and distribute pipe and fittings at the project site.

Handle piping with care to avoid damage.

Inspect each joint of pipe and reject or repair any damaged pipe before lowering into the trench.

Use only nylon ropes, slings, or other lifting devices that must not damage the surface of the pipe for handling pipe.

3.3.6.5. **Pipe Installation.** Engineer or Inspector may request to inspect pipe before installation.

Install pipe, fittings, specials, and appurtenances as specified herein, and in conformance with the pipe manufacturer's recommendations or Engineer's requirements.

Must follow manufacturer recommendation for initial and bedding.

Lay pipe to the lines and grades as shown on the plans. Clean ends of pipe and coupling components. Apply manufacturer-approved joint lubricant to pipe ends and to the elastomeric seals of coupling. Use suitable equipment and end protection to push or pull the pipes together, applying a uniform seating force across the entire pipe and coupling circumference. Do not exceed forces recommended by the manufacturer for coupling pipe. Join pipes in straight alignment then deflect to required angle. Do not allow the deflection angle to exceed the deflection permitted by the manufacturer, and not more than 2° unless approved by the Engineer. Excavate and backfill trenches in accordance with this Specification.

Pipe Separation: Sewer pipe separation distances must be maintained in accordance with TCEQ rules 30 §217.53.

Laser Beams: The use of laser beams for vertical control must be required.

Contractor must also make available to the Inspector, when requested, a level and rod of enough sensitivity to accurately determine differences in elevation between points 300 ft. apart with one instrument setup.

Contractor must provide a written summary to the Inspector of all elevations that all installed, repaired, or replaced sewer main enter and exit at the manhole or structure.

No pipe should be installed in tunnels except as noted in the Contract documents or by approval of the Engineer. If the Contractor finds it necessary to install pipe in tunnels not provided in the Contract documents, he must submit to the Engineer a detailed outline of procedures, methods, and use of materials depending on existing soil conditions. This information requires review and approval before the commencement of work. Only City of Schertz product standards committee-approved pipe manufacturers must be allowed for tunneling.

No horizontal or vertical curves must be permitted in conformance with appropriate regulatory agency requirements.

Before leaving the work unattended, the upper ends of all pipelines must be securely closed with a tight-fitting plug or closure in conformance with manufacturers' recommendations and approved by the City of Schertz.

The interior of laid pipe must be kept free from dirt, silt, gravel, or foreign material at all times.

All pipes in place must be approved by the Inspector before backfilling.

All fabricated bends must be encased with reinforced concrete, with #4 Bars at 12 in. on center each way completely around pipe, approximately centered in the encasement thickness, and extending longitudinally one pipe diameter each direction along trench, measured from the pipe interior bend point. Concrete encasement must extend across the full width of the trench to both trench walls. Encasement requirement may be waived by the Engineer if manufacturer certifies that fabricated bends have been designed and constructed to withstand all static and dynamic loads imposed by the service conditions

When replacing an existing system in place, Contractor must maintain screens to prevent the entrance of construction debris into the sewer system. Ensure properly temporarily connected or maintain continuous bypass.

At the close of each operating day, keep the pipe clean and free of debris, dirt, animals, and trash, during and after the laying operation. Effectively seal the open end of the pipe using a gasketed night cap when not temporarily connected. Cap must be in conformance with manufacturer's recommendations.

3.3.7. **HDPE Pipe.** Pipe and fittings must be thermal butt fusion, saddle fusion, or socket fusion according to manufacturer recommended procedures. The butt-fused joint must be true alignment and must have uniform roll back beads resulting from the use of proper temperature and pressure. The joint surfaces must be smooth. The fused joint must be watertight and must have tensile strength equal to that of the pipe. All joints must be subject to acceptance by the Engineers or his representative before insertion. All defective joints must be cut out and replaced. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than 10% of the wall thickness, must not be used and must be removed from the site. In addition, if, in the opinion of the Engineers or his representative, any section of pipe has other defects, including those hereinafter listed, that may indicate damaged, improperly manufactured, faulty, or substandard pipe, said pipe must be discarded and not used. Defects warranting pipe rejection include the following: concentrated ridges, discoloration, excessive spot roughness, and pitting; insufficient or variable wall thickness; pipe damage from bending, crushing, stretching or other stress; pipe damage that impacts the pipe strength, the intended use, the internal diameter of the pipe, internal roughness characteristics; or any other defect of manufacturing or handling.

The manufacturer must provide fusion training. The Contractor (actual installers) and the onsite joint inspector must be trained by the manufacturer or manufacturer's authorized representative.

It will not be permitted to join unlike DR's to one another. Transition from unlike SDR's must be accomplished by mechanical couplings capable of identical pressure ratings or machined polyethylene nipples where a thicker wall polyethylene has been matched to the companion pipe wall.

Mechanical joining systems: Polyethylene pipe and fittings must be connected by means of a polyethylene flange adapter and backup ring. The polyethylene flange adapter must be of the same Specifications as the Light View except must be made from black plate stock. This method is also approved to join to another piping system or valves. Mechanical compression couplings or full circle encasement clamps may be used depending on the test specification.

Mechanical couplings must be installed in conformance with the mechanical coupling manufacturer's recommended procedures.

The fusion equipment and operator must be required to demonstrate successful field experience. Regarding fusion over 36 in. capability, the fusion unit must be field tested for a period of five years and the fusion operator must have pipe size experience of the same pipe on the project for five years or longer.

3.3.8. **Protective Coating and Wrapping on Joints.** All bolts and nuts installed for underground service on cast-iron mechanical joint fittings and other ferrous metal appurtenances must be packed in an approved protective coating material after installation. After the joint has been made and bolts drawn to proper tension, the joint including glands, flanges, bolt heads, and nuts must be covered with an approved City of Schertz coating. Coating and wrapping of joints will be considered subsidiary to this Item and will not be paid for directly. Asphaltic material such as Talcote must not be used.

3.4. **Bypass Pumping—Small Diameter Sanitary Sewers.** For sanitary sewers less than 24 in. in diameter. During construction, it must be the Contractor's responsibility to maintain a safe and secure environment at all times. All provisions and requirements of the BPP must be followed throughout the course of any bypass flow operations. Contractor must notify the City of Schertz's inspections department 72 hr. before commencing the bypass pumping operations.

The Contractor must have full time (24 hour), onsite qualified pump personnel including supervision for monitoring the entire bypass installation while it is in operation. The entire length of bypass piping must be walked and inspected hourly to monitor for leaks. High-level alarm notification to cell phones must not eliminate this requirement. Where bypass pumping systems exceed 1,500 ft. in length or cannot be completely observed from the bypass pump location, at least one attendant must be assigned to the pump operation, and one additional attendant must be assigned to walk and monitor the pipeline.

Before installing any plugs, the Contractor and City of Schertz must inspect the existing pipe using a pole camera for imperfections that might cause damage to the plug, cause the plug to not seal or function properly, or compromise the integrity of the pipe when the plug is inflated. The results of this inspection will directly impact the planned plugging locations. Afford City of Schertz an opportunity to confirm that the location of plugs is acceptable.

Lines inserted into any manholes or structures must be constructed with elbows, or be otherwise angled, to direct discharge along the most efficient path for entry into the downstream line without causing unnecessary turbulence of flow. The termination point of the discharge piping must extend to the crown of the pipe housed within the manhole or structure receiving the bypassed flows.

Contractor must provide continuous supply onsite fuel storage enough for 24 hr. operation of the bypass pumping installation.

Contractor must protect all components of the bypass operations from vandalism and vehicular damage by making the site secure.

Contractor must minimize sanitary sewer odors by using lids, shroud covers, or any method accepted by the Engineer.

Contractor must be solely responsible for any and all damages to private or public property caused by, or during, the installation, operation, or removal of the bypass pumping system. Contractor must be fully responsible for all damages and costs related to the installation, operation, and maintenance of Contractor's bypass pumping operations including damages, clean up, fines, penalties, and other related costs.

Once all work is completed and the bypass pumping operation is no longer required, the Contractor must disinfect and drain the entire BPP system in conformance with approved submittal.

City of Schertz will not be responsible for additional traffic control measures that might be required by COSA, Bexar County, the Department, or any other public entity with jurisdiction of the project location.

Plug installation:

- The Contractor must be solely responsible for the safe and effective use of plugs, including the proper combination of inflatable or mechanical plugs to block the sewer flow at both the upstream and downstream ends of a sewer bypass.
- Inflatable plugs should be used only after receiving training as recommended by the manufacturer.

- An inherent danger exists with all inflatable products. If any conditions with this equipment exist that may jeopardize the safety of workers or others, corrective actions should be taken before the equipment use.
- Plugs must be selected and installed in conformance with the manufacturer's recommendations.
- Plugs must also be selected and installed according to the size of the line to be plugged.
- Spare plugs: Provide spare plugs onsite and ready to be installed in the event a plug fails or becomes dislodged.
- Plugs must be in good condition and reviewed by the Contractor for defects that might lead to failure before being installed. The Contractor must sign the plug inspection form.
- Plugs must be removed from the system upon completion of the work.
- Damages: The Contractor must be responsible for damages due to plugs being left in place or dislodged, including but not limited to damages to City of Schertz infrastructure or private property, costs associated with sanitary sewer overflows including: regulatory fines; sewage and debris cleanup; debris disposal at an appropriate landfill; disinfection of all surfaces which have come in contact with the sewage, and costs associated with locating and retrieving lost or dislodged plugs.

3.5. **Bypass Pumping—Large Diameter Sanitary Sewer.** For sanitary sewers 24 in. in diameter or greater. During construction, it must be the Contractor's responsibility to maintain a safe and secure environment at all times. All provisions and requirements of the BPP must be followed throughout the course of any bypass flow operations. When working inside manhole or force main, the Contractor should exercise caution and comply with OSHA requirements when working in the presence of sewer gases, combustible or oxygen-deficient atmospheres, and confined spaces. Contractor must notify the City of Schertz's inspections department 72 hr. before commencing the bypass pumping operations. The Contractor must ensure that the temporary pumping system is properly maintained, and a responsible operator must be on hand at all times when pumps are operating.

The Contractor must have full time (24 hr.), onsite qualified pump personnel including supervision for monitoring the entire bypass installation while it is in operation. The entire length of bypass piping must be walked and inspected hourly to monitor for leaks. High-level alarm notification to cell phones must not eliminate this requirement. Where bypass pumping systems exceed 1,500 ft. in length or cannot be completely observed from the bypass pump location, at least one attendant must be assigned to the pump operation, and one additional attendant must be assigned to walk and monitor the pipeline.

Before installing any plugs, the Contractor and City of Schertz must inspect the existing pipe using a pole camera for imperfections that might cause damage to the plug, cause the plug to not seal and function properly, or compromise the integrity of the pipe when the plug is inflated. The results of this inspection will directly impact the planned plugging locations. Afford City of Schertz an opportunity to confirm that the location of plugs is acceptable.

After installation of the plug, the Contractor must monitor on daily basis the radio transmitter battery and radio signal strengths. If either are found to be below the manufacturer's requirements, the radio transmitter must be immediately replaced.

Lines inserted into any manholes or structures must be constructed with elbows, or be otherwise angled, to direct discharge along the most efficient path for entry into the downstream line without causing unnecessary turbulence of flow. The termination point of the discharge piping must extend to the crown of the pipe housed within the manhole or structure receiving the bypassed flows.

Contractor must provide continuous supply onsite fuel storage enough for 24 hr. operation of the bypass pumping installation.

Contractor must protect all components of the bypass operations from vandalism and vehicular damage by making the site secure.

Contractor must minimize sanitary sewer odors by using lids, shroud covers, or any method accepted by the Engineer.

Contractor must be solely responsible for any and all damages to private or public property caused by, or during, the installation, operation, or removal of the bypass pumping system. Contractor must be fully responsible for all damages and costs related to the installation, operation, and maintenance of Contractor's bypass pumping operations including damages, clean up, fines, penalties, and other related costs.

Once all work is completed and the bypass pumping operation is no longer required, the Contractor must drain the entire sanitary sewer system flows into an existing City of Schertz sanitary sewer manhole before disassembly and removal of the system from the construction site. The intent is to prevent spillage of sewage.

City of Schertz will not be responsible for additional traffic control measures that might be required by CoSA, Bexar County, the Department, or any other public entity with jurisdiction of the project location.

Plug installation:

- The Contractor must be solely responsible for the safe and effective use of plugs, including the proper combination of inflatable or mechanical plugs to block the sewer flow at both the upstream and downstream ends of a sewer bypass.
- Inflatable plugs should be used only after receiving training as recommended by the manufacturer.
- An inherent danger exists with all inflatable products. If any conditions with this equipment exist that may jeopardize the safety of workers or others, corrective actions should be taken before the equipment use.
- Plugs must be selected and installed in conformance with the manufacturer's recommendations.
- Plugs must also be selected and installed according to the size of the line to be plugged.
- Spare plugs: Provide spare plugs onsite and ready to be installed in the event a plug fails or becomes dislodged.
- Plugs must be in good condition and reviewed by the Contractor for defects that might lead to failure before being installed. The Contractor must sign the plug inspection form.
- Plugs must be removed from the system upon completion of the work.
- Damages: The Contractor must be responsible for damages due to plugs being left in place or dislodged, including but not limited to:
  - damages to City of Schertz infrastructure or private property;
  - costs associated with sanitary sewer overflows including regulatory fines, sewage and debris cleanup;
  - debris disposal at an appropriate landfill;
  - disinfection of all surfaces which have come in contact with the sewage;
  - costs associated with locating and retrieving lost or dislodged plugs; and
  - if the plug is damaged, it must be immediately removed from the worksite.

3.6. **Manhole Construction.** Manholes must be constructed of materials and workmanship as prescribed by these Specifications, at such places shown on the Contract documents or as designated by the Engineer, and in conformity with the typical details and sketches shown.

Footings or bases of manholes must be at least 6 in. in depth below the bottom of the pipe.

All invert channels of manholes are to be constructed and shaped accurately to be smooth, uniform, and cause minimum resistance to flow. The bench is to be finished smooth with a slope of 1/2 in. per ft. from the manhole walls to the edges of the invert. The top half of all sewer pipes within the invert channel or bench zone are to be removed flush to the inside manhole walls.

Joints on sewer pipes are not to be cast or constructed within the wall sections of manholes.

Concrete cradles are required for new pre-cast manholes. Concrete cradles are to be provided for all influent and effluent pipes on new monolithic manhole and sewer pipe systems. Concrete cradles are to extend beyond the outside walls of the manhole at least 36 in.

Voids between exterior pipe walls and manhole walls at all pipe connections in manholes must be filled with a non-shrink grout, concrete or mortar, as approved by the Engineer, or as shown on the Contract documents, and inspected before backfilling.

Where connections to existing manholes are required, the adjacent pipe bedding is to be prepared to proper grade, the existing manhole neatly cut, and the new pipe inserted so that the end is projecting 2 in. from the inside wall. The invert is then to be reshaped to properly channel new flows. Debris of any kind is to be kept out of new or existing manholes or mains.

Joints between cones, risers, adjustment rings, flat tops, and between the ductile cast iron ring and the uppermost adjustment ring or flat top, as applicable, must be thoroughly sealed in conformance with manufacturer's recommendations with strongly adhesive bitumastic products as specified. Where precast concrete risers are used, any gaps in the outer joint surfaces must be additionally coated with non-shrink grout to at least a thickness of 1/4 in.

After adjustment ring joints have been sealed as specified above and before the placement of final backfill and pavement, the Contractor must apply the specified heat shrink wrap around the outer perimeter of the adjustment "throat rings." All receiving surfaces must first be thoroughly cleaned to allow proper adhesion of the heat shrink wrap. Installation of the wrap must be in strict conformance with manufacturer's instructions and using the proper hot air equipment under suitable temperature and dry weather conditions. Provide enough vertical overlaps of the wrap around the base of the manhole ductile cast iron ring and the top of the manhole cone as applicable to the finished manhole geometry. Final backfill and pavement work must be conducted in a careful manner to avoid damaging the plastic wrap, as further specified below.

No more than 6 "throat rings" of 2 in. thickness, or no more than 4 "throat rings" of 3 in. thickness may be used on any new manhole.

3.6.1. **Manhole Ring Encasement.** All manhole rings are to be encased with 4,000 psi reinforced Class B concrete as shown on the plans or approved by the Engineer. Manhole ring encasements are to extend 6 in. below the top of the cone and have a minimum thickness, when measured at the manhole ring, of 1 ft. The surface of the encasement is to be 4 1/2 in. below the top of the manhole ring as shown on the plans or as approved.

Where manholes are constructed in existing streets and where directed by the Engineer or shown on the Contract documents, the exterior exposed surfaces of the ring, mortar, "throat rings", and manhole surface must be coated with a 1/8 in. minimum thickness of heat shrink wrap plastic before placement of concrete.

3.7. **Glass-Fiber Reinforced Polyester (FRP) Manholes.** Fiberglass manholes must be installed according to manufacturer's installation instructions. In addition to these instructions, local codes may apply and should be consulted as applicable in manhole installation. Correct manhole installation requires proper concrete foundation, good backfill, and proper handling to prevent manhole damage and ensure long term corrosion resistant service.

Preparation of excavation at manhole location should be at least wide enough to accommodate the slab specified and to provide working room around manhole. Ensure the depth of the manhole is enough to allow between two and four concrete rings for adjustment of ring and cover at top of final grade. Quarter marks have been provided on barrel to facilitate alignment.

To lift manhole, insert 4 in. x 4 in. timber crosswise inside the manhole to the underside of the collar with a rope or woven fabric slings attached to backhoe or other lifting device and lower the manhole. Level manhole and connect sewer lines to manhole. A concrete base encasement must be placed at least 12 in. from the manhole and must come over the top of the anti-flotation ring at least 12 in.

Initial backfill material must be used for backfill around the manhole for a minimum distance of one ft. from the outside surface and extending from the bottom of the excavation to the top of the reducer section. Secondary backfill material may be used for the remainder of the backfill, subject to pre-approval by the Engineer. An approved flowable-fill material may also be used for backfilling operations.

Backfill material must be placed in layers of not more than 12 in. loose and mechanically tamped to 98% standard proctor density. Flooding will not be permitted. Backfill must be placed in such a manner as to prevent any wedging action against the fiberglass manhole structure.

3.8. **Sanitary Sewer System Cleaning.** The sanitary sewer mains, manholes, and structures must be cleaned using mechanical, hydraulically propelled, and high velocity sewer cleaning equipment. The cleaning process must remove all debris, grease, sand, silts, solids, rags, rock, etc. from each sewer segment, including the manholes or structures. Selection of cleaning equipment and the method for cleaning must be based on the condition of the sanitary sewer lines at the time work commences and must be subject to City of Schertz's pre-approval. All cleaning equipment and devices must be operated by experienced personnel. Satisfactory precautions must be taken to protect the sanitary sewer lines, manholes, or structures from damage that might be inflicted by the improper use of the cleaning process or equipment. Any damages done to a sewer line manhole or structure by the Contractor must be repaired by the Contractor at no additional cost and to the satisfaction of City of Schertz. Cleaning must also include the manhole or structure wall washing by a high-pressure water jet.

3.8.1. **Hydraulic Cleaning.** Hydraulic propelled devices which require a head of water to operate must use a collapsible dam. The dam must be easily collapsible to prevent damage to the sewer line, property, etc. When using hydraulically propelled devices, precautions must be taken to ensure that the water pressure created does not cause damage or flood public or private property. The Contractor must not increase the hydraulic gradient of the sanitary sewers beyond the elevation that could cause overflow of sewage into area waterways or laterals. The flow of wastewater present in the sanitary sewer line must be used to provide necessary fluid for hydraulic cleaning devices whenever possible.

3.8.2. **High Velocity Cleaning.** Cleaning equipment that uses a high velocity water jet for removing all debris must be capable of producing a minimum volume of 50 gpm, with a pressure of 1,500 psi, for the sanitary sewer main and 3,500 psi for the (manhole) structure at the pump. Any variations to this pumping rate must be pre-approved by the Inspector. To prevent damage to older sewer lines and property, a pressure less than 1,500 psi can be used. A working pressure gauge must be used on the discharge of all high-pressure water pumps. The Contractor must use, in addition to conventional nozzles, a nozzle which directs the cleaning force to the bottom of the pipe for sewers 18 in. and larger in diameter. The Contractor must operate the equipment so that the pressurized nozzle continues to move at all times. The pressurized nozzle must be turned off or reduced anytime the hose is on hold or delayed, preventing damage to the line.

3.8.3. **Mechanical Cleaning.** Mechanical cleaning, in addition to normal cleaning when required, must be with approved equipment and accessories driven by power winching devices. The Contractor must submit the equipment manufacturer's operational manual and guidelines to the Inspector, which must be followed strictly unless modified by the Inspector. All equipment and devices must be operated by experienced operators so that they do not damage the pipe in the process of cleaning. Buckets, scrapers, scooters, porcupines, kites, heavy duty brushes, and other debris removing equipment and accessories must be used as appropriate and necessary in the field, in conjunction with the approved power machines. The use of cleaning devices such as rods, metal pigs, porcupines, root saws, snakes, scooters, sewer balls, kites, and other approved equipment, in conjunction with hand winching device, or gas, electric rod propelled devices, must be considered normal cleaning equipment.

In addition to the requirements specified herein, the Contractor must maintain a clean work area and surrounding premises within the work limits to comply with federal, state, and local environmental and anti-pollution laws, ordinances, codes, and regulations when cleaning and disposing of waste materials, debris, and rubbish. The Contractor must also keep the work and surrounding premises within work limits free of accumulations of dirt, dust, waste materials, debris, and rubbish. Suitable containers for storage of waste materials, debris, and rubbish must be provided until time of disposal. It is the responsibility of the Contractor to secure a licensed legal dump site for the disposal of this material. Under no circumstances must sewage

or solids removed from the main or manhole be dumped on the ground, streets, ditches, catch basins, storm drains, or sanitary sewers. Cost for this Item must be included in the price bid for sanitary sewer system cleaning.

In addition to the requirements specified herein, the Contractor must maintain a clean work area and surrounding premises within the work limits to comply with federal, state, and local environmental and anti-pollution laws, ordinances, codes, and regulations when cleaning and disposing of waste materials, debris, and rubbish. The Contractor must also keep the work and surrounding premises within work limits free of accumulations of dirt, dust, waste materials, debris, and rubbish. Suitable containers for storage of waste materials, debris, and rubbish must be provided until time of disposal. It is the responsibility of the Contractor to secure a licensed legal dump site for the disposal of this material. Under no circumstances must sewage or solids removed from the main or manhole be dumped on the ground, streets, ditches, catch basins, storm drains, or sanitary sewers. Cost for this Item must be included in the price bid for sanitary sewer system cleaning.

The Contractor, when instructed, must be required to demonstrate the performance capabilities of the cleaning equipment proposed for use. If the results obtained by the proposed sanitary sewer cleaning equipment are not satisfactory, the Contractor must use different equipment or attachments, as required, to meet Specification. More than one type of equipment or attachments may be required at a location. When hydraulic or high velocity cleaning equipment is used, a suitable sand trap, weir, dam, or suction must be constructed in the downstream manhole in such a manner that all solids and debris are trapped for removal.

Whenever hydraulically propelled cleaning tools which depend upon water pressure to provide their cleaning force, or any tool which retard the flow of water in the sanitary sewer lines are used, precautions must be taken to ensure that the water pressure created does not cause any damage or flooding to public or private property being served by the manhole section involved. Any damage of property, as a result of flooding, must be the liability and responsibility of the Contractor. The flow of wastewater present in the sanitary sewer main must be used to provide necessary fluid for hydraulic cleaning devices whenever possible. When additional quantities of water from fire hydrants are necessary to avoid delay in normal working procedures, the water must be conserved and not used unnecessarily. No fire hydrant must be obstructed or used when there is a fire in the area. The Contractor must be responsible for obtaining the water meter and all related charges for the setup, including the water usage bills from respective water purveyor agency. All expenses must be considered incidental to the cleaning of the existing sanitary sewer system.

3.9. **Jacking, Boring, or Tunneling Pipe.** Jacking: Suitable pits or trenches must be excavated for the purpose of jacking operations for placing end joints of the pipe. When trenches are cut in the side of embankment, such work must be securely sheeted and braced. Jacking operations must in no way interfere with the operation of railroads, streets, highways, or other facilities and must not weaken or damage such facilities. Barricades and lights must be furnished as directed to safeguard traffic and pedestrians.

The pipe to be jacked must be set on guides to support the section of pipe being jacked and to direct it in the proper line and grade. Embankment material must be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the opening thus provided.

The excavation for the underside of the pipe, for at least 1/3 of the circumference of the pipe, must conform to the contour and grade of the pipe. A clearance of no more than 2 in. may be provided for the upper half of the pipe.

The distance that the excavation must extend beyond the end of the pipe will depend on the character of the material, but it must not exceed 2 ft. in any case.

Generally, the pipe should be jacked from the downstream end. Permissible lateral or vertical variation in the final position of the pipe from line and grade must be as shown on the Contract documents or as determined by the Engineer. Any pipe that cannot be repaired to its original condition or is damaged in jacking operations must be removed and replaced at the Contractor's expense. Jacking pits must be backfilled immediately upon completion of jacking operations.

Excavation for “boring” pits and installation of shoring must be as outlined under “Jacking.” Boring operations may include a pilot hole, which must be bored the entire length of crossing and must be used as a guide for the larger hole to be bored. Water or drilling fluid may be used to lubricate cuttings. Variation in line and grade must apply as specified under “Jacking.”

Tunneling: Tunneling may be used when the size of the proposed pipe or the use of a monolithic sewer would make the use of tunneling more satisfactory than “Jacking” or “Boring.” The excavation for pits and the installation of shoring must be as specified under “Jacking.” The lining of the tunnel must be of the material shown on the plans.

Access holes for grouting annular space must be spaced a maximum of 10 ft.

Joints: Joints for pipe for “Jacking,” “Boring,” or “Tunneling,” must be as specified in these Specifications, or as shown on the project plans or shop drawings as per pipe manufacturer's recommendation.

Grouting of Bores or Tunnels: Annular Space between casing pipe and limits of excavation (borehole) must be pressure grouted, unless otherwise shown on the plans.

3.10. **Concrete Encasement, Cradles, Saddles and Collars.** Concrete Encasement. When concrete encasement is shown on the plans or when directed, the trench is to be excavated and fine graded to a depth conforming to the details and sections as shown on the plans. The main must be supported by precast concrete blocks of the same strength as the concrete for encasement and securely tied down to prevent floatation. Encasement must then be placed to a depth and width conforming to the details and sections shown on the Contract documents or per the referenced standard drawings.

3.10.1. **Concrete Cradles.** When concrete cradles are shown on the plans or when directed, the trench is to be prepared and the pipe supported in the same manner as described in “Concrete Cradles” of this section. The cradle must be constructed as shown on the plans. Straps and tie downs must be No. 4 rebar diameter minimum or better as determined by the water system Inspector.

3.10.2. **Concrete Saddles.** When shown on the plans or when directed, pipe to receive concrete saddle is to be backfilled in accordance with this Specification to the spring line and concrete placed for a depth and width as shown on the plans.

3.10.3. **Concrete Collars.** When shown on the plans or when directed, concrete collars are to be constructed.

3.11. **Existing Manhole Adjustments.** Existing manholes are to be adjusted or abandoned in accordance with Item 479, “Adjusting Manholes and Inlets,” and as specified herein.

Manholes must be lowered below street subgrade before placing base materials, and openings must be protected by temporary hatch covers. Manholes adjusted in non-paved areas must be set per proposed final grade.

Existing manhole rings and covers which are determined by the Inspector to be in an unacceptable condition, must be removed and replaced with new rings and covers. If the cone section is removed, the Contractor is to upgrade it to a 30 in. opening as required by 30 TAC § 217. All manhole openings upgraded to 30 in. must then be considered reconstruction of manholes and subjected to all provisions contained under the appropriate section in this Specification. Contractor should take all necessary measures to prevent damage to existing or new rings, covers, or cones from equipment and materials used in, or taken through, the work area. If an existing or new manhole cover, ring, or cone is damaged by the Contractor, it must be replaced (as directed by the Inspector) by the Contractor at his own expense. If concrete “throat rings” are to be installed, they must be used in conjunction with a UV stabilized polyethylene liner and I/I barrier. I/I barrier must meet the following ASTM standards: ASTM D 790/1505 Density of Polyethylene Materials, ASTM D 1238 10 Melt Flow Index, ASTM 638 10 Tensile Strength @ Yield (50 mm/mm), ASTM 790 Flexural Modulus, ASTM 648 Heat Deflection Temperature @ IGEPAL, ASTM 1693 12 EsCR, 100% IGEPAL/10% IGEPAL.

Manholes should be adjusted after the street's base material has been laid and before placing of the final surface course. Manholes that are going to be adjusted on an existing surface course (not planned for replacement) must be as shown on the plans. All manholes should then be raised or lowered enough height so as to be level with the finished surface course. Adjustment in height must be made by the addition or removal of "throat rings" above the manhole cone, where feasible. A minimum of two and a maximum of six "throat rings" may be used at each adjusted manhole.

Joints between cones, risers, adjustment "throat rings," flat tops, and between the ductile cast iron ring and the uppermost adjustment ring or flat top must be thoroughly sealed in conformance with manufacturer's recommendations with strongly adhesive bitumastic products: RAM-NEK, as manufactured by Henry, Inc.; Kent Seal, as manufactured by Hamilton-Kent, Inc.; Encapseal, as manufactured by Miller Pipeline Corporation; or approved alternate. Where precast concrete risers are used, any gaps in the outer joint surfaces must be additionally coated with quick-set, non-shrink grout.

Material excavation from around the manholes must be replaced with flowable fill in accordance with these Specifications and select materials from the excavation (as shown in the Contract documents). All excess materials must be disposed of by the Contractor at his own expense and in an approved location. The Contractor also has the option of backfilling with approved secondary materials, subject to the provisions in this Specification.

Manholes existing on sewer lines replaced by new sewer piping and which are no longer needed for the revised sewer network are to be classified as "Abandon Manhole." Work required on an abandoned manhole is to consist of installing a permanent concrete plug on all pipes within the manhole, removing the top of the manhole to an elevation of 2 ft. below proposed subgrade or existing grade, whichever is the lower elevation, and backfilling the manhole with a grout material as specified. The ring and cover of the manholes are to be removed and delivered to sanitary sewer owner's facility designated by the Engineer. If directed, drainage holes are to be drilled in the bottom of manhole walls before backfilling.

3.12. **Reconstruction of Existing Manholes.** Manholes must be raised or lowered by replacing the existing cone and manhole section or sections as required for installation to the finished surface course. All openings must be protected by hatch covers or the necessary steel plates. The Contractor must be required to backfill all manholes with an approved flowable fill (in conformance with all requirements of the right of way owner with jurisdiction over the project scope) up to 1 ft. above the cone section. The Contractor also has the option of backfilling with approved secondary materials, subject to the provisions of this Specification. All excess materials (of any type) must be disposed of by the Contractor at his own expense, and in an approved location.

Reconstructed manholes must also be cleaned of any debris as required by the Inspector. If a new manhole cover, ring, or reconstructed manhole is damaged by the Contractor, it must be replaced (as directed by Inspector) by the Contractor at his own expense. All installed concrete "throat rings" must be used in conjunction with a UV stabilized polyethylene liner and I/I barrier as specified above. Coat all interior concrete surfaces with a City of Schertz -approved coating system as specified above.

Voids between exterior pipe walls and manhole walls at all pipe connections in manholes must be filled with a non-shrink grout, as specified above, or as approved by the Engineer, or as shown on the Contract documents and inspected before backfilling.

Joints between cones, risers, adjustment rings, flat tops, and between the ductile cast iron ring and the uppermost adjustment ring or flat top, as ductile cast iron ring and the uppermost adjustment ring or flat top, as applicable, must be thoroughly sealed in conformance with manufacturer's recommendations with strongly adhesive bitumastic products as specified above. Where precast concrete risers are used, any gaps in the outer joint surfaces must be additionally coated with non-shrink grout to a minimum thickness of 1/4 in.

3.12.1. **Manhole Ring Encasement.** All manhole rings must be encased with 4,000 psi reinforced concrete as shown on the Contract documents or as approved by the Engineer.

Concrete manhole ring encasement must extend 6 in. below the top of the cone and have a minimum width when measured at the manhole ring of 1 ft. The surface of the encasement must be flush with the top of the manhole ring.

Where manholes are reconstructed in existing streets and where directed by the Engineer or shown on the Contract documents, the exterior exposed surfaces of the ring, mortar, “throat rings,” and manhole surfaces must be coated with a 1/8 in. minimum thickness of heat shrink wrap plastic before placement of concrete.

3.13. **Cut and Restore Pavement.** Where sewers must be installed in streets or other paved areas that are going to remain, the work is required to be in accordance with Item 400, “Excavation and Backfill for Structures.”

When allowed by the construction sequence as shown on the plans or as directed, a “temporary concrete cap” of the depth and class of concrete as shown on the plans or as directed may be used instead of a permanent repair.

3.14. **Concrete Sidewalks, Driveways, Curbs, Medians and Islands Replacement.** Existing concrete sidewalks, driveways, curbs, medians, and islands required to be removed and replaced solely for sewer installation are to be a part of sewer work. Removal is to be in accordance with Item 104, “Removing Concrete.” Replacement is to be as shown on the plans and with Item 529, “Concrete Curb, Gutter and Combined Curb and Gutter,” Item 530, “Intersections, Driveways and Turnouts,” Item 531, “Sidewalks,” and Item 536, “Concrete Medians and Directional Islands.”

Any work done due to damage to curbs, sidewalks, driveways, islands, or medians outside the limits shown on the plans or approved in advance will not be measured for payment but is to be restored at the Contractor's expense.

3.15. **Removing and Replacing Chain-Link and Wire Fence.** Existing chain link or wire fences required to be removed solely for sewer installation is to be replaced as part of the sewer work to a condition comparable to that at removal. The existing fence materials may be reused if they are not damaged during removal. Any removal or damage to existing fences outside the limits shown on the plans or not approved in advance must not be measured for payment but is to be restored at the Contractor's expense.

3.16. **Abandon Sewer Lines.** Abandonment of existing sewer lines must be in accordance with the requirements under the “Grouting of Sewer Mains” section of this Special Specification.

3.17. **Sewer Main Television Inspection.**

3.17.1. **Bypass Pumping.** The Contractor must perform bypass pumping operations in accordance with “Bypass Pumping” sections of this Special Specification.

The Contractor must furnish all labor, supervision, tools, equipment, appliances, and materials to perform all operations in connection with bypass pumping of sewage flow for the purpose of preventing interference with the televising of the sanitary sewer manholes and mainlines as well as providing reliable sewer service to the occupants of the buildings being served.

3.17.2. **Post-Repair TV Inspection.** Upon completion of any repairs required by the Engineer, the Contractor must re-televise the sewer and submit the DVDs to the Inspector. These DVDs are to be permanently labeled as described in this Specification and are to be used as a portion of the acceptance criteria. This post-repair TV inspection is to be done to the satisfaction of the Engineer and is subject to the same acceptance criteria as the post construction TV inspection DVDs. Post-repair TV inspection is to be provided at the Contractor’s expense.

3.17.3. **Negotiability of Sewers.** The Engineer makes no guarantee that all of the sanitary sewer mains proposed to be TV inspected are clear for the passage of a camera.

No separate or additional payments will be made for any excavation, man entry, or any other method which may be required to retrieve video equipment that has been hung up, destroyed, or lost during the televising operation.

3.18. **Reconstruct Manholes.** The reconstruction of existing manholes, all types and sizes, must include the replacement of manhole ring and covers; existing cone, manhole section, or sections required, regardless of the type shown on the plans, and as specified herein.

Manholes must be raised or lowered by replacing the existing cone and manhole section or sections as required for installation to the finished surface course. All openings must be protected by hatch covers or the necessary steel plates. The Contractor must be required to backfill all manholes with an approved flowable fill (in conformance with all requirements of the right of way owner with jurisdiction over the project scope) up to 1 ft. above the cone section. All excess materials (of any type) must be disposed of by the Contractor at his own expense, and in an approved location. All openings must be protected by hatch covers or steel plates, as needed.

Reconstructed manholes must be cleaned of any debris as accepted by the City of Schertz's Inspector. If a new manhole cover, ring, or reconstructed manhole is damaged by the Contractor, it must be replaced as directed by the City of Schertz Inspector and by the Contractor, at his expense. All installed concrete "throat rings" must be used in conjunction with a UV-stabilized polyethylene liner and I/I barrier. Coat all interior concrete surfaces with a City of Schertz-approved coating system as specified.

Voids between exterior pipe walls and manhole walls at all pipe connections in manholes must be filled with a non-shrink grout, as specified above, or as approved by the Engineer, or as shown on the Contract documents and inspected before backfilling.

Joints between cones, risers, adjustment rings, flat tops, and between the ductile cast iron ring and the uppermost adjustment ring or flat top, as applicable, must be thoroughly sealed in conformance with manufacturer's recommendations with strongly adhesive bitumastic products as specified above. Where precast concrete risers are used, any gaps in the outer joint surfaces must be additionally coated with non-shrink grout to a minimum thickness of 1/4 in.

3.19. **Air Release Assembly.** Air release valves and appurtenant Items must be installed at the locations as shown on the plans unless otherwise directed.

3.20. **Anchorage and Blocking.** Suitable reaction blocking or anchorage must be provided at all locations specified on the plans. Anchor blocks must be constructed solidly behind the fitting and symmetrical with the axis of resultant thrust except where this is not possible, as in the case of gravity anchorage for vertical bends. Special ties and anchor fittings may be used in conjunction with blocking when shown on the plans or as directed.

Concrete blocking for mains must be a minimum of 3,000 psi placed between solid ground and the fitting except as otherwise as shown on the plans. The area of bearing in contact with solid ground must as shown on the plans or as directed.

All thrust blocking placed in conjunction with mains and appurtenances constructed in pressure zones (formally known as service levels) 9 through 15 must be as shown on the plans. In all cases, the design of thrust blocking must be of enough size to withstand a soil pressure of 3,000 psf, unless specified otherwise on the job plans or specifications. The maximum soil pressure value that will be allowed for the design of thrust blocking must be 5,000 psf. When soil pressure bearing values of 4,000 psf or 5,000 psf are recorded for design of thrust blocks, copies of soil tests made for determining the bearing value of the soil in question must be submitted to the Engineering for verification.

The blocking must be placed so that pipe and fitting joints will be accessible. Pipe polywrap must be placed between the pipe or fitting and the concrete.

The reaction block on the unused branch of a fitting must be poured separately from the block across the back of the fitting. If they are poured simultaneously, a rigid partition must be placed between the blocks.

Valves 12 in. or larger in size must be supported on a concrete pad extending vertically from 12 in. below the bottom of the valve to the lower quarter point of the hub and laterally from face to face of hubs and transversely form wall to wall of the trench.

3.21. **Rehabilitation of Sanitary Sewer by Cured in Place Pipe (Hot Water or Steam Cured).**

3.21.1. **Installer Qualification Requirements.** Installation of the CIPP products must be performed by a work force that is experienced and certified in installation of the products. The installer must be certified by the CIPP product manufacturer to have been trained and approved in the installation of their CIPP products and have a minimum of 3 years total experience with the product. The Contractor must submit such certification of hot water or steam cured CIPP installer to owner. Contractor must also submit to owner at least five recent references of the CIPP installer, indicating successful installation of proposed hot water or steam cured CIPP on projects of similar size and scope. Installer's project manager must have a minimum of 3 years of CIPP installation experience and must be onsite during the installation of the CIPP products.

3.21.2. **Installer Equipment Requirements.** Installer must only use hot water or steam curing equipment that has been certified and approved for use by the CIPP product manufacturer.

3.21.3. **Public Notification.** The Contractor must maintain service usage throughout the duration of the project. If a service will be out of service, the maximum quantity of time of no service will be 8 hr. for any property served by the sewer. A public notification program must be implemented, and must at a minimum, require the Contractor to be responsible for contacting each home or business connected to the sanitary sewer informing them of the work to be conducted, when the sewer will be offline, and any alternative method of service that may be provided.

Written notice is to be delivered to each home or business two business days before the beginning of work being conducted on the section, including a local telephone number of the Contractor they can call to discuss the project or any problems which could arise.

Personnel must contact any home or business which cannot be reconnected within the time stated in the written notice.

Inform City of Schertz Inspection Department 48 hr. before starting the work.

3.21.4. **Protection.** The Contractor must provide for the general safety of workers, pedestrians and traveling public throughout the project. Existing surface improvements, underground facilities, and utilities must also be protected. Damage caused by the Contractor must be repaired at his own expense. Protection to be provided must include but not be limited to:

- Provide barricades, warning lights, and signs for excavations created by point repairs and excavation pits. Conform to requirements of the Department, City of San Antonio, Bexar County, or any other governing entity, and of Contract documents.
- Protection of Manholes and Structures: Install all pulleys, rollers, bumpers, alignment control devices and other equipment required to protect existing manholes and structures, and to protect the pipe from damage during installation. Lubrication may be used as recommended by the manufacturer. Under no circumstances must the liners be stressed beyond their elastic limit.
- Do not allow sand, debris, or runoff to enter sewer system.
- Verify location of all underground utilities and facilities potentially impacted by rehabilitation or other related project activities and take necessary precautions to provide protection from damage. Damage caused by the Contractor must be his responsibility and repaired at no additional cost to City of Schertz.
- Protect the liner and components during all phases of work including, but not limited to, hauling, installation, entry into the entry pit, and prevention of scarring or gouging of the liner, pipe, or components.

- Contractor must be responsible for monitoring weather before planning a CIPP tube insertion to account for an enough duration of tube wet out, insertion, and curing to ensure wet weather that will prevent access to the project site is accounted for. Contractor's failure to account for oncoming weather must be Contractor's responsibility which may extend to removal of damaged or improperly cured CIPP resulting from interrupted CIPP construction process.
- Contractor must notify owner 72 hr. before liner wet out process for approval. Weather conditions and onsite conditions need to be considered.
- One hour before liner being installed, Contractor must televise host pipe with Inspector present to ensure no pipe condition changes have occurred.

3.21.5. **Access Pit Location.** Location and number of insertion or launching pits must be chosen by the Contractor and approved by City of Schertz, and will typically be located at or near existing or proposed manholes or junction boxes, points of intersection (P.I.) in the line, at logical breaks in the construction phasing, or at locations to comply with access or maintenance requirements. The ends of the insertion excavation pit must be sloped 2:1 or flatter, or proper shoring devices must be used. Pits must be placed and located to minimize the total number of pulls and maximize the length of CIPP, within the constraints of maintaining service, access, and other requirements. When excess ground water is encountered, it must be removed by the Contractor and will be considered incidental to the project.

3.21.6. **Sewage Bypass.** A detailed bypass plan must be submitted by Contractor and approved before starting work. The bypass plan must be developed in accordance with the Bypass Pumping sections of this Specification.

3.21.7. **Cleaning and Television Inspection.** Before installing the new pipe, the existing sewer must be cleaned and television inspected per the requirements of this Specification. Notify City of Schertz Inspection Department of any conditions which may prevent proper installation of the liner. All CCTV work must confirm active laterals and location.

3.21.8. **Point Repairs and Obstruction Removal.** City of Schertz must be notified and must approve any point repair or obstruction removal before it is constructed. Point repairs and obstruction removals must be in accordance with the requirements of this Specification.

3.21.9. **Pipe Leakage Control.** Contractor must stop infiltration or leakage into the existing pipeline to prevent contamination of resin in liner.

3.21.10. **Operation.** CIPP installation must be in accordance with ASTM F 1216, Section 7, or ASTM F 1743, Section 6, and manufacturer's recommendations with the following modifications:

- Resin Impregnation: The quantity of resin used for tube impregnation must be enough to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall. A vacuum impregnation process must be used. To ensure thorough resin saturation throughout the length of the felt tube, the point of vacuum must be no further than 25 ft. from the point of initial resin introduction.
- After vacuum in the tube is established, a vacuum point must be no further than 75 ft. from the leading edge of the resin. The leading edge of the resin slug must be as near to perpendicular as possible. A roller system must be used to uniformly distribute the resin throughout the tube. If the installer uses an alternate method of resin impregnation, the method must produce the same results. Any alternate resin impregnation method must be proven.
- Tube Insertion: The wetout tube must be positioned in the pipeline using either inversion or a pull in method. Under the inversion method, care must be taken during the inversion process to not overstress the tube. If pulled into place, a power winch should be used, and care should be exercised not to damage the tube as a result of pull in friction. The tube should be pulled in or inverted through an existing manhole or approved access point and fully extended to the next designated manhole or termination point. The Contractor must install a gauge to monitor the pulling force of the pulled in tube. A written log must be kept noting the pulling force and any fluctuations in the pulling force. The force must not exceed the manufacturer's recommendations. Any occurrences exceeding the manufacturer's recommendations will be cause for rejection of work.

- The manufacturer must provide the minimum pressure required to hold the tube tight against the existing conduit, and the maximum allowable pressure so the tube is not damaged. These pressure ranges must be maintained until the inversion has been completed. A temporary water meter must be installed on the fire hydrant, if used for inversion process. The cost to coordinate and install the meter for construction purposes must be at the Contractor's expense.
- Temperature gauges must be placed between the impregnated tube and the existing pipe at the invert level of each end to monitor the temperatures during the cure cycle. A written log must be kept and submitted to the owner. Any invalid temperature readings not recommended from the manufacturer will be cause for rejection.
- The curing must be accomplished by utilizing hot water or steam under hydrostatic pressure in conformance with the manufacturer's recommended cure schedule. After the tube is cured, the new pipe must be cooled to a temperature below 100°F (38°C) before relieving the internal pressure within the section. In addition, care must be taken during cool down so that a vacuum will not develop that may damage the newly installed pipe.
- The finished pipe must be continuous over the entire length of an inversion run and be free of dry spots, lifts, and delaminations. If these conditions are present, the Contractor must remove and replace the CIPP in these areas at no cost.
- Branch connections or service reconnections must be reopened without excavation, utilizing a remote-controlled cutting device and monitored by a video TV camera. The Contractor must certify he has a minimum of two complete working cutters plus spare key components on the site before each inversion. Unless otherwise directed by the owner or his authorized representative, all laterals must be reinstated. Open cut excavation for service reconnections must only be allowed if it has been approved in writing from a City of Schertz Inspector. Service reconnections must be in accordance with this Specification. Contractor must provide all coupons removed as part of the reinstatement of service process to confirm that the appropriate number of service connections has been made and no coupons were left in the pipe to create an obstruction.

3.21.11. **Cleanup.** Upon acceptance of the installation work and testing, the Contractor must restore the project area affected by the operations to a condition at least equal to that existing before the work.

3.22. **Point Repairs.**

3.22.1. **General.** Locate and replace small lengths of one or more pipe sections where isolated line failure has occurred due to settlement, corrosion, crushing, or separation of joints.

The Inspector may identify potential locations for point repair, but the Contractor is responsible for verifying locations.

Determine the location of service line repairs by smoke testing the manhole section in which the failed pipe is located. The City of Schertz Engineer must authorize the Contractor to make point repairs based on results of smoke testing.

Smoke testing must not be performed within 24 hr. of a rainfall event or if ponded or standing water is present on the ground or in the drainage channels in the area planned for smoke testing.

Smoke testing must be accomplished utilizing two minimum 1,750 CFM blowers designed specifically for smoke testing of sewers. Place blower on the upstream and downstream manhole of the line section to be tested. Place sandbags in the upstream and downstream manholes to isolate the section being tested and prevent the migration of smoke into sections not being tested. Use smoke bombs as necessary to ensure a continuous supply of smoke is provided for the entire duration of the test period.

Determine the location of point repairs by smoke testing or video inspection of the manhole section in which the failed pipe is located. The Inspector must authorize the Contractor to make additional point repairs. Replace all identified damaged pipe for point repairs unless otherwise directed by the Inspector.

The Inspector must authorize each point repair after failure points are located. Do not make point repairs without prior authorization of the Inspector. Perform point repairs only on those portions of service lines which are located in an easement or right of way; perform no repairs to service lines on private property.

3.22.2. **Typical Sequence of Point Repair.** Perform pre-installation video inspection, if required, to verify location of sewer main point repair locations. Perform service testing between manholes to verify location of service lateral point repair locations.

After the location of a point repair is determined, excavate the required length for the point repair.

Before replacing a damaged section of pipe, determine condition of the existing line on both sides of the point repair by lamping the main at least 10 ft. in each direction. Determine whether additional lengths of main (beyond “minimum length” criteria) need replacement. Report need for additional replacement to Inspector and obtain authorization before proceeding.

Remove the damaged sections pipe and replace with new pipe, shaping the bottom of the trench and placing the required pipe bedding so that the grade of the replaced pipe matches the grade of the existing main. Establish proper grade for the sections of pipe being replaced using methods acceptable to the Inspector.

Connect the new pipe to existing main using flexible adapters. If joints cannot be made watertight using flexible adapters, place waterstop gaskets on each joint and encase in a reinforced concrete collar. Reconnect affected service connections or stacks using full bodied fittings. No field fabrication of fittings is allowed.

After completion of point repair and before backfill, perform a smoke test to demonstrate satisfactory integrity of the repair, in the presence of the Inspector. Test as specified in this Specification. Repair and retest sections that fail until repaired sections pass the test.

Encase exposed pipe in cement stabilized sand. Backfill the excavation as specified in this Specification.

Perform a post installation video inspection as specified in these Specifications. Point repairs that show offset joints, non-uniform grade, incorrect alignment, excessive deflection, or similar conditions are considered defective work. Contractor must replace pipe and bedding, as required, to correct defective work.

3.22.3. **Abandonment of Point Repair.** Notify the Inspector if a pipe is exposed by excavation and is found to be in good condition, not requiring a point repair. That point repair must not be performed.

Notify the Inspector if the pre-installation video inspection reveals that no point repair is required. The point repair must not be performed.

Backfill the excavation, replace pavement or sidewalk, and repair and seed or sod unpaved areas. No separate pay Item.

3.22.4. **Obstruction Removal.** Remote Device: Remove obstructions identified on video of a sanitary sewer line segment which could cause a non-uniform liner pipe installation or obstruction of the liner during installation. Obtain authorization from the City of Schertz Construction Inspector for obstruction removal with a remote device before proceeding.

Use a power-driven cutting device (robotic cutter) to remove protruding taps. Cut protruding taps so that protrusions are no greater than 3/4 in. If a protruding tap cannot be removed by the cutting device, then a point repair may be performed. Obtain authorization from the City of Schertz Construction Inspector before proceeding.

To remove other obstructions, use a remote device. Pull or drive the device from manhole to manhole up to a continuous length of 500 ft. using a solid steel mandrel, porcupine, root saw, bucket, robotic cutter, or similar device to remove the obstruction. Select a device that is adequately sized to remove the obstruction.

Use excavation as the method of obstruction removal when installation of the liner in the sanitary sewer is in progress. If during the liner insertion operation, a collapsed sewer, offset joint, or other obstruction is encountered which prevents or blocks the passage or insertion of the liner, notify the Inspector for authorization to excavate.

Excavate at the point where there is an obstruction. Use a trench safety system as required.

Break out the existing sanitary sewer pipe (carrier pipe) as directed by the City of Schertz Construction Inspector. Remove only that quantity of material which is causing the obstruction. Remove the minimum quantity of carrier pipe.

Under such conditions, replacement of the carrier pipe is not required. Do not disturb the existing sewer bedding during excavation. However, if embedment is disturbed during the obstruction removal procedure, place cement stabilized sand or crushed stone beneath the liner. No separate pay Item.

When the liner is completely in place, encase it with crushed stone or cement stabilized sand.

3.22.5. **Bypass Pumping.** Install and operate bypass pumping equipment as required to maintain sewage flow and to prevent backup or overflow. Comply with “Bypass Pumping” sections of this Specification.

3.23. **Reconstruction of Sanitary Sewer by Pipe Bursting Replacement Process.**

3.23.1. **Pit Location.** Location and number of insertion or launching pits must be chosen by the Contractor and will typically be located near existing or proposed manholes, P.I.’s in the line, at logical breaks in the construction phasing, or at locations to comply with access or maintenance requirements.

Pits must be placed and located to minimize the total number of pulls and maximize the length of pipe replaced per pull, within the constraints of maintaining service and access and other requirements. Use excavations at point repair locations for insertion pits where possible.

3.23.2. **Operations.** The Contractor must provide equipment, planning, and job execution necessary to accomplish the work in an efficient manner and consistent with the objectives of this Specification, including preventing damage to existing infrastructure, maintaining pedestrian and vehicle access, and providing continual sewer service to customers.

Pipe must be assembled and fused on the ground in sections equivalent to the length of the anticipated pull. During installation, all bending and loading the pipe must be in conformance with manufacturer’s recommendations and must not damage the pipe.

Manholes must be prepared to provide pipe installation at the lines and grades as shown on the Contract documents. The invert in the manholes must be removed as required to allow for pipe installation activities and to accommodate invert replacement. Manhole inverts must be restored upon completion with 3,000 psi grout to establish a minimum 4 in. thick bottom on the manhole after shaping per the Contract documents.

3.23.3. **Equipment.** The Contractor must use pipe bursting or crushing equipment with adequate pulling and pushing force to complete pulls in timely manner. The Contractor must provide equipment on the pulling mechanism to verify the pulling or pushing force exerted on the pipe does not exceed the manufacturer’s recommendation for allowable pulling force to prevent damage to the pipe. The pulling force may not exceed the following: 6 tons for 8.625 in. O.D.; 10 tons for 10.75 in. O.D.; 17 tons for 14 in. O.D.; 23 tons for 16 in. O.D.; 28 tons for 18 in. O.D. Allowable pulling force for all diameters must be determined by the Contractor depending on the pipe size, wall thickness, manufacturer, field conditions, pull distance, manhole integrity, bearing capacity of soils, adjacent infrastructure, related equipment and cable strength, and related considerations.

3.23.4. **Equipment Configuration.** Equipment must be configured with adequate knives or other appropriate devices to minimize interruptions in the installation process due to obstruction removal and other problems.

Pipe must be secured to the pulling or pushing device in conformance with standard practice. The diameter of the pulling or pushing head must be equal or slightly greater than the pipe O.D.

3.23.5. **Minimize Noise Impact.** Equipment used to perform the work must be located away from buildings so as not to create noise impact. Provide silencers or other devices to reduce machine noise as required to meet requirements.

3.23.6. **Protection.** The Contractor must provide for the general safety of workers, pedestrians, and traveling public throughout this project. Existing surface improvements, underground facilities, and utilities must also be protected. Damage caused by the Contractor must be repaired at his own expense. Protection to be provided includes:

- Providing barricades, warning lights, and signs for excavations created by point repairs. Conform to requirements of the Department, City of San Antonio, and in accordance with Contract documents.
- Protection of Manholes: The Contractor must install all pulleys, rollers, bumpers, alignment control devices, and other equipment required to protect existing manholes, and to protect the pipe from damage during installation. Lubrication may be used as recommended by the manufacturer. Under no circumstances must the pipes be stressed beyond their elastic limit.
- Do not allow sand, debris, or runoff to enter the sewer system.
- Verify location of all underground utilities and facilities potentially impacted by rehabilitation related or other project activities and take necessary precautions to provide protection from damage. Damage caused by the Contractor must be at his cost and responsibility.
- Protect the new pipe and components during all phases of work, including hauling, installation, entry into the entry pit, and prevention of scarring or gouging of the pipe or components.

3.23.7. **Sealing Liner in Manhole.** Allow liner pipe to normalize to ambient temperatures as well as recover from imposed stretch before cutting to fit between manholes, sealing at manholes, and manhole invert shaping. Normalization usually takes at least 12 hr. for polyethylene.

Cut liner so that it extends 4 in. into manhole. Make a smooth, vertical cut and slope area over top of exposed liner using non-shrink grout.

Seal the annular space between liner and sanitary sewer main at each manhole with a chemical seal and non-shrink grout. Place strips of oakum soaked in sealer (Scotchseal 5600 as manufactured by 3M Corporation or approved equal) in a band to form an effective watertight gasket in the annular space between liner and existing opening in manhole. Make width of the sealing band a minimum of 8 in. or the thickness of the manhole wall, whichever is greater.

Finish seal with a non-shrink grout placed around annular space from inside manhole. Apply grout in a band not less than 6 in. wide.

Reshape and smooth the manhole invert. Form a smooth transition with a reshaped invert and a raised manhole bench to eliminate sharp edges of liner pipe, concrete bench, and channeled invert. Build up and smooth invert of manhole to match flow line of new liner.

3.24. **Slip-lining Sanitary Sewers.**

3.24.1. **Obstruction Removal and Point Repair.** Make point repairs and remove obstructions, such as roots, rocks, and other debris, before installing liner pipe. Inspector is to first validate the need for either an obstruction removal or point repair. Refer to “Obstruction Removal” under “Point Repair” section of this Specification.

3.24.2. **Bypass Pumping.** Install and operate bypass pumping equipment as required to maintain sewage flow and to prevent backup or overflow. Act in accordance with “Bypass Pumping” section of this Specification.

3.24.3. **Insertion or Access Pits.** Locate pits so that the total number is minimized, and footage of liner pipe installed in a single pull is maximized. Where possible, use excavations at point repair locations for insertion pits.

Before excavating, check with various utility providers (e.g., CPS Energy, AT&T, Time Warner, etc.), and determine locations of utilities in or near the work area. Costs of utility repairs, temporary service, and other costs arising out of damage to, or interruption of, utilities resulting from operations under this Contract must be borne by Contractor at no additional cost to City of Schertz.

Perform excavation and backfill in accordance with this Specification. Perform excavation requiring trench safety in accordance with OSHA standards and this Specification. Install and operate necessary dewatering and surface water control measures.

3.24.4. **FRP Liner Pipe Installation.** FRP Liner pipe may be pushed or pulled into existing sewers. Insert pipes, spigot, end first, with bell end trailing. Apply pushing force to pipe wall end inside bell in conformance with manufacturer's instruction. Do not apply jacking loads to end of bell. Maximum allowable joint angular deflection one degree.

3.24.5. **Clamp Installation.** Where excavations for liner pipe insertion are made between two manholes, cut ends of liner pipe smooth, square to pipe axis. Join liner pipes with appropriately sized stainless steel universal clamp couplings. Butt together gap between ends of liner pipe with space between ends not exceeding 2 in.

Install bedding in accordance with this Specification.

3.24.6. **FRP Collar Closure.** Install FRP collar closure pieces in conformance with manufacturer's recommendations.

3.24.7. **Field Quality Control.** After liner installation, perform the following tests:

Service lateral connection test: After all service laterals have been completed for a particular sewer section, verify integrity of re-connections at points where they join liners and existing service lines by performing smoke test.

3.24.8. **Sealing Liner in Manhole.** Allow liner pipe to normalize to ambient temperatures and recover from imposed stretch before cutting to fit between manholes, sealing at manholes, and shaping manhole invert. Allow at least 12 hr. for normalization of polyethylene.

Cut liner so it extends 4 in. into manhole. Make smooth, vertical cuts and slope areas over top of exposed liner using non-shrink grout.

Seal annular spaces between liner and sanitary sewer main at each manhole with chemical seal and non-shrink grout. Place strips of oakum soaked in sealer in a band to form effective watertight gasket in annular space between liner and existing pipes in manhole. Make width of the sealing band at least 12 in., or 1/2 pipe diameter, whichever is greater.

Finish seal liner pipe to host pipe with non-shrink grout placed around annular space from inside manhole. Apply grout in a band at least 6 in. wide. Obtain the City of Schertz Engineer's approval of sealing methods, including seal chemicals and materials.

Use cementitious grout to form smooth transitions with reshaped inverts and raised manhole benches to eliminate sharp edges of liner pipe, concrete benches, and channeled inverts. Build up and smooth manhole invert to match flow line of new liner.

3.24.9. **Grouting Annular Space.** Provide grouting plan and obtain approval of grouting plan from City of Schertz Engineer before proceeding with the work.

Grout annular space between the outside of liner and inside of existing pipe for sewer pipe 18 in. in diameter and larger.

3.24.10. **Post-Installation Videotape Recording.** Provide the City of Schertz Engineer with DVD showing completed work including condition of restored connections. Act in accordance with requirements of "Television Inspection" of this Specification.

3.24.11. **Final Cleanup.** Upon completion of installation and testing, clean and restore project area affected by work of this Section. No separate pay Item.

3.25. **Sanitary Sewer System Cleaning.** The Contractor must be required to have all materials, equipment, and labor necessary to complete the cleaning of the sanitary sewer system on the jobsite before isolating it for the cleaning process. The Contractor must only use the type of cleaning identified below to perform the necessary removal of all material which must not create hazards to health, property, affect downstream treatment plant processes, or damage to the sanitary sewer system.

The sanitary sewer mains, manholes, and structures must be cleaned using mechanical, hydraulically propelled, and high velocity sewer cleaning equipment. The cleaning process must remove all debris, grease, sand, silts, solids, rags, rock, etc. from each sewer segment, including the manholes or structures. Selection of cleaning equipment and the method for cleaning must be based on the condition of the sanitary sewer lines at the time work commences and must be subject to City of Schertz's pre-approval. All cleaning equipment and devices must be operated by experienced personnel. Satisfactory precautions must be taken to protect the sanitary sewer lines, manholes, or structures from damage that might be inflicted by the improper use of the cleaning process or equipment. Any damages done to a sewer line manhole or structure by the Contractor must be repaired by the Contractor at no additional cost and to the satisfaction of City of Schertz. Cleaning must also include the manhole or structure wall washing by a high-pressure water jet.

3.25.1. **Hydraulic Cleaning.** Hydraulic-propelled devices which require a head of water to operate must use a collapsible dam. The dam must be easily collapsible to prevent damage to the sewer line, property, etc. When using hydraulically propelled devices, precautions should be taken to ensure that the water pressure created does not cause damage or flood public or private property. The Contractor must not increase the hydraulic gradient of the sanitary sewers beyond the elevation that could cause overflow of sewage into area waterways or laterals. The flow of wastewater present in the sanitary sewer line must be used to provide necessary fluid for hydraulic cleaning devices whenever possible.

3.25.2. **High Velocity Cleaning.** Cleaning equipment that uses a high velocity water jet for removing all debris must be capable of producing a minimum volume of 50 gpm, with a pressure of 1,500 psi, for the sanitary sewer main and 3,500 psi for the (manhole) structure at the pump. Any variations to this pumping rate must be pre-approved by the Inspector. To prevent damage to older sewer lines and property, a pressure less than 1,500 psi can be used. A working pressure gauge must be used on the discharge of all high-pressure water pumps. The Contractor must use, in addition to conventional nozzles, a nozzle which directs the cleaning force to the bottom of the pipe for sewers 18 in. and larger in diameter. The Contractor must operate the equipment so that the pressurized nozzle continues to move at all times. The pressurized nozzle must be turned off or reduced anytime the hose is on hold or delayed to prevent damage to the line.

3.25.3. **Mechanical Cleaning.** Mechanical cleaning, in addition to normal cleaning when required, must be with approved equipment and accessories driven by power winching devices. The Contractor must submit the equipment manufacturer's operational manual and guidelines to the Inspector, which must be followed strictly unless modified by the Inspector. All equipment and devices must be operated by experienced operators so that they do not damage the pipe in the process of cleaning. Buckets, scrapers, scooters, porcupines, kites, heavy duty brushes, and other debris-removing equipment and accessories must be used as appropriate and necessary in the field, in conjunction with the approved power machines. The use of cleaning devices such as rods, metal pigs, porcupines, root saws, snakes, scooters, sewer balls, kites, and other approved equipment, in conjunction with hand winching device, and gas, electric rod propelled devices, must be considered normal cleaning equipment.

3.25.4. **General Requirements.** In addition to the requirements specified herein, the Contractor must maintain a clean work area and surrounding premises within the work limits to comply with federal, state, and local environmental and anti-pollution laws, ordinances, codes, and regulations when cleaning and disposing of waste materials, debris, and rubbish. The Contractor must also keep the work and surrounding premises within work limits free of accumulations of dirt, dust, waste materials, debris, and rubbish. Suitable containers for storage of waste materials, debris, and rubbish must be provided until time of disposal. It is the responsibility of the Contractor to secure a licensed legal dump site for the disposal of this material. Under no circumstances must sewage or solids removed from the main or manhole be dumped on the ground, streets, ditches, catch basins, storm drains, or sanitary sewers. Cost for this Item must be included in the price bid for sanitary sewer system cleaning.

The Contractor may be required to demonstrate the performance capabilities of the cleaning equipment proposed for use on the project. If the results obtained by the proposed sanitary sewer system cleaning equipment are not satisfactory to the Inspector, the Contractor must use different equipment and attachments, as required, to meet the requirements of the Contract documents. More than one type of equipment or attachments may be required at any given location within the project scope. When hydraulic or high velocity cleaning equipment is used, a suitable sand trap, weir, dam, or suction must be constructed in the downstream manhole in such a manner that all the solids and debris are trapped for removal.

Whenever hydraulically propelled cleaning tools, which depend upon water pressure to provide their cleaning force, or any tool which retard the flow of water in the sanitary sewer mains, are used, precautions must be taken to ensure that the water pressure created does not cause any damage or flooding to public or private property being served by the manhole section involved. Any damage of property, as a result of flooding, must be the liability and responsibility of the Contractor. The flow of wastewater present in the sanitary sewer system must be used to provide necessary fluid for hydraulic cleaning devices whenever possible. When additional quantities of water from fire hydrants are necessary to avoid delay in normal working procedures, the water must be conserved and not used unnecessarily. No fire hydrant must be obstructed or used when there is a fire in the area. The Contractor must be responsible for obtaining the water meter and all related charges for the setup, including the water usage bills from respective water purveyor agency. All expenses will be considered incidental to the cleaning of the existing sanitary sewer system.

3.26. **Grouting of Sewer Mains.** Abandoning and grouting of sewer lines must not occur until all existing sewer mains and services have been transferred to a relocated sewer line or another line as designated in the Contract documents. The Contractor must be responsible for the satisfactory coordination of the pipe abandonments with other construction and activities in the area. Delays in work resulting from lack of coordination must not be cause for additional compensation. Any work involving or impacting asbestos concrete pipe must be in accordance with the Specifications.

Remove or pump out any free-standing wastewater in compliance with TCEQ and EARZ requirements before starting grout placement.

Place grout or flowable fill using concrete or grout pumps capable of continuous delivery at planned placement rate to fill volume between placement points not to exceed 500 ft. at a time. Pump grout and flowable fill through bulkheads constructed for placement of PVC pipes or other methods to contain grout in line to be abandoned. These pipes must be used for injection points or vents during placement. Place grout or flowable fill under pressure into properly vented open system until grout emerges from vent pipes indicating pipe is completely filled. Pumping must be completed under enough pressure to overcome friction and to fill sewer main from downstream to upstream end. Remediate areas where grout or flowable fill did not fill voids in sewer main by pressure grouting from inside sewer main or from surface if necessary. Plug each end of the sewer main being abandoned. Ensure that concrete is placed around plug or bulkhead and around pipe including bedding area, such that it is not penetrable by groundwater and that bedding at this location is not a conduit for groundwater. The method of installation must meet the requirement of completely filling the existing sewer main and any voids adjacent to it.

Backfill to grade above pipe left in place. Place and compact backfill in accordance with the Special Specifications.

Remove, transport, and dispose of spoils. Spoils including pipe, unused grout or flowable fill, and other unsuitable materials must be hauled to a facility permitted to accept the material. The abandonment method must provide for the release of air. When intermediate points are required to be constructed for the abandonment of the system, they must be a part of the abandonment project process. The method must provide for the isolation of sewer mains to be grouted from sewer mains that are abandoned in place without grouting as shown on the plans.

Sewer mains that are not under proposed pavement are generally not required to be grouted unless it is specified on the Contract documents. Mains to be abandoned must be grouted only if required by the Contract documents and payment as per these Specifications is provided.

3.27. **Remove Existing Sewer Lines.** The Contractor is responsible for locating all sewer lines to be removed.

Remove the sewer line and all related appurtenances, including existing casing to be replaced or those that will no longer be in service. Perform all work to accomplish this requirement including, but not limited to, coordination, potholing, excavation and backfill with native or select soil, dewatering of pipe, groundwater dewatering, trenching, backfill and surface restoration, cutting, capping, removal of pipe including existing casing, and legal disposal of sewer materials.

3.28. **Remove Existing Manholes.** Remove the existing manhole and all related appurtenances to be replaced or will no longer be in service. Perform all work to accomplish this requirement including, but not limited to, coordination, excavation and backfill with native or select soil, dewatering of the manhole, groundwater dewatering, trenching, shoring, backfill and surface restoration, and legal disposal of sewer materials.

4. TESTING

4.1. **Manhole Testing.** The Contractor must perform the testing for all sanitary sewer manholes in conformance with the following.

4.1.1. **Leakage Testing.** All manholes must pass a leakage test. The Contractor must test each manhole (after assembly and backfilling) for leakage, separate and independent of all other sanitary sewer piping, by means of either a hydrostatic test, vacuum test, or other methods approved. The Contractor is hereby instructed to conduct either of the two identified tests in the following manner:

4.1.1.1. **Hydrostatic Testing.** Hydrostatic testing must be conducted by utilizing approved plugs to seal all influent and effluent pipes in the manhole and filling the manhole to the top of the cone with water. Additional water may be added over a 24-hr. period to compensate for absorption and evaporation losses. At the conclusion of the 24-hr. saturation period, the manhole must be filled to the top and observed. Any measurable loss within a 30 min. period must be considered an unsuccessful test and thus require the Contractor to assess the needed repairs, perform such repairs (subject to the approval), and notify the Inspector when the retest will be performed. All effort, materials, or other costs must be solely at the Contractor's expense.

4.1.1.2. **Vacuum Testing.** General: Manholes must be tested after construction and installation and backfilling, with all connections (existing or proposed) in place. Drop connections and gas sealing connections must be installed before testing.

Test Procedure: The lines entering the manhole must be temporarily plugged, with the plugs braced to prevent them from being drawn into the manhole. The plugs must be installed in the lines beyond drop connections, gas sealing connections, etc. Before performing the test, the Contractor must plug all lift holes and exterior joints with a non-shrink grout and plug all pipes entering the manhole. No grout must be placed in horizontal joints before testing. Contractor must use a minimum 60-in. lb. torque wrench to tighten the external clamps that secure the test cover to the top of the manhole. The test head must be inflated in conformance with the manufacturer's recommendations. A vacuum of 10 in. of mercury must be drawn and the vacuum pump must be turned off. With the valve closed, the level vacuum must be read after the required test time. If the drop in the level is less than 1 in. of mercury (final vacuum greater than 9 in. of mercury), the manhole must have passed the vacuum test. The required test time is 2 min.

Acceptance: Manholes must be accepted with relation to vacuum test requirements if they meet the criteria above. Any manhole which fails the initial test must be repaired with a non-shrink grout or other suitable material based on the material of which the manhole is constructed. The manhole must be retested as described above until a successful test is attained. After a successful test, the temporary plugs must be removed. To ensure that the plugs have been removed, Contractor must only do so in the presence of the Inspector.

Repairs to Existing Manholes: Any existing manhole which fails to pass the vacuum test must be closely examined by the Inspector and the Contractor to determine if the manhole can be repaired. Thereafter, the Contractor must either repair or remove and replace the manhole as directed. The manhole must then be retested and coated with a City of Schertz-approved sewer coating as stated above. The owner may elect to simply remove and replace the existing manhole with a new one. Any manhole excavated for repairs or excavated for tie in must be backfilled with flowable fill up to 1 ft. below the top of the cone.

Measurement and Payment: Vacuum testing of new structures will not be a pay Item. The cost of this work must be included in the bid price for the new manhole. Each vacuum test of an existing manhole must be a separate pay Item. Repairs to existing manholes must be a separate pay Item when authorized.

4.1.2. **Holiday Testing.** Inspect each sanitary sewer manhole using high-voltage holiday detection equipment. All detected holidays must be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional protective coating material must be applied to the repair area. All touch-up repair procedures must follow the protective coating manufacturer's recommendations.

If a sanitary sewer manhole fails to pass one of the above tests, it must be repaired in conformance with the manufacturer's recommendations and re-tested. It must not be accepted until it passes all tests. All repairs and re-testing will be at no additional cost to City of Schertz.

4.2. **Sanitary Sewer Pipe Low-Pressure Air Testing.** The Contractor must perform a low-pressure air test, or an infiltration or exfiltration test, and a mandrel test before the installed work will be considered accepted. If a gravity collection main is composed of flexible pipe, a deflection test must also be required. Flexible pipe is defined as pipe that must deflect at least 2% without structural distress. Contractor must ensure that all testing is performed in the presence of the Inspector, with copies of all written test results made available to the Inspector.

Materials for Air Testing: The Contractor must furnish all materials and equipment for air testing including the air compressor.

Compressor Air Supply: Any source which will provide at least 300 cu. ft. per min. at 100 lb. per sq. in.

The equipment for air testing must consist of valves, plugs, and pressure gauges used to control the rate at which air flows to the test section and to monitor the air pressure inside the plugs and, for large diameter pipe, joint testers as manufactured by Cherne Industrial, Inc., of Edina, Minn., or an approved equal. Test equipment is to be assembled as follows and as shown in Figure 1 below:

- hose connection,
- shut off valve,
- throttle valve,
- pressure reduction valve,
- gage cock, and
- monitoring pressure gage.

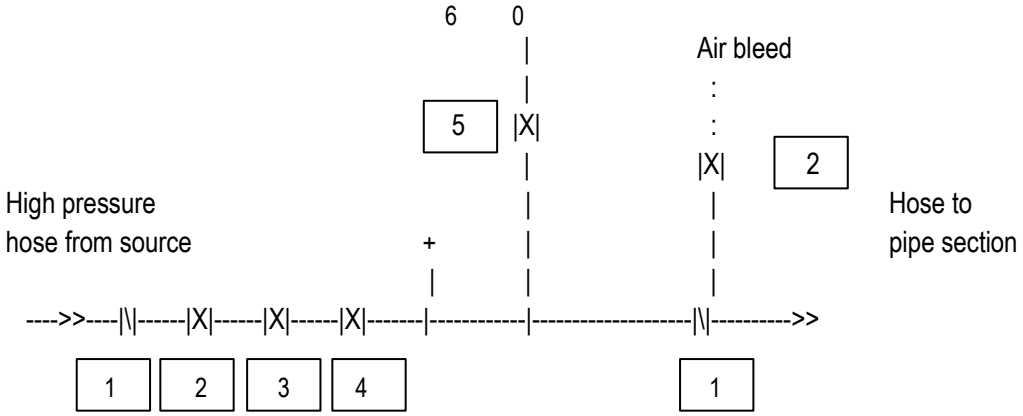


Figure 1
Air Testing Equipment Assembly Order

Test Procedures: The procedure for the low-pressure air test must conform to the procedures described in ASTM C 828, ASTM C 924, ASTM F 1417, or other appropriate procedures, except for testing times. The test times must be as outlined in this section. For sections of pipe less than 36 in. average inside diameter, the following procedure must apply unless the pipe is to be joint tested. The pipe must be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure is stabilized, the minimum time allowable for the pressure to drop from 3.5 psi gauge to 2.5 psi gauge must be computed from the following equation:

T = (0.085 x D x K) Q

T = Time for pressure to drop 1 lb.per sq. in. gauge in seconds

K = 0.000419 x D x L, but not less than 1

D = Average inside pipe diameter in inches

L = Length of line of same pipe size being tested, in feet

Q = Rate of loss, 0.0015 cu. ft. per min.per sq. ft. internal surface must be used since a K value of less than 1 will not be used.

There are minimum testing times for each pipe diameter as shown in Table 8.

Table 8
Minimum Testing Times

Pipe Diameter	Minimum Time	Length for Minimum Time	Time for Longer Length
Inches	Second per Foot	Feet	Seconds per Foot
6	340	398	0.855
8	454	298	1.52
10	567	239	2.374
12	680	199	3.419
15	850	159	5.342
18	1,020	133	7.693
21	1,190	114	10.471
24	1,360	100	13.676
27	1,530	88	17.309
30	1,700	80	21.369
33	1,870	72	25.856

Note—Test time starts after the required 60 sec. of stabilization time.

The test may be stopped if no pressure loss has occurred during the first 25% of the calculated testing time. If any pressure loss or leakage has occurred during the first 25% of the testing period, then the test must continue for the entire test duration as outlined above or until failure.

Mains with a 27 in. average inside diameter and larger must be air tested at each joint. If the joint test is used, a visual inspection of the joint must be performed immediately after testing. The pipe is to be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure has stabilized, the minimum time allowable for the pressure to drop from 3.5 psi gauge to 2.5 psi gauge must be 10 sec.

Mains that are greater than 33 in. diameter must be tested for leakage at each joint, or as approved.

4.3. **Sanitary Sewer Pipe Infiltration or Exfiltration Test.** The Contractor must perform a low-pressure air test, or an infiltration or exfiltration test, and a mandrel test before the installed work will be considered accepted. The total exfiltration, as determined by a hydrostatic head test, must not exceed 50 gal. per inch of diameter per mile of main per 24 hr., at a minimum test head of 2 ft. above the crown of the main at an upstream manhole. The Contractor must use an infiltration test instead of an exfiltration test when mains are installed below the ground water level. In such cases, the total exfiltration, as determined by a hydrostatic head test, must not exceed 50 gal. per inch of diameter per mile of main per 24 hr., at a minimum test head of 2 ft. above the crown of the main at an upstream manhole, or at least 2 ft. above the existing groundwater level, whichever is greater. For construction work occurring within a 25-yr. floodplain, the infiltration or exfiltration must not exceed 10 gal. per inch of diameter per mile of main per 24 hr., at the same minimum test head as stated in the previous sentence. If the quantity of infiltration or exfiltration exceeds the maximum quantity specified, the Contractor must propose to the Engineer, and receive approval therefrom, all necessary remedial action, solely at the Contractor's own cost, to reduce the infiltration or exfiltration to an amount within the limits specified herein.

4.4. **Sanitary Sewer Pipe Deflection Testing.** The Contractor must perform a low-pressure air test, or an infiltration or exfiltration test, and a mandrel test before the installed work will be considered accepted. As stated in the 30 TAC § 217, deflection test must be performed on all flexible pipe installed.

- For mains with inside diameters less than 27 in., a rigid mandrel must be used to measure deflection.
- For mains with an inside diameter 27 in. and greater, an approved method must be used to test for vertical deflections.

The deflection test must be accurate to within +0.2% deflection. The test must be conducted after the final backfill has been in place at least 30 days. No pipe must exceed a deflection of 5%. If a pipe should fail to pass the deflection test, the problem must be corrected, and a second test must be conducted after the failed area's final backfill has been in place an additional 30 days. The tests must be performed without mechanical pulling devices. The Engineer should recognize that this is a maximum deflection criterion for all pipes, and a deflection test less than 5% may be more appropriate for specific types and sizes of pipe. Upon completion of construction, the Engineer, or other Texas Licensed Professional Engineer appointed by the owner, must certify to the Inspector that the entire installation has passed the deflection test. This certification may be made in conjunction with the notice of completion required in 30 TAC § 217.14. (1) of this title (relating to general provisions). This certification must be provided for the owner to consider the requirements of the approval have been met.

Mandrel Sizing: The rigid mandrel must have an O.D. not less than 95% of the inside diameter (I.D.) of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, will be the average outside diameter minus 2 minimum wall thicknesses for O.D. controlled pipe, and the average inside diameter for I.D. controlled pipe. All dimensions must be per appropriate standard. Statistical or other "tolerance packages" must not be considered in mandrel sizing.

Mandrel Design: The rigid mandrel must be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed. The mandrel must have 9 or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the mandrel must have a length of at least 75% of the inside diameter of the pipe. A proving ring must be provided and used for each size mandrel in use.

Method Options: Adjustable or flexible mandrels are prohibited. A television inspection is not a substitute for the deflection test.

4.5. **Testing for Reconstruction of Existing Manholes.** The Contractor must perform the testing for all sanitary sewer manholes in conformance with the following:

- All manholes must pass a leakage test.
- The Contractor must test each manhole (after reconstruction and backfilling) for leakage, separate and independent of all other sanitary sewer piping, by means of either a hydrostatic test, vacuum test, or other methods approved.
- The Contractor is hereby instructed to conduct either of the two identified tests in the following manner.

4.5.1. **Hydrostatic Testing.** Hydrostatic testing must be conducted by utilizing approved plugs to seal all influent and effluent pipes in the manhole and filling the manhole to the top of the cone with water. Additional water may be added over a 24-hr. period to compensate for absorption and evaporation losses. At the conclusion of the 24-hr. saturation period, the manhole must be filled to the top and observed. Any measurable loss within a 30 min. period must be considered an unsuccessful test and thus require the Contractor to assess the needed repairs, perform such repairs (subject to approval), and notify the Inspector when the retest must be performed. All effort, materials, or other costs must be solely at the Contractor's expense.

4.5.2. **Vacuum Testing.** Manholes must be tested after construction or installation and backfilling with all connections (existing and proposed) in place. Drop connections and gas sealing connections must be installed before testing.

Test Procedure: The lines entering the manhole must be temporarily plugged, with the plugs braced to prevent them from being drawn into the manhole. The plugs must be installed in the lines beyond drop connections, gas sealing connections, etc. Before performing the test, the Contractor must plug all lift holes and exterior joints with a non-shrink grout and plug all pipes entering the manhole. No grout must be placed in horizontal joints before testing. Contractor must use a minimum 60-in. per lb. torque wrench to tighten the external clamps that secure the test cover to the top of the manhole. The test head must be inflated in conformance with the manufacturer's recommendations. A vacuum of 10 in. of mercury must be drawn, and the vacuum pump must be turned off. With the valve closed, the level vacuum must be read after the required test time. If the drop in the level is less than 1 in. of mercury (final vacuum greater than 9 in. of mercury), the manhole must have passed the vacuum test. The required test time is 2 min.

Acceptance: Manholes must be accepted with relation to hydrostatic or vacuum test requirements if they meet the criteria above. Any manhole which fails the initial test must be repaired with non-shrink grout or other suitable material based on the material of which the manhole is constructed. The manhole must be retested as described above until a successful test is attained. After a successful test, the temporary plugs must be removed. To ensure that the plugs have been removed, Contractor must only do so in the presence of the Inspector.

Repairs to Existing Manholes: Any existing manhole which fails to pass the hydrostatic or vacuum test must be closely examined by the Inspector and the Contractor to determine if the manhole can be repaired. Thereafter, the Contractor must either repair or remove and replace the manhole as directed. The manhole must then be retested and coated with a City of Schertz-approved sewer coating as stated above. The owner may elect to simply remove and replace the existing manhole with a new one. Any manhole excavated for repairs or excavated for tie in must be backfilled with flowable fill up to 1 ft. below the top of the cone. The Contractor also has the option of backfilling with approved secondary materials, subject to the provisions of this Specification.

Measurement and Payment: Hydrostatic and vacuum testing of new structures will not be a pay Item. The cost of this work must be included in the bid price for the new manhole. Each hydrostatic or vacuum test of an existing manhole must be a separate pay Item. Repairs to existing manholes must be a separate pay Item when authorized.

4.5.3. **Holiday Testing.** Inspect each sanitary sewer manhole using high-voltage holiday detection equipment. All detected holidays must be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional protective coating material must be applied to the repair area. All touch-up repair procedures must follow the protective coating manufacturer's recommendations.

4.5.4. **Test Failure.** If a sanitary sewer manhole fails to pass one of the above tests, it must be repaired in conformance with the manufacturer's recommendations and retested. It must not be accepted until it passes all tests. All repairs and re-testing must be at no additional cost to City of Schertz.

4.6. **Bypass Pumping.** Testing and quality control must be required for all bypass pumping systems, stationary pumping, and flow diversion systems, as indicated below. Contractor must obtain and keep copies of all required permits on site before beginning testing and throughout performance of the work.

Contractor must prove to the owner that the equipment, materials, and all operational aspects & appurtenances related to the BPP are in good condition before commencing the bypass pumping operation. Failure to do so must result in the Contractor not being permitted to continue with any construction work requiring bypass pumping operations. Contractor must notify the City of Schertz Inspections Department 48 hr. before commencing any testing. Any flows excessively surcharging the sanitary sewer system during the test or during actual bypass periods must deem the BPP to be unacceptable, and it must be revised and resubmitted for approval. There must be no separate pay Item if this condition occurs during the timeframe in which bypass pumping testing or operations are underway during the project. No testing of the bypass pumping operation must be conducted between Thursday and Sunday, unless approved by City of Schertz. If bypass pumping must take place outside normal work hours which are between 8 A.M. to 5 P.M. Mondays through Fridays (except for City of Schertz observed holidays), Contractor must reimburse City of Schertz for the overtime costs required by his bypass pumping testing outside of City of Schertz normal work hours.

Discharge piping, joints, and all accessories must be required to be hydrostatic tested. All piping, joints, and accessories must be able to withstand at least twice the maximum system pressure or a minimum of 50 psi, whichever is greater.

For any bypass operations proposed a 24-hr. test run must be satisfactorily performed before commencing any construction work. The Inspector must provide acknowledgment first. Contractor must provide both a strobe light type, high-level alarm and alarm notification to Contractor cell phones, as well as other appointed personnel to be identified by City of Schertz and ensure adequate alarm notification is attained before actual startup of the test period.

During the testing period, the Contractor must install a float monitoring system in the upstream manhole or pipe to confirm that the bypass pumping flow data shown in their BPP remains applicable. The float monitoring system must remain in the manhole or pipe for the duration of the bypass operation. The data collected during the test and duration of the bypass operation must be provided to City of Schertz for evaluation and recording. It must be required of the Contractor to have personnel remain onsite at the flow monitoring system to continuously record (every 30 min.) the flows during both the test and actual bypass pumping periods. Contractor must submit a copy of Testing Float Monitoring System Data log to City of Schertz upon successful completion of test. Data log must be in column format with each line entry indicating the time, elapsed time of test, level of flow indicated in manholes, total flow being pumped by the BPP system, and any comments pertaining to the test.

Contractor must perform a full-scale demonstration test of his proposed pump and haul bypass system to prove that his system can be successfully used for bypass pumping at the proposed locations. Contractor's test must use all of the equipment and staff that will operate the bypass pumping system during performance of the work. Traffic control systems required during the work must be used during the test. Withdrawals and discharges of flow must be from or into the manhole locations identified in the Contractor's BPP except for pump and haul system. This requirement is intended to demonstrate that the Contractor's proposed BPP is capable of providing satisfactory bypass pumping before Contractor beginning the work, including the size and number of trucks and cycles times. Pump and haul system flow must be disposed of in a TCEQ licensed facility, and all manifests must be kept and submitted. Disposal of pump and haul flow in a nearby manhole is not acceptable.

Any failure of equipment or activities associated with the bypass pumping operations contributing to either an excessive surcharge or SSO must be deemed a failed test. The test must then be stopped and any necessary cleanup or reporting efforts performed. The BPP must need to be revised, resubmitted, and acknowledged before test initiating again. Any effort by City of Schertz or other third parties to mitigate damages resulting from any surcharging or SSOs must be the direct and sole responsibility of the Contractor. This includes any related fines, penalties, or damages.

Plugs must be tested before use. The inflatable plug must be placed inside of a structurally sound pipe or conduit and inflated to its operating pressure, then monitored for 24 hr. to observe that it holds the required pressure. This testing must be performed in conformance with the manufacturer's recommendations. Inflating a plug, when it is not constrained, or overinflating the plug creates a risk of being injured by pieces of the plug exploding if it fails.

4.7. **Sewer Force Main Flushing and Testing.**

4.7.1. **Flushing.** Immediately upon completion of pipe laying, the Contractor must flush all mains which are scheduled to be tested. This flushing must be at the direction of the Engineer and must consist of completely filling sections of main between valves and then displacing such initial volumes of water by introducing clear water from existing facilities into and through the main to the point of discharge from the main being flushed. The flow-through must continue until the Engineer determines all dust, debris, or foreign matter that may have entered during pipe laying operations have been flushed out. The new line must then be left under system pressure for testing.

To avoid damage to pavement and inconvenience to the public, fire hoses must be used to direct flushing water from the main into suitable sewers.

4.7.2. **Operation of Valves.** No valve in the sanitary sewer force main system must be operated by the Contractor without prior permission. The Contractor must notify the Engineer when a valve is to be operated and must only operate the valve in the presence of the Engineer's representative.

4.7.3. **Hydrostatic Tests.** All new pressure mains must be hydrostatically field tested at a maximum test pressure of 200 psi before acceptance. It is the intent of these Specifications that all joints be watertight and that all joints which are found to leak by observation during any test must be made watertight by the Contractor.

All joints which are found to leak either by observation or during any test must be made watertight by the Contractor. In case repairs are required, the hydrostatic field test must be repeated until the pipe installation conforms to the specified requirements and is acceptable. The expense for tests which meets specified requirements must be made in conformance with the unit price for the hydrostatic pressure test. No payment will be made for tests which fail to meet specified test leakage requirements.

After the new main has been laid and backfilled as specified, but before replacement of pavement, it must be filled with water for a minimum of 24 hr. and then subjected to a hydrostatic pressure test.

The specified test pressure must be supplied by means of a pump connected to the main in a satisfactory manner. The pump, pipe connection, and all necessary apparatus including gauges and meters must be furnished by the Contractor. Unless otherwise specified, the City of Schertz must furnish potable water for filling lines and making tests through existing mains. Before applying the specified test pressure, all air must be expelled from the main. To accomplish this, taps must be made, if necessary, at the points of highest elevation and afterwards tightly plugged. At intervals during the test, the entire route of the new main must be inspected to locate any leaks or breaks. If any are found, they must be stopped or repaired. The test must be repeated until satisfactory results are obtained.

The hydrostatic test must be made so that the maximum pressure at the lowest point does not exceed the specified test pressure. The duration of each pressure test must be a minimum of 4 hr. for new mains in excess of 1,000 ft. after the main has been brought up to test pressure. The test pressure must be measured by means of a tested and properly calibrated pressure gauge. All pressure tests must be continued until the Engineer is satisfied that the new main meets the requirements of these Specifications. Should any test of pipe in place disclose leakage greater than as shown in Table 9, the Contractor must, at his expense, locate and repair the defective joints until the leakage is within the specified allowance. Leakage is defined as the quantity of water supplied into the newly laid main, or any valved section of it, necessary to maintain the specified leakage test pressure after the main has been filled with water and the air expelled. The Contractor must notify the Engineer before beginning the test, and the City of Schertz's Inspector must be present during the pressure test.

Table 9
Hydrostatic Test Leakage Allowances (Max) @ 200 psi

Nominal Diameter and Pipe Material	Allowable Leakage in Gallons Per Hour (gph) 2									
	100 ft.	200 ft.	300 ft.	400 ft.	500 ft.	600 ft.	700 ft.	800 ft.	900 ft.	1000 ft.
6 in. DI[1]	0.13	0.25	0.38	0.51	0.64	0.76	0.89	1.02	1.14	1.27
8 in. DI[1]	0.17	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70
12 in. DI[1]	0.26	0.51	0.77	1.02	1.28	1.53	1.79	2.04	2.30	2.55
16 in. DI[1]	0.34	0.68	1.02	1.36	1.70	2.04	2.38	2.72	3.06	3.40
20 in. DI[1]	0.43	0.85	1.28	1.70	2.13	2.55	2.98	3.40	3.83	4.25
24 in. DI[1]	0.51	1.02	1.53	2.04	2.55	3.06	3.57	4.08	3.59	5.10
30 in. DI[1]	0.64	1.27	1.91	2.55	3.19	3.82	4.46	5.10	5.73	6.37
36 in. DI[1]	0.76	1.53	2.29	3.06	3.82	4.58	5.35	6.11	6.88	7.64
42 in. DI[1]	0.89	1.78	2.68	3.57	4.46	5.35	6.24	7.14	8.03	8.92
48 in. DI1	1.02	2.04	3.06	4.08	5.10	6.11	7.13	8.15	9.17	10.19

1. PVC pipe must be tested to DI pressures. DI Pipe includes mechanical and push-on joints.
2. **Note—**Leakage allowances may be determined for footages not specifically listed by interpolation or by the combination of various tabular data.

4.7.4. **Contractor's Personnel and Equipment.** The Contractor must supply labor and equipment necessary to make all excavations required for flushing, equipment connections, and placing the mains in service.

4.7.5. **Safeguarding and Backfilling Open Holes.** The Contractor must be responsible for safeguarding any open holes excavated or left open for flushing and testing purposes. Following completion of testing, the Contractor must backfill such holes in accordance with these Specifications.

4.8. **Rehabilitation of Sanitary Sewer by Cured-In-Place Pipe Testing.**

4.8.1. **Chemical Resistance.** The CIPP must meet the chemical resistance requirements of ASTM F 1216, Appendix X2 except as modified herein. Table X2.1 of ASTM F 1216 must be modified as follows. It is required that CIPP samples, with and without plastic coating, meet these chemical testing requirements. Proof of a chemical resistance test must be provided to the Engineer at least 15 days before commencement of work.

Table 10

Chemical Solution	Concentration %
tap water	pH of 5 to 11
acids	pH not less than 5
gasoline	Total BETX limit of 100 mg/L
oil & grease	50 mg/L
total phosphorous	40 mg/L
sodium hydroxide and other strong bases	pH not higher than 11
ferric chloride	3 mg/L
sodium hypochlorite	3 mg/L

Note—BETX is benzene, toluene, ethylbenzene, and xylene.

4.8.2. **Hydraulic Capacity.** The Contractor must submit design calculations verifying that the CIPP must have flow capacity equal to at least 100% of the existing pipe. Flow capacity calculation must be based on Manning's formula using n (Manning's roughness coefficient) of 0.013 for existing sewer. The "n" value for CIPP used must have been verified by an independent testing laboratory (third party testing) which the Contractor must provide.

4.8.3. **Samples.** For each CIPP liner section installed, the Contractor must obtain CIPP samples large enough to provide a minimum of 3 specimens and a recommended 5 specimens for flexural testing. CIPP samples must be prepared, and physical properties tested in accordance with ASTM F 1216 or ASTM F 1743, Section 8, using either method proposed. The properties must meet or exceed the values listed in this Specification. If test results do not meet the properties, Contractor must remove and replace CIPP at no additional cost.

4.8.4. **Television Inspection.** Visual inspection of the CIPP must be in accordance with ASTM F 1743, Section 8.6, and these Specifications.

4.9. **Reconstruction of Sanitary Sewer by Pipe Bursting Replacement Process Testing.** After the existing sewer is completely replaced, internally inspect with television camera and DVD as required. The finished tape must be continuous over the entire length of the sewer between two manholes and to be free from visual defects.

Defects which may affect the integrity or strength of the pipe in the opinion of the Engineer must be repaired or the pipe must be replaced at the Contractor's Expense.

The Contractor must smoke test to verify all sewer service connections.

The following Items are excerpted from 30 TAC § 217 requirements for gravity sewer construction testing. Compliance with these requirements is required unless the Contractor obtains and provides written authorization from the TCEQ authorizing alternative testing and compliance procedures.

Testing of Installed Pipe: An infiltration, exfiltration, or low-pressure air test must be specified. Copies of all test results must be made available to the executive director (TCEQ) upon request. Test must conform to the following requirements:

Infiltration or Exfiltration Tests: The total exfiltration as determined by a hydrostatic head test must not exceed 50 gal. per in. diameter per mile of pipe per 24 hr. at a minimum test head of 2 ft. above the crown of the pipe at the upstream manhole. When pipes are installed below the groundwater level, an infiltration test must be used instead of the exfiltration test. The total infiltration, as determined by a hydrostatic head test, must not exceed 50 gal. per in. diameter per mile of pipe per 24 hr. at a minimum test head of 2 ft. above the crown of the pipe at the upstream manhole, or at least 2 ft. above existing groundwater level, whichever is greater. For construction within the 25 yr. flood plain, the infiltration or exfiltration must not exceed 10 gal. per in. diameter per mile of pipe per 24 hr. at the same minimum test head. If the quantity of infiltration or exfiltration exceeds the maximum quantity specified, remedial action must be undertaken to reduce the infiltration or exfiltration to an amount within the limits specified.

Low Pressure Air Test: Perform in accordance with this Specification.

Deflection Testing: Perform in accordance with this Specification.

Cleanup and Restoration: Any damage to existing utilities, structures, storm drain systems, curbs, sprinkler systems, mailboxes, driveway, etc., must be repaired as directed. All repairs and replacements must be made at the Contractor's expense. Upon acceptance of the installation work and testing, the Contractor must clean up and restore the project area affected by operations. Daily cleanup of the project site to the satisfaction of the Engineer must also be required.

5. MEASUREMENT

5.1. **Sewer Excavation and Non-stabilized Backfill.** Sewer excavation and non-stabilized backfill will not be measured for payment and must be considered subsidiary to the sewer line installation.

5.2. **Trench Excavation Protection.** Trench excavation safety protection must be measured by the foot along the centerline of any OSHA defined trench that may be entered by personnel and is not greater than 15 ft. wide, including manholes and other structures.

5.3. **Sanitary Sewers.** Longitudinal measurement of sanitary sewers must be made along the centerline of the sewer from center of manhole to center of manhole or end of main by the foot of the various sizes and types (when a specific type is required) of sewers as shown on the plans, in accordance with this Specification, complete and accepted.

One-way cleanouts must be installed in all laterals at the customer's property line and must be measured for payment by each installed.

Plugging existing sewer lines must be considered subsidiary to the pipe installation.

Casing installed in open trenches, where required by the plans, of the size and material required must be measured by the foot installed as shown on the plans.

5.4. **Sanitary Sewer Laterals.** Sanitary sewer laterals must be measured by the foot installed at the various diameter sizes. The measured dimension must be taken from the centerline of the main to the connection at, or just inside, the customer's property line. Measurement must be continuous through any fittings in the main. Wyes, tees, and bends of any kind must not be paid for separately for laterals but must be measured for payment by the foot of lateral to be installed.

5.5. **Force Mains.** Longitudinal measurement of force mains must be made along the centerline of the sewer from fitting to fitting or end of main by the foot of the various sizes and types (when a specific type is required) of force mains as shown on the plans, in accordance with this Specification, complete and

accepted. Hydrostatic pressure test must not be measured separately but must be inclusive of the force main installation and must be considered subsidiary to the force main bid Item.

Tie-In (complete) must be measured as each of the various sizes and types completed.

Restraint anchor must not be measured separately, must be inclusive of the force main installation, and must be subsidiary to the force main bid Item.

5.6. **Jacking, Boring, or Tunneling.** Jacking, Boring, or Tunneling must be measured by the foot of bore or tunnel as measured from face to face of jacking pits.

Carrier pipe used in bores and tunnels or backed into place must be measured by the foot of pipe installed from end to end of pipe to the limits as shown on the plans.

Casing or liners of the size and material required must be measured by the foot actually installed as shown on the plans.

5.7. **Steel Casing Installed in Open Cut.** "Pipe Sewer Main (Steel Casing) (Open Cut)" for sewer pipe of the various sizes as shown on the plans must be measured by the foot.

5.8. **Vertical Stacks.** Vertical Stacks must be measured by the foot. Footage must be computed as the dimension from the top of the lateral (where it appears in the trench wall) to the invert of the sewer main.

5.9. **Sanitary Sewer Cleanouts.** "Sanitary Sewer Cleanout" must be measured by each cleanout of the size and type (when a specific type is required) as shown on the plans.

5.10. **Sanitary Sewer Structures.** Manhole structures must be measured by each manhole structure. Manhole structures must be installed where any pipe intercepted is larger than 24 in. in diameter. Rings and water-tight covers, concrete ring encasement, and I&I barriers must not be measured for payment but will be considered subsidiary to the manhole.

5.11. **Pre-Cast Manholes.** Manholes to 6 ft. deep and as shown on the plans must be measured by each type of manhole including those exceeding 6 ft. in depth, from the lowest invert elevation to the top of the ring. Rings and watertight covers, concrete ring encasement, and I&I barriers must not be measured for payment but will be considered subsidiary to the manhole.

Manholes deeper than 6 ft. must be measured by the number of feet in excess of 6 ft. as measured vertically.

5.12. **FRP Manholes.** FRP manholes to 6 ft. deep and as shown on the plans must be measured by each type of manhole including those exceeding 6 ft. in depth, from the lowest invert elevation to the top of the ring. Rings and water-tight covers, concrete ring encasement, and I&I barriers must not be measured for payment but will be considered subsidiary to the FRP manhole.

Manholes deeper than 6 ft. must be measured by the number of feet in excess of 6 ft. as measured vertically.

5.13. **Doghouse Manholes.** Manholes up to 6 ft. deep and as shown on the plans must be measured by each type of manhole including those exceeding 6 ft. in depth from the lowest invert elevation to the top of the ring. Rings and watertight covers, concrete ring encasement, and I&I barriers must not be measured for payment but will be considered subsidiary to the manhole.

Manholes deeper than 6 ft. must be measured by the number of feet in excess of 6 ft. as measured vertically.

5.14. **Abandoned Manholes.** Manholes abandoned and excavation & backfill required must not be measured for payment but will be considered subsidiary to other Items.

5.15. **Sanitary Sewer Bypass Pumping.** Measurement for the work specified herein must be by lump sum for either “Small Diameter Sanitary Sewers” or “Large Diameter Sanitary Sewers” as defined herein. Any effort required for multiple setups and operations must be included in the lump sum price. Measurement of the work for pipe plugs will be incidental to the work and must not have a separate pay Item. Any damages, repairs, etc. to private or public property will not be considered for any additional payment.

5.16. **Select Backfill.** Cement stabilized backfill must be measured by the cubic yard in accordance with the backfill diagram as shown on the plans.

5.17. **Flowable Fill.** Flowable backfill must be measured by the cubic yard based on the dimensions and depths as shown on the plans or as directed.

5.18. **Select Bedding Material.** Where directed to be used for rigid pipe installations, select bedding material must be measured by the cubic yard as shown on the plans. Select bedding material is always required for flexible pipe installation; therefore, it will not be measured for payment.

5.19. **Concrete Encasement, Cradles, Saddles, and Collars.** Concrete encasement, cradles, saddles, and collars for pipe must be measured by the cubic yard as shown on the plans or as directed. Reinforcing, if required, will not be measured.

5.20. **Concrete Curb, Sidewalks, Driveways, Islands, and Medians.** For concrete curbs, sidewalks, driveways, islands, and medians required to be removed and replaced due to placement of sewer lines, removal of the existing concrete must be measured by the foot or by the square yard as dimensioned and as shown on the plans.

5.21. **Cut and Restore Pavement.** The work to be done in the cutting and restoring of pavement must be measured by the square yard as shown on the plans.

5.22. **Television Inspection.** Measurement and payment must be made for the work to be done on the basis of the unit bid price per foot of pipe diameters 8 in. through 15 in., 18 in. through 27 in., and 30 in. & larger, and will be considered full compensation for all labor, materials, equipment, tools, logging, cleaning, bypass pumping, and incidentals necessary to complete the work.

5.23. **Automatic Air Release Valve.** Automatic Air Release Valve must be measured as each assembly of the size installed.

5.24. **Ductile-Iron Fittings.** Ductile-iron and gray-iron fittings must be measured by their weight as listed in Table 10 of this Specification of the various sizes of fittings installed.

Table 11
Weights of Gray Iron and Ductile Iron Fittings (lb.)

BENDS							
Size (In.)	**MJ Compact (C153)**	**MJ (C110)**	**FLG SB**	**Size (In.)**	**MJ Compact (C153)**	**MJ (C110)**	**FLG SB**
1/4 Bend (90°)				1/8 Bend (45°)			
4	25	55	44	4	21	51	36
6	43	86	67	6	35	75	57
8	61	125	115	8	50	110	105
12	119	258	236	12	96	216	196
16	264	454	478	16	200	345	315
20	447	716	878	20	337	555	485
24	602	1,105	1,085	24	441	777	730
30	979	1,740	1,755	30	775	1,393	1,355
36	1,501	2,507	2,135	36	1,140	2,163	1,755
42	2,277	3,410	3,055	42	1,652	2,955	2,600
48	3,016	4,595	4,095	48	2,157	4,080	3,580

BENDS							
Size (In.)	MJ Compact (C153)	MJ (C110)	FLG SB	Size (In.)	MJ Compact (C153)	MJ (C110)	FLG SB
1/16 Bend (22-1/2°)				1/32 Bend (11-1/4°)			
4	18	50	35	4	17	50	40
6	32	75	64	6	30	73	56
8	46	110	90	8	42	109	90
12	85	220	194	12	74	220	193
16	175	354	315	16	153	354	315
20	314	550	505	20	265	553	505
24	414	809	528	24	339	815	760
30	668	1,500	1,385	30	603	1,410	1,395
36	963	2,182	1,790	36	830	2,195	1,805
42	1,354	3,020	2,665	42	1,210	3,035	2,680
48	1,790	4,170	3,665	48	1,523	4,190	3,695

TEES				
Size (in.)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
3	3	26	56	53
4	3	31	76	54
	4	33	80	60
6	4	49	114	90
	6	60	124	98
8	4	65	163	155
	6	76	175	148
	8	89	188	179
12	4	99	316	322
	6	115	325	297
	8	127	339	346
	12	162	407	369
16	6	226	563	573
	8	240	565	555
	12	283	615	590
	16	326	676	635
20	6	344	750	773
	8	371	766	720
	12	427	799	816
	16	503	975	950
	20	566	1,068	1,005

TEES				
Size (in.)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
24	6	466	1,035	1,089
	8	487	1,047	1,060
	12	539	1,075	1,125
	16	625	1,109	1,070
	20	729	1,504	1,510
	24	785	1,617	1,685
30	8	739	1,808	-
	12	800	1,842	1,801
	16	959	1,885	-
	20	1,026	1,941	-
	24	1,228	2,496	2,475
	30	1,373	2,531	2,615
36	24	1,548	2,710	2,255
	30	1,901	3,545	3,000
	36	2,012	3,686	3,160
42	24	2,272	3,690	3,245
	30	2,512	4,650	4,125
	36	3,048	5,119	5,360
	42	3,225	6,320	5,580
48	24	2,934	4,995	4,385
	30	3,147	5,140	4,455
	36	4,046	6,280	5,555
	42	4,249	8,130	7,195
	48	4,469	8,420	7,385

CROSSES				
Size (in.)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
3	3	34	70	-
4	3	42	90	-
	4	46	105	-
6	4	63	140	-
	6	74	160	160
8	4	88	185	185
	6	97	205	205
	8	105	239	234
12	4	114	340	-
	6	135	360	360
	8	151	382	385
	12	199	493	495
16	6	250	590	575
	8	270	619	605
	12	332	685	-
	16	409	811	790
20	6	358	760	-
	8	379	822	790
	12	413	883	860
	16	550	1,117	1,085
	20	598	1,274	1,230

CROSSES				
Size (in.)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
24	6	566	1,025	-
	8	578	1,085	1,045
	12	610	1,153	1,110
	16	663	1,256	1,200
	20	975	1,733	1,675
	24	907	1,906	1,835
30	8	650	1,795	-
	12	870	1,925	1,865
	16	900	1,950	-
	20	1,220	2,060	-
	24	1,497	2,776	2,675
	30	1,808	3,188	3,075
36	24	1,853	2,928	2,980
	30	2,580	3,965	-
	36	2,698	4,370	4,370
42	24	2,415	3,910	-
	30	2,920	5,040	-
	36	3,788	5,835	-
	42	3,908	6,493	7,145
48	24	3,435	5,210	-
	30	4,145	5,495	-
	36	4,873	6,790	-
	42	5,465	8,815	-
	48	5,588	9,380	-

CAPS			PLUGS	
Size (in.)	MJ Compact (C153)	MJ (C110)	MJ Compact (C153)	MJ (C110)
4	10	17	12	16
6	16	29	19	28
8	24	45	30	46
12	45	82	54	85
16	95	160	97	146
20	141	235	146	218
24	193	346	197	350
30	362	644	381	626
36	627	912	688	884
42	893	1,322	1,200	1,222
48	1,076	1,737	1,550	1,597

SOLID SLEEVES				
Size (In.)	Weight			
	MJ Short Compact (C153)	MJ Long Compact (C153)	MJ Short (C110)	MJ Long (C110)
4	17	21	35	46
6	28	35	45	65
8	38	48	65	86
12	57	77	113	143
16	127	172	192	257
20	201	258	258	359
24	264	337	340	474
30	500	651	690	1,005
36	725	960	947	1,374
42	877	1,209	1,187	1,628
48	1,406	1,516	1,472	2,033

CONCENTRIC REDUCERS			
Size (In.)			Weight
Large End	Small End	MJ Compact (C153)	MJ (C110)
6	4	27	59
8	4	38	81
8	6	41	95
12	4	70	136
12	6	69	150
12	8	70	167
16	6	134	234
16	8	136	258
16	12	126	310
20	12	213	427
20	16	221	492
24	12	304	562
24	16	315	633
24	20	315	727
30	16	596	1,027
30	20	599	1,085
30	24	492	1,204
36	20	1,042	1,459
36	24	785	1,580
36	30	655	1,868
42	24	1,356	2,060
42	30	1,112	2,370
42	36	1,116	2,695
48	30	1,722	3,005
48	36	1,650	3,370
48	42	1,429	3,750

2 In. Tapped Tees and Crosses		
Size (In.)	Weight	
	MJ Compact (C153)	MJ (C110)
4	24	47
6	36	71
8	54	97
10	69	130
12	87	169
20	-	259
24	-	320

OFFSETS		
Size (In.)	Weight	
	MJ Compact (C153)	MJ (C110)
4 x 6	35	75
4 x 12	55	83
6 x 6	35	110
6 x 12	67	138
6 x 24	96	189
8 x 6	82	164
8 x 12	98	209
8 x 24	141	280
12 x 6	121	320
12 x 12	178	420
12 x 24	240	645
20 x 12	-	1,025
20 x 24	-	1,245

5.25. **Hydrostatic Pressure Test.** Hydrostatic pressure test must be measured as each successful test conducted on sanitary sewer force mains only. Hydrostatic testing of manholes will not be measured for payment.

5.26. **Rehabilitation of Sanitary Sewer by Cured-In-Place Pipe.** This Item must be measured by the foot, based on the measured distance of existing sanitary sewer line to be rehabilitated from centerline of manhole to centerline of manhole.

5.27. **Point Repair.** Measurement for sewer line point repair is on a unit price basis for each repair performed. Minimum length of pipe to be replaced for each repair, determined by depth of sewer line measured from natural ground to flow line at point of repair. Is 9 ft. minimum length. Measurement for sewer line extra length point repair is on a foot basis in excess of minimum replacement length specified above.

5.28. **Obstruction Removal.** Obstruction removal by excavation must be paid per each obstruction removal performed. Obstruction removal can be submitted for payment when the obstruction has been cleared from the sewer line to be lined. Liner work must proceed at least 6 ft. before payment for removal of another obstruction will be considered (i.e., all obstruction within a distance of 6 ft. is considered to be part of the same obstruction).

5.29. **Reconstruction of Existing Manholes.** All reconstructed manholes must be measured by the unit of each manhole (any type or size) regardless of the type shown on the Contract documents.

5.30. **Existing Manhole Adjustments.** Manholes completely adjusted, as prescribed above, must be measured by the unit of each manhole adjusted. The excavation and the amount of flowable fill, reinforced concrete, or any other material as necessary to fill the area excavated, will not be measured for payment.

5.31. **Cleaning Manhole and Mains.** Sanitary sewer manhole and mainline cleaning will not be measured for payment and will be subsidiary to rehabilitation of manholes and lines.

5.32. **Reconstruction of Sanitary Sewer by Pipe Bursting Replacement Process.** All pipe bursting installations must be measured from center of manhole to center of manhole or end of main. Measurement must be continuous through any fittings in the main.

5.33. **Sliplining Sanitary Sewers.** Measurement for sliplining is on a by foot basis for installed liner pipe, measured from centerline of upstream manhole to centerline of downstream manhole. Depth range for

payment is based on depth measured at sewer main from natural ground level to flow line of sanitary sewer for each pipeline segment.

5.34. **Grouting of Sewer Mains.** All type of pipe abandonment with grout, including asbestos-concrete pipe, must be measured per foot for each size diameter of pipe, irrespective of the depth of the main, which will include the cost of removing the content within the pipe, cleaning, grouting, plugging, capping and abandoning all pipe, pipe bend section, and all other appurtenances, and for dewatering, trenching, excavation and backfill, removal, transportation and disposal, and all material or work necessary to properly abandon the pipe.

5.35. **Remove Existing Sewer Lines.** "Remove Existing Sewer Lines" must be measured by the foot of line removed of the various sizes at the locations as shown on the plans.

5.36. **Remove Existing Manholes.** "Remove Existing Manholes" must be measured by each manhole removed.

6. PAYMENT

6.1. **Sewer Excavation.** Payment for sewer excavation and non-stabilized backfilling in accordance with these Specifications will not be paid for directly but must be included in the unit price bid for the sanitary sewer pipe installation. Select bedding and stabilized backfill must be paid for under their own Items of work.

6.2. **Trench Excavation Protection.** Payment must be made at the unit price bid per foot for "Sanitary Sewer Trench Excavation Protection" in place. This price will be full compensation for all labor, equipment, materials, tools, all components of the trench protection system which can include, but not limited to, sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate and acceptable drainage, any additional excavation or backfill required, jacking, jack removal, removal of the trench support after completion, and all other labor, materials, tools, equipment, and incidentals necessary to complete the work.

6.3. **Sanitary Sewers.** Payment must be made at the unit price bid per foot, and will be full compensation for all labor, equipment, materials, tools, and incidentals for "Sanitary Sewers" of the size and type (when a specific type is required) as shown on the plans.

Sanitary sewer service connections must be paid for at the unit price bid which will be full compensation for all labor, equipment, materials, tools, and incidentals for "Sanitary Sewers (Lateral Pipe)" of the size specified per foot.

Casings installed in open cut trenches must be paid for at the Contract unit price bid for "Sanitary Sewer Casing Open Cut" per foot which will be full compensation of casing installed and measured as prescribed above.

6.4. **Sanitary Sewer Laterals.** Payment must be made at the unit price bid which will be full compensation for all labor, equipment, materials, tools, and incidentals for "Sanitary Sewer Lateral" of the size and type (when a specific type is required) as shown on the plans per foot.

6.5. **Force Mains.** Force mains must be paid for at the unit price bid which will be full compensation for all labor, equipment, materials, tools, and incidentals for "Force Mains" of the size and type as shown on the plans per foot.

6.6. **Jacking, Boring, or Tunneling.** "Sanitary Sewer (Jack, Bore, or Tunnel)" must be paid for at the Contract unit price bid per foot of jacking, boring, or tunneling, which will be full compensation for furnishing all materials (except carrier pipe, casings, or liners), labor, tools, equipment, and incidentals necessary to complete the work, including excavation, grouting, backfilling, restoration to original ground conditions, and disposal of surplus materials.

Carrier pipe will be paid for at the Contract unit price bid which will be full compensation for "Sanitary Sewer Carrier Pipe in Casing" per foot of pipe installed and measured as prescribed above.

Steel casings or liners must be paid for at the Contract unit price bid which will be full compensation for "Sanitary Sewer Jack, Bore, Tunnel Pipe (Steel)" or "Liner" per foot of steel casing or liner installed and measured as prescribed above.

6.7. **Steel Casing Installed in Open Cut.** Steel casings installed via open cut must be paid for at the Contract unit price bid which will be full compensation for "Pipe Sewer Main (Steel Casing) (Open Cut)" per foot for the various sizes as shown on the plans and measured as prescribed above.

6.8. **Vertical Stacks.** Payment must be made at the unit price bid per foot which will be full compensation for all labor, equipment, materials, tools, and incidentals.

6.9. **Sanitary Sewer Cleanouts.** Payment must be made at the unit bid price for "Sanitary Sewer Cleanout" of the size and type (when a specific type is required) as shown on the plans per each which will be full compensation for all labor, equipment, materials, tools, and incidentals.

6.10. **Sanitary Sewer Structures.** Payment for manholes structures, including the stack, rings, watertight covers, steps, concrete ring encasement, and I&I barriers must be made at the unit price bid for "Sanitary Sewer Structures" of the type specified per each which will be full compensation for all labor, equipment, materials, tools, and incidentals.

Payment for extra depth structures must be made at the unit price bid per foot as measured vertically.

6.11. **Pre-Cast Manholes.** Payment for pre-cast manholes, including the stack, rings, watertight covers, steps, concrete ring encasement, and I&I barriers must be made at the unit price bid for "Sanitary Sewer Precast Manholes" of the type specified per each which will be full compensation for all labor, equipment, materials, tools, and incidentals.

Payment for extra depth manholes must be made at the unit price bid per foot as measured vertically.

6.12. **FRP Manholes.** Payment for FRP manholes, including the stack, rings, watertight covers, concrete ring encasement, and I&I barriers must be made at the unit price bid for "Sanitary Sewer FRP Manholes" of the type specified per each which will be full compensation for all labor, equipment, materials, tools, and incidentals.

Payment for extra depth FRP manholes must be made at the unit price bid per foot as measured vertically.

6.13. **Doghouse Manholes.** Payment for doghouse manholes, including the stack, rings, watertight covers, steps, concrete ring encasement, and I&I barriers must be made at the unit price bid for "Sanitary Sewer Manhole (Doghouse)" of the type specified per each which will be full compensation for all labor, equipment, materials, tools, and incidentals.

Payment for extra depth manholes must be made at the unit price bid per foot as measured vertically.

6.14. **Abandoned Manholes.** Manholes abandoned must not be paid for separately.

6.15. **Sanitary Sewer Bypass Pumping.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" must be paid for at the unit price bid for "Bypass Pumping for Small Diameter Sanitary Sewers" or "Bypass Pumping for Large Diameter Sanitary Sewers." Payment of the "Lump Sum" bid for bypass pumping will be in conformance with the following:

- When initial setup and operation of the bypass pumping system begins (including a successful test), 20% of the "Lump Sum" cost must be paid as applicable to stationary bypass pumping to include flow diversion if used.
- 60% of the "Lump Sum" cost must be paid over equal monthly payments (estimated from the BPP or other documentation approved by the Inspector) during the course of the bypass pumping operation as applicable to stationary bypass pumping to include flow diversion if used.

- 20% of the remaining “Lump Sum” cost must be paid upon an acceptable removal or disassembly of all components of the BPP, including site cleanup as applicable to stationary bypass pumping to include flow diversion if used.

Any effort required for multiple setups and operations must be included in the lump sum price.

For multi-bypass pumping setups, payment must be proportional to the overall amount of the established bid line Item.

6.16. **Select Backfill.** Payment must be made for “Cement Stabilized Backfill” at the unit price bid for “Sanitary Sewer (Cement Stabilized Backfill)” per cubic yard which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work.

6.17. **Flowable Fill.** Payment for flowable backfill must be made at the unit price bid for “Sanitary Sewer Flowable Fill” per cubic yard which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work.

6.18. **Select Bedding Material.** Payment for “Select Bedding Material” for rigid pipe installations must be made at the unit price bid for “Sanitary Sewer (Select Bedding)” per cubic yard. The select bedding for flexible pipes will not be paid for directly but will be subsidiary to the flexible pipe.

6.19. **Concrete Encasement, Cradles, Saddles, and Collars.** Payment must be made at the unit price bid for “Concrete Encasement,” “Concrete Cradles,” “Concrete Saddles,” and “Concrete Collars” per cubic yard which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work.

6.20. **Concrete Curbs, Driveways, Sidewalks, Islands, and Medians.** Payment for replacement of curbs, driveways, sidewalks, islands, and medians must be made at the unit price bid for “Sanitary Sewer (Concrete Sidewalk),” “Sanitary Sewer (Concrete Driveway),” “Sanitary Sewer (Concrete Islands),” “Sanitary Sewer (Concrete Medians),” and “Sanitary Sewer (Concrete Curb)” per square yard which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work.

6.21. **Cut and Restore Pavement.** Payment must be made at the unit price bid for “Sanitary Sewer (Cut and Restore Pavement)” per square yard which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work.

6.22. **Television Inspection.** The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” must be paid for at the unit price bid for “Sanitary Sewer Pre-Television Inspection” or “Sanitary Sewer Post-Television Inspection” per foot of the pipe sizes as shown on the plans. This price will be full compensation all labor, materials, equipment, tools, logging, and all incidentals necessary to complete the work.

6.23. **Automatic Air Release Valve.** Payment for “Automatic Air Release Valve” must be made at the unit price bid for “Sanitary Sewer (Automatic Air Release Valve) (Complete)” and will be full compensation for each assembly of the various sizes installed as shown on the plans. This payment will also include selected embedment material, anti-corrosion embedment when specified, blocking, and various sizes and types of meter boxes.

6.24. **Ductile-Iron Fittings.** Payment for “Ductile-Iron Fittings” must be made at the unit price bid for “Sanitary Sewer (Ductile-Iron Fittings)” and will be full compensation for each ton of fittings of all sizes and types installed and will be based upon the weights of fittings shown in Table 10.

6.25. **Hydrostatic Pressure Test.** Payment for “Hydrostatic Pressure Test” must be made at the unit price bid for “Sanitary Sewer (Hydrostatic Pressure Test)” and will be full compensation for each successful test conducted on sanitary sewer force mains only. No direct payment will be made for hydrostatic testing manholes.

No direct payment will be made for concrete blocking of sanitary sewer force mains; furnishing and installing the joint restraint system; coating and wrapping pipe joints; polyethylene wrapping; trench excavation below specified limits; excavation and removal of unsuitable material at bottom of trench grade and restoration with approved material; supporting pipe or conduits of public utilities; and flushing sanitary sewer force mains. This work will be considered subsidiary to the various bid Items.

6.26. **Rehabilitation of Sanitary Sewer by Cured-in-Place Pipe.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" must be paid for at the unit price bid for "Rehabilitation of Sanitary Sewer by Cured-in-Place Pipe" per foot. This price must be full compensation for all labor, equipment, materials, tools, pre-rehabilitation line cleaning, water, cleanup, dump sites and hauling of debris, labor, materials and equipment used in replacing bases and pavements, access to right of ways and easements as necessary, removal of equipment due to bad ground or poor pipe conditions, and other incidentals necessary to complete the work for either method of sanitary sewer line rehabilitation.

6.27. **Point Repair.** The work performed and materials furnished in accordance with this Item and measured under "Measurement" must be paid for at the unit price bid for "Sanitary Sewer Point Repair," per each for sizes and types constructed (when a specific type is required), regardless of depth. This price will include all materials, including pipe, trenching, pumping, shoring and bracing, sand cushion, concrete plugs, laying and jointing, backfilling, tapping, water, labor, tools, equipment, pavement work, and all incidentals necessary to complete the work.

Payment for sewer line extra length must be in accordance with this Item and measured under "Measurement" and must be paid for at the unit price bid for "Sanitary Sewer (Point Repair Sewer Line Extra Length)," per foot for sizes and types constructed (when a specific type is required), regardless of depth. This price must include all materials, including pipe, trenching, pumping, shoring and bracing, sand cushion, concrete plugs, laying and jointing, backfilling, tapping, water, labor, tools, equipment, pavement work, and all incidentals necessary to complete the work.

6.28. **Obstruction Removal.** The work performed and materials furnished in accordance with this Item and measured under "Measurement" must be paid for at the unit price bid for "Sanitary Sewer Obstruction Removal," for sizes and types constructed (when a specific type is required), regardless of depth. This price will include all materials, labor, tools, equipment, pavement work and all incidentals necessary to remove obstructions.

6.29. **Reconstruction of Existing Manholes.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" must be paid for at the unit price bid for "Reconstruction of Existing Manholes." This price will be full compensation for materials, labor, equipment, tools, testing, and all incidentals necessary to complete the work.

6.30. **Existing Manhole Adjustments.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" must be paid for at the unit price bid for "Existing Manhole Adjustments." This price will be full compensation for materials, labor, equipment, tools, testing, and all incidentals necessary to complete the work.

6.31. **Cleaning Manholes and Mains.** All work described by this Item will be subsidiary to rehabilitation of manholes and lines.

6.32. **Reconstruction of Sanitary Sewer by Pipe Bursting Replacement Process.** The inserted pipe must be paid for per foot of pipe installed using pipe-bursting and crushing method for the pipe diameter, type, quantity, and depth specified and will be full compensation for all labor, equipment, materials, tools, incidentals, all pipe installation materials, all submittals, sealing materials at manholes and annulus (if required), launching pits, receiving pits, post testing, shoring, bedding, backfill, and all necessary, corresponding, and related work specified herein.

6.33. **Sliplining.** Payment must be made at the unit price bid which will be full compensation for all labor, equipment, materials, tools, and incidentals for "Sliplining" of the size and type (when a specific type is required) as shown on the plans per foot.

Insertion pits, access pits, clamp installation, embedment (bedding, haunching, and initial backfill), field quality control (testing), sealing liner at manholes, grouting annular space, building up, shaping and reworking manhole inverts and benches, and pre-installation and post-installation cleaning, and television inspection of completed work are included in the sliplining unit price and not paid for separately.

Excavations initially begun as obstruction removals or point repairs which the Contractor later decides to use as insertion pits are not paid for separately.

Trench safety systems, well pointing, and other applicable bid Items associated with insertion pits must be paid for at their respective Contract unit prices.

6.34. **Grouting of Sewer Mains.** Payment for "Grout Abandonment Sewer Main" must be made on the Contract unit price per foot per each size diameter of pipe at locations as shown on the plans. Said price will be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the work.

6.35. **Remove Existing Sewer Lines.** "Remove Existing Sewer Lines," must be paid for at the unit price bid, measured as provided under "Measurement," regardless of the depth of the main, which will include the cost of coordination; potholing; dewatering of pipe; groundwater dewatering; trench excavation; removing the utility; transporting and legal disposing of the utility; backfill and surface restoration; and all labor, equipment, tools, and materials necessary to remove the pipe, pipe bends, and all other appurtenances including existing casing.

6.36. **Remove Existing Manholes.** "Remove Existing Manholes," must be paid for at the unit price bid, measured as provided under "Measurement," which will include the cost of coordination; dewatering of manhole; groundwater dewatering; excavation; shoring; removing the manhole; transporting and legal disposing of the manhole; backfill and surface restoration; and all labor, equipment, tools, and materials necessary to remove the manhole and all other appurtenances.

Special Specification 7330
Water Mains and Service Lines

1. DESCRIPTION

Provide and install a complete water main system as shown on the plans and in accordance with the Specifications and the Department's Utility Accommodation Policy (UAP) (43 TAC § 21.31–21.55). The water mains must be as shown on the plans. The water mains must include all pipe, joints and connections to new and existing pipes, valves, fittings, fire hydrants, pipe joint restraint systems, blocking, and other items required to complete the work.

The abbreviations AWWA, ASA, ASTM, ANSI, and NSF, as used in this Specification, refer to the following organizations or technical societies:

- **AWWA.** American Water Works Association;
- **ASA.** American Standards Association;
- **ASTM.** American Society for Testing and Materials;
- **ANSI.** American National Standards Institute; and
- **NSF.** National Science Foundation.

Where reference is made to specifications of the above organizations, it is construed to mean the latest standard in effect on the date of the proposal.

2. MATERIALS

All materials used in this project must be new and unused unless otherwise shown on the plans or in accordance with the Specifications or the proposal.

2.1. **Ductile Iron Pipe (DIP) and Fittings.**

2.1.1. **Ductile Iron Pipe (DIP): 3 in–64 in.** All DIPs should be manufactured using the centrifugal casing process and in accordance with ANSI/AWWA C 151/A 21.51.91, unless otherwise modified or supplemented herein.

The pipe should be in accordance with Table 1, including the pressure classes based on Type 3 bedding conditions, burial depth of 6 ft., and working pressure of 150 psi.

Table 1
Pipe Pressure Classes

Pipe Inside Diameter	Pressure
2"–3"	350 psi
16"–20"	250 psi
24"	200 psi
30"–64"	150 psi

Dimensions and tolerances for each nominal pipe size must be in accordance with AWWA C 151, Table 51.5 (push-on) or Table 51.5 (mechanical joint), for pipe with a nominal laying length of 20 ft.

All pipes should have standard water works interior cement mortar lining applied in accordance with ANSI/AWWA C 104/A 21.4. No asphaltic coating will be required on the interior cement mortar lining.

Exterior coating must consist of a nominal 1-mil thick asphaltic material applied to the outside of the pipe in accordance with AWWA C 151, Section 51.8.

Rubber joint gaskets used on DIP must be in accordance with ANSI/AWWA C 111/A 21.11. Each length of pipe must bear identification markings in accordance with AWWA C 151, Section 51.10. The manufacturer should take adequate measures during pipe production to assure compliance with AWWA C 151 by performing quality control (QC) tests and maintaining results of those tests in accordance with Section 51.14 of that standard.

The City of Schertz may, at no cost to the manufacturer, subject random lengths of pipe for testing by an independent laboratory in accordance with this Specification. Any visible defects or failure to meet quality standards herein will be grounds for rejecting the entire order.

2.1.2. **Fittings for Ductile Iron Pipe (DIP), Polyvinyl Chloride (PVC) C900, or PVC C950.** This Section covers ductile iron fittings 3 in.–48 in. in size. These fittings are designed and manufactured for use with gray iron, ductile iron, PVC C900, or PVC C905 pipe. The joint types for the standard, compact, and anchor fittings are flanged and mechanical joints.

Unless otherwise modified or supplemented herein, AWWA C 110 for gray iron and ductile iron fittings, 3 in.–48 in. for water and other liquids, and AWWA C 153 for ductile iron compact fittings govern the design, manufacture, and testing of all fittings.

For 3-in.–24-in. size range, the pressure rating of all fittings should be at least 250 psi. The working pressure for all fittings of size greater than 24 in. should be at least 150 psi, unless a change in pressure rating is directed by purchase documents.

Fittings must be furnished with the types of end combination specified. Flanged fittings must be faced and drilled in accordance with ANSI B 16.1, Class 125. Anchor fittings must be furnished in size and type or length as specified.

The exterior of all fittings must be provided with a petroleum asphaltic coating in accordance with AWWA C 110. The interior of flanged fittings in accordance with this Specification must be either cement-mortar lined in accordance with AWWA C 104 or lined with a petroleum asphaltic material in conformance with the AWWA standard specified. The interior of all other fittings in accordance with this Specification must be cement-mortar lined in accordance with AWWA C 104.

Two-inch fittings should be the manufacturer's standard design in accordance with AWWA C 110.

2.2. **Concrete Steel Cylinder Pipe and Fittings: 20 in. and Larger.** This Section Covers prestressed, reinforced concrete water pipe with a steel cylinder and wire reinforcement in sizes 20 in. and larger.

Except as otherwise modified or supplemented herein, AWWA C 301 governs the design, component materials, manufacture, and testing of all concrete steel cylinder pipe.

Unless otherwise specified, all pipes must be AWWA, Class 150, and must be designed for an internal working pressure of 150 psi and a minimum external load equivalent to 6 ft. of earth cover. Where the burial depth of the pipe must be greater than 6 ft. in accordance with the Specifications or as shown on the plans, the design of the pipe must be suitable for the earth loads specified.

All data submitted by the Contractor must include a tabulated layout schedule referencing the stationing and grade lines as shown on the plans. A design summary for each size of pipe furnished must be provided for each pressure and burial depth.

Each special and length of straight pipe must have plainly marked on the inside of the bell end the class of pipe and enough identification marks to show the proper location of the pipe by reference to layout drawings.

Pipe 20 in.–42 in. in size must be furnished in nominal lengths of 20 ft.–32 ft.; pipe 48 in.–72 in. in size must be furnished in nominal lengths of 16 ft., except where modified as shown on the plans.

Each joint of pipe must be furnished with a rubber gasket and a 12-in. diaper.

2.3. **Steel Pipe, Fittings, and Flanges.** This Section covers steel pipe 4 in. and larger in size and manufactured for the purpose of conveying water.

2.3.1. **Steel Pipe.** Steel pipe with nominal diameters from 4 in.–20 in. must conform to the standard weight class in accordance with ASTM A106, A53 (Grade B) or A139 (Grade B), at minimum.

Steel pipe greater than 20 in. must be in accordance with AWWA C 200 and AWWA M 11 or as required by the Engineer for special circumstances.

Pipe must be designed for at least 150-psi working pressure with an additional 50% of the working pressure allowance for surge pressure, unless otherwise specified. Pipe design must be in accordance with AWWA M 11.

Pipe must be designed to cover conditions as shown on the plans. The design for deflection must be in accordance with AWWA M 11.

Use of an enhanced or better soil backfill to limit deflection will be allowed with approval (criteria must be in accordance with AWWA M 11).

Pipe for use with sleeve-type couplings must have plain ends at right angles to the axis.

Pipe joint length must be up to 50-ft. net-laying lengths, except for special lengths, field trim pieces, and closure pieces as otherwise shown on the plans for location of elbows, tees, reducers, and other inline fittings. Manufacturer must prepare a lay schedule showing the location of each piece by a mark number with station and invert elevation at each bell end.

2.3.2. **Fittings for Steel Pipe.** Unless otherwise shown on the plans, all specials and fittings must be in accordance with AWWA C 208. Pipe material used in fittings must be of the same material and thickness as the pipe. The minimum radius of elbows must be 2.5 times the pipe diameter, and the maximum miter angle on each section of the elbow must not exceed 11-1/4° (one cut elbow up to 22-1/2°). If elbow radius is less than 2.5 times pipe diameter, stresses must be checked in accordance with AWWA M 11 and wall thickness or yield strength increased, if necessary. Fittings must be equal in pressure design strength. Specials and fittings, unless otherwise shown on the plans, must be made of segmentally welded sections from hydrostatically tested pipe, with ends compatible with the type of joint or coupling specified for the pipe. All welds made after hydrostatic testing of the straight sections of pipe must be checked in accordance with AWWA C 200, Section 5.2.2.1.

2.3.3. **Joints.**

2.3.3.1. **Rolled-Groove Rubber Gasket Joint.** The standard joint must be rolled-groove rubber gasket joint unless otherwise shown on the plans. Rolled-grooved rubber gasket joints must be in accordance with AWWA C 200 and AWWA M 11, Chapter 8.

The O-ring rubber gasket must have enough volume to approximately fill the area of the groove and must be in accordance with AWWA C 200.

The joint must be suitable for a safe working pressure equal to the class of pipe furnished and must operate satisfactorily with a deflection angle, the tangent of which must not exceed 1.00/D, where D is the outside diameter (OD) of the pipe in inches with a pull-out of 1 in.

Rolled-groove rubber gasket joints may be furnished only by a manufacturer that has furnished pipe with joints of similar design for comparable working pressure, pipe diameter, pipe length, and wall thickness that have been in successful service for at least 5 yr.

2.3.3.2. **Lap Weld.** Lap field-welded joints must be used where tied joints are as shown on the plans. The standard bell must provide for a 2-1/2 in. lap. The minimum lap must be 1 in. The design maximum joint deflection or offset must be a 1-in. joint pull.

2.3.3.3. **Mechanical Couplings.** Mechanical couplings, as shown on the plans, must be Smith Blair Style 411, Baker Style 200, Brico Depend-O-Loc, or equal. Insulating mechanical couplings, as shown on the plans, must be double-insulated Smith Blair Style 416, Baker Style 216, or equal. Mechanical couplings must be rated to meet or exceed the working pressures and surge pressure of the pipe.

Couplings for buried service must have all metal parts painted with epoxy paint and be in accordance with AWWA C 219.

Pipe ends for mechanical couplings must be in accordance with AWWA C 200 and AWWA M 11. The shop-applied outside coating must be held back as required for field assembly of the mechanical coupling or to the harness lugs or rings.

Harness lugs or rings and pipe ends must be painted with one shop coat of epoxy in accordance with AWWA C 210. The inside lining must be continuous to the end of the pipe.

2.3.4. **Flanges, Gaskets, Bolts, and Nuts.**

2.3.4.1. **Flanges.** Flanges must be in accordance with:

- AWWA C 207, Class D, for operating pressures to 175 psi on 4 in.–12 in. diameter, and operating pressures to 150 psi on diameters more than 12 in.;
- AWWA C 207, Class E, for operating pressures up to 275 psi; or
- AWWA C 207, Class F, for pressures to 300 psi (drilling in accordance with ANSI B 016.5, Class 250).

Shop lining and coating must be continuous to the end of the pipe or back of the flange. Flange faces must be shop-coated with a soluble rust-preventive compound.

2.3.4.2. **Gaskets.** Gaskets must be full-face, 1/8 in. thick, cloth-inserted rubber, Garlock 3000, John Crane Co. Style 777, or equal.

2.3.4.3. **Bolts and Nuts.** Bolts for flanges located indoors and in enclosed vaults and structures must be carbon steel, ASTM A307, Grade B, for Class B and Class D flanges. Nuts must be ASTM A563, Grade A, heavy hex. Bolts for Class E and Class F flanges must be ASTM A193, Grade B7. Nuts must be ASTM A194, Grade 2H, heavy hex.

2.3.4.4. **Bolts.** Bolts for buried and submerged flanges and flanges located outdoors above ground or in open vaults in structures must be Type 316 stainless steel in accordance with ASTM A193, Grade B8M, Class 1, for Class B and Class D flanges with ASTM A194, Grade 8M, nuts. For Class E and Class F flanges, the bolts must be in accordance with ASTM A194, Grade 2H, nuts, with bolt and nuts to be zinc-plated in accordance with ASTM B633.

2.3.5. **Linings and Coatings.**

2.3.5.1. **Polyethylene Tape Coating.** Prefabricated multi-layer cold-applied tape coating must be the coating system for straight-line pipe. This coating must be in accordance with AWWA C 214. The system must consist of three layers of polyethylene material with a nominal thickness of 80 mils when complete.

2.3.5.2. **Coating Repair.** Coating repair must be made using tape and primer in accordance with AWWA C209, Type II. The tape and primer must be compatible with the tape system used for straight-line pipe.

2.3.5.3. **Coating of Fittings, Specials, and Joints.**

2.3.5.3.1. **General.** Fittings, specials, and joints that cannot be machine-coated in accordance with Section 2.3.5.1., "Polyethylene Tape Coating," and Section 2.3.5.2., "Coating Repair," must be coated in accordance with AWWA C 209. Prefabricated tape must be Type II and must be compatible with the tape system used for straight-line pipe. The system must comprise three layers. Alternative coating methods for fittings, specials, and field joints must be shrink sleeves in accordance with AWWA C 216, or paint in accordance with AWWA C 210, C 218, or C 222. The field-coating must completely encapsulate the joint bonds on O-ring joints.

2.3.5.3.2. **Coating Repair.** Coating repair for fittings and specials must be in accordance with Section 2.3.5.1. and Section 2.3.5.2. for straight-line pipe and as recommended by the manufacturer.

2.3.5.4. **Other Coating Systems.** If specified must be governed by the pertinent AWWA standard.

2.3.5.5. **Cement Mortar in Accordance with AWWA C 205.**

2.3.5.5.1. **Cement Mortar Lining of Steel Pipe.** Except as otherwise provided in accordance with AWWA C 205, the interior surface of all steel pipes, fittings, and specials must be cleaned and lined in the shop with cement-mortar lining applied centrifugally.

The pipe ends must be left bare where field joints occur as shown on the plans. The ends of the linings must be left square and uniform. Feathered or uneven edges will not be permitted.

Defective linings as identified in accordance with AWWA C 205 must be removed from the pipe wall and must be replaced to the full thickness required. Defective linings must be cut back to a square shoulder to avoid feather-edged joints.

Cement mortar lining must be kept moist during storage and shipping.

2.3.5.5.2. **Fittings.** The fittings must be lined and coated in accordance with AWWA C 205.

2.3.6. **Steel Casing Pipe.** Steel casing pipe must be in accordance with ASTM A134 with a minimum thickness of 3/8 in.; actual thickness must be as shown on the plans.

2.3.7. **Quality Assurance (QA).** Commercial standards include the following. All manufacturing tolerances referenced in these standards apply unless specifically excluded:

- ANSI/AWWA C 200, "Steel Water Pipe, 6 in. and Larger";
- ANSI/AWWA C 205, "Cement-Mortar Protective Lining and Coating for Steel Water Pipe, 4 in. and Larger—Shop Applied";
- ANSI/AWWA C 206, "Field Welding of Steel Water Pipe";
- ANSI/AWWA C 207, "Steel Pipe Flanges for Waterworks Service—4 in. Through 144 in.";
- ANSI/AWWA C 208, "Dimensions for Fabricated Steel Water Pipe Fittings";
- ANSI/AWWA C 209, "Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines";
- ANSI/AWWA C 210, Liquid-Epoxy Coatings and Linings for Steel Water Pipe and Fittings";
- ANSI/AWWA C 214, "Tape Coating Systems for the Exterior of Steel Water Pipelines";
- ANSI/AWWA C 216, "Heat-Shrinkable Cross-Linked Polyolefin Coatings for Steel Water Pipe and Fittings";
- ANSI/AWWA C 218, "Liquid Coatings for Aboveground Steel Water Pipe and Fittings";
- ANSI/AWWA C 219, "Bolted Sleeve-Type Couplings for Plain-End Pipe";
- ANSI/AWWA C 222, "Polyurethane Coatings and Linings for Steel Water Pipe and Fittings";
- AWWA M 11, "Steel Pipe: A Guide for Design and Installation";
- ASTM A106, "Seamless Carbon Steel Pipe for High-Temperature Service";
- ASTM A53, "Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless";

- ASTM E165, “Method for Liquid Penetrant Examination”;
- ASTM E709, “Guide for Magnetic Particle Testing”;
- ASME, Section V, “Nondestructive Testing Examination”;
- ASME, Section IX, “Welding and Brazing Qualification”; and
- AWS B 2.1, “Specification for Welding Procedure and Performance Qualifications.”

2.3.8. **Qualifications.** Manufacturers that are fully experienced, reputable, and qualified in the manufacture of the products to be furnished must furnish all steel pipe and fittings. The pipe and fittings must be designed, constructed, and installed in conformance with the best practices and methods and must be in accordance with these Specifications.

Pipe must be the product of one manufacturer with at least 5 yr. of successful experience manufacturing pipe in the United States of the type and size indicated. All pipe manufacturing, including cylinder production, lining, coating, and fittings, must be produced by one manufacturer. The pipe manufacturer must have a certified QA program. This certified program must be in accordance with ISO 9001:2000 or an equivalent nationally recognized program.

2.4. **Polyvinyl Chloride (PVC) Pipe and Fittings.**

2.4.1. **Polyvinyl Chloride (PVC) Pipe, 4 in.–12 in. (AWWA C 900).** This Section covers 4-in.–12-in. PVC pressure pipe made from Class 1245A or Class 1245B compounds in accordance with ASTM D1784 and provides a hydrostatic test basis (HTB) of 4,000 psi. All pipe furnished must be in accordance with AWWA C 900.

Except as shown on the plans or in conformance with procurement specifications for specific jobs, all PVC pipe used in accordance with AWWA C 900 must be Class 150 (DR 18) with a sustained pressure requirement of 500 psi (in accordance with ASTM D2241) and a minimum burst pressure of 755 psi (in accordance with ASTM D1599). The PVC pipe installed in the City of Schertz high-pressure zone must be Class 200 (DR 14) with a sustained pressure requirement of 650 psi (in accordance with ASTM D1598) and a minimum burst pressure of 985 psi (in accordance with ASTM D1599). Pipe pressure class must be written on the pipe and in conformance with pertinent AWWA standards.

Dimensions and tolerances for each nominal pipe size must be in accordance with AWWA C 900, Section 2.2, Table 1.

Pipe must be furnished in standard laying lengths of 20 ft. (±1 in.) unless otherwise specified. Each pipe must have an integral bell formed on the pipe end and be designed to be at least as strong as the pipe wall (in accordance with ASTM D2472).

An elastomeric gasket must be designed with a retainer ring that “locks” the gasket into integral bell groove and must be installed at the point of manufacture. Gasket must be in accordance with ASTM F477.

Each length of pipe furnished must bear identification markings in accordance with AWWA C 900, Section 2.6.

Pipe must be bundled in pallets for ease of handling and storage. Pipe bundles (units) must be packaged to provide structural support to ensure that the weight of upper units does not cause deformation to pipe in lower units. No pipe bundles that show evidence of ultraviolet radiation “sunburn” on exposed pipe, as may be caused by extended unprotected storage conditions, will be accepted.

The manufacturer must take adequate measures during pipe production to be in accordance with AWWA C 900, Section 3, by performing QC tests and maintaining results of those tests. Submission of product will constitute certification of compliance with this standard.

The pipe is intended for use as an underground, direct-burial pressure pipe for transport of potable water. The expected life of the pipe system, after installation, is 25 yr.–50 yr.

Inductive tracer detection tape must be placed directly above the centerline of all non-metallic pipe at least 12 in. below subgrade, or, in areas outside the limits of pavement, at least 18 in. below finished grade, to aid locating pipe in the future. The tracer tape must be encased in a protective, inert, plastic jacket, and color-coded in accordance with the APWA Uniform Color Code. Except for minimum depth of cover, the tracer tape must be placed in conformance with manufacturer's recommendations.

A 1-yr. warranty must be provided for all materials sold and delivered for use and incorporated into the City of Schertz distribution system. Such warranty must take effect on the date on which the pipe is received and accepted by an authorized representative of the City of Schertz.

User references and a claims history must be provided for further investigation, before rendering a final decision on the acceptance of the product to be furnished.

The City of Schertz may, at no cost to the manufacturer, subject random lengths of pipe to testing by an independent laboratory in accordance with this Specification. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order.

2.4.2. **Polyvinyl Chloride (PVC) Pipe, 14 in.–36 in. (AWWA C 905).** This Section covers pipe that has a nominal diameter of 14 in.– 36 in. for PVC potable water transmission pipe with integral bell and spigot joints. The pipe must be extruded from Class 1245-A or Class 1245-B PVC compound in accordance with ASTM D1784 and provide for an HDB of 4,000 psi. The pipe ODs must conform to dimensions of cast iron pipe. All pipe furnished must be in accordance with AWWA C 905.

Pipe must be homogenous throughout. It must be free of voids, cracks, inclusions, and other defects. It must be as uniform as commercially practical in color, density, and other physical properties. Pipe surfaces must be free of nicks and scratches. Joining surfaces of spigots and joints must be free of gouges and imperfections that could cause leakage.

Inductive tracer detection tape must be placed directly above the centerline of all non-metallic pipe at least 12 in. below subgrade, or, in areas outside the limits of pavement, at least 18 in. below finished grade, to aid locating pipe in the future. The tracer tape must be encased in a protective, inert, plastic jacket, and color-coded in accordance with the APWA Uniform Color Code. Except for minimum depth of cover, the tracer tape must be placed in conformance with manufacturer's recommendations.

2.4.2.1. **Definitions.** All definitions are in accordance with AWWA C 905-97, Section 1.2, "Definitions."

2.4.2.1.1. **Dimension Ratio (DR).** The ratio of the pipe OD to the minimum wall thickness. The quotient is rounded to the nearest 0.5 when necessary.

2.4.2.1.2. **Pressure Rating (PR).** The nominal PR of transmission pipe is determined from formulas in accordance with AWWA C 905-97, Section 5, "Transmission-Pipe Ratings," using a safety factor of 2.0. There is no allowance for surge pressure in the PR.

2.4.2.2. **General Requirements.** Except as shown on the plans or in conformance with procurement specifications for specific jobs, all PVC C905 pipe must have a PR of 235 psi and a DR of 18, or have the highest pressure rating available for each size of pipe.

Dimensions and tolerances for each nominal pipe size must be in accordance with AWWA C 905-97, Section 3, "Pipe Requirements," Table 2, "Dimensions for PVC Transmission Pipe with CI Outside Diameter." All pipes must be suitable for use as a pressure conduit.

Pipe must be gauged full-length and furnished in standard laying lengths of 20 ft. ±1 in. (6.1 m ±25 mm), unless otherwise specified. Each pipe must have an integral bell formed on the pipe end and be designed to be at least as strong as the pipe wall.

An elastomeric gasket must be designed with a retainer ring that locks the gasket into integral bell groove and must be installed at the point of manufacture. The dimensions and design of the gasket joint provided for the PVC transmission pipe must be in accordance with ASTM D3139 and ASTM D2122. The gasket must be reinforced with a steel band and must be in accordance with ASTM F477.

Each length of pipe furnished must bear identification markings that will remain legible after normal handling, storage, and installation. Markings must be applied in a manner that will not weaken or damage the pipe. Markings must be applied at intervals of no more than 5 ft. (1.5 m) on the pipe. The minimum required markings are as follows. Marking requirements must be in accordance with AWWA C 905-97, Section 4.7, "Marking Requirements":

- nominal size and OD base (e.g., 24 CI);
- PVC;
- DR (e.g., DR 18);
- AWWA pressure rating (e.g., PR 235);
- AWWA designation number for this standard (i.e., AWWA C 905);
- manufacturer's name or trademark, and
- manufacturer's production code, including day, month, year, shift, plant, and extruder of manufacture.

Pipe must be bundled in pallets for ease of handling and storage. Pipe bundles (units) must be packaged to provide structural support to ensure that the weight of upper units will not cause deformation to pipe in lower units. No pipe bundles that show evidence of ultraviolet radiation "sunburn" on exposed pipe, as may be caused by extended unprotected storage conditions, will be accepted.

The manufacturer must take adequate measures during pipe production in accordance with AWWA C 900, Section 4, "Inspection and Testing," by performing QC tests and maintaining results of those tests. Submission of product will constitute certification in accordance with that standard.

The pipe is intended for use as an underground, direct-burial pressure pipe for transport of potable water. The expected life of the pipe system, after installation, is 25 yr.–50 yr.

A 1-yr. warranty must be provided for all materials sold and delivered for use and incorporated into the City of Schertz distribution system. Such warranty must take effect on the date on which the pipe is received and accepted by an authorized representative of the City of Schertz.

User references and a claims history must be provided for further investigation, before rendering a final decision on the acceptance of the product to be furnished.

2.4.2.2.1. **Test.** The manufacturer must pressure-test all pipe, including the joint, that is marked with the designation number of AWWA C 900 at 73.4ºF ±3.6ºF (23ºC ±2ºC). Each length of pipe must be proof-tested at twice the PR in accordance with AWWA C 900, Section 4.6, "Pressure Strength and Hydrostatic Proof Testing," Table 3, "Transmission-Pipe Pressure Rating."

2.4.2.2.2. **Random Tests.** The City of Schertz may, at no cost to the manufacturer, subject random lengths of pipe to testing by an independent laboratory in accordance with this Specification. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order.

2.4.2.2.3. **References.** The documents listed below are referenced in this Specification:

- ASTM D1784, "Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds";
- ASTM D2122, "Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings";
- ASTM D313, "Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals"; and
- ASTM F477, "Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe."

2.4.3. **Polyvinyl Chloride (PVC), 4 in.–12 in. (AWWA C 909).** This Section covers molecularly oriented 4-in.–12-in. diameter PVC pressure pipe manufactured from starting stock pipe made from Class 12454A or Class 12454B compounds in accordance with ASTM D1784. The starting stock materials are then oriented through circumferential expansion to provide an HDB of 7,100 psi. Pipe must be homogenous throughout. It must be free of voids, cracks, inclusions, and other defects. It must be as uniform as commercially practical in color, density, and other physical properties. Pipe surfaces must be free of nicks and scratches. Joining surfaces of spigots and joints must be free of gouges and imperfections that could cause leakage. All pipe furnished must be in accordance with AWWA C 909 and ANSI/NSF 61. Inductive tracer detection tape must be placed directly above the centerline of all non-metallic pipe at least 12 in. below subgrade, or, in areas outside the limits of pavement, at least 18 in. below finished grade, to aid locating pipe in the future. The tracer tape must be encased in a protective, inert, plastic jacket and color-coded in accordance with the APWA Uniform Color Code. Except for minimum depth of cover, the tracer tape must be placed in conformance with manufacturer's recommendations.

2.4.3.1. **General Requirements.** Except as shown on the plans or in conformance with procurement specifications for specific jobs, all PVC C909 pipe must be Class 150 with a sustained pressure requirement of 500 psi (in accordance with ASTM D2241) and a minimum burst pressure of 755 psi (in accordance with ASTM D1599).

Dimensions and tolerances for each nominal pipe size must be in accordance with AWWA C 909, Section 4.3, "Pipe Requirements," Table 1.

Pipe must be furnished in standard lengths of 20 ft. (±1 in.) unless otherwise specified. Each pipe must have an integral bell formed on the pipe end and be designed to be at least as strong as the pipe wall.

An elastomeric gasket that "locks" into the integral bell groove must be installed at the point of manufacture. The gasket must be in accordance with ASTM F477.

Each length of pipe furnished must bear identification markings in accordance with AWWA C 909, Section 6.1.2, "Pipe."

Pipe must be bundled in pallets for ease of handling and storage. Pipe bundle units must be packaged to provide structural support to ensure that the weight of upper units will not cause deformation to pipe in the lower units.

No pipe bundles that show evidence of ultraviolet radiation "sunburn" on exposed pipe, as may be caused from extended unprotected storage conditions, will be accepted.

The manufacturer must take adequate measures during pipe production in accordance with AWWA C 909, Section 5.2, "Quality-Control Records," by performing QC tests and maintaining results of those tests. Submission of product will constitute certification of compliance with this standard.

The pipe is intended for use as an underground, direct-burial pressure pipe for transport of potable water. The expected life of the pipe is received and accepted by an authorized representative of the City of Schertz.

A 1-yr. warranty must be provided for all materials sold and delivered for use and incorporated into the City of Schertz. Such warranty must take effect on the date on which the pipe is received and accepted by an authorized representative of the City of Schertz.

User references and a claims history must be provided for further investigation before rendering a final decision on the acceptance of the product to be furnished.

The City of Schertz may, at no cost to the manufacturer, subject random lengths of pipe to testing by an independent laboratory in accordance with this Specification. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order.

2.4.3.2. **References.** The documents listed below are referenced in this Specification**:**

- ANSI/AWWA C 909, “Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 in. and Larger”;
- ASTM D1598, “Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure”;
- ASTM D1599, Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings”;
- ASTM D1784, “Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds”;
- ASTM D2122, “Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings”;
- ASTM D2152, “Standard Test Method for Adequacy of Fusion of Extruded Poly(Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion”;
- ASTM D2241, “Standard Specification for Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)”;
- ASTM D2412, “Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading”;
- ASTM D2837, “Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products”;
- ASTM D3139, “Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals”;
- ASTM F477, “Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe”;
- ANSI/NSF 61, “Drinking Water System Components—Health Effects”; and
- PPI TR 3, “Policies and Procedures for Developing Hydrostatic Design Basis (HBD), Hydrostatic Design Stresses (HDS), Pressure Design Basis (PDB), Strength Design Basis (SDB), Minimum Required Strength (MRS) Ratings, and Categorized Required Strength (CRS) for Thermoplastic Piping Materials or Pipe.”

2.5. **Joint Restraint System.** This Section covers pipe joint restraint systems to be used on domestic water mains for PVC AWWA C 900 pipe sizes 4 in.–12 in. in diameter and PVC AWWA C 905 pipe sizes 16 in.–24 in. diameter, and for DIP sizes from 4 in.–24 in. in diameter. Joint restraint systems are classified as “compression,” “mechanical joint,” or “non-metallic restrained joint” for the specific type of pipe joint to be restrained.

2.5.1. **General Requirements.** UL and Factory Mutual (FM) certifications are required on all restraint systems.

Unless otherwise specified, restraint systems to be used on PVC AWWA C 900 pipe must be in accordance with ASTM F1674, “Standard Test Method for Joint Restraint Products for Use with PVC Pipe.” Restraint systems used on ductile pipe must be in accordance with UL 194.

Non-metallic restrained joint pipe and couplings must be used specifically for PVC AWWA C 900 pipe and fittings in sizes 4 in.–12 in.

Each restraint system must be packaged individually and include installation instructions.

2.5.2. **Specific Requirements.**

2.5.2.1. **Restrainer for Polyvinyl Chloride (PVC) AWWA C 900 and Ductile Iron Push-On Type Connections.** Pipe restraints must be used to prevent movement for push-on ductile iron (DI) or PVC (AWWA C 900 compression-type) bell-and-spigot pipe connections or where a transition or flexible coupling has been used to join two sections of DI or PVC (AWWA C 900) plain-end pipe. The restrainer may be adapted to connect a plain-end DI or PVC pipe to a DI mechanical joint bell fitting. The restrainer must not be directionally sensitive.

The pipe must be restrained by a split retainer band. The band must be cast DI, in accordance with ASTM A536, Grade 65-45-12. The inside face or contact surface of the band must be of enough width to

incorporate cast or machined non-directionally sensitive serration to grip the outside circumference of the pipe. The serration must provide full (360°) contact, maintain pipe roundness, and avoid any localized points of stress. The split-band casting must be designed to "bottom-out" before clamping bolt forces (110-ft. lb. minimum torque) can overstress the pipe, but must provide full non-directionally sensitive restraint at the rated pressures.

Bolts and nuts used to attach the split retainer ring must be in accordance with ANSI B 18.2/18.2.2, SAE Grade 5. T-bolts, nuts, and restraining rods must be fabricated from high-strength, low-alloy steel in accordance with AWWA C 111.

The split-ring type non-directionally sensitive restrainer system must be capable of a test pressure twice the maximum sustained working pressure in accordance with Section 2.5.3., "Maximum Sustained Working Pressure Requirement," and be for both DI and PVC AWWA C 900.

Restraint system sizes 6 in.–12 in. must be capable of use for both DI and PVC AWWA C 900.

The restraint system may consist of two types: the two split retainer rings and, for new construction use only, the one split and one solid cast backup ring.

2.5.2.2. **Compression-Ring Fitting Restrainer for Ductile Iron Pipe (DIP) and Polyvinyl Chloride (PVC) AWWA C 900.** Compression ring with follower-gland type of restrainer may be used in conjunction with mechanical joint bell end DI pipe fittings for restraining PVC AWWA C 900 and DI pipe.

The system must use a standard mechanical joint gasket with a color-coded compression ring and replacement gland in accordance with ASTM A536, Grade 65-45-12.

Standard mechanical-joint fitting T-bolts and nuts must be fabricated from high-strength steel in accordance with ANSI/AWWA C 111/A 21.11 and AWWA C 153/A 21.53-88.

Standard mechanical joint gasket must be virgin styrene butadiene rubber (SBR), in accordance with ASTM D 2000, 3 BA 715 or 3 BA 515.

The restraint system must be capable of a test pressure twice the maximum sustained working pressure in accordance with Section 2.5.3.

2.5.2.3. **Non-Metallic Restrained Joint Pipe and Couplings for Polyvinyl Chloride (PVC) AWWA-C-900 Type Connections.** Gasketed restrained coupling connections must join two sections of factory-grooved PVC AWWA C 900 pipe. The restrainer coupling must not be directionally sensitive.

The coupling must incorporate twin elastomeric sealing gaskets in accordance with ASTM F477 and must be DR-14, Class 200, PVC in all applications, in accordance with AWWA C 900. The inside face or contact surface of the coupling connection must be of enough width to incorporate a factory-machined non-directionally sensitive groove in both pipe and coupling to grip the outside circumference of the pipe. The couplings must provide full (360°) contact, maintain pipe roundness, and avoid any localized points of stress. The coupling must be designed with an internal stop to align the precision-machined grooves in the coupling and pipe before installation of a non-metallic thermoplastic restraint spleen, and provide full non-directionally sensitive restraint at the rated pressures.

High-strength flexible thermoplastic spleens must be inserted into mating precision-machined grooves in the pipe and coupling to provide full non-directional restraint with evenly distributed loading.

The non-metallic restrained joint pipe and couplings for PVC AWWA-C-900 type non-directionally sensitive restrainer system must be capable of a test pressure twice the maximum sustained working pressure in accordance with Section 2.5.3., and be for PVC AWWA 900 pipe sizes 4 in.–12 in.

Non-metallic restrained joint pipe and couplings for PVC AWWA C 900 restrained systems sizes 4 in.–12 in. must be capable of use for both Class 150 (DR 18) and 4 in.–8 in. for Class 200 (DR 14) PVC AWWA C 900 pipe.

The non-metallic restrained joint pipe and couplings for PVC AWWA C 900 restraint system must consist of a pipe and couplings system produced by the same manufacturer meeting the performance qualifications of FM and UL.

2.5.2.4. **Fitting Restraint for Ductile Iron Pipe (DIP) (Only).** Radial-bolt type restrainer systems must be limited to DIP in conjunction with mechanical joint bell end pipe of fittings. The system must use a standard mechanical joint gasket with a DI replacement gland in accordance with ASTM A536. The gland dimensions must conform to standard mechanical joint bolt circle criteria.

Individual wedge restrainers must be DI-heat treated to a minimum hardness of 370 Brinell. The wedge screws must be compressed to the outside wall of the pipe using a shoulder bolt and twist-off nuts to ensure proper actuating of the restraining system.

Standard mechanical-joint fitting T-bolts and nuts must be high-strength steel in accordance with AWWA C 111/A 21.11 and AWWA C 153/A 21.53-88.

Standard mechanical joint gasket must be virgin SBR in accordance with ASTM D2000, 3 BA 715 or 3 BA 515.

2.5.3. **Maximum Sustained Working Pressure Requirement.**

Table 2
Maximum Sustained Working Pressure Requirement

Nominal Diameter	PVC AWWA C 900	Ductile Iron
4 in. and 6 in.	200 psi	350 psi
8 in.	200 psi	250 psi
10 in. and 12 in.	200 psi	200 psi
14 in. and 16 in.	200 psi (C 900)/235 psi (C 905)	200 psi
20 in. and 24 in.	200 psi (C 900)/235 psi (C 905)	200 psi

2.5.3.1. **Tests**. The City of Schertz may, at no cost to the Contractor, subject random joint restraint system products to testing by an independent laboratory for compliance with these standards. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order.

2.6. **Stainless Steel Casing Spacer and Insulators.** This Section covers casing spacers for use in water supply service. Casing spacers are used to facilitate installing a water pipe inside a casing pipe or tunnel. Casing spacers must consist of two or more segments of circular steel that bolt together, forming a shell around the carrier pipes. Casing spacers should protect the carrier pipe and any protective coating or wrapping from damage during the installation, and properly support and electrically isolate the carrier pipes within the casing or tunnel. Occasionally, multiple carrier pipes may be installed in one casing or tunnel.

2.6.1. **General Requirements.** Casing spacers must be 8 in. long for carrier pipes up to 16 in. in diameter and 12 in. long for larger carrier pipe sizes. Manufacturer's approval in writing will be required for installations exceeding 300 ft. in length, carrier pipes greater than 48 in. in diameter, or multiple carrier pipes in one casing or tunnel.

Casing spacers must have a minimum 14-gauge steel band and 10-gauge steel riser when required. The band, risers, and connecting studs must be welded and cleaned at the factory before the application of a fluidized bed fusion-bonded PVC coating. Stainless steel (Type 304) casing spacer is an acceptable alternative.

The fluidized bed fusion-bonded PVC coating must be between 10 mils and 16 mils thick. The PVC coating must provide good resistance to acids and alkalinity, and excellent resistance in accordance with

ASTM B117 salt spray tests. The coating must have a minimum 1,380V per mil in accordance with ASTM D149-61 short-time 0.010-in. test, and a Durometer-shore A at 10 sec. of 80 in accordance with ASTM D1706-61T. Epoxy coatings are not an acceptable alternative.

The spacers must have a flexible PVC liner of 0.09-in. thickness with Durometer A 85–90 hardness and a minimum 58,000V dielectric strength (60,000V minimum surge test). Moisture absorption must not exceed 1%.

The runners must be of high-pressure molded-glass reinforced polyester with a minimum compressive strength of 18,000 psi in accordance with ASTM D695, flexural strength of 25,300 psi in accordance with ASTM D790, tensile strength of 17,600 psi in accordance with ASTM D638, and Rockwell hardness (M) of 90 in accordance with ASTM D785. The riser must be designed and fabricated to place the runner (skid) in full contact with the inside surface of the casing pipe. This design evenly distributes the load force to all support members. The ends of all runners must be shaped to resist hanging or sticking inside casing during installation of the carrier pipe. Polyethylene runners are not acceptable.

Runners must be at least 1 in. in width and at least 7 in. long for carrier pipes up to 16 in., and at least 2 in. in width and 11 in. long for larger carrier pipes. Bolts on runners are not acceptable. The runners must be attached to the band or riser by 3/8 the wearing surface on the runner. The recess must be filled with a corrosion-inhibiting filler. There must be four runners per casing spacer for carrier pipes up to 12 in. in diameter, six runners for 14 in.–36 in., and eight or more runners for carrier pipes greater than 36 in. in diameter. The number of top and bottom runners must be in multiples of two.

The band section must be bolted together with 5/16-in. cadmium-plated studs, nuts, and washers. There must be six sets per 8-in. long casing spacer and eight sets per 12-in. long spacer. Stainless steel casing spacers must be furnished with stainless steel studs, nuts, and washers.

Casing spacers must have ample riser height to limit vertical movement of the carrier pipe in the casing. At least 1-in.–2-in. of clearance must be provided between the top runner and the inside diameter (ID) of the casing or tunnel.

Continuous operating temperatures for the PVC-coated casing spacers should not exceed 150°F. Stainless steel casing must be used in applications where continuous operating temperatures exceed 150°F.

Unless specified otherwise, casing spacers and end seals will be required on all carrier pipes installed in casing or tunnel applications.

2.6.2. **Quality Assurance (QA).** All casing spacers must be manufactured in accordance with NACE International Recommended Practice (RP) 0286, “Isolation Spacers.” Each casing spacer must be manufactured in the United States at a facility that has a registered ISO-9002 quality management system.

If on receipt of casing spacers they are found to be non-compliant, the manufacturer must replace the defective casing spacer with a casing spacer that meets the City of Schertz’ specifications, at no charge to City of Schertz.

If the City of Schertz audit, product inspection, and performance data review in accordance with these Specifications determine excessive casing spacer non-compliance, the manufacturer will be subject to removal by the Products Standard Committee. Provide a copy of the current ISO 9002 registration with material submittal.

2.7. **Copper Tubing and Brass Fittings for Copper Service Lines.**

2.7.1. **Copper Tubing.** This Section covers copper tubing in nominal sizes of 3/4 in., 1 in., 1-1/2 in., and 2 in.

2.7.1.1. **General Requirements.** Copper tubing must be of the type commercially known as “Type K soft” and in accordance with NSF 61 and ASTM B88.

All 3/4-in. and 1-in. copper tubing must be furnished in 60-ft. coils or 100-ft. coils as specified; 1-1/2 in. copper tubing must be furnished in 20-ft. lengths, 40-ft. coils, or 60-ft. coils as specified; and 2-in. copper tubing must be furnished in 20-ft. lengths or 40-ft. coils as specified.

Copper tubing is the only allowable material for small service lines.

2.7.2. **Brass Fittings.** This Section covers waterworks brass goods, such as corporation stops, curb stops, couplings, connectors, and nipples.

2.7.2.1. **General Requirements.** The brass composition must be in accordance with ASTM B62. Fittings must be in accordance with ANSI/AWWA C 800.

All brass components in contact with potable water must be lead-free and marked by stamping, etching, or casting “NL” in the main body made from Copper Development Association (CDA) and Unified Numbering System (UNS) Brass Alloy C89520 in accordance with ASTM B584 or ASTM C89833. Brass saddles must be made from CDA/UNS C83600.

Any brass component not in contact with potable water must be made of 85-5-5-5 brass as defined in accordance with ASTM B62, ASTM B584, and AWWA C 800.

All service fittings must be certified as suitable for contact with drinking water by an ANSI-accredited organization in accordance with ANSI/NSF 61. Proof of certification is required. The lead content of the wetted components in contact with potable water must also be verified by an ANSI-accredited testing facility.

All brass fittings and valves must have the manufacturer’s name or trademark integrally stamped or cast into them indicating that the product is manufactured from the low-lead alloy as specified. Another marking such as “NL,” “EBII,” “FD,” or other commonly accepted identifier, indicating the alloy as “no-lead,” must also be cast or stamped into the fitting or valve.

Painting, printing, stickers, or decals attesting to the components’ “no-lead” certification will not be permitted.

All casting must have a natural, clean, uniform, smooth surface, and be free of internal porosity.

All machining must be completed in a workmanlike manner and within the acceptable tolerances.

2.7.2.2. **Design Criteria for Ball-Type Curb Stops and Angle Valves**. All curb stop, corporation, and angle valves must be ball valves. “Inverted/ground-key” type angle valves will not be accepted.

Ball-type valves must not have a stop.

All ball valves, couplings, and adapters must be pressure-rated to 300 psi, and must be supplied with blowout-proof stainless steel stems with double SBR, nitrile rubber (NBR), or ethylene propylene diene monomer (EPDM) O-ring steam seal.

Stem and cap assembly must be two-piece design and able to withstand at least 200 ft. lb. of torque.

Ball seats must be made with unfilled Teflon or EPDM for resilience and minimal friction.

Ball must be lead-free cast brass or stainless design. Coated ball is not permitted.

All fittings must have a lifetime guarantee against lead leachate from the casting.

The reduced port design will not be acceptable.

Pack joints will not be accepted.

2.8. **Gate Valves, Tapping Valves, and Tapping Sleeves.**

2.8.1. **Resilient Seated Gate and Tapping Valves (ANSI/AWWA C 509)**. The product specification covers resilient seated gate valves with nominal diameters of 3 in., 4 in., 6 in., 8 in., 10 in., 12 in., 16 in., and 20 in. Sizes refer to the nominal diameter, in inches, of the waterway through the inlet and outlet connections and the closure area. All products furnished must be in accordance with ANSI/AWWA C 509.

2.8.1.1. **Definitions**. All definitions are in accordance with ANSI/AWWA C 509.

2.8.1.1.1. **Cosmetic Defect**. A blemish that has no effect on the ability of the component to meet the structural design and production test requirements of the standard. Should the blemish or the activity of plugging, welding, grinding, or repairing of such blemish cause the component to fail these requirements, then the blemish will be considered a structural defect.

2.8.1.1.2. **Flanged Joint**. The flanged and bolted joint in accordance with ANSI/AWWA C 110/A 21.10.

2.8.1.1.3. **Mechanical Joint**. The gasket and bolted joint in accordance with ANSI/AWWA C 111/A 21.11.

2.8.1.1.4. **Push-On Joint**. The single rubber gasket joint in accordance with ANSI/AWWA C 111/A 21.11.

2.8.1.1.5. **Structural Defect**. A flaw that causes the component to fail the structural design or test requirement of the standard. This includes, but is not limited to, imperfections that result in leakage through the walls of a casting, failure to meet the minimum wall thickness requirement, or failure to meet production tests.

2.8.1.1.6. **Tapping Valve**. A special gate valve designed with end connections and an unobstructed waterway to provide proper alignment and positioning of a tapping sleeve, valve, and machine for tapping pipe dry or under pressure in accordance with AWWA C 509 and Manufacturers Standardization Society (MSS) SP-60.

2.8.1.2. **General Requirements**. Except as otherwise modified or supplemented herein, AWWA C 509-01 will govern the design, component materials, construction, manufacture, and testing of all resilient seated gate valves. Valves must be suitable for frequent operation and service involving long periods of inactivity. Valves must be NSF-61 certified.

The City of Schertz reserves the right to limit the purchase of resilient seat gate valves from manufacturers and to the models specified, provided such resilient seat gate valves conform to the provision contained herein.

The minimum design working water pressure for gate valves with nominal diameters of 3 in., 4 in., 6 in., 8 in., 10 in., and 12 in. must be 200 psig unless otherwise specified.

The minimum design working water pressure for gate valves with nominal diameters of 16 in., 20 in., and 24 in. must be 150 psig unless otherwise specified.

Valves must be resilient-seated types, bronze-mounted with non-rising stems. The closure member must be fully encapsulated by an elastomer without thin spots or voids. When open, the valve must have a clear, full-port, unobstructed waterway.

Gray iron, DI, steel, brass, and bronze materials must be in accordance with AWWA C 509, Section 2, “Materials.”

Gaskets, O-rings, coatings, and elastomers must be in accordance with AWWA C 509, Section 2, “Materials.”

The gate valves must be designed and constructed for installation in either a horizontal or vertical position. Valves must be designed for buried installation with stem in the vertical position and must be furnished for mounting in a horizontal pipeline, unless otherwise specified.

Valve components of brass or bronze must be manufactured to ASTM-recognized alloy specifications for low-zinc content bronze, in accordance with ANSI/AWWA C 509, Section 2.2.4., Table 1. Materials for the stem must have minimum yield strength of 40,000 psi; have a minimum elongation in 2 in. of 12%; be made of bronze in accordance with ASTM B763, Alloy No. UNS C99500; and have a maximum zinc content of 2% in accordance with ASTM B763, Table 2, “Chemical Requirements.” Stem nut material must be in accordance with ASTM B62, UNS C83600, or ASTM B584, UNS C84400. The stem must have a visible external marking at the top to indicate low-zinc, high-strength material. The marking must include a red plastic or neoprene washer placed around the top of the stem under the operating nut.

Valve ends must be either flanged, tapping valve, mechanical joint, push-on joint, or any combination thereof, as specified. All mechanical joint valves must be supplied with glands, bolts, and gaskets. Valve body bolts and nuts must meet the strength requirements in accordance with ASTM A307 with dimensions in accordance with ANSI B 18.2.1. The size of the bolt head must be equal to the size of the nut and must be stainless steel in accordance with ASTM 276.

All gate valves must be left-handed open valves, unless otherwise specified.

The following parts of the valve must be made of either gray iron or DI:

- bonnet,
- body,
- yoke,
- wrench nut,
- O-ring packing plate or seal plate, and
- gland follower.

The gate may be made of gray iron or DI.

If glands and bushings are used for NRS valves, they must be made of ASTM B763 bronze, UNS C99500. The stem must be made of cast, forged, or rolled ASTM B763 bronze, UNS C99500. The stem nut material must be ASTM B62 bronze, UNS C83600, or ASTM B584 bronze, UNS C84400. The gate may be made of ASTM B763 bronze, UNS C99500. Stem seals must be O-ring type. The seals must be designed for dynamic applications.

The design must be such that the seal above the stem collar can be replaced with the valve under full pressure in the fully open position. Materials for the O-ring packing plate must be in accordance with ANSI/AWWA C 509, Section 4.8.3.

Enclosed and buried valves must be coated inside and outside with a fusion-bonded epoxy with a nominal 8-mil dry film thickness in accordance with AWWA C 550, and to the maximum extent possible must be free of holidays. All coatings in contact with the potable water must be approved for potable water immersion service in accordance with ANSI/NSF 61.

The bidder must submit with its proposal three sets of certified drawings showing the principal dimensions, general construction, and material specification of the valve proposed. The number of turns to open (close) must be clearly noted in the valve information submitted with the proposal documents. The number of turns to open or close the valve must be consistent for each valve size for each approved manufacturer.

Valves furnished in accordance with this Specification must be supplied from the City of Schertz approved list. To be included on the qualified product list, the manufacturer must provide an Affidavit of Compliance in accordance with ANSI/AWWA C 509, Section 1.5, including compliance with City of Schertz. Records of all tests performed in accordance with ANSI/AWWA C 509-01, Section 6.1 and Section 6.2, must be made available or provided. These records will be representative test results for Section 6.1 and certificate of testing for Section 6.2. An affidavit of testing for the valve assembly in accordance with ANSI/AWWA C 509, Section 6.2.2, (350-ft. lb.) must also be provided. A copy of the manufacturer’s QA program must be submitted. Blueprints and parts list for the valve must also be provided.

All gate valve parts must be designed to withstand the following two pressure requirements, without being structurally damaged:

- an internal test pressure of twice the rated design working pressure of the valve, and
- the full rated internal working pressure when the closure member is cycled once from a fully open to a fully closed position against the full-rated unbalanced working water pressure.

In addition to these pressure requirements, the valve assembly and mechanism must be capable of withstanding an input torque as follows:

- 200-ft. lb. for 3-in. and 4-in. nominal diameters, and
- 300-ft. lb. for 6-in., 8-in., 10-in., and 12-in. nominal diameters.

For sizes larger than a 12-in. nominal diameter, refer to the manufacturer's specifications.

Resilient seats must be applied to the gate and must seat against a corrosion-resistant surface. The non-metallic seating surface must be applied in a manner to withstand the action of line fluids and the operation of the sealing gate under long-term service. A metallic surface must have a corrosion resistance equivalent to or better than bronze. A non-metallic surface must be in accordance with ANSI/AWWA C 550. The gate must be fully encapsulated by an elastomer without thin spots or voids. Resilient seats must be bonded. ASTM D429, Method A or Method B, must prove the method used for bonding or vulcanizing. For Method A, the minimum strength must not be less than 250 psi. For Method B, the peel strength must be 75 lb. per inch.

The end flanges of flanged valves must conform to dimensions and drillings in accordance with ANSI/AWWA C 110/A 21.10 or ANSI B 16.1, Class 125.

Mechanical joint bell dimensions must be in accordance with ANSI/AWWA C 111/A 21.11.

Push-on joints must be in accordance with ANSI/AWWA C 111/A 21.11.

The tapping valves must be mechanical joints with tapping flange on the other end. The tapping valves must be furnished complete with glands, bolts, and gaskets. The tapping valve must have a clear unobstructed waterway.

The seat rings must be of a large diameter to the permit entry of the full-diameter tapping machine cutters. The valve end that mates with the tapping sleeve must have an alignment lip to fit the recess in the tapping sleeve flange for proper alignment. The lip must be dimensioned in accordance with MSS SP-60 for valves 20-in. nominal pipe size and smaller.

All interchangeable parts must conform to their required dimensions and must be free of defects that could prevent proper functioning of the valve. When assembled, valves manufactured in accordance with MSS SP-60 must be well-fitted and operate smoothly. All like parts of valves of the same model and size produced by the same manufacturer must be interchangeable.

All castings must be clean and sound, without defects that will weaken their structure or impair their service. Plugging, welding, or repairing of cosmetic defects is allowed. Repairing of structural defects is not allowed. Repaired valves must comply with the testing requirements in accordance with this Specification after repairs have been made. Repairs within the bolt circle of any flange face are not allowed.

All gate valves must be hydrostatically tested with twice the specified rated pressure applied to one side of the gate and zero pressure applied to the other side. The test must be conducted in each direction across the gate. All tests must be performed at the manufacturer's plant.

Each gate valve must be operated through a complete cycle in the position for which it was designed to ensure free and proper functioning of all parts in the intended manner. Any defects in workmanship must be

corrected and the test repeated until satisfactory performance is demonstrated. All tests must be performed at the manufacturer's plant.

A hydrostatic test pressure equal to twice the rated working pressure of the valve must be applied to all assembled valves with the gates in the open position. The test must show no leakage through the metal, pressure-containing joints, or stem seals. All tests must be performed at the manufacturer's plant.

A test must be conducted from each direction at rated working pressure to prove the sealing ability of each valve from both directions of flow. The test must show no leakage through the metal, through pressure-containing joints, or past the seat. All tests must be performed at the manufacturer's plant.

Markings must be cast on the bonnet or body of each valve and must show the manufacturer's name or mark, the year the valve casting was made, the size of the valve, and the designation of working water pressure (e.g., "200 W").

The City of Schertz may, at no cost to the Contractor, subject random valves to testing by an independent laboratory for compliance with these standards. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order and removal from the approved list.

2.8.1.3. **Workmanship.** All parts of the resilient seat gate valve must be designed and manufactured to the tolerances in accordance with ANSI/AWWA C 509.

All parts of the resilient seat gate valve manufactured by a given manufacturer must be interchangeable with like parts from another resilient seat gate valve of the same model and size and by the same manufacturer.

All interchangeable parts must conform to their required dimensions and must be free of defects that could prevent proper functioning of the valve.

All castings must be clean and sound, without defects that will weaken their structure or impair their service. Plugging, welding, or repairing of cosmetic defects is allowed. Repairing of structural defects is not allowed. Repaired valves must comply with the testing requirements in accordance with this Specification after repairs have been made. Repairs within the bolt circle of any flange face are not allowed.

The resilient seat gate valves must be well-fitted. Operation of the resilient seat gate valve must be smooth. All parts must be free of structural defects. The resilient seat gate valve must be watertight.

2.8.1.4. **Painting.** All exterior and interior surfaces of the valve must be coated with epoxy, NSF-61 certified. The epoxy must have a nominal dry film thickness of 8 mils, and must be in accordance with AWWA C 550.

Coating must be as close to holiday-free as technologically possible.

2.8.1.5. **Testing.**

- **Hydrostatic Test.** Must be performed on the valve in accordance with ANSI/AWWA C 509, Section 6.1, "Proof of Design Testing";
- **Torque Test.** Prototype valve tests must be performed on the valve in accordance with ANSI/AWWA C 509, Section 6.1, "Proof of Design Testing";
- **Leakage Test.** Must be performed on the valve in accordance with ANSI/AWWA C 509-01, Section 6.1, "Proof of Design Testing";
- **Pressure Test.** Must be performed on the valve in accordance with ANSI/AWWA C 509, Section 6.1, "Proof of Design Testing";
- **Operation Test.** Must be performed on the valve in accordance with ANSI/AWWA C 509, Section 6.2, "Production Testing";
- **Shell Test.** Must be performed on the valve in accordance with ANSI/AWWA C 509-01, Section 6.2, "Production Testing"; and

- **Seat Test.** Must be performed on the valve in accordance with ANSI/AWWA C 509, Section 6.2, "Production Testing."

An Affidavit of Compliance certifying that all required tests have been performed must be provided in accordance with ANSI/AWWA C 509, Section 6.3, "Affidavit of Compliance."

The Affidavit of Compliance, results of ASTM testing procedures and requirements for materials, manufacturer's QA program, and records of all tests performed on the valve must be kept and provided by the supplier or manufacturer in a single hard-cover bound notebook with the bid or with the shipping documents and must be approved by the City of Schertz.

2.8.1.6. **Quality Assurance (QA).** Manufacturers must have an ASME- or ISO-9001 registered commercial quality system. The manufacturer must replace non-compliant resilient gate valves in accordance with these Specifications. Return the defective resilient gate valve freight-collect to the manufacturer. The manufacturer must replace the resilient seat gate valve freight-prepaid. If City of Schertz audits, product inspection, and performance data review in accordance with these Specifications determine excessive resilient seat gate valve non-compliance, the manufacturer will be subject to removal by the Products Standards Committee. If the resilient seat gate valve becomes defective during the manufacturer's specified warranty period, a City of Schertz QA and manufacturer review will ensue. If the review determines manufacturing non-conformance, the manufacturer must replace the resilient seat gate valve according to size with a resilient seat gate valve in conformance with the City of Schertz specifications. The defective resilient seat gate valve removed from the field must be returned to the manufacturer, freight-collect, and the manufacturer must replace the resilient seat gate valve, freight-prepaid. If the non-conformance product amounts are excessive and result in increased product replacement by City of Schertz field staff, the manufacturer may be subject to time and material charges.

2.8.1.7. **References**. The documents listed below are referenced in this Specification:

- ANSI/AWWA C 509, and
- MSS SP-60.

2.8.2. **Reduced Wall, Resilient Seated Gate, and Tapping Valves (AWWA C 515).** This product Specification covers reduced wall resilient seated gate valves with nominal diameters of 4 in.–48 in. Sizes refer to the nominal diameter, in inches, of the waterway through the inlet and outlet connections and the closure area. All products furnished must be in accordance with ANSI/AWWA C 515 and MSS SP-60.

2.8.2.1. **Definitions.** All definitions are in accordance with ANSI/AWWA C 515.

2.8.2.1.1. **Cosmetic Defect.** A blemish that has no effect on the ability of the component to meet the structural design and production test requirements of the standard. Should the activity of plugging, welding, grinding, or repairing of such blemish cause the component to fail these requirements, the blemish will be considered a structural defect.

2.8.2.1.2. **Flanged Joint.** The flanged and bolted joint in accordance with ANSI/AWWA C 110/A 21.10 or ANSI B 16.1, Class 125.

2.8.2.1.3. **Mechanical Joint.** The gasketed and bolted joint in accordance with ANSI/AWWA C 110/A 21.10, ANSI/AWWA C 111/A 21.11, or ANSI/AWWA C 153/21.53.

2.8.2.1.4. **Push-On Joint.** The single rubber gasket joint in accordance with ANSI/AWWA C 111/A 21.11.

2.8.2.1.5. **Structural Defect.** Flaws that cause the component to fail the structural design or test requirements of this standard. This includes, but is not limited to, imperfections that result in leakage through the walls of a casting, failure to meet the minimum wall thickness requirement, or failure to meet production tests.

2.8.2.1.6. **Tapping Valve.** A special gate valve designed with end connections and an unobstructed waterway to provide proper alignment and positioning of a tapping sleeve, valve, and machine for tapping pipe dry or under pressure.

2.8.2.2. **General Requirements.** Except as otherwise modified or supplemented herein, ANSI/AWWA C 515 will govern the design, component materials, construction, manufacture, and testing of all reduced wall resilient seated gate valves. Valves must be suitable for frequent operation and service involving long periods of inactivity. Valves must be NSF-61 certified.

The City of Schertz reserves the right to limit the purchase of reduced wall resilient seat gate valves from manufacturers and to the models specified.

The minimum design working water pressure for gate valves with nominal diameters of 4 in., 6 in., 8 in., 10 in., 12 in., 14 in., and 16 in. must be 200 psig unless otherwise specified.

The maximum fluid velocity for flow through the valve in fully open position must be 16 ft. per second.

Valves must be reduced wall, resilient-seated types, bronze-mounted with non-rising stems. The closure member must be fully encapsulated by an elastomer without thin spots or voids. When open, the valve must have a clear, full-port, unobstructed waterway.

Gray iron, DI, steel, brass, and bronze materials must be in accordance with AWWA C 515, Section 4.2, “Materials,” and Table 3.

Table 3
Reduced Wall, Resilient Seated Gate, and Tapping Valves

Material	Standard
Gray iron	ASTM A126, Class B
Ductile iron	ASTM A536, no more than 0.08% phosphorus
Steel	SAE, Grade 2; ASTM A307; and zinc-plated
Bronze	ASTM B763, UNS C99500
Bronze stem nuts only	ASTM B62, UNS C836000 ASTM B584, UNS C84400

Gaskets, O-rings, coatings, and elastomers must be in accordance with AWWA C 515, Section 4.2., “Materials.”

The gate valves must be designed and constructed for installation in either a horizontal or vertical position. Valves designed for buried installation must have a stem in the vertical position and must be furnished for mounting in a horizontal pipeline, unless otherwise specified.

Valve components of brass or bronze must be manufactured to ASTM-recognized alloy specifications of low-zinc content bronze, in accordance with ANSI/AWWA C 515, Section 4.2, “Materials.” Material for the stem must have minimum yield strength of 40,000 psi; have minimum elongation in 2 in. of 12%; be made of bronze in accordance with ASTM B763, Alloy No. UNS C99500; and have maximum zinc content of 2% in accordance with ASTM B763, Table 2, “Chemical Requirements.” Stem nut material must comply with the above requirements. The stem must have a visible external marking at the top to indicate low-zinc, high-strength material. The marking must include a red plastic or neoprene washer placed around the top of the stem under the operating nut.

Valve ends must be either flanged, tapping valve, mechanical joint, push-on joint, or any combination thereof, as specified. All mechanical joint valves must be supplied with glands, bolts, and gaskets. Valve body bolts and nuts must meet the strength requirements in accordance with ASTM A307 with dimensions in accordance with ANSI B 18.2.1. The size of the bolt head must be equal to the size of the nut and must be stainless steel in accordance with ASTM 276.

All gate valves must be left-handed open valves, unless otherwise specified.

The valve bonnet and body must be made of DI. Shell thickness must meet the minimum thickness requirements in accordance with ANSI/AWWA C 515, Section 4.4, “Detailed Design,” Table 1, “Minimum Thickness of Body and Bonnet.” Valves larger than 16 in. must meet the performance requirements in conformance with the City of Schertz resilient seat reduced gate valve specification.

If glands and bushings are used, the valves must be made of ASTM B763 bronze UNS C99500. The stem must be made of cast, forged, or rolled ASTM B763 bronze UNS C99500. The gate may be made of bronze ASTM B763 UNS C99500. Stem seals must be O-ring type. The seals must be designed for dynamic applications. The design must be such that the seal above the stem collar can be replaced with the valve under full pressure in the fully open position. Materials for the O-ring packing plate must be in accordance with ANSI/AWWA C 515, Section 4.4.6, “Stem Sealing.”

Enclosed and buried valves must be coated inside and outside with a fusion-bonded epoxy with a nominal 8-mil dry film thickness in accordance with AWWA C 550-01 and to the maximum extent possible must be free of holidays. All coatings in contact with the potable water must be approved for potable water immersion service in accordance with ANSI/NSF 61.

The bidder must submit with its proposal three sets of certified drawings showing the principal dimensions, general construction, and material specification of the valve proposed. The number of turns to open (close) must be clearly noted in the valve information submitted with the proposal documents. The number of turns to open or close the valve must be consistent for each valve size for each approved manufacturer.

Valves furnished in accordance with this Specification must be supplied by the City of Schertz approved manufacturer.

All gate valve parts must be designed to withstand the following two pressure requirements, without being structurally damaged:

- an internal test pressure of twice the rated design working pressure of the valve. In no case must the pressure be less than 500 psi without any visual deformation; and
- the full rated internal working pressure when the closure member is cycled once from a fully open to a fully closed position against the full rated unbalanced working water pressure.

In addition to these pressure requirements, the valve assembly and mechanism must be capable of withstanding an input torque as follows:

- 200-ft. lb. for a 4-in. nominal diameter;
- 300-ft. lb. for 6-in., 8-in., 10-in., and 12-in. nominal diameters;
- 400-ft. lb. for 14-in.–20-in. nominal diameters; and
- 600-ft. lb. for a 24-in. nominal diameter.

Resilient seats must be applied to the gate and must seat against a corrosion-resistant surface. The non-metallic seating surface must be applied in a manner to withstand the action of line fluids and the operation of the sealing gate under long-term service. A metallic surface must have a corrosion resistance equivalent to or better than bronze. A non-metallic surface must be in accordance with ANSI/AWWA C 550. The gate must be fully encapsulated by an elastomer without thin spots or voids. Resilient seats must be bonded. ASTM D429, Method A or Method B, must prove the method used for bonding or vulcanizing. For Method A, the minimum strength must not be less than 250 psi. For Method B, the peel strength must be 75 lb. per inch.

The end flanges of flanged valves must conform to dimensions and drillings in accordance with ANSI/AWWA C 110/A 21.10 or ANSI B 16.1, Class 125.

Mechanical joint bell dimensions must be in accordance with ANSI/AWWA C 111/A 21.11.

Push-on joints must be in accordance with ANSI/AWWA C 111/A 21.11.

Markings must be cast on the bonnet or body of each valve and must show the manufacturer's name or mark, the year the valve casting was made, the size of the valve, the letters "C515," and the designation of working water pressure (e.g., "200 W"). Markings must be in accordance with ANSI/AWWA C 515-01, Section 6.1, "Marking."

The City of Schertz may, at no cost to the manufacturer, subject random valves to testing by an independent laboratory for compliance with these standards. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order and removal of the manufacturer from the approved list.

The tapping valves must be configured with a mechanical joint on one end and a tapping flange on the other end. The tapping valves must be furnished complete with glands, bolts, and gaskets. The tapping valve must have a clear unobstructed waterway. The seat rings must be of a large diameter to permit the entry of the full-diameter tapping machine cutters. The valve end that mates with the tapping sleeve must have an alignment lip to fit the recess in the tapping sleeve flange for proper alignment. The lip must be dimensioned in accordance with MSS SP-60 for valves 20-in. nominal pipe size and smaller.

2.8.2.3. **Workmanship.** All parts of the reduced wall resilient seat gate valve must be designed and manufactured to the tolerances in accordance with ANSI/AWWA C 515 and this Specification.

All parts of the reduced wall resilient seat gate valve manufactured by a given manufacturer must be interchangeable with like parts from another reduced wall resilient seat gate valve of the same model and size and by the same manufacturer.

All interchangeable parts must conform to their required dimensions and must be free of defects that could prevent proper functioning of the valve.

All castings must be clean and sound, without defects that will weaken their structure or impair their service. Plugging, welding, or repairing of cosmetic defects is allowed. Repairing of structural defects is not allowed. Repaired valves must comply with the testing requirements in accordance with this Specification after repairs have been made. Repairs within the bolt circle of any flange face are not allowed.

The reduced wall resilient seat gate valve must be well-fitted. Operation of the reduced wall resilient seat gate valve must be smooth. All parts must be free of structural defects. The reduced wall resilient seat gate valve must be watertight.

2.8.2.4. **Painting.** All exterior and interior surfaces of the valve must be coated with epoxy, NSF-61 certified. The epoxy must have a nominal dry film thickness of 8 mil, and must be in accordance with AWWA C 550.

Coating must be as close to holiday-free as technologically possible.

2.8.2.5. **Testing.**

- **Hydrostatic Gate Test.** Must be performed on the valve in accordance with ANSI/AWWA C 515, Section 5.1, "Testing";
- **Torque Test.** Prototype test must be performed on the valve in accordance with ANSI/AWWA C 515, Section 5.1, "Testing." Prototype valves larger than 16 in. must meet the torque requirements in accordance with Section 2.7.2.2., "Design Criteria for Ball-Type Curb Stops and Angle Valves";
- **Leakage Test.** Must be performed on the valve in accordance with ANSI/AWWA C 515, Section 5.1, "Testing";
- **Hydrostatic Shell Test.** Must be performed on the valve in accordance with ANSI/AWWA C 515-01, Section 5.1, "Testing." Valves larger than 16 in. must be shell-tested at twice the rated working pressure but at least 500 psi;
- **Production Test.** Must be performed on the valve in accordance with ANSI/AWWA C 515, Section 5.1, "Testing." This same test must apply to valves larger than 16 in.;
- **Operation Test.** Must be performed on the valve in accordance with ANSI/AWWA C 515, Section 5.1, "Testing"; and

- **Seat Test.** Must be performed on the valve in accordance with ANSI/AWWA C 515, Section 5.1, "Testing."

An Affidavit of Compliance certifying that all required tests have been performed must be provided in accordance with ANSI/AWWA C 515, Section 6.3, "Affidavit of Compliance."

The Affidavit of Compliance, results of ASTM testing procedures and requirements for materials, manufacturer's QA program, and records of all tests performed on the valve must be kept and provided by the supplier and manufacturer in a single hard-cover bound notebook with the bid or with the shipping documents and must be approved by the City of Schertz.

2.8.2.6. **Quality Assurance (QA).** Manufacturers must have an ASME- or ISO-9001 registered commercial quality system. If on receipt of reduced wall resilient seated gate valves they are found to be non-compliant, the manufacturer must replace the defective reduced wall resilient seated gate valves, according to reduced wall resilient seated gate valve size, with a reduced wall resilient seated gate valve in conformance with the City of Schertz' specifications. The defective reduced wall resilient seated gate valve must be returned to the manufacturer, freight-collect, and the manufacturer must replace the reduced wall resilient seated gate valve, freight-prepaid. If City of Schertz audits, product inspection, and data review in accordance with these Specifications determine excessive reduced wall resilient seated gate valve non-compliance, the manufacturer will be subject to removal by the Products Standards Committee. If the reduced wall resilient seated gate valve becomes defective during the manufacturer's specified warranty period, a City of Schertz QA and manufacturer review will ensue. If the review determines manufacturing non-conformance, the manufacturer must replace the reduced wall resilient seated gate valve, according to size, with a reduced wall resilient seated gate valve in conformance with the City of Schertz' specifications. The defective reduced wall resilient seated gate valve removed from the field must be returned to the manufacturer, freight-collect, and the manufacturer must replace the reduced wall resilient seated gate valve, freight-prepaid. If the non-conformance product amounts are excessive and result in increased product replacement by City of Schertz field staff, the manufacturer may be subject to time and material charges.

2.8.2.7. **References.** The documents listed below are referenced in this Specification**:**

- ANSI/AWWA C 509-01, and
- MSS SP-60.

2.8.3. **Tapping Valves and Tapping Sleeves.** This Section covers tapping sleeves installed on pipe of 4 in. and larger nominal pipe diameter.

2.8.3.1. **General Requirements.** Band must conform to the minimum OD size ranges and lengths as shown in Table 8. The flange must be manufactured in accordance with AWWA C 223, Class D, and ANSI B 16.1 drilling, recessed for tapping valves in accordance with MSS SP-60. Mechanical joint-tapping sleeve outlet must be in accordance with Section 2.8.3.2., "Tapping Sleeves from 4-in.–12-in. Nominal Pipe Diameter," and Section 2.8.3.3., "Tapping Sleeves 16-in. and Larger Nominal Pipe Diameter," and be suitable for use with standard mechanical joint x mechanical joint resilient wedge gate valves in accordance with ANSI/AWWA C 509.

2.8.3.2. **Tapping Sleeves from 4-in.–12-in. Nominal Pipe Diameter.** Entire fitting must be stainless steel Type 304 (18-8). The body, lug, and gasket armor plate must be in accordance with ASTM A240. The flange must be cast stainless steel in accordance with ASTM A743. The mechanical joint outlet must be one-piece casting made of stainless steel. The test plug must be 3/4 in. in accordance with ANSI B 2.1 and must be lubricated or coated to prevent galling. All metal surfaces must be passivated after fabrication in accordance with ASTM A380.

The gasket must provide a Type-360 sealing surface of such size and shape to provide an adequate compressive force against the pipe after assembly, to effect a positive seal under combinations of joint and gasket tolerances. The materials used must be vulcanized natural or synthetic rubber with antioxidants and anti-oziant ingredients to resist set after installation. No reclaimed rubber should be used. A heavy-gauge Type 304 stainless armor plate must be vulcanized into the gasket to span the lug area.

The lugs must be Heliarc-welded (gas metal arc-welded) to the shell. Lug must have a pass-through bolt design to avoid alignment problems and allow tightening from either side of the main. Bolts must not be integrally welded to the sleeve. Finger lug designs are not approved; tapping sleeve that has a lug design like the approved models is allowed.

Bolts and nuts must be Type 304 (18-8) stainless steel and lubricated or Teflon-coated to prevent galling or seizing. Bent or damaged unit will be rejected.

QC procedures must be employed to ensure that the shell, lug (4 in. and larger nominal pipe diameter), armor plate, gasket, and pertinent hardware are manufactured to be free of any visible defects. Each unit, after proper installation, must have a working pressure rating up to 200 psi, and a test pressure of 250 psi.

The sleeve construction must provide a positive means of preventing gasket cold flow and extrusion.

Each sleeve must be stenciled, coded, or marked in a satisfactory manner to identify the size range. The markings must be permanent-type, water-resistant, that will not smear or become illegible.

2.8.3.3. **Tapping Sleeves 16 in. and Larger Nominal Pipe Diameter.** The body must be in accordance with ASTM A285, Grade C, or ASTM A36. Test plug must be 3/4-in. NPT in accordance with ANSI B 2.1.

The gasket must provide a watertight sealing surface of such size and shape to provide an adequate compressive force against the pipe. After assembly, the gasket must insure a positive seal under all combinations of joint and gasket tolerances. Gasket must be formed from vulcanized natural or synthetic rubber with antioxidant ingredients to resist set after installation. No reclaimed rubber may be used.

Bolts and nuts must be a high-strength, corrosion-resistant, low-alloy type in accordance with AWWA C 111 and ANSA A 21.11.

QC procedures must be employed to ensure that the shell, gasket, and pertinent hardware are manufactured to be free of any visible defects. Each unit, after proper installation, must have a working pressure rating up to 150 psi, and a test pressure of 200 psi.

Unless otherwise specified, unit must be protected by fusion epoxy 8-mil–10-mil line and coat in accordance with AWWA C 213.

Units for concrete steel cylinder pipe must be furnished with load-bearing set screws on the gland flange to transfer loads on the outlet away from the steel cylinder and onto the sleeve. Epoxy-coated tapping sleeves do not require grout seal cavity, in accordance with AWWA M-9, “Manual of Practice.”

Each sleeve must be stenciled, coded, or marked in a satisfactory manner to identify the size range. The markings must be permanent-type, water-resistant, that will not smear or become illegible.

Standard dimension ranges are as shown in Table 4.

Table 4
Standard Ranges (4-in.–30-in. Nominal Pipe Diameter)

Nominal Diameter (in.) × Minimum Length (in.)	Flange Outlet (in.)	Range	Min OD Range (in.)[1]
4 × 16	4	A	4.75–4.95
		B	4.90–5.10
6 × 16	4	A	6.70–7.10
		B	7.00–7.40
		C	7.35–7.75
6 × 16	6	A	6.80–7.15
		B	7.05–7.40
		C	7.40–7.75
8 × 16	4 and 6	A	9.00–9.45
		B	9.35–9.70

Nominal Diameter (in.) × Minimum Length (in.)	Flange Outlet (in.)	Range	Min OD Range (in.)[1]
		C	9.70–10.10
8 × 20	8	A	9.00–9.35
		B	9.35–9.70
		C	9.70–10.00
10 × 16	4 and 6	A	11.03–11.47
10 × 20	8	B	11.60–12.00
10 × 24	10[2]	N/A	N/A
12 × 16	4 and 6	A	13.00–13.40
12 × 20	8	B	13.40–13.80
12 × 24	10	C	14.10–14.50
12 × 32	12[2]	N/A	N/A
16 × 12	4 and 6	N/A	17.33–17.87
16 × 16	8	N/A	18.62–19.19
16 × 20	10[2]	N/A	N/A
16 × 24	12[2]	N/A	N/A
16 × 36	16[2]	N/A	N/A
20 × 12	4 and 6	A	21.51–22.15
20 × 16	8	B	23.46–24.16
20 × 20	10[2]	N/A	N/A
20 × 24	12[2]	N/A	N/A
20 × 36	16[2]	N/A	N/A
20 × 40	20[2]	N/A	N/A
24 × 12	4 and 6	A	25.71–26.41
24 × 16	8	B	28.14–28.84
24 × 20	10[2]	N/A	N/A
24 × 24	12[2]	N/A	N/A
24 × 36	16[2]	N/A	N/A
24 × 40	20[2]	N/A	N/A
24 × 48	24[2]	N/A	N/A
30 × 12	4 and 6	A	29.78–30.48
30 × 16	8	B	31.52–32.22
30 × 20	10[2]	N/A	N/A
30 × 24	12[2]	N/A	N/A
30 × 36	16[2]	N/A	N/A
30 × 40	20[2]	N/A	N/A
30 × 48	24 × 30[2]	N/A	N/A

1. Ranges may be broadened but not narrowed. For concrete steel cylinder pipe, the OD of the pipe and cylinder must be supplied with the order.
2. Range to be specified when ordered.

For pipe larger than 30-in. nominal diameter, tapping sleeves must be custom-fabricated to fit non-standard ranges, in accordance with these Specifications.

The City of Schertz may, at no cost to the manufacturer, subject random units to testing by an independent laboratory for compliance with these standards. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order.

2.9. **Butterfly Valves.** This Section covers Class 150/250 rubber-seated butterfly valves, 4 in.–54 in. All products furnished must be in accordance with ANSI/AWWA C 504; however, the body construction of the valve must exceed the ANSI/AWWA C 504 values as specified herein. All coatings in contact with potable water must be NSF-61 certified. A proof of design certification must be provided upon request.

2.9.1. **Definitions.** All definitions are in accordance with ANSI/AWWA C 504.

2.9.1.1. **Actuator.** A device attached to the valve for the purpose of rotating the valve disc to an open, closed, or intermediate position; preventing disc-over travel; and maintaining the disc in any position.

2.9.1.2. **Butterfly Valve.** A valve that uses a disc rotatable through an angle of approximately 90° as a closure member. The valve is closed when the disc is perpendicular to the flow way, open when parallel to the flow way, or used for throttling when positioned between open and closed.

2.9.1.3. **Disc.** The closure member that is positioned in the flow stream to permit flow or to obstruct flow (depending on closure position) and that rotates through an angle of 90° from full open to full shutoff.

2.9.1.4. **Rubber Seat.** A rubber ring around the inside of the valve body to effect a seal against the metal-seating surface when the disc is closed, or resilient seats must be located on the valve disc and must provide a 360° continuous, uninterrupted seating surface. Seats must be mechanically retained with a stainless steel retaining ring and stainless steel Nylok cap screws, which must pass through both the resilient seat and the retaining ring.

The resilient seat's mating surface must be to a 360° continuous, uninterrupted stainless steel body seat ring. The retaining ring must be continuous or investment-cast with overlapping sections, serrated grooves, and shoulders.

2.9.2. **General Requirements.** Except as otherwise modified or supplemented herein, AWWA C 504 will govern the design, component material construction, manufacture, and testing of all butterfly valves.

The City of Schertz reserves the right to limit the purchase of butterfly valves from manufacturers and to the models specified.

Valves must be Class 150/250 of the short-body type with a 150/250-pound per square gauge (psig) bi-directional shutoff rating, a 500-psig hydrostatic body shell test, and a maximum upstream line velocity rating in accordance with Table 5 unless specified otherwise.

Table 5
Butterfly Valves Maximum Velocity

Diameter (in.)	Velocity (ft. per second)
3–20	16
24–72	8

Valve must be in the same alignment as a horizontal pipe and must be for buried service, unless otherwise specified. Valve must be configured with a horizontal valve shaft and a vertical actuator shaft with standard 2-in. AWWA operating nut. The actuator must be side-mounted.

Valve body must be of cast iron in accordance with ASTM A26, Class B, or ductile iron in accordance with ASTM A536, Grade 65-45-12.

Valve body ends must be flat-faced flanged in accordance with ANSI B 16.1, Class 150/250. All cast iron valves must exceed minimum body shell thickness in accordance with AWWA C 504, Class 150B/250B, Section 3.1, "Valve Bodies," Table 2.

Laying lengths for flanged and wafer valves and minimum body shell thickness for all body types are as follows:

- **Sizes 3 in.–10 in.** 15% or greater;
- **Sizes 12 in.–24 in.** 20% or greater; and
- **Sizes 30 in.–54 in.** 50% or greater.

Ductile iron valve body thicknesses and ductile iron and cast iron laying lengths must be in accordance with Table 6a and Table 6b, unless otherwise specified.

Table 6a
Ductile Iron Valve Laying Length

Valve Diameter (in.)	Thickness (in.)	Laying Length (in.)
3	0.37	5
4	0.40	5
6	0.43	5
8	0.46	6
10	0.54	8
12	0.58	8
14	0.63	8
16	0.68	8
18	0.79	8
20	0.83	8
24	0.93	8
30	1.10	12
36	1.22	12
42	1.35	12
48	1.48	15
54	1.63	15
60	1.89	15
66	2.00	18
72	2.375	18

Table 6b
Cast Iron Valve Laying Length

Valve Diameter (in.)	Thickness	Laying Length (in.)
6	In accordance with Specification	6
8–12	In accordance with Specification	8
14–30	In accordance with Specification	12
36–54	In accordance with Specification	15

Valve must be of such design that the disc will seat at 90° with the pipe axis.

Valve must be of such design that the disc will not flutter or vibrate when operated in a throttled position.

Valve discs must be of Cast Iron A-48; Cast Iron A-126, Class B; or Ductile Iron ASTM A536, Grade 65-45-12, and must be of disc design to provide 360° uninterrupted seating.

The valve seat must be natural or synthetic rubber and may be applied to the disc or body. For valves 24 in. or larger, the rubber seat must be capable of mechanical adjustment in the field and must be field-replaceable. Special tools required for seat adjustment must be provided with the valve. Special tools required for seat replacement must be furnished with the replacement seat. Mechanical adjustment or attachment of the seat and seat ring does not include welding. The mating seat surface must be Type 304 or Type 316 stainless steel, Ni-Chrome or Monel. Sprayed or plate-mating seat surfaces are not acceptable.

Valve shafts must be Type 630 stainless steel in accordance with ASTM A564, Condition H-1100, and must have a diameter equal to or greater than that shown for Class 150B in accordance with AWWA C 504, Table 3. Shafts must be in accordance with AWWA C 504, Section 3.3, “Valves Shaft,” for one-piece or stub-shaft types. Connection between the shaft and disc must be dowel, taper pins, or torque plugs, which are mechanically secured.

The valve assembly must be furnished with a factory-set, non-adjustable disc shaft thrust bearing that ensures the valve disc is always centered within the valve body seat.

Valve shaft bearings must be permanent, self-lubricated bearings that provide continuous, low-friction, maintenance-free operation. Shaft bearing must be contained in integral hubs of the valve body.

Valve shaft seal must consist of O-ring, V-type, or U-cup type packing where the shaft projects through the valve body for the actuator connection.

The valve must be provided with a fully enclosed, permanently lubricated actuator of the traveling nut or worm gear design. The actuator must be connected to the valve shaft by key and keyway connection.

All actuators must have adjustable, mechanical stop limits in accordance with AWWA C 504, Section 3.8.2. All 4-in–54-in. valve actuators must be capable of withstanding 450-ft. lb. of input torque against the open or closed stops without damage.

Valves for belowground applications must be provided with an AWWA wrench nut. The wrench nut must have an arrow cast thereon, indicating the direction of opening. The wrench nut must be suitably fastened to the actuator input shaft. If the shaft is smooth, the wrench nut must be fastened to the input shaft by a minimum 5/16-in. diameter steel pin passing entirely through the shaft and the wrench nut. Key with keyway will be acceptable. If the shaft is splined, the wrench nut must be formed to fit the splined shaft. The actuator must be designed to produce the specified torque with a maximum input of 150-ft. lb. applied to the wrench nut.

Valves for aboveground applications must be provided with a handwheel. The handwheel must have an arrow thereon, indicating the direction of the opening. The handwheel must be suitably fastened to the actuator input shaft. Actuators equipped with handwheels must be designed to produce the specified torque with a maximum pull of 80 lb. of the handwheel rim.

The requirement for either wrench nut or handwheel and the direction of opening must be specified on each purchase order.

The bidder must submit with its proposal three sets of certified drawings showing the principal dimensions, general construction, and material specification of the valve proposed. The number of turns to open (close) must be clearly noted in the valve information submitted with the proposal documents.

The supplier and manufacturer must provide an Affidavit of Compliance in accordance with AWWA C 504, including the following:

- results of ASTM testing procedures and requirements for materials provided to the owner upon request;
- manufacturer's QA program; and
- leak tightness testing and proof of design testing of representative actuators in accordance with AWWA C 504, Section 3.8.5.2, as modified herein (450-ft. lb.).

Compliance assurance will be required in accordance with AWWA C 504, Section 5.1.2, "Affidavits." Results of performance tests; proof of design test; and AWWA C 504, Section 5.2.4, "Hydrostatic Test, Leakage Test, and Affidavit of Compliance," must be provided with the bid or with the shipping documents and must be approved by the City of Schertz.

2.9.3. **Workmanship.** All parts of the butterfly valve must be designed and manufactured to the tolerances in accordance with ANSI/AWWA C 509 and this Specification.

All parts of the butterfly valve manufactured by a given manufacturer must be interchangeable with like parts from another butterfly valve of the same model and size and by the same manufacturer.

2.9.4. **Painting.** All interior and exterior ferrous surfaces of the valve, including the disc, must be coated with epoxy, NSF-61 certified, or fusion-bonded epoxy, NSF-61 certified. The epoxy (or fusion-bonded epoxy) must have a nominal thickness of 8 mil, and must be in accordance with AWWA C 550.

Coating must be as close to holiday-free as possible.

2.9.5. **Testing and Inspection.**

- **Performance Tests.** Must be performed on each valve in accordance with ANSI/AWWA C 504, Section 5.2.1, "Testing";

- **Leakage Tests.** Must be performed on each valve in accordance with ANSI/AWWA C 504, Section 5.2.2, "Testing";
- **Hydrostatic Tests.** Must be performed on each valve in accordance with ANSI/AWWA C 504, Section 5.2.3, "Testing"; and
- **Proof of Design Tests.** Must be performed on each valve in accordance with ANSI/AWWA C 504, Section 5.2.4, "Testing."

An Affidavit of Compliance certifying that all required tests have been performed must be provided.

The Affidavit of Compliance and the records of all tests performed on the valves must be kept and provided in a single hard-cover bound notebook.

2.9.6. **Quality Assurance (QA).** Manufacturers must have an ASME- or ISO-9001 registered commercial quality system. If on receipt of butterfly valves they are found to be non-compliant, the manufacturer must replace the defective butterfly valves according to butterfly valve size with a butterfly valve in conformance with the City of Schertz' specifications. The defective butterfly valves must be returned to the manufacturer, freight-collect, and the manufacturer must replace the butterfly valve, freight-prepaid.

If City of Schertz audits, product inspection, and performance data review in accordance with these Specifications determine excessive butterfly valve non-compliance, the manufacturer will be subject to removal by the Products Standards Committee. If the butterfly valve becomes defective during the manufacturer's specified warranty period, a City of Schertz QA and manufacturer review will ensue. If the review determines manufacturing non-conformance, the manufacturer must replace the butterfly valve according to size with a butterfly valve in conformance with the City of Schertz' specifications. The defective butterfly valve removed from the field must be returned to the manufacturer, freight-collect, and the manufacturer must replace the butterfly valve, freight-prepaid. If the non-conformance product amounts are excessive and result in increased product replacement by City of Schertz field staff, the manufacturer may be subject to time and material charges.

2.9.7. **References.** ANSI/AWWA C 504 is referenced in this Specification.

2.10. **Valve Boxes.** This Section covers cast iron valve box assemblies.

2.10.1. **General Requirements.** Each valve box assembly must be of cast iron and must consist of a base, top section, and lid, as shown on the plans.

Valve boxes must be of a single size with a nominal diameter of 6 in.

The valve box lid must be labeled "water" and must be designed so that it will remain firmly seated in place when subjected to vehicular traffic.

The valve box assembly must have enough toughness and strength to withstand impact loads and shock resulting from vehicular traffic.

The valve box assembly must be coated with a standard bituminous coating of either coal tar or asphalt basic applied to all inside and outside surfaces.

2.11. **Pressure-Reducing Valves.** This Section covers pressure-reducing valves of the watertight, globe-style bodies with flange bodies in sizes of 1-in.–36-in. Pressure ranges must be as shown on the plans or in purchase orders.

2.11.1. **General Requirements.** Valves furnished in accordance with this Specification must be manufactured by one of the following manufacturers or approved equal:

- Cla-Val,
- GA Industries,
- Watts Singer, or

- Bermad 720.

Valves must be Class 150 lb. (unless otherwise specified) and must be cast iron globe body.

Materials for the valve body must be in accordance with ASTM A126B.

The valves must have flanged ends. Flanges must be faced and drilled in accordance with ASTM B16.1.

The main valve seat must be provided with V-notch port sections.

All internal removable working parts must be bronze.

The valve must be repairable without removing the valve body from the line.

Valves must be solenoid-controlled or diaphragm-operated, hydraulically actuated, and of heavy-duty waterproof construction in a NEMA IV enclosure.

The valve must have an indicator rod that is an integral part of the valve to show the position of the diaphragm within the valve body. Valves must be equipped with speed controls for regulating the speed of opening and closing.

The valve must have a single-pole double throw limit for both open and closed positions to perform the function as shown on the electrical plans or drawing.

All construction materials must be certified in writing to ASTM specifications in accordance with Table 7.

Table 7
Pressure**-Reducing Valve Body and Door Material Specifications**

Body	All accepted and approved	Ductile Iron ASTM A536 Cast Steel ASTM A216 WCB Cast Iron ASTM A136 GR.B Ductile Iron ASTM A538
Doors	Both accepted and approved	Cast Steel ASTM A216 WCB As. Bronze ASTM B148 C95200

- Sealing Element Buna-N,
- Torsion Spring T316 Stainless Steel,
- Hinge Shaft T316 Stainless Steel, and
- Stop Shaft T316 Stainless Steel.

2.11.2. **Painting.** All interior and exterior ferrous surfaces of the valve, including the disc, must be coated with epoxy, NSF-61 certified, or fusion-bonded epoxy, NSF-61 certified. The epoxy (or fusion-bonded epoxy) must have a nominal thickness of 8 mils, and must be in accordance with AWWA C 550.

2.11.3. **Testing and Inspection.** Valves must be ANSI/NSF-61 certified.

2.12. **Meter Boxes.** This Section covers meter boxes for 5/8-in., 3/4-in., 1-in., 1-1/2 in., and 2-in. meters.

2.12.1. **General Requirements.** For non-traffic bearing locations, the meter box assembly for 5/8-in.–1-in. meters must be made of 100% high-quality recycling plastic. The meter box and lid must be black and constructed of modified polyethylene material for maximum durability and corrosion resistance. The black material is for maximum UV protection. The black material must be uniform throughout the meter box and lid for maximum longevity and not have a foaming agent that creates air pockets within the plastic wall. The body and lid must withstand 20,500-lb. loading in non-deliberate and incidental traffic.

For traffic-bearing locations, the meter box assembly for 5/8-in.–2-in. meters must consist of a cast iron rectangular box and a steel checkered plate rectangular cover with raised lug pattern as shown on the plans.

2.12.2. **Specific Requirements.**

2.12.2.1. **Plastic Lid.** The plastic lid must have the following:

- the words “water meter” molded into the lid;
- seat securely and evenly inside the meter box and not overlapping the top edge of the meter box;
- “overlap” securely and evenly on the existing cast iron meter box with like dimensions;
- a diamond pattern for skid resistance and an AMR slide mount molded into the lid on the underneath side and off center for placement for an AMR transponder to help in the protection of the radio antenna;
- a brass-worn gear lock that will secure the existing cast iron meter box of like dimensions and secure the plastic meter box, as shown on the plans;
- a molded receptacle for placement of a key; and
- one piece of 1/2-in. rebar secured in lid, as shown on the plans.

2.12.2.2. **Plastic Body.** The plastic body must have the following:

- crush-resistant ribbing along the outside of box,
- a flange around the top opening to help prevent setting and aid in adjustment to grade, and
- design to accommodate all plastic lids.

2.12.2.3. **Cast Iron Rectangular Box for Traffic-Bearing Locations.** The cast iron rectangular box for traffic-bearing locations must have the following characteristics:

- ultimate tensile strength of 25,000 psi and not brittle;
- an “as-cast” clean smooth surface and free of internal porosity. Castings that are made smooth by grinding will not be considered;
- dipped in a coal tar at 350°F, with metal at 300°F before dipping. The casting should be dipped and cured independently, and the coating must have ceased to be “tacky” within 72 hr. after dipping; and
- the steel checkered plate rectangular cover hot-dip galvanized after fabrication.

2.12.3. **Quality Assurance (QA).** If on receipt of meter boxes or lids, they are found to be non-compliant, the manufacturer must replace the defective boxes or lids with a replacement that meets the City of Schertz’ specifications, at no charge to City of Schertz. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order.

Product that is non-compliant will be returned to the manufacturer, freight-collect, and the manufacturer must replace the defective product, freight-prepaid, within 30 days from receipt of the defective product.

2.13. **Fire Hydrants.** This Section covers post-type, dry-barrel fire hydrants with compression shutoff (opening against pressure) or gate shutoff for use in water supply service in all climates, including those where freezing occurs. All products furnished must be in accordance with ANSI/AWWA C 502-05 and UL-approved.

2.13.1. **Definitions.** All definitions are in accordance with ANSI/AWWA C 502.

2.13.1.1. **Cosmetic Defect.** A blemish that has no effect on the ability of a component to meet the structural design and production test requirements of this standard. Should the blemish or the activity of plugging, welding, grinding, or repairing such blemishes cause the component to fail these requirements, the blemish must be considered a structural defect.

2.13.1.2. **Structural Defect.** A flaw that causes a component to fail the structural design or test requirements of this standard. This includes, but is not limited to, imperfections that result in leakage through the walls of a casting, failure to meet minimum wall thickness requirements, and failure to meet production tests.

2.13.1.3. **Bury.** The length of bury is the distance measured to the nearest 1/2 ft. from the bottom of the connecting pipe to the ground line of the hydrant.

2.13.2. **General Requirements.** The City of Schertz reserves the right to limit the purchase of fire hydrants from manufacturers and to the models specified.

Each hydrant must be designed for a minimum working pressure of 200 psig.

All parts of the hydrant must be designed to withstand, without being functionally impaired or structurally damaged, a hydrostatic test of not less than 400 psig or twice the rated working pressure, whichever is greater, with the hydrant completely assembled and pressurized as follows:

- with the nozzle caps in place, the main valve open, the hydrant inlet capped, and the test pressure applied to the interior of the hydrant; and
- with the main valve closed, the hydrant inlet capped, and the test pressure applied at the hydrant inlet.

The design safety factor of the operating mechanism must not be less than 5 and must be based on the foot-pound of torque required for the closing and opening of the hydrant at a working pressure of 200 psig. Hydrants must be functional and capable of being opened or closed without difficulty following an application of an operating torque of 200-lb. ft. at the operating nut in the opening direction, with the hydrant fully opened and the closing direction with the hydrant fully closed. The torque requirements apply only to hydrants of 5-ft. bury or less.

The length of bury must be as specified but not less than 4 ft. The fire hydrant must have two hose nozzles and one pumper nozzle. The nominal ID of the hose nozzle must be 2.5 in. The nominal ID for the pumper nozzle must be 4 in. The outlet nozzle threads must be in accordance with the NFPA 2003 *Standard for Fire Hose Connections*. The nominal diameter of the main valve opening must be 5.25 in. The hydrant shoe must be provided with a 6-in. mechanical joint connection to fit the connecting pipe. The fire hydrant must open right (clockwise). The color of the finish paint above the ground line must be aluminum; however, fire hydrants for private use must be painted red. The fire hydrant must have a non-rising stem. No more than one 6-in. stem extension must be provided if required to make the base of the fire hydrant grade level.

The bonnet section must be designed so all bearing surfaces and stem threads are sealed in a lubricant reservoir. If oil is used as a lubricant, the reservoir must be designed to allow for easy filling through a fitting or plug. Where grease is used as a lubricant, the reservoir must be sealed. The reservoir must be adequately sealed with O-rings or other suitable sealing system approved by the City of Schertz.

The fire hydrant must have a safety flange or breakaway flange at the ground line in accordance with ANSI/AWWA C 502, Section 3.1, “General Design.”

Fire hydrant nozzle cap chains will be required and must be attached permanently to the fire hydrant in accordance with ANSI/AWWA C 502, Section 3.2, “Detailed Design.”

Parts that require lubrication and contact water must be lubricated with a non-toxic food-grade lubricant that does not pose a health hazard to the public if consumed.

2.13.3. **Workmanship.** All foundry and machine work must be performed in conformance with good standard practice for the class of work involved and as shown on plans, if required. When assembled, hydrants manufactured in accordance with this Specification must be well-fitted and must operate smoothly. The body and shaft must be watertight.

All parts must conform to the required dimensions and must be free of defects that could prevent proper functioning of the hydrant.

All castings must be clean and sound, without defects that will weaken their structure or impair their service.

2.13.4. **Paint.** The exterior surface of the hydrant must be coated in accordance with Federal Specification TT C 494b. A second coat of water-based or oil-based enamel paint aluminum in color must then be applied from the top of the hydrant to a point 18 in.–20 in. below the centerline of the pumper nozzle, or down to the traffic safety flange connection at the ground line.

All interior surfaces and machined surfaces, such as the threaded portion of the stem or stem nut, which must fit closely with the adjacent parts, must be coated in accordance with Federal Specification TT C 494b. Stem surfaces contained within a lubricant reservoir and not in contact with potable water may be free of coating.

The interior and exterior of the hydrant shoe must be coated with a fusion-bonded epoxy with a nominal dry film thickness of 8 mils, in accordance with ANSI/AWWA C 550, and NSF-61 certified.

Coating must be as close to holiday-free as possible.

2.13.5. **Testing and Inspection.** Each assembled hydrant must be subjected to two shop tests under a hydrostatic pressure of 400 psig, or twice the rated working pressure, whichever is greater. One test must be conducted with the entire interior of the hydrant under pressure, and another with the main valve closed and the base under pressure from the inlet side. Under the test procedure, there should be no leakage through the main valve or seals, or through the castings or the joints of the assembled hydrant. Under the test conditions, the leakage through the drain valves must not exceed 5 oz. per minute. Other leakage or other imperfections found in either test must be corrected, or the hydrant re-tested. The tests must be conducted for enough time to allow a check of all points of possible leakage and for at least 30 sec. after all air has been exhausted.

Each assembled hydrant must be operated through a full open-close cycle when not under pressure. The torque required for performing this operation must not exceed 20 lb. ft.

All fire hydrant tests and inspections must be in accordance with ANSI/AWWA C 502, Section 5.1, “Production Testing”; ANSI/AWWA C 502, Section 5.2, “Prototype Testing”; and ANSI/AWWA C 502-05, Section 5.3, “Inspection and Rejection.”

The manufacturer must provide an Affidavit of Compliance in accordance with ANSI/AWWA C 502, Section 1.7, “Affidavit of Compliance.”

2.13.6. **Quality Assurance (QA).** Manufacturers must have an ASME- or ISO-9001 registered commercial quality system. Non-compliance will result in removal of the manufacturer’s product from the approved manufacturers list. If on receipt of fire hydrants they are found to be non-compliant, the manufacturer must replace the defective fire hydrants according to fire hydrant size with a fire hydrant in conformance with the City of Schertz’ specifications. The defective fire hydrants must be returned to the manufacturer, freight-collect, and the manufacturer must replace the fire hydrant, freight-prepaid. If City of Schertz audits, product inspection, and performance data review in accordance with these Specifications determine excessive fire hydrant non-compliance, the manufacturer will be subject to removal by the Products Standards Committee. If the fire hydrant becomes defective during the manufacturer’s specified warranty period, a City of Schertz QA and manufacturer review will ensue. If the review determines manufacturing non-conformance, the manufacturer must replace the fire hydrant according to size with a fire hydrant in conformance with the City of Schertz’ specifications. The defective fire hydrant removed from the field must be returned to the manufacturer, freight-collect, and the manufacturer must replace the fire hydrant, freight-prepaid. If the non-conformance product amounts are excessive and result in increased product replacement by City of Schertz field staff, the manufacturer may be subject to time and material charges.

2.13.7. **Maintenance Kits.** The City of Schertz will attempt to use fire hydrant maintenance kits in the repair of the approved hydrants.

2.13.8. **References.** The documents listed below are referenced in this Specification:

- ANSI/AWWA C 502, and
- ANSI/AWWA C 55005.

2.14. **Polyethylene Wrapping Material.** This Section covers polyethylene-wrapping material for use in encapsulating DI and cast iron pipe.

General Requirements. Polyethylene wrapping for DI and cast iron water mains must consist of a 4-mil tubular section of cross-laminated high-density polyethylene (HDPE), which has a high dielectric and tensile strength, for use in insulating cast iron and DIP from the electrolytic action encountered in highly active soils. Polyethylene wrapping must consist of opaque cross-laminated HDPE sheet continuously thermally bonded to form a tubular section. The tubes may be supplied in bulk length on rolls or in individual pre-cut lengths. Minimum size and length requirements in accordance with AWWA C 105, Table 1, are as shown in Table 8. When supplied in specific pipe lengths, the tubes must be at least 4 ft. longer than the actual pipe length to allow for overlap.

Table 8
4-mm Polyethylene Wrapping Material Sizes and Lengths
(All Sizes Lay Flat)

Pipe Size (in.)	Product Size Width (in.) × Length
4, 6, and 8	20 × 200/500
8, 10, and 12	27 × 200/500
16 and 18	37 × 200/500
20	41 × 200/500
24	54 × 200/500
30	67 × 140/500
36	81 × 120/500
48	95 × 100/500
54	108 × 100/500

The polyvinyl sheet of film for the tubular wrapping must be of virgin resins meeting raw and physical properties in accordance with ASTM D1248 and AWWA C 105. The material must be 4-mil cross-laminated HDPE of uniform film thickness and free of imperfections, such as pin holes, after being thermally seamed into tubular form. The finished product must have a nominal thickness of 4 mils, with tolerances of minus 10%.

The polyethylene wrapping material must have no volatile constituents, the loss of which may affect ductility. The material must also have the following properties:

- **Mechanical.** The polyethylene film must have a tensile strength, in accordance with ASTM D882, of 6,300 psi minimum. The film must have an elongation of not less than 100% of the test strip in accordance with ASTM D882. The film must have an impact resistance of 800 g per minute in accordance with ASTM D1709, Method B. The film must have a propagation tear resistance of 250 gf (grams/force) minimum in machine and transverse direction in accordance with ASTM D1922;
- **Dielectric.** The film must have a dielectric strength of 800V-per-mil thickness in accordance with ASTM D149;
- **Inspection and Certification.** By manufacturer;
- **QC and Inspection.** The manufacturer must establish the necessary QC and inspection practice to ensure compliance with this standard;
- **Manufacturer's Statement.** The manufacturer must provide a sworn statement on each lot purchased that the inspection and all pertinent material requirements in accordance with Section 2.13., "Polyethylene Wrapping Material," have been met and that all results are in conformance with this standard; and
- **Freedom from Defects.** All polyethylene film must be clean, sound, and without defects that could impair service.

2.14.1. **Marking Requirements.** The polyethylene film supplied must be clearly marked, at least every 2 ft. along its length, with the following information:

- manufacturer's name or trademark;
- year of manufacture;
- "ANSI/AWWA C 105/A 21.5";
- minimum film thickness and material type;
- applicable range of nominal pipe diameter sizes; and

- "WARNING: Corrosion protection. Repair any damage."

The City of Schertz may, at no cost to the Contractor, subject random testing by an independent laboratory in accordance with this Specification. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order.

2.15. **Standard- and Wide-Range Ductile Iron (DI) Couplings.** This Section covers DI couplings for use in connection of smooth end joints of cast iron, DI, asbestos cement, steel, PVC, or other types of pipe. The couplings must be capable of fitting this variety of pipes with one set of follower flanges or end rings.

2.15.1. **General Requirements.** Sleeve or center ring must be nominal OD size range and length specified. Sleeve must be of ductile iron in accordance with ASTM A536. Ends must have a smooth inside taper to provide uniform gasket seal. Sleeve must be given a shop coat of oil-modified urethanes, corrosion-resistant paint, or epoxy coating.

Follower flanges or end rings must be of the thickness determined by the coupling size and must be DI in accordance with ASTM 536. Flanges must be identified by a color-coded shop coat finish in accordance with Section 2.14.1., "Marking Requirements."

Gaskets must be compression-type, formed with virgin SBR, in accordance with ASTM D2000 3 BA715, and compounded with ingredients to produce permanence and resistance to set after installation. OD range must be imprinted or molded on the gasket in permanent ink (at minimum).

Bolts and nuts must be of high-strength, low-alloy steel, with nominal coarse thread, and hex nuts with black finish. Dimensions and minimum stress values must be in accordance with AWWA/ANSI C 111/A 21.11.

Where Specification states a cast transition or reducing coupling in place of a straight coupling, the sleeve and follower flange must be of the same manufacturer and compatible for the specific use intended.

QC procedures must be employed to ensure that the sleeve, follower flanges, and gaskets are properly fabricated and free of any visible defects. Each coupling must have a minimum working pressure rating in accordance with Table 9.

Table 9
Ductile Iron Couplings

Pipe Size (in.)	Minimum Working Pressure Rating (psi)
16 and smaller	175
20	150
24	150

2.15.2. **Straight Coupling Ranges.** DI straight and wide-range coupling ranges are as shown in Table 10 and Table 11, respectively.

Table 10
Ductile Iron Straight Coupling Ranges

Nominal Diameter (in.) × Minimum Length (in.)	Outside Diameter Range[1] (in.)
4 × 6	4.80–5.10
6 × 6	6.90–7.22
8 × 6	9.05–9.45
10 × 6	11.10–11.60
12 × 6	13.20–13.50 13.78–14.38
16 × 6	17.40–17.80 18.46–19.00
20 × 7	21.35–21.75 21.75–22.25
24 × 10	25.00–25.80

Nominal Diameter (in.) × Minimum Length (in.)	Outside Diameter Range[1] (in.)
	26.10–26.32

1. Ranges may be broadened, but not narrowed.

Table 11
Ductile Iron Wide-Range Coupling

Coupling Size (in.)	Outside Diameter Range[1] (in.)
3	3.40–4.20
4	4.20–5.33
6	6.25–7.45
8	8.40–9.79
10	10.70–12.12
12	12.75–14.38

1. Ranges may be broadened, but not narrowed.

The City of Schertz may, at no cost to the manufacturer, subject random couplings to testing by an independent laboratory for compliance with these standards. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order.

2.16. **Air Release, Vacuum, and Combination Air Valves.** This Specification covers automatic valves installed on water mains to vent accumulated air under system pressure, and to provide air exhaust during initial fill or to prevent a vacuum during draining or water column separation of the system.

2.16.1. **General Requirements.** Valves furnished in accordance with this Specification must be in accordance with ANSI/NSF 60 for direct additives and ANSI/NSF 61 for indirect additives. Cast iron valve body and cover must be in accordance with ASTM A48-35 or ASTM A126, Class B. Non-metallic valve body must be fabricated from fiberglass-reinforced nylon. Inlet sizes 2 in. or less must be screwed (NPT). Pipe sizes 3 in. or more must have flanged inlets (125# in accordance with ANSI B 16.1). A protective hood or cowl must be installed on the outlet of flange-bodied valves.

Metallic internal seat trim float arm and pivot pin must be stainless steel Type 303, 304, or 316. Metallic floats must be stainless steel in accordance with ASTM A240. Other stainless steel metal internal parts must be stainless steel in accordance with ASTM A240 or ASTM A276.

Non-metallic floats must be foamed polyethylene with stainless steel Type 316 fasteners.

Valves requiring internal seats or orifice buttons must be Buna-N rubber compounded for water service. For valves requiring cover gaskets, the cover gasket must be composition-type, equal to Armstrong CS 231, Garlock 3000, or Lexide NK 511. If an O-ring is used to seal the cover, it must be on NSF-61 certified rubber. Cover bolts must be alloy steel. Rolling seals must be furnished for non-metallic valves 2 in. and less.

Valve body must have a test pressure rating of 300 psi and working pressure rating of 150 psi.

All components in contact with potable water must be lead-free and marked by stamping, etching, or casting “NL” in the main body.

2.16.2. **General Operation Requirements.** The air release valve must be designed to vent accumulated air automatically. The outlet orifice must be properly sized to facilitate valve operation at pressures up to 150 psi. The air release valve must be simple-lever, compound-lever, ball-and-orifice, or rolling-seal depending on volume requirements and the design of the valve.

The air and vacuum valve must be designed with the inlet and outlet of equal cross-sectional area where applicable. The valve must be capable of automatically allowing large quantities of air to be exhausted during the filling cycle and automatically allowing air to re-enter the system to prevent a negative pressure at water column separation or during the draining cycle. The float must be guided to minimize premature closure by air and to provide proper alignment for normal closure by floating on the water surface.

Combination air and vacuum relief valves must provide for automatic air release under system pressure and allowance of air movement during filling or draining operations or water column separation. The combination valve may be housed in a single casting. The housing must be designed to incorporate conventional or kinetic flow principles to properly vent the air without premature closure. Flange sized 4 in. or larger may be furnished in a dual housing. When dual casings are used, a bronze manual isolation valve must be installed if specified by the manufacturer. This will allow the air release valve to be serviced when the system is under pressure. Field service of the valve may also be performed by closing the isolation valve between the air valve and the pipe connection.

2.16.3. **Tests.** The City of Schertz may, at no cost to the manufacturer, subject random valves to testing by an independent laboratory for compliance with these standards. Any visible defect or failures to meet the quality standards herein will be grounds for rejecting the entire order.

2.16.4. **Quality Assurance (QA).** The manufacturers must provide certification that products furnished in accordance with this Specification are manufactured in an ISO-9001 certified facility or documentation from an accredited facility that ISO 9001 certification is in process.

2.17. **Reinforced Concrete Vaults.**

2.17.1. **General Requirements.** Concrete used should be transit mix and must have a 28-day compressive strength of 3,000 psi with a maximum slump of 6 in. and a minimum slump of 3 in. The use of admixtures will not be permitted unless approved. Cement should be Type I or Type III and must be in accordance with ASTM C150 and ASTM C156, or most applicable approved equal provision.

2.18. **Blow-Off Assemblies.** The materials required for permanent and temporary 2-in. and 4-in. blow-off assemblies must be in accordance with these Specifications and as shown on the plans.

2.19. **Backfill.**

2.19.1. **Bedding and Initial Backfilling.** The bedding and initial backfill materials for concrete steel cylinder (CSC) pipe, pipe, HDPE pipe, wrapped steel pipe, and PVC pipe in all nominal diameters must consist of well-graded crushed stone or gravel in accordance with Table 12 unless modified by the Engineer.

Table 12
Modified Grade 5 Gravel

Retained on 1/2" sieve	0%
Retained on 3/8" sieve	0–5%
Retained on No. 4 sieve	20–80%
Retained on No. 10 sieve	70–100%
Retained on No. 20 sieve	98–100%

The quantity and thickness of lifts and compaction of initial backfill materials must be in accordance with Section 3.3., “Backfill,” of this Specification.

Where copper services (3/4 in.–2 in.) are installed, initial backfill must be sand conforming to the following requirements:

- natural sand or sand produced from crushed gravel or crushed rock, maximum 1/4 in., 95% of which must pass No. 4 sieve; or
- free of clay and organic material, with a maximum 8% passing the No. 200 sieve.

Larger services using DIP or PVC pipe in accordance with AWWA C 900 must be backfilled in the same manner as for mains.

2.19.2. **Secondary Backfill for Water Mains. “**Secondary backfill” is defined as backfill from 1 ft. above the top of the pipe to the top of the trench or bottom of pavement section. Secondary backfill must be constructed in conformance with the construction documents.

Secondary backfill must generally consist of materials removed from the trench and should be free of brush, debris, and trash. Rock or stones larger than 6 in. at the largest dimension must be sifted out and removed before the material is used in the secondary backfilling zone. Secondary backfill material should primarily consist of compactible soil materials. The secondary backfill material must be placed in maximum 12-in. loose lifts or as directed.

2.20. **Asphalt.** All asphaltic concrete used in the replacement of pavement over the trench line must be in accordance with Item 341, "Dense-Graded Hot-Mix Asphalt," QC and QA, Type C, except when the use of 6 in. of asphalt-treated base is directed, unless otherwise shown on the plans.

2.21. **Concrete.** All concrete used as the trench cap and in sidewalks and blocking mains must be in accordance with Item 421, "Hydraulic Cement Concrete." Class A concrete must be used in sidewalks and for blocking concrete steel cylinder mains. Class D concrete must be used for the trench cap and for blocking all other types, unless otherwise shown on the plans.

2.22. **Reinforcing Steel.** All bar reinforcement must be Grade 60, in accordance with Item 440, "Reinforcement for Concrete."

2.23. **Affidavit of Compliance.** Unless otherwise directed, the Contractor must furnish a manufacturer's Affidavit of Compliance for each material used in this project. The affidavit must certify that factory inspection and all specified tests have been conducted and that the material furnished complies with the requirements specified herein.

2.24. **Recycled Water System.** All material used in the improvement, adjustment, removal, or construction of the recycled water system must meet these standards (e.g., uses of CSC pipe and trenching and excavation), except as otherwise specified, and must be wrapped or painted with Pantone 512 color.

2.25. **Grouting of Water Mains.** This Section governs the grouting of existing water mains with diameter larger than 4 in. for abandonment underneath roadways, paved areas, and other specified locations. The location of this work is as shown on the plans or as encountered in the field during construction. The Contractor must, unless otherwise specified, furnish all labor, materials, equipment, tools, and all other appurtenances necessary to abandon water line segments in place by filling them with flowable cementitious low-strength grout, including plugs, bulkheads, and excavation and backfill, at locations as required to completely fill the line to be abandoned in place to protect against future collapse of the line.

Submittals for grouting water mains should contain the following information:

- proposed mix design report for grout;
- manufacturer's data for proposed plugs and detail of bulkhead;
- technical information for equipment and operation procedures, including projected injection rate, grout pressure, method of controlling grout pressure, bulkhead and vent design, and number of stages of grout application; and
- project-specific plan for abandonment at least 15 days before commencing grouting activities, describing proposed sequence, access points, and other appropriate information for completion of work.

The materials needed for grouting water mains are:

- cement-based grout and flowable fill with self-leveling and non-shrink characteristics, and
- unconfined compressive strength, minimum 100 psi at 56 days as determined based on average of three tests for same placement. Present at least three acceptable strength tests for proposed mix design in mix design report.

2.26. **Remove Existing Waterlines**. All materials specified to be removed must become the Contractor's property and must be disposed of at an approved and permitted disposal site. The Contractor must obtain City approval before disposing of any material within the Schertz city limits.

3. CONSTRUCTION

3.1. **Excavation.** Excavation (trenching) as required to complete the water main installation must be in accordance with Item 400, "Excavation and Backfill for Structures," as outlined herein, as shown on the plans, and as directed.

3.1.1. **Trenches.** Trench walls must be vertical. The practice of undercutting at the bottom or flaring at the top will not be permitted except where it is justified for safety or at the Engineer's or Inspector's direction. In special cases, where trench flaring is required, the trench walls must remain vertical to a depth of at least 1 ft. above the top of the pipe.

The trench bottom must be square or slightly curved to the shape of the trenching machine cutters. The trench must be accurately graded along its entire length to provide uniform bearing and support for each section of pipe installed on the bedding material. Bell holes and depressions for joints should be dug after the trench bottom has been graded and bedding installed. The pipe should rest on the new bedding material for its full length.

Where over-excavation occurs, the undercut trench must be restored to grade at no cost to the Department by replacement with a material conforming to the requirements of the bedding material or a material approved.

3.1.2. **Width of Trench.**

3.1.2.1. **Minimum Width of Trench.** The minimum width of pipe trenches, measured at the crown of the pipe, must be not less than 12 in. greater than the exterior diameter of the pipe, excluding bells. The minimum base width of such trench must be not less than 12 in. greater than the exterior diameter of the pipe, excluding special structures or connections. Such minimum width must exclude trench supports and not be greater than the width at the top of the trench.

3.1.2.2. **Maximum Width of Trench.** The maximum allowable width of trench for pipelines measured at the top of the pipe must be the OD of the pipe (excluding bells or collars) plus 24 in. A trench wider than the OD plus 24 in. may be used without special bedding if the Contractor, at its sole expense, furnishes pipe of the required strength to carry additional trench load. Such modifications must be submitted to the Engineer and approved in writing. Whenever such maximum allowable width of trench is exceeded, except as shown on the plans, in accordance with the Specifications, or by written approval, the Contractor, at its sole expense, must encase the pipe in concrete from trench wall to trench wall, or other pipe bedding material approved. Any excavation wider than this maximum width or subsequent surface or paving work must be completed at the Contractor's sole expense.

3.1.3. **Classification of Excavated Materials.** Excavated materials must not be classified. Excavation and trench work must include the removal and subsequent handling of all materials excavated in accordance with Item 400.

3.1.4. **Grade of Trench Bottom.** The trench must be over-excavated to a depth of 6 in. below the grade line established for the bottom of the pipe, regardless of the type of pipe. The grade line of the pipe must then be met by the addition of a layer of approved bedding material as directed.

3.1.5. **Excavation Below Grade.** Any part of the bottom of the trench excavated below the limits in accordance with Section 3.1.4., "Grade of Trench Bottom," must be corrected with approved material and compacted by mechanical tamping or other means that provide a stable foundation for the pipe. Should excessive over-excavation occur, except at bell holes, the grade must be restored in accordance with Section 3.1.6, "Unstable Conditions at Grade," at no cost to City of Schertz.

3.1.6. **Unstable Conditions at Grade.** Where the bottom of the trench at grade is found to be unstable or includes ashes, cinders, any type of refuse, vegetable or other organic material, or large pieces of fragments or inorganic materials that in the judgment of the Engineer shouldbe removed, the Contractor must excavate

and remove such unsuitable material to a depth at least 6 in. below pipe. Before the pipe is laid, the grade must be restored by backfilling with an approved material in layers of 3 in. before mechanical compaction to provide stable foundation. The layers must be slightly moistened and thoroughly compacted to provide a uniform and continuous bearing and support for the pipe at every point between bell or collar holes. The finished grade must be accurately graded to provide uniform bearing and support for each section of pipe at every point along its entire length, except for the portions of the pipe sections where it is necessary to excavate for bell holes and for the proper seating of pipe joints.

3.1.7. **Trench Excavation Protection.** All trench excavation must be in accordance with Item 402, "Trench Excavation Protection."

3.1.8. **Caution in Excavation.** The Contractor must proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures and utilities may be determined whether as shown on the plans or not. Machine excavation is not permitted closer than 12 in. on either side of other existing underground utilities. The Contractor must be responsible for the repair of such structures and utilities when broken or damaged. The Contractor also must be responsible for adjusting alignment and trench grades with reference to such structures to obtain specified clearance for the water main construction.

Whenever the Engineer determines that it is necessary to explore and excavate to determine the location of existing underground structures and utilities, the exploration and excavation for such purposes must be at Contractor's expense.

3.1.9. **Protection and Restoration of Underground Structures and Facilities.** The Contractor must furnish temporary support; adequate protection; and maintenance of all underground and surface structures, drains, sewers, and other obstructions encountered in the progress of the work. All underground structures and utilities that are disturbed must be restored by the Contractor at its expense. Materials and methods used for restoration must be in conformance with current building codes with local amendments, in accordance with the Department's UAP (43 TAC § 21.31–21.55), and in conformance with the requirements of the utility agency involved.

If a sanitary sewer is broken by the Contractor's operations, the release of sewage into the trench must be immediately intercepted by the insertion of a section of sheet metal tubing known as a "tin-horn" between the broken ends of the sewer. All leakage at the ends of the tin-horn must be effectively stopped. The tin-horn must remain in place until permanent repairs can be made. The Contractor must determine in advance of its trenching operations the size of all sanitary sewer lines and services that will require this treatment.

All sanitary sewer lines crossing the excavation, whether bridged or replaced, must have proper support consisting of sound timber supports with a minimum 2-in. nominal thickness and a minimum 6-in. nominal width placed with the width horizontal and extending at least 12 in. into the trench wall on either side.

In all cases where a sewer pipe is replaced or bridged, the backfill material must be thoroughly compacted to the bottom of the pipe and compacted by hand from this point to 6 in. above the top of the sewer line being replaced.

The locations of all sewer lines crossing excavations, whether replaced or bridged, must be properly marked, and care must be taken to avoid damage to the pipe using a hydra tamping machine or other mechanical equipment. The Contractor is liable for the failure of such lines due to negligence or poor workmanship.

3.1.10. **Backfill Material Derived from Excavation.** Any excess excavated material not used after all fill requirements have been met must become the responsibility of the Contractor. The Contractor must transport and dispose of the material outside the limits of the rights of way or easements of this project, and public thoroughfares and water courses, to a permitted fill site in conformance with all pertinent city, county, state, and federal codes and ordinances, without liability to City of Schertz or any individual.

3.1.11. **Trench Restoration.** The surface of the backfilled trench must be restored to match the previous existing conditions, including final grading, placement of topsoil and seeding, placement of sod (e.g., at homes or businesses that had maintained grass), or other unprepared and prepared surfaces.

Trenches in alleys actively being used by vehicles (e.g., trash pickup and vehicle parking) must be restored by grading and compacting to 98% or more with at least 4 in. of flex base materials for the entire width of the alley. Asphaltic materials must have a compaction density of 95%. Alleys not actively used by vehicles must be graded and compacted to 98% or more from the top of the initial backfill to the bottom of the pavement section, then grass seed spread for entire width of the alley.

Trenches in paved streets must be covered with a temporary all-weather surface to allow for vehicular traffic until the final asphalt and concrete paving is complete. This surface must be at least 4 in. of compacted and rolled asphaltic black base, either hot-mix or cold-mix applied. The Contractor must maintain this surface until the final street restoration is complete. Temporary street striping may also be required. This surface must be removed before final asphalting.

All street work must be completed in conformance with Department construction Specifications. Included in this requirement is replacement of any curbs or sidewalks damaged or removed during the construction.

No separate payment for the surface restoration is permitted. The cost for this work must be included in the appropriate bid item.

3.1.12. **Pavement.** The Contractor must remove pavement and surfaces as a part of the trench excavation. The removal of pavement and surfaces and their restoration must be based on the minimum trench widths as specified, plus 6 in. either side or as otherwise specified herein. The Contractor must use such methods as sawing, drilling, or chipping to assure the breaking of the pavement along straight lines.

If the Contractor removes or damages pavement or surfaces beyond the limits specified above, such pavement and surfaces must be restored at the expense of the Contractor.

Where waterline construction necessitates cutting through existing streets outside the limits of new street construction, the existing streets must be replaced in kind as directed.

Where, in the opinion of the Engineer, it is necessary to maintain traffic across a trench, the Contractor must install temporary metal bridges to facilitate the movement of traffic.

The street surface adjacent to the trench must be kept free of surplus spoil. Construction materials must be placed at locations that will minimize interference with the traveling public.

3.1.13. **Concrete Sidewalks and Driveways.** All concrete sidewalks and driveways must be cut using a concrete saw. When transverse expansion or “dummy” joints are encountered, the concrete must be removed to the nearest transverse joint on each side of the trench and restored. The depth of cut must be such that upon removal of the concrete, the sides of the cut are straight and square.

Existing reinforcing wire fabric or bars must be cut and removed to permit completion of trench excavation, pipe laying, and backfill operations. When the backfill operations have been completed, the existing reinforcement must be replaced in its original position and satisfactorily spliced before the replacement of concrete over the new trench alignment.

Transverse “dummy” joints must be made using a jointing tool or other acceptable means, and must match in depth and thickness in the existing transverse joints.

Expansion joint material must be provided where new construction abuts the existing curb or driveway if the Engineer deems it necessary.

Concrete must be spaded, tamped, and thoroughly compacted until mortar entirely covers the surface and has a monolithic finish. The top surface must be floated, troweled, and finished to match the existing concrete surface.

Immediately after finishing, the concrete surface must be protected by a membrane-compound curing agent, or by wetted cotton or burlap mats. Either method is subject to approval.

3.1.14. **Dewatering.** Prevent surface water, subsurface water, and groundwater from flowing into excavations and from flooding project site and surrounding areas.

The Contractor must not allow water to accumulate in excavations or at subgrade level. Remove water to prevent softening of foundation bottoms and soil changes detrimental to stability of subgrades and foundations. Provide and maintain dewatering system components necessary to convey water from excavations.

Convey water removed from excavation and rainwater to collecting or runoff areas away from buildings and other structures. Establish and maintain temporary drainage ditches and other diversion outside excavation limits. Do not use trench excavations as temporary drainage ditches.

Dewatering devices must be provided by the Contractor with filters to prevent the removal of fines from the soil. Should the pumping system draw fines from the soil, the Engineer must order immediate shutdown, and remedial measures must be the responsibility of the Contractor.

Upon completion of the dewatering work, the Contractor must remove all equipment and leave the construction area in a neat, clean condition that is acceptable to the owner.

The Contractor must maintain groundwater table at least 12 in. below the finished excavation subgrade.

Performances of the dewatering system for lowering groundwater must be measured by observation wells on piezometers installed in conjunction with the dewatering system, and these must be documented at least daily. The Contractor must maintain a log of these readings and submit them to the owner.

No direct payment will be made for costs associated with dewatering. All costs in connection therewith will be included in the pertinent Contract price for the item to which the work pertains.

3.2. **Pipe Laying.**

3.2.1. **General Requirements.** The Contractor must start its work at a tie-in point, unless otherwise shown on the plans. Pipe must be laid with bell ends facing the direction of lying, unless otherwise authorized or directed by the owner. Under no circumstances may pipe be laid in water, and no pipe may be laid under unsuitable weather or trench conditions. All valves and fire hydrants must be installed as soon as pipe laying reaches their established location. Pipe must be installed to the required lines and grades with fittings, valves, and hydrants placed at the required locations.

Spigots must be centered in bells or collars, all valves and hydrant stems must be set plumb, and fire hydrant nozzles must face as shown on the plans or as directed by the owner. The Contractor must not operate valves or other controls on the existing system for any purpose unless a representative of City of Schertz is present.

The Contractor must maintain a neat and orderly work area. Complete cleanup should always be maintained as closely behind the pipe-laying operations as possible, but in no case may such cleanup be permitted to lag more than 1,000 ft. behind the pipe laying, unless otherwise directed.

The Contractor must always maintain service to water connections, whether connected to the existing or proposed waterlines, for the duration of the construction, unless directed otherwise by the Engineer.

3.2.2. **Crossing Other Underground Lines.** New water mains crossing other utilities must have at least 30 in. of cover over the top of the pipe, unless otherwise waived or modified by the Engineer. Excavation around other utilities must be completed by hand for at least 12 in. all around. Any damage to the protective wrap on gas lines or electrodes must be reported immediately to CPS Energy, (210) 353-4357. Any damage to other

utilities must be reported to their proper governing entity. In any case of utility damage, Contractor must also promptly notify the Inspector.

3.2.3. **Pipe Separation—Parallel Lines.** Where a new potable water line parallels an existing non-pressure or pressure-rated wastewater main or lateral, and a professional engineer licensed in the State of Texas can determine that the existing wastewater main or lateral is not leaking, the new potable water line must be located at least 2 ft. above the existing wastewater main or lateral, measured vertically, and at least 4 ft. away, measured horizontally, from the existing wastewater main or lateral. Every effort must be made not to disturb the bedding and backfill of the existing wastewater main or lateral.

Where a new potable water line parallels an existing pressure-rated wastewater main or lateral and it cannot be determined by the licensed professional engineer whether the existing line is leaking, the existing wastewater main or lateral must be replaced with at least 150-psi pressure-rated pipe. The new potable water line must be located at least 2 ft. above the new wastewater line, measured vertically, and at least 4 ft. away, measured horizontally, from the replaced wastewater main or lateral.

Where a new potable water line parallels a new wastewater main, the wastewater main or lateral must be constructed of at least 150-psi pressure-rated pipe. The new potable water line must be located at least 2 ft. above the wastewater main or lateral, measured vertically, and at least 4 ft. away, measured horizontally, from the wastewater main or lateral.

3.2.4. **Pipe Separation—Crossing Lines.** Where a new potable water line crosses an existing, non-pressure rated wastewater main or lateral, one segment of the water line pipe must be centered over the wastewater main or lateral such that the joints of the water line pipe are equidistant and at least 9 ft. horizontally from the centerline of the wastewater main or lateral. The potable water line must be at least 2 ft. above the wastewater main or lateral. Whenever possible, the crossing must be centered between the joints of the wastewater main or lateral. If the existing wastewater main or lateral is disturbed or shows signs of leaking, it must be replaced for at least 9 ft. in both directions (18 ft. total) with at least 150-psi pressure-rated pipe.

Where a new potable water line crosses an existing pressure-rated wastewater main or lateral, one segment of the water line pipe must be centered over the wastewater main or lateral such that the joints of the water line pipe are equidistant and at least 9 ft. horizontally from the centerline of the wastewater main or lateral. The potable water line must be at least 6 in. above the wastewater main or lateral. Whenever possible, the crossing must be centered between the joints of the wastewater main or lateral. If the existing wastewater main or lateral shows signs of leaking, it must be replaced for at least 9 ft. in both directions (18 ft. total) with at least 150-psi pressure-rated pipe.

Where a new potable water line crosses a new, non-pressure rated wastewater main or lateral and the standard pipe segment length of the wastewater main or lateral is at least 18 ft., one segment of the water line pipe must be centered over the wastewater main or lateral such that the joints of the water line pipe are equidistant and at least 9 ft. horizontally from the centerline of the wastewater main or lateral. The potable water line must be at least 2 ft. above the wastewater main or lateral. Whenever possible, the crossing must be centered between the joints of the wastewater main or lateral. The wastewater pipe must have a minimum pipe stiffness of 115 psi at 5% deflection. The wastewater main or lateral must be embedded in cement-stabilized sand for the total length of one pipe segment plus 12 in. beyond the joint on each end.

Where a new potable water line crosses a new non-pressure rated wastewater main or lateral and a standard length of the wastewater pipe is less than 18 ft., the potable water pipe segment must be centered over the wastewater line. The materials and method of installation must conform to one of the following options:

- Within 9 ft. horizontally of either side of the water line, the wastewater pipe and joints must be constructed of pipe material with a minimum pressure rating of 150 psi. An absolute minimum vertical separation distance of 2 ft. must be provided. The wastewater main or lateral must be located below the water line; and
- All sections of wastewater main or lateral within 9 ft. horizontally of the water line must be encased in an 18-ft. (or longer) section of pipe. Flexible encasing pipe must have a minimum pipe stiffness of 115 psi

at 5% deflection. The encasing pipe must be centered on the water line and must be at least two nominal pipe diameters larger than the wastewater main or lateral. The space around the carrier pipe must be supported at 5-ft. (or less) intervals with spacers or be filled to the spring line with washed sand. Each end of the casing must be sealed with watertight non-shrink cement grout or a manufactured watertight seal. An absolute minimum separation distance of 6 in. between the encasement pipe and the water line must be provided. The wastewater line must be located below the water line.

3.2.5. **Pipe Grade.** Water mains 16 in. or smaller must have at least 60 in. of cover from the proposed final finished ground and street elevation and 60 in. of cover when the main is installed in a parkway or under the pavement where there are no existing or proposed curb or existing drainage facilities. Water mains 20 in. and more must have at least 60 in. of cover over the top of the pipe from the proposed final finished ground and street elevation unless otherwise waived or modified by the Engineer.

Contractor is responsible for maintaining line grade with an electronic grade-maintaining laser device. Pipe grades must be as shown on the plans, or as directed in writing. Grades must be met in accordance with Section 3.1., "Excavation." If Contractor fails to maintain grade, all cost to re-establish grade must be borne by the Contractor. Care must be taken to ensure that the pipe barrel has uniform contact with the bedding material for its full length, except at couplings. The coupling must not be in contact with the original trench bottom before backfilling. Bedding material must be placed under the coupling and compacted by hand before backfilling to provide an even bearing surface under the coupling and pipe. Change in grade must be made only at joints.

3.2.6. **Bedding and Bedding Materials.** Before placing pipe in a trench, the trench must be excavated to the proper depth in accordance with Section 3.1. Approved imported materials or Engineer-approved materials selected from suitable fines derived from the excavation must be smoothly worked across the entire width of the trench bottom to provide a supporting cushion.

3.2.7. **Structures to Support Pipe.** When either the Inspector or Engineer notes that the material at the bottom of a trench at subgrade consists of material that is notably unstable and conditions are such that the existing material cannot be reworked to make it stable, then the trench subgrade must be over-excavated, filled with approved material, and properly compacted in place to provide a suitable base to support the pipe. If it is determined by the Engineer that this method cannot be used to stabilize the trench subgrade, the Contractor must construct a foundation for the pipe, consisting of piling, concrete beams, or other supports, as shown on the plans. Extra compensation will be allowed for the Contractor for the additional work completed. Coordinate with Engineer for approval of extra compensation before beginning work.

3.2.8. **Lowering Materials into Trench.** Proper implements, tools, and facilities satisfactory to the Engineer must be approved and used by the Contractor for the safe and convenient execution of work. All pipe, fittings, valves, and hydrants must be carefully lowered into the trench piece-by-piece using a derrick, ropes, or other suitable tools or equipment to prevent damage to water main materials and protective coatings and lining. Under no circumstances may water main materials be dropped or dumped into the trench. Avoid damaging polywrap films. Use of chains or slings is not allowed unless entire sling is wrapped with a protective nylon web sock.

3.2.9. **Installing Pipe.** Take precautions to prevent foreign material from entering the pipe while it is being placed in the line. Under adverse trench conditions or extended periods, or otherwise as required by the Engineer, a manufactured cap or plug must be used to prevent any foreign material from entering. Leave the cap or plug in place until a connection is made to the adjacent pipe. Inspect the interior of each pipe for defects, and reject if defects are found.

After placing a length of pipe in the trench, the jointed end must be centered on the pipe already in place, forced into place, brought to correct line and grade, and completed in accordance with this Specification. Pipe must be installed in a continuous bedding envelope that should extend the full trench width to a depth of at least 6 in. below the pipe and to a depth at least 12 in. above water pipe. The pipe must be secured in place with approved bedding placed in lifts not exceeding 8 in. loose thickness and compacted thoroughly to provide uniform support for the pipe barrel and to fill all voids around the pipe. Pipe and fittings that do not

allow enough uniform space for joints will be rejected and must be replaced with pipe and fittings of proper dimensions. Precautions must be taken to prevent dirt or other foreign matter from entering the joint space.

When pipe laying is not in progress, close the open end of pipe in the trench by watertight plug or other means approved. Pipe in the trench that cannot temporarily be jointed must be capped or plugged at each end to make it watertight. This provision applies during all periods when pipe laying is not in progress. Should water enter the trench, the seal must remain in place until the trench is completely dry. The Contractor must provide plug and caps of the various sizes required.

3.2.9.1. **Steel Pipe.** The Contractor must furnish all steel piping, including fittings, couplings, specials, pipe supports, eyebolts, nuts, and accessories as shown on the plans and as required for proper connection to existing piping. The exact location and elevation of existing piping must be determined in the field before fabrication of connecting piping.

All steel pipe and specials may be either mill pipe or fabricated pipe and, in either case, must be fabricated to the sizes, dimensions, and shapes as shown on the plans. Unless otherwise shown on the plans, all steel pipe, bends, or specials must have an OD minimum wall thickness and unit weights.

Any pipe section, fitting, or special that shows dents, kinks, abrupt changes of curvature other than specified, or any other damage will be rejected. Any pipe section, fittings, or special section that has been dropped from a truck or crane will be rejected. The Contractor must, at its own expense, replace or recondition each rejected section. All reconditioning procedures must first be presented to the Engineer for review and approval.

3.2.9.1.1. **Ends of Sections.** Ends of pipe sections, bends, and specials must be beveled for field-welding, unless shown otherwise on the plans.

3.2.9.1.2. **Seams.** All piping must be made of steel plate rolled into cylinders or sections thereof, with not more than two longitudinal butt welds, or must be spirally formed and butt-welded. Girth seams must be butt-welded and not be closer than 6 ft. apart, except in specials and bends.

3.2.9.1.3. **Length Tolerance.** Standard and special section must be within ±1/16 in. of the specified or theoretical lengths.

3.2.9.1.4. **Welded Joints.** Except where ends are as shown on the plans to be joined by mechanical couplings, all joints for steel pipe installed on a bridge structure and in open trench must be welded.

Welders appointed to do welding on steel pipe must be 4F- and 5G-certified. All welds must be sound, be free of embedded scale and slag, have a tensile strength across the weld not less than that of the thinner of the connective sections, and be watertight. Use butt welds for all welded joints in line-pipe assemblies and in the fabrication of bends and other specials. All welds must be subject to pre-manufacturing inspection and available to the Inspector and Engineer upon request.

Welding for field joints must be in accordance with AWWA C 206, “Standard Specification for Field Welding of Steel Water Pipe Joints.” Parties involved in the construction of mains must pay special attention to AWWA C 206, “Standard Specification for Field Welding of Steel Water Pipe Joints, Control of Temperature Stresses.” After welding, the joints must be prepared, primed and painted, or wrapped in accordance with this Specification.

Repair leaks in welds by chipping out defective material and re-welding. Hammering is not permitted.

3.2.9.2. **Polyvinyl Chloride (PVC) (AWWA C 900).** Lay PVC mains to the depths and grades as shown on the plans. Lay pipe by inserting spigot end into bell flush with insertion line or as recommended by manufacturer. At no time is bell end allowed to go past “insertion line.” A gap between end of spigot and adjoining pipe is necessary to allow for expansion and contraction.

3.2.10. **Defective or Damaged Material.** Pipe and accessories must be inspected for defects before being lowered into the trench. Any pipe section, fitting, or special that shows dents, kinks, abrupt changes of curvature other than specified, or any other damage will be rejected. Any pipe section, fittings, or special section that has been dropped from a truck or crane will be rejected. The Contractor must, at its expense, replace or recondition each rejected section. Reconditioning procedures must be acceptable to the Engineer. Any defective, damaged, or unsound material must be repaired or replaced as directed.

Should a damaged piece of pipe furnished by the Contractor be placed in the water main, the Contractor must furnish, at its expense, all labor and materials required for removing and replacing the defective pipe and restoring the street to its condition just before the failure of the pipe. Should the Contractor damage the pipe after installation, the Engineer may permit the damaged section to be cut from the length unless it is the opinion of the Engineer that the entire length was damaged. The cost and replacement of broken pipe must be at the expense of the Contractor.

3.2.11. **Holes at Bells and Collars.** Bell holes of appropriate size must be provided at each joint to permit the joints to be made properly. For mechanical-type joints, the minimum clearance between the bell and natural ground must be 6 in. in all directions. Bell holes for concrete steel cylinder pipe must be sized to properly join the pipe and place the required grout. Subject to the above provisions, the length of excavation for bell holes below grade of the trench bottom must be kept to a minimum.

3.2.12. **Deviations in Line or Grade.** Wherever obstructions not as shown on the plans are encountered during the progress of the work, and such obstructions interfere such that alteration on the plan is required, the Engineer has the authority to change the plans and direct a deviation from the line and grade or to arrange with the owners of the structures for the removal, relocation, or reconstruction of the obstruction. Any deviation from the line must be accomplished using appropriate bends unless such requirements are specifically waived by the Engineer. These deviations must clearly and accurately be reflected in the Contractor's submittal of its redline drawings for permanent recording purposes.

Whenever it is necessary to deflect pipe from a straight line, the deflection must be as directed. In no case may the amounts as shown in Table 13 and Table 14 be exceeded.

Table 13
Maximum Deflections of Ductile Iron Pipe

Nominal Pipe Diameter (in.)	Maximum Joint Open (in.)	Maximum Deflection Angle (°/min.)	Maximum Deflection (in.) with Pipe Length		Approximate Radius of Curve (ft.) Produced by Succession of Joints with Pipe Length	
			18 ft.	20 ft.	18 ft.	20 ft.
6	0.58	4/25	16.7	18.5	234	260
8	0.65	3/51	14.6	16.2	268	297
10	0.75	3/42	14.0	15.5	279	310
12	0.75	3/08	11.9	13.2	327	363
16	0.75	2/21	8.8	9.7	440	488
20	0.75	1/55	7.2	8.0	540	600
24	0.75	1/35	6.0	6.7	648	720

Table 14
Maximum Deflections of Concrete Steel Cylinder Pipe

Nominal Pipe Diameter (in.)	Maximum Deflection Angle (°/min.)	Maximum Deflection (in.) with Pipe Length		Approximate Radius of Curve (ft.) Produced by Succession of Joints with Pipe Length	
		16 ft.	20 ft.	16 ft.	20 ft.
16	2/20	N/A	9.8	N/A	500
20	1/52	N/A	7.8	N/A	600
24	1/34	N/A	6.6	N/A	750
30	1/16	N/A	5.3	N/A	900
36	1/02	N/A	4.3	N/A	1,100
42	0/54	N/A	3.8	N/A	1,300
48	0/47	2.6	N/A	1,170	N/A
54	0/44	2.5	N/A	1,237	N/A
60	0/54	3.0	N/A	1,024	N/A

3.2.13. **Cutting Pipe.** The cutting of pipe for inserting valves, fittings, or closure pieces must produce a smooth end at right angles to the axis of the pipe. Strictly follow the recommendations of the pipe manufacturer. Under no circumstances may a worker not equipped with proper safety goggles and helmet and other required safety attire be permitted to engage in this work.

3.2.13.1. **Asbestos Cement (AC).** No field-cutting will be allowed on AC pipe. Repairs to AC pipe must be accomplished by removing one full joint of AC pipe and replacing it with appropriate PVC pipe or DIP and fittings. Refer to Section 3.2.19., "Tie-In to Existing Mains," and Section 3.2.20., "Asbestos Cement (AC) Pipe Removal," for information pertinent to handling AC pipe.

All cuts made on DIP must be completed using a torch or power saw. The cuts must be made smooth at right angles to the pipe axis. The edges of the cut must be finished smoothly using a hand or machine tool to remove all rough edges. The outside edge of pipe should be finished with a small taper at an angle of approximately 30°.

Field-cut PVC (in accordance with AWWA C 900 and AWWA C 909) using a power saw with a steel blade or abrasive disc, depending on the size of pipe. If a bevel is needed after field-cutting, it should be in conformance with Uni-Bell recommendations.

To facilitate future repair work on water mains, no sections less than 3 ft. in length between fittings are allowed.

3.2.14. **Coating and Wrapping Underground Pipe.**

3.2.14.1. **Steel Pipe.** Steel pipe, bends, and specials must be prepared, primed, painted, or wrapped in the field as follows:

- **Exterior Surface Above Ground.** Exterior surfaces of new pipe and appurtenances installed must be thoroughly cleaned to bare metal by high-speed wire brushing, scraping, or other suitable methods

approved, and given a single coat of industrial-grade rust-inhibitive primer and two finish coats of aluminum paint; and

- **Exterior Surfaces Under Ground.** Exterior surface of steel pipe, bends, and specials installed in open trench must be thoroughly cleaned to bare metal by high-speed wire brushing, scraping, or other suitable methods approved; given a single-coat rust-inhibitive primer; and wrapped with polyvinyl tape in accordance with AWWA C 203, "Protective Coatings for Steel Water Pipelines," Appendix C, or most applicable equal provision.

The procedure for coating flanged joints and mechanical coupling joints when used with steel pipe must be as specified.

For field-welded joints, after installation of pipe, bends, and specials, all ends of pipe adjacent to welded field joints, including the weld proper, must be cleaned, primed, painted, or wrapped as specified for the pipe adjacent to the weld.

For interior surfaces, the interior surfaces of all steel pipe, fittings, and specials must be cleaned by sand-blasting and then primed and coated with a cement mortar lining. Cement-mortar lined and coated steel pipe must be used for transmission mains 4 in. and larger.

All cement-lined steel pipes must be prepared using the following processes:

- Steel pipe must not be tested until the factory-applied mortar lining and coatings on all piping and specials have been in place for at least 14 days;
- Steel piping with cement mortar field-applied to the interior of the pipe must not be filled with water until at least 8 hr. has elapsed after the final placement of cement mortar, unless otherwise approved;
- The Contractor must submit details of all specials, and of the lining and coating;
- Ensure that the lining used is in accordance with AWWA C 205 or most applicable approved equal provision, except as specified otherwise in the Contract documents;
- The cement used in mortar lining must be Portland cement, in accordance with ASTM C 150 or most applicable approved equal provision, Type II or Type V for lining; and
- The pipe must be cement-mortar lined in the shop by the centrifugal process, in accordance with AWWA C 205 or most applicable approved equal provision.

Cement-mortar lined pipe must be braced as required to maintain roundness during the shipping and handling activities and must have ends capped before shipment. For pipes with 14-in. nominal diameter and larger, the finished ID after lining must be the nominal size. For pipes with 12-in. nominal diameter and smaller, standard OD pipe sizes must be furnished.

3.2.14.2. **Ductile Iron Pipe (DIP).**

3.2.14.2.1. **Open Trench.** DIP to be installed in a trench must be protected. Each pipe joint must be covered with a 4-mil thick polyethylene sleeve that is 2 ft. longer than the pipe joint. The sleeve must cover the full length of the pipe joint, lap over 1 ft. on each end of the adjoining pipe joints, and be secured with at least two circumferential turns of pressure-sensitive polyvinyl tape. Excess material should be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe, and held in place by pieces of pressure-sensitive tape at approximately 5-ft. intervals. After assembling the joint, the polywrap tube from the previously installed pipe must be pulled over the joint and secured by the Contractor. The polywrap tube from the new joint must be pulled over the first tube and secured to provide a double seal.

Cast iron and ductile iron fittings must be completely wrapped in 8-mil thick polyethylene film with at least 1-ft. overlap on each end and appropriately taped. Laps must cover joints with adjoining pipe joints or fittings when installed. Fire hydrant barrel from the surface to the valve must be wrapped as specified herein.

Any damaged areas in the polyethylene film must be repaired by covering the area with a sheet of polyethylene film large enough to lap over the damaged area 1 ft. minimum in any direction and appropriately taped. Take care at service to locations to ensure that tape extends beyond corporation and onto service line pipe 1 ft.

Before placing pipe in the trench, a cushion of approved materials must be placed in the trench in accordance with Section 3.3. This backfill material must be carefully placed on the pipe to avoid any damage to the polyethylene sleeve.

The Contractor must use care to protect and preserve the polyethylene wrap around DI water mains when installing service corporations. The required method is to wrap pipe tape around the pipe over the polywrap in the area to be tapped. The tap must be made through the tape and polywrap. It is not necessary to remove and replace polywrap. All exposed pipe, the corporation, and the first 3 ft. of the service must be wrapped and taped to achieve a complete seal. In addition, a sand envelope must extend over and around the connection to a depth of 8 in. above the main.

3.2.14.2.2. **In Casing.** Where DIP is installed in a bore, the pipe must be thoroughly cleaned down to the coal tar enamel pipe coating by approved methods. Where damaged, a prime coat compatible to the polyvinyl tape to be used must then be applied to the pipe. Following application of prime coat, wrap pipe with Scotchrap Trantex V 10 polyvinyl tape, or approved equal. Tape must not be applied until prime coat is completely dry.

The tape must be spirally and tightly wrapped on each section of the pipe with a 50% lap. The wrap must be made to the bell on the bell end and to a point 6 in. from the spigot end. The joint must be protected with tape 6 in. in width on pipe 12 in. or less in size and with tape 8 in. in width on pipe greater than 12 in. in size.

3.2.15. **Protective Coating and Wrapping on Joints.** All bolts and nuts installed for underground service on valves, fire hydrants, cast iron mechanical joint fittings, pipe joints, and other ferrous metal appurtenances must be packed in an approved protective coating material after installation. After the joint has been made and bolts drawn to proper tension, the joint, including glands, flanges, bolt heads, and nuts, must be covered with an approved coating. Such protective coating is supplemental to anti-corrosive sand embedment. Asphaltic coatings, such as Talcote, are not allowed. Coating and wrapping of joints will not be paid for directly.

3.2.16. **Steel Pipe Field-Welded Joints.** After installation of pipe, bends, and specials, all end of pipe adjacent to welded field joints, including the weld proper, must be cleaned, primed, painted, or wrapped as specified for the pipe adjacent to the weld.

3.2.17. **Joint Assembly.**

3.2.17.1. **Rubber Ring Joints.** The installation of pipe and the assembly of rubber ring joints for DIP, concrete steel cylinder pipe, and AC pipe must be in conformance with the pipe manufacturer's assembly instructions. The method of inserting spigot ends of pipe in bells or collars, known as "stabbing," is not permitted with pipe larger than 6 in. in size. Spigot ends of pipe larger than 6 in. in size must be properly inserted in the joint using suitable pushing or pulling devices, or an approved manufacturer's method.

3.2.17.2. **Mechanical Couplings.** Mechanical couplings must be assembled and installed in conformance with the standards recommended by the manufacturer. Before the installation of the mechanical coupling, the pipe ends must be cleaned by wire brush or other acceptable method to provide a smooth bearing surface for the rubber compression gasket. The pipe must be marked to align the end of the coupling, which will center the coupling over the joint. After positioning, the nuts must be drawn up finger-tight. Uniform pressure on the gaskets must be applied by tightening alternating bolts on the opposite side of the circle in incremental amounts. Final tensioning must be accomplished using a torque wrench and in a manner similar to the tightening procedure. The coupling must then be left undisturbed for 24 hr. to allow the gaskets to "pack in." Final torque check must then be made before coating and wrapping the joint. The proper torque for various sizes of mechanical couplings is as shown in Table 15 and is included for the convenience of the Contractor.

Table 15
Torque for Mechanical Couplings

Coupling Size	Bolt Diameter (in.)	Torque (ft. lb.)
2"–24"	5/8	75
2"–24"	3/4	90
30" and 36" (1/4" × 7" middle rings)	5/8	65
30"–36" (3/8" and heavier middle rings)	5/8	70
30"–48"	3/4	80
48"–72"	3/4	70

3.2.17.3. **Restrained Joints.** Install restraint joints as shown on the plans or as directed. Install in conformance with manufacturer's recommendations.

3.2.18. **Gray Iron and Ductile Iron Fittings.** Fittings 6 in.–12 in. in size must be mechanical joint, push-on joint short body, or push-on joint compact body, unless otherwise shown on the plans. Fittings must be installed with the thrust blocking or joint restraint as shown on the plans. Fittings 16 in.–24 in. in size must be mechanical-joint type unless otherwise shown on the plans. Adaptors must be used where necessary to provide a transition between AC pipe and the fittings. Restraint or thrust blocking must be provided as shown on the plans or as directed. Anti-corrosion embedment must be provided as specified, and no separate payment will be made for this embedment.

3.2.18.1. **Cleaning Ductile Iron.** All lumps, blisters, and excess coal tar coating must be removed from the ends of DIP fittings. The outside of the spigot and the inside of the bell must be wire-brushed and wiped clean, dry, and free of oil and grease before the pipe is laid. The interior of the pipe must be blown clean using compressed air or swabbed out clean and dry as directed. Immediately before placing any pipe in the trench, the interior must be cleaned using an approved brush or swab, or compressed air, to remove all dirt and foreign materials. All pipe and fittings must be inspected by the Contractor for defects while they are suspended above ground.

3.2.19. **Corrosion Protection for Ferrous Pipe, Fittings, and Valves.** Except as otherwise shown on the plans or as directed, anti-corrosion embedment must be provided for all DIP, fittings, and valves and at all valve fittings or outlets for nonferrous or reinforced concrete steel cylinder pipe. The embedding material must be Modified Grade 5 gravel-washed sand in accordance with Section 2.19., "Backfill."

Prepare the trench in accordance with Section 3.1. After subgrade has been prepared, lay pipe to grade as shown on the plans and in accordance with these Specifications. Pipe, fitting, or valve must be firmly embedded in and surrounded by an insulating blanket of embedding material. The minimum thickness of this blanket must be 6 in. in every direction.

3.2.20. **Tie-In to Existing Mains.** The Contractor must make tie-ins from new water mains to existing water mains in conformance with Contract documents or as directed. The Contractor must be responsible for all shutdowns and isolation of the existing mains; cutting pipe for the connection; dewatering the excavation; customer notification of the shutdown; and all other requirements as directed by the Inspector to complete this effort in a safe and secure manner. Work performed by the Contractor on mains 16 in. and larger will require operation of any valves by City of Schertz forces. Therefore, ample coordination beforehand (2 workdays) must be provided by the Contractor for this interaction to occur. All tie-ins must be completed after normal workhours (8 A.M.–5 P.M.). During construction, the planned shutdown and tie-in work must be coordinated with and approved by the Inspector with at least 2 weeks prior notice of such activity, and accomplished at a time that will be at the least inconvenience to the customers. No additional compensation will be provided for tie-ins accomplished after normal working hours.

Tying into existing mains of AC pipe, the Contractor must be in accordance with Item 6, "Control of Materials." At each location as shown on the plans or identified by the Contractor to involve AC pipe, the Contractor must be in accordance with Item 6 for the removal of the necessary amount of AC pipe required to make the connection without creating any friable material. Excavate to the top of the AC waterline to allow

a separate contractor hired by the State to remove the AC waterline. The third-party contractor must remove whole sections of AC pipe so that the Contractor can make the tie-in at the nearest joint.

3.2.21. **Asbestos Cement (AC) Pipe Removal.** AC pipe removal quantities as shown on the plans are estimated and must be field-verified. Estimated quantities for removal are based on removal required to perform tie-ins to existing AC mains (in accordance with Section 3.2.19.) and locations where existing AC pipe conflicts with proposed Department storm drains, culverts, streets, grading, retaining walls, and traffic signal foundations. The Contractor must be in accordance with Item 6. Excavate to the top of the AC waterline to allow a separate contractor hired by the State to remove the AC waterline. The third-party contractor must remove whole sections of AC pipe.

3.2.22. **Abandonment of Old Mains and Valves.** Regarding planned main abandonment, the Contractor must accomplish all cutting, capping, plugging, and blocking necessary to isolate those existing mains retained in service from those abandoned. The open ends of abandoned mains and all other openings or holes in such mains caused by cutting or removal of outlets must be blocked off by manually forcing cement grout or concrete into and around the openings in enough quantity to provide a permanent substantially watertight seal. Abandonment of old, existing water mains will be included in the work required, and no direct payment will be made.

When specified or in conformance with the Contract documents, Contractor must remove the main and all pertinent appurtenances that must be replaced, or will no longer be in service, and all effort to accomplish this requirement must be included in the work required, and no direct payment will be made.

3.2.22.1. **Abandoned Valves.** Valves abandoned in the execution of the work must have the valve box and extension packed with sand to within 8 in. of the street surface. The remaining 8 in. must be filled with 2,500-psi concrete or an equivalent sand-cement mix and finished flush with the adjacent pavement or ground surface. The valve covers must be salvaged and returned to the owner.

3.2.22.2. **New or Existing Valves.** At no time during the project work may any valves be covered or rendered inaccessible for operation because of any activities by the Contractor. Any work during construction activities will be suspended until this requirement is met. No claims for cost or schedule delays will be accepted.

3.2.23. **Jacking, Boring, or Tunneling Pipe.**

3.2.23.1. **Jacking.** Suitable pits or trenches must be excavated for jacking operations for placing end joints of the pipe. When trenches are cut in the side of embankment, such work must be securely sheeted and braced. Jacking operations must in no way interfere with the operation of railroads, streets, highways, or other facilities, and must not weaken or damage such facilities. Barricades and lights must be furnished as directed to safeguard traffic and pedestrians.

The pipe to be jacked must be set on guides to support the section of pipe being jacked and to direct it in the proper line and grade. Embankment material must be excavated just ahead of the pipe, material removed through the pipe, and the pipe forced through the opening thus provided.

The excavation for the underside of the pipe, for at least 1/3 of the circumference of the pipe, must conform to the contour and grade of the pipe. A clearance of not more than 2 in. may be provided for the upper half of the pipe.

The distance that the excavation must extend beyond the end of the pipe will depend on the character of the material, but it should not exceed 2 ft. in any case.

The pipe should be jacked from downstream end. Permissible lateral or vertical variation in the final position of the pipe from line and grade must be as shown on the plans or as determined by the Engineer.

Any pipe that cannot be repaired to its original condition or is damaged in jacking operations must be removed and replaced at the Contractor's expense. Jacking pits must be backfilled immediately upon completion of jacking operations.

3.2.23.2. **Excavation.** Excavation for boring pits and installation of shoring must be in accordance with Section 3.2.23.1., "Jacking." Boring operations may include a pilot hole, which should be bored the entire length of crossing and must be used as a guide for the larger hole to be bored. Water or drilling fluid may be used to lubricate cuttings. Variation in line and grade must apply in accordance with Section 3.2.23.1.

3.2.23.3. **Tunneling.** Tunneling may be used when the size of the proposed pipe would make the use of tunneling more satisfactory than jacking or boring. The excavation for pits and the installation of shoring must be in accordance with Section 3.2.23.1. The lining of the tunnel must be of the material as shown on the plans.

Access holes for grouting annular space should be spaced at most 10 ft.

3.2.23.4. **Joints.** Joints for pipe for jacking, boring, or tunneling must be in accordance with these Specifications, or as shown on the plans or shop drawings in conformance with pipe manufacturer's recommendation.

3.2.23.5. **Grouting of Bores or Tunnels.** Annular space between casing pipe and limits of excavation (borehole) must be pressure-grouted, unless otherwise shown on the plans.

3.2.24. **Cutting in Valves.** The work involved in cutting a valve into an existing main must consist of excavation and backfilling with approved selected material, hauling and disposing of surplus excavation and other materials, installation of the valve, valve box assembly, all pipe cut used to complete cut-in, reaction blocking, and polyethylene wrapping where required.

3.2.25. **Tapping Sleeves and Valves.** Size-on-size taps are not permitted.

The work involved in the installation of a tapping sleeve and valve must consist of excavation, backfilling the excavation with approved selected material, installing the tapping sleeve, reaction blocking, tapping valve, valve box assembly, concrete collar (where subjected to street traffic), and a cast iron lid. New taps will not be permitted closer than 2 ft. of a joint or existing tap. The use of a shell-type cutter will be required with tapping sleeves and valves. Whenever working on potable or recycled water system, disinfect the shell cutter with bleach before start of work. The cutting edge must be sharp and round. Inspector will reject defective cutters.

Air-test tapping sleeves to 50 psi before tapping main line.

The valve box must be placed to prevent shock or stress from being transmitted to the valve. Valve boxes must be centered over the valve's operating nut with the box cover flush with the finished pavement surface or located at another level as directed by the Inspector. Valve boxes located in streets or other areas subject to vehicular traffic must be provided with concrete collars as shown on the plans. Collars around such valve boxes must be formed and finished off neatly in a sound, workmanlike manner.

3.2.26. **Cutting-In Tees.** The work involved in cutting-in a tee must consist of excavation, shutdown and isolation of existing main to which the new main is to be connected, cutting pipe for connection, dewatering the excavation, customer notification of service interruption where required, installation of all pipe used to complete the connection, all necessary tie-ins (connection to existing or new main), fittings, approved reaction blocking required, and backfilling the excavation with approved selected materials or flowable backfill if required. Where the installation of a valve is required, payment will be for valve in accordance with this Specification.

The processes pertinent to disturbing and restoring pavements (any type), curbs, sidewalks, backfilling to final grade, flowable backfill (if required), and sodding for the installation of a cut-in tee must be included in the work and must be in conformance with the pertinent Department Specification; any other governing entity's specifications; and pertinent street cut policies, ordinances, or permits.

3.2.27. **Pipe Joint Restraint System.** Pipe joint restraints must be used to prevent movement for PVC push-on bell-and-spigot pipe connections. The restrainer may be adapted to connect a plain-end PVC pipe to a DI mechanical joint bell fitting. Joint restraint must be non-directional and installed to fully restrain system. All pipe and fitting systems with restrained joints must be identified by applying an adhesive-backed warning

tape to the top of the pipe and for the full length of the pipe, regardless of the type of pipe. For plastic pipes, the warning tape must be applied directly to the top of the pipe. For metal pipes and fittings, the warning tape must be applied to the top of the polyethylene film wrap.

3.2.28. **Concrete Encasement, Cradles, Saddles, and Collars.**

3.2.28.1. **Concrete Encasement.** When concrete encasement is as shown on the plans, or when directed, the trench must be excavated and fine-graded to a depth as shown on the plans. The pipe must be supported by precast concrete blocks of the same strength as the concrete for encasement and securely tied down to prevent flotation. Encasement concrete must be placed to a depth and width as shown on the plans.

3.2.28.2. **Concrete Cradles.** When concrete cradles are as shown on the plans, or when directed, the trench must be prepared and the pipe supported in accordance with Section 3.2.28.1., "Concrete Encasement." The cradle must be constructed as shown on the plans. Strap and tie-downs must be No. 4-rebar diameter minimum or more as determined by the water system Inspector.

3.2.28.3. **Concrete Saddles.** When as shown on the plans or when directed, pipe to receive concrete saddle must be backfilled in accordance with Section 3.3. to the spring line and concrete placed for a depth and width as shown on the plans.

3.2.28.4. **Concrete Collars.** When as shown on the plans or when directed, concrete collars must be constructed as shown on the plans.

3.2.29. **Fire Hydrants.** Hydrants must be connected to the main as shown on the plans or as directed. They must be installed in a manner that will provide complete accessibility and in a safe location where there is minimum possibility of damage from vehicles or injury to pedestrians.

When the hydrant is placed directly behind the curb, the hydrant barrel must be set so that no portion of the hydrant will be less than 12 in. and no more than 7 ft. from the back of the curb.

When the hydrant is set in the lawn space between the curb and the sidewalk, or between the sidewalk and the property line, no portion of the hydrant or nozzle cap may be within 6 in. of the sidewalk. Setting final grade of fire hydrants to match proposed or existing field conditions must be the responsibility of the Contractor.

Hydrants must be set as shown on the plans, plumb with their nozzles parallel or at right angles to the curb, with the pumper nozzle facing the curb. Drainage and concrete pad must be provided at the base of the hydrant as shown on the plans. No fire hydrant drainage system or pit may be connected to a storm sewer or to a sanitary sewer.

Restrained mechanical joints that require field-welding or groove cuts into the pipe barrel for restraint will not be accepted. Restrained joints must be furnished for pipe at all changes in direction as shown on the plans or as directed. Restrained mechanical joints must be locked mechanical joints. Joints must be capable of test pressure twice the maximum sustained working pressure of 350 psi for DIP and PVC pipe.

Replace or relocate existing fire hydrants when needed. The work should be accomplished by either:

- cutting or installing a tee of the size and type as shown on the plans or as directed;
- using a tapping sleeve and valve of the size and type as shown on the plans to install a new fire hydrant to an existing or new water main. Size-on-size taps are not permitted; or
- relocating the existing fire hydrant by closing the existing fire hydrant, extending the fire hydrant branch, and installing the existing fire hydrant as specified herein.

Salvage the existing fire hydrant and other materials as specified in the field by the Inspector, and deliver to the Water System material storage yard located at 3930 E. Houston Street, San Antonio, TX. Fire hydrant branches must be abandoned by cutting and capping fire hydrant cast iron tee at the service main and surface restored to its original condition.

After the fire hydrant has been set, paint hydrant with suitable primer and finish with oil-based aluminum paint from top of hydrant to a point 18 in.–20 in. below centerline of the pumper nozzle, and apply to all exposed metal surfaces above the hydrant base flange. The payment for fire hydrant painting will be included in the unit cost for installing the fire hydrant.

For installation on water mains, DIP, cast iron and DI fittings, and valves used in the placement of fire hydrants and connections to the main must be considered part of the fire hydrant installation and not part of the main construction. No separate payment will be made for this pipe. Hydrants should be connected to the mains in conformance with the Contract documents or as directed. Hydrants must also be installed in a safe, accessible location where there is minimum possibility of damage from vehicles or injury to pedestrians.

3.2.30. **Gate Valves, Valve Boxes, and Adjustments.** Gate valve installation should include valve, reaction blocking, cast iron boot, valve box extension (with DI riser pipe), valve box, concrete collar (where subjected to vehicular traffic), and valve box lid. Gate valves constructed in the terrace must be constructed with No. 3 bars all around.

The valve box must be placed to prevent shock or stress being transmitted to the valve. All valves located 6 ft. and deeper must include valve key extensions inside the valve box. The Contractor has the option to install fully adjustable valve box and valve key extension systems on all valves located between 6 ft. and 13 ft. Adjustable valve box and valve key extension systems must be centered over the valve's operating nut with the box cover flush with the finished pavement surface or located at another level as directed. Valve boxes located in streets or other areas subject to vehicular traffic must be provided with concrete collars as shown on the plans. Collars around such valve boxes must be formed and finished off neatly and in a sound, workmanlike manner.

Valve pits must be located so that the valve-operating nut is readily accessible for operation through the opening in the valve box. The valve box must be set flush with the finished pavement surface or at other finished elevations as may be specified. Pits should be constructed to permit minor valve repairs and provide protection to the valve and pipe from impact (where penetrating through pit walls).

In Pressure Zones 9–16, all valves 6 in. and larger must be supported on a concrete pad as shown on the plans.

Existing valve boxes located within the limits of new street construction that are in conflict must be adjusted to match proposed finished grades.

3.2.31. **Air Release Assembly.** Air release valves and appurtenant items must be installed at the locations as shown on the plans unless otherwise directed.

Install air release assemblies in open trench as shown on the plans. Assemblies include the valve, valve box, tapping saddle, pipe fittings, accessories, and appurtenances. Assemblies also include service line and tap to main. Air release assemblies installed in parkways or easements and outside street pavement must be installed as shown on the plans.

Air release assemblies installed on steel pipe attached to bridge structure include the outlet on the steel pipe, valve, valve box, pipe fittings, security enclosure, accessories, and appurtenances.

3.2.32. **Blow-Offs.** Permanent and temporary blow-off assemblies should be installed as shown on the plans or at locations designated by the Engineer or owner, and at the end of all dead-end mains in accordance with 30 TAC § 290.44(d)(5) and (6).

The permanent blow-off must consist of the following:

- all galvanized iron pipe, valve, and fittings of the various sizes as shown on the plans; and
- 6-in. valve box assembly and concrete collar around the valve box.

The temporary blow-off must consist of the following:

- all galvanized iron pipe, valve, and fittings of the various sizes as shown on the plans.

Valve box must be raised or installed to finished grade and installed as shown on the plans.

3.2.33. **Anchorage and Blocking.** Suitable reaction blocking or anchorage must be provided at all dead ends, plugs, caps, tees, crosses, valves, and bends, as shown on the plans. All mechanical (joint) restraints must be bidirectional. Anchor blocks must be constructed solidly behind the fitting and symmetrical with the axis of resultant thrust, except where this is not possible as in the case of gravity anchorage for vertical bends. Special ties and anchor fittings may be used in conjunction with blocking as shown on the plans or as directed.

Thrust blocking must be at least 3,000-psi Class A concrete placed between solid ground and the fitting, except as otherwise shown on the plans. The area of bearing in contact with solid ground must be that as shown on the plans or as directed.

All thrust blocking placed in conjunction with mains and appurtenances constructed in Pressure Zones 9–15 should be as shown on the plans. In all cases, the design of thrust blocking must be sized to withstand a soil pressure of 3,000 psf, unless otherwise shown on the plans or in accordance with Specifications. The maximum soil lateral load-bearing capacity that will be allowed for the design of thrust blocking is 5,000 psf. When soil lateral load-bearing capacities of 4,000 psf or 5,000 psf are recorded for design of thrust blocks, copies of soil tests for determining the bearing value of the soil in question should be submitted to the Engineer for verification.

The blocking must be placed so that pipe and fitting joints will be accessible. Pipe polywrap must be placed between the pipe or fitting and the concrete.

The reaction block on the unused branch of a tee must be poured separately from the block across the back of the tee. If the reaction block is poured simultaneously, a rigid partition must be placed between the blocks.

Valves 12 in. and larger in size must be supported on a concrete pad extending vertically from 12 in. below the bottom of the valve to the lower quarter point of the hub, and laterally from face to face of hubs and transversely from wall to wall of the trench.

3.2.34. **Butterfly Valves.** Butterfly valve installation must include butterfly valve, coated and wrapped steel pipe nipple with reaction stop ring, concrete reaction blocking, cast iron boot, valve box extension (DI riser pipe), valve box and lid, concrete collar where subjected to vehicular traffic, all couplings, and all coupling adapters required to complete the connection. The entire valve, except for the operating nut, must be coated with an approved City of Schertz sewer structural coating, and wrapped with polywrap. Butterfly valves constructed in a terrace must be constructed with No. 3 bars all around.

The valve box must be placed to prevent shock or stress transmitted to the valve. All valves located 6 ft. and deeper must include valve key extensions inside the valve box. The Contractor may install fully adjustable valve box and valve key extension systems on all valves located between 6 ft. and 13 ft. Adjustable valve box and valve key extension systems must be centered over the valve's operating nut with the box cover flush with the finished pavement surface or located at another level as directed. Valve boxes located in streets or other areas subject to vehicular traffic must be provided with concrete collars as shown on the plans. Collars around such valve boxes must be formed and finished off neatly and in a workmanlike manner.

3.2.35. **Reinforced Concrete Vaults.**

3.2.35.1. **Forms.** Forms should be designed to produce hardened concrete with the shape, lines, and dimensions as shown on the plans.

Surfaces that will be exposed to view when construction is completed should be prefabricated plywood panel forms, job-built plywood forms, or forms that are lined with plywood or fiberboard. The forms must produce finished surfaces that are free of offsets, ridges, waves, and concave or convex areas.

Plywood or lined forms will not be required for surfaces that are normally submerged or not ordinarily exposed to view. Other types of forms, such as steel or unlined wooden forms, may be used for surfaces that are not restricted to plywood or lined forms, and may be used as backing for form linings.

Before concrete is placed, a film of light form oil must be applied to the forms.

Forms should be substantial and tight to prevent leakage of mortar. Form must be thoroughly cleaned, braced, or tied to maintain the desired position, shape, and alignment during and after concrete placement.

Form ties must be corrosion-resistant and must have enough strength and rigidity to support and maintain the form in proper position and alignment.

3.2.35.2. **Form Removal.** Form must be removed after 24 hr., provided that the exposed surfaces can be immediately and effectively sealed to prevent loss of moisture. Otherwise, the forms should remain in place for 48 hr. Precautions should be taken in form removal to avoid surface gouging, corner or edge breaking, and other damage to the concrete.

3.2.35.3. **Reinforcing Steel.** Reinforcing steel should be accurately formed and must be free of loose rust, scale, and contaminants that reduce bond. Unless otherwise shown on the plans, bar reinforcement must be deformed and in accordance with Item 440.

3.2.35.4. **Reinforcing Steel Placement.** Reinforcing steel should be accurately positioned on supports, spaces, hangers, or other reinforcements, and must be secured in place with wire ties or suitable clips. All bars must be shop-fabricated and bent cold.

3.2.35.5. **Concrete Placement.** Concrete should be placed as nearly as practicable in its final position to avoid segregation due to re-handling. When the concrete pour has commenced, it should be a continuous operation until the placing of the panel or section is completed. All concrete must be thoroughly compacted by suitable means during pouring operations and must be thoroughly worked around reinforcement bars and into the corners of the forms. Mechanical vibration or other acceptable means should be used to completely embed the reinforcement and eliminate honeycomb. Finished surfaces should be brought to proper grade, struck off, and completed in a workmanlike manner. No honeycombing, rough spots, or protruding stones should be left exposed.

3.2.35.6. **Curing.** Concrete must be protected from loss of moisture for at least 7 days after placement. Curing of concrete should be by methods that will keep the concrete surfaces adequately wet during the specified curing period.

3.2.35.7. **Water Curing.** Water saturation of concrete surfaces should begin as quickly as possible after the initial set of the concrete. The rate of water application should be regulated to provide complete surface coverage with minimal runoff.

3.2.35.8. **Membrane Curing.** Chlorinated, rubber-type membrane-curing compound may be used instead of water curing on concrete that will not be covered later with mortar or additional concrete. Membrane-curing compound should be spray-applied at coverage of not more than 300 sq. ft. per gallon. If forms are removed before the end of the specified curing period, curing compound must be immediately applied to the formed surfaces before they dry.

Curing compound should be suitably protected against abrasion during the curing period.

3.2.35.9. **Finishing Surfaces.** Fins and other surface projections should be removed from all formed surfaces. All exposed exterior surfaces should have a rubbed finish. The floor surface should be brush-finished, unless otherwise specified.

3.2.35.10. **Repairing Defective Concrete.** Defects in formed concrete surfaces must be repaired to the satisfaction of the Engineer within 24 hr., and defective concrete must be replaced within 48 hr. after the forms have been

removed. All concrete that is honeycombed or otherwise defective should be cut out and removed to sound concrete with edges square cut to avoid feathering.

Concrete repair work should be performed in a manner that will not interfere with thorough curing of surrounding concrete. Repair work must be adequately cured.

3.2.35.11. **Painting.** All exposed metallic surfaces, such as the cover plate, hinges, handles, and other exposed hardware, must be primed and painted with one coat of primer and one coat of aluminum paint of approved and compatible quality.

3.2.35.12. **Backfill.** The Contractor should cover the openings at each end of the vault with 1/4-in. plywood placed outside the vault. Selected backfill (consisting of job-excavated materials, finely divided and free of debris, organic material, and stones larger than 2 in. in greatest dimension) must be placed in uniform layers not exceeding 8 in. in uncompacted thickness, and must be carefully compacted around the sides of the vault until level with the surrounding ground.

3.3. **Backfill.**

3.3.1. **Initial Backfill.** "Initial backfill" is defined as backfill with a thickness in its compacted state from the surface of the bedding to a point 1 ft. above the top of pipe. The first lift of initial backfill must be inspected and approved before placement of the second lift. The second lift of initial backfill material must extend from the spring line of the pipe with at least 1 ft. above the top of the pipe. The second lift must be evenly spread in a similar manner as the first lift.

For diameters 24 in. and larger, simultaneously spread initial backfill material alongside, under the lower quadrant of pipe and over the pipe in 12-in. lifts to at least 1 ft. above the top of pipe.

Consolidate initial backfill material to assure it is incorporated. A handheld vibrator, commonly used for concrete work, may be used for this purpose. The vibrator must be inserted every 3 ft. on each side of pipe.

3.3.2. **Secondary Backfill. "**Secondary backfill" is defined as backfill from 1 ft. above the top of pipe to the top of the trench or bottom of pavement section. Secondary backfill must be constructed as shown on the plans and in accordance with these Specifications.

Secondary backfill material should be placed in maximum 12-in. loose lifts or as directed.

3.3.3. **Sand Backfilling of Cross-Trenches and Open Holes.** Blow-offs, tie-ins, air release valves, service lines, meter boxes, or other specials must be backfilled with sand and thoroughly consolidated by saturating with water, unless otherwise directed. The use of mechanical tamping equipment for compaction of backfill will not be permitted at such locations. Disposal of surplus excavated material and placement of sand must be included in the trenching and backfilling and will not be paid for directly.

3.3.4. **Trench Backfill Across Traffic Arteries.** Any trench in or across traffic arteries must be backfilled immediately after the pipe is installed, unless the Engineer determines unusual conditions exist that render immediate backfilling unfeasible.

3.3.5. **Flowable Backfill.** Instead of normal backfill materials, the Contractor must backfill the trench with flowable backfill with fly ash material at the locations as shown on the plans or directed. The flowable backfill material and operation must be in accordance with Item 401, "Flowable Backfill."

3.4. **Flushing and Testing Mains.**

3.4.1. **Flushing.** Immediately upon completion of water main work, the Contractor must flush all mains affected by the scope of the work. This flushing must consist of completely filling sections of main between valves and then displacing such initial volumes of water by introducing clear water from existing facilities into and through the main to the point of discharge from the main being flushed. The flow-through should continue

until it is determined all dust, debris, or foreign matter that may have entered during pipe-laying operations have been flushed out. All new mains must then be left under system pressure for testing.

To avoid damage to pavement and inconvenience to the public, fire hoses should be used to direct flushing water from the main into suitable drainage channels or sewers. The Contractor must coordinate with the Inspector before flushing.

3.4.2. **Operation of Valves.** No valve in the distribution system may be operated by the Contractor without prior permission of the Inspector. The Contractor must notify the Inspector when a valve is to be operated and must operate the valve only in the presence of the Inspector.

3.4.3. **Hydrostatic Tests.** After the pipe has been installed and backfilled and all service laterals, fire hydrants, and other appurtenances installed and connected, a hydrostatic pressure followed by a leakage test must be performed. Except in the high-pressure sections of the water distribution system (Pressure Zones 9–16), where test pressures will exceed 150 psi, all new mains must be hydrostatically field-tested at a maximum test pressure of 150 psi before acceptance by the Engineer or Inspector. Where designated as a "high-pressure area," all new mains must be hydrostatically field-tested at a maximum test pressure of 200 psi before acceptance by the Engineer or Inspector. All joints must be watertight, and all joints that are found to leak by observation during any test must be made watertight by the Contractor. When repairs are required, the hydrostatic field test must be repeated until the pipe installation conforms to the specified requirements and is acceptable to the Engineer and Inspector. The Contractor must ensure that the Engineer and Inspector are present for the duration of the pressure test.

3.4.4. **Test Procedures.** After the new main has been laid and backfilled as specified, but before chlorination and replacement of pavement, it must be filled with water for at least 24 hr. and then subjected to a hydrostatic pressure test.

The specified test pressure must be supplied by a pump connected to the main in a satisfactory manner. The pump, pipe connection, and all necessary apparatuses, including gauges and meters, must be furnished by the Contractor. Unless otherwise specified, the Water System Company will furnish water for filling lines and testing through existing mains. Before applying the specified test pressure, all air must be expelled from the main. To accomplish this, taps must be made, if necessary, at the points of highest elevation and afterward tightly plugged at no cost to the Department. At intervals during the test, the entire route of the new main must be inspected to locate any leaks or breaks. If any are found, they must be stopped or repaired. The test must be repeated until satisfactory results are obtained. The hydrostatic test must be conducted so that the maximum pressure at the lowest point does not exceed the specified test pressure.

The duration of each pressure test must be at least 4 hr. for new mains more than 1,000 ft. and at least 1 hr. for new mains less than 1,000 ft. after the main has been brought up to test pressure. The test pressure must be measured using a tested and properly calibrated pressure gauge acceptable to Engineer. All pressure tests must be continued until the Engineer is satisfied that the new main is in accordance with these Specifications.

Should any test of pipe in place disclose leakage greater than as shown in Table 16 and Table 17, the Contractor must, at its expense, locate and repair the defective joints until the leakage is within the specified allowance. "Leakage" is defined as the quantity of water supplied into the newly laid main, or any valve section of it, necessary to maintain the specified leakage test pressure after the main has been filled with water and the air expelled. The Contractor must notify the Engineer before beginning the test, and the Water System Company's Inspector must be present during the pressure test.

Table 16
Hydrostatic Test Leakage Allowance (Maximum) at 150 psi

Nominal Diameter and Pipe Material	Allowable Leakage in Gallons per Hour (gph)[1]													
	100 ft.	200 ft.	300 ft.	400 ft.	500 ft.	600 ft.	700 ft.	800 ft.	900 ft.	1,000 ft.	2,000 ft.	3,000 ft.	4,000 ft.	5,000 ft.
6" DI[2]	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88	0.99	1.10	2.20	3.30	4.40	5.50
8" DI[2]	0.15	0.29	0.44	0.59	0.74	0.88	1.03	1.18	1.32	1.47	2.94	4.41	5.88	7.35
12" DI[2]	0.22	0.44	0.66	0.88	1.10	1.32	1.54	1.76	1.98	2.20	4.40	6.60	8.80	11.00
16" DI[2]	0.29	0.59	0.88	1.18	1.47	1.76	2.06	2.35	2.65	2.94	5.88	8.82	11.76	14.70
20" DI[2]	0.39	0.74	1.10	1.47	1.84	2.21	2.55	2.94	3.31	3.68	7.63	11.04	14.72	18.40
20" CSC	0.08	0.16	0.24	0.32	0.40	0.47	0.55	0.63	0.71	0.79	1.58	2.37	3.16	3.95
24" DI[2]	0.44	0.88	1.32	1.76	2.21	2.65	3.09	3.53	3.97	4.41	8.82	13.23	17.64	22.05
24" CSC	0.10	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.95	1.90	2.85	3.80	4.75
30" DI[2]	0.55	1.10	1.66	2.21	2.76	3.31	3.86	4.42	4.97	5.52	11.04	16.56	22.08	27.60
30" CSC	0.12	0.24	0.35	0.47	0.59	0.71	0.83	0.94	1.06	1.18	2.36	3.54	4.72	5.90
36" DI[2]	0.66	1.32	1.99	2.65	3.31	3.97	4.63	5.30	5.96	6.62	13.24	19.86	26.48	33.10
36" CSC	0.14	0.28	0.43	0.57	0.71	0.85	0.99	1.14	1.28	1.42	2.84	4.26	5.68	7.10
42" DI[2]	0.77	1.54	2.32	3.09	3.86	4.63	5.40	6.18	6.95	7.72	15.44	22.16	30.88	38.60
42" CSC	0.17	0.33	0.50	0.66	0.83	1.00	1.16	1.33	1.49	1.66	3.32	4.98	6.64	8.30
48" DI[2]	0.88	1.77	2.65	3.53	4.42	5.30	6.18	7.06	7.95	8.83	17.66	26.16	35.32	44.15
48" CSC	0.19	0.38	0.57	0.76	0.95	1.13	1.32	1.51	1.70	1.89	3.78	4.98	6.64	8.30
54" CSC	0.21	0.42	0.63	0.84	1.05	1.26	1.47	1.68	1.89	N/A	N/A	N/A	N/A	N/A
60" CSC	0.24	0.48	0.72	0.96	1.20	1.44	1.68	1.92	2.16	N/A	N/A	N/A	N/A	N/A

1. The gph for CSC pipe are manufacturer's maximum.
2. PVC pipe must be tested to DI pressures. DIP includes mechanical and push-on joints.

Note—Leakage allowances may be determined for footages not specifically listed by interpolation or by the combination of various tabular data.

Table 17
Hydrostatic Test Leakage Allowance (Maximum) at 200 psi

Nominal Diameter and Pipe Material	Allowable Leakage in Gallons per Hour (gph)[1]									
	100 ft.	200 ft	300 ft.	400 ft.	500 ft.	600 ft.	700 ft.	800 ft.	900 ft.	1,000 ft.
6" DI[2]	0.13	0.25	0.38	0.51	0.64	0.76	0.89	1.02	1.14	1.27
8" DI[2]	0.17	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70
12" DI[2]	0.26	0.51	0.77	1.02	1.28	1.53	1.79	2.04	2.30	2.55
16" DI[2]	0.34	0.68	1.02	1.36	1.70	2.04	2.38	2.72	3.06	3.40
20" DI[2]	0.43	0.85	1.28	1.70	2.13	2.55	2.98	3.40	3.83	4.25
20" CSC	0.08	0.16	0.24	0.32	0.40	0.47	0.55	0.63	0.71	0.79
24" DI[2]	0.51	1.02	1.53	2.04	2.55	3.06	3.57	4.08	3.59	5.10
24" CSC	0.10	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.95
30" DI[2]	0.64	1.27	1.91	2.55	3.19	3.82	4.46	5.10	5.73	6.37
30" CSC	0.12	0.24	0.35	0.47	0.59	0.71	0.83	0.94	1.06	1.18
36" DI[2]	0.76	1.53	2.29	3.06	3.82	4.58	5.35	6.11	6.88	7.64
36" CSC	0.14	0.28	0.43	0.57	0.71	0.85	0.99	1.14	1.28	1.42
42" DI[2]	0.89	1.78	2.68	3.57	4.46	5.35	6.24	7.14	8.03	8.92
42" CSC	0.17	0.33	0.50	0.66	0.83	1.00	1.16	1.33	1.49	1.66
48" DI[2]	1.02	2.04	3.06	4.08	5.10	6.11	7.13	8.15	9.17	10.19
48" CSC	0.19	0.38	0.70	0.76	0.95	1.13	1.32	1.51	1.70	1.89
54" CSC	0.21	0.42	0.63	0.84	1.05	1.26	1.47	1.68	1.89	2.10
60" CSC	0.23	0.46	0.69	0.92	1.15	1.38	1.61	1.84	2.07	2.30

1. The gph for CSC pipe are manufacturer's maximum.
2. PVC pipe must be tested to DI pressures. DIP includes mechanical and push-on joints.

Note—Leakage allowances may be determined for footages not specifically listed by interpolation or by the combination of various tabular data.

PVC pipe leakage allowances must conform to DI leakage allowances as shown in Table 16 and Table 17.

3.5. **Disinfection of New Mains Using Machine Chlorination.** After the new mains have successfully passed the pressure test in accordance with Section 3.4.3, "Hydrostatic Tests," the City of Schertz will disinfect those mains as shown on the plans or otherwise specified as "Machine Chlorination." This disinfection must include chlorination, flushing, and placing the mains in service. All other disinfection requirements must be accomplished by the Contractor. Disinfection by the Contractor is limited to sections of pipe less than 800 ft. in length between sections.

3.5.1. **Operation of Valves.** During and after disinfection of mains less than or equal to 16 in. in diameter, the Contractor must be notified by the Inspector in advance (2 workdays) to enable the Contractor to have a competent representative present whenever valves are to be operated that will affect the pressure in any part of the work for which the Contractor is responsible.

3.5.2. **Contractor's Personnel and Equipment.** The Contractor must supply labor and equipment necessary to make all excavations required for chlorination, equipment connections, subsequent flushing, and placing the mains in service.

3.5.3. **Safeguarding and Backfilling Open Holes.** The Contractor must be responsible for safeguarding any open holes excavated or left open for flushing and disinfection purposes. Following completion of disinfection, the Contractor must backfill such holes in accordance with Section 3.3.

3.5.4. **Disinfection of Mains Using Dry Calcium Hypochlorite (HTH).** Mains must be disinfected with dry HTH as shown on the plans or as directed and must not exceed a total length of 800 ft. This method must also be followed for main repairs. The Contractor must use pertinent safety measures to protect personnel during disinfection operation.

3.5.5. **Dosage.** The Contractor must disinfect the new or replaced mains with of 70% available chlorine. HTH must be used to obtain a minimum chlorine concentration of 50 ppm. Chlorine dosage, as shown in Table 18, is included for the convenience of the Contractor.

Table 18
Chlorine Dosage

Diameter of Pipe (in.)	To Obtain 50-ppm Chlorine Dosage (oz. per foot)
6	0.0138
8	0.0233
10	0.0364
12	0.0523
14	0.0708
16	0.0934
18	0.1175
20	0.1455
24	0.2080
30	0.3270
36	0.4690
42	0.6370
48	0.8330
54	1.0575
60	1.308

A heaping tablespoon holds approximately 1/2 oz., and a standard measuring cup holds approximately 8 oz.

3.5.6. **Filling the Main.** Those sections of main to which dry HTH has been applied must be filled slowly to allow for the even distribution of the disinfecting material. The manipulation of valves must be under the direction of the Engineer in accordance with Section 3.5.1., "Operation of Valves."

3.5.7. **Holding Time.** The length of time in which sections of main disinfected with HTH must be allowed to stand undisturbed will depend on project-specific requirements and TCEQ criteria:

- When circumstances permit a shutdown with no customers out of service, the required minimum detention time will be 24 hr. with a 50-ppm chlorine dosage;
- When customers are out of service during a shutdown with no leakage past valves, the required minimum detention time will be 3 hr. and the chlorine dosage will be 300 ppm; and
- When customers are out of service during a shutdown with some leakage past valves, the required minimum detention time will be 30 min. with a 500-ppm chlorine dosage.

3.5.8. **Flushing.** Following the expiration of the specified holding time, the treated section of main must be flushed thoroughly by the Contractor in accordance with Section 3.4., "Flushing and Testing Mains." Flushing must continue until no chlorine remains detectable by taste or odor or until the chlorine residual is less than 0.3 ppm. The Contractor must make provisions for the disposal and runoff of the flushing operations to minimize erosion or impact on residents.

3.5.9. **Preventing Reverse Flow.** Valves must be manipulated so that the strong chlorine solution in the line being treated will be flushed out of the main and will not flow back into the line supplying the water.

3.5.10. **Supervision.** All disinfection must be completed under the general supervision of the City of Schertz.

3.5.11. **Additional Treatment.** Should the new main fail to meet minimum public health standards for bacteriological quality after flushing, further treatment must be as directed. If further disinfection is required, chlorination must be completed in accordance with Section 3.5., "Disinfection of New Mains Using Machine Chlorination." In no case, however, may the new line be acceptable as complete and satisfactory until the bacteriological quality of the water taken from the main meets TCEQ standards.

If an open hole is unsafe and does not have proper trench protection, owner's chlorination crew will not chlorinate project until acceptable trench protection is provided.

3.6. **Service Supply Lines.** Service supply lines and fittings, meter boxes, and appurtenances must be in accordance with material Specifications and must be installed by the Contractor as specified herein, or as directed and as shown on the plans. Service supply lines in high-pressure zones should be installed with two strap service saddle clamps.

3.6.1. **Designation of Service Supply Lines.** A service supply line located between the water main and the inlet side of the water meter is designated as a "water service line." A service supply line located between the outlet side of the water meter to the point of connection within the limits of the customer's lot or property is designated as "customer's yard piping." Services 2 in. and smaller are designated "small services"; services 4 in. and larger are designated "large services."

3.6.1.1. **Service Relays.** New transfer mains to which services must be relayed and are on the same side of the street as the customer's meter are defined as "short relays." New transfer mains to which services must be relayed and are on the opposite side of the street from the customer's meter are defined as "long relays."

3.6.1.2. **Service Reconnects.** New transfer mains to which services must be reconnected and on the same side of the street as the old main are defined as "service reconnects." Existing services on the opposite side of the street from the new main are defined as "long reconnects."

3.6.1.3. **Service Relocates.** "Service relocates" are defined as services that are relocated from an alley to a side or front street. New transfer mains to which services must be relocated and on the same side of the street as the customer's new meter box location are designated as "short relocates." New transfer mains to which services are to be relocated and on the opposite side of the street from the customer's new meter box location are designated as "long relocates."

3.6.1.4. **New Services.** If a new main is required to be extended to provide water service for new customers, the service lines laid to the new main will be designated as "new services." Newly laid mains to which new services are on the same side of the street as the customer's new meter box location are designated as "new short services." Newly laid mains to which new services are on the opposite side of the street from the customer's new meter box location are designated as "new long services."

3.6.1.5. **New Unmetered Services.** "New unmetered services" are defined as services that are installed on existing mains or new mains to provide service to customers' platted vacant lots. Where the new main or existing main to which new unmetered services are being installed is on the same side of the street as the customer's new or existing meter box location (Inspector to set location of new meter box if no existing meter box is set), the services to be laid are designated "new unmetered short services." Where the new main or the existing water main to which new unmetered services are installed is on the opposite side of the street from the customer's new or existing meter box location (Inspector to set location of new meter box if no existing meter box is set), the services to be laid are designated "new unmetered long service." New unmetered long services and new unmetered short services must not include "customer's yard piping," and no meter may be set.

3.6.1.6. **Tap Holes.** "Tap holes" are defined as excavations at existing mains that are required pertinent to replacements of water service lines by pulling, boring, or jacking operations.

All backfill material must be as specified for main and service line trench excavation.

For service lines and tap holes, payment for bedding, initial backfill, and secondary backfill will be included in the various sizes of each service placed.

3.6.1.7. **Service Line Installation.** Unless otherwise specified, service relays, service reconnects, service relocates and new services must be installed as specified herein, and as shown on the plans. Unless otherwise specified, existing meter and meter box relocation must be included in the service line installation.

All service line installation must include a dielectric union to be installed within the meter box on the outlet side of the meter, as shown on the plans.

Cutting, excavation, backfill, and replacement of pavement must be completed as specified herein and in conformance with the Contract documents. The minimum trench width for small service lines must be 8 in., while the minimum trench width for large service lines must be the nominal pipe diameter plus 16 in., except when specified otherwise by the Engineer. For 3/4-in.–2-in. service lines, minimum burial depth must be 3 ft. For services greater than 2 in., minimum depth of burial must be 4 ft.

All service lines should be installed as shown on the plans and in accordance with Specifications, except that two strap service saddle clamps must be installed for all tap connections made on water mains located within boundaries of Pressure Zones (formally known as “Service Levels”) 9–16.

The Contractor must use precaution to protect and preserve the polyethylene wrap around DI water mains when installing service corporations. Wrap pipe tape around the pipe, over the polywrap, in the area to be tapped. The tap should be made through the tape and polywrap. It is not necessary to remove and replace polywrap. All exposed pipe, corporation, and the first 3 ft. of the service must be wrapped and taped to achieve a complete seal. In addition, a sand envelope must extend over and around the connection to a depth of 8 in. above the main.

Small service lines must be embedded in sand in accordance with Specifications.

When approved by the construction Inspector, the Contractor may lay the new service line from the corporation stop to the curb stop or angle valve. Upon completion, the Contractor must isolate the new service line by closing the curb stop or angle valve until the meter box is set.

3.6.1.8. **Splicing.** A long service line single splice may be permitted by three-part compression or flared coupling only when approved in advance, provided the location of the splice is not under pavement or concrete. The segment added must be of the same material as the existing service line, unless otherwise directed by the Engineer. Splicing short service lines will not be permitted.

3.6.1.9. **Boring or Jacking Service Lines.** Service lines that cross paved streets may be installed at the Contractor’s option by boring or jacking operations. Where it becomes necessary to widen the main trench section to accommodate a bore pit, such widening must not extend more than an additional 1 ft. into the traffic side of the street.

3.6.1.10. **Tapping Asbestos Cement (AC) Water Mains.** All necessary service line tapping of AC pipe must be completed during the period immediately before or after hydrostatic-pressure testing operations so that subsequent flushing will maximize the elimination of contaminants pertinent to the tapping process. Direct tapping will not be allowed. Service saddles must be used when tapping AC pipe. Drill tools should be used for services less than 2 in. Shell-type drills should be used for all services 2 in. and greater.

Tapping of AC pipe must be completed in conformance with manufacturers’ recommendation and using only a tap machine with a built-in flush valve, and the flush valve must be open during the entire procedure.

3.6.1.11. **Abandonment of Service Lines.** The Contractor should accomplish all cutting, capping, and plugging necessary to isolate new service lines transferred to new and existing mains from those abandoned, including service lines as shown on the plans as “tap plug” and “tap kill.” The corporation stop for an abandoned service line tapped on a ferrous main must be removed, and the tap at the main must be plugged with an appropriately sized brass plug. For a non-ferrous main, the corporation stop must not be removed from the main. Instead, the corporation stop must be closed and the flared nut should be removed from the corporation stop. After the appropriately sized copper disc is inserted inside the flared nut, replace the flared nut on the corporation stop. The Contractor should salvage copper service line tubing, brass fittings, and other materials as directed by the Inspector and return them to the owner.

3.6.1.12. **Tapping Polyvinyl Chloride (PVC) Pipe (AWWA C 900).** Tapping of PVC must be completed in conformance with Uni-Bell procedures. Direct tapping will not be allowed. All drill-cutting tools must be the

"shell type," with internal teeth or double slots that will retain the coupon. The shell cutters must be designed for pipe in accordance with AWWA C 900, thus with enough root depth to handle the heavier-walled pipe.

3.6.1.13. **Small Service Lines.** Copper tubing should be used for 3/4-in.–2-in. service lines. Brass fittings for 3/4-in. and 1-in. service lines should be of the flared or compression type for use with Type K soft annealed copper tubing. Brass fittings for 1-1/2-in. and 2-in. lines should be of the flared or compression type for use with Type K soft annealed copper tubing, except as modified in accordance with this Specification.

Copper tubing must be cut squarely using an approved cutting tool and avoiding excessive pressure on the cutting wheels, which may bend or flatten the pipe walls. Following the copper tubing cut, but before flaring, a reamer should be used to remove the inside rolled lip from the tubing. Flared ends should be expanded using a flaring tool, taking care to avoid splitting, crimping, or overstressing the metal. Pipe adjacent to the fittings must be straight for at least 10 in. Bending of tubing should be accomplished using an appropriately sized bending tool. No kinks, dents, flats, or crimps will be permitted, and should such occur, the damaged section should be cut out and replaced. When compression fittings are used, the copper tubing should be cut squarely before insertion into the fitting. Final assembly must be in conformance with the manufacturers' recommendations.

3.6.1.14. **Small Service Lines on New Mains.** Installation of new copper service lines must consist of all excavation through miscellaneous material encountered; trench excavation protection; drilling and tapping the new main using an approved tapping machine; setting the curb stop or angle valve at the meter; laying the new copper service line at the specified depth between the main and the meter and its tie-in at the corporation and the curb stop or the angle valve; relocating the existing meter and installing a new meter box where required in accordance with this Specification; backfilling the trench with approved selected material and disposal of surplus excavated material; capping the tap hole with asphalt-treated base, including the outer limits of the main trench line with service line trench; and cutting and replacing pavements, curbing, and sidewalks of all types over the limits of the main line trench and the completed service line trench.

3.6.1.15. **Reconnecting Service Lines.** Both old and new water mains at existing service line connections as shown on the plans must be exposed. The old main must be exposed to gain access to the existing service corporation stop and the new main to install the new corporation stop. The new main must be exposed to be drilled and tapped using an approved tapping machine, a new corporation stop installed under pressure, and the trench extended laterally to expose enough length of the existing service line to provide slack to bend it to position for tying to the new corporation stop. After suitable notification to the customer, the Contractor should "kill" the existing service by closing the corporation stop, removing the existing flare nut, inserting the existing flared nut on the corporation stop if the main is non-ferrous, or plugging the existing service line at the main if the main is ferrous. The Contractor must then immediately open the stop and restore water service to the customer. Where it is not possible to obtain enough length in the existing service to tie directly to the new main, at the direction of the Engineer, the Contractor must splice the necessary length of new tubing and tie it to the existing service using a compression coupling at a point as close as practicable to the new main.

Cutting and bending of the tubing, introduction of slack to compensate for soil movement, and completion of the installation must be as specified herein.

Where old and new mains are on opposite sides of the street, service lines may be installed under the street pavement by boring rather than trenching.

3.6.1.16. **Relaying Service Lines.** The existing or new mains as shown on the plans must be exposed opposite location stakes placed onsite at the direction of the Engineer. The existing or new main should be drilled and tapped using an approved tapping machine, a new corporation stop installed, and the trench extended laterally to the location specified for the meter box. The existing meter must be reset, and the meter box and base must be installed at their staked location and perpendicular to the corporation stop in the water main. The meter box location should not vary more than 24 in. in any direction from its staked location. The service line must be installed with enough slack to compensate for soil movement. Where the location of the existing meter is not changed, the new service line should be extended from the main to the existing meter, with new curb stop installed at the end of the service line, and connected to the inlet side of the meter. If disturbed, the

existing meter box must be reset to correct grade. Long service relays may be placed under the street pavement by boring or jacking rather than trenching.

3.6.1.17. **Single Service Line—Dual Meters.** The single service line - dual meter installation will consist of a 1 in. copper service line reducing to two 3/4 in. copper service lines at a tee which should be set in line with the front edge of meter boxes for 5/8 in. and 3/4 in. meters. A single service line with dual meters should be installed in those new residential developments where new 5/8 in. and 3/4 in. meters are required and in main replacement work where it is necessary to change the location of existing 5/8 in. and 3/4 in. meters. Single service line - dual meter materials and installation requirements must conform to requirements established herein.

3.6.1.18. **Small Service Lines on Existing Mains.** The work involved in the installation of new copper service lines on existing mains will consist of jacking, boring, tunneling, and, where authorized, open trench operations all excavation through whatever material encountered; trench excavation protection; using the existing corporation when approved by the Engineer; tapping the existing main and installing the new corporation and setting the curb stop or angle valve at the meter; relocating the existing meter and installing a new meter box where required in accordance with this specification; abandoning the existing corporation stop, removing the existing flared nut, inserting inside the existing flared nut an appropriately sized copper disc and replacing the existing flared nut on the corporation stop if the main is non-ferrous, or plugging the existing service line at the main if the main is ferrous; installing the new service line at the same grade as the existing service line or at the specified grade between the main and the existing meter and its tie-in at the corporation and the curb stop; disposal of surplus excavated material; capping the tap hole with asphalt treated base including the outer limits of the main line trench and the service line trench; cutting and replacing all surfaces of whatever type encountered over the completed service line trench; restoration of the site.

3.6.1.19. **Large Service Lines.** DI pipe and cast-iron fittings used for metered service lines and non-metered fire service lines larger than 2 in. must be installed in accordance with the applicable provisions of this specification, except where otherwise approved by the Engineer.

3.6.1.20. **Large Service Lines on New Mains.** Work involved in the installation of a new metered service lines and non-metered fire service lines will consist of all excavation through whatever material encountered; trench excavation protection, installing tees, pipe and fittings of various sizes including main line and service line valves, valve boxes, DI pipe, fittings, in accordance with plans and reaction block required; backfilling with approved selected material; cutting and replacing pavements, curbing, and sidewalks of all types over the limits of the main line trench and the completed DI service line.

3.6.1.21. **Large Service Lines on Existing Mains.** The work involved in the installation of the new metered service lines and non-metered fire service lines will consist of all excavation through whatever material encountered, trench excavation protection, cutting in tees and installing tapping sleeves and valves, pipe and fittings of various sizes including main line and service valves; valves boxes, DI pipe, fittings and reaction block required; backfilling with approved selected material; cutting and replacing pavements, curbing, and sidewalks of all types over the limits of the main line trench and the completed DI service line.

3.6.2. **Meter Boxes.** Physical movement of existing meters and meter boxes to new locations may be required where service lines are transferred to new mains in conjunction with main replacement work. Unless specified otherwise, the Contractor should move existing meters and meter boxes and reconnect and adjust customer's yard piping as part of transferring service lines. A dielectric coupling PVC pipe Schedule 80 must be installed within the meter box between the meter and the customer's yard piping.

Round and oval meter boxes with round covers should be salvaged and returned to the Owner by the Contractor. The Contractor must also replace the salvaged meter boxes with the new, appropriately styled oval plastic meter box with oval cover, or rectangular meter box. Unless otherwise specified, the old service line should be abandoned after the existing meter has been reset in the existing or new meter box.

Where meter boxes are installed in sidewalks or driveways, the Contractor should install a number one meter box (two pieces) as shown on plans.

New meters will be set by the Owner where mains are extended, and new services lines are installed for new or initial customer service. Instead of the new meter, the Contractor should furnish and install a meter template in accordance with plans.

Meter and meter box configuration should have the meter set horizontal, approximately 6 in. below the top of meter box, so that the meter is above the bottom of the meter box and in line with the meter box lid opening. The top of the meter box should be flush with the existing ground surface. All excess soil above the meter coupling, meter flange and meter nuts inside the meter box should be removed so that the meter register is clearly visible. The Contractor must exercise special precautions during excavation at the existing meter location to minimize the disturbance of the customer's yard piping. However, if the existing meter elevation is low, the Contractor must raise the existing meter to conform to the correct configuration indicated herein. Adjustment of meter to proper grade is incidental to the construction and will not be paid for separately.

Where required, pressure reducing valves should be installed by the customer in accordance with the Uniform Plumbing Code and must be placed beyond the outlet side of the meter, but not within the Owner's meter box. The pressure reducing valve will be the property of the water user who will be responsible for its installation, maintenance, and replacement as required.

The meter box adjustment must not exceed 10 ft. from the existing box.

3.6.3. **Water Service for Fire Lines.**

3.6.3.1. **Start of Work.** Three working days' notice will be given to the assigned Inspector before start of a project after permit has been issued. The Contractor must start his work at a tie-in or point designated by the Engineer. Pipe must be laid with bell ends facing in the direction of laying, unless otherwise authorized or directed by the Engineer. All valves and fire hydrants must be installed as soon as pipe laying reaches their established location. Pipe must be installed to the required lines and grades with fittings, valves, and hydrants placed at the required locations. Spigots must be centered in bells or collars, all valves and hydrant stems must be set plumb, and fire hydrant nozzles must face as shown on the plans or as directed. No valve or other control on the existing system should be operated for any purpose by the Contractor unless a representative of the City of Schertz is present.

3.6.3.2. **Crossing Other Underground Lines.** New fire line services crossing any other utilities must have a minimum of 48 in. of cover over the top of the pipe unless otherwise waived or modified by the Engineer. Excavation around other utilities must be completed by hand for at least 12 in. all around. Any damage to other utilities must be reported to the governing entity/owner of said utility as well as the Inspector.

3.6.3.3. **Pipe Grade.** Fire line services must have a minimum of 48 in. of cover for mains 16 in. and below, and 60 in. for mains 20" and above, over the top of the pipe unless otherwise waived or modified by the Engineer. Pipe grades must be as required by the plans or as directed. Grades must be met as specified. Precautions must be taken to ensure that the pipe barrel has uniform contact with the Modified Grade 5 for its full length except at couplings. Couplings should not be in contact with the original trench bottom before backfilling. Modified Grade 5 material should be placed under the coupling and compacted by hand before backfilling so as to provide an even bearing surface under the coupling and pipe. Changes in grade should be made only at joints.

3.6.4. **Modified Grade 5 Materials.** Before placing pipe in a trench, the trench should have been excavated to the proper depth as required herein. Approved imported materials or Engineer approved materials selected from suitable fines derived from the excavation should be smoothly worked across the entire width of the trench bottom to provide a supporting cushion.

3.6.5. **Structures to Support Pipe.** When either the Inspector or Engineer note that the material at the bottom of a trench is unstable or unsuitable, and conditions are such that the existing material cannot be reworked to make it stable then the trench subgrade should be over-excavated, with approved material, and properly compacted in place to provide a suitable base to support the pipe. If it is determined by the Engineer that this method cannot be used to stabilize the trench subgrade, the Contractor should then construct a foundation for the pipe consisting of piling, concrete beams, or other supports in accordance with plans prepared by the

Engineer. Extra compensation will be allowed for the Contractor for the additional work completed. Coordinate with Engineer for approval of extra compensation before beginning work.

3.6.6. **Lowering Materials into Trench.** Proper implements, tools, and facilities satisfactory to the Engineer must be provided and used by the Contractor for the safe and convenient completion of work. All pipe, fittings, valves, and hydrants must be carefully lowered into the trench piece by piece, by means of a derrick, ropes, or other suitable tools or equipment in such a manner as to prevent damage to water service materials and protective coatings and linings. Under no circumstances should water service materials, pipes, fittings, etc., be dropped or dumped into the trench. Extreme care must be taken to avoid damaging polywrap films. No chains or slings should be allowed unless the entire sling is wrapped with a protective nylon web sock.

3.6.7. **Laying of Pipe.** Every precaution must be taken to prevent foreign material from entering the pipe during its installation. Under adverse trench conditions, work stoppage for more than 24 hr. or as otherwise required by the Engineer, a manufactured cap/plug is to be used to prevent any foreign material from entering the pipe. The cap/plug must be left in place until a connection is made to the adjacent pipe. The interior of each pipe must be inspected for foreign material or defects, and the pipe must be cleaned or rejected if any foreign debris or defects are found, respectively.

After placing a length of pipe in the trench, the jointed end should be centered on the pipe already in place, forced into place, brought to correct line and grade, and completed in accordance with the requirements herein. The pipe should be secured in place with approved backfill material tamped around it. Pipe and fittings which do not allow enough and uniform space for joints will be rejected by the Engineer or Inspector and must be replaced with pipe and fittings of proper dimensions. Precautions must be taken to prevent dirt or other foreign matter from entering the joint space.

At times when pipe laying is halted, the open end of pipe in the trench must be closed by a watertight plug or other means approved by the Engineer. Pipe in the trench which cannot temporarily be joined must be capped or plugged at each end to make it watertight. This provision will apply during all periods when pipe laying is not in progress. Should water enter the trench, the seal must remain in place until the trench is pumped completely dry. The Contractor must provide all plugs and caps of the various sizes required.

3.6.8. **Deviations in Line or Grade.** Wherever obstructions not shown on the plans are encountered during the progress of the work and interfere to an extent that an alteration in the plan is required, the Construction Inspector will have the authority to change the plans and direct a deviation from the line and grade or to arrange with the owners of the structures for the removal, relocation, or reconstruction of the obstructions. Any deviation from the line should be accomplished by the use of appropriate bends unless such requirement is specifically waived by the Construction Inspector. These deviations must be clearly and accurately reflected in the Contractor's submittal of redline drawings for permanent recording purposes.

Whenever it is necessary to deflect pipe from a straight line, the deflection must be as directed by the Construction Inspector and as described herein. In no case should the amounts exceed those shown in Table 19 "Maximum Deflections of Ductile-Iron Pipe" for ductile iron pipe.

3.6.9. **Cutting Pipe.** The cutting of pipe for inserting valves, fittings, or closure pieces must be accomplished in a neat manner so as to produce a smooth end at right angles to the axis of the pipe. The recommendations of the pipe manufacturer should be strictly followed by the Contractor. Only qualified and experienced workmen must be used and, under no circumstances, should a workman not equipped with proper safety goggles, helmet and all other required safety attire be permitted to engage in this work.

3.6.9.1. **Asbestos Cement (AC).** No field cutting, breaking, or crushing will be allowed on AC pipe. Installation of fire line services to AC pipe mains must be accomplished by removing one full joint of AC pipe and replacing with appropriate PVC or ductile iron pipe and fittings.

All cuts made on ductile iron pipe must be completed with a power saw. The cuts should be made at right angles to the pipe axis and must be smooth. The edges of the cut must be finished smoothly with a hand or machine tool to remove all rough edges. The outside edge of pipe should be finished with a small taper at an

Table 19
Max Deflections of Ductile Iron Pipe

Nominal Pipe Diameter	Max Deflection Angle	Max Deflection (in.)		Approximate Radius of Curve (ft.)	
		18 ft.	20 ft.	18 ft.	20 ft.
6"	4 25'	16.7	18.5	234	260
8"	3 51'	14.6	16.2	268	297
10"	3 42'	14.0	15.5	279	310
12"	3 08'	11.9	13.2	327	363
16"	2 21'	8.8	9.7	440	488
20"	1 55'	7.2	8.0	540	600
24"	1 35'	6.0	6.7	648	720

angle of about 30°. Solid sleeves or cast couplings must be allowed on precast/prefab vaults only. All other fire line services should be installed with full joints of pipe.

To facilitate future repair work on water mains, no sections less than 3 ft. in length between fittings will be allowed.

3.6.10. **Joint Assembly.**

3.6.10.1. **Rubber Ring Joints.** The installation of pipe and the assembly of rubber ring joints for Ductile-Iron pipe must conform to the pipe manufacturer's assembly instructions. The method of inserting spigot ends of pipe in bells or collars known as "stabbing" will not be permitted. Spigot ends of pipe must be properly inserted in the joint by means of suitable pushing/pulling devices or a manufacture approved method.

3.6.10.2. **Mechanical Couplings.** Mechanical couplings must be assembled and installed according to the standards recommended by the manufacturer.

Mechanical coupling consists of a cylindrical steel middle ring, two steel follower rings, two rubber compound gaskets, and a set of steel bolts. The middle ring is flared at each end to receive the wedge-shaped gasket which is compressed between the middle ring flare and the outer surface of the pipe by pressure exerted on the follower rings through the bolt circle.

Before the installation of the mechanical coupling, the pipe ends must be cleaned by wire brush or other acceptable method to provide a smooth bearing surface for the rubber compression gasket. The pipe must be marked to align the end of the coupling which will center it over the joint. After positioning, the nuts should be drawn up finger tight. Uniform pressure on the gaskets should be applied by tightening alternate bolts on the opposite side of the circle in incremental amounts. Soap and final tensioning should be accomplished with a torque wrench and in a matter like the tightening procedure after 15 min.

3.6.10.3. **Restrained Joints.** Restrained Joints should be installed as shown on the plans or as directed by the Construction Inspector. Installation must conform to the manufacture’s recommendations

3.7. **Installation of the Non-metallic Pipe Detection System.** The nonmetallic pipe detection system is to be installed concurrently with the proposed pipe placement. Tracer wire will be used for location purposes and taped directly to the pipe. The tracer wire must be solid core (14 gauge insulated) and should be taped to the main in 10 in. increments. Wire should also come up to the top of valve extensions and fire hydrant stems, as directed by the Inspector.

3.8. **High Pressure Zone.** Work performed for construction of a high pressure water distribution system, including water mains, services, fire hydrants, and all related appurtenances, is to be completed in

accordance with this specification. This Section applies solely to the construction of high pressure water systems and will govern when in conflict with of sections of this specification.

3.8.1. **High Pressure Systems.** Each water distribution system that furnishes water in Pressure Zone 9 through Pressure Zone 16 will be designated as a high pressure system. The static water pressure in each in each Service Level must be not less than 35 psi nor exceed 175 psi with no fire hydrants in use.

3.8.2. **Locations of High Pressure Levels.** Geographically, boundaries of Pressure Zones 9 through 16 conform to the surface contour tabulation shown in Table 20, High Pressure Levels. Most of the area within Pressure Zones 9—16 is located north of Loop 1604 between IH 35 North and Bandera Road.

Table 20
Pressure Zone Surface Contour Tabulation

Static Gradient Service Level	Max Ground Elevation (ft.)	Ground Elevation (ft.)	Ground Elevation 110 psi (ft.)	Ground Elevation 150 psi (ft.)	Ground Elevation 175 psi (ft.)
9	1,125	1,000	870	780	720
10	1,290	1,160	1,040	940	880
11	1,400	1,270	1,150	1,050	1,000
12	1,520	1,390	1,270	1,170	1,120
14	1,630	1,500	1,380	1,280	1,230
15	1,860	1,730	1,600	1,510	1,460
16	1,990	1,860	1,740	1,640	1,590

3.9. **Recycled Water System.** The installation of any recycle water system components will be completed in accordance with these Specifications, except as otherwise noted. Recycled Water mains must also be installed at the TCEQ required separation distance between sewer and water mains as required by TAC rules to include: The latest provision of 30 TAC § Chapters 210, 290, and 217, or most applicable approved equal provision.

3.10. **Grouting of Water Mains.** Abandoning and grouting of water lines must not occur until all existing water mains and services have been transferred to a relocated water line or another line as designated in the Contract Documents. The Contractor will be responsible for the satisfactory coordination of the pipe abandonments with other construction and activities in the area. Delays in work resulting from lack of coordination will not be cause for additional compensation. Any work involving or impacting asbestos concrete pipe must be in accordance with the specifications.

Remove all water line appurtenances, such as hydrants, valves and valve casing and castings. Return these appurtenances to the designated utility representative or dispose of properly. Make cuts, install bulkheads, vents to allow for air release. Remove any free standing water before starting grout placement.

Place grout/flowable fill using concrete or grout pumps capable of continuous delivery at planned placement rate to fill volume between placement points not to exceed 500 ft. at a time. Pump grout/flowable fill through bulkheads constructed for placement of PVC pipes or other methods to contain grout in line to be abandoned. These pipes will be used for injection points or vents during placement. Place grout/flowable fill under pressure into properly vented open system until grout emerges from vent pipes indicating the pipe is completely filled. Pumping must be completed under enough pressure to overcome friction and to fill water main from downstream to upstream end. Remediate areas where grout/flowable fill did not fill voids in water main by pressure grouting from inside water main or from surface if necessary. Plug each end of the water main being abandoned. Ensure that concrete is placed around plug/bulkhead and around pipe including bedding area, such that it is not penetrable by groundwater and that bedding at this location is not a conduit for groundwater. The method of installation must be able to meet the requirement of completely filling the existing water main and any voids adjacent to it.

Backfill to grade above pipe left in place. Place and compact backfill in compliance with Section 3.3 “Backfill.”

Remove, transport, and dispose of spoils. Spoils including pipe, unused grout/flowable fill and other unsuitable materials must be hauled to a facility permitted to accept the material. The abandonment method should provide for the release of air. When intermediate points are required to be constructed for the abandonment of the system, they will be a part of the abandonment project process. The method should provide for the isolation of water mains to be grouted from water mains that are abandoned in place without grouting as shown on the plans.

Water mains that are not under proposed pavement are generally not required to be grouted unless it is specified in the contract documents. Mains to be abandoned should be grouted only if required by the contract documents and payment as per these specifications is provided.

3.11. **Cutting and Replacing Concrete Sidewalk, Driveway, Etcetera.** The Contractor will cut and replace concrete sidewalks, driveways, etc. per the plans.

3.12. **Cutting and Replacing Concrete Sidewalk (Asphalt).** The Contractor will cut and replace concrete asphalt sidewalks per the plans.

3.13. **Cutting and Replacing Asphalt Pavement.** The Contractor will cut and replace asphalt pavement per the plans.

3.14. **Cutting and Replacing Concrete Curb.** The Contractor will cut and replace concrete curb per the plans.

3.15. **Cutting and Replacing Asphalt Pavement with 6 in. Asphalt Treated Base.** The Contractor will cut and replace Asphalt Pavement with 6 in. Asphalt Treated Base, per the plans.

3.16. **Remove Existing Water Lines.** The Contractor is responsible for locating all water mains to be removed.

When specified or in conformance with the Contract documents, Contractor must remove the water main and all pertinent appurtenances including existing casing to be replaced. It will no longer be in service, and all effort to accomplish this requirement, including, but not limited to, coordination, pot-holing, excavation, and backfill with native or select soil, dewatering of pipe, groundwater dewatering, trenching, backfill and surface restoration, cutting, capping, removal of pipe including existing casing, disposal of materials, and all other items, will be subsidiary to the work required.

4. MEASUREMENT

4.1. Water main installed as pipe water main (DI, PVC, CSC, PVC casing (open cut), or steel casing (open cut)), for water pipe of the various sizes shown on the plans, will be measured by the foot as follows:

- from the centerline intersection of runs and branches of tees to the end of the valve of a dead-end run,
- between the centerline intersections of runs and branches of tees, and where the branch is plugged for future connection,
- the measurement will include the entire laying length of the branch or branches of the fitting,
- the measurement of each line of pipe of each size will be continuous and is to include the full laying lengths of all fittings and valves installed between the ends of such line except that the laying lengths of reducers will be divided equally between the connected pipe sizes,
- lines leading to a tapping connection with an existing main will be measured to the center of the main tapped, and
- excavation and installation of the nonmetallic pipe detection system will not be measured for payment.

4.2. **Fire Lines.** Fire Lines will be measured by the foot for each size and type from the centerline intersection of the fire line with the main distribution line to the property line. The measurement will include the entire laying

length of the branch or branches of the fitting and valves. Line leading to a tapping connection with an existing main will be measured to the center of the main tapped.

4.3. **Water (Jacking, Boring or Tunneling).** Water (jacking, boring, or tunneling) will be measured by the foot of bore or tunnel as measured from face to face of jacking pits.

4.4. **Carrier Pipe used in Bores and Tunnels or Jacked into Place.** Carrier pipe used in bores and tunnels or jacked into place will be measured by the foot of pipe installed from end to end of pipe to the limits shown on the plans.

4.5. **Carrier Pipe Installed in Open Trenches.** Carrier pipe installed in open trenches, where required by the plans, will be measured by the foot of pipe installed from end to end of pipe to the limits shown on the plans.

4.6. **Casing or Liners Used in Bores and Tunnels.** Casing or liners used in bores and tunnels, where required by the plans, of the size and material required will be measured by the foot actually installed in accordance with plans.

4.7. **Casing Installed in Open Trenches.** Casing installed in open trenches, where required by the plans, of the size and material required will be measured by the foot actually installed in accordance with plans.

4.8. **Butterfly Valve and Box (Complete).** "Butterfly valve and box (complete) will be measured as each assembly of the various sizes installed to finished grade.

4.9. **Gate Valve and Box (Complete).** Gate valve and box (complete) will be measured as each assembly of the various sizes installed to finished grade.

4.10. **Pressure Reducing Valve (Complete).** Pressure reducing valve (complete) will be measured as each assembly of the various sizes installed to finished grade.

4.11. **Tapping Sleeve, Valve and Box (Complete).** Tapping sleeve, valve, and box (complete) will be measured as each assembly of the various sizes installed.

4.12. **Cut in Tee (Complete).** Cut in tee (complete) will be measured by the unit of each such assembly of the various sizes of tee installed.

4.13. **Adjust Valve Box.** Adjust valve box will be measured as each assembly adjusted to correspond to finish grade.

4.14. **Removal Transport and Disposal of Asbestos Cement.** Removal transport and disposal of AC will be measured by the unit linear foot of AC water main removed regardless of size, to the limits shown on the plans. The measurement shown on the plans is for contractor's information only and the work will be performed by a third party Contractor as per Item 6 of the Department Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges.

4.15. **Concrete Encasement, Concrete Cradles, Concrete Saddles, and Concrete Collars.** Concrete encasement, concrete cradles, concrete saddles, and concrete collars for pipe will be measured by the cubic yard of accepted work, complete in place. Reinforcing, if required, will not be measured for payment.

4.16. **Fire Hydrant Assembly.** Fire hydrant assembly will be measured as each fire hydrant assembly installed. Also included will be enough pipe, valve, box and fittings.

4.17. **Tapped Fire Hydrant.** Tapped fire hydrant" will be measured as each fire hydrant including the various sizes of tapping sleeves, valves, and boxes installed.

4.18. **Relocate Fire Hydrant.** Relocate fire hydrant will be measured as each fire hydrant relocated.

4.19. **Permanent Blow-off (Complete).** Permanent blow-off (complete)" will be measured as each assembly of the various sizes installed.

4.20. **Temporary Blow-off (Complete).** Temporary blow-off (complete) will be measured as each assembly of the various sizes installed.

4.21. **Air Release Valve (Complete).** Air release valve (complete) will be measured as each assembly of the size installed.

4.22. **Trench Excavation Protection.** Trench excavation protection will be measured by the foot along the centerline of trench where the depth of trench exceeds 5 ft.

4.23. **Tie-in (Complete).** Tie-in (complete) will be measured as each of the various sizes and types completed.

4.24. **New Short Service.** New short service will be measured as each of the various sizes and types of new service lines installed.

4.25. **New Long Service.** New long service will be measured as each of the various sizes and types of new service lines installed.

4.26. **New Unmetered Short Service.** New unmetered short service will be measured as each of the various sizes and types of new unmetered service lines installed.

4.27. **New Unmetered Long Service.** "New unmetered long service will be measured as each of the various sizes and types of new unmetered service lines installed.

4.28. **Reconnect Short Service.** Reconnect short service will be measured as each of the various sizes of service lines reconnected.

4.29. **Reconnect Long Service.** Reconnect long service will be measured as each of the various sizes of service lines reconnected.

4.30. **Relay Short Service.** Relay short service will be measured as each of the various sizes of service lines re-laid.

4.31. **Relay Long Service.** Relay long service will be measured as each of the various sizes of service lines re-laid.

4.32. **Relocate Short Service.** Relocate short service will be measured as each of the various sizes of service lines relocated.

4.33. **Relocate Long Service.** Relocate long service will be measured as each of the various sizes of service lines relocated.

4.34. **Relocate Existing Meter and Existing Meter Box.** Relocate existing meter and existing meter box will be measured as each assembly relocated and customer's service reconnected.

4.35. **Relocate Existing Meter and New Meter Box.** Relocate existing meter and new meter box will be measured as each assembly relocated and customer's service reconnected.

4.36. **Cut and Replace Concrete Sidewalk, Driveway, Etcetera.** Cut and replace concrete sidewalk, driveway, etcetera. will be measured by the square yard of surface area of the concrete sidewalk and driveway cut and replaced, but not to exceed the maximum trench width specified in Section 3.1.2, "Width of Trench" or as shown on plans.

4.37. **Cut and Replace Concrete Sidewalk (Asphalt).** Cut and replace concrete sidewalk (asphalt) will be measured by the square yard of surface area of concrete sidewalk to be cut and replaced with temporary asphalt (4 in. depth, Type C) pavement, but not to exceed the maximum trench width specified in Section 3.1.2, "Width of Trench" or as shown on the plans.

4.38. **Cut and Replace Asphalt Pavement.** Cut and replace asphalt pavement will be measured by the square yard of surface area of the asphalt pavement cut and replaced, but not to exceed the maximum trench width specified in Section 3.1.2, "Width of Trench" or as shown on plans.

4.39. **Cutting and Replacing Concrete Curb.** Cutting and replacing concrete curb will be measured by the foot of the concrete curb cut and replaced, but not to exceed the maximum trench width specified in Section 3.1.2, "Width of Trench" or as shown on plans.

4.40. **Cut and Replace Asphalt Pavement with 6 in. Asphalt Treated Base.** Cut and replace asphalt pavement with 6 in. asphalt treated base will be measured by the square yard of surface area of the asphalt pavement cut and replaced with 6 in. of asphalt treated base, but not to exceed the maximum trench width specified in Section 3.1.2, "Width of Trench" or as shown on plans.

4.41. **Hydrostatic Pressure Test.** Hydrostatic pressure test will be measured as each successful test conducted.

4.42. **Flowable Fill Backfill.** Flowable fill backfill will be measured by the cubic yard in accordance with Item 401, "Flowable Backfill," but not to exceed the maximum trench width specified in Section 3.1.2, "Width of Trench" or as shown on the plans.

4.43. **Water Service Line Breaks Leak Repair.** Water service line breaks leak repair will be measured by the unit of each such assembly of all types and sizes of service lines, repair and tap clamps required to repair the service line break and or leak.

4.44. **Water Main Breaks Leak Repair.** Water main breaks leak repair will be measured by the unit of each such assembly of the various types and sizes of water mains, services, repair, and tap clamps required to repair the water main break or leak.

4.45. **Ductile Iron and Gray Iron Fittings.** Ductile iron and gray iron fittings" will be measured by the weight to the nearest 1/100 of a ton of the various sizes of fittings installed.

4.46. **Reinforced Concrete Vault.** Reinforced concrete vault will be measured by the each of the various sizes.

4.47. **Grout Abandonment Water Main.** Grout abandonment water main will be measured by the unit foot of main grout abandoned of the various sizes to the limits shown on the plans.

4.48. **Removal Transport and Disposal of Asbestos Cement.** Removal transport and disposal of AC will be measured by the unit foot of AC water main removed regardless of size, to the limits shown on the plans. The measurement shown on the plans is for Contractor's information only and the work will be performed by a third party contractor as per Item 6 of the Department Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges.

4.49. **New Meter Box.** New meter box will be measured for payment as each new meter box is placed.

4.50. **Remove Existing Water Lines.** Remove existing water lines will be measured by the foot of main removed of the various sized at the locations as shown on the plans.

5. PAYMENT

The work performed and materials furnished in accordance with each item and measured as provided under "Measurement" will be paid for at the unit prices bid for the items of work hereinafter described. These prices are to be full compensation for furnishing and hauling all materials; for placing or installing the materials; for

inspection and testing; and for all other items of material, labor, equipment, tools and incidentals necessary to complete the work in accordance with the plans and specifications.

5.1. **Pipe Water Main (DI, PVC, CSC, PVC Casing (Open Cut), and Steel Casing (Open Cut).** Payment for pipe water main (DI, PVC, CSC, PVC casing (open cut), and steel casing (open cut) will be made at the unit price bid per foot of pipe of the various sizes installed by the open cut method. This price will be full compensation for all labor, equipment, materials, tools, selected bedding, excavation, backfill materials, polyethylene sleeve, and hauling and disposition of surplus excavated materials.

5.2. **Fire Lines.** Payment for Fire lines installed will be made at the unit price bid per linear foot of pipe of various sizes installed by the open cut method. This price will be full compensation for all labor, equipment, materials, tools, excavating selected embedment material, backfill, compaction of trench backfill, testing of compaction, tie-in, polyethylene sleeve where required, hauling, disposing of surplus excavated material, and restoration of the surface, including asphalt, concrete, curbing, sidewalks, sod grass, landscaping, and any other surface type encountered. All replacement mains will include tie-in costs for existing fire lines.

5.3. **Water (Jacking, Boring, or Tunneling).** Payment for water (jacking, boring, or tunneling), will be paid for at the contract unit price bid per foot of jacking, boring or tunneling, which price will be full compensation for furnishing all materials (except carrier pipe, casings or liners), casing spacers, grout, labor, tools, equipment and incidentals necessary to complete the work, including excavation, grouting, backfilling, restoration to original ground conditions, end caps, and disposal of surplus materials.

5.4. **Carrier Pipe Used in Bores or Tunnels.** Payment for carrier pipe used in bores or tunnels will be paid for at the Contract unit price bid for carrier pipe (in casing) per foot which will be full compensation of pipe installed and measured as prescribed above.

5.5. **Carrier Pipe Installed in Open Cut Trenches.** Payment for carrier pipe installed in open cut trenches will be paid for at the contract unit price bid for carrier pipe for open cut trench per foot which will be full compensation of pipe installed and measured as prescribed above.

5.6. **Casings or Liners Used in Bores or Tunnels.** Payment for casings or liners used in bores or tunnels will be paid for at the contract unit price bid for casing (bore) per foot which will be full compensation of casing or liner installed and measured as prescribed above.

5.7. **Casings Installed in Open Cut Trenches.** Payment for Casings installed in open cut trenches will be paid for at the contract unit price bid for casing (open cut) per foot which will be full compensation of casing installed and measured as prescribed above.

5.8. **Butterfly Valve and Box (Complete).** Payment for butterfly valve and box (complete), will be made at the unit price bid for each such assembly of the various sizes installed. This price will be full compensation for all labor, equipment, materials, tools, selected embedment material, anti-corrosion embedment, concrete collar at the valve box where subjected to vehicular traffic, ductile iron riser pipe, cast-iron boot, packing, tarpaper, concrete grout, concrete reaction blocking, asphaltic material for bolts, nuts and ferrous surfaces, polyethylene sleeve, hauling and disposition of excavated surplus material and backfill where required. Such payment is also to include mechanical or transition couplings and coated and wrapped steel pipe nipples required to complete the connection.

5.9. **Gate Valve and Box (Complete).** Payment for gate valve and box (complete) will be made at the unit price bid for each such assembly of the various sizes installed. This price will be full compensation for all labor, equipment, materials, tools, selected embedment material, anti-corrosion embedment, concrete collar at the valve box where subjected to vehicular traffic, ductile iron riser pipe, cast-iron boot, packing, tarpaper, concrete grout, concrete reaction blocking, asphaltic material for bolts, nuts and ferrous surfaces, polyethylene sleeve, hauling and disposition of excavated surplus material and backfill where required.

5.10. **Pressure Reducing Valve (Complete).** Payment for pressure reducing valve (complete) will be made at the unit price bid for each such assembly of the various sizes installed. This price will be full compensation for all labor, equipment, materials, tools, selected embedment material, anti-corrosion embedment, concrete vault,

piping, manhole, fittings, and appurtenances necessary to complete the installation of valve including hauling and disposition of excavated surplus material and backfill where required.

5.11. **Tapping Sleeve and Valve.** Payment for tapping sleeve and valve" will be made at the unit price bid for each such assembly of the various sizes installed. This price will be full compensation for all labor, equipment, materials, tools, selected embedment material, anti-corrosion embedment when specified, concrete collar at the valve box where subjected to vehicular traffic, ductile iron riser pipe, cast-iron boot, packing, tarpaper, concrete grout, concrete reaction blocking, asphaltic material for bolts, nuts and ferrous surfaces, polyethylene sleeve, hauling and disposition of excavated surplus material and backfill where required.

5.12. **Cut-in Tee (Complete).** Payment for cut-in tee (complete) will be made at the unit price bid for each assembly of the various types and sizes of tees to be installed. This price will be full compensation for all labor, equipment, materials, tools, necessary tie-ins, protective coating for bolts, nuts, ferrous surfaces, selected embedment material, anti-corrosion embedment when specified, backfill, fittings, polyethylene sleeve when required, site restoration, and any necessary hauling and disposition of surplus excavated materials.

5.13. **Adjust Valve Box.** Payment for adjust valve box will be made at the unit price bid which will be full compensation for each valve box adjusted to finish grade including all labor, materials, and incidentals to complete the work.

5.14. **Removal Transport and Disposal of Asbestos Cement.** Payment for Removal transport and disposal of AC will be made to a third party contractor through force account for safely removing, transporting, and disposing of AC pipe.

5.15. **Concrete Encasement, Concrete Cradles, Concrete Saddles, and Concrete Collars.** Payment will be made at the unit price bid for concrete encasement, concrete cradles, concrete saddles, and concrete collars by the cubic yard of concrete placed, which price will be full compensation for furnishing and placing all materials, manipulation, labor, tools, equipment and incidentals necessary to complete the work. Reinforcing, if required, will not be measured separately for payment.

5.16. **Fire Hydrant Assembly.** Payment for fire hydrant assembly will be made at the unit prices bid which will be full compensation for each such assemblies, including excavation, backfill, selected material, anti-corrosion embedment when specified, branch line pipe, fittings exclusive of the tee from the main line pipe, polyethylene sleeve, hauling and disposition of excavated surplus material where required, asphalted material for ferrous surfaces, joint restraints, concrete pad, restoration of existing fire hydrant sites, and removal of existing fire hydrant as specified.

5.17. **Tapped Fire Hydrant.** Payment for tapped fire hydrant will be made at the unit prices bid which will be full compensation for each such assemblies installed, including excavation, backfill, selected material, anti-corrosion embedment when specified, branch line pipe, fittings exclusive of the tee from the main line pipe, polyethylene sleeve, hauling and disposition of excavated surplus material where required, asphalted material for ferrous surfaces, joint restraints, concrete pad, restoration of existing fire hydrant sites, and removal of existing fire hydrant as specified. Payment for fire hydrant with tapping sleeve, 6 in. valve and box will include tapping sleeve specified on plans and 6 in. valve and box.

5.18. **Relocate Fire Hydrant.** Payment for relocate fire hydrant will be made at the unit prices bid which will be full compensation for each such assemblies installed, including excavation, backfill, selected material, anti-corrosion embedment when specified, branch line pipe, fittings exclusive of the tee from the main line pipe, polyethylene sleeve, hauling and disposition of excavated surplus material where required, asphalted material for ferrous surfaces, joint restraints, concrete pad, restoration of existing fire hydrant sites, and removal and relocation of existing fire hydrant as specified.

5.19. **Permanent Blow-off (Complete).** Payment for permanent blow-off (complete) will be made at the unit price bid which will be full compensation for each such assembly installed in accordance with the details shown on the plans. Payment for the eccentric reducer will be made at the unit price bid for each ton of fittings of all

types and sizes installed. Payment for the pipe nipple with reaction stop ring will be made at the unit price bid for each foot of pipe of the various sizes installed by the open cut method. These payments are also to include excavation, anti-corrosion when specified, the housing and disposition surplus excavated materials and approved selected backfill.

5.20. **Temporary Blow-off (Complete).** Payment for temporary blow-off (complete) will be made at the unit price bid which will be full compensation for each such assembly installed in accordance with the details shown on the plans. Payment for the eccentric reducer will be made at the unit price bid for each ton of fittings of all types and sizes installed. Payment for the pipe nipple with reaction stop ring will be made at the unit price bid for each foot of pipe of the various sizes installed by the open cut method. These payments are also to include excavation, anti-corrosion when specified, the housing and disposition surplus excavated materials and approved selected backfill.

5.21. **Air Release Valve (Complete).** Payment for air release valve (complete) will be made at the unit price bid for each assembly of the various sizes installed in accordance with the details shown on the plans. This price will be full compensation for all labor, equipment, materials, tools, selected embedment material, anti-corrosion embedment when specified, excavation and hauling and disposition of surplus excavated materials, blocking, and various sizes and types of meter boxes.

5.22. **Trench Excavation Protection.** Payment for trench excavation protection is to be made on the basis of the unit price bid which will be full compensation for each foot of trench excavation protection in place. Payment is to include all components of the trench excavation safety protection system which can include, but not limited to sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage. Payment is also to include the additional excavation and backfill required, any jacking, jack removal, and removal of the trench support after completion and be full compensation for all other labor, materials, tools, equipment, and incidentals necessary to complete the work.

5.23. **Tie-in (Complete).** Payment for tie-in (complete) will be made at the unit price bid for each tie-in of the various sizes and types completed. This price will be full compensation for all labor, equipment, materials, tools, shutdown, and isolation of the existing main to which the tie is to be made, cutting pipe for connection, de-watering the excavation, and customer notification of service interruption where required. Connections between new and existing mains which are made with tapping sleeves and valves by cutting in tees will be as a no separate pay item.

5.24. **New Short Service.** Payment for new short service will be made at the unit price bid for each new service line of the various sizes and types installed. This payment is to include reconnection of new service to the existing meter and the adjustment of the meter, meter box, and customer valve. This price will be full compensation for all labor, equipment, materials, tools, excavation, trench excavation protection, hauling and disposition of surplus excavated materials, sand backfill, cutting pavement and surface structures of whatever type fittings of the various sizes used in the service line relay and copper tubing or DI pipe (4 in. and larger).

5.25. **New Long Service.** Payment for new long service will be made at the unit price bid for each new service line of the various sizes and types installed. This payment is to include reconnection of new service to the existing meter and the adjustment of the meter, meter box, and customer valve. This price will be full compensation for all labor, equipment, materials, tools, excavation, trench excavation protection, hauling and disposition of surplus excavated materials, sand backfill, cutting pavement and surface structures of whatever type fittings of the various sizes used in the service line relay and copper tubing or DI pipe (4 in. and larger).

5.26. **New Unmetered Short Service.** Payment for new unmetered short service will be made at the unit price bid for each new unmetered service line of the various sizes and types installed. This price will be full compensation for all labor, equipment, materials, tools, excavated materials, trench excavation protection, sand backfill, cutting in pavement and surface structures of whatever type encountered and replacement with whatever type specified, a new meter box where required, copper tubing or ductile iron pipe (4 in. and

larger), valve and valve box assembly, and fittings of the various sizes used in the installation of new service lines.

5.27. **New Unmetered Long Service.** Payment for new unmetered long service will be made at the unit price bid for each new unmetered service line of the various sizes and types installed. This price will be full compensation for all labor, equipment, materials, tools, excavated materials, trench excavation protection, sand backfill, cutting in pavement and surface structures of whatever type encountered and replacement with whatever type specified, a new meter box where required, copper tubing or ductile iron pipe (4 in. and larger), valve and valve box assembly, and fittings of the various sizes used in the installation of new service lines.

5.28. **Reconnect Short Service.** Payment for reconnect short service will be made at the unit price bid for each service line of the various sizes and types reconnected. This price will be full compensation for all labor, equipment, materials, tools, excavation, trench excavation protection, hauling and disposition of surplus excavated materials, sand backfill, meter box relocation where required, cutting pavement and surface structures of whatever type encountered and replacement with whatever type specified, copper tubing, or DI pipe (4 in. and larger), valve and valve box assembly, and fittings of the various sizes used in the service line reconnection.

5.29. **Reconnect Long Service.** Payment for reconnect long service will be made at the unit price bid for each service line of the various sizes and types reconnected. This price will be full compensation for all labor, equipment, materials, tools, excavation, trench excavation protection, hauling and disposition of surplus excavated materials, sand backfill, meter box relocation where required, cutting pavement, and surface structures of whatever type encountered and replacement with whatever type specified, copper tubing or ductile iron pipe (4 in. and larger), valve and valve box assembly, and fittings of the various sizes used in the service line reconnection.

5.30. **Relay Short Service.** Payment for relay short service" will be made at the unit price bid for each service line of the various sizes and types re-laid. This price will be full compensation for all labor, equipment, materials, tools, reconnection of new service to existing meter, sand backfill, meter box relocation where required, copper tubing or ductile iron pipe (4 in. and larger), valve and valve box assembly, and fittings of the various sizes used in the service line relay.

5.31. **Relay Long Service.** Payment for relay long service will be made at the unit price bid for each service line of the various sizes and types re-laid. This price will be full compensation for all labor, equipment, materials, tools, reconnection of new service to existing meter, sand backfill, meter box relocation where required, copper tubing or ductile iron pipe (4 in. and larger), valve and valve box assembly, and fittings of the various sizes used in the service line relay.

5.32. **Relocate Short Service.** Payment for relocate short service will be made at the unit price bid for each service line of the various sizes relocated. This price will be full compensation for all labor, equipment, materials, tools, sand backfill, meter box relocation where required, copper tubing or ductile iron pipe (4 in. and larger) when required, valve and valve box assembly when required, and fittings of the various sizes used in the service line relocation.

5.33. **Relocate Long Service.** Payment for relocate long service will be made at the unit price bid for each service line of the various sizes relocated. This price will be full compensation for all labor, equipment, materials, tools, sand backfill, meter box relocation where required, copper tubing or ductile iron pipe (4 in. and larger) when required, valve and valve box assembly when required, and fittings of the various sizes used in the service line relocation.

5.34. **Relocate Existing Meter and Existing Meter Box.** Payment for relocate existing meter and existing meter box" will be made at the unit price bid for each assembly relocated. This price will be full compensation for all labor, equipment, materials, tools, sand backfill, removal and replacement of yard piping with piping of the various sizes, and types and in the quantities necessary to complete the connection between the relocated existing meter and the existing yard piping.

Payment for the number one meter box installation in sidewalks and driveways will be paid in the amount difference between the standard meter box and the number one meter box.

5.35. **Relocate Existing Meter and New Meter Box.** Payment for relocate existing meter and new meter box will be made at the unit price bid for each assembly relocated. This price will be full compensation for all labor, equipment, materials, tools, sand backfill, removal and replacement of yard piping with piping of the various sizes and types and in the quantities necessary to complete the connection between the new meter box and the existing yard piping.

Payment for the number one meter box installation in sidewalks and driveways will be paid in the amount difference between the standard meter box and the number one meter box.

5.36. **Cut and Replace Concrete Sidewalk, Driveway, Etcetera.** Payment for cut and replace concrete sidewalk, driveway, etc. will be made at the unit price bid which will be full compensation of concrete sidewalk, driveways, etc. to be removed and replaced.

5.37. **Cut and Replace Concrete Sidewalk (Asphalt).** Payment for cut and replace concrete sidewalk (asphalt) will be made at the unit price bid which will be full compensation of concrete sidewalk removed and replaced with asphalt.

5.38. **Cut and Replace Asphalt Pavement.** Payment for cut and replace asphalt pavement will be made at the unit price bid which will be full compensation of asphalt pavement removed and placed.

5.39. **Cutting and Replacing Concrete Curb.** Payment for cutting and replacing concrete curb will be made at the unit price bid which will be full compensation for concrete curb placed.

5.40. **Cut and Replace Asphalt Pavement with 6 in. Asphalt Treated Base.** Payment for cut and replace asphalt pavement with 6 in. asphalt treated base" will be made at the unit price bid which will be full compensation of asphalt and asphalt treated base removed and placed.

5.41. **Hydrostatic Pressure Test.** Payment for hydrostatic pressure test will be made at the unit price bid which will be full compensation for each successful test. Such payment includes all materials and equipment required to conduct test.

5.42. **Flowable Fill Backfill.** Payment for flowable fill backfill will be made at the unit price bid, which will be full compensation for each cubic yard of flowable fill placed, but not to exceed the maximum trench width specified in Section 3.1.2, "Width of Trench."

5.43. **Water Service Line Breaks Leak Repair.** Payment for water service line breaks leak repair" will be made for if during construction, certain water service lines break or if leaks occur within or immediately adjacent to the Contractor's specified area of construction operations, the Inspector may authorize the replacement or repair to be performed. However, the Contractor is cautioned that no payment will be made by City of Schertz when breaks or leaks are direct results of the Contractor's construction operations. Where encountered, payment to the Contractor for cutting and replacing pavements (any type), curbs, trench protection, sidewalks, and sodding must be considered subsidiary to this item and no direct payment will be made. Such payment must include any necessary hauling and disposition of surplus excavated material and pumping of water.

5.44. **Water Main Breaks Leak Repair.** Payment for water main breaks leak repair will be made if during construction, certain water main breaks or if leaks occur within, or immediately adjacent to, the Contractor's specified area of construction operations, the Inspector may authorize the replacement or repair to be performed by the Contractor. The work involved must consist of excavation, hauling of disposition material, dewatering, shutdown and isolation of the existing main if required, installation of the necessary repair clamps and or new water main (length to be determined by the Inspector) to include all necessary tie-ins, fittings, approved reaction blocking required, backfilling the excavation with approved materials; customer notification or service interruption where required. Cutting and replacing pavements (any type), curbs, sidewalks, trench protection, and sodding will be considered subsidiary to the work. However, the Contractor

is cautioned that no payment will be made by City of Schertz when breaks or leaks are direct results of the Contractor's construction operations. Where encountered, payment to the Contractor for cutting and replacing pavements (any type), curbs, trench protection, sidewalks, and sodding must be considered subsidiary to this item and no direct payment will be made. Such payment must include any necessary hauling and disposition of surplus excavated material and pumping of water.

5.45. **Gray Iron Fittings and Ductile Iron Fittings.** Payment for gray iron fittings" and ductile iron fittings will be made at the unit price bid for each ton of fittings of all sizes and types installed and will be based upon the weights of fittings shown in Table 21, "Weights of Ductile Iron and Gray Cast Iron Fittings." This price will be full compensation for all labor, equipment, materials, tools, excavation, selected embedment material, anti-corrosion embedment when specified, hauling and disposition of surplus excavated materials, polyethylene sleeve, asphaltic material for ferrous surfaces, all glands, nuts, bolts, gaskets and concrete reaction and thrust blocking. If compact fittings are not manufactured and other fittings are installed, Contractor will provide quantities and unit weights with pay request.

Weigh tables are estimated quantities and can be verified by vender information. Payments will be made by the lesser of the two (weights versus supplier) at the inspector's discretion.

5.46. **Reinforced Concrete Vault.** Payment for reinforced concrete vault" will be made at the unit price for each size vault installed.

5.47. **Grout Abandonment Water Main.** Payment for grout abandonment water main" will be made for all types of pipe abandonment with grout, including asbestos-concrete pipe, and will be paid for at the contract bid price per foot for each size diameter of pipe, irrespective of the depth of the main, which will include the cost of removing content within the pipe, cleaning, grouting, plugging, capping and abandoning all pipe, pipe bend section and all other appurtenances, and for dewatering, trenching, excavation and backfill, removal, transportation and disposal and all material or work necessary to properly abandon the pipe. Payment for abandoning water lines will be made on the contract unit price per foot per each size diameter of pipe complete in place at locations shown on the plans. Said price will be full compensation for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the work.

5.48. **Removal Transport and Disposal of Asbestos Cement.** Payment for removal transport and disposal of AC will be paid to a third party Contractor through force account for safely removing, transporting, and disposing of AC pipe.

5.49. **New Meter Box.** Payment for new meter box will be made at unit price bid which will be full compensation for all labor, equipment, materials, and tools required to set the new meter box.

No direct payment will be made for concrete blocking of water mains; coating and wrapping pipe joints; trench excavation below specified limits; excavation and removal of unsuitable material at bottom of trench grade and restoration with approved material; supporting pipe or conduits of public utilities; abandonment of water mains and valves; resetting existing meters and meter boxes in proper configuration; salvaging fire hydrants, valve boxes and meter boxes; flushing water mains; and disinfection of water mains. This work is to be considered subsidiary to the various bid items.

No direct payment will be made for furnishing and installing the non-metallic pipe detection system. This work and materials are to be considered subsidiary to the various pay items. In addition, the Contractor is to ensure that the detection system is complete and operational to the satisfaction of the Engineer.

No direct payment will be made for furnishing and installing the pipe joint restraint system. This work and materials will be considered subsidiary to the various bid items.

No direct payment will be made for furnishing and installing the Joint Restraint System for PVC pipe AWWA C900. This work and materials will be considered subsidiary to the various pay items.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the various unit prices. These prices are full compensation for furnishing materials and for equipment, labor, tools, and incidentals.

5.50. **Remove Existing Water Lines.** Payment for removing existing water lines for all types of pipe removal, excluding AC pipe removal, will be paid for at the unit price bid measured as provided under "Measurement," regardless of the depth of the main, which will include the cost of coordination; potholing; dewatering of pipe; groundwater dewatering; trench excavation; removing the utility; transporting and disposing of the utility; backfill and surface restoration; and all labor, equipment, tools, and materials necessary to remove the pipe, pipe bends, and all other appurtenances including existing casing. AC pipe removal will be performed and paid for in accordance with Section 3.2.20., "Asbestos Cement (AC) Pipe Removal;" Sections 4.13., "Removal Transport and Disposal of AC;" and Section 5.13., "Removal Transport and Disposal of AC."

Table 21
Weights of Gray Iron and Ductile Iron Fittings (lbs.)

Bends							
Size (in.)	Mechanical Joint Compact (AWWA C153)	Mechanical Joint (AWWA C110)	FLG SB	Size (in.)	Mechanical Joint Compact (AWWA C153)	Mechanical Joint (AWWA C110)	FLG SB
1/4 Bend (90°)				1/8 Bend (45°)			
4	25	55	44	4	21	51	36
6	43	86	67	6	35	75	57
8	61	125	115	8	50	110	105
12	119	258	236	12	96	216	196
16	264	454	478	16	200	345	315
20	447	716	878	20	337	555	485
24	602	1,105	1,085	24	441	777	730
30	979	1,740	1,755	30	775	1,393	1,355
36	1,501	2,507	2,135	36	1,140	2,163	1,755
42	2,277	3,410	3,055	42	1,652	2,955	2,600
48	3,016	4,595	4,095	48	2,157	4,080	3,580
Bends							
Size (in.)	Mechanical Joint Compact (AWWA C153)	Mechanical Joint (AWWA C110)	FLG SB	Size (in.)	Mechanical Joint Compact (AWWA C153)	Mechanical Joint (AWWA C110)	FLG SB
1/16 Bend (22-1/2°)				1/32 Bend (11-1/4°)			
4	18	50	35	4	17	50	40
6	32	75	64	6	30	73	56
8	46	110	90	8	42	109	90
12	85	220	194	12	74	220	193
16	175	354	315	16	153	354	315
20	314	550	505	20	265	553	505
24	414	809	528	24	339	815	760
30	668	1,500	1,385	30	603	1,410	1,395
36	963	2,182	1,790	36	830	2,195	1,805
42	1,354	3,020	2,665	42	1,210	3,035	2,680
48	1,790	4,170	3,665	48	1,523	4,190	3,695

Table 21 Continuation
Weights of Gray Iron and Ductile Iron Fittings (Lbs.)

Tees				
Size (in.)		Weight		
Run	Branch	Mechanical Joint Compact (AWWA C153)	Mechanical Joint (AWWA C110)	FLG Short Body
3	3	26	56	53
4	3	31	76	54
	4	33	80	60
6	4	49	114	90
	6	60	124	98
8	4	65	163	155
	6	76	175	148
	8	89	188	179
12	4	99	316	322
	6	115	325	297
	8	127	339	346
	12	162	407	369
16	6	226	563	573
	8	240	565	555
	12	283	615	590
	16	326	676	635
20	6	344	750	773
	8	371	766	720
	12	427	799	816
	16	503	975	950
	20	566	1,068	1,005

Table 21 Continuation
Weights of Gray Iron and Ductile Iron Fittings (Lbs.)

Tees				
Size (In.)		Weight		
Run	Branch	Mechanical Joint Compact (AWWA C153)	Mechanical Joint (AWWA C110)	FLG Short Body
24	6	466	1,035	1,089
	8	487	1,047	1,060
	12	539	1,075	1,125
	16	625	1,109	1,070
	20	729	1,504	1,510
	24	785	1,617	1,685
30	8	739	1,808	-
	12	800	1,842	1,801
	16	959	1,885	-
	20	1,026	1,941	-
	24	1,228	2,496	2,475
	30	1,373	2,531	2,615
36	24	1,548	2,710	2,255
	30	1,901	3,545	3,000
	36	2,012	3,686	3,160
42	24	2,272	3,690	3,245
	30	2,512	4,650	4,125
	36	3,048	5,119	5,360
	42	3,225	6,320	5,580
48	24	2,934	4,995	4,385
	30	3,147	5,140	4,455
	36	4,046	6,280	5,555
	42	4,249	8,130	7,195
	48	4,469	8,420	7,385

Table 21 Continuation
Weights of Gray Iron and Ductile Iron Fittings (lbs.)

Crosses				
Size (In.)		Weight		
Run	Branch	Mechanical Joint Compact (AWWA C153)	Mechanical Joint (AWWA C110)	FLG Short Body
3	3	34	70	-
4	3	42	90	-
	4	46	105	-
6	4	63	140	-
	6	74	160	160
8	4	88	185	185
	6	97	205	205
	8	105	239	234
12	4	114	340	-
	6	135	360	360
	8	151	382	385
	12	199	493	495
16	6	250	590	575
	8	270	619	605
	12	332	685	-
	16	409	811	790
20	6	358	760	-
	8	379	822	790
	12	413	883	860
	16	550	1,117	1,085
	20	598	1,274	1,230

Table 21 Continuation
Weights of Gray Iron and Ductile Iron Fittings (lbs.)

Crosses				
Size (In.)		Weight		
Run	Branch	Mechanical Joint Compact (AWWA C153)	Mechanical Joint (AWWA C110)	FLG Short Body
24	6	566	1,025	-
	8	578	1,085	1,045
	12	610	1,153	1,110
	16	663	1,256	1,200
	20	975	1,733	1,675
	24	907	1,906	1,835
30	8	650	1,795	-
	12	870	1,925	1,865
	16	900	1,950	-
	20	1,220	2,060	-
	24	1,497	2,776	2,675
	30	1,808	3,188	3,075
36	24	1,853	2,928	2,980
	30	2,580	3,965	-
	36	2,698	4,370	4,370
42	24	2,415	3,910	-
	30	2,920	5,040	-
	36	3,788	5,835	-
	42	3,908	6,493	7,145
48	24	3,435	5,210	-
	30	4,145	5,495	-
	36	4,873	6,790	-
	42	5,465	8,815	-
	48	5,588	9,380	-

Table 21 Continuation
Weights of Gray Iron and Ductile Iron Fittings (Lbs.)

Caps			Plugs	
Size (in.)	Mechanical Joint Compact (AWWA C153)	Mechanical Joint (AWWA C110)	Mechanical Joint Compact (AWWA C153)	Mechanical Joint (AWWA C110)
4	10	17	12	16
6	16	29	19	28
8	24	45	30	46
12	45	82	54	85
16	95	160	97	146
20	141	235	146	218
24	193	346	197	350
30	362	644	381	626
36	627	912	688	884
42	893	1,322	1,200	1,222
48	1,076	1,737	1,550	1,597

Table 21 Continuation
Weights of Gray Iron and Ductile Iron Fittings (lbs.)

Solid Sleeves				
Size (in.)	Weight			
	Mechanical Joint Short Compact (AWWA C153)	Mechanical Joint Long Compact (AWWA C153)	Mechanical Joint Short (AWWA C110)	Mechanical Joint Long (AWWA C110)
4	17	21	35	46
6	28	35	45	65
8	38	48	65	86
12	57	77	113	143
16	127	172	192	257
20	201	258	258	359
24	264	337	340	474
30	500	651	690	1,005
36	725	960	947	1,374
42	877	1,209	1,187	1,628
48	1,406	1,516	1,472	2,033

Table 21 Continuation
Weights of Gray Iron and Ductile Iron Fittings (lbs.)

Concentric Reducers			
Size (in.)			Weight
Large End	Small End	Mechanical Joint Compact (AWWA C153)	Mechanical Joint (AWWA C110)
6	4	27	59
8	4	38	81
8	6	41	95
12	4	70	136
12	6	69	150
12	8	70	167
16	6	134	234
16	8	136	258
16	12	126	310
20	12	213	427
20	16	221	492
24	12	304	562
24	16	315	633
24	20	315	727
30	16	596	1,027
30	20	599	1,085
30	24	492	1,204
36	20	1042	1,459
36	24	785	1,580
36	30	655	1,868
42	24	1,356	2,060
42	30	1,112	2,370
42	36	1,116	2,695
48	30	1,722	3,005
48	36	1,650	3,370
48	42	1,429	3,750