Control	**0342-03-037, ETC.**
Project	**C 342-3-37, ETC.**
Highway	**SH 107**
County	**CAMERON**

ADDENDUM ACKNOWLEDGMENT

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

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

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

ADDENDUM NO. 1 ☐

ADDENDUM NO. 2 ☐

ADDENDUM NO. 3 ☐

ADDENDUM NO. 4 ☐

ADDENDUM NO. 5 ☐

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

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Control	**0342-03-037, ETC.**
Project	**C 342-3-37, ETC.**
Highway	**SH 107**
County	**CAMERON**

PROPOSAL TO THE TEXAS TRANSPORTATION COMMISSION

2014 SPECIFICATIONS

WORK CONSISTING OF REHABILITATE EXISTING ROADWAY

CAMERON 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 225 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	**0342-03-037, ETC.**
Project	**C 342-3-37, ETC.**
Highway	**SH 107**
County	**CAMERON**

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

Signed this _____ Day of _____ 20_____

By: _____

(Contractor/Principal Name)

_____

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

*By: _____

(Surety Name)

_____

(Signature of Attorney-in-Fact)

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

Impressed Surety Seal Only

This form may be removed from the proposal.

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BIDDER'S CHECK RETURN

IMPORTANT

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

NOTE

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

RETURN BIDDERS CHECK TO (PLEASE PRINT):

Control	**0342-03-037, ETC.**
Project	**C 342-3-37, ETC.**
Highway	**SH 107**
County	**CAMERON**

IMPORTANT

PLEASE RETURN THIS SHEET IN ITS ENTIRETY

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

Check Received By: _____ Date:_____

Title: _____

For (Contractor's Name): _____

Project _____ County_____

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NOTICE TO THE BIDDER

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

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

$_____

Total Bid Amount

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

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

EXAMPLE

Total Bid Amount _____$2,664.00_____

Signed _____
Title _____
Date _____

Additional Signature for Joint Venture:

Signed _____
Title _____
Date _____

EXAMPLE OF BID PRICES SUBMITTED BY COMPUTER PRINTOUT

EXAMPLES

BID PRICES SUBMITTED BY HAND WRITTEN FORMAT

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

Unit price for each plant in place

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

Unit price for each ton of Flexible Base

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

Unit price for each cubic yard of Concrete

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

Unit price of each Roadway Illumination Assembly

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ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	100	6002		PREPARING ROW DOLLARS and CENTS	STA	71.500	1
	104	6001		REMOVING CONC (PAV) DOLLARS and CENTS	SY	11,226.000	2
	104	6017		REMOVING CONC (DRIVEWAYS) DOLLARS and CENTS	SY	1,502.000	3
	104	6021		REMOVING CONC (CURB) DOLLARS and CENTS	LF	40.000	4
	104	6026		REMOVE CONC (GUTTER) DOLLARS and CENTS	LF	100.000	5
	105	6158		REMOV STAB BASE AND ASPH PAV (12") DOLLARS and CENTS	CY	1,688.000	6
	110	6001		EXCAVATION (ROADWAY) DOLLARS and CENTS	CY	8,239.000	7
	132	6006		EMBANKMENT (FINAL)(DENS CONT)(TY C) DOLLARS and CENTS	CY	230.000	8
	134	6001		BACKFILL (TY A) DOLLARS and CENTS	STA	56.000	9
	158	6004		SPEC EXCAV WORK (FRONT-END LOADER) DOLLARS and CENTS	HR	5.000	10
	160	6005		FURNISHING AND PLACING TOPSOIL DOLLARS and CENTS	CY	50.000	11

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	164	6023		CELL FBR MLCH SEED(PERM)(RURAL)(CLAY) DOLLARS and CENTS	SY	67,415.000	12
	164	6029		CELL FBR MLCH SEED(TEMP)(WARM) DOLLARS and CENTS	SY	67,415.000	13
	168	6001		VEGETATIVE WATERING DOLLARS and CENTS	MG	1,113.000	14
	204	6003		SPRINKLING (DUST CONTROL) DOLLARS and CENTS	MG	286.000	15
	216	6001		PROOF ROLLING DOLLARS and CENTS	HR	4.000	16
	247	6225	003	FL BS (RDWY DEL)(TY E GR 4)(FNAL POS) DOLLARS and CENTS	CY	2,048.000	17
	251	6055		RWRK BS MTL(TY B)(6")(DEN CNT)(ORG POS) DOLLARS and CENTS	CY	6,011.000	18
	251	6210		RWRK BS MTL (TY B)(14")(DC)(ORG POS) DOLLARS and CENTS	CY	2,226.000	19
	260	6011		LIME TRT (EXST MATL) (12") DOLLARS and CENTS	SY	36,405.000	20
	260	6043		LIME (HYD, COM OR QK)(SLURRY) DOLLARS and CENTS	TON	731.000	21
	275	6001		CEMENT DOLLARS and CENTS	TON	355.000	22
	275	6032		CEMENT TREAT (NEW BASE) (16") DOLLARS and CENTS	SY	606.000	23

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	275	6061		CEM TRT (MX EXT MTL/NW BASE)(DC)(10") DOLLARS and CENTS	SY	36,028.000	24
	305	6012		SLV, HAUL & STKPL RCL APH PV (6 TO 12") DOLLARS and CENTS	SY	35,088.000	25
	310	6009		PRIME COAT (MC-30) DOLLARS and CENTS	GAL	7,025.000	26
	316	6005	002	ASPH (TIER II) DOLLARS and CENTS	GAL	10,355.000	27
	316	6531	002	AGGR (TY-B GR-4P SAC-B) DOLLARS and CENTS	CY	283.000	28
	354	6041		PLANE ASPH CONC PAV (1.5") DOLLARS and CENTS	SY	10,323.000	29
	354	6048		PLANE ASPH CONC PAV (3") DOLLARS and CENTS	SY	18,841.000	30
	400	6005		CEM STABIL BKFL DOLLARS and CENTS	CY	322.000	31
	400	6010		STRUCT EXCAV (SPECIAL) DOLLARS and CENTS	CY	106.000	32
	402	6001		TRENCH EXCAVATION PROTECTION DOLLARS and CENTS	LF	264.000	33
	416	6030		DRILL SHAFT (TRF SIG POLE) (24 IN) DOLLARS and CENTS	LF	6.000	34
	416	6032		DRILL SHAFT (TRF SIG POLE) (36 IN) DOLLARS and CENTS	LF	104.000	35

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	432	6003		RIPRAP (CONC)(6 IN) DOLLARS and CENTS	CY	24.000	36
	464	6003	001	RC PIPE (CL III)(18 IN) DOLLARS and CENTS	LF	2,307.000	37
	464	6017	001	RC PIPE (CL IV)(18 IN) DOLLARS and CENTS	LF	60.000	38
	464	6021	001	RC PIPE (CL IV)(42 IN) DOLLARS and CENTS	LF	240.000	39
	464	6068	001	RC PIPE (CL V) (36 IN) (SPL) DOLLARS and CENTS	LF	144.000	40
	467	6356		SET (TY II) (18 IN) (RCP) (3: 1) (C) DOLLARS and CENTS	EA	2.000	41
	467	6363		SET (TY II) (18 IN) (RCP) (6: 1) (P) DOLLARS and CENTS	EA	94.000	42
	496	6004		REMOV STR (SET) DOLLARS and CENTS	EA	30.000	43
	496	6007		REMOV STR (PIPE) DOLLARS and CENTS	LF	2,352.000	44
	500	6001		MOBILIZATION DOLLARS and CENTS	LS	1.000	45
	502	6001	008	BARRICADES, SIGNS AND TRAFFIC HAN-DLING DOLLARS and CENTS	MO	15.000	46
	506	6003	005	ROCK FILTER DAMS (INSTALL) (TY 3) DOLLARS and CENTS	LF	60.000	47

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	506	6011	005	ROCK FILTER DAMS (REMOVE) DOLLARS and CENTS	LF	60.000	48
	506	6020	005	CONSTRUCTION EXITS (INSTALL) (TY 1) DOLLARS and CENTS	SY	624.000	49
	506	6024	005	CONSTRUCTION EXITS (REMOVE) DOLLARS and CENTS	SY	624.000	50
	506	6038	005	TEMP SEDMT CONT FENCE (INSTALL) DOLLARS and CENTS	LF	100.000	51
	506	6039	005	TEMP SEDMT CONT FENCE (REMOVE) DOLLARS and CENTS	LF	100.000	52
	506	6043	005	BIODEG EROSN CONT LOGS (REMOVE) DOLLARS and CENTS	LF	3,430.000	53
	506	6045	005	BIODEG EROSN CONT LOGS (INSTL) (6") DOLLARS and CENTS	LF	3,430.000	54
	508	6001		CONSTRUCTING DETOURS DOLLARS and CENTS	SY	5,711.000	55
	512	6001		PORT CTB (FUR & INST)(SGL SLOPE)(TY 1) DOLLARS and CENTS	LF	570.000	56
	512	6009		PORT CTB (FUR & INST)(LOW PROF)(TY 1) DOLLARS and CENTS	LF	2,540.000	57
	512	6010		PORT CTB (FUR & INST)(LOW PROF)(TY 2) DOLLARS and CENTS	LF	640.000	58
	512	6025		PORT CTB (MOVE)(SGL SLP)(TY 1) DOLLARS and CENTS	LF	360.000	59

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	512	6033		PORT CTB (MOVE)(LOW PROF)(TY 1) DOLLARS and CENTS	LF	4,060.000	60
	512	6034		PORT CTB (MOVE)(LOW PROF)(TY 2) DOLLARS and CENTS	LF	1,680.000	61
	512	6045		PORT CTB (STKPL)(LOW PROF)(TY 1) DOLLARS and CENTS	LF	400.000	62
	512	6049		PORT CTB (REMOVE)(SGL SLP)(TY 1) DOLLARS and CENTS	LF	570.000	63
	512	6057		PORT CTB (REMOVE)(LOW PROF)(TY 1) DOLLARS and CENTS	LF	2,480.000	64
	512	6058		PORT CTB (REMOVE)(LOW PROF)(TY 2) DOLLARS and CENTS	LF	640.000	65
	529	6029		CONC CURB & GUTTER (TY A) DOLLARS and CENTS	LF	70.000	66
	529	6030		CONC CURB & GUTTER (VALLEY GUTTER) DOLLARS and CENTS	LF	65.000	67
	530	6004		DRIVEWAYS (CONC) DOLLARS and CENTS	SY	2,198.000	68
	530	6005		DRIVEWAYS (ACP) DOLLARS and CENTS	SY	2,979.000	69
	545	6003		CRASH CUSH ATTEN (MOVE & RESET) DOLLARS and CENTS	EA	4.000	70
	545	6005		CRASH CUSH ATTEN (REMOVE) DOLLARS and CENTS	EA	4.000	71

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	545	6019		CRASH CUSH ATTEN (INSTL)(S)(N)(TL3) DOLLARS and CENTS	EA	4.000	72
	560	6011		MAILBOX INSTALL-S (TWW-POST) TY 4 DOLLARS and CENTS	EA	8.000	73
	560	6025		RELOCATE EXISTING MAILBOX DOLLARS and CENTS	EA	7.000	74
	618	6023		CONDT (PVC) (SCH 40) (2") DOLLARS and CENTS	LF	65.000	75
	618	6033		CONDT (PVC) (SCH 40) (4") DOLLARS and CENTS	LF	61.000	76
	620	6007		ELEC CONDR (NO.8) BARE DOLLARS and CENTS	LF	85.000	77
	620	6009		ELEC CONDR (NO.6) BARE DOLLARS and CENTS	LF	65.000	78
	620	6010		ELEC CONDR (NO.6) INSULATED DOLLARS and CENTS	LF	154.000	79
	621	6005		TRAY CABLE (4 CONDR) (12 AWG) DOLLARS and CENTS	LF	1,060.000	80
	624	6010		GROUND BOX TY D (162922)W/APRON DOLLARS and CENTS	EA	1.000	81
	625	6003		ZINC-COAT STL WIRE STRAND (3/8") DOLLARS and CENTS	LF	1,150.000	82
	628	6301		ELC SRV TY T 120/240 000(NS)GS(L)TS(O) DOLLARS and CENTS	EA	3.000	83

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	636	6001	001	ALUMINUM SIGNS (TY A) DOLLARS and CENTS	SF	95.000	84
	636	6002	001	ALUMINUM SIGNS (TY G) DOLLARS and CENTS	SF	22.500	85
	644	6027		IN SM RD SN SUP&AM TYS80(1)SA(P) DOLLARS and CENTS	EA	91.000	86
	644	6030		IN SM RD SN SUP&AM TYS80(1)SA(T) DOLLARS and CENTS	EA	9.000	87
	644	6033		IN SM RD SN SUP&AM TYS80(1)SA(U) DOLLARS and CENTS	EA	3.000	88
	644	6038		IN SM RD SN SUP&AM TYS80(1)SA(U-EXAL) DOLLARS and CENTS	EA	1.000	89
	644	6070		RELOCATE SM RD SN SUP&AM TY S80 DOLLARS and CENTS	EA	24.000	90
	644	6076		REMOVE SM RD SN SUP&AM DOLLARS and CENTS	EA	105.000	91
	658	6100		INSTL OM ASSM (OM-2Z)(WFLX)GND(BI) DOLLARS and CENTS	EA	4.000	92
	662	6006		WK ZN PAV MRK NON-REMOV (W)6"(DOT) DOLLARS and CENTS	LF	250.000	93
	662	6008		WK ZN PAV MRK NON-REMOV (W)6"(SLD) DOLLARS and CENTS	LF	39,840.000	94
	662	6016		WK ZN PAV MRK NON-REMOV (W)24"(SLD) DOLLARS and CENTS	LF	412.000	95

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	662	6023		WK ZN PAV MRK NON-REMOV (W)(RR XING) DOLLARS and CENTS	EA	2.000	96
	662	6030		WK ZN PAV MRK NON-REMOV(W)18"(YLD TRI) DOLLARS and CENTS	EA	14.000	97
	662	6035		WK ZN PAV MRK NON-REMOV (Y)6"(BRK) DOLLARS and CENTS	LF	1,710.000	98
	662	6037		WK ZN PAV MRK NON-REMOV (Y)6"(SLD) DOLLARS and CENTS	LF	33,195.000	99
	662	6050		WK ZN PAV MRK REMOV (REFL) TY II-A-A DOLLARS and CENTS	EA	413.000	100
	662	6109		WK ZN PAV MRK SHT TERM (TAB)TY W DOLLARS and CENTS	EA	7,110.000	101
	662	6111		WK ZN PAV MRK SHT TERM (TAB)TY Y-2 DOLLARS and CENTS	EA	6,142.000	102
	666	6036	007	REFL PAV MRK TY I (W)8"(SLD)(100MIL) DOLLARS and CENTS	LF	1,019.000	103
	666	6042	007	REFL PAV MRK TY I (W)12"(SLD)(100MIL) DOLLARS and CENTS	LF	80.000	104
	666	6048	007	REFL PAV MRK TY I (W)24"(SLD)(100MIL) DOLLARS and CENTS	LF	1,009.000	105
	666	6306	007	RE PM W/RET REQ TY I (W)6"(BRK)(100MIL) DOLLARS and CENTS	LF	2,000.000	106
	666	6309	007	RE PM W/RET REQ TY I (W)6"(SLD)(100MIL) DOLLARS and CENTS	LF	19,270.000	107

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	666	6318	007	RE PM W/RET REQ TY I (Y)6"(BRK)(100MIL) DOLLARS and CENTS	LF	1,810.000	108
	666	6321	007	RE PM W/RET REQ TY I (Y)6"(SLD)(100MIL) DOLLARS and CENTS	LF	12,720.000	109
	666	6343	007	REF PROF PAV MRK TY I(W)6"(SLD)(100MIL) DOLLARS and CENTS	LF	1,300.000	110
	668	6019		PREFAB PAV MRK TY B (W)(ARROW) DOLLARS and CENTS	EA	1.000	111
	668	6027		PREFAB PAV MRK TY B (W)(WORD) DOLLARS and CENTS	EA	1.000	112
	668	6031		PREFAB PAV MRK TY B (W)(RR XING) DOLLARS and CENTS	EA	4.000	113
	668	6033		PREFAB PAV MRK TY B (W)(18")(YLD TRI) DOLLARS and CENTS	EA	46.000	114
	672	6007		REFL PAV MRKR TY I-C DOLLARS and CENTS	EA	107.000	115
	672	6009		REFL PAV MRKR TY II-A-A DOLLARS and CENTS	EA	362.000	116
	672	6018		TRAFFIC BUTTON TY B DOLLARS and CENTS	EA	540.000	117
	677	6001		ELIM EXT PAV MRK & MRKS (4") DOLLARS and CENTS	LF	12,019.000	118
	677	6003		ELIM EXT PAV MRK & MRKS (8") DOLLARS and CENTS	LF	125.000	119

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	677	6005		ELIM EXT PAV MRK & MRKS (12") DOLLARS and CENTS	LF	178.000	120
	677	6007		ELIM EXT PAV MRK & MRKS (24") DOLLARS and CENTS	LF	134.000	121
	677	6008		ELIM EXT PAV MRK & MRKS (ARROW) DOLLARS and CENTS	EA	2.000	122
	677	6012		ELIM EXT PAV MRK & MRKS (WORD) DOLLARS and CENTS	EA	1.000	123
	680	6001	006	INSTALL HWY TRF SIG (FLASH BEACON) DOLLARS and CENTS	EA	2.000	124
	680	6002	006	INSTALL HWY TRF SIG (ISOLATED) DOLLARS and CENTS	EA	1.000	125
	680	6004	006	REMOVING TRAFFIC SIGNALS DOLLARS and CENTS	EA	3.000	126
	681	6001		TEMP TRAF SIGNALS DOLLARS and CENTS	EA	3.000	127
	682	6001		VEH SIG SEC (12")LED(GRN) DOLLARS and CENTS	EA	8.000	128
	682	6003		VEH SIG SEC (12")LED(YEL) DOLLARS and CENTS	EA	16.000	129
	682	6005		VEH SIG SEC (12")LED(RED) DOLLARS and CENTS	EA	12.000	130
	682	6018		PED SIG SEC (LED)(COUNTDOWN) DOLLARS and CENTS	EA	8.000	131

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	682	6060		BACKPLATE W/REFL BRDR(3 SEC) DOLLARS and CENTS	EA	8.000	132
	684	6007		TRF SIG CBL (TY A)(12 AWG)(2 CONDR) DOLLARS and CENTS	LF	1,435.000	133
	684	6010		TRF SIG CBL (TY A)(12 AWG)(5 CONDR) DOLLARS and CENTS	LF	2,430.000	134
	686	6008		INS TRF SIG PL AM (S)STR(TY B)LUM DOLLARS and CENTS	EA	8.000	135
	687	6001		PED POLE ASSEMBLY DOLLARS and CENTS	EA	1.000	136
	688	6001		PED DETECT PUSH BUTTON (APS) DOLLARS and CENTS	EA	8.000	137
	688	6003		PED DETECTOR CONTROLLER UNIT DOLLARS and CENTS	EA	1.000	138
	3077	6065		SP MIXES SP-D SAC-A PG76-22 DOLLARS and CENTS	TON	10,126.000	139
	3084	6001		BONDING COURSE DOLLARS and CENTS	GAL	5,858.000	140
	5001	6002		GEOGRID BASE REINFORCEMENT (TY II) DOLLARS and CENTS	SY	606.000	141
	6185	6002	002	TMA (STATIONARY) DOLLARS and CENTS	DAY	440.000	142
	6185	6005	002	TMA (MOBILE OPERATION) DOLLARS and CENTS	DAY	27.000	143

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	6292	6001		RVDS(PRESENCE DETECTION ONLY) DOLLARS and CENTS	EA	4.000	144
	7016	6028		REMOVE EXIST WATER PIPE (6") DOLLARS and CENTS	LF	169.000	145
	7032	6231		WTR(PIPE WTR MAIN)(PVC C900DR18)(6") DOLLARS and CENTS	LF	169.000	146
	7103	6033		CONNECTION TO EXISTING 4"-12" WTR MAIN DOLLARS and CENTS	EA	4.000	147
	7111	6001		STEEL CASING (12 IN) (OPEN CUT) DOLLARS and CENTS	LF	151.000	148
	7112	6014		45-DEGREE ELBOW (6") DOLLARS and CENTS	EA	8.000	149
	7334	6001		TESTING DOLLARS and CENTS	LS	1.000	150

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.

ENGINEER SEAL

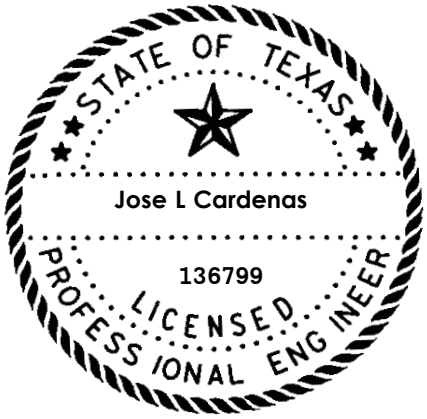
Control **0342-03-037, ETC.**

Project **C 342-3-37, ETC.**

Highway **SH 107**

County **CAMERON**

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

Jose L Cardenas, P.E.

JUNE 21, 2023

County: Cameron **Control:** 0342-03-037

Highway: SH 107

2014 SPECS GENERAL NOTES:

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General Requirements and Covenants to ITEMS 1 thru 9:

For all pits or quarries, comply with the "Texas Aggregate Quarry and Pit Safety Act."

Provide on a weekly basis a list of equipment, including idle equipment, utilized on the project that week.

The 1-800 call services for utility locations do not include TxDOT facilities. Contact the Pharr District Signal Section (956-702-6225) for coordination regarding TxDOT underground lines.

ITEM 2: Instructions to Bidders

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

Andres Espinoza, P.E., San Benito Area Engineer; Andres.Espinoza@txdot.gov
Gabriel Villareal, P.E., Assist. Area Engineer; Gabriel.Villarreal@txdot.gov

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

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.

Information found on TxDOT's FTP server will be considered for informational purposes only. (Index of /pub/txdot-info/Pre-Letting Responses/Pharr District/21-Pharr District (Construction) (state.tx.us))

ITEM 5: Control of the Work

The responsibility for the construction surveying on this contract will be in accordance with Article 5.9.1., "Method A."

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

Work in this contract is required to be done on railroad property. Cooperate with the railroad companies and comply with all their requirements including obtaining any training they require before performing work on railroad property.

ITEM 7: Legal Relations and Responsibilities

No significant traffic generator events identified.

Roadway or Lane closures during the following key dates and/or special events are prohibited:

- National Holidays
- The day before a National Holiday
- During emergency events such as natural disasters or as directed by the Engineer

ITEM 8: Prosecution and Progress

Working days will be computed and charged in accordance with Article 8.3.1.4. Standard Workweek.

Where road closures or detours around structures are necessary to accomplish proposed work, the removal of existing structures and/or cutting of existing pavement will not be permitted until all precast members for the proposed structure have been cast, tested, and approved for use.

Prepare progress schedules using the Critical Path Method (CPM).

ITEM 100: Preparing Right of Way

Preparation of right of way will be done in accordance with the construction phasing shown on the Traffic Control Plans. Performance of this item will not be allowed outside of the project's current construction phase without prior approval by the Engineer.

Removal of all existing vegetation and trees within the ROW will be subsidiary to prep ROW.

ITEM 132: Embankment

Embankment (DENS CONT) shall be Type C with a max. PI of 40. Material used as embankment material in the top two feet below the bottom of Flexible Base shall meet the following requirements based on preliminary tests and such other tests found necessary by the Engineer.

1. The material shall be such as to produce a well-bonded embankment and shall have a minimum PI of 8 and a maximum PI of 30.

It is the Contractor's responsibility to advise the Engineer of the location of the source sufficiently in advance to avoid delay.

ITEM 134: Backfilling Pavement Edges

Areas to be backfilled shall extend approximately 3-ft out from the edges of the proposed overlay. Final slopes shall be uniform and smooth. The 100-foot station payment includes backfilling of both sides.

Backfill Ty A shall not contain particles more than two inches in size and shall have a minimum PI of 10 and a maximum PI of 20.

Any additional backfill material necessary due to pre-existing edge conditions or to replace existing fill removed during blading operations will not be paid for directly. It will be considered subsidiary to this bid Item.

ITEM 160: Topsoil

Use topsoil as needed and directed by the Project Engineer for select problem areas. Unless otherwise approved by the Project Engineer, use topsoil from approved sources outside the right of way as per standard specifications. Existing topsoil is to be salvaged and retained for re-use on the project as topsoil.

ITEM 164: Seeding for Erosion Control

During drill seeding operations, application methods shall be in accordance with the method shown in the Standard Specification Book.

SS-1 Tacking Agent shall be a ratio of 2:1, two (Emulsion) to one (water) and applied at a rate of 0.05 gallons per square yard. The SS-1 Tacking Agent required for Drill Seed operations, will not be paid for directly, but will be subsidiary to Item 164 "Drill Seeding." Watering shall not be used with the Drill Seed Method. A biodegradable tacking agent may be used in lieu of the SS-1 tacking agent in accordance with the manufacturer's recommendations when approved by the Engineer.

Cool Season or Warm Season Grasses shall be included as part of Item 164 (See Table 3 and/or Table 4 in the Standard Specification Book or dates and seed type).

Seed mixture shall be as specified under Item 164.

ITEM 166: Fertilizer

Fertilizer rate is based on a rate of 100 Lbs. of Nitrogen per acre. The Nitrogen-Phosphorous Potassium (NPK) ratio shall include a minimum of 5% Phosphorous and 5% Potassium.

Fertilizer shall be homogenized.

ITEM 247: Flexible Base

Flexible Base Type E will be composed of caliche (argillaceous Limestone, calcareous or calcareous clay particles) and may contain stone, conglomerate, gravel, sand, or granular materials when these materials are in situ with the caliche.

Flexible Base (TY E GR 4) caliche shall conform to the following requirements:

Retained on Sq. Sieve:	**Percent Retained**
2"	0
½"	20-60
No. 4	40-75
No. 40	70-90
Max. PI	15
Max. Wet Ball PI	15
Wet Ball Mill Max. Amount	50

Min. Comp. Strength PSI	150 at 15 PSI lateral pressure
Triaxial Test	Tex-117-E

The Wet Ball Test (Tex-116-E) shall be run and the Plasticity Index of the material passing the No.40 sieve shall be determined (Wet Ball PI).

The percent of density as determined by Compaction Ratio (Tex-113-E) for the new Flexible Base shall be a minimum of 98%.

The Contractor's attention is called to the fact that certain existing and/or proposed structures may be within the limits of the Flexible Base. It shall be the Contractor's responsibility to perform construction operations without damage to these structures.

For water added under Item 247, the sulfate content will not exceed 3000-ppm and the chloride content will not exceed 3000-ppm.

ITEM 251: Reworking Base Courses

Quantities of Flexible Base to be salvaged, shown on the typical sections, are for estimating purposes only. All acceptable base material encountered in existing base is to be salvaged as directed by the Engineer regardless of the quantities involved.

Salvaged base shall be used in the bottom course on any of the proposed roadway and/or turnout sections.

Salvaged base may be used on any of the proposed driveway sections.

All surplus salvage base not used on the project will remain the property of the Contractor, unless otherwise directed by Engineer.

Proof roll the roadbed in accordance with Item 216, “Proof Rolling.” Correct soft spots as directed.

ITEM 260: Lime Treatment (Road-Mixed)

The Contractor's attention is called to the fact that certain existing and/or proposed structures are within the limits of the lime-treated Subgrade. Unless otherwise directed by the Engineer, these structures shall be installed before the final rolling of this Subgrade. It shall be the Contractor's responsibility to perform the proper lime treating operation without damage to these structures.

The slurry method of applying lime will be required, except when the lime is to be added to naturally wet materials as directed by the Engineer.

For this project, the Engineer will direct a random number of lime trucks to be check weighed.

The percent of density as determined by Tex-121-E for the new and salvage Flexible Base shall be a minimum of 98% for all courses.

In order to avoid damaging the Geogrid, add lime to the first lift of new base and/or salvage base at a central mixing site or mixing plant away from the construction area. The Engineer shall approve the site or plant location and method of mixing.

Proof roll all constructed lime treated subgrade and bases courses in accordance with Item 216, "Proof Rolling." Correct soft spots as directed. Correction of soft spots in the subgrade or base courses will be at the Contractor's expense.

Contractor is to place an underseal and/or pavement course as indicated on plans within 14 calendar days of initial prime coat application. Otherwise, reapply prime coat as directed by the Engineer. Reapplication of the prime coat will be at the Contractor's expense.

Allow the mixture to mellow for a minimum period of 48 hours for all types of lime utilized. Additional time might be required due to sulfate and organic testing requirements, as directed by Engineer.

ITEM 275: Cement Treatment (Road-Mixed)

The percent of density as determined by Tex-120-E for the new and salvage Flexible Base shall be a minimum of 98% for all courses.

Proof roll all constructed cement treated subgrade and bases courses in accordance with Item 216, "Proof Rolling." Correct soft spots as directed. Correction of soft spots in the subgrade or base courses will be at the Contractor's expense.

In order to avoid damaging the Geogrid, add cement to the first lift of new base and/or salvage base at a central mixing site or mixing plant away from the construction area. The Engineer shall approve the site or plant location and method of mixing.

Contractor is to place an underseal and/or pavement course as indicated on plans within 14 calendar days of initial prime coat application. Otherwise, reapply prime coat as directed by the Engineer. Reapplication of the prime coat will be at the Contractor's expense.

ITEM 301: Asphalt Antistripping Agents

Hydrated Lime shall be added as an Antistripping additive between the rates of 1% minimum and 2.0% maximum by weight for Items 292, 3076, 3077, and 3080. If the Hamburg Wheel Test cannot be met within these limits, Liquid Antistripping agents as approved by the Engineer may be used in conjunction with lime for Items 3076, 3077, and 3080.

ITEM 302: Aggregates for Surface Treatments

Loc.	County	CSJ	Highway	Tier	SAC
1	Cameron	0342-03-037	SH 107	II	B

* Crushed gravel will not be allowed on the above locations noted with (*).

The aggregate for the surface treatment shall be surface dry before application unless otherwise directed by the Engineer.

ITEM 310: Prime Coat

The Contractor shall exercise diligence in the application of asphalt by the use of flagging and rolling procedures to keep from spraying or splattering the traveling public with asphaltic material.

All existing Flexible Base, which may become exposed by the milling operation, shall be primed at the rate of 0.2 Gal/SY.

Do not apply subsequent courses over the initial prime coat no earlier than 12 hours after the prime coat was applied, unless otherwise authorized or directed by the Engineer.

ITEM 316: Seal Coat

In addition to cleaning by brooming of paved surfaces to be sealed as required by this Item, blading may also be necessary to clean dirt and grass from edges of the pavement and/or turnout areas. The cost of this blading will not be paid for directly but will be considered subsidiary to the various bid Items of the project.

When applying surface treatment at railroad crossings, a strip of paper shall be placed over the rail and flange areas across the pavement.

The type and grade of asphalt as shown on the plans and/or as directed by the Engineer, shall be used on these projects. Asphalt cement will be used during the warm season. An emulsified asphalt will be used during the cooler season if permitted in writing by the Engineer. The emulsified asphalt, if used, shall be HFRS 2P. Estimated quantities shown for the bid Item is based on an average of the estimated rates of application for asphaltic cement and emulsified asphalt. These rates should be used for estimating and comparison purposes only.

The one or two-course surface treatment shall be in place for a sufficient period of time in the opinion of the Engineer, for the surface treatment to properly dry and cure before placing the Asphaltic Concrete Pavement.

Traffic will not be permitted on the surface treatment unless authorized by the Engineer.

When emulsified asphalt is used, do not apply subsequent courses over the surface treatment any earlier than the day after the surface treatment was applied, unless otherwise authorized or directed by the Engineer.

Contractor is to place ACP layer(s) as indicated on plans within 14-calendar days of seal coat placement unless otherwise directed by the Engineer.

ITEM 3077: Superpave Mixtures

The Contractor shall exercise diligence in the application of "Bonding Course" by the use of flagging and rolling procedures to keep from spraying or splattering the traveling public with asphaltic material.

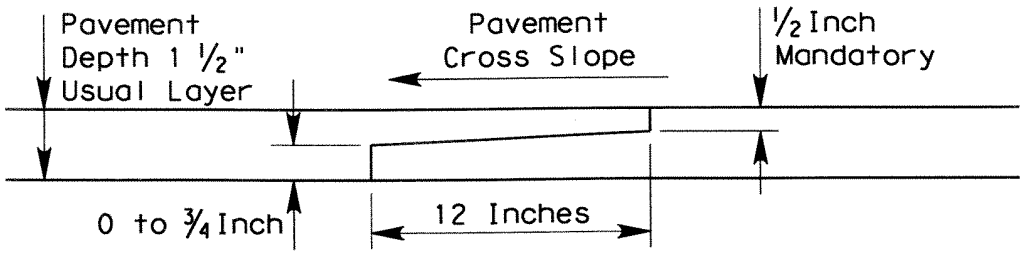
Blading (not to exceed more than 3-ft from the pavement edge) may also be necessary to clean dirt and grass from pavement edges and turnout areas as work under this bid Item. The cost of this blading will not be paid for directly but shall be considered subsidiary to this bid Item.

All surplus RAP from this project will remain the property of the Contractor.

Level-up will be placed before the surface course. An asphaltic concrete spreading and finishing machine and/or motor graders; when approved by the Engineer may be used to place the ACP level-up.

Aggregates used on shoulders and ramps are required to meet SAC requirements.

All unconfined longitudinal joints shall be constructed with a joint maker providing a maximum ½-inch vertical edge and a minimum 6:1 edge taper or as approved by the Engineer. The Engineer may waive this requirement when no impacts to the traveling public are foreseen.



NOTCHED WEDGE JOINT

The engineer may allow for variances to the dimensions shown.

Public and private driveways need to have a smooth vertical transition between the edge of pavement and the existing driveways. The Contractor is to add a vertical taper if needed which will be subsidiary to Item 3077.

The use of RAP and RAS (recycled asphalt shingles) will not be allowed as part of the mix design for the final riding surface.

Use a release agent from the Department's MPL to clean and to coat the inside of truck beds for hauling equipment. Hauling equipment shall be cleaned prior to hauling material to job site. Submit a copy of the bill of lading to the Engineer as part of the QCP. Ensure the pavement is free from any spillage of hydraulic oil or diesel from construction equipment. The Department may reject trucks that contain any foreign material and suspend production if the pavement is contaminated by any pollutants mentioned above.

The percentage of RAS used in the total mix shall not exceed 3% when allowed.

ITEM 3084 – Bonding Course

The minimum application rates are listed in Table BC.

The target shear bond strengths are listed in Table BCS. The informational test cores shall be taken once a shift for first 5 lots of placement or a change to placement method of bonding course, bonding material, or hot mix material. The remaining informational test cores shall be taken once every 3 lots for surface mix. Informational tests are not required for non-surface mix beyond the first 5 lots unless there is a change to placement method of bonding course, bonding material, or hot mix material. Results from these informational tests will not be used for specification compliance.

Table BC

Material	Minimum Application Rate (gal. per square yard)
TRAIL – Emulsified Asphalt	0.06
TRAIL – Hot Asphalt	0.12
Spray Applied Underseal Membrane	0.10

Table BCS (For Informational Tests)

Material	Target Shear Bond Strength (Tex-249-F psi)
SMA – Stone-Matrix Asphalt	60.0
All Other Materials	40.0

ITEM 354: Planing and Texturing Pavement

Contractor is to place seal coat or ACP layer(s) as indicated on plans within 14-calendar days of planing/milling operation unless otherwise directed by the Engineer.

All planing/milling operation drop offs greater than 1-inch need to have a 3:1 slope taper unless otherwise directed by the Engineer. The cost of the 3:1 slope taper is subsidiary to Item 354.

For full width planing/milling locations, Contractor is to place seal coat or ACP layer(s) as indicated on the plans within 2-calendar days of the planing/milling operation unless otherwise directed by the Engineer. Contractor will not be allowed to move onto the next planing/milling location or seal coat/ACP overlay location until the exposed area is covered as per above. Contractor cannot get paid for the planing/milling operation until exposed area is covered as per above.

ITEM 400: Excavation and Backfill for Structures

If the Contractor elects to cut pavement (existing/detour) for structural work beyond that required by the construction phasing shown in the plans and approved by the Engineer, it shall be restored at his expense and backfilled to its original condition or better in accordance with Item 400.

Unless shown otherwise in the plans, use a 1-ft depth for Item 400 Structural Excavation (Special) for gravel bedding needed below drainage structures with unstable material.

Structural Excavation Special (Gravel):

Use durable natural stone when tested in accordance with Tex-411-A, has weight loss of no more than 18% after 5 cycles of magnesium sulfate solution. Provide gravel conforming to an aggregate Grade No. 1 as shown on Table 4 of Article 421.2.

ITEM 416: Drilled Shaft Foundations

Payment for furnishing and installing anchor bolts mounted in drill shafts will be included in the unit price bid for the various diameter drill shafts.

The Contractor shall coordinate with the utility companies to verify utility locations before drilling foundations.

The Contractor shall form, or provide a smooth finish, the portions of drilled shaft that project above the ground line. Place a ¾ inch chamfer on the top edge of each pole foundation. This work will not be paid for directly but will be considered subsidiary to this bid Item.

All drilled shaft foundations will be based on the lengths shown on the plans or those established in writing. Adequate calculations for measurements of foundations have been made in accordance with Article 9.1. of the Standard Specifications. Increases or decreases in the quantities required by change in design will be measured as specified and the revised quantities will be the basis for payment.

In the presence of excess ground water and/or unstable conditions in sub-grade soils prevents excavation to the line and depths indicated on the plans for “Drilled Shaft Foundation”, other proposed methods of foundation installation such as casing, etc. shall be submitted for review and approved by the Engineer.

ITEM 420: Concrete Substructures

Pay bent concrete as plan quantity.

ITEM 421: Hydraulic Cement Concrete

Provide Sulfate Resistant Concrete for all concrete piling and drilled shafts.

Provide equipment at the batch plant for determining the free moisture and/or absorption of aggregates in accordance with applicable TXDOT Test.

Provide the following items for concrete batch inspection in accordance with specifications outlined in DMS-10101, “Computer Equipment”:

(1) One Desktop Microcomputer or One Laptop Microcomputer
(2) One Integrated Printer/Scanner/Copier/Fax Unit
(3) Contractor-Furnished Software
(4) Hardware

Submit to the Engineer for approval the project locations for all Portland Cement concrete washout areas prior to starting any concrete work.

Fiber Reinforced Concrete is not permitted.

ITEM 432: Riprap

Provide Class "A" concrete minimum for riprap aprons placed around all box culvert and pipe safety end treatments. Provide ¼-inch thick dummy joints at least every 15-ft for riprap aprons placed around box and pipe culverts.

Do not use fiber reinforced concrete RIPRAP on side slopes equal to or steeper than 6:1 unless approved by the Engineer.

ITEM 464: Reinforced Concrete Pipe

Use tongue and groove pipe where the RCP extends into the lime treated subgrade. The 4-foot depth restriction for heavy equipment passage over pipe structures is voided. The Contractor will be responsible for any construction damage to these facilities.

Do not use mortar joints.

All reinforced concrete pipe shall include rubber gaskets unless shown otherwise on the plans or directed by the Engineer.

ITEM 467: Safety End Treatment

All Type II SET's shall have riprap, Class "A" minimum, aprons as shown on the plans. The Contractor may submit an alternate precast SET design for approval by the Engineer.

ITEM 502: Barricades, Signs, and Traffic Handling

Shadow vehicles equipped with Truck-Mounted Attenuators are required for traffic handling. See notes for Item 6185: Truck Mounted Attenuator/Trailer Attenuator, for additional references pertaining to the TMAs.

A pilot car and radio equipped flaggers shall be required for all undivided roadway locations as directed by the Engineer. The pilot car with necessary flaggers and/or radio equipped flaggers and all signs, equipment, labor, and incidentals required for this method of traffic control will not be paid for directly but shall be considered subsidiary to Item 502.

Replace/relocate all regulatory signs removed due to construction operations with the same sign on fixed support(s) immediately upon its removal. First obtain Project Engineer approval before removing any regulatory roadway sign. Required flaggers are to be available to direct traffic during sign intermediate down time.

Relocate any Directional Sign Assemblies removed during construction operations immediately upon their removal.

These signs shall be relocated to a location in accordance with the Latest Version of the "Texas Manual on Uniform Traffic Control Devices". In no case will a sign be removed without a replacement sign and support(s) being readily available and a location established. Removal and relocation of these signs required for traffic control will not be paid for directly but shall be considered subsidiary to Item 502.

From the beginning to the end of the project, all traffic control devices need to be in acceptable condition as per the Texas Quality Guidelines for Work Zone Traffic Control Devices.

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 "Safety Contingency" is not intended to be used in lieu of bid Items established by the contract.

Remove and dispose of all litter, debris, objectionable material, excess materials that accumulate at the base of all traffic control devices as directed by the Engineer.

ITEM 504: Field Office and Laboratory

Furnish (1) Field Office (Type C).

The Contractor will furnish a Type D Structure (Asphalt Mix Laboratory) modified by the following.

Laboratory room:

The other room of this building will be used as a laboratory and will include access to a bathroom facility from the interior. The laboratory and bathroom facility will have the walls, ceiling and floor insulated such that the air temperature can always be maintained at 76 degrees Fahrenheit.

Furnish for the Department's use in the asphalt laboratory one (1) desktop computer.

ITEM 506: Temporary Erosion, Sedimentation, and Environmental Controls

Before starting each phase of construction, review with the Engineer the SW3P used for temporary erosion control as outlined on the plans. Before construction, place the temporary erosion and sedimentation control features as shown on the SW3P. Location of Construction Exits are to be approved by the Engineer. After completing earthwork operations, restore and reseed the disturbed areas in accordance with the Department’s specifications for permanent or temporary erosion control. Before starting grading operations and during the project duration, place the temporary or permanent erosion control measures to prevent sediment from leaving the right of way.

The Contractor Force Account “Erosion Control Maintenance” that has been established for this project is intended to be utilized for work zone Best Management Practice (BMP) maintenance, to improve the effectiveness of the Environmental Controls that may need maintenance attention and/or require replacement while the project is still under the construction stage. These procedures will be mutually agreed upon by the Engineer and the Contractor’s Responsible Person based on weekly or more frequent BMP management reviews on the project. The “Erosion Control Maintenance” is not intended to be used in lieu of bid Items established by the contract.

ITEM 508: Constructing Detours

Flexible Base, prime coat, and Asphaltic Concrete Pavement used for detours shall meet the requirements of Items 247, 310 and 3076 respectively, except for measurement and payment.

ITEM 512: Portable Traffic Barrier

During the various construction phases, provide drainage slots in every temporary concrete traffic barrier used for traffic control in order to handle temporary drainage. Provide any additional drainage measures needed as directed by the Engineer.

ITEM 529: Concrete Curb, Gutter, and Combined Curb and Gutter

Before final acceptance of the project, remove discoloration caused by tire marks, mud, asphalt, paint, or other similar material by any method satisfactory to the Engineer to achieve a uniform color and texture of the finished surface exposed to view.

ITEM 530: Intersections, Driveways, and Turnouts

Prime coat shall meet the requirements of Item 310.

Public and private driveways need to have a smooth vertical transition tie-in between the proposed driveway and the existing driveway. The Contractor is to add a vertical taper if needed which will be subsidiary to Item 530.

ITEM 560: Mailbox Assemblies

Coordinate and verify final mailbox locations with TxDOT and the US Postmaster.

ITEM 585: Ride Quality for Pavement Surfaces

Diamond grinding shall be used to remove localized roughness.

Rehab Section.

Use Surface Test Type B pay adjustment schedule 2 to evaluate ride quality of the travel lanes in accordance with Item 585, “Ride Quality for Pavement Surfaces.” This includes ramps and service road travel lanes.

Overlay Section.

Use Surface Test Type B pay adjustment schedule 3 to evaluate ride quality of the travel lanes in accordance with Item 585, “Ride Quality for Pavement Surfaces.” This includes ramps and service road travel lanes.

ITEM 610: Roadway Illumination Assemblies

Luminaires shown on the proposed Traffic Signal installation layout sheets may be shown at an angle for clarity. All luminaires shown shall be installed perpendicular to the main roadway under construction.

In addition to ED (3)-14, each cable for luminaires shall be identified in each ground box, pole base, or other accessible location with yellow electrical tape wrapped around the cable. The tape marking shall be at least 2 inches.

All luminaires on traffic signal poles shall be rated for 240 vac. All safety lighting poles shall be serviced for 480 vac.

Luminaires installed on traffic signal poles will not be paid for directly but shall be considered subsidiary to the various bid Items of the project.

ITEM 618: Conduit

All conduit ends in pole bases, controllers and ground boxes shall be plugged with 4 to 6 inches of polyurethane sealant or its equivalent after cables are in place.

Conduit shall be placed in a straight line not to exceed 2.0 feet in any direction. The depth of the conduit shall be 2.0 feet except when crossing a roadway where the depth shall not be more than 3.0 feet nor less than 1.0 foot below the bottom of the base material in the roadway when placed by the jacking or boring method. Any evidence of damage to the roadway during the jacking or boring operation shall be sufficient grounds to stop the method being used.

Conduit runs under paved roadways or driveways shall be jacked or bored and then pushed across. At these locations, galvanized rigid metal may be used. All other runs shall be made by trenching. Existing pavement which will be removed, reconstructed, or overlaid with new pavement may be trenched across. Trenches for conduit runs shall be a minimum 2 feet deep and 4 inches wide. The conduit shall be placed on a 2-inch sand cushion and then backfilled with a minimum of 6 inches sand fill. The remainder of the trench shall be backfilled with flexible base, soil or two-sack concrete as required by location of conduit on the project or as directed. The top 3 inches shall match the existing surface material.

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

Use materials from prequalified Material Producer List as shown on the Texas Department of Transportation (TxDOT) - Construction Division's (CST) Material Producer List. Category is "Roadway Illumination and Electrical Supplies."

ITEM 620: Electrical Conductors

For Flashing Beacons (Item 685) and Ped poles (Item 687) within the project, provide single-pole breakaway disconnects.
Use Bussman HEBW, Littelfuse LEB, Ferraz-Shawmut FEB, or equal on ungrounded conductors.

For all grounded conductors use Bussman HET, Littelfuse LET, Ferraz-Shawmut FEBN, or equal on ungrounded conductors. For all grounded conductors use Bussman HET, Littelfuse LET, Ferraz Shawmut FEBN, or equal. These breakaway connectors have a white colored marking and a permanently installed solid neutral.

ITEM 621: Tray Cable

Connect luminaires on traffic signal poles using a 4-conductor tray cable with conductor colors of red, black, and green #12 AWG (XHHW). The white (neutral) conductor will not be needed and will be capped.

ITEM 628: Electrical Services

Arrange for and cooperate with the utility company to provide electrical power for the service(s) shown and as required by the plans. A meter will be required on all electrical services.

ITEMS 636: Signs

Complete sign blanks and panels shall be handled and stored at the job site in such a manner that corners, edges and faces are not damaged. Finished sign blanks shall be stored in either a weatherproof warehouse or outside and off the ground in a vertical position. All paper, cardboard and chemically treated separators and packaging shall be removed prior to outside storage.

ITEM 644: Small Roadside Sign Assemblies

All signs shall be installed as shown in the plans and in accordance with the current edition of the "Texas Manual on Uniform Traffic Control Devices" and the “Sign Crew Field Book” (SCFB).

All signs shall be erected according to the locations shown on the signing layout sheets except that a sign may be shifted in order to secure a more desirable location. All sign locations will be staked as shown in the plans and as approved. It is the intent of the plans to erect all roadside traffic signs with the sign edge a minimum of 6 feet from the edge of the shoulder, or if none, 12

feet from the edge of the travel lane. In curb and gutter sections, the sign edge shall be a minimum of 2 feet from the face of the curb.

For this project, aluminum type sign blanks as provided for under Item 636 will be required for all proposed signing installed under Item 644. Aluminum sign blanks less than 7.5 square feet shall be 0.08-inch-thick, sign blanks 7.5 to 15 square feet shall be 0.100-inch-thick and sign blanks greater than 15 square feet shall be 0.125 inch thick.

All excess excavation shall be spread uniformly inside the right of way as directed and shall be included in the price of these Items.

Sign types which design details are not shown on the plans shall conform with the latest edition of the Department's "Standard Highway Sign Design for Texas" Manual.

Signs shown to be removed shall include the complete sign installation and separate the sign post at the concrete foundation. The concrete foundation shall be disposed in accordance with this bid Item. Except for concrete foundations, all removed sign panels, sign posts, and hardware shall remain then property of the Department. All removed sign installations shall be completely disassembled. All salvageable sections of sign panels shall be recycled by TxDOT. The removed sign material will be required to be hauled to the maintenance yard closest to the project. No signs shall be removed without prior approval.

Existing signs shown to be removed and relocated within this project shall first be identified in the field before they are removed and relocated to their new installation position as determined in the plans. The complete sign assembly shall be removed and the sign with post shall be separated at the concrete foundation. The concrete foundation shall be disposed off in accordance with this bid Item. No sign shall be removed without prior approval.

All excess excavation shall be spread uniformly inside the right of way as directed and shall be included in the price of this Item.

ITEM 656: Foundations for Traffic Control Devices

The dimensions shown on the plans for location of signal pole foundations, conduit and other items may be varied to meet existing conditions as approved.

The work area shall be cleaned up and all loose material resulting from the contract operations shall be removed from the work area each day before work is suspended.

No traffic signal pole shall be placed on the foundations prior to seven (7) days following placement of concrete.

ITEM 658: Delineator and Object Marker Assemblies

Delineator assemblies shall be installed 8 feet from the edge of the shoulder unless restricted by some obstruction, in which case, the delineator assembly shall be placed between 2 and 8 feet from the edge of the shoulder.

Bi-directional object markers shall be in accordance with the D&OM standard sheets. The Contractor is directed to the standards when instructed where and how to install the object markers.

ITEMS 662 and 666: Work Zone Pavement Markings and Retroreflectorized Pavement Markings

All permanent pavement markings and work zone pavement markings for this project under these Items shall be 0.100 inches (100 mil) thick thermoplastic.

Any permanent pavement markings or non-removal work zone pavement markings lacking reflectivity in accordance with the requirements of Tex 828-B, or that fail to meet minimum retro reflectivity requirements for longitudinal pavement markings when required, will be addressed per the requirements of the specification. The roadway will be re-striped at no additional compensation.

Pavement surface preparation for markings and markers will not be paid for directly but shall be considered subsidiary to Item 666.

Prior to any striping operations, an on-site coordination meeting between all the parties involved will be required to review striping details and requirements to ensure quality work.

The beads used on this project shall meet the requirements of Departmental Materials Specification DMS-8290, Glass Traffic Beads Texas Type II & III. Use a 50% Type II/ 50% Type III mix utilizing a double drop system with Type III beads dropped first.

ITEM 677: Eliminating Existing Pavement Markings and Markers

Asphalt and aggregate types and grades shall be as approved in writing when a surface treatment is used to eliminate existing pavement markings.

ITEM 680: Highway Traffic Signals

The installation of highway traffic signals shall consist of the following principal Items:

1. Furnishing and installing 16-phase full traffic actuated controllers, base mounted cabinets, conflict monitors, load switches and loop amplifiers.
2. Furnishing and installing post mounted flashing beacon controllers and cabinets.
3. Furnishing and installing either, steel strain and/or mast arm poles, electrical service, luminaires, signal heads and cables, pedestrian heads and push buttons with signs that meet the "Americans with Disabilities Act" Standards, galvanized steel span wire, loop detectors, ground boxes, conduit runs and controller foundations.
4. Removal and disposal of existing signal material specified in the plans.
5. All other Items not listed above which are needed to provide for complete traffic signal installations and for proper signal operation as called for in the plans and specifications shall be furnished and installed.

Any deviation of location for proposed signal work shall be as approved.

Signal controller

The signal installations shall be wired in accordance with the phase diagrams in the plans. The proposed base mounted cabinets shall contain 16-phase conflict monitors, which display the "R-Y-G" and "Walk" phases. In addition to detecting phasing conflicts, the Conflict monitors shall also be able to detect multiple signal head indications within every phase. The conflict monitors shall continue to operate in the event of a power supply failure in the timer and shall be able to retain in memory the time and date of the failure detection. Time changes shall be programmable in the field without replacing components or use of external devices. The full-actuated controllers shall meet N.E.M.A. Specifications. The flasher Controllers shall be solid state.

A controller manufacturer's technician shall be required to load initial timing programs into the controllers as called for in the plans. Once the traffic signals are turned on, the same technician shall monitor the signal operation and traffic movement and shall adjust settings for best signal operation. The technician shall provide the State with a certification that the timing plan and coordination has been established according to the plans. This certification shall include a record showing all settings and functions programmed into the timer and any related units.

The controller must be delivered with two sets of wiring diagrams and operating manuals enclosed in a weatherproof bag.

All wiring not covered by the plans and specifications shall be in accordance with the latest edition of the National Electrical Code.

Under this Item, the proposed cabinets shall be base mounted or as shown in the plans.

Existing utilities

The exact location of existing underground utilities shall be verified with the utility companies prior to construction to avoid conflict with or damage to these utilities.

The coordination with the utility companies will be required to make any adjustments, due to utility conflicts, as defined in the specifications or deemed necessary.

Uniformity in equipment

1. All traffic signal controllers furnished shall be by the same manufacturer.
2. All flashing beacon controllers furnished shall be by the same manufacturer.
3. All traffic signal heads, and flashing beacon heads furnished shall be by the same manufacturer.
4. All signal fittings and pipe brackets shall be of an approved metallic material and of the same design and manufacturer.
5. All traffic signal poles furnished shall be by the same manufacturer.
6. All loop detector amplifiers furnished shall be by the same manufacturer and of the same type.

Handling of traffic

Roads and streets shall always be kept open to traffic. The setting of loop detectors shall be arranged so as to close only one lane of a roadway at a time. The installation of signal heads, poles and conduit shall also be arranged so as to permit the continuous movement of traffic in both directions at all times.

All construction operations shall be conducted to provide the least possible interference to traffic as shown on the plans, as provided for in the specifications and/or as directed. All signing, barricading, and handling of traffic shall conform to the current edition of the "Texas Manual on Uniform Traffic Control Devices".

Sequence of work

1. The existing traffic signal installations and/or flashing beacon installations shall always remain in operation during construction of the proposed traffic signal and/or flashing beacon installations or modifications.
2. The complete removal of the specified existing traffic signal and/or flashing beacon installations or specified Items when the proposed traffic signal and/or flashing beacon installations are in place and operational.
3. All labor, tools, and materials used to remove the specified existing traffic signal material shall not be paid for directly but shall be considered subsidiary to the various items of work.
4. Final inspection shall be performed in conjunction with the district signal shop.

ITEM 682: Vehicle and Pedestrian Signal Heads

All signal heads shall be covered with burlap from the time of installation until the signal is placed in operation. All signal heads shall be of polycarbonate material and yellow in color. Signal heads shall have standard detachable visors. LEDs shall be furnished for all traffic signal heads.

Signal heads shall be positioned carefully to provide the best view of signal indications to motorists. All signal heads shall be installed to a neat overall appearance. Nominal height for signal heads above pavement surface shall be 18 feet 6 inches, plus/minus 3 inches.

Pedestrian signal heads shall be positioned carefully to provide the best view to pedestrians.

ITEM 682: Vehicle and Pedestrian Signal Heads

All flashing beacon heads shall be covered with burlap from the time of installation until they are placed in operation. All flashing beacon heads shall be of polycarbonate material and yellow in color. Flashing beacon heads shall have standard detachable visors. LEDs shall be furnished for all traffic signal heads.

Flashing beacon heads shall be positioned carefully to provide the best view of head indications to motorists. All beacon heads shall be installed to a neat overall appearance.

Nominal height for flashing beacon heads above pavement surface shall be 18 feet 6 inches, plus/minus 3 inches.

ITEM 684: Traffic Signal Cables

All signal cable shall be #12 AWG; 2/c loop. Lead-In shall be #14 AWG shielded and loop wires in pavement.

ITEM 686: Traffic Signal Pole Assemblies (Steel)

The locations for the proposed traffic signal poles are approximate. The exact locations will be determined in the field in coordination with the District Signal Shop.

Erection and/or removal of poles and luminaries located near any overhead electrical power lines shall be accomplished using established industry and utility safety practices. The appropriate utility company shall be consulted with prior to beginning such work.

ITEM 688: Pedestrian Detectors and Vehicle Loop Detectors

The Contractor shall install loop vehicle detectors in accordance with the Intersection layouts in the plans or as directed. Each loop detector Lead-In cable shall be tagged inside the controller cabinet with its loop number. The loop amplifiers shall indicate the loop and phase of control or direction of control. Loop wires in street shall be #14 AWG. Pedestrian detectors shall meet the minimum requirements called for by the "Americans with Disabilities Act".

Loop detector lead-in cable shall be continuous from ground box to the controller.

Splices for loop wire will be permitted only at ground boxes or pole base with approved weatherproof splice kits.

A minimum length of 2.0 feet for each cable shall be left in each ground box.

ITEM 5001: Geogrid Base Reinforcement

Provide a construction plan to the Engineer detailing how the base will be lime treated without damaging the Geogrid Base Reinforcement placed on top of the subgrade.

ITEM 6185: Truck Mounted Attenuator/Trailer Attenuator

In addition to the shadow vehicles with truck mounted attenuator (TMA) that are specified as being required on the traffic control plan for the project, provide 2 additional shadow vehicle(s) with TMA as per TCP (2-1) -18 as detailed on General Note 5 of this standard sheet;
or as per TCP (2-2) -18 as detailed on General Note 7 of this standard sheet;
or as per TCP (2-3) -18 as detailed on General Note 8 of this standard sheet.
or as per TCP (2-4) -18 as detailed on General Note 6 of this standard sheet.

Therefore, 3 total shadow vehicles with TMA will be required on this project for the type of work as shown on the plans. The Contractor will be responsible for determining if one or more of his construction operations will be ongoing at the same time and thus determine the total number of TMAs needed for the project.

CONTROL : 0342-03-037, ETC
PROJECT : C 342-3-37, ETC
HIGHWAY : SH 107
COUNTY : CAMERON

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 134 BACKFILLING PAVEMENT EDGES (162)(166)(168)(300)(314)
ITEM 158 SPECIALIZED EXCAVATION WORK (132)
ITEM 160 TOPSOIL (168)
ITEM 164 SEEDING FOR EROSION CONTROL (162)(166)(168)
ITEM 168 VEGETATIVE WATERING
ITEM 204 SPRINKLING
ITEM 216 PROOF ROLLING (210)
ITEM 247 FLEXIBLE BASE (105)(204)(210)(216)(520)
ITEM 251 REWORKING BASE COURSES (204)(210)(216)(247)(520)
ITEM 260 LIME TREATMENT (ROAD-MIXED) (105)(132)(204)(210)(216) (247)(300)(310)(520)
ITEM 275 CEMENT TREATMENT (ROAD-MIXED) (132)(204)(210)(216)(247) (300)(310)(520)
ITEM 305 SALVAGING, HAULING, AND STOCKPILING RECLAIMABLE ASPHALT PAVEMENT
ITEM 310 PRIME COAT (300)(316)
ITEM 316 SEAL COAT (210)(300)(302)(340)(520)
ITEM 354 PLANING AND TEXTURING PAVEMENT
ITEM 400 EXCAVATION AND BACKFILL FOR STRUCTURES (110)(132)(401) (402)(403)(416)(420)(421)(423)
ITEM 402 TRENCH EXCAVATION PROTECTION
ITEM 416 DRILLED SHAFT FOUNDATIONS (405)(420)(421)(423)(440)(448)
ITEM 432 RIPRAP (247)(420)(421)(431)(440)
ITEM 464 REINFORCED CONCRETE PIPE (400)(402)(403)(467)(476)

ITEM 467 SAFETY END TREATMENT (400)(420)(421)(432)(440)(442)(445)(460)(464)
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)(360)(421)(440)
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 625 ZINC-COATED STEEL WIRE STRAND
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 668 PREFABRICATED PAVEMENT MARKINGS (678)
ITEM 672 RAISED PAVEMENT MARKERS (677)(678)
ITEM 677 ELIMINATING EXISTING PAVEMENT MARKINGS AND MARKERS (300)(302)(316)
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 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)

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

SPECIAL LABOR PROVISIONS FOR STATE PROJECTS (000---008)
SPECIAL PROVISION "NONDISCRIMINATION" (000---002)

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SPECIAL PROVISION "SMALL BUSINESS ENTERPRISE IN STATE FUNDED PROJECTS
                  " (000---009)
SPECIAL PROVISION "CERTIFICATE OF INTERESTED PARTIES (FORM 1295)"
                    (000--1019)
SPECIAL PROVISION "SCHEDULE OF LIQUIDATED DAMAGES" (000--1243)
SPECIAL PROVISION "NOTICE OF CONTRACTOR PERFORMANCE EVALUATIONS"
                    (000---659)
SPECIAL PROVISIONS TO ITEM     2  (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---001)(006---012)
SPECIAL PROVISIONS TO ITEM     7  (007---004)(007---008)(007---010)
                                  (007---011)
SPECIAL PROVISIONS TO ITEM     8  (008---030)(008---033)
SPECIAL PROVISIONS TO ITEM     9  (009---010)(009---011)
SPECIAL PROVISION  TO ITEM   247  (247---003)
SPECIAL PROVISION  TO ITEM   300  (300---020)
SPECIAL PROVISION  TO ITEM   302  (302---003)
SPECIAL PROVISION  TO ITEM   314  (314---001)
SPECIAL PROVISION  TO ITEM   316  (316---002)
SPECIAL PROVISION  TO ITEM   334  (334---003)
SPECIAL PROVISION  TO ITEM   340  (340---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   440  (440---004)
SPECIAL PROVISION  TO ITEM   441  (441---004)
SPECIAL PROVISION  TO ITEM   442  (442---001)
SPECIAL PROVISION  TO ITEM   448  (448---001)
SPECIAL PROVISION  TO ITEM   449  (449---002)
SPECIAL PROVISION  TO ITEM   464  (464---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   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:
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ITEM 3077 SUPERPAVE MIXTURES
ITEM 3084 BONDING COURSE
ITEM 5001 GEOGRID BASE REINFORCEMENT
ITEM 6185 TRUCK MOUNTED ATTENUATOR (TMA) AND TRAILER ATTENUATOR (TA)
ITEM 6292 RADAR VEHICLE DETECTION SYSTEMFOR SIGNALIZED INTERSECTION
           CONTROL
ITEM 6438 MOBILE RETROREFLECTIVITY DATA COLLECTION FOR PAVEMENT
          MARKINGS
ITEM 7016 ATER AND SANITARY SEWER SYSTEM
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ITEM 7032 WATER MAINS AND SERVICE LINES
ITEM 7103 WATER MAINS, SEWER LINES AND APPURTENANCES REPLACEMENTS
ITEM 7111 SANITARY SEWER
ITEM 7112 WATER MAINS AND SERVICE LINES
ITEM 7334 WATER AND SANITARY SEWER

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	**0342-03-037, ETC.**
Project	**C 342-3-37, ETC.**
Highway	**SH 107**
County	**CAMERON**

SMALL BUSINESS ENTERPRISE REQUIREMENTS

The following goal for small business enterprises is established:

SBE
0.0%

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.

Special Provision to Item 000
Special Labor Provisions for State Projects

1. GENERAL

This is a "Public Works" Project, as provided under Government Code Title 10, Chapter 2258, "Prevailing Wage Rates," and is subject to the provisions of the Statute. No provisions in the Contract are intended to be in conflict with the provisions of the Statute.

The Texas Transportation Commission has ascertained and indicated in the special provisions the regular rate of per diem wages prevailing in each locality for each craft or type of worker. Apply the wage rates contained in the specifications as minimum wage rates for the Contract.

2. MINIMUM WAGES, HOURS AND CONDITIONS OF EMPLOYMENT

All workers necessary for the satisfactory completion of the work are within the purview of the Contract.

Whenever and wherever practical, give local citizens preference in the selection of labor.

Do not require any worker to lodge, board or trade at a particular place, or with a particular person as a condition of employment.

Do not charge or accept a fee of any from any person who obtains work on the project. Do not require any person who obtains work on the project to pay any fee to any other person or agency obtaining employment for the person on the project.

Do not charge for tools or equipment used in connection with the duties performed, except for loss or damage of property. Do not charge for necessary camp water.

Do not charge for any transportation furnished to any person employed on the project.

The provisions apply where work is performed by piece work, station work, etc. The minimum wage paid will be exclusive of equipment rental on any shipment which the worker or subcontractor may furnish in connection with his work.

Take responsibility for carrying out the requirements of this specification and ensure that each subcontractor working on the project complies with its provisions.

Any form of subterfuge, coercion or deduction designated to evade, reduce or discount the established minimum wage scales will be considered a violation of the Contract.

The Fair Labor Standards Acts (FLSA) established one and one-half (1-1/2) pay for overtime in excess of 40 hours worked in 1 week. Do not consider time consumed by the worker in going to and returning from the place of work as part of the hours of work. Do not require or permit any worker to work in excess of 40 hours in 1 week, unless the worker receives compensation at a rate not less than 1-1/2 times the basic rate of pay for all hours worked in excess of 40 hours in the workweek.

The general rates of per diem wages prevailing in this locality for each class and type of workers whose services are considered necessary to fulfill the Contract are indicated in the special provisions, and these rates govern as minimum wage rates on this Contract. A penalty of $60.00 per calendar day or portion of a calendar day for each worker that is paid less than the stipulated general rates of per diem wages for any work done under the Contract will be deducted. The Department, upon receipt of a complaint by a worker,

will determine within 30 days whether good cause exists to believe that the Contractor or a subcontractor has violated wage rate requirements and notify the parties involved of the findings. Make every effort to resolve the alleged violation within 14 days after notification. The next alternative is submittal to binding arbitration in accordance with the provisions of the Texas General Arbitration Act (Art. 224 et seq., Revised Statutes).

Notwithstanding any other provision of the Contract, covenant and agree that the Contractor and its subcontractors will pay each of their employees and contract labor engaged in any way in work under the Contract, a wage not less than what is generally known as the “federal minimum wage” as set out in 29 U.S.C. 206 as that Statute may be amended from time to time.

Pay any worker employed whose position is not listed in the Contract, a wage not less than the per diem wage rate established in the Contract for a worker whose duties are most nearly comparable.

3. RECORD AND INSPECTIONS

Keep copies of weekly payrolls for review. Require subcontractors to keep copies of weekly payrolls for review. Show the name, occupation, number of hours worked each day and per diem wage paid each worker together with a complete record of all deductions made from such wages. Keep records for a period of 3 years from the date of completion of the Contract.

Where the piece-work method is used, indicate on the payroll for each person involved:

- Quantity of piece work performed.
- Price paid per piece-work unit.
- Total hours employed.

The Engineer may require the Contractor to file an affidavit for each payroll certifying that payroll is a true and accurate report of the full wages due and paid to each person employed.

Post or make available to employees the prevailing wage rates from the Contract. Require subcontractors to post or make available to employees the prevailing wage rates from the Contract.

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

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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
Small Business Enterprise in State Funded Projects

1. DESCRIPTION

The purpose of this Special Provision is to carry out the Texas Department of Transportation's policy of ensuring that Small Business Enterprise (SBE) has an opportunity to participate in the performance of contracts. If the SBE goal is greater than zero, Article A of this Special Provision shall apply to this Contract; otherwise, Article B of this Special Provision applies. The percentage goal for SBE participation in the work to be performed under this contract will be shown in the proposal.

2. DEFINITIONS

Small Business Enterprise (SBE) is a firm (including affiliates) certified by the Department whose annual gross receipts do not exceed the U.S. Small Business Administration's size standards for 4 consecutive years. Firms certified as Historically Underutilized Businesses (HUBs) by the Texas Comptroller of Public Accounts and as Disadvantaged Business Enterprises (DBEs) by the Texas Uniform Certification Program automatically qualify as SBEs.

2.1. **Article A - SBE Goal is Greater than Zero.**

2.1.1. **Policy**. The Department is committed to providing contracting opportunities for small businesses. In this regard, it is the Department's policy to develop and maintain a program in order to facilitate contracting opportunities for small businesses. Consequently, the requirements of the Department's Small Business Enterprise Program apply to this contract as follows:

2.1.1.1. The Contractor shall make a good faith effort to meet the SBE goal for this contract.

2.1.1.2. The Contractor and any Subcontractors shall not discriminate on the basis of race, color, national origin, age, disability or sex in the award and performance of this contract. These nondiscrimination requirements shall be incorporated into any subcontract and purchase order.

2.1.1.3. After a conditional award is made to the low bidder, the Department will determine the adequacy of a Contractor's efforts to meet the contract goal, as is outlined under Section 2, "Contractor's Responsibilities." If the requirements of Section 2 are met, the contract will be forwarded to the Contractor for execution.

The Contractor's performance, during the construction period of the contract in meeting the SBE goal, will be monitored by the Department.

2.1.2. **Contractor's Responsibilities**. These requirements must be satisfied by the Contractor. A SBE Contractor may satisfy the SBE requirements by performing at least 25% of the contract work with its own organization as defined elsewhere in the contract.

2.1.2.1. The Contractor shall submit a completed SBE Commitment Agreement Form for each SBE they intend to use to satisfy the SBE goal so as to arrive in the Department's Office of Civil Rights (OCR) in Austin, Texas not later than 5:00 p.m. on the 10th business day, excluding national holidays, after the conditional award of the contract. When requested, additional time, not to exceed 7 business days, excluding national holidays, may be granted based on documentation submitted by the Contractor.

2.1.2.2. A Contractor who cannot meet the contract goal, in whole or in part, shall document the good faith efforts taken to meet the SBE goal. The Department will consider as good faith efforts all documented explanations

that are submitted and that describe a Contractor's failure to meet a SBE goal or obtain SBE participation, including:

2.1.2.2.1. Advertising in general circulation, trade association, and/or minority/women focus media concerning subcontracting opportunities,

2.1.2.2.2. Dividing the contract work into reasonable portions in accordance with standard industry practices,

2.1.2.2.3. Documenting reasons for rejection or meeting with the rejected SBE to discuss the rejection,

2.1.2.2.4. Providing qualified SBEs with adequate information about bonding, insurance, plans, specifications, scope of work, and the requirements of the contract,

2.1.2.2.5. Negotiating in good faith with qualified SBEs, not rejecting qualified SBEs who are also the lowest responsive bidder, and;

2.1.2.2.6. Using the services of available minorities and women, community organizations, contractor groups, local, state and federal business assistance offices, and other organizations that provide support services to SBEs.

2.1.2.3. The good faith effort documentation is due at the time and place specified in Subarticle 2.(a). of this Special Provision. The Director of the DBE & SBE Programs Section will evaluate the Contractor's documentation. If it is determined that the Contractor has failed to meet the good faith effort requirements, the Contractor will be given an opportunity for reconsideration by the Department.

2.1.2.4. Should the bidder to whom the contract is conditionally awarded refuse, neglect or fail to meet the SBE goal and/or demonstrate to the Department's satisfaction sufficient efforts to obtain SBE participation, the proposal guaranty filed with the bid shall become the property of the State, not as a penalty, but as liquidated damages to the Department.

2.1.2.5. The Contractor must not terminate a SBE subcontractor submitted on a commitment agreement for a contract with an assigned goal without the prior written consent of the Department.

2.1.2.6. The Contractor shall designate a SBE contact person who will administer the Contractor's SBE program and who will be responsible for submitting reports, maintaining records, and documenting good faith efforts to use SBEs.

2.1.2.7. The Contractor must inform the Department of the representative's name, title and telephone number within 10 days of beginning work.

2.1.3. **Eligibility of SBEs.**

2.1.3.1. The Department certifies the eligibility of SBEs.

2.1.3.2. The Department maintains and makes available to interested parties a directory of certified SBEs.

2.1.3.3. Only firms certified at the time of letting or at the time the commitments are submitted are eligible to be used in the information furnished by the Contractor required under Section 2.(a) above.

2.1.3.4. Certified HUBs and DBEs are eligible as SBEs.

2.1.3.5. Small Business Size Regulations and Eligibility is referenced on e-CFR (Code of Federal Regulations), Title 13 – Business Credit and Assistance, Chapter 1 – Small Business Administration, Part 121 – Small Business Size Regulations, Subpart A – Size Eligibility Provisions and Standards.

2.1.4. **Determination of SBE Participation**. SBE participation shall be counted toward meeting the SBE goal in this contract in accordance with the following:

2.1.4.1. A Contractor will receive credit for all payments actually made to a SBE for work performed and costs incurred in accordance with the contract, including all subcontracted work.

2.1.4.2. A SBE Contractor or subcontractor may not subcontract more than 75% of a contract. The SBE shall perform not less than 25% of the value of the contract work with its own organization.

2.1.4.3. A SBE may lease equipment consistent with standard industry practice. A SBE may lease equipment from the prime contractor if a rental agreement, separate from the subcontract specifying the terms of the lease arrangement, is approved by the Department prior to the SBE starting the work in accordance with the following:

2.1.4.3.1. If the equipment is of a specialized nature, the lease may include the operator. If the practice is generally acceptable with the industry, the operator may remain on the lessor's payroll. The operator of the equipment shall be subject to the full control of the SBE, for a short term, and involve a specialized piece of heavy equipment readily available at the job site.

2.1.4.3.2. For equipment that is not specialized, the SBE shall provide the operator and be responsible for all payroll and labor compliance requirements.

2.1.5. **Records and Reports**.

2.1.5.1. The Contractor shall submit monthly reports, after work begins, on SBE payments, (including payments to HUBs and DBEs). The monthly reports are to be sent to the Area Engineer's office. These reports will be due within 15 days after the end of a calendar month.

These reports will be required until all SBE subcontracting or supply activity is completed. The "SBE Progress Report" is to be used for monthly reporting. Upon completion of the contract and prior to receiving the final payment, the Contractor shall submit the "SBE Final Report" to the Office of Civil Rights and a copy to the Area Engineer. These forms may be obtained from the Office of Civil Rights and reproduced as necessary. The Department may verify the amounts being reported as paid to SBEs by requesting, on a random basis, copies of invoices and cancelled checks paid to SBEs. When the SBE goal requirement is not met, documentation supporting Good Faith Efforts, as outlined in Section 2.(b) of this Special Provision, must be submitted with the Final Report.

2.1.5.2. SBE subcontractors and/or suppliers should be identified on the monthly report by SBE certification number, name and the amount of actual payment made to each during the monthly period. **These reports are required regardless of whether or not SBE activity has occurred in the monthly reporting period.**

2.1.5.3. All such records must be retained for a period of 3 years following completion of the contract work and shall be available at reasonable times and places for inspection by authorized representatives of the Department.

2.1.6. **Compliance of Contractor**. To ensure that SBE requirements of this contract are complied with, the Department will monitor the Contractor's efforts to involve SBEs during the performance of this contract. This will be accomplished by a review of monthly reports submitted by the Contractor indicating his progress in achieving the SBE contract goal and by compliance reviews conducted by the Department.

A Contractor's failure to comply with the requirements of this Special Provision shall constitute a material breach of this contract. In such a case, the Department reserves the right to employ remedies as the Department deems appropriate in the terms of the contract.

2.2. **Article B - No SBE Goal**.

2.2.1. **Policy**. It is the policy of the Department that SBEs shall have an opportunity to participate in the performance of contracts. Consequently, the requirements of the Department's Small Business Enterprise Program apply to this contract as specified in Section 2-5 of this Article.

2.2.2. **Contractor's Responsibilities**. If there is no SBE goal, the Contractor will offer SBEs an opportunity to participate in the performance of contracts and subcontracts.

2.2.3. **Prohibit Discrimination**. The Contractor and any subcontractor shall not discriminate on the basis of race, color, national origin, religion, age, disability or sex in the award and performance of contracts. These nondiscrimination requirements shall be incorporated into any subcontract and purchase order.

2.2.4. **Records and Reports**.

2.2.4.1. The Contractor shall submit reports on SBE (including HUB and DBE) payments. The reports are to be sent to the Area Engineer's office. These reports will be due annually by the 31st of August or at project completion, whichever comes first.

These reports will be required until all SBE subcontracting or supply activity is completed. The "SBE Progress Report" is to be used for reporting. Upon completion of the contract and prior to receiving the final payment, the Contractor shall submit the "SBE Final Report" to the Office of Civil Rights and a copy to the Area Engineer. These forms may be obtained from the Office of Civil Rights and reproduced as necessary. The Department may verify the amounts being reported as paid to SBEs by requesting copies of invoices and cancelled checks paid to SBEs on a random basis.

2.2.4.2. SBE subcontractors and/or suppliers should be identified on the report by SBE Certification Number, name and the amount of actual payment made.

2.2.4.3. All such records must be retained for a period of 3 years following completion of the contract work and shall be available at reasonable times and places for inspection by authorized representatives of the Department.

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
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," 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

For this project, Item 6, "Control of Materials," 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., "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/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 and e-mail;
- reimburse the Department for CL Table 1 testing using the contract fee schedule for the CL (including mileage and travel/standby time) 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 and 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 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 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 Specification is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 8.2., "Subcontracting," is supplemented by the following paragraph, which is added as paragraph six to this article:

The Contractor certifies by signing the Contract that the Contractor will not enter into any subcontract with a subcontractor that is not registered in the Department of Homeland Security's (DHS) E-Verify system. Require that all subcontractors working on the project register and require that all subcontractors remain active in the DHS E-Verify system until their work is complete on the project.

Special Provision to Item 8
Prosecution and Progress

Item 8, "Prosecution and Progress" of the Standard Specifications is amended with respect to the clause cited below. No other clauses or requirements of this Item are waived or changed.

Article 8.7.2., "Wrongful Default," is revised and replaced by the following:

If it is determined after the Contractor is declared in default, that the Contractor was not in default, the rights and obligations of all parties will be the same as if termination had been issued for the convenience of the public as provided in Article 8.8 "Termination of Contract."

Special Provision to Item 009
Measurement and Payment

Item 009 "Measurement and Payment" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 9.5., "PROGRESS PAYMENTS" is supplemented with the following:

It is the Department's desire to pay a Contractor for work through the last working day of the month; however, the use of early cut-off dates for monthly estimates and MOH is a project management practice to manage workload at the Area Office level. Approval for using early cut-off dates is at the District's discretion. The earliest cut-off date for estimates is the 25th of the month.

Article 9.6., "PAYMENT FOR MATERIAL ON HAND (MOH)" first paragraph is amended as follows:

If payment for MOH is desired, request compensation for the invoice cost of acceptable nonperishable materials that have not been used in the work before the request, and that have been delivered to the work location or are in acceptable storage places. Nonperishable materials are those that do not have a shelf life or whose characteristics do not materially change when exposed to the elements. Include only materials that have been sampled, tested, approved, or certified, and are ready for incorporation into the work. Only materials which are completely constructed or fabricated on the Contractor's order for a specific Contract and are so marked and on which an approved test report has been issued are eligible. Payment for MOH may include the following types of items: concrete traffic barrier, precast concrete box culverts, concrete piling, reinforced concrete pipe, and illumination poles. Any repairs required after fabricated materials have been approved for storage will require approval of the Engineer before being made and will be made at the Contractor's expense. Include only those materials and products, when cumulated under an individual item or similar bid items, that have an invoice cost of at least $1,000 in the request for MOH payment (e.g. For MOH eligibility, various sizes of conductor are considered similar bid items and may be cumulated to meet the threshold; for small roadside signs, the sign supports, mounting bolts, and the sign face is considered one bid item or similar bid items for more than one pay item for sign supports.) Requests for MOH are to be submitted at least two days before but not later than the estimate cutoff date unless otherwise agreed. If there is a need to request MOH after the established cut-off date, the district can make accommodation as the need arises. This needed accommodation is to be the exception, though, and not the rule.

Special Provision to Item 9
Measurement and Payment

Item 9, "Measurement and Payment" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 9.7.1.4.3., "Standby Equipment Costs," is voided and replaced by the following:

7.1.4.3. **Standby Equipment Costs.** Payment for standby equipment will be made in accordance with Section 9.7.1.4., "Equipment," except that the 15% markup will not be allowed and that:

Section 7.1.4.3.1., "Contractor-Owned Equipment," is voided and replaced by the following:

7.1.4.3.1. **Contractor-Owned Equipment**. For Contractor-owned equipment:

- Standby will be paid at 50% of the monthly Equipment Watch rate after the regional and age adjustment factors have been applied. Operating costs will not be allowed. Calculate the standby rate as follows.

  Standby rate = (FHWA hourly rate - operating costs) × 50%

- If an hourly rate is needed, divide the monthly *Equipment Watch* rate by 176.
- No more than 8 hr. of standby will be paid during a 24-hr. day period, nor more than 40 hr. per week.
- Standby costs will not be allowed during periods when the equipment would have otherwise been idle.

Special Provision to Item 247
Flexible Base

Item 247, "Flexible Base" of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Section 2.4., "Certification." This section is added.

Personnel certified by the Department-approved soils and base certification program must conduct all sampling, field testing, and laboratory testing required by the following:

- Section 2.1, "Aggregate,"
- Section 2.1.3.2, "Recycled Material (Including Crushed Concrete) Requirements,"
- Section 4.3, "Compaction," for measuring flexible base depth, and
- Section 4.3.2, "Density Control," for determining the roadway density and moisture content.

Supply the Engineer with a list of certified personnel and copies of their current certificates before laboratory and field testing is performed and when personnel changes are made. At any time during the project, the Engineer may perform production tests as deemed necessary in accordance with Item 5, "Control of the Work."

Section 2.5., "Reporting and Responsibilities." This section is added.

Use Department-provided templates to record and calculate all test data. Obtain the current version of the templates at http://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/forms/site-manager.html or from the Engineer. The Engineer and the Contractor will provide any available test results to the other party when requested. Record and electronically submit all test results and pertinent information on Department-provided templates.

Section 2.6., "Sampling." This section is added.

The Engineer will sample flexible base from stockpiles located at the production site or at the project location in accordance with Tex-400-A, Section 5.3. The Engineer will label the sample containers as "Engineer," "Contractor" or "Supplier," and "CST/M&P." Witness the sampling and take immediate possession of the sample containers labeled "Contractor" or "Supplier." The Engineer will maintain custody of the samples labeled "CST/M&P" until testing and reporting is completed.

Section 2.7., "Referee Testing." This section is added.

CST/M&P is the referee laboratory. The Contractor may request referee testing when the Engineer's test results fail to meet any of the material requirements listed in Table 1. Make the request via email within 5 working days after receiving test results from the Engineer. Submit test reports signed and sealed by a licensed professional engineer from a commercial laboratory listed on the Department's Material Producer List (MPL) of laboratories approved to perform compaction and triaxial compression testing located at http://ftp.dot.state.tx.us/pub/txdot-info/cmd/mpl/complabs.pdf. Submit completed test reports electronically on Department-provided templates in their original format. The referee laboratory will report test results to the Engineer within the allowable number of working days listed in Table 2 from the time the referee laboratory receives the samples. It is at the discretion of the Engineer or the referee laboratory to deny a referee request upon review of the test reports provided by the Contractor.

Table 2
Number of Allowable Working Days to Report Referee Test Results

Material Property	Test Method	Working Days
Gradation	Tex-110-E, Part I	5
Liquid Limit (Multi-Point Method)	Tex-104-E, Part I	5
Plasticity Index	Tex-106-E	5
Wet Ball Mill Value	Tex-116-E, Parts I and II	5
Wet Ball Mill, % Increase passing #40 sieve		
Compressive Strength[1]	Tex-117-E, Part II	6
Compressive Strength[2]	Tex-117-E	12

1. Moisture-Density curve provided by the District
2. Moisture-Density curve determined by the referee laboratory

Section 4.6., "Ride Quality." This section is voided and replaced by the following.

Measurement of ride quality only applies to the final travel lanes that receive a 1- or 2-course surface treatment for the final riding surface, unless otherwise shown on the plans. Measure the ride quality of the base course either before or after the application of the prime coat, as directed, and before placement of the surface treatment. Use a certified profiler operator from the Department's MPL. When requested, furnish the Engineer documentation for the person certified to operate the profiler.

Provide all profile data to the Engineer in electronic data files within 3 days of measuring the ride quality using the format specified in Tex-1001-S. The Engineer will use Department software to evaluate longitudinal profiles to determine areas requiring corrective action. Correct 0.1-mi.sections for each wheel path having an average international roughness index (IRI) value greater than 100 in. per mile to an IRI value of 100 in. per mile or less, unless otherwise shown on the plans.

Re-profile and correct sections that fail to maintain ride quality, as directed. Correct re-profiled sections until specification requirements are met, as approved. Perform this work at no additional expense to the Department.

Special Provision to Item 300
Asphalt, Oils, and Emulsions

Item 300, “Asphalt, Oils, and Emulsions” of the Standard Specifications is replaced by Special Specification 3096, “Asphalts, Oils, and Emulsions.” All Item 300 Special Provisions are no longer available, beginning with the April 2022 letting.

Special Provision to Item 302
Aggregates for Surface Treatments

Item 302, "Aggregates for Seal Coats," of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Section 2.1., "Aggregate." Tables 2 and 3 are voided and replaced by the following.

Table 2
Aggregate Gradation Requirements (Cumulative % Retained[1])

Sieve	Grade								
	1	2	3S[2]	3		4S[2]	4	5S[2]	5
				Non-Lightweight	Lightweight				
1"	-	-	-	-	-	-	-	-	-
7/8"	0–2	0	-	-	-	-	-	-	-
3/4"	20–35	0–2	0	0	0	-	-	-	-
5/8"	85–100	20–40	0–5	0–5	0–2	0	0	-	-
1/2"	-	80–100	55–85	20–40	10–25	0–5	0–5	0	0
3/8"	95–100	95–100	95–100	80–100	60–80	60–85	20–40	0–5	0–5
1/4"	-	-	-	95–100	95–100	-	-	65–85	-
#4	-	-	-	-	-	95–100	95–100	95–100	50–80
#8	99–100	99–100	99–100	98–100	98–100	98–100	98–100	98–100	98–100

1. Round test results to the nearest whole number.
2. Single-size gradation.

Table 3
Aggregate Quality Requirements

Property	Test Method	Requirement[1]	
		Minimum	Maximum
SAC	AQMP	As shown on the plans	
Deleterious Material[2], %	Tex-217-F, Part I	-	2.0
Decantation, %	Tex-406-A	-	1.5
Flakiness Index, %	Tex-224-F	-	17
Gradation	Tex-200-F, Part I	Table 2 Requirements	
Los Angeles Abrasion, %	Tex-410-A	-	35
Magnesium Sulfate Soundness, 5 Cycle, %	Tex-411-A	-	25
Micro-Deval Abrasion, %	Tex-461-A	Note 3	
Coarse Aggregate Angularity[4], 2 Crushed Faces, %	Tex-460-A, Part I	85	-
Additional Requirements for Lightweight Aggregate			
Dry Loose Unit Wt., lb./cu. ft.	Tex-404-A	35	60
Pressure Slaking, %	Tex-431-A	-	6.0
Freeze-Thaw Loss, %	Tex-432-A	-	10.0
Water Absorption, 24hr., %	Tex-433-A	-	12.0

1. Material requirements are listed below, unless otherwise shown on the plans.
2. Not required for lightweight aggregate.
3. Used to estimate the magnesium sulfate soundness loss in accordance with Section 2.1.1.
4. Only required for crushed gravel.

Section 2.1.1., "Micro-Deval Abrasion," is added.

The Engineer will perform a minimum of one Micro-Deval abrasion test in accordance with Tex-461-A for each coarse aggregate source per project that has a Rated Source Soundness Magnesium (RSSM) loss value greater than 15 as listed in the BRSQC. The Engineer may waive all Micro-Deval testing based on a satisfactory test history of the same aggregate source.

The Engineer will estimate the magnesium sulfate soundness loss for each coarse aggregate source, when tested, using the following formula.

$Mg_{est.} = (RSSM)(MD_{act.}/RSMD)$

where:
$Mg_{est.}$ = magnesium sulfate soundness loss
$MD_{act.}$ = actual Micro-Deval percent loss
RSMD = Rated Source Micro-Deval

When the estimated magnesium sulfate soundness loss is greater than the maximum magnesium sulfate soundness loss specified, the coarse aggregate source will not be allowed for use unless otherwise approved by the Engineer. The Engineer may require additional testing before granting approval.

Section 2.2., "Precoating." The third paragraph is voided and replaced by the following.

The Engineer retains the right to remove precoat material from aggregate samples in accordance with Tex-210-F, or as recommended by the Construction Division, and test the aggregate to verify compliance with Table 2 and Table 3 requirements. Gradation testing may be performed with precoat intact.

Section 2.3., "Sampling," is added.

Personnel who conduct sampling and witnessing of sampling must be certified by the Department-approved certification program. Supply the Engineer with a list of certified personnel and copies of their current certificates before beginning construction and when personnel changes are made. At any time during the project, the Engineer may perform production tests as deemed necessary in accordance with Item 5, "Control of the Work."

The Engineer will sample aggregate from stockpiles located at the production site, intermediate distribution site, or project location in accordance with Tex-221-F, Section 3.2.3. The Engineer will split each sample into 2 equal portions in accordance with Tex-200-F, Section 3.3, and label these portions "Engineer" and "Contractor" or "Supplier." Witness the sampling and splitting, and take immediate possession of the samples labeled "Contractor" or "Supplier".

Section 2.4., "Reporting and Responsibilities," is added.

The Engineer will provide test results to the Contractor and Supplier within 10 working days from the date the stockpile was sampled for sources listed on the Department's Bituminous Rated Source Quality Catalog (BRSQC), unless otherwise directed. The Engineer will provide test results for the LA Abrasion (Tex-410-A) and Magnesium Sulfate Soundness (Tex-411-A) tests within 30 calendar days for sources not listed on the BRSQC, or for sources not meeting the requirements of Section 2.1.1., "Micro-Deval Abrasion." The Engineer will report to the other party within 24 hours when any test result does not meet the requirements listed in Table 2 or Table 3.

Special Provision to Item 314
Emulsified Asphalt Treatment

Item 314, "Emulsified Asphalt Treatment" 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.

Articles 1 through 6 are voided and replaced by the following**:**

1. DESCRIPTION

Apply a mixture of water and asphalt emulsion as a base or subgrade treatment; for erosion control, including dust prevention; or as a prime coat.

2. MATERIALS

Furnish materials of the type and grade shown on the plans in accordance with the following:

2.1. **Emulsion.** Furnish emulsified asphalt meeting the requirements of Item 300, "Asphalt, Oils, and Emulsions."

2.2. **Emulsion and Water Mixture.** Dilute the emulsion by adding water to create a mixture containing a proportion of emulsion, expressed as a percentage of total volume, in accordance with the percentage shown on the plans or as directed.

3. EQUIPMENT

Provide a self-propelled sprinkler in accordance with Article 204.3., "Equipment." Provide current calibration documentation for the tank used for distribution.

4. CONSTRUCTION

Agitate the emulsion and water mixture to produce a uniform blend. Evenly distribute at the rate selected by the Engineer to locations shown on the plans or as directed.

4.1. **Base or Subgrade Treatment**. Treat the base or subgrade to the depth and width shown on the plans or as directed.

Regulate the percentage of emulsion in the mixture and distribute successive applications to achieve the specified rate. Maintain the proper moisture content of the treated material. Mix the treated material, then shape and compact as required by the specification for the course. Finish the course to the line, grade, and typical section shown on the plans. Maintain the surface with light applications of the mixture while curing the course, as directed.

4.2. **Erosion Control**. Apply the mixture as shown on the plans or as directed.

4.3. **Prime Coat**. Regulate the percentage of emulsion in the mixture and distribute successive applications to achieve the specified rate.

5. MEASUREMENT

The treatment will be measured by the gallon of emulsion used in the emulsion and water mixture.

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 "Emulsified Asphalt (Base or Subgrade Treatment)," "Emulsified Asphalt (Erosion Control)," or "Emulsified Asphalt (Prime Coat)," of the type and grade specified. This price is full compensation for materials, including emulsion and water, and for equipment, labor, tools, and incidentals.

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
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 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 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 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 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 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 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 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 3084
Bonding Course

1. DESCRIPTION

Construct a bonding course where improved bonding is needed using a Tracking-Resistant Asphalt Interlayer (TRAIL) or a Spray Applied Underseal Membrane, applied before the placement of a new hot-mix asphalt concrete pavement.

2. MATERIALS

2.1. Furnish the materials for one of the following two options:

2.1.1. **TRAIL.** Furnish asphalt material described as "tack" for typical use in the TRAIL Material Producer List. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

2.1.2. **Spray Applied Underseal Membrane.** Furnish asphalt material meeting the requirements of Special Specification 3002, "Spray Applied Underseal Membrane." Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

2.2. Furnish the material for applying tack coat to all miscellaneous contact surfaces when approved by the Engineer:

2.2.1. **Miscellaneous Tack.** FurnishTRAIL asphalt, CSS-1H, SS-1H, or a PG binder with a minimum high-temperature of PG 58 for tack coat binder in accordance with Item 300, "Asphalts, Oils, and Emulsions." Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

2.3. **Sampling**. The Engineer will witness the collection of at least one sample of each asphalt binder per project in accordance with Tex-500-C, Part III, and test it to verify compliance with Item 300, "Asphalts, Oils, and Emulsions" or Special Specification 3002, "Spray Applied Underseal Membrane."

3. EQUIPMENT

3.1. **TRAIL.** Provide the equipment recommended by the producer.

3.2. **Spray Applied Underseal Membrane.** Provide in accordance with Special Specification 3002, "Spray Applied Underseal Membrane."

4. CONSTRUCTION

4.1. **Preparation.** Remove existing raised pavement markers. Repair any damage incurred by removal as directed. Remove dirt, dust, or other harmful material before sealing. When shown on the plans, remove vegetation and blade pavement edges. When approved by the Engineer, apply a thin, uniform coating of Miscellaneous Tack to all miscellaneous contact surfaces such as curbs, structures, and manholes. Prevent splattering of the tack coat when placed adjacent to curb, gutter, and structures.

4.2. **Test Strips.** When required by the Engineer, perform a test strip of TRAIL at a location on or near the project as directed. Allow the strip to cure for a maximum of 30 min. Drive over the test strip with equipment used during laid-down construction to simulate the effect of paving equipment. There should be no evidence of tracking or picking up of the TRAIL material on the wheels of the equipment.

4.3. **TRAIL.** Perform the following construction methods when applying a TRAIL for a bonding course:

4.3.1. **Placement.** Uniformly apply the TRAIL material to all areas where mix will be placed, including joints, at the rate shown on the plans or as directed, within 15°F of the approved temperature, and not above the maximum allowable temperature. Unless otherwise directed, uniformly apply the TRAIL material at a minimum rate specified on the plans. The Engineer may adjust the application rate, taking into consideration the existing pavement surface conditions.

4.4. **Spray Applied Underseal Membrane.** Place in accordance with Special Specification 3002, "Spray Applied Underseal Membrane."

4.4.1. **Placement.** Do not allow any loose mixture onto the prepared surface before application of the membrane. Unless otherwise directed, uniformly apply the membrane to all areas where mix will be placed, including joints, at the rate shown on the plans. Unless otherwise directed, uniformly apply the membrane at the minimum rate specified on the plans. The Engineer may adjust the application rate, taking into consideration the existing pavement surface conditions.

4.5. **Informational Shear Test.** Obtain one set of full depth core specimens per project in accordance with Tex-249-F within one working day of the time the lot placement is completed. The Engineer will select the core locations. Provide the cores to the Engineer in a container labeled with the Control-Section-Job (CSJ) and lot number. The district will determine the shear bond strength between the two bonded pavement layers in accordance with Tex-249-F. Results from these tests will not be used for specification compliance.

4.6. **Quality Control.** Stop application if it is not uniform due to streaking, ridging, pooling, or flowing off the roadway surface. Verify equipment condition, operating procedures, application temperature, and material properties. Determine and correct the cause of non-uniform application.

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 stop the application 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;
- Evidence of tracking or picking up of the TRAIL;
- In 3 consecutive shots, application rate differs by more than 0.02 gal. per square yard from the rate directed; or
- Any shot differs by more than 0.04 gal. per square yard from the rate directed.

The Engineer will approve the test strip location. The Engineer may require additional test strips until surface treatment application meets specification requirements.

5. MEASUREMENT

5.1. **Volume**. The asphalt material, including all components, will be measured at the applied temperature by strapping the tank before and after road application and determining the net volume from the calibrated distributor. The Engineer will witness all strapping operations for volume determination. All asphalt material, including emulsions, will be measured 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 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 "Measurement" will be paid for at the unit bid price for "Bonding Course." These prices are full compensation

for all materials, Miscellaneous Tack used for miscellaneous contact surfaces, equipment, labor, tools, and incidentals necessary to complete the work.

Special Specification 5001
Geogrid Base Reinforcement

1. DESCRIPTION

Furnish and place geogrid base reinforcement in accordance with the lines and grades shown on the plans or as directed.

2. MATERIALS

Provide geogrid base reinforcement, of the type shown on the plans, meeting the requirements of DMS-6240 "Geogrid for Base/Embankment Reinforcement." Use roll widths and lengths shown on the plans or as approved.

3. CONSTRUCTION

Prepare the subgrade as indicated on the plans or as directed. Set string lines for alignment if directed. Install geogrid in accordance with the lines and grades as shown on the plans. Place base material in lift thicknesses and compact as shown on the plans or as directed. Do not operate tracked construction equipment on the geogrid until a minimum fill cover of 6 in. is achieved. Rubber tire construction equipment may operate directly on the geogrid at speeds of less than 5 mph if the underlying material will support the loads. Where excessive substructure deformation is apparent, correct grid placement operations as recommended by the manufacturer or as directed

3.1. **Geogrid Placement.** Orient the geogrid length as unrolled parallel to the direction of roadway. Overlap geogrid sections as shown on the plans or as directed. Use plastic ties at overlap joints or as directed. Placement of geogrid around corners may require cutting and diagonal lapping. Pin geogrid at the beginning of the backfill section as directed. Keep geogrid taut at the beginning of the backfilling section but not restrained from stretching or flattening.

3.1.1. **Longitudinal Joints.** Overlap longitudinal joints by a minimum of 1 ft. Space longitudinal ties 10 ft. to 20 ft. or as directed.

3.1.2. **Transverse Joints.** Overlap transverse joints by a minimum of 1 ft. Space transverse ties 4 ft. to 5 ft. or as directed.

3.2. **Damage Repair.** As directed, remove and replace contractor damaged or excessively deformed areas without additional compensation. Lap repair areas a minimum of 3 ft in all directions. Tie each side of repair grid in at least 3 locations but do not exceed normal construction spacing; tie spacing for odd shapes will be as directed. Repair excessively deformed materials underlying the grid as directed

4. MEASUREMENT

Geogrid base reinforcement will be measured by the square yard of roadway placement as shown in the plans with no allowance for overlapping at transverse and longitudinal joints.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" are paid for at the unit bid price for "Geogrid Base Reinforcement" of the type specified. This

price is full compensation for furnishing, preparing, hauling and placing materials including labor, materials, freight, tools, equipment 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 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 7016
WATER AND SANITARY SEWER SYSTEMS

1. DESCRIPTION

This Item will govern for furnishing new materials and installing water and sanitary sewer systems shown on the plans.

2. TABLE OF CONTENTS

3. WATER MAINS

3.1. **Description.** Furnish all labor, materials, equipment and incidentals required to install water mains as shown on the plans and as specified.

3.2. **Materials.**

3.2.1. **Polyvinyl Chloride (PVC) Pressure Pipe.** The following specifications cover the requirements for polyvinyl chloride (PVC) pressure plastic pipe materials and installation for potable water use and apply to PVC pipe, sizes 4 inch through 16 inch diameters.

3.2.1.1. Quality Assurance. Color-code PVC pipe in blue to provide positive identification and prevent accidental damage to or interruption of the water facilities. Pipe will conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 “Drinking Water System Components - Health Effects” and be certified by and organization accredited by ANSI. Provide compliance affidavit from the manufacturer or vendor. If the pipe does not conform to this standard, information from the manufacturer regarding action being taken to comply with this standard must be submitted.

Only pipe manufactured in the United States of America will be accepted.

Pipe must be suitable for use in the conveyance of water for human consumption. Mark each piece of pipe with two seals of the testing agency that certified the pipe material as being suitable for potable water use.

3.2.1.2. Submittals. Furnish all necessary shop drawings, certificates, etc. for review and acceptance. A certification from the manufacturer must be furnished attesting compliance with appropriate ASTM Standards and ANSI/NSF Standard 61.Such compliance will be evidenced by an affidavit from the manufacturer or vendor.

If the pipe does not presently conform to this standard, information from the manufacturer regarding action being taken to comply with this standard must be submitted. Failure to provide this information may result in rejection of pipeline material. Include documentation on pipe products, fittings, and related materials as may be required by the plans or the Engineer. Review all submittals prior to submission. Submit it in a timely manner so as not to delay the project. Allow sufficient time for Engineer's review and resubmission, if necessary. Include certifications from manufacturer that the product complies with appropriate ASTM standards

3.2.1.3. Standards**.** Comply with the applicable requirements of the following items listed below. In case of conflict between the requirements of this Specification and those of the listed documents, the requirements of this Section will prevail.

- ANSI/NSF 61 Drinking Water System Components - Health Effects
- ASTM F-477 Specifications for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- ASTM D-1784 Specifications for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds
- ASTM D-2241 Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series)
- ASTM D-2774 Recommended Practice for Underground Installation of Thermoplastic Pressure Piping
- ASTM D-2837 Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
- ASTM D-3139 Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
- AWWA C-651 Standard for Disinfecting Water Mains
- AWWA C-900 Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch through 12-inches, for Water Distribution
- AWWA C-905 Standard for Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14-inch through 36-Inches
- AWWA M-23 Manual: PVC Pipe - Design and Installation
- UNI-BELL-3 Polyvinyl Chloride (PVC) Pressure Pipe (Complying with AWWA Standard C-900)
- UNI-BELL-11 Polyvinyl Chloride (PVC) Water Transmission Pipe Nominal Diameters 14-36 inches
- Texas Commission on Environmental Quality, Chapter 290 - Public Drinking Water

3.2.1.4. Delivery and Storage**.** Pipe, fittings, and accessories will be inspected upon delivery and during progress of the work. Any material found defective will be rejected and must be promptly removed from the site.

Unload at point of delivery all pipe, fittings, and other accessories, unless otherwise directed, haul to and distribute at the work site. In loading and unloading, lift materials by hoists or roll on skidways to avoid shock or damage. Do not incorporate materials that have been dropped. Do not skid or roll pipe handled on skidways against pipe already on the ground.

Do not store PVC pipe outside exposed to prolonged periods of sunlight. Any discoloration of pipe due to such exposure is an indication of reduced pipe impact strength, and will be sufficient cause for rejection of the pipe. Remove rejected all pipe from the job site.

3.2.1.5. Pipe Materials. Meet the requirements of AWWA C-900 for 4 inch through 12 inch sizes, and AWWA C-905 for 14 inch through 36 inch pipe. Provide pipe that is Underwriters Laboratories (UL) approved. Furnish all PVC pressure pipe in cast iron pipe equivalent outside diameters and a standard laying length of 20 feet. Provide a minimum pressure class of 235 psi (DR 18) for 4 inch through 12 inch diameters and 200 psi (DR 21) for 14 inch through 16 inch pipe.

3.2.1.6. Joints. Furnish push-on flexible, elastomeric gasketed pipe joints. The pipe length must contain one bell-end or couple with a synthetic elastomeric gasket.

Gaskets must meet the requirements of ASTM F-477. The bell will be an integral part of the pipe length, and have the same strength and DR as the pipe. The spigot pipe end will be beveled.

All push-on joint PVC pipe must have dual insertion marks on the spigot indicating proper penetration when the joint is assembled and only one mark remains visible. The sockets and/or spigot configurations for the fittings and couplings will be compatible to the pipe. Socket configuration must prevent improper installation of gasket and will ensure that the gasket remains in place during joining operations.

Cartridge-style restrained joint PVC pipe will be joined using a non-metallic coupling to form an integral system. Coupling will be designed for use at or above the pressure class of the pipe with which they are utilized and will incorporate twin elastomeric sealing gaskets meeting ASTM F-477. High strength, flexible thermoplastic splines will be inserted mating, machined grooves in the pipe and coupling to provide full 360° restraint.

Restrained joint pipe systems must have a restrained joint that in and of itself prevents over belling of the pipe during assembly of the joint and every joint already assembled in that string of pipe. Restrained joint system will allow the installer to both push and pull the pipe during installation without the risk of over belling of any of the pipe joints in the string. Joint will not require electrical power or other additional equipment (other than hand tools) to assemble.

3.2.1.7. Fittings**.** Provide DIP, cement lined pipe fittings in accordance with AWWA C-110 and Article 7, "Valves and Fittings". Provide mechanical joint (MJ) pipe fittings unless otherwise specified.

3.2.1.8. Provisions for Thrust**.** For 12-inch diameter water mains and smaller, concrete thrust blocks or other approved thrust restraint method will be installed at all fittings and valves per design plans and in accordance with these Specifications. If approved, thrust restraint devices may be installed in lieu of thrust blocks as per manufacturer's specifications.

For 16-inch diameter water mains and larger, thrust restraint devices must be installed at all fittings and valves per manufacturer's specifications and as shown on design plans. Concrete thrust blocks are not allowed unless approved by the Engineer.

Acceptable thrust restraint devices include EBAA Iron, Ford Uni-Flange, or approved equal.

NOTE: At connection of new water line to existing main, both concrete thrust blocking in accordance with this Specification and thrust restraint devices must be used, regardless of main size.

Thrust restraint devices must be used for a sufficient distance from each bend, tee, plug, or other fitting to resist thrust which will be developed at the test pressure of the pipe. For the purposes of thrust restraint, test pressure will be 1.5 times the design working pressure indicated. Length of pipe with restrained joints to resist thrust forces will be determined by pipe manufacturer.

3.2.1.9. Pipe Trenching, Installation and Backfill**.** Except as noted, Pipe Trenching, Installation and Backfill for PVC Pressure Pipe will be in accordance with AWWA M-23, C-900, C-905, and conforming to "Excavation and Backfill for Structures" Item 400 and details shown on construction plans.

3.2.1.9.1. Trench Width**.** Provide a minimum trench clear width of 1foot greater than the outside diameter of the pipe and a maximum clear width at a point 1 foot above the top of the pipe equal to the pipe outside diameter plus 2 feet. If the maximum recommended trench width is exceeded or if the pipe is installed in a compacted embankment, compact pipe embedment to a minimum point of 2 1/2 pipe diameters from the side of the pipe or to the trench walls.

3.2.1.9.2. Pipe Zone Embedment**.** Unless otherwise specified, embed PVC pressure pipe in Class II material as defined in Item 400, "Excavation and Backfill for Structures". Native material or imported material meeting or exceeding Class II requirements may be used. Class I material is acceptable at the Engineer's discretion.

3.2.1.9.3. Installation**.** Install plastic pressure pipe in accordance with AWWA M 23 and C-900/C-905 and/or manufacturer's printed recommendations, whichever is applicable. Where a conflict arises, this Specification controls.

Exercise care to insert the pipe spigot to the correct reference mark per manufacturer's recommendation to prevent buckling or separation of the pipe joint. The second insertion mark must be visible after installation and not be further than 3/4-inch from the leading edge of the pipe bell. Verify that the manufacturer's reference marks are correct per manufacturer's literature.

Do not drop pipe or accessories into the trench. When pipe laying is not in progress, close the open ends of installed pipe to prevent entrance of trench water, dirt, and foreign matter into the line.

3.2.1.9.4. Marking Tape**.** Mark PVC pressure water pipe by installing the appropriate marking tape for detection purposes concurrently. Provide a high visibility blue detectable tape consisting of a 5.0 mil inert polyethylene plastic material with the standard warning and identification for potable water imprinted on the tape. Provide a minimum width of 6 inches for all potable water lines and bury tape to a depth of 36 inches, measured from finished grade. Use detecting tape manufactured by Empire, Lineguard, or approved equal.

3.2.1.9.5. Deflection**.** Maximum ring deflection (cross-sectional deflection) of installed PVC pressure pipe is 5 percent. Joint deflection (horizontal deflection) will not exceed manufacturer's recommendations for the particular pipe size.

3.2.1.9.6. Corrosion Protection**.** As a precaution against corrosion, coat all flanges, bolts, nuts and other exposed metal surfaces underground with Texaco, Koppers, or approved equal rustproof compound.

3.2.1.10. Testing**.** Disinfect and test the piping system as detailed in AWWA C-651 and in accordance with Article 10, "Cleaning, Disinfection, and Testing of Water System".

3.2.2. **Ductile Iron Pipe**. The following specifications cover the requirements for ductile iron pipe (DIP) materials.

3.2.2.1. Quality Assurance**.** Manufacturer must have a minimum of ten years successful experience in designing and manufacturing DIP, pipe joints of similar design, pipe diameter, and pressure class of the type specified. The entire pipeline will be the product of one manufacturer. Pipe must conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 "Drinking Water System Components - Health Effects" and be certified by and organization accredited by ANSI. Such compliance will be evidenced by an affidavit from the manufacturer or vendor. If the pipe does not presently conform to this standard, information from the manufacturer regarding action being taken to comply with this standard must be submitted.

3.2.2.2. Submittals**.** Submit documentation on pipe products, fittings, and related materials as required by the plans or Engineer. Review all submittals prior to submission. Submit in a timely manner so as not to delay the project. Allow sufficient time for Engineer's review and resubmission, if necessary. Include certifications from manufacturer that the DIP complies with appropriate AWWA Standards and ANSI/NSF Standard 61. Provide by an affidavit from the manufacturer or vendor as evidence of compliance. If the pipe does not presently conform to this standard, information from the manufacturer regarding action being taken to comply with this standard must be submitted. If requested, provide copies of results of factory hydrostatic tests.

3.2.2.3. Standards**.** Comply with applicable requirements of the following items listed below. In case of conflict between the requirements of this Specification and those of the listed documents, the requirements of this Section will prevail:

- ANSI/NSF 61 Drinking Water System Components - Health Effects
- ASTM A-536 Specification for Ductile Iron Castings
- AWWA C-104 Standard for Cement Mortar Lining for Ductile Iron Pipe and Fittings
- AWWA C-105 Standard for Polyethylene Encasement for Ductile Iron Piping
- AWWA C-110 Standard for Ductile Iron and Gray Iron Fittings

- AWWA C-111 Standard for Rubber Gasket Joints for Ductile Iron Pipe and Fittings
- AWWA C-150 Standard for Thickness Design of Ductile Iron Pipe
- AWWA C-151 Standard for Ductile Iron Pipe
- AWWA C-214 Tape Coating Systems for the Exterior of Steel Water Pipelines
- AWWA C-600 Standard for Installation of Ductile Iron Water Mains & Appurtenances
- AWWA C-651 Disinfecting Water Mains
- Texas Commission on Environmental Quality, Chapter 290 - Public Drinking Water

3.2.2.4. Pipe Material**s.** Manufacture DIP in accordance with AWWA C-151 and conform to ASTM Specification A-536 with physical properties of Grade 60-40-18 with a minimum pressure class rating of 350 psi, unless otherwise specified. Design pipe for five (5) feet of cover or for the depths shown on the plans, whichever is greater. Provide a standard joint length of 18 or 20 feet and an industry standard inside diameter. Replace any material found to be damaged or defective in manufacture at Contractor's expense.

3.2.2.5. Joints**.** Provide push-on standard joints for DIP manufactured in accordance with AWWA C-111, AWWA C-151. Where indicated on the plans, joints will be mechanical or flanged. Flanged joints will have pressure ratings equal to or greater than adjacent pipe. Flange pattern will match pattern of valve, fitting, or appurtenance to be attached.

3.2.2.6. Fittings**.** Provide DIP in accordance with AWWA C-110 and Article 7 of this Specification. Fittings will be rated for a minimum working pressure of 250 psi, unless otherwise specified. Factory welded outlets, minimum pressure rating 250 psi, may be used in lieu of tee fittings for 18 inch and larger tee fittings. Do not use factory welded outlets near sources of vibration, such as pump stations or roads, unless specifically noted on the plans.

3.2.2.7. Exterior Coating**.** Provide a standard asphaltic coating in accordance with AWWA C-151, unless otherwise specified. The finished coating will be continuous, and smooth and strongly adherent to the pipe.

For DIP sizes 30 inches and smaller, use a 30 mils minimum thickness polyethylene wrap applied wrap in accordance with AWWA C-105/A21.5.

Tape coat DIP 36 inches and larger. The exterior of the pipe must have a prefabricated cold-applied tape coating system conforming to the requirements of ANSI/AWWA C-214, except as noted herein. Blast clean the surface to achieve a surface preparation at least equal to that specified in SSPC SP6. The blast profile must have an anchor pattern as specified by the tape manufacturer. Hold the coating back from the end of the pipe the minimum distance recommended by the pipe manufacturer for the type of joint used. Taper the tape wrap cut back. Provide a nominal thickness of 80 mils.

3.2.2.8. Interior Lining**.** DIP Pipe and fittings will have a cement mortar lining in accordance with AWWA C-104 and bituminous seal coat. Cement Type for lining will be appropriate for pipe application. Provide lining thickness as specified in AWWA C-104.

3.2.2.9. Provisions for Thrust**.** Where indicated and where required for thrust restraint, joints must be restrained. Restrained joints will be mechanically interlocking joints. Provide restrained joints such as U.S. Pipe "TR Flex", American Cast Iron Pipe "Flex Ring", or Clow Corporation "Super-Lock" that are capable of sustaining the specified design pressure. If thrust cannot be accommodated using restrained joints, such as bends adjacent to casing pipe, use approved thrust restraint devices.

Thrust at bends, tees, plugs, or other fittings must be resisted using thrust restraint devices. Concrete thrust blocks are not allowed unless approved by the Engineer. Acceptable thrust restraint devices are as manufactured by EBAA Iron, Ford Uni-Flange, or approved equal.

NOTE: At connection of new water line to existing main, both concrete thrust blocking (per Article II of these Specifications) and thrust restraint devices must be used.

Restrained joints and thrust restraint devices must be used for a sufficient distance from each bend, tee, plug, or other fitting to resist thrust which will be developed at the design pressure of the pipe. For the purposes of thrust restraint, design pressure is 1.5 times the design working pressure class indicated. Length of pipe with restrained joints and restraint devices will be determined by pipe manufacturer and/or in accordance with the Handbook of Ductile Iron Pipe.

The following parameters will be used: laying condition equal to AWWA C-600 Type 5 soil, safety factor of 1.8, a unit bearing resistance equal to zero, an a factor for polyethylene encasement as recommended by DIPRA (Ductile Iron Pipe Research Association), if required.

3.2.2.10. Pipe Trenching, Installation, and Backfill**.** Except as noted, perform pipe trenching, Installation, and Backfill for DIP in accordance with AWWA C-600 and Article 6 of this Specification.

3.2.2.10.1. General. Repair any damage to polyethylene wrap according to AWWA C-105. Keep pipe clean during installation. Provide two coats of Koppers Bitumastic No. 50, or approved equal to exposed ferrous metal that cannot be protected with field-applied tape coating. Install pipe and fittings to line and grade indicated. In areas where the line and grades indicated cannot be achieved using standard manufactured bends and fittings, make slight adjustments by deflecting joints according to the limitations of AWWA C-600.

3.2.2.10.2. Pipe Zone Embedment. Unless otherwise specified, embed DIP in Class II material as defined in Article 6. Native material or imported material meeting or exceeding Class II requirements may be used.

3.2.2.10.3. Marking Tape**.** Mark DIP by installing the appropriate marking tape for detection purposes concurrently. Provide a high visibility blue detectable tape consisting of a 5.0 mil inert polyethylene plastic material with the standard warning and identification for potable water imprinted on the tape. Provide a minimum width of 6 inches for all potable water lines and bury tape to a depth of 36 inches, measured from finished grade. Use detecting tape manufactured by Empire, Lineguard, or approved equal.

3.2.2.10.4. Pipe Cutting. When required, machine cut DIP leaving a smooth cut at right angles to the axis of the pipe. Bevel ends of cut pipe to be used with a push-on joint bell to comply with manufactured spigot end. Do not damage cement lining.

3.2.2.10.5. Corrosion Protection. As a precaution against corrosion, coat all flanges, bolts, nuts and other exposed metal surfaces underground with Texaco, Koppers, or equal rustproof compound.

3.2.2.11. Testing**.** Disinfect and test the piping system in accordance with Article 10 of this Specification and as detailed in AWWA C-651.

3.2.3. **Steel Main Pressure Pipe (STEEL)**. The following specifications cover the requirements for steel main pressure pipe (STEEL) materials and for proper and function of the pipe.

3.2.3.1. Quality Assurance**.** Conform to applicable standards of ASTM and AWWA and ANSI/NSF Standard 61 “Drinking Water System Components – Health Effects”.

Manufacturer must have a minimum of five years successful experience in manufacturing pipe of the particular type and size indicated. The entire pipeline will be the product of one manufacturer and pipe manufacturing operations (pipe, fittings, lining, coating) must be performed at one location. Clearly mark one end of each pipe joint and fitting with the class for which it is designed, the date of manufacturer and the identification number.

The quality of materials, the process of manufacture and finished pipe will be subject to inspection and approval. Inspections may be made at the place of manufacture, on the jobsite or both places. Pipe may be subject to inspection by an independent testing laboratory selected and retained by the El Paso Water Utilities (EPWU). Pipe manufacturer must provide proper facilities for access and inspection and allow laboratory representatives or Engineer to inspect whenever work is in preparation or progress. Notify EPWU, through Engineer in writing, at least two weeks prior to pipe fabrication so that the manufacturer is advised of the decision regarding independent laboratory tests to be performed. Material, fabricated parts,

and pipe, discovered to be defective, or do not conform to the requirements of this specification are subject to rejection at any time prior to final acceptance of the product. Promptly remove rejected materials from the jobsite.

The inspection and testing by the independent testing laboratory anticipates that production of pipe be done over a normal period of time and without “slowdowns” or other abnormal delays. In the event that an abnormal production time is required, and EPWU is required to pay excessive costs for inspection, reimburse EPWU for such laboratory costs over and above those incurred under a normal schedule of production as determined by the Engineer.

Welders must be certified as qualified in accordance with Chapter 9 of the ASME Boiler and Pressure Vessel Code and AWWA C-206. Welds will be tested for conformance with ASTM E-165. Submit welded test specimens upon request.

3.2.3.2. Submittals**.** Provide record drawings from the pipe manufacturer for pipe and fittings prior to fabrication that a schematic location-profile and a tabulated layout schedule, both of which are appropriately referenced to the stationing of the proposed pipeline as shown on the plan-profile sheets. Base record drawings on the plans and specifications and incorporate changes necessary to avoid conflicts with existing details of reinforcement, lining, and dimensions for pipe and fittings. Include details for the design and fabrication of all fittings, specials and provisions for thrust restraint. Where welded joints are required, include proposed welding requirements and provisions for thermal stress control. Record drawings are for record purposes only and will not be reviewed or approved.

Provide an affidavit stating that the pipe to be furnished complies with AWWA C-200, AWWA C-205, AWWA C-214, and these specifications.

Furnish the procedure, specifications and qualification records of welding procedures for all pipe welding to be performed for review and approval. Submit a list of the welders and the type of welding for which each has been qualified. All qualification and requalification tests costs are at Contractor's expense.

3.2.3.3. Standards**.** Comply with the following applicable requirements:

- ASTM A-307 Low Carbon Steel Externally Threaded Standard Fasteners
- AWWA C-200 Standard for Steel Water Pipe 6-inches and Larger
- AWWA C-205 Standard for Cement Mortar Protective Lining and Coating for Steel Water Pipe – 4" and Larger
- AWWA C-206 Standard for Field Welding of Steel Water Pipe
- AWWA C-207 Standard for Steel Pipe Flanges Waterworks Service – Sizes 4”-144”
- AWWA C-208 Standard for Dimensions for Steel Water Pipe Fittings
- AWWA C-209 Standard for Cold Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings
- AWWA C-214 Standard for Tape Coating Systems for the Exterior of Steel Water Pipelines
- AWWA M-11 Manual: Steel Pipe – A Guide for Design and Installation

3.2.3.4. Delivery and Storage. Deliver, handle, and store pipe in accordance with the Manufacturer’s recommendations to protect coating systems. Prepare pipe for shipment to afford maximum protection from normal hazards of transportation and allow pipe to reach project site in an undamaged condition. Do not deliver pipe damaged in shipment to the project site unless such damaged pipe is properly repaired.

Band plastic end covers to pipe ends and maintain until pipe is placed in the trench. Maintain moisture inside the pipe by periodic application of water, as necessary.

Support pipes carefully during shipment and storage. Internally support and brace each end of each length of pipe, fitting, or special and the middle of each pipe joint with stulls to maintain a true circular shape. Provide internal supports consisting of timber or steel stulls firmly wedged and secured so that the stulls remain in place during handling. Rotate pipe so that one of the stulls is vertical during storage, shipment and

installation. Do not remove stulls from pipe until backfill operations are complete. Separate pipe, fittings, and specials so that they do not bear against each other, and securely fasten the entire load to prevent movement in transit. Ship pipe on padded bunks with tie-down straps approximately over stulling. Store pipe on padded skids, sand or dirt berm, tires, or other suitable means to protect the pipe from damage.

3.2.3.5. Pipe Materials**.** Steel pipe manufactured under AWWA C-200 must be fabricated from sheet or coil conforming to the requirements of ASTM A-570, Grades 30, 33, 36, or 40. It can also be fabricated from plate in coil form conforming to the requirements of ASTM A-36, A-283, Grades C or D, or A 572, Grade 42, or coil conforming to the requirements of ASTM A-139, Grades B or C. Butt weld all longitudinal and girth seams, whether straight or spiral using an approved electric-fusion weld process. Standard laying length is 45 feet.

3.2.3.5.1. Wall Thickness. Determined wall thickness by performance requirements as follows: Minimum pipe wall thickness is 0.188" or pipe O.D./230, whichever is greater for pipe and fittings with no minus tolerance. Maximum fiber stress for minimum wall thickness must not exceed 21,000 psi at design working pressure and not exceed 50% of the minimum yield strength of the steel used at the specified maximum working pressure for each class of pipe. In addition, the fiber stress must not exceed 75% of the maximum yield strength at the working pressure plus transient pressure. Minimum wall thickness for pipe placed in casing or tunnel liner is O.D./144 or 0.25" whichever is greater.

3.2.3.5.2. Exterior Tape Coating. Coat and wrap pipe outside with the pre-fabricated multi-layer cold-applied polyethylene tape coating in accordance with AWWA C-214. Provide machine-applied tape coating system in accordance with AWWA C-214 and is 80 mils consisting of a primer, 20 mil inner layer, and two 30 mil outer layers. Hold coating back from the end of the pipe the minimum distance recommended by the pipe manufacturer for the specified joint type. Taper tape wrap cut back. Hand wrap specials and fittings that cannot be machine wrapped. The application must conform to AWWA C-209 and consist of three layers, a primer layer and two 35 mm tape layers. Allow the fitting coating system to overlap the machine-applied coating system a minimum of 6-inches and bond together. Use the same manufacturer for hand wrap tape and machine wrap tape. Tape coating manufacturer will recommend the procedure and tape product required to smooth sharp or abrupt changes at bell, spigot, or flanged joints.

3.2.3.5.3. Cement Mortar Lining. Shop-applied cement linings must conform to the requirements of AWWA C-205. Use ASTM C-150 Type I or II cement and silica sand. Field applied cement mortar-lining must conform to the requirements of ASTM C-602. Linings on fittings and specials, such as miters, angles, bends and reducers, may be hand troweled. Thoroughly cleaned the pipe interior a method acceptable to the Engineer.

3.2.3.5.4. Mortar for Interior Joints. Furnish mortar that is one part cement to two parts sand using ASTM C-150 Type I or II cement and silica base sand is plaster and meets ASTM C-35 requirements. Dry mix cement and sand adding sufficient water added to permit packing and troweling without crumbling.

3.2.3.6. Pipe Design**.** Design, manufacture, and test steel pipe in accordance with AWWA C-200, AWWA Manual M-11, and with the criteria specified herein for sizes and pressure classes (working pressure) shown. For the purpose of pipe design, the total design internal pressure (transient pressure plus working pressure) will be 1.5 times the working pressure class specified. Design fittings, specials, and connections for the same pressure as the adjacent pipe. Base pipe design on trench conditions and the design pressure in accordance with AWWA Manual M-11. The trench depth is as shown on the plans. Provide the Unit Weight of Fill (W) of 130 pcf, and use live load for AASHTO HS-20 truck load (unless otherwise specified). Use a deflection lag factor 1.1, a bedding constant of 0.1, the modulus of Soil Reaction (E') for design purposes of 700 and the maximum allowable horizontal or vertical deflection of 2% after backfill. Submit design calculations for approval prior to the fabrication of the pipe. Standard laying length is 45 feet with special lengths, field trim pieces and closure pieces as required by plan and profile for location of elbows, tees, reducers, and other in-line fittings.

3.2.3.7. Joints**.** The standard field joint for steel pipe is either a single welded lap joint or a rubber gasket joint. Mechanically coupled or flanged joints are required where shown. Use butt strap joints where shown. Furnish joints that have the same or higher pressure rating as the abutting pipe.

3.2.3.7.1. Lap Welded Slip Joint. Provide lap welded slip joint at all locations where pipe is to be installed in casing or tunnels and where specified. Do not exceed a clearance of 1/8 inch at any point around the periphery between the surfaces of lap joints. In addition to the provisions of AWWA C-200 for a minimum lap of 1-1/2", the depth of bell must provide a minimum distance of 1inch between the weld and the nearest tangent of the bell radius when welds are to be located on the inside of the pipe. Weld joints from the outside for pipe diameters 30 inches or smaller and on the inside for pipe diameters larger than 30 inches. If specified on the plans, weld joints on the inside and outside.

3.2.3.7.2. Bell and Spigot with Rubber Gasket. The standard joint is bell and spigot with rubber gasket at locations where other joint types are not specified and for working pressures not exceeding 250 psi. Joints must conform to AWWA Standards C-200 and AWWA M-11. Form and size the spigot and groove designed to retain the O-ring rubber gasket and size by rolling on male-female dies to match the bell. The differences in diameter between the I.D. of bell and the O.D. of spigot shoulder, at point of full engagement with allowable deflection, is 0.00" to 0.04" as measured on the circumference with a diameter tape. Provide gasket with sufficient volume to approximately fill the area of the groove in conformance to AWWA C-200 and AWWA M-11. Ensure that the joint is suitable for a safe pressure equal to the pressure class of the pipe and operates satisfactorily with a deflection tangent not to exceed 0.75D where D is the outside diameter of the pipe in inches or with a pull-out of 3/4 inch.

3.2.3.7.3. Flanged Joints. Provide flanged joints on pipe, fittings and specials on welded steel piping exposed in vaults, on buried pipe system to connect valves and appurtenances or where otherwise indicated that conform to the requirements of AWWA C-207 and AWWA C-206. Ends to be fitted with slip-on flanges must have the longitudinal or spiral welds ground flush to accommodate the type of flanges provided. Rate pipe flange pressure equal to or greater than the adjacent pipe class and match the fittings or appurtenances that are to be attached.

3.2.3.7.4. Butt Strap Closure Joints. Provide butt strap closure joints in accordance with AWWA C-206 and applicable provisions of this specification where necessary to provide closure to previously laid pipe.

3.2.3.7.5. Flexible Couplings. Provide flexible couplings where specified. Prepare ends to be joined by flexible couplings as stipulated in AWWA C-200 with plain end type. Ground flush welds on ends to be joined by couplings to permit slipping the coupling in at least one direction to clear pipe joint. Provide harness bolts and lugs that comply with AWWA Manual M-11.

3.2.3.8. Fittings and Specials. Employ special shop fabricated fittings fabricated in accordance with AWWA C-200 and M-11 where abrupt changes in grade and direction occur. Provide fittings in conformance to the dimensions specified in AWWA C-208. Provide elbows with a minimum radius of 2.5 times the pipe O.D. Provide welded fittings of the sizes and types indicated on the plans. Provide steel plate thickness for fittings equal to or greater than nominal thickness of steel pipe. Reinforce all tees, laterals, and outlets in accordance with M-11. Do not field cut the ends of the steel pipe to accomplish angular changes in grade or direction of the line.

3.2.3.9. Provisions for Thrust**.** Use restrained joints to resist thrust at bends, tees, or other. If thrust cannot be resisted using restrained joints, such as bends adjacent to casing pipe, use thrust blocking or concrete anchors. Restrained joints consist of welded joints and will be used a sufficient distance from each side of the bend, tee, plug, or other fitting to resist thrust which develops at the design pressure of the pipe. For the purposes of thrust restraint, use a design pressure of 1.5 times the working pressure class. The length of pipe with restrained joints to resist thrust forces will be determined by the pipe manufacturer in accordance with AWWA Manual M-11. Apply the following criteria for unsaturated soil conditions: calculate the earth weight as the weight of the projected soil prism above the pipe, soil density = 110 pcf (maximum value to be used) and the coefficient of friction = 0.25 (maximum value to be used). In locations where groundwater is encountered, reduce the soil density to its buoyant weight for all backfill below the water table and reduce the coefficient of friction to 0.20.

3.2.3.10. Pipe Trenching, Installation, and Backfill**.** Except as noted, Pipe Trenching, Installation, and Backfill for DIP will be in accordance with AWWA C-600 and Article 6 of this Specification.

3.2.3.10.1. General. Inspect and "jeep" each joint for holidays just before it is lowered into the ditch. Repair all holidays before the pipe is lowered into the trench. Place and consolidate embedment and backfill prior to removing pipe stulls.

3.2.3.10.2. Trench Width. The minimum clear width of the trench is the outer diameter plus 36 inches.

3.2.3.10.3. Pipe Embedment. Unless otherwise specified or shown on the plans, embed steel pipe in Native material as defined in Article 6. If Native material is not suitable, use Class II material as defined in Article 6.2.4.2

3.2.3.10.4. Installation-Welded Joints. Weld joints in accordance with the AWWA C-206. Provide full circle fillet welds. Remove the pipe from the line if the ends of the pipe are laminated, split, or damaged to the extent of satisfactory welding contact cannot be obtained.

Welders are required to identify their work with a code marking. Furnish a listing of the welder's names with corresponding code marks. Any welder making defective welds will not be allowed to continue to weld. If a disagreement arises with the Engineer's interpretation of welding tests, test sections may be cut from the joint for physical testing. Repair joint, regardless of the results of physical testing, at no additional cost to the Department. Submit repair procedure for approval before proceeding.

Provide adequate provisions for reducing temperature stresses.

Shim or tack the spigot and bell essentially concentric to obtain clearance tolerance around the periphery of the joint after the pipes have been joined and properly aligned and prior to the start of the welding procedure. Clearance tolerances are not permitted to accumulate.

Before welding, thoroughly clean pipe ends. Weld pipe by machine or by the manual shielded electric arc process. Perform welding in a manner that does not damage lining or coating. Cover the tape coating as necessary to protect from welding.

Furnish labor, equipment, tools and supplies, including shielded type welding road. Protect welding road from any deterioration prior to its use. If any portion of a box or carton is damaged, reject entire box or carton.

Deposit metal in successive layers so that there will be at least 2 passes or beads in the completed welds. Deposit no more than 1/4 inch of metal on each pass. Thoroughly clean each pass, including the final pass, by wire brushing and hammering to remove dirt, slag, or flux.

In all hand welding, deposit metal in successive layers so that there are at least as many passes or beads in the completed weld as indicated in Table 1.

Table 1.
Hand Welding Requirements

Plate Thickness Inches	Fillet Weld, Minimum Number of Passes
3/16	1
1/4	2
5/16	2
3/8	3
13/32	3
7/16	3
15/32	4
1/2	4
More than 1/2	1 for each 1/8" and any remaining fraction thereof

Do not deposit more than 1/8" of metal in each pass for hand welds. Thoroughly bob or peen each pass except the final one, whether in butt or fillet welds, to relieve shrinkage stresses and to remove dirt, slag, or

flux before the succeeding bead is applied. Thoroughly fuse each pass into the plates at each side of the welding groove or fillet and do not permit to pile up in the center of the weld. Undercutting along the side is not permitted.

Construct welds free from pin holes, non-metallic inclusions, air pockets, undercutting and/or any other defects.

3.2.3.10.5. Installation – Rubber Gasket Joints. Join rubber gasket joints in accordance with the manufacturer's recommendations. Clean bell and spigot of foreign materials. Lubricate gaskets and relieve gasket tension around the perimeter of the pipe. Engage spigot as far as possible in bell, allowing for a 3/8 inch to 1 inch gap for inside joint grouting after any joint deflection.

3.2.3.10.6. Interior Joint Grouting for Pipe with Plant-Applied Mortar Lining. Upon completion of backfill, fill the inside joint recess with a stiff cement mortar as indicated. Prior to the placing of mortar, clean out dirt or trash that has collected in the joint, and moisten the mortar surfaces of the joint space by spraying or brushing with a wet brush. Ram or pack the stiff mortar into the joint and take extreme care to insure that no voids remain in the joint space. After the joint has been filled, level the surface of the joint with the interior surfaces of the pipe by steel troweling. Carefully inspect every joint to ensure a smooth continuous interior surface. Thoroughly clean the interior of the pipe and remove any obstructions that may reduce its carrying capacity. Butter with mortar the bottom of the bell on the interior joints of pipe smaller than 21 inches in diameter prior to inserting the spigots, such that when the spigot is pushed into position it extrudes surplus mortar from the joint. Strike off the surplus mortar flush by pulling a filled burlap bag or inflated ball through the pipe.

3.2.3.10.7. Field-Applied Outside Joint Coating. Clean the surface of foreign materials. Remove weld slag, splatter, and scale. Remove by grinding or filing the sharp edges or burrs that could puncture or cut the tape. Clean the surface using a solvent wash and wire brushing, dry, and prime the surface prior to tape coating. Wrap joints with a tape coating system conforming to AWWA C-209, consisting of three layers, a primer layer and two (2) 35 mm tape layers. Overlap the factory-applied coating system with the field-applied coating system a minimum of 6 inches and bond together.

3.2.3.10.8. Protection of Exposed Metal. Coat exposed ferrous metal such as bolts and flanges that cannot be protected with field-applied tape coatings with a coat of Koppers Bitumastic No. 50 or approved equal.

3.2.3.10.9. Patch of Coating: When visual inspection shows a portion of the tape system has sustained physical damage, the area in question may be subjected to an electrical holiday test to 6000 volts. When the area is tested and there are no holidays or tearing of the material (only winkling or bruising), no patching is required. When the damaged area has a tearing of material, remove the damaged layer(s) of outer-wrap by carefully cutting with a sharp razor type utility knife. Wipe the area clean and dry with a rag. Apply the repair tape using a "cigarette wrap" in accordance with the tape manufacturer's recommendation of sufficient size to completely cover the damaged areas, plus a minimum overlap of 6 inches tape in all directions. Apply a second patch of repair tape over the first patch. Overlap the first patch a minimum of 6 inches with the second patch.

3.2.3.10.10. Patch of Lining. Repair cracks larger than 1/16 inch and disbanded linings. Excessive patching of lining is not permitted. Field-patching of lining will be allowed where area to be repaired does not exceed 100 sq. in. and has no dimension greater than 12 inches. Repair larger areas by gunite method and reinforce work. No more than one patch in the lining of any joint of pipe is allowed. Wherever necessary to patch the pipe, make the patch with the mortar indicated. Do not install patched pipe until the patch has been properly and adequately cured and unless approved for laying by the pipe manufacturer's technician and by the Engineer.

3.2.3.11. Testing**.** Disinfect the piping system in accordance with Article 10 of this Specification and as detailed in AWWA C-651. Test the field-applied joint coating for holidays after field-applied coating and prior to backfilling as per AWWA C-209. Where welds cannot be tested by hydrostatic tests, such as fittings adjacent to test valves, perform a dye penetrant test in accordance with ASTM E-165. Replace or repair welds that prove to be defective. Engineer must approve all patch work necessary during such tests.

3.2.4. **Cathodic Protection**.

3.2.4.1. Anodes. Magnesium bar in pre-packaged backfill with test lead wire in weights shown on plans.

3.2.4.2. Chemical Composition of Magnesium Anodes: Percent by weight in accordance with Table 2.

Table 2.
Chemical Composition of Magnesium Anodes

Chemical	Standard	High Potential
Aluminum	5.0-7.0	0.01 Max.
Zinc	2.0-4.0	0.05 Max.
Manganese	0.150 Min.	0.5-1.30
Copper	0.100 Max.	0.02 Max.
Silicon	0.300 Max	0.05 Max.
Iron	0.003 Max	0.03 Max.
Nickel	0.003 Max	0.001 Max.
Others	0.300 Max	0.50 each or 0.300 Max Total
Magnesiurm	Balance	Balance

3.2.4.3. Pre-packaged Backfill.

- 75 percent ground hydrated gypsum
- 20 percent powdered bentonite
- 5 percent anhydrous sodium sulfate
- In water permeable fabric sack with anode centered in sack

3.2.4.4. Lead Wire: No. 12 AWG 600 volts solid copper wire with THW, THWN, or THHN white insulation, at least 15-feet long and factory connected to core with silver brazing alloy with minimum silver content of 15 percent.

3.2.4.5. Detectable Warning Tape. Yellow Mylar encased aluminum foil, minimum 6 inches wide, with imprinted words “CATHODIC PROTECTION”.

3.2.4.6. Thermite Welding Of Wires. Thermite weld test lead and joint bond wires to ductile iron and steel pipe joints and fittings, except where limited use of lugs is permitted following standard details. This weld process may be specified for use on other metallic structures.

3.2.4.7. Select and use thermite welding equipment following equipment manufacturer’s instructions and standard details.

- Use equipment and molds to accommodate wire size, metallic structure’s shape, wire position of attachment (vertical or horizontal) and other criteria specified.
- Before a mold is used, remove and clean slag, dirt, and other foreign matter from mold.
- Use cartridge and charge size based on manufacturer’s recommendations for specific application.
- Different charges are required for steel and ductile iron.

3.2.4.8. Surface Preparation

Surfaces with Little or No Coating. Clean to bare metal by grinding or filing area approximately 3-inches square to produce bright metal surface. Remove coating, dirt, mill scale, oxide, grease, moisture, and other foreign matter from weld areas.

Surfaces with High Performance or Thick Coating. Cut 4 inch square window through coating and clean 3 inch square of surface to bright metal, avoiding damage to surrounding coating.

3.2.4.9. Preparation for Welding. Before welding, remove wire insulation as required to fit mold, avoiding damage to exposed copper wire

- If wire is cut or nicked over half way through its diameter, cut off and strip new end.
- If manufacturer requires use of copper sleeve, crimp it securely to wire and remove excess wire protruding from end of sleeve.

3.2.4.10. Test Connection. After charge is set, remove mold and slag from weld area with welder's hammer. Strike top and sides of weld with hammer to test secureness of connection. If weld does not hold, remove scrap weld material, clean, and begin weld process again. After welding and before coating cleaned weld area, joint bond wires may be test for electrical continuity.

3.2.4.11. Weld Caps. When weld passes test for soundness and electrical continuity, repair coating in weld area with petrolatum or petroleum wax mastic and weld cap placed over weld following standard details.

- Apply mastic to fill weld cap or pre-filled weld cap and cover exposed metal of structure and wire to minimum thickness of 1/4 inch. Repair damage to coating around weld area following coating manufacturer's recommendations.
- If weld cap will not fit due to physical space limitations, coat bare metal and wire in weld area with minimum 1/4-inch thickness of petrolatum or petroleum wax mastic

3.2.5. **Flowable Backfill.** Backfill trenches to the elevations shown with flowable backfill as per Item 401, "Flowable Backfill".

3.2.6. **Cutting and Restoring Pavement.** Where water facilities must be installed in streets or other paved areas beyond limits of the roadway improvements, the work includes saw-cutting of the pavement and base to neat lines and prompt replacement of these materials after water excavation and backfill are completed. The replacement materials, as to type and thickness, are shown on the plans.

3.3. **Measurement.**

3.3.1. **Water Main (PVC).** This Item will be measured in place by the linear foot of PVC along the centerline of pipe as installed.

3.3.2. **Water Main (DIP).** This Item will be measured in place by the linear foot of DI pipe along the centerline of pipe as installed**.**

3.3.3. **Water Main (STEEL).** This Item will be measured in place by the linear foot of STEEL pipe along the center line of pipe as installed.

3.3.4. **Abandon and Fill Existing Water Pipe.** This Item will be measured by the linear foot of existing water main pipe that is abandoned in place for the size indicated

3.3.5. **Remove Existing Water Pipe.** This Item will be measured by the linear foot of existing water main pipe that is removed as identified in the plans.

3.3.6. **Cutting and Restoring Pavement.** This Item will be measured by the square yard as shown under Item 400, "Excavation and Backfill for Structures.

3.3.7. **Flowable Backfill.** This Item will be measured by the cubic yard as shown under Item 401, "Flowable Backfill".

3.4. **Payment.**

3.4.1. **Water Main (PVC).** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Water Main (PVC)" of the type and size specified. This price is full compensation for furnishing all required materials, including all

pipe, valves, fittings and accessories; mechanical joint restraints; and all appurtenances defined herein to include, but not limited to the following items: gate valves, tapping sleeves and valves, butterfly valves with manholes, air/vacuum release valves, blow-off valve assemblies, bonnet boxes, valve/access manholes, concrete collars, end plugs, bends, tees, couplings, reducers, marking tape, concrete thrust blocks, thrust restraint devices and all other items for the project not indicated as being covered under the other specific bid items shown on the proposal; furnishing all required labor, including coordination, traffic control, potholing, excavation, including hand-digging, if needed; embedment and backfilling; compaction and compaction testing; disinfection, pressure testing, dewatering of groundwater, where required; cutting, capping, and connection of new water main to existing water lines.

All fittings and appurtenances shown on the plans will not be paid for directly but will be subsidiary to the water pipe installation.

Cutting and restoring pavement will be paid for in accordance with Item 400, "Excavation and Backfill for Sturctures". Flowable fill will be paid for in accordance with Item 401, "Flowable Fill". Trench excavation protection will be paid for in accordance with Item 402, "Trench Excavation Protection".

3.4.2. **Water Main (DIP).** The work performed and the materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Water Main (DIP)” of the type and size specified. This price is full compensation for furnishing all required materials, including all pipe, valves, fittings and accessories; mechanical joint restraints; and all appurtenances defined herein to include, but not limited to the following items: gate valves, tapping sleeves and valves, butterfly valves with manholes, air/vacuum release valves, blow-off valve assemblies, bonnet boxes, valve/access manholes, cathodic protection, concrete collars, end plugs, bends, tees, couplings, reducers, marking tape, polyethylene wrap, concrete thrust blocks, thrust restraint devices and all other items not indicated as being covered under the other specific bid items; furnishing all required labor, including coordination, traffic control, potholing, excavation, including hand-digging, if needed; embedment and backfilling; compaction and compaction testing;; disinfection, pressure testing, dewatering of groundwater, where required; cutting, capping, and connection of new water main to existing water lines.

All fittings and appurtenances shown on the plans will not be paid for directly but will be subsidiary to the water pipe installation.

Cutting and restoring pavement will be paid for in accordance with Item 400, "Excavation and Backfill for Sturctures". Flowable fill will be paid for in accordance with Item 401, "Flowable Fill". Trench excavation protection will be paid for in accordance with Item 402, "Trench Excavation Protection" .

3.4.3. **Water Main (STEEL)**. The work performed and the materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Water Main (STEEL)” of the type and size specified. This price is full compensation for furnishing all required materials, including all pipe, valves, fittings and accessories; welded joint restraint systems; and all appurtenances defined herein to include, but not limited to the following items: gate valves, tapping sleeves and valves, butterfly valves with manholes, air/vacuum release valves, blow-off valve assemblies, valve/access manholes, cathodic protection, bonnet boxes, concrete collars, end plugs, bends, tees, couplings, reducers, marking tape, concrete thrust blocks, welded thrust restraint and all other items for the project not indicated as being covered under the other specific bid items shown on the proposal; furnishing all required labor, including testing, coordination, traffic control, potholing, excavation, including hand-digging, if needed; embedment and backfilling; compaction and compaction testing; disinfection, pressure testing, dewatering of groundwater, where required; cutting, capping, and connection of new water main to existing water lines.

All fittings and appurtenances shown on the plans will not be paid for directly but will be subsidiary to the water pipe installation.

Cutting and restoring pavement will be paid for in accordance with Item 400, "Excavation and Backfill for Sturctures". Flowable fill will be paid for in accordance with Item 401, "Flowable Fill". Trench excavation protection will be paid for in accordance with Item 402, "Trench Excavation Protection".

3.4.4. **Abandon and Fill Existing Water Pipe**. The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Abandon and Fill Existing Water Pipe" of the size specified. This price is full compensation for furnishing all required materials, labor, and equipment, including but not limited to the following items: coordination, traffic control, potholing, excavation, complete draining (dewatering) of pipe, flowable backfill, cutting, capping, complete filling with approved flowable backfill of water mains to be abandoned, removal of bonnet boxes from abandoned valves, and all other items for the project not indicated as being covered under the other specific bid items shown on the proposal.

3.4.5. **Remove Existing Water Pipe.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Remove Exist Water Pipe" of the size specified. This price is full compensation for furnishing all required materials, labor, and equipment, including but not limited to the following items: coordination, traffic control, potholing, excavation and backfill, complete draining (dewatering) of pipe, groundwater dewatering, flowable backfill, cutting, capping, removal of pipe, disposal of materials, and all other items not indicated as being covered under the other specific bid items.

4. CONCRETE

4.1. **Description.** Furnish all labor, materials, equipment and incidentals necessary to mix and place concrete, consisting of Portland cement, fine aggregate, coarse aggregate, admixtures, and water in the proper proportions as specified herein for use in Water and Sewer Mains.

4.2. **Materials.**

4.2.1. Quality Assurance. Proportion cement to give the necessary workability and strength and conform to the requirements shown on Table 3.

Table 3.
Cement Requirements

CLASS	MINIMUM 28-DAY COMPRESSIVE STRENGTH	MINIMUM CEMENT	MAXIMUM SIZE COARSE AGGREGATE	SLUMP (inches)
A	3,000 psi	5.5 bag/cy	3/4"	3 1/2"
B	2,500 psi	4 bag/cy	1 1/2"	4"
C	4,000 psi	6 bag/cy	3/4"	4"

4.2.2. Class Designations. The class designations provided above are as defined by El Paso Water Utilities (EPWU) and are to be used as listed:

- Class A Use for curb, gutter, and sidewalk replacement, unless otherwise directed.
- Class B Use for thrust blocks, pipe encasement, ground anchors for piping and as noted in the plans.
- Class C Use for cast in place sewer manhole bases, special structures or as required by manufacturer's specifications for pre-cast structures, unless otherwise indicated.

4.2.3. Submittals**.** Submit certified test reports regarding concrete mix design and reinforcing steel as may be required by the plans or the Engineer. Submit in a timely manner so as not to delay the project. Allow sufficient time for Engineer's review and resubmission, if necessary.

4.2.4. Standards**.** Comply with the following applicable requirements for concrete and related products:

- ASTM C-33 Specification for Concrete Aggregates
- ASTM C-150 Specification for Portland Cement
- ASTM C-260 Specification for Air-Entraining Admixtures for Concrete
- ASTM C-494 Specification for Chemical Admixtures for Concrete

4.2.5. Portland Cement**.** Conform to ASTM C-150 for the appropriate required Type.

Aggregates. Conform to ASTM C-33. Use fine aggregate consisting of natural, washed, and screened sand having clean, hard, strong, durable, un-coated grains complying with ASTM C-33. Use coarse aggregates that comply with ASTM C-33 Size 467, Size 57, or Size 67. Local aggregates of proven durability may be used with prior approval

Use air-entraining admixture for concrete of 3,000 psi or greater and complies with ASTM C-260. The total average air content will be in accordance with ACI 211.1.

Use water reducing admixture when required by job conditions in conformance with ASTM C-494. Use only admixtures that have been tested and accepted in mix designs, unless otherwise acceptable. Use according to manufacturer's recommendations.

Use set retarding admixtures as approved, in conformance with ASTM C-494 and according to manufacturer's recommendations.

Use water that is clean and free from impurities. Drinking and ordinary household water is acceptable.

4.2.6. Manufactured Products**.** Provide forms of wood or metal of sufficient strength to support the concrete without bulging between supports and sufficiently water tight to hold the concrete mortar. Construct forms to the shape and dimensions of finished concrete shown on the plans. For exposed surfaces, provide form work material and construct to produce a smooth, even surface when the concrete is poured. Oil all forms before use. Remove wall forms after the concrete has been in place for 24 hours. Chamfer all exposed edges 3/4 inch chamfer. Repair any honeycombed sections immediately upon removal of the form as directed.

Embedded Items**.** Accurately set in place and maintained in position during concreting operations all bolts, pipe, pipe sleeves, inserts, or other fixtures, required by the plans or this specification to be embedded in the concrete.

Reinforcing Steel**.** Provide bar reinforcement that is round, deformed bars, Grade 60, conforming to either "Specification for Rail Steel Deformed and Plain Bars for Concrete Reinforcement" (ASTM A-616), or "Specifications for Axle Steel Deformed and Plain Bars for Concrete Reinforcement" (ASTM A-617).

- Rail Steel Bars will be permitted only where bending is not required.
- Permanently mark all reinforcement bars with grade identification marks or, on delivery, be accompanied by a manufacturer's guarantee of grade that will identify variation.
- Protect reinforcement stored on the site from accumulation of grease, mud or other foreign matter and from rust producing conditions.
- Ensure that bars are free from rust, scale, oil, mud, or structural defects when incorporated in the structures.
- Accurately place and securely hold in place reinforcement during concrete placement in accordance with the ACI Detailing Manual.

4.2.7. Concrete Thrust Blocking**.** Block with concrete all underground piping bearing solidly against undisturbed trench walls, at all changes in direction subsidiary to the installation of fittings, valves, and all other appurtenances requiring provisions for thrust restraint.

Place concrete blocking against undisturbed trench walls with a minimum 18 inches between trench wall and pipe extending a minimum of 0.75 times the pipe diameter shown on Table 4 and above the centerline of pipe. Do not extend beyond any joints. Place blockings in accordance with the recommendations of "A Guide for the Installation of Ductile Iron Pipe" published by Cast Iron Pipe Research Association. If requested, contain the ends of the thrust blocks in wood or metal forms. Reinforce concrete anchor where upward thrusts are to be resisted.

Use Class B concrete for Blocking. The minimum area of concrete bearing against undisturbed trench bank is shown on Table 4.

Table 4.
Bearing Surface Per Bend

PIPE SIZE	TEE, DEAD END, 90 DEGREE BEND	45 AND 22-1/2 DEGREE BEND
6"	4 sq. ft.	3 sq. ft.
8"	6 sq. ft.	3 sq. ft.
12"	13 sq. ft.	7 sq. ft.
16"	23 sq. ft.	12 sq. ft.
20"	37.02 sq. ft.	20.04 sq. ft.

4.3. **Measurement and Payment.** The work performed and the materials furnished in accordance with this Article will not be measured or paid for individually as it is considered subsidiary to the various water main bid items and related appurtenances items. This includes furnishing all required materials including concrete used for thrust blocking or anchoring fitting (bends, plugs, reducers, etc.), valves, fire hydrants, manholes, water services or water fire lines, and all other concrete items damaged by Contractor due to negligence during the course of the project; and all hauling, mixing, manipulation, tools, labor, equipment, forming and incidentals necessary to complete the work.

5. GROUT

5.1. **Description.** Provide all labor, materials, equipment, and incidentals for grout uses other than masonry.

5.2. **Materials.**

5.2.1. Non-shrink, Epoxy Type**.** Provide a non-metallic, 100% solids, high strength epoxy grout such as Epoxtite as manufactured by A.C. Horn Company, or Five Star Epoxy Grout by U.S. Grout Corporation, or approved equal.

5.2.2. Non-shrink, Non-metallic Type**.** Provide a premixed non-staining cementitious grout requiring only the addition of water at the job site. Provide Darex In-Pakt Grout Pre-mix by A.C. Horn Company, or Masterflow 713 by Master Builders Company, or approved equal.

5.2.3. Ordinary Cement-Sand Grout**.** Consisting of one part by weight of Portland cement complying with ASTM C-150, Type V, to three parts by weight of clean sand of suitable gradation and complying with ASTM C-33. Ordinary grout may be of masonry cement, 4 sacks per cu. yd. of clean sand, together with approved air-entraining agent and a minimum of clean water for placing. Where water repelling and shrinkage reducing requirements are shown or specified, use approved admixtures.

5.2.4. Water**.** Use clean, fresh, potable water free from injurious amounts of oils, acids, alkalies, or organic matter.

5.3. **Standards.** Comply with the following applicable requirements:

- ASTM C-33 "Specification for Concrete Aggregates"
- ASTM C-150 "Specification for Portland Cement"

5.4. **Measurement and Payment.** The work performed and the materials furnished in accordance with this Article will not be measured or paid for individually as it is considered subsidiary to the various water main bid items.

6. EXCAVATION, INSTALLATION, AND BACKFILL

6.1. **Description.** Excavation classification is defined as "unclassified" and involves removing unnecessary materials and excavating trenches to the alignment, width, and depth as indicated in the plans or as required

for the proper installation of the pipe and appurtenances. Protect adjacent structures from damage by construction equipment. Pile all excavated material along the trench in a manner that will not endanger the work.

6.2. **Materials.**

6.2.1. Standards**.** Comply with the following applicable requirements for embedment materials:

- ASTM D-75 "Methods for Sampling Aggregates"
- ASTM D-448 "Specification for Standard Sizes of Coarse Aggregate for Highway Construction"
- ASTM D-2321 "Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe"
- ASTM D-2487 "Classification of Soils for Engineering Purposes"

6.2.2. Definitions**.** For the purpose of this specification, "pipe zone" defines the area extending from the bottom of the trench bedding to 12 inches above the top of the pipe and to the undisturbed trench walls on either side of the pipe. "Embedment" is defined as those vertical stratas of backfill material in the pipe zone consisting of bedding, haunching, and initial backfill, as defined in ASTM D-2321.

6.2.3. Submittals**.** Include certified test reports for embedment material from an independent laboratory. Include sieve analysis and Atterberg's limits on test reports. Submit a gradation of Class I material for approval prior to installation.

6.2.4. Pipe Zone and Backfill**.** Classify materials according to The Unified Soil Classification System as defined in ASTM D-2487.

Class I Material**.** Provide manufactured angular, well-graded, crushed stone per ASTM D-2321, 1/4 inch to 3/4 inch size material. Acceptable materials under this class designation are: ASTM D-448 - Stone Sizes 4, 67, 5, 56, 57, and 6. Pea Gravel and other uniformly graded material are not acceptable under this class.

Class II Material. Provide coarse sands and gravels per ASTM D-2487 with maximum particle size of 3/4 inch, including variously graded sands and gravels, containing less than 5 percent fines (material passing the #200 sieve) generally granular and non-cohesive, either wet or dry. Soil Types GW, GP, SW and SP are included in this class.

Class III Material**.** Provide fine sand and clayey (clay filled) gravels, per ASTM D-2487, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Class III includes soil Types GM, GC, SM and SC.

Do not use Class IV or V material, as defined in ASTM D-2487, for embedment of flexible pipe.

6.2.5. Final Backfill**.** Unless otherwise shown, material for backfilling above the pipe zone is defined as follows:

Native. The most granular material excavated from the trench comprising the spoil bank may be used, provided it is devoid of rocks larger than three inches in greatest dimension, organic material, and other unsuitable material. If initially saturated during the excavation, allow backfill to dry sufficiently, being manipulated if necessary, prior to placing back into trench, to achieve the specified compaction at plus or minus 2 percent of optimum moisture content.

Select. Select material is designated as Class II as described in 6.2.4.2. If material excavated from the trench is unsuitable as backfill material, or the required compaction is unattainable for the particular spoil backfill material, import select material to be mixed with or used in place of the spoil material.

Soil Cement**.** When shown on the plans, cement stabilized backfill will consist of a mixture of soil or sand and 2 sacks of Portland cement per cubic yard. Use a sandy material, free from lumps, clods or organic material. If excavated material is not suitable, use pit-run sand. Mix cement stabilized backfill in a concrete mixer or transit mixer.

6.3. **Construction.**

6.3.1. Sources and Evaluation Testing**.** Obtain materials to be used for embedment and for backfill in accordance with a sampling plan and ASTM D-75. Perform testing of materials to certify conformance with specification requirements by an approved independent testing laboratory. Perform tests and provide results upon change of source and at sufficient intervals to certify conformance of all material furnished.

6.3.2. Trench Excavation and Preparation**.** Construct trench walls in the "pipe zone" vertically.

Trench Width**.** See Tables 5 and 6 below for trench widths for flexible and rigid pipes.

Table 5.
Flexible Pipe Trench Width

PIPE DIAMETER	TRENCH WIDTH = BARREL OUTER DIAMETER PLUS	
	Minimum	Maximum
Less than 24 inch	15 inches	18 inches
24 inch – 48 inch	18 inches	24 inches
Greater than 48 inch	24 inches	1/2" Pipe O.D.

Table 6.
Rigid Pipe Trench Width

Do not exceed the outside diameter of the pipe barrel plus the following allowance for RIGID PIPE trench width:	
PIPE DIAMETER	**TRENCH WIDTH = BARREL OUTER DIAMETER PLUS**
Less than 18-inch	16 inch
18 inch - 24 inch	19 inch
27 inch – 39 inch	22 inch
42-inch & Larger	½ Pipe O.D.

If maximum trench width specified above is exceeded at the top of the pipe, provide additional load-bearing capacity by means of improved bedding, concrete cradle, cap, or encasement, or other approved means

Lay back or bench the trench walls above the pipe zone, where space permits, as necessary to satisfy the requirements of OSHA and additional requirements for Trench Support as specified herein.

Wherever the prescribed maximum trench width is exceeded, remove all loose and sloughed-in material from the trench and replace with compacted granular material such that haunching and initial backfill is compacted to at least 2.5 pipe diameters from either side of the pipe or to the trench walls.

Unless otherwise agreed upon, no additional payment will be made for extra material and labor required to fill excessive trench widths caused by Contractor's equipment or natural collapse of trench walls.

6.3.3. Trench Bottom**.** Excavate the trench to an even grade so that the full length of the pipe barrel is supported and joints may be properly assembled.

For 30 inch diameter and smaller pipe, "rough cut the trench a minimum of 4 inches below the bottom of the pipe. For 33 inches and larger pipe, "rough cut the trench a minimum of 6 inches below the bottom of the

pipe. Increase the “rough cut” dimension as necessary to provide a minimum clearance of 2 inches from the bottom of the trench to the bottom of the bells, flanges, valves, fittings, etc.

The entire foundation area at the bottom of all excavations will be firm, stable material. Remove loose material leaving a clean, flat trench bottom. Do not disturb material below required subgrade except as described elsewhere in this specification.

If the subgrade is soft, spongy, disintegrated, or where the character of the foundation materials is such that a proper foundation cannot be achieved at the elevation specified, deepen the excavation, not less than 6 inches to a depth where a satisfactory foundation may be obtained. Bring back subgrade to the required grade with Class I coarse gravel compacted to 70% relative density per ASTM D-4254.

6.3.4. Over Excavation. If the trench is excavated to a faulty grade (at a lower elevation than indicated), correct the faulty grade at no additional cost as follows:

- In uniform, stable dry soils, correct the faulty grade with Class II granular embedment material thoroughly compacted to 90% Modified Proctor Density per ASTM D-1557.
- In soft spongy disintegrated soils, or where necessary to allow proper drainage, correct the faulty grade with Class I coarse gravel compacted to 70% of relative density.

6.3.5. Rock Excavation. When pipe is to be laid in rock cut, provide a clearance of at least 6 inches below parts of the pipe, valves or fittings. Provide adequate clearance at bell holes to permit proper jointing of pipe laid in rock trenches. Refill excavation to pipe grade with Class II granular embedment material compacted to 90% Modified Proctor Density. Blasting is not be permitted unless specifically required and called for in the plans and with a permit issued by governing authorities.

6.3.6. Bell Holes. Dig, in trenches, bell holes of ample dimension at each joint of pipe to permit the jointing to be made properly, visually inspected, and so that the pipe will rest on the full length of the barrel.

6.3.7. Dewatering. Dewater excavations by physically installing/drilling dewatering wells, laying of discharge piping, other preparatory work and the maintenance of the operating system so that the work is performed in dry conditions.

Use coarse gravel and geo-synthetic material to maintain the integrity of pipe and embedment material. Geo-synthetic material must wrap completely around pipe and gravel.

Determine and record the elevation of the groundwater level prior to dewatering. Unless otherwise specified, the method of dewatering will maintain a phreatic water surface a minimum of 18 inches below pipe grades. Should over-excavation be necessary due to unsuitable foundation conditions, lower the ground water as necessary.

Direct water removed from trenches to natural drainage ways, drains, or storm sewers in such a manner as to prevent damage to adjacent property or to the public. Provide pumps of ample capacity and in duplicate to ensure that once an excavation is dried, the water level remains below the trench depth until that portion of the work is completed. Obtain approval for discharge from the appropriate governing agency. Do not discharge into the sanitary sewer systems.

Determine if any wells used for domestic purposes are affected by the dewatering and furnish potable water to any affected residents when dewatering may affect the production of private wells along the route. Prepare baseline water level analysis in area to confirm affect on private wells.

Dispose of the water from the dewatering operation according to the conditions of the discharge permit. Coordinate dewatering effort with El Paso Water Utilities Engineering staff, insofar as compliance with discharge permit is concerned, and where dewatering effluent will enter drainage ditches operated and maintained by the Department.

Equip engines or engine generators used to run the dewatering pumps with residential grade silencers. Provide silencers that have an attenuation range of 25 to 30 dBA as required by the El Paso Municipal Code, Title 9, Chapter 9.40.

Submit a dewatering plan indicating proposed locations of dewatering wells, pumping facilities, collector and discharge pipe-lines, and discharge points (names of ditches, laterals, etc.). If discharging into El Paso County Water Improvement District No. 1 (EPCWID #1) drains, provide the plan for EPCWID#1 comments and approval. To comply with the requirements of the discharge permit between EPWU and the EPCWID #1, provide discharge monitoring points. EPWU personnel will obtain samples for laboratory analysis to check water quality limitations imposed by the permit.

Record pumping rates at dewatering wells, pump times, and flows and become familiar with the methods of measurements as shown on Table 7.

Table 7.
Pumping Rates Schedule

DATA RECORDED	METHOD OF MEASUREMENT	FREQUENCY OF MEASUREMENT
Pumping Rate At Each Dewatering Well or Discharge Point	"California-Pipe Method"	Daily If Changes Occur
Pumping Time	Hours	Daily
Total Dissolved Solids (TDS)	PSB Laboratory	Monthly
Total Discharge	Rate x Time	Continuous

Record obtained data on a standard data sheet and submit monthly. Comply with EPCWID #1 requirements and allow EPCWID#1 inspection of dewatering system at any time during project life.

Submit a Dewatering Plan, a Final Schedule for Dewatering, and an estimate of fees due EPCWID #1 within fifteen (15) working days from the date of the Notice to Proceed. The Plan is a mandatory submittal and must include the estimated quantities of dewatering for each month and the point(s) of discharge. The Engineer will review and approve the Dewatering Submittal and forward it, through the EPWU, to the District. EPWU must receive the approved plan at least two weeks in advance of the planned dewatering operations. Dewatering Fees due are estimated on the following basis:

- Non-refundable application fee of $1,000
- $150 per acre-foot of estimated groundwater estimated that will be discharged into the EPCWID #1's facilities during term of the agreement
- Payment due a minimum of seven (7) calendar days in advance of any discharge.

EPWU will prepay dewatering fees to EPCWID #1 based upon the estimates in the approved Submittal. EPWU is responsible for all Dewatering Fees, including those for water pumped in addition to the quantities presented in the approved Dewatering Plan.

Provide monthly reports of discharge quantities and quality (TDS and sulfates), which specific requirements may be more particularly described in the Technical Specifications, to EPWU through the Engineer for submittal to EPCWID #1. Resolve high TDS penalties with EPCWID#1.

6.3.8. Trench Support**.** Brace and sheet excavations to provide complete safety to persons working therein in conformance with applicable federal (OSHA), state and local laws and ordinances. Meet the requirements specified in the current OSHA Standard for all trenches exceeding 5 feet in depth as measured from the ground surface at the highest side of the trench to the trench bottom.

Provide sufficient and adequate bracing for excavations with respect to work under construction and to adjacent utility lines and private property. Where soil conditions within trench area require support, use tight

sheeting, skeleton sheeting, stay bracing, trench jacks, movable trench shield, or other approved methods to support the trench during pipe installation operations such as bedding preparation, pipe laying, and backfilling of haunches and initial zone.

Do not extend trench support below the pipe crown whenever possible. Where trench support must extend below the crown, such support should either be left in place or consist of approved steel sheets that can be retracted with minimal disturbance. Treat remaining voids with grout or granular embedment material.

When a movable trench shield is used, the trailing half of the shield should be notched to the height of the top of the pipe. This will allow the haunch area of the pipe to be compacted properly to the wall of the trench. Dragging of a trench shield at pipe grade may be done provided such practice does not disturb the bedding. Fill and compacted voids created by the shield properly.

6.3.9. Trenching in Public Right-of-Way**.** Except where otherwise specified, indicated on the plans, or approved in writing, do not exceed the maximum length of open trench shown on Table 8, where the construction is in any stage of completion. The definition of "open trench" for the purposes of this description includes excavation, pipe laying, backfilling, and pavement replacement. The descriptions under the area designations are general in nature and may be amended in writing by the Engineer due to particular or peculiar field conditions.

Table 8.
Maximum Open Trench Lengths

TYPE OF AREA	MAX LENGTH (LF)	DESCRIPTION
Business District	300	Store front areas
Commercial	300	Industrial, shopping centers, churches, schools, hotels, motels, markets, gas stations, government and private office buildings, hospitals, fire and police stations, and nursing homes
Residential	One (1) block or 300 linear feet, whichever is the least:	Single and multi-family residences, apartments, and condominiums
Undeveloped	1,500	Parks, golf courses, farms, undeveloped subdivided land

Any excavated areas is considered "open trench" until all pavement replacement has been made, or until all trenches outside of pavement replacement areas have been backfilled and compacted in accordance with the plans. Completely backfill trenches across streets with temporary or permanent pavement in place within 72 hours after pipe laying. An open trench is not permitted overnight, unless approved and adequately barricaded.

Provide steel plates with adequate trench shoring and bracing, designed to support traffic loads where required to bridge across trenches at street and alley crossings, commercial driveways, and residential driveways where trench backfill and temporary patch have not been completed during regular working hours. Provide safe and convenient passage for pedestrians. Maintain access to fire stations, fire hydrants, and hospitals at all times.

6.3.10. **Pipe Installation.** Install pipes true to lines and grades as indicated on the plans. Inspect all pipe and fittings before placing in the trench. Clean all joint surfaces and soiled materials prior to connecting one another. As work progresses, maintain interior of pipes clean.

6.3.10.1. Standard Cover**.** Standard cover depends on the water main size and installation conditions and is generally

- 6 and 8 inch diameter Main: Minimum of 4-foot cover from top of pipe to finished grade
- 12 inch & larger diameter Main: Minimum of 5-foot cover from top of pipe to finished grade

6.3.10.2. Potholing. Existing utilities shown on plans are for informational purposes only. Prior to new pipe installation, pothole all existing utilities and structures to confirm their location, depth, and size. In the event

of conflict or discrepancy that affects the project design, notify Engineer before proceeding with pipe installation in order to formulate a solution

6.3.10.3. Pipe Zone Embedment**.** Unless otherwise specified or shown on the plans, embed pipelines either Class I, II, or III material defined in this Article 6.2.4 and installed as described. Native or imported material for embedment may be used provided material conforms to this Specification.

Place embedment materials in lifts not exceeding 8 inches loose depth. Unless otherwise specified or directed in writing, provide homogenous material in the embedment zone

Place bedding to provide uniform and adequate longitudinal support under the pipe. Place the first lift of bedding material from the bottom of the trench to slightly above the bottom of the pipe grade. Unless otherwise shown on the plans, provide a minimum bedding of 4 inches in depth for pipe sizes 30 inches and smaller, and 6 inches for pipe sizes greater than 30 inches.

Install material true to line and grade with bell holes of ample dimension to permit pipe to rest on the full length of the barrel and to permit joint make-up and coating application at joints. Consolidate and compact the bedding material as described in Article 6, and lay pipe to indicated grade.

Place a second lift, and if required, subsequent lifts, of embedment material to the springline of pipe. This process is defined as Haunching. Slice material under the haunches of the pipe, carefully filling all voids, and using care to prevent movement of the pipe.

Place Initial Backfill using a third lift from the springline of the pipe to the pipe crown, and a fourth lift from the pipe crown to a point 12 inches above the pipe.

6.3.10.4. Groundwater Installation**.** In areas where the pipe is installed below existing or future ground water levels, use Class I material throughout the pipe zone and enclose with a layer of approved geotechnical filter fabric. Place fabric carefully along the bottom of the trench and up the side of the trench a sufficient distance to lap over the top of the completed pipe installation. Lap fabric a minimum of 3 feet in the longitudinal at the end of one roll and beginning of the next, and lap 2 feet in the transverse at the top of pipe, except that for trench widths greater than 3 feet measured at the top of pipe, the top overlap will be 3-feet. Follow manufacturer's recommendations for installation. Provide fabric that is either Mirafi 140N, Dupont Typar 3401, or approved equal.

6.3.10.5. Embedment Class Schedule**.** Unless otherwise shown on the plans, use the Utility Standard Embedment Class designations for the pipe material types listed in this Article to define each particular pipe's Embedment Condition allowed. Examine the detail drawings for additional information or other special bedding requirements.

6.3.10.6. Consolidation Methods in Embedment Zone**.** Compact embedment backfill by equipment that is suitable for the type of soil encountered, and is capable of producing the degree of compaction specified. Where applicable, provide backfill materials that is moisture conditioned to produce the required degree of compaction.

Do not use flooding or jetting methods for compaction of embedment material.

Use hand or mechanical tamping to compact Class II or III material used in bedding, haunching, and initial backfill, except that the use of mechanical tampers or vibratory compactors directly over the pipe in the embedment area is prohibited. Exercise caution in the use of mechanical compactors in the haunch and initial backfill to 12 inches above the pipe to avoid damaging or misaligning the pipe.

6.3.10.7. Compaction and Testing of Pipe Embedment Zone**.** Class I material used in the embedment zone may be placed by loose dumping with a minimum of compactive effort, exercising care to assure proper placement of material under the pipe haunches.

Class I material does not specifically require testing unless directed by the ENGINEER, in which case, such test will be measured by ASTM D-4254 by percent of relative density.

Compact Class II material used in the embedment zone to a density of not less than 90% of Standard Proctor Density defined by ASTM D-698.

Compact Class III material used in the embedment zone to a density of not less than 90% of Standard Proctor Density defined by ASTM D-698.

Do not exceed a moisture content of 3% over the optimum in Class II or III material to assure proper compaction.

Unless otherwise directed, one compaction test in the embedment zone for Class II or III material will be taken at 200 feet intervals along the trench on either side of the pipe, or at any other intervals as may be judged warranted by questionable installation conditions. For pipe sizes 8 inches to 12 inches diameter, perform the first test on the side level with the top of pipe. For sizes 15 inches and larger, perform the first test at the springline of the pipe. For all sizes, perform the second test at the top of the embedment zone.

6.3.10.8. Density Control and Laboratory Testing. Unless otherwise specified, reference to "maximum dry density" means maximum density defined by ASTM D-1557 or D-698. Determination of density of backfill in-place, will be in accordance with the requirements of ASTM D-2922.

Unless otherwise specified, the Engineer selects a soils testing laboratory to perform initial density testing of in-place backfill and Contractor is responsible for all density testing of backfills, including tests found not to be within the minimum requirements of the specifications.

Provide laboratory materials testing, including but not limited to determination of Atterberg Limits, Proctor Curves, Grain Size Analysis, as well as laboratory certification of manufactured materials and as required by this Article

Notify the soils testing laboratory and Engineer 24 hours in advance to obtain soil density tests to fulfill the compaction requirements.

6.3.11. **Final Backfill.**

6.3.11.1. General. Backfill trench, as soon as practicable after laying and jointing of the pipe, the completion of embedment and the completion of structures. Take the necessary precautions to protect the pipe during backfilling operations.

Remove sheeting and shoring as backfilling operations progress. Incorporate methods so that a good bond is achieved between the backfill material and the undisturbed trench walls. Where sheeting or trench protection is intact below the top of pipe and their removal cause obvious damage to the bedding and haunching, it may be necessary to leave portions of sheeting or bracing in place.

Exercise caution in the use of mechanical compactors in the haunch and initial backfill to 12 inches above the pipe avoid damaging or misaligning the pipe. Provide at least 3 feet of compacted cover over the top of the pipe before the trench is wheel-loaded, and 4 feet of cover before using pneumatic hammers during compaction. Avoid contact between pipe and compaction equipment at all times.

6.3.11.2. Consolidation Methods. Backfill above the pipe zone to surface subgrade with backfill material as indicated on the plans and described in this Article. Compact backfill above the pipe zone by mechanical means. Water consolidation (flooding) may be used if approved.

Mechanical Compaction. Place backfill material above the pipe zone in lifts not exceeding 8 inches loose depth, moisten or aerate to obtain optimum moisture, and compact to the required density as described in this Article.

Ponding Method. When permitted, place backfill material above the pipe zone in the trench not exceeding 3 feet loose depth, and flood until free water is evident on the surface for at least two hours. Place approximately 1 foot of water in the trench and start subsequent lifts by depositing backfill material in the water until a maximum 3 foot lift is placed. Add additional water to the backfill material until free water is again evident as before. Repeat procedure until the entire trench is filled and thoroughly settled

Jetting Method of water tamping is not allowed.

6.3.11.3. Cement Stabilized Backfill. Stabilize backfill material with a minimum of 2 sacks per cubic yard of Portland cement of material placed. Place stabilized soil as shown on the plans under roads, driveways, concrete slabs, and in the excavation zone for structures. Cement stabilized soil placed around all adjusted manholes is subsidiary to the various manhole installation items. No compensation will be made for use of soil cement backfill at the Contractor's discretion, without prior approval, or for over-excavated trenches.

6.3.11.4. Compaction and Testing Final Backfill. This subsection may be superseded by the Department requirements, if stricter. Under existing or proposed paved streets, compact final backfill to the Modified Proctor Densities shown on Table 9 and as per ASTM D-1557 and to standard plan detail layouts, "Typical Trench Backfill Detail under Existing or Proposed Paved Streets".

Table 9.
Paved Street Compaction Densities

ZONE	SOIL CONDITION	% OF PROCTOR
Top of Pipe Embedment to 18 inches Below Finished Subgrade	Native Material As Specified	90%
Top of Finished Subgrade to 18 inches Below Top of Subgrade	Cohesive Non-cohesive	90% 95%

Compaction tests are required on backfill under proposed or existing streets and easements as follows, unless otherwise directed and deemed necessary.

- Tests at 8 inches below subgrade at 200 feet intervals and not less than two per street at this level
- One test for every 2 feet of vertical trench backfill between top of pipe bedding and 18 inches below subgrade at 200 feet horizontal intervals and not less than two per street at each level

Obtain density of not less than 85% ASTM D-1557 from top of pipe bedding to ground surface for all other areas not in existing or proposed paved streets.

Provisions for selection of the testing laboratory and responsibilities for density control as described in this Article also apply to this backfilling section.

6.4. **Measurement**

6.4.1. **Excavation and Backfill.** This Item will not be measured individually and is subsidiary to the installation of the various water mains, sanitary sewer mains, and related appurtenances.

6.4.2. **Cement Stablized Backfill .** Unless shown on the plans as a pay item, quantities shown are for informational purposes. When specified as a pay item, this Item will be measured by the cubic yard as shown under Item 401, "Flowable Backfill".

6.5. **Payment.** The work performed and the materials furnished in accordance with this Article will not be measured or paid for individually as it is considered subsidiary to the various bid items for water main, sanitary sewer mains and manhole installations, including related appurtenances, such as all excavation, bedding, backfill for pipe zone (embedment), final backfill, compaction and compaction testing. Associated dewatering is subsidiary to the different materials and sizes of water mains, sanitary sewer mains, steel casings, valves, fittings and appurtenances, and service installation, including but not limited to excavation, embedment and final backfill for "Additional Fittings" as described in Article 7.

When Flowable Backfill is specified as a pay item, flowable backfill will be paid as provided in Item 401, "Flowable Backfill."

7. VALVES AND FITTINGS

7.1. **Description.** Furnish all valves and fittings as shown on the plans and as called for in this specification or as required for proper operation of the equipment in general. Unless otherwise indicated, conform to requirements as specified herein. Upon acceptance, provide and install valves similar and comparable to valves specified for similar and comparable duty in other parts of the project where proper operation and utilization of equipment and facilities require installation of valves not indicated or specified.

7.2. **Materials.** Conform to the pertinent material requirements of the items listed. Furnish complete shop drawings and specifications. If requested, submit a list of similar installations that have been in satisfactory operation for at least three years.

Furnish a complete set of installation, operation, and maintenance instructions, bound in a cover, for each type of valve furnished.

Quality Assurance**.** Conform to American National Standards Institute / National Sanitation Foundation (ANSI/NSF) Standard 61 “Drinking Water system Components - Health Effects” and be certified by an organization accredited by ANSI. Provide an affidavit from the manufacturer or vendor. If the pipe does not presently conform to this standard, submit information from the manufacturer regarding action being taken to comply with this standard. Include manufacturer’s name or trademark permanently stamped or cast on all valves and fittings along with “No Lead” brass alloy, e.g. “NL”. Design all valves installed in a given line to withstand the test pressure for that particular line and fabricate with ends to fit the piping.

7.2.1. **Valves.**

7.2.1.1. **Non-Rising Stem Double Disc Gate Valves (NRS)**. Provide Non-Rising Stem Gate Valves that are iron-body, bronze mounted, parallel seat internal wedging type with non-rising stem and designed for a gauge working pressure of 200 psig. Comply with latest revisions of AWWA C-500 “Gate Valves for Water and Sewage Systems”

Provide 12 inches or smaller valves for horizontal installation with a minimum number of turns to open at least three times the valve diameter. Acceptable manufacturers and models are:

- American-Darling 52NRS (Flanged Ends), 55NRS (Mechanical Joint Ends)
- Clow F5065 (Mechanical Joint Ends), F5070 (Flanged Ends)
- Kennedy 561X (Flanged Ends), 571X (Mechanical Joint Ends)
- M&H Style 67NRS
- MuellerA-2380-6 (Flanged), A-2380-20 (Mechanical Joint Ends)

Submittals. Provide submittals for approval. Provide manufacturer's Affidavit of Compliance in accordance with Section 6.3 of AWWA Standard C-500. Provide records of all tests performed in accordance with Section 5.1 of AWWA Standard C-500 that are representative test results per Section 5.1 of AWWA Standard C-500 along with an affidavit of testing for the valve assembly as outlined in Section 6.3 of AWWA Standard C-500 (300 ft-lbs.*).*

Markings. Cast markings on the bonnet or body of each valve. Include the manufacturer’s name or mark, the year the valve casting was made, the size of the valves, and the designated working pressure.

Valve Ends. Provide mechanical joint or flanged with drilling valve ends and size, as specified, in compliance with ANSI B16.1.

Valve Body and Bonnet. Provide in cast iron conforming to ASTM A-126 Class B, or ductile iron conforming to ASTM A-395 or ASTM A-536.

Gate. Manufacture in cast iron or Grade A bronze. Grade A gate rings must be rolled, peened, or pressed into grooves machined in the discs, or may be fastened by some other accepted method.

Body-Seat Ring. Construct of Grade A bronze, back-face threaded and machined screwed into the valve body.

Wedges. Equip double-disc gate valves with a free and positive-operating internal device that presses the disc seats firmly against the body seats when the valve is closed and releases the load before the discs begin to move when the valve is opened. Provide a simple and rugged design with materials as specified in AWWA C-500. Iron to iron contact surface is not allowed.

Valve Stem. Construct of low zinc bronze CDA Copper Alloy No. C99500 with a minimum yield strength of 40,000 psi and minimum elongation in 2 inches of 10%.

Stem Seals. Provide two O-rings such that the seal above the stem collar can be replaced with the valve under pressure in the fully open position meeting the requirements of ASTM D-2000 and have physical properties suitable for the application.

Valve Operator. Provide a cast iron, ASTM A-126 Class B, wrench nut that has a 2 inch square base, a 1 15/16 inch square top and 1 3/4 inch high, opening counterclockwise (left). Paint wrench nut black with and cast an arrow indicating direction of opening in accordance with AWWA C-509.

Protective Coating. Apply an epoxy coating to all exterior and all stationary interior ferrous surfaces including all interior openings in the valves body in accordance with AWWA C-550 and the manufacturer's instructions. After the coating is completely cured, test coated surface for porosity, holidays, and pinholes using a holiday detector. Repair all holidays or irregularities and test the coating again. Do not apply coating to the gasket surfaces of the end flanges

7.2.1.2. **Outside Screw and Yoke (OS&Y) Gate Valves.** Provide iron-body, bronze mounted, parallel seat internal wedging type with outside screw and yoke in conformance with AWWA C-500 "Gate Valves for Water and Sewage Systems". Provide OS&Y gate valves for the size specified. Acceptable manufacturers and models are listed:

- American Darling 52 OS&Y
- Clow F5072
- Kennedy 566
- M&H STYLE 68
- Mueller A-2483-6

Submittals. Provide submittals for approval. Provide manufacturer's Affidavit of Compliance in accordance with Section 6.3 of AWWA Standard C-500. Provide records of all tests performed in accordance with Section 5.1 of AWWA Standard C-500 that are representative test results per Section 5.1 of AWWA Standard C-500 along with an affidavit of testing for the valve assembly as outlined in Section 6.3 of AWWA Standard C-500 (300 ft-lbs.). Provide records of all tests performed in accordance with Section 5.2 and 6.3 of AWWA Standard C-504.

Markings. Cast markings on the bonnet or body of each valve. Include the manufacturer's name or mark, the year the valve casting was made, the size of the valves, and the designated working pressure.

Valve Ends. Provide flanged ends with drilling in compliance with ANSI B16.1 or otherwise specified.

Valve Body and Bonnet. Provide in cast iron conforming to ASTM A-126 Class B, or ductile iron conforming to ASTM A-395 or ASTM A-536.

Gate. Manufacture in cast iron or Grade A bronze. Grade A gate rings must be rolled, peened, or pressed into grooves machined in the discs, or may be fastened by some other accepted method.

Body-Seat Ring. Construct of Grade A bronze, back-face threaded and machined screwed into the valve body.

Wedges. Equip double-disc gate valves with a free and positive-operating internal device that presses the disc seats firmly against the body seats when the valve is closed and releases the load before the discs begin to move when the valve is opened. Provide a simple and rugged design with materials as specified in AWWA C-500. Iron to iron contact surface is not allowed.

Valve Stem. Construct of low zinc bronze CDA Copper Alloy No. C99500 with a minimum yield strength of 40,000 psi and minimum elongation in 2 inches of 10%. Brush the opening through the bonnet for the stem with grade A, B, C, D, or E bronze as defined in AWWA C-500.

Yoke. The yoke may be either integral or bolted on to bonnet such that a hand may not be jammed between the yoke and handwheel.

Valve Operator. Provide a cast iron, ASTM A-126 Class B, wrench nut that has a 2 inch square base, a 1 15/16 inch square top and 1 3/4 inch high, opening counterclockwise (left). Paint wrench nut black with and cast an arrow indicating direction of opening in accordance with AWWA C-509.

Protective Coating. Apply an epoxy coating to all exterior and all stationary interior ferrous surfaces including all interior openings in the valves body in accordance with AWWA C-550 and the manufacturer's instructions. After the coating is completely cured, test coated surface for porosity, holidays, and pinholes using a holiday detector. Repair all holidays or irregularities and test the coating again. Do not apply coating to the gasket surfaces of the end flanges.

7.2.1.3. **Tapping Valves.** Provide iron-body, bronze mounted, parallel seat internal wedging type with non-rising stem tapping valves that conform to AWWA C-500 "Gate Valves for Water and Sewage Systems" except that tapping valves will have over-sized seat rings to accommodate full size cutters. Provide for the size specified. Acceptable manufacturers and models are listed:

- American Darling 565
- Clow 2640 (Figure F-6114)
- Kennedy 8950 KEN-SEAL II
- M&H STYLE 751
- Mueller H-667

Minimum number of turns to open is three times the valve diameter.

Submittals. Provide submittals for approval. Provide manufacturer's Affidavit of Compliance in accordance with Section 6.3 of AWWA Standard C-500. Provide records of all tests performed in accordance with Section 5.1 of AWWA Standard C-500 that are representative test results per Section 5.1 of AWWA Standard C-500 along with an affidavit and certificate of testing for the valve assembly as outlined in Section 6.3 of AWWA Standard C-500.

Markings. Cast markings on the bonnet or body of each valve. Include the manufacturer's name or mark, the year the valve casting was made, the size of the valves, and the designated working pressure.

Valve Ends. Provide mechanical joint outlet ends unless otherwise specified.

Valve Body and Bonnet. Provide in cast iron conforming to ASTM A-126 Class B, or ductile iron conforming to ASTM A-395 or ASTM A-536.

Gate. Manufacture in cast iron or Grade A bronze. Grade A gate rings must be rolled, peened, or pressed into grooves machined in the discs, or may be fastened by some other accepted method.

Body-Seat Ring. Construct of Grade A bronze, back-face threaded and machined screwed into the valve body.

Wedges. Equip double-disc gate valves with a free and positive-operating internal device that presses the disc seats firmly against the body seats when the valve is closed and releases the load before the discs begin to move when the valve is opened. Provide a simple and rugged design with materials as specified in AWWA C-500. Iron to iron contact surface is not allowed.

Valve Stem. Construct of low zinc bronze CDA Copper Alloy No. C99500 with a minimum yield strength of 40,000 psi and minimum elongation in 2 inches of 10%.

Stem Seals. Provide two O-rings such that the seal above the stem collar can be replaced with the valve under pressure in the fully open position meeting the requirements of ASTM D-2000 and have physical properties suitable for the application.

Valve Operator. Provide a cast iron, ASTM A-126 Class B, wrench nut that has a 2 inch square base, a 1 15/16 inch square top and 1 3/4 inch high, opening counterclockwise (left). Paint wrench nut black with and cast an arrow indicating direction of opening in accordance with AWWA C-509.

Protective Coating. Apply an epoxy coating to all exterior and all stationary interior ferrous surfaces including all interior openings in the valves body in accordance with AWWA C-550 and the manufacturer's instructions. After the coating is completely cured, test coated surface for porosity, holidays, and pinholes using a holiday detector. Repair all holidays or irregularities and test the coating again. Do not apply coating to the gasket surfaces of the end flanges.

7.2.1.4. **Non-Rising Stem (NRS) Resilient-Seated Gate Valves**. Provide NRS gate valves that are resilient seat, non-rising stem and have a minimum rated gauge working pressure of 200 psig that comply with AWWA C-509 "Resilient-Seated Gate Valves for Water and Sewage Systems" and AWWA C-550 "Standard for Protective Coatings for Valves and Hydrants". Valve designed with recesses, insets in the bottom of the waterway that would promote build-up or collection of residue and debris are not acceptable. Provide NRS Gate Valves the size specified. Acceptable manufacturers and models are listed:

- American Flow Control — Series 500, Series 2500
- Clow — 2640 (Figure F-6100)
- Kennedy — 8571 KS – FW
- M&H — 3067
- US Pipe — METROSEAL 250
- Mueller — A-2360
- J&S — Series 6800, Series 6900

Submittals. Provide submittals for approval. Provide manufacturer's approved certified test data or an affidavit stating that the valve complies with AWWA C-509 Section 5.1 and the following, in accordance with AWWA C-509 Section 6.3:

- Hydrostatic Test. Provide results of manufacturer's pressure test for one valve of each size and class with 400 psi applied to one side and zero to the other made in each direction across the closed gate.
- Torque Test. Provide results of manufacturer over-torque test on one valve of each size to demonstrate that no distortion of the valve stem occurs. Applied torque for a 4-inch valve is 250 ft-lb and 350 ft-lb for the larger valves in both the open and closed position.
- Leakage Test. Provide results of manufacturer's leakage test where manufacturer selects two valves of each size to be fully opened and closed for 500 complete cycles with a 200 psi differential pressure across the gate and the valve is drip tight upon completion of the test.
- Pressure Test. Test one valve of each size with the gate fully open to a pressure of 500 psi. No evidence of rupture or cracking of valve body, bonnet or seal plated should be detected

Markings. Cast markings on the bonnet or body of each valve. Include the manufacturer's name or mark, the year the valve casting was made, the size of the valves, and the designated working pressure.

Valve Ends. Provide mechanical joint or flanged ends as specified.

Valve Body and Bonnet. Provide in cast iron conforming to ASTM A-126 Class B, or ductile iron conforming to ASTM A-395 or ASTM A-536.

Bolts. Provide all bonnet and seal plate bolts that are factory installed and made from stainless steel ASTM A-276 with either regular-square or hexagonal heads with dimensions conforming to ANSI B18.2.1.

Wedge. Provide cast iron or ductile iron fully encapsulated wedge with resilient rubber material bonded to the disc in conformance with ASTM D-429 as required by AWWA C-509.

Valve Stem. Construct of low zinc bronze CDA Copper Alloy No. C99500 with a minimum yield strength of 40,000 psi and minimum elongation in 2 inches of 10%.

Stem Seals. Provide two O-rings such that the seal above the stem collar can be replaced with the valve under pressure in the fully open position meeting the requirements of ASTM D-2000 and have physical properties suitable for the application.

Valve Operator. Provide a cast iron, ASTM A-126 Class B, wrench nut that has a 2 inch square base, a 1 15/16 inch square top and 1 3/4 inch high, opening counterclockwise (left). Paint wrench nut black with and cast an arrow indicating direction of opening in accordance with AWWA C-509.

Protective Coating. Apply an epoxy coating to all exterior and all stationary interior ferrous surfaces including all interior openings in the valves body in accordance with AWWA C-550 and having a minimum dry film thickness of 8 mils. After the coating is completely cured, test coated surface for porosity, holidays, and pinholes using a holiday detector. Repair all holidays or irregularities and test the coating again. Do not apply coating to the gasket surfaces of the end flanges.

7.2.1.5. **Butterfly Valves**. Provide butterfly valves that are tight-closing, rubber-seated type for Class 150B service and comply with the requirements of AWWA C-504, "Standard for Rubber-Seated Butterfly Valves". Provide valves for the size specified. Acceptable manufacturers and models are listed:

- Val-Matic — Class 150B Flanged or Mechanical Joint
- M&H — 450, 4500, 1450
- Kennedy — 30A, 30C
- Mueller — Lineseal III
- Pratt — Groundhog Flanged or Mechanical

Submittals. Provide submittals for approval. Provide manufacturer's approved certified test data or an affidavit stating that the valve complies with the performance tests, leakage tests, hydrostatic test and proof-of-design tests as described in Sections 5.2 and 6.3 of AWWA C-504.

Valve Ends. Provide short body flanged, mechanical joint valve ends or as otherwise specified.

Valve Bodies. Construct valve bodies of cast iron ASTM A-126, Class B, or ASTM A-48, Class 40 or Ductile Iron, ASTM A-536, Grade 65/45/12.

Valve Discs. Construct valve discs of cast iron conforming to ASTM A-126, Class B or Ductile Iron conforming to ASTM A-536, Grade 65/45/12, seat in a position of 90 degrees to the pipe axis and rotates 90 degrees between full open and tight closed position. Dimensions of clearance for valve discs are required.

Valve Shafts. Provide Type 304 or 316 Stainless Steel valve shafts, keys, dowel pins, or taper pins used for attaching valve shaft to the valve disc in conformance with ASTM A-276, or equivalent corrosion resistant material. All portions of shaft bearings must be stainless steel or bronze. Valve shafts may consist of a one-piece unit extending completely through the valve disc, or may be of the "stub shaft" type as defined in AWWA C-504. Provide butterfly valves with an extended bonnet, unless otherwise specified.

Shaft Seals. Provide a Split-V or O-ring type shaft seal that allows replacement without removing the valve shaft.

Valve Seats. Provide new natural or synthetic rubber resilient seats attached to either the disc or the body that provide tight shut off at the specified pressure. Seats must be clamped, mechanically secured, bonded or vulcanized to either the disc or body, be stainless steel and fastened by stainless steel cap screws.

Mating Seat Surface. Conform to ASTM A-276, stainless steel 18-8, Type 304, or have a 95% pure nickel overlay.

Valve Bearings. Manufacture bearings from corrosion resistant, and "self-lubricated" materials that will not damage natural or synthetic rubber and are sleeve type.

Valve Operators. Provide manual valve operations with a 2-inch square operating-nut and turn left (counterclockwise) to open. Totally enclose, pre-lubricate or grease pack all gearing. Provide operators of the worm gear or traveling nut and link type with field adjustable stops capable of withstanding 300 ft. lbs. input torque, as required by AWWA C-504.

Protective Coating. Except as otherwise specified, shop coat all interior steel or cast iron surfaces in accordance with the requirements of AWWA Standard C-504. Shop coat all external surfaces for buried valves with two coats of asphalt varnish according to AWWA C-504. When specified, apply a standard epoxy interior coating in accordance with AWWA Standard C-550, "Standard for Protective Interior Coatings for Valves and Hydrants".

7.2.1.6. **Air Release, Air/Vacuum, and Combination Air Valves**. Conform to AWWA C-512 requirements, testing requirements found in Section 5.1 of AWWA C-512 and the following specifications that apply to valve sizes 6" and smaller.

Air Release Valves (AR). Design to automatically release accumulated air pockets within the pipeline while in operation and under pressure. Provide air release valves APCO Model 200, Val-Matic Model 38, or Crispin Model P.

Air/Vacuum Valves (AV). Design to allow large volumes of air to escape through the valve orifice when filling a pipeline and to close watertight once the air has been expelled. Permit large volumes of air to enter through the valve orifice when the pipeline is being drained to break the vacuum. Provide AV valves that are APCO Series 140, Val-Matic Series 100, or Crispin Model AL.

Combination Air Valves (CAV). Provide heavy-duty air and vacuum valves with air release designed to release accumulations of air at high points within a pipeline by exhausting large volumes of air as the pipeline is being filled and by releasing accumulated pockets of air while the pipeline is in operation and under pressure. Also design CAV to permit large volumes of air to enter the pipeline during pipeline drainage. Provide CAV that are APCO, Val-matic Series 200, or Crispin Model C.

Submittals. Provide submittals for approval. Provide manufacturer's affidavit stating that the valve and all materials used in its construction conform to the applicable requirements of AWWA C-512 and these specifications. When required, the manufacturer shall provide and affidavit stating that the valve has been tested and is in compliance with the requirements specified in Section 5.1 of AWWA C-512.

Markings. Cast markings on the bonnet or body of each valve. Include the manufacturer's name or mark, the year the valve casting was made, the size of the valves, and the designated working pressure.

Body and Cover. Provide each air valve with a cast or ductile iron body and cover that complies with ASTM A-126 Class B, or ASTM A-48 Class 35. Ductile iron requirements in conformance with ASTM A-536, Grade 65-45-12. Meet or exceed the strength requirements of ASTM A-307 for bolting material. Provide all internal trim of stainless steel.

Float. Provide stainless steel float that is baffled to prevent air from blowing valve closed until air is exhausted. Design valve body, float, etc., for a working pressure equal to that of the system in which it is installed. Floats for valves with inlet sizes less than 4inches must be capable of withstanding a collapse pressure of 1000 psig. For larger inlet sizes, floats must be capable of withstanding a collapse pressure of 750 psig.

Valve Outlet. Fit outlet to attach discharge pipe as indicated. Provide N.P.T valve inlet. for 2 inch and smaller valves and ANSI flange for 3 inch and larger valves. Flange rating must equal or exceed the maximum working pressure of the system in which it is installed.

Installation. Install AR and AV valves within valve vaults, or manhole, in accordance with Utility Standard Details 263-1, 263-2, 263-3, 263-4 and plans.

Protective Coatings. Interior surface coatings are not required unless otherwise specified. Coat external surfaces with the manufacturer's standard primer.

7.2.1.7. **Swing Check Valves**. Provide swing check valves 2 1/2 inches to 12 inches in diameter that withstand a working pressure of 175 psig, comply with the requirements of AWWA C-508 and are tight seating to prevent the backflow of the media during pump shut-off or power failure. Design the closure assembly to assume the closed position by gravity under no flow conditions in a horizontal position. Provide fully open swing check valves with a net flow area not less than the area of a circle with a diameter equal to the nominal pipe size. Check valves can be either Swing Type Spring and Lever or Swing Type Lever and Weight. Acceptable manufacturers are Kennedy Company, Mueller, or equal.

Provide internals that are replaceable in the field without removing the main valve from the pipeline.

Submittals. Comply with the requirements of Article 7.2.1.2 in accordance to the applicable requirements of AWWA C-508. When required, the manufacturer must provide an affidavit stating that the valve has been tested and is in compliance with the requirements specified in Section 5.2 of AWWA C-508.

Markings. Cast markings on the bonnet or body of each valve. Include the manufacturer’s name or mark, the year the valve casting was made, the size of the valves, and the designated working pressure.

Valve Ends. Provide flanged valve ends unless otherwise specified.

Body. Provide heavy cast-iron body conforming to ASTM Standard A-126, Class B.

Disc. Provide cast-iron disc conforming to ASTM Standard A-126, Class B that is either Rubber-Faced, or Bronze-Faced conforming to ASTM B-584 "Specification for Copper Alloy Sand Castings for General Applications".

Disc Seat or Plate. Provide resilient Buna-N material or Bronze disc seat or plate conforming to ASTM Standard B-62 for drip tight shut-off and easily replaced in the field without the use of special tools.

Seat Ring. Provide Bronze seat ring conforming to ASTM Standard B-584 and is mechanically attached to machined surfaces in the body.

Hinge or Clapper Arm. Provide Bronze hinge or clapper arm conforming to ASTM Standard B-584.

Hinge Pins. Provide stainless steel hinge pins conforming to ASTM A-276 "Specification for Stainless and Heat Resisting Steel Bars and Shapes" in accordance with AWWA C-508.

Lever. For Swing-Type Lever and Weight, provide the lever with an adjustable counterweight to control opening and closing of clapper arm. For Swing-Type Spring and Lever, provide lever with an adjustable spring tension to control opening and closing of clapper. Install lever on either side of valve.

Protective Coating. Apply epoxy coating to all stationary interior ferrous surfaces including all interior openings in the valves body in accordance with AWWA C-550 and the manufacturer's instructions. Do not apply coating to the gasket surfaces of the end flanges. Paint valve exterior with Red Oxide Phenolic Primer Paint as accepted by the FDA for use on materials in contact with potable water.

7.2.1.8. **Pressure Reducing Valves.** Provide pressure reducing valves that maintain a constant downstream pressure regardless of varying inlet pressure and, unless otherwise specified, will be a direct acting, spring loaded, normally open globe pattern valve designed to permit flow when controlled pressure is less than the spring setting. Acceptable manufacturers and models are listed:

- Cla-Val Co. Model 90
- Fisher Governor Co. Type 616
- Bailey Model 30A

2 inches or smaller. Provide valves with a bronze body, nylon reinforced diaphragm, single seat, composition disc, Watt No. 223 or Masoneilan No. 227, or approved equal.

Larger than 2 inches. Provide valves with a cast iron body conforming to ASTM B-61, bronze main valve trim conforming to ASTM B-61, a reinforce neoprene diaphragm, stainless steel stem and flanged ends.

Pressure Rating. Provide a pressure rating of 125 psi with an adjustment range of 30-300 psi.

Valve Components. Provide removable and repairable components while the valve body remains in the line.

Diaphragm Assembly. Provide a synthetic rubber assembly a stem fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. Do not use diaphragm as a seating surface.

Resilient Disc. Provide discs that form a sealed chamber against the disc seat when the valve is closed. Provide seat that is removable and has a smooth surface that will not induce seal cutting or wear.

Strainer: For valves 3 inches and smaller, provide a standard flow clean strainer mounted in the inlet supply port of the main valve. For valves 4 inches and larger, provide a standard y-strainer externally mounted for the protection of the control circuit.

Protective Coating: Apply an epoxy coating to all exterior and all stationary interior ferrous surfaces including all interior openings in the valves body in accordance with AWWA C-550 and the manufacturer's instructions. After the coating is completely cured, test coated surface for porosity, holidays, and pinholes using a holiday detector. Repair all holidays or irregularities and test the coating again. Do not apply coating to the gasket surfaces of the end flanges.

7.2.2. **Fittings.** Provide ductile iron (DIP) fittings for use with ductile iron and polyvinyl chloride (PVC) for water pressure or transmission pipe that are smooth cement lined in accordance with AWWA C-104 and outside asphaltic coated per AWWA C-110. The size, body type, type of joint ends, and applicable reference standard are shown on plans or are specified.

Standards. Comply with the following applicable requirements:

ANSI B16.1"Cast Iron Pipe Flanges and Fittings"

AWWA C-104"American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water"

AWWA C-105 "Standard for Polyethylene Encasement for Ductile Iron Pipe and Fittings"

AWWA C-110"American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 inches through 48 inches, for Water and Other Liquids"

AWWA C-111 "Rubber-Gasket Joints"

AWWA C-153 "American National Standard for Ductile-Iron Compact Fittings, 3 inches through 16 inches, for Water and Other Liquids"

Minimum Requirements**.** Apply minimum requirements of shown Table 10 and Table 11 to the specified fittings.

Table 10.
Standard Short-Body Fittings per AWWA C-110

TYPE OF JOINT	DIAMETER	RATE WORKING PRESSURE	MATERIAL
Mechanical (Rubber Gasket/C-111)	4-24 inches	350 psi	DI
Flanged	4-24 inches	250 psi	DI
All Types	30-80 inches	250 psi	DI
Push-On (Rubber-Gasket/C-111)	4-24 inches	250 psi	DI

Table 11.
Compact Short-Body Fittings per AWWA C-153

TYPE OF JOINT	DIAMETER	RATE WORKING PRESSURE	MATERIAL
Mechanical or Push-On (Rubber Gasket/C-111)	4-24 inches	350 psi	DI

Provide all joint accessories such as gaskets, glands, bolts, and nuts with mechanical joints, and gaskets and lubricant furnished with push-on joints in sufficient quantity for assembly of each joint.

Mark push-on joint fittings with the proprietary name or trademark of the joint marked on the outside with their applicable AWWA Standard and information specified in the standard.

Provide polyethylene wrapped fittings in accordance with AWWAC-105.:

7.2.3. **Valve Vaults.** Provide pre-cast vaults with pre-cast or cast-in-place bases as shown on the plans.

Quality Assurance**.** Provide vaults that meet the requirements of ACI 318 and are designed for a minimum H-20 loading per AASHTO Specifications, plus a 30% impact factor, or greater if shown on the plans or specified. Mark date of manufacture and name or trademark of manufacturer on inside of each pre-cast vault section.

Submittals. Submit structural calculations sealed by a Structural Engineer registered in the State of Texas for approval along with shop drawings.

Materials. Provide concrete with a minimum 28 days compressive strength of 4,000 psi and reinforcing steel that meets the requirements of Article 4. Provide metal frames, covers, steps, toe pockets and similar required items as shown. Each pipe entering and exiting the vault required an approved flexible joint the provides a watertight installation. Submit jointing system or material for approval..

Installation. Cast-In-Place. Place cast-in-place bases on suitable foundations after the pipes are laid. Exercise special care when placing the concrete around the bottom of the pipes to obtain a waterproof structure. Cast an approved bell in the base to receive the pipe sections forming the barrel.

Pre-Cast. Set pre-cast bases on a concrete or crushed stone foundation as shown at the proper grade and carefully aligned. Set pre-cast vault sections vertical in true alignment. Install sections, joints, and gaskets in accordance with manufacturer's recommendations.

Seal lifting holes tight with a solid rubber plug driven into hole and the remaining void filled with cement-sand mortar.

7.3. **Provisions for Thrust.** Block all underground piping with concrete, bearing solidly against undisturbed trench walls, at all changes in direction, fittings, and valves subsidiary to the installation of fittings, valves, and all other appurtenances requiring provisions for thrust restraint.

Place concrete blocking against undisturbed trench walls with a minimum 18 inches between trench wall and pipe. Extend blocking a minimum of 0.75 times pipe diameter below and above the centerline of pipe and do not extend beyond any joints. Place blockings in accordance with the recommendations of “A Guide for the Installation of Ductile Iron Pipe” published by Cast Iron Pipe Research Association and according to details shown on the plans.

If directed, contain the ends of the thrust blocks in wood or metal forms as provided for under Item 420, “Concrete Structures”. Where upward thrusts are to be resisted, reinforce concrete anchor with reinforcing conforming to the provisions of Item 440, “Reinforcing Steel”.

Use Class B concrete used for Blocking in accordance Item 421, “Portland Cement Concrete” and Table 12 depicting the minimum area of concrete bearing against undisturbed trench bank.

Table 12.
Bearing Surface Per Bend

PIPE SIZE	TEE, DEAD END, 90 DEGREE BEND	45 AND 22-1/2 DEGREE BEND
6 Inch	4 sq. ft.	3 sq. ft.
8 Inch	6 sq. ft.	3 sq. ft.
12 Inch	13 sq. ft.	7 sq. ft.
16 Inch	23 sq. ft.	12 sq. ft.
20 Inch	37.02 sq. ft.	20.04 sq. ft.

Install mechanical joint restrainers as specified that are manufactured by EBAA Iron, Uni-Flange or approved equal.

7.4. **Construction.**

Valve Installation**.** Polyethylene-wrap valves in accordance with AWWA C-105, unless otherwise specified. Provide thrust blocking as specified. Carefully handle and install valves horizontally in such a manner as to prevent damage to any parts of the valves in accordance with manufacturer’s instruction. Valves delivered closed to the site will be opened by Contractor prior to installation. Record number of turns required to open the valve and submit information on the standard valve report to EPWU through Engineer.

Valve Testing**.** Upon completion of installation of the valves, conduct an acceptance test to verify the satisfactory operation of the valves. Check unit for operation and leakage. The valves must perform in a manner acceptable to the Engineer.

7.5. **Measurement.**

7.5.1. **Valves.** This Item will not be measured individually and is subsidiary to the installation of the various water mains and related appurtenances.

7.5.2. **Fittings.** This Item will not be measured individually and is subsidiary to the installation of the various water mains and related appurtenances.

7.5.3. **Additional Fittings.** This Item will be measured in place by the pound of additional fittings installed.

7.6. **Payment.**

7.6.1. **Valves.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be not paid for individually as it is considered subsidiary to the various water mains Items. All valves shown on the plans are subsidiary to the various water mains and services pay items and include all costs associated with coordination; excavation; disposal of excess material; backfill, compaction, compaction testing for utilities, all labor, equipment and materials required for furnishing and installing all valves shown on the plans to include those required as part of the different pay items, complete in place, including but not limited to: thrust blocking, mechanical joint restrainers, concrete anchoring, polyethylene wrapping, and provisions for corrosion protection. Use of mechanical joint restrainers in lieu of or in conjunction with concrete thrust blocking is not be considered for additional compensation.

7.6.2. **Fittings.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be not paid for individually as it is considered subsidiary to the various water mains pay items. All fittings shown on the plans are subsidiary to the different pay items for water mains and services and include all costs associated with coordination; excavation; disposal of excess material; backfill, compaction, compaction testing for utilities, all labor, equipment and materials required for furnishing and installing all fittings shown on the plans to include those required as part of the different pay items, complete in place, including but not limited to: thrust blocking, mechanical joint restrainers, concrete anchoring, polyethylene wrapping, and provisions for corrosion protection. Use of mechanical joint restrainers in lieu of or in conjunction with concrete thrust blocking will not be considered for additional compensation.

7.6.3. **Additional Fittings.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Additional Fittings". This price is full compensation for furnishing all required materials based on the cost of material only. Include labor costs, all costs associated with coordination; excavation; backfill, compaction, compaction testing for utilities; disposal of excess material; equipment and materials required for cutting and removal of water mains, furnishing and installing additional valves, bends, tees, crosses, couplings, reducers, adaptors, flexible fittings, not originally shown on the plans or details, as deemed necessary, complete in place, including but not limited to: thrust blocking, mechanical joint restrainers, concrete anchoring, polyethylene wrapping, and provisions for corrosion protection in the unit price for Water Main (PVC), Water Main (DIP) and/or Water Main (STEEL). Mechanical joint restrainers in lieu of or in conjunction with concrete thrust blocking are not considered for individual payment through the "Additional Fittings" provisions. The actual amount of additional fittings may be less than, but may not exceed the total quantities on the plans without approval.

8. WATER SERVICE CONNECTIONS

8.1. **Description.** Furnish labor, materials, equipment and incidentals necessary to construct and install pre-cast concrete meter boxes and vaults, water service connections and fire lines, complete for potable water supply including .

8.2. **Materials.**

General. Provide fittings and valves in contact with potable water in conformance to the latest revision of NSF/ANSI Standard 61 (Annex F) and the requirements of Article 7. Include certifications from manufacturers that the products comply with appropriate ASTM, AWWA and Utility Standards with required submittals. New water meters will be furnished by EPWU when required unless otherwise specified.

Quality Assurance. Fittings and valves in contact with potable water must conform to the latest revision of NSF/ANSI Standard 61 (Annex F). Such compliance must be evidenced by an affidavit from the manufacturer or vendor.

All fittings and valves must have the manufacturer's name or trademark permanently stamped or cast on it and "No Lead" brass allow, e.g. "NL" shall be cast or stamped on the valves and fittings.

8.2.1.1. **Water Service Connections**.

Castings and Washer Nuts**.** Provide certified cast bronze composition castings and washer nuts, 85-5-5-5 percent per ASTM B-62, fully formed, tapped threads meeting requirements of AWWA C-800 for underground service.

Gaskets**.** Provide gaskets that are self-sealing, 100 percent neoprene or Buna-N rubber, formulated for water service.

Service Saddles**.** Provide two or three piece all-bronze, double strap with National Coarse Class 2 thread saddles suitable for Class 200 asbestos cement pipe, cast iron pipe and ductile iron pipe with double straps. Provide single strap saddles for C-900 or C-905 PVC pipe. Extend saddle body 180 degrees around pipe. Acceptable manufacturers and models are listed:

- Ford Meter Box Co. Model S90
- James Jones Co. J-996
- A.Y. McDonald Mfg. Co. 3805
- Mueller H-1344X

Straps**.** Provide silicon bronze straps, approximate tensile strength of 70,000 psi chamfered for easy nut starting and flattened to provide wide bearing surface.

Valves. Provide valves in accordance with Utility acceptable standards and requirements for Article 7.2.1.11, "Gate Valves".

Use bronze valves for copper pipes with minimum 85% copper content casting and cast iron valves for PVC pipe that conform to requirements for Article 7.2.1.11, "Gate Valves".

Provide corporation stops manufactured by Ford Meter Box Co., Mueller, or approved equal and conform to the requirements of AWWA C800.

Provide angle ball valves with padlock wings that are copper flared inlet and female iron pipe thread outlet such as James Jones Company Model J-1965W, McDonald MFG Model 74606B, or approved equal. Use outlet meter coupling nut for 3/4 inch and 1 inch meters. Use inlet female iron pipe by outlet oval flange ends valves for 1 1/2 inch and 2 inch meters.

Service Pipe**.** Provide copper Type "K" for service pipe sizes up to and including 2 inch, meeting ASTM B-88 requirements with bronze fittings. For 3-inch services, provide 4 inch PVC per AWWA C-900 with reducers at meters. For 4 inch services and larger, provide PVC pipe per AWWA C-900. Provide ductile iron fittings for PVC pipe.

8.2.1.2. **Meter Boxes.** Meet the standards listed:

- ASTM A-27 Specifications for Steel Castings, Carbon, for General Application
- ASTM A-36 Specification for Structural Steel
- ASTM A-48 Specification for Gray Iron Castings
- ASTM C-33 Specification for Concrete Aggregates
- ASTM C-150 Specification for Portland Cement
- ASTM C-309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- ASTM C-615 Specification for Granite Building Stone

Shop Drawings. Submit shop drawings on molds, meter boxes, and associated hardware for approval prior to fabrication. Provide manufacturer's certification that products comply with appropriate ASTM, AWWA, and Utility standard details

Testing. When requested, provide compressive tests results and allow Engineer to inspect of the manufacturing process at any time, perform tests on materials used and to extract cores from completed meter boxes for compressive strength testing and placement of reinforcement.

Cement. Use Portland cement conforming to ASTM C-150, Type I or Type III. Provide concrete with a minimum 28 day compressive strength of 4,500 psi, a water cement ratio of 0.5 or less by weight, and a maximum 5.5 gallons water per sack cement. Handle concrete from the mixer or transport vehicle to the place of final deposit in a continuous manner, as rapidly as practicable, and without segregation or loss of ingredients, until the operation is completed. Place concrete in layers not exceeding 2 feet deep. Compact each layer by mechanical internal or external vibrating equipment. Limit duration of the vibration cycle to the time necessary to produce satisfactory consolidation without causing objectionable segregation.

Aggregates. Conform to specifications outlined by ASTM C-33 for aggregates other than lightweight aggregates. Provide aggregate that is free of deleterious substances and graded in a manner as to produce a homogeneous concrete mix. Accurately weigh all materials at a central batching facility for mixture.

Curing. For the purposes of early re-use of forms, concrete may be heated in the mold, after initial seat has taken place. Do not exceed a temperature of 71.11°C (160°F) and raise temperature from normal ambient temperatures at a rate not to exceed 4.44˚C (40°F) per hour. Do not remove the cured unit from the forms until sufficient strength is obtained for the unit to withstand any structural strain that may be subjected during the form stripping operation. After the stripping of forms further curing by means of water spraying or a membrane curing compound of a clear or white type, conforming to ASTM C-309 may be used.

Steel Reinforcing. Comply with ASTM A-615 Grade 60 steel, F_Y= 60,000 psi. Minimum concrete cover on re-bar top slab is 1 1/4 inch and 1 1/2 inch on re-bar for walls. Comply latest ACI Standards for bar bending and placement. Provide all reinforcing steel, including welded wire mesh, of the size and place in location shown on the plans. Tie all reinforcing sufficiently to withstand displacement during the pouring operation. Design lifters to handle the imposed weights, and place as shown on the plans or manufacturer's requirements.

Steel Frames and Covers. Conform to ASTM A-27, Grade 70-36. For structural welded steel, conform to the requirements of ASTM A-36 with dimensions as specified on the plans.

Cast Iron Ring and Covers. Conform to the requirements of ASTM 48, Class 30. Provide all castings of uniform quality, free from blowholes, shrinkage, distortion or other defects, smoothed and well cleaned by shot-blasting. Manufacture true to pattern. Provide component parts that fit together in a satisfactory manner. Provide round frames and covers s with continuously machined bearing surfaces to prevent rocking and rattling. Do not exceed tolerances of 1/16 inch per foot and deviation in weight of 5%.

8.2.1.3. **Tapping Sleeves and Pipe Couplings**. Furnish labor, materials, equipment and incidentals necessary to install tapping sleeves and pipe couplings as specified suitable for operation at pressures as specified for the pipelines in which they will be installed, including test pressures and surge allowances. Furnish shop drawings a required.

8.2.1.3.1. Cast Tapping Sleeves**.** Provide tapping sleeves of suitable construction and reinforced to provide resistance to line pressures that are designed for the pipe size and material on which they will be used. Build tapping sleeves in halves for assembly around the main to be tapped. The branch outlet will have a flanged face for bolting to the tapping valve with the inside diameter of outlet branch larger than the nominal size to provide clearance for the full size cutters of the tapping machine. Acceptable manufactures are Mueller Company, Kennedy Valve Squareseal and M&H.

Type 1. Cast tapping sleeve allows water to circulate between the sleeve and the outside surface of the pipe. Gaskets of suitable material, designed for use on potable water must form watertight joints along the

entire length of the sleeve. Seal circumferential joints at the ends of the run of the sleeves by mechanical joints, conforming to AWWA C-111 as to dimensions, clearances, and materials, except that gaskets and glands from mechanical joints must be totally confined or compressed between ridges or grooves extending continuously for the full length of both halves of the sleeve casting. Locate bolts close to the outside of the gaskets and spaced so as to exert sufficient pressure to form a watertight joint and withstand stresses imposed by the intended use.

Type 2. Water is confined to the immediate area of the tap opening. Fit the outlet half of each sleeve with a continuous gasket of approximately circular cross section, permanently cemented into a groove surrounding the outlet opening and the back half of each sleeve fitted with elastomeric pads, a metal shoe, or other device for developing adequate pressure on the gasket to prevent leakage at any pressure within the design capacity of the pipe.

Protective Coating: Coat all surfaces exposed to flow in accordance with AWWA C-550.

8.2.1.3.2. Fabricated Tapping Sleeves**.** Fabricated tapping sleeves must be rated for a working pressure of 150 psi and meet the following requirements. Acceptable manufacturers and models are listed:

- Ford FTSC
- JCM 412
- Romac FTS 420
- Powerseal 3490

Markings: Permanently mark each tapping sleeve to identify the outer diameter size range.

Test Plug: Provide a 3/4" NPT with standard square head.

Nuts and Bolts: Provide high strength, corrosion resistant 18-8 Type 304 Stainless Steel.

4 inch to 12 inch. Provide tapping sleeve body and flange 18-8 Type 304 Stainless Steel or AWWA C111 Carbon Steel with fusion epoxy coating. Provide body, lug, and gasket armor plate in compliance with ASTM A-240 having all metal surfaces passivated, in accordance with ASTM A-380, after fabrication.

- Provide gasket with a watertight sealing surface around the full circumference of the pipe formed of natural or synthetic rubber.
- Weld lugs to the shell and prevent alignment problems by allowing the bolts to pass through. Do not weld bolts to the sleeve.

16 inch and Larger: Proving tapping sleeves that have a heavy welded steel body in compliance with ASTM A-36 or ASTM A-285, Grade C.

- Provide natural or synthetic rubber compounded gaskets for water use providing a watertight sealing surface.
- Construct flanges in accordance with AWWA C-207 Class D and properly recess for aligning the sleeve and tapping valves.
- Coat steel tapping sleeves with 8 mils minimum thickness epoxy

8.2.1.3.3. Flexible Couplings**.** Furnish and install couplings where shown on the plans, specified, or in locations as approved. Use ductile iron flexible couplings and Type 316 Stainless Steel nuts and bolts when installed underground. When flexible couplings are used as expansion joints, separate the pipe ends to allow for expansion. Where indicated on the plans or required by field conditions, flexible couplings must be suitable for connecting pipes having different outside diameters. Restrain flanged coupling adapters with tie rods.

Protective Coating: Coat entire coupling assembly with a 20 mil coating of T.C. Mastic as manufactured by Tape Coat Company, Bitumastic No. 50 as manufactured by Koppers Company, or approved equal.

Ductile Iron Pipe. Flexible Joint Couplings will be Dresser Style 38, Rockwell Style 411, or equal. Flanged coupling adapters for ductile iron pipe will be Dresser Type 127, Rockwell International 112, Baker Series 600, or equal.

Steel Pipe. Flexible couplings will be Dresser Style 38, Rockwell International 411, or equal, except where other styles are required for special conditions.

Provide neoprene rubber or equal gaskets.

8.2.1.3.4. Installation. Install tapping sleeves in accordance with the manufacturer's recommendations. Construct disc and seat ring in a manner that the inside diameter of the ring is at least 3/16 inch larger than nominal size of valve. Block tapping sleeve and valve assembly blocked as indicated.

8.3. **Construction.**

8.3.1. General**.** Furnish and install service taps for 3/4 inch to 2 inch services with service saddle. Direct taps, i.e. without the saddle, are not allowed. For 3 inch and 4 inch services, construct taps using 4 inch tapping sleeve and valve. Insulate copper service pipe attached to metallic water mains at the corporation stop with a dielectric insulator in accordance with Utility Standards for Excavating, Backfilling, and Compacting.

Do not install multiple tapping, two or more taps on a length of pipe, on a common line parallel to the longitudinal axis of the pipe and no closer than 18 inches on the longitudinal axis of the pipe.

Splices are not allowed in any portion of the service pipe run between the main line connection and the meter assembly. Connect all services to new main by means of wet-tapping. Dry or direct taps are not allowed.

Perform meter installations larger than 1-inch with a bypass meter connection as listed:

- 1 1/2 inch and 2 inch meters 1-inch bypass
- 3 inch and 4 inch meters 2-inch bypass
- 6 inch and 8 inch meters 3-inch bypass

8.3.2. Existing Services**.** Where existing water services are indicated on the plans to be replaced, relocated, or reconnected to new water lines, make prior arrangements with each water customer as to the time and length of shutdown necessary. Notify the customer 24 hours before any connections are made. A maximum shut-off time of four (4) hours will be allowed for making connections, after which time supply the customer with potable water from an approved source at no additional cost to Department.

8.3.3. Metallic Tracer Tape**.** For 3-inch services and larger (i.e. PVC), provide a minimum width of 6 inches or twice the line diameter. Do not exceed a burial depth of 36 inches below final grade or be at an elevation of less than 12 inches above the utility line. Follow tape manufacturer's recommended burial depths.

8.3.4. Meter Box Installation**.** Install in accordance with these specifications and Utility Standard Details to grade matching top of curb.

Do not install under sidewalks, driveways, or proposed above-ground structures. Where no curbing exists, install boxes in accessible locations beyond limits of street surfacing, walks, and driveways.

Install standard meter boxes for their respective meter size according to Table 13.

Table 13.
Standard Meter Boxes

METER SIZE	BOX TYPE	CONSTRUCTION	DIMENSIONS W x H
3/4 inch	Type A	Single Unit	19.25 inch O.D. x 17 inch
1 inch	Type B	Single Unit	26 inch O.D. x 17 inch
1 1/2 inch to 2 inch	Type C	Single Unit	50 inch sq. x 24 inch
3 inch and larger	Type D	Modular	7 ft.-8 inch sq. x 4 ft.-6 inch

Where it is necessary to install Type A or B boxes for 3/4 inch or 1 inch meters under roadways or traffic bearing surfaces, encase boxes in 12 inches concrete 3,000 psi minimum.

8.3.5. Testing and Flushing Procedures**.** Pressure test all services for leakage by opening the corporation or service valve at the main service connection point, maintaining the meter angle valve closed, and visually observing all connections and piping for leaks. If no leaks are observed, then flush service line as follows. The angle valve is opened to "full" and then the corporation valve is slowly opened to full capacity. Water is allowed to flow until piping has been thoroughly flushed. Then the angle valve is slowly closed to prevent water hammer or shock pressure, which might rupture the main or adjacent water service connections. If no customer piping is currently connected to the meter outlet connection, use a fitted plug at the end of this connection to prevent the entrance of dirt or muddy water.

8.4. **Measurement.**

8.4.1. **Water Service Replace and Reconnect.** This Item will be measured in place by each water service replaced and reconnected for the size and type indicated.

8.4.2. **New Water Service Installation.** This Item will be measured in place by each new service installed for the size and type indicated.

8.4.3. **Meter Boxes.** This Item will not be measured for individual payment and is subsidiary to the water connection items.

8.5. **Payment**.

8.5.1. **Water Service Replace and Re-connect.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Water Service Replace & Reconnect" of the size and type specified. This price is full compensation for furnishing all required materials, including all costs associated with: furnishing labor, new materials, equipment, and incidentals to replace and reconnect existing water services of the specific size and type (water service or fire line); complete restoration to its original condition, any disturbed areas associated with the replacement and reconnection of existing water services; coordination; and all appurtenances defined herein to include, but not limited to the following items: concrete meter boxes, all fittings and valves in accordance with EPWU requirements and as indicated on the plans.

8.5.2. **New Water Service Installation.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "New Water Service Installation" of the size and type specified. This price is full compensation for furnishing all required materials, including all costs associated with: furnishing labor, new materials, equipment, and incidentals to install new water services of the specific size and type (water service or fire line); complete restoration to its original condition, any disturbed area associated with the installation of new water services; coordination; and all appurtenances defined herein to include, but not limited to the following items: concrete meter boxes and vaults, all fittings and valves in accordance with EPWU requirements and as indicated on the plans.

8.5.3. **Meter Boxes.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" are subsidiary to the "Water Service Replace & Reconnect" or "New Water Service Installation" bid items.

9. FIRE HYDRANTS

9.1. **Description.** Furnish labor, materials, equipment and incidentals to install fire hydrants as shown on the plans in accordance with Utility requirements and typical fire hydrant installation.

9.2. **Materials.**

Submittals**.** Submittals include certified drawing showing dimensions and construction details and certification from manufacturers that the products comply with appropriate AWWA Standards and this Specification. Submit catalog data illustrating equipment to be furnished and a schedule of parts and materials. Provide manufacturer guarantee that friction loss meet the requirements of AWWA C-502.

Standards**.** Comply with requirements of AWWA C-502, Dry-Barrel Fire Hydrants, and AWWA C-550, Protective Epoxy Interior Coatings for Valves and Hydrants.

9.2.1. **Manufactured Products**.

General**.** Provide dry-barrel compression type fir hydrants, with the main valve opening against the pressure, in accordance with AWWA C-502. Design hydrant for a minimum working pressure of 150 psi and tested at 300 psi hydrostatic pressure.

Provide hydrant with permanent markings identifying name of manufacturer, size of main valve opening and year of manufacture that are easily located and legible after the hydrant has been installed.

Construct hydrant so that the standpipe may be rotated to eight (8) different positions.

Provide center of the lowest nozzle a minimum ground clearance of 15 inches. Supply with extension sections in multiples of 6 inches with rod and coupling as required to increase barrel length.

The fire hydrant manufacturer must provide local representation and support services, through an established vendor, within the County of El Paso. Acceptable manufacturers and models are listed.

- American Flow Control B84B
- Clow Medallion
- M&H Model 129
- Mueller Centurion

Size**.** Provide a minimum inside barrel diameter of 7 inches with a minimum diameter of the main valve opening of 5 inches.

9.2.2. **Traffic Type**. Design the barrel and operating mechanism that the main valve will remain closed and reasonably tight against leakage in the event of an accident, damage, or breaking of the hydrant above or near the grade level.

Provide manufacturer guarantee that the hydrant valve stem will not be bent when the hydrant is damaged or broken at or near ground level. Provide a safety breaking flange or thimble. Make provisions in the design of the stem to disconnect the stem from the hydrant parts above the standpipe break point in the event of a traffic accident.

If breakable couplings are used, design the barrel safety flange and stem safety collar to break before any other hydrant part in the event of an accident. Design coupling so that no part of the coupling will drop into the hydrant barrel in the event of an accident.

Corrosion Resistant Valve**:** Include a Davidson Anti-Terrorism Corrosion Resistant Valve Kit (DATV) designed to protect against accidental backflow and intentional contamination of drinking water via the

hydrant. The DATV must be a stealth check valve located internal to the upper barrel of the hydrant and consisting of four main parts.

- A sleeve-insert valve seat, made of E-coated or fusion-bonded epoxy steel. Provide a machined slot to the top of the valve seat to accommodate an EPDM quad ring that will provide an impenetrable seal between the seat and the valve and separates the valve from the insert to prevent the chance of galvanic corrosion. The sleeve will have a plug in the drain hole located at the bottom of the sleeve.
- A valve made of brass with machined slots to accommodate a Viton O-ring between the valve and the upper stem.
- A 304 stainless steel machined upper stem to replace the original upper stem. Attach the brass valve to the upper stem in such a manner as to provide free vertical movement along the shaft and be sealed and separated from the stem by a Viton o-ring that prevents contact between dissimilar metals to eliminate the chance of galvanic corrosion.
- A 302 stainless steel spring that fits around the upper stem and is of adequate compression strength and length such that sufficient pressure is placed on the valve to provide an impenetrable seal when the hydrant is not in use and yet allows water to flow freely when the hydrant is flowed.

Provide a technician certified by the DATV manufacturer to install the DATV. The DATV manufacturer or authorized representative must provide both initial and ongoing refresher training, free of charge to governmental entities utilizing their product. Install DATV in a manner that does not alter the standard warranty offered by the hydrant manufacturer, except that such warranty will not cover the DATV itself

The DATV must be shop-installed by the hydrant distributor and be delivered to the project site ready for installation. The hydrant distributor will order the hydrants without the hydrant parts that are to be replaced by the DATV. Provide DATV with a minimum 10 year warranty against defects in workmanship and materials that also guarantees that its installation inside the hydrant will not cause failure of any of the original fire hydrant parts while the hydrant is under warranty, provided that: (a) the hydrant and DATV are installed and maintained in accordance with the corresponding manufacturers' recommendations; (b) the installer of the DATV was certified for such installation by the DATV manufacturer; and (c) that analysis of the failure clearly establishes that installation of the DATV as the primary cause of the failure.

Ensure that the DATV does not interfere with the breakaway functionality of the fire hydrant.

Drain Outlet**.** Provide upper valve plate, seat ring and drain ring or shoe bushing in bronze, to form an all bronze drain way and drains the hydrant properly by opening as soon as the main valve is closed.

Inlet Connections**.** Provide mechanical joint, with accessories, gland, bolts, gaskets, and a 6 inch diameter inlet connection. Provide synthetic rubber main valve facing against seats. Equip top of the stem or bonnet with O-ring seal. Provide oil or grease lubricated hydrant.

Outlet and Pumper Nozzles**.** Provide two hose outlets with two 1/2 inch nozzles with National Standard hose coupling screw threads. Provide outlet nozzles of the caulked type or mechanically connected into the barrel with an O-ring seal and a non-corrosive locking pin to lock the nozzle to the barrel.

Provide pumper Nozzle with an inner diameter of 4 inches with threads conforming to the City of El Paso Standards.

Provide nozzle caps with one, 1 inch square nut, gaskets and non-kinking chains. Provide operating nut and nozzle cap nuts that have one, 1 inch square at the base and tapered to 7/8 inch square at the end and not less than 1 inch deep. Provide nozzle caps with rubber gaskets.

Hydrant Operator**.** Provide operator that is 1 inch square at the base and tapered to 7/8 inch at the end and not less than 1 inch deep. Attachment of the operator nut must not, in any way, hinder operating the hydrant with the wrench and must open by turning left (counterclockwise). Design hydrants with O-ring seals to prevent water from damaging the operating threads.

Tamper Proof Cover**.** Equip hydrant with a tamper proof cover, minimum inside diameter of 2 1/4 inches, with drainage holes, that deters unauthorized operation of the hydrant and provides adequate wrench clearance. The height of the cover ranges from 2 1/4 inches to 2 1/2 inches, measured from the base at the bonnet to the top of the collar.

Painting**.** Prime coat barrels above ground with two coats of aluminum colored paint as approved by EPWU.

Protective Coating**.** Epoxy coat all interior ferrous surfaces of shoe exposed to flow to a minimum dry thickness of 4 mils. Factory- apply epoxy coating by an electrostatic or thermosetting process in accordance with manufacturer's printed instructions. Epoxy materials must be 100 percent powder epoxy or liquid epoxy conforming to AWWA C-550 and to the current requirements of the Food and Drug Administration and the EPA for potable water.

9.3. **Construction.** Install hydrants at locations shown on the plans or in approved standard locations. Touch up paint damaged during installation. Disinfect hydrants with the connecting pipe in accordance with Article 10, "Cleaning, Disinfection and Testing of Water System" in this Specification. Ensure installed hydrants are left in good working order with control valve open.

9.4. **Measurement.**

9.4.1. **Fire Hydrant (Relocate & Reconnect).** This Item will be measured in place by each fire hydrant reconnected to the new or existing water main.

9.4.2. **Fire Hydrant (New).** This Item will be measured in place by each new fire hydrant connected to the new water main.

9.4.3. **Fire Hydrant (Remove and Salvage**). This Item will be measured in place by each fire hydrant removed and salvaged.

9.5. **Payment.**

9.5.1. **Fire Hydrant (Relocate & Reconnect).** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Fire Hydrant (Reconnect Only)" as specified. This price is full compensation for furnishing all required materials, including new piping from the new or existing water main to the fire hydrant, new gate valve with bonnet box, concrete thrust blocking or mechanical joint restraints, Davidson Anti-Terrorism Corrosion Resistant Valve Kit (DATV), new spool extensions as needed, new fittings and appurtenances for a complete installation as shown in plans.

9.5.2. **Fire Hydrant (New).** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Fire Hydrant (New)" as specified. This price is full compensation for furnishing all required materials, installation of new fire hydrant, Davidson Anti-Terrorism Corrosion Resistant Valve Kit (DATV), spool extensions as needed, mechanical joint tee at the main, gate valve with bonnet box and lid, all PVC C900 pipe from the main to the fire hydrant, thrust blocking or mechanical joint restrainers and all fittings and appurtenances for a complete installation as shown in the plans.

9.5.3. **Fire Hydrant (Remove and Salvage).** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Fire Hydrant (Remove and Salvage)" as specified. This price is full compensation for furnishing all required labor, materials, equipment, and incidentals to remove and salvage existing fire hydrants as indicated on the plans in accordance with EPWU's requirements.

10. CLEANING, DISINFECTION, AND TESTING OF WATER SYSTEM

10.1. **Description.** Perform disinfection and testing of all water mains and related appurtenances.

10.2. **Materials.**

Standard**s.** Comply with applicable requirements of AWWA B-300 “Standard for Hypochlorites”, AWWA B-301,“Standard for Liquid Chlorine” and AWWA C-651,“Standard for Disinfecting Water Mains”.

Water**.** Provide water required for filling, flushing and testing the line at such points along the pipeline as water is available from the existing distribution or supply systems (See ”Water for Construction” in Project General Notes). Do not waste water. Such action may require appropriate charges. Provide water, by tank truck or other means, to the points necessary to produce specified test pressure. Coordinate disposal of water with Engineer and El Paso Water Utilities Operations Division. Do not dispose water onto the streets as that will be considered “wasting of water”, unless otherwise approved.

Chlorinating Material**.** Provide either liquid chlorine conforming to AWWA B-301 or hypochlorite conforming to AWWA B-300.

10.3. **Construction.**

General**.** After completion of all pipe line section, use the following procedure to clean, sterilize and pressure test the pipeline. Fill the pipeline and flush until all evidence of dirt or debris has been washed from the pipeline, then refill line, if necessary, introducing the chlorinating material. Perform pressure and leakage test at each valved section. After all sections have been approved, clean all valves and leave line full of sterilizing water.

Quality Assurance**.** Exercise special care to keep the interior of the pipe clean during storing, handling, and laying operations in order to reduce the need for flushing to an absolute minimum. In addition, tightly cover all open ends whenever unattended to prevent small animals and dirt from entering the pipeline after it is in place.

10.3.1.1. Sterilization**.** Before acceptance for operation, sterilize each unit of completed water system as specified below or as prescribed by AWWA Standard C-651. (As per C-651, collect two consecutive sets of acceptable samples taken at least 24 hours apart from the new main.)

- Thoroughly flush with water the unit to be sterilized until all entrained dirt and mud have been removed before introducing the chlorinating material.
- Provide all chlorination material for sterilization and introduce the chlorinating material into the water line in an approved manner at a dosage of not less than 50 parts per million.
- Retain treated water in the pipe at least 25 hours to destroy all nonspore-forming bacteria except where a shorter period is approved. Retention time should produce not less than 10 ppm of chlorine at the extreme end of the line at the end of the retention period.
- Open and close all valves on the lines being sterilized several times during the contact period.

10.3.1.2. Hydrostatic Pressure and Leakage Testing**.** Furnish meter, pressure gauges, pump, small piping and hose connections, and all labor necessary for conducting hydrostatic pressure and leakage tests. Check all valves and hydrants for proper operation and pressure. Subject the pipe system to a hydrostatic pressure and leakage test after completion of each valved section and following the filling and disinfection of the section.

After the section of pipeline has been filled, pump water into the section and raise the pressure to 150 psi. Maintain this test pressure for a period of at least two (2) hours. Deliver water required to maintain this pressure through the meter. The amount of water through the meter during the two-hour test period will be the total leakage. Should this leakage exceed the allowable amount, make repairs as may be required until the actual leakage, as determined by succeeding tests, is no greater than the allowable as determined by the following formula:

$L = S \times D \times (P^{1/2}) / 133{,}200$ except that L = 0 in above ground systems and otherwise

L =Allowable Leakage in gallons/hour

S =Length of pipe tested in feet
D =Nominal diameter of pipe in inches
P =Average test pressure during the test, in pounds per square inch, gage; determined by computing the weighted average of actual pressures on various portions of the section

After all sections of the pipeline have been tested, as described above, close all valves and leave line filled with the water used for disinfection and testing.

10.4. **Measurement and Payment.** The work performed and the materials furnished in accordance with this Article will not be measured or paid for individually as it is considered subsidiary to the various water main and related appurtenances bid items.

11. SANITARY SEWER FACILITIES

11.1. **Description.** Furnish all labor, materials, equipment and incidentals required and install sanitary sewer systems and adjustments as shown on the plans and as specified.

Verification of Utilities**.** The data furnished in the plans regarding the size and location of utility lines has been obtained from field surveys and the various utility companies. Verify the location of all utilities prior to commencing sewer construction. Perform all work within public right-of-way. Do not extend into or encroach upon private property including basements, residences, and places of business.

Coordination with El Paso Water Utilities (EPWU). Coordination with EPWU is required for sewer line tie-ins and bypassing, where indicated in the specifications and on the plans, and for CCTV video-inspection of new sewer lines. EPWU will perform video-inspection of all new sewer lines to determine acceptance. Notify EPWU through Engineer, a minimum of 48 hours in advance of any scheduled inspection; and provide a staging area that is free and accessible for TV camera activities.

Water Main Crossing**.** Where gravity or force main sewers are constructed in the vicinity of water mains, ensure that the most current requirements of the Texas Commission on Environmental Quality (TCEQ) are met.

11.2. **Materials.**

11.2.1. **Polyvinyl Chloride (PVC) Flexible Pipe.** These standard specifications designate the requirements for furnishing and installing PVC gravity pipe for sanitary sewage, with a standard dimension ratio (SDR) as shown in the plans and/or specified herein. Furnish all materials, equipment, tools, labor, superintendence, and incidentals required for the complete construction of the work designated.

Quality Assurance**.** Code all PVC pipe to provide positive identification and prevent accidental damage to or interruption of the sanitary sewer facilities. Only provide pipe manufactured in the United States of America. Provide new materials including all pipe, fittings, and accessories. Perform manufacturer's physical and chemical tests according to the ASTM standard applicable to the respective PVC pipe type and diameter herein specified, in order to demonstrate pipe quality.

Submittals**.** Submit documentation on pipe products, fittings, and related materials as may be required by the contract documents or the Engineer. Review all submittals prior to submission. Submit in a timely manner so as not to delay the project. Allow sufficient time for Engineer's review and resubmission, if necessary. Include certifications from manufacturer that the product complies with appropriate ASTM standards.

Standards**.** Comply with applicable following requirements:

- ASTM D-1784 Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
- ASTM D-2321 Specification for Underground Installation of Flexible Thermoplastic Sewer Pipe

- ASTM D-3034 Specification for Type PSM Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings
- ASTM D-3212 Joints for Drain and Sewer Pipes Using Flexible Elastomeric Seals
- ASTM F-477 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- ASTM F-679 Specification for Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings
- ASTM F-789 Specification for Type PS-46 Poly (Vinyl Chloride) (PVC) Plastic Gravity Flow Sewer Pipe and Fittings
- ASTM F-794 Specification for Poly (Vinyl Chloride) (PVC) Large Diameter Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter

Delivery and Storage**.** Inspect pipe, fittings, and accessories upon delivery and during progress of the work. Any material found defective will be rejected. Remove rejected material promptly from site.

Replace, at no additional cost to Department, any material found to be defective in manufacture or damaged.

Unload at point of delivery all pipe, fittings, and other accessories, haul to and distribute at the work site. In loading and unloading, lift materials by hoists or rolled on skidways so as to avoid shock or damage. Do not incorporate materials that have been dropped into the work. Do not skid or roll pipe handled on skidways against pipe already on the ground.

Do not store PVC pipe outside exposed to prolonged periods of sunlight. Any discoloration of pipe due to such exposure is an indication of reduced pipe impact strength, and will be sufficient cause for rejection of the pipe. Remove rejected all pipe from the job site.

Pipe Schedule**.** PVC pipe will be designated as gravity sewer conduit and must meet the requirements shown on Table 14.

Table 14.
Gravity Sewer Conduit Dimensions

Pipe Size	ASTM Standard	Material	Wall Type	Minimum Stiffness	Standard Length
8" 12" 15"	D-3034	PVC	Solid SDR-35	46 psi	20'
	F-789	PVC	Solid T1-Wall	46 psi	20'
18"	F-679	PVC	Solid T1-Wall	46 psi	20'
	F-789	PVC	Solid T1-Wall	46 psi	20'
	F-794	Large Dia PVC	Profile Open	46 psi	13'
21"-27"	F-679	PVC	Solid T1-Wall	46 psi	20'
	F-794	Large Dia PVC	Profile Open or Closed	46 psi	13'
30"-36"	F-794	Large Dia PVC	Profile Open or Closed	46 psi	13'
39" - 60"	F-794	Large Dia PVC	Profile Closed	46 psi	13'

Joints**.** Provide push-on, bell and spigot type joints with elastomeric seals that conform to the requirements of ASTM D-3212. Provide factory installed gaskets that are chemically bonded to the bell end of the pipe with gasket material that conforms to the requirements of ASTM F-477.

Pipe Materials**.** Provide pipe and fittings made from polyvinyl chloride compounds that comply with the requirements for minimum cell classification defined by ASTM D-1784. Provide PVC fittings, service risers, and laterals with a SDR 35 rating.

Pipe Trenching, Installation and Backfill**.** Except as noted, Pipe Trenching, Installation and Backfill of PVC gravity sewer pipe will be in accordance with ASTM D-2321 and Article 6 of this specification.

- Trench Width: Refer to Article 6.3.2.1 for FLEXIBLE PIPE
- Pipe Installation: Following the preparation of the trench bottom and trench bracing installed where required, proceed up grade with spigot ends pointing down grade. Lay pipe true to lines and grades as shown on plans. Grade may be established by laser beam, or batter boards (not exceeding 50 foot intervals), and string line may be used with each pipe set to grade, from the string line, with a grade rod equipped with a "shoe" designed to fit into the flow line of the pipe

Testing**.** Inspect PVC and test for leakage and deflection in accordance with Article 11.3.3.

11.2.2. **Ductile Iron Pipe (DIP).** These standard specifications designate the requirements for furnishing and installing DIP for sanitary sewage. Furnish all materials, equipment, tools, labor, superintendence, and incidentals required for the complete construction of the work designated.

Quality Assurance**.** Manufacturer must have a minimum of ten years successful experience in designing and manufacturing DIP, pipe joints of similar design, pipe diameter, and pressure class of the type specified. The entire pipeline will be the product of one manufacturer. Pipe must conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 “Drinking Water System Components - Health Effects” and be certified by and organization accredited by ANSI. Such compliance will be evidenced by an affidavit from the manufacturer or vendor. If the pipe does not presently conform to this standard, information from the manufacturer regarding action being taken to comply with this standard must be submitted.

Submittal. Submit documentation on pipe products, fittings, and related materials as required by the plans or Engineer. Review all submittals prior to submission. Submit in a timely manner so as not to delay the project. Allow sufficient time for Engineer's review and resubmission, if necessary. Include certifications from manufacturer that the DIP complies with appropriate AWWA Standards and ANSI/NSF Standard 61. Provide by an affidavit from the manufacturer or vendor as evidence of compliance. If the pipe does not presently conform to this standard, information from the manufacturer regarding action being taken to comply with this standard must be submitted. If requested, provide copies of results of factory hydrostatic tests.

Standards. Comply with applicable requirements of the following items listed below:

- ASTM A-746 Specification for Ductile Iron Gravity Sewer Pipe
- AWWA C-104 Standard for Cement Mortar Lining for Ductile Iron Pipe and Fittings
- AWWA C-105 Standard for Polyethylene Encasement for Ductile Iron Piping
- AWWA C-110 Standard for Ductile Iron and Gray Iron Fittings
- AWWA C-111 Standard for Rubber Gasket Joints for Ductile Iron Pipe and Fittings
- AWWA C-150 Standard for Thickness Design of Ductile Iron Pipe
- AWWA C-151 Standard for Ductile Iron Pipe

Pipe Materials**.** Manufacture DIP in accordance with AWWA C-151 and conform to ASTM Specification A-746 with physical properties of Grade 60-40-18 with a minimum pressure class rating of 150 psi, unless otherwise specified. Design pipe for five (5) feet of cover or for the depths shown on the plans, whichever is greater. Provide a standard joint length of 18 or 20 feet and the inside diameter will be industry standard. Replace any material found to be damaged or defective in manufacture at Contractor's expense.

Joints**.** Provide push-on standard joints for DIP manufactured in accordance with AWWA C-111, AWWA C-151. Where indicated on the plans, joints will be mechanical or flanged. Flanged joints will have pressure ratings equal to or greater than adjacent pipe. Flange pattern will match pattern of valve, fitting, or appurtenance to be attached.

Fittings. Provide DIP in accordance with AWWA C-110 and Article 7 of this Specification. Fittings will be rated for a minimum working pressure of 250 psi, unless otherwise specified. Factory welded outlets,

minimum pressure rating 250 psi, may be used in lieu of tee fittings for 18 inch and larger tee fittings. Do not use factory welded outlets near sources of vibration, such as pump stations or roads, unless specifically noted on the plans.

Exterior Coating**.** Provide a standard asphaltic coating in accordance with AWWA C-151, unless otherwise specified. The finished coating will be continuous, and smooth and strongly adherent to the pipe.

For DIP sizes 30 inches and smaller, use a 30 mils minimum thickness polyethylene wrap applied wrap in accordance with AWWA C-105/A21.5.

Tape coat DIP 36 inches and larger. The exterior of the pipe must have a prefabricated cold-applied tape coating system conforming to the requirements of ANSI/AWWA C-214, except as noted herein. Blast clean the surface to achieve a surface preparation at least equal to that specified in SSPC SP6. The blast profile must have an anchor pattern as specified by the tape manufacturer. Hold the coating back from the end of the pipe the minimum distance recommended by the pipe manufacturer for the type of joint used. Taper the tape wrap cut back. Provide a nominal thickness of 80 mils.

Interior Lining. DIP Pipe and fittings will have an epoxy lining in accordance with ASTM D714. Provide epoxy lining appropriate for wastewater pipe application with a minimum lining thickness of 40 mils.

Provisions for Thrust**.** Where indicated and where required for thrust restraint, joints must be restrained. Restrained joints will be mechanically interlocking joints. Provide restrained joints such as U.S. Pipe "TR Flex", American Cast Iron Pipe "Flex Ring", or Clow Corporation "Super-Lock" that are capable of sustaining the specified design pressure. If thrust cannot be accommodated using restrained joints, such as bends adjacent to casing pipe, use approved thrust restraint devices.

Use thrust restraint devices to resist thrust at bends, tees, plugs, or other fittings. Do not use concrete thrust blocks unless approved by the Engineer. Acceptable thrust restraint devices are those as manufactured by EBAA Iron, Ford Uni-Flange, or approved equal.

NOTE: At connection of new sewer force main to existing main, use both concrete thrust blocking and thrust restraint devices as per Article 4.2.5 of this specification.

Use restrained joints for a sufficient distance from each bend, tee, plug, or other fitting to resist thrust which will be developed at the design pressure of the pipe. For the purposes of thrust restraint, design pressure will be 1.5 times the design working pressure class indicated. Pipe manufacturer will determine length of pipe with restrained joints to resist thrust forces in accordance with the Handbook of Ductile Iron Pipe. Use the following parameters:

- Laying condition equal to AWWA C-600 Type 5 soil
- Safety factor of 1.8
- Unit bearing resistance equal to zero
- Factor for polyethylene encasement as recommended by DIPRA, if required.

Pipe Trenching, Installation, and Backfill**.** Except as noted, perform pipe trenching, installation, and backfill for DIP in accordance with AWWA C-600 and Article 6 of this Specification.

General. Repair any damage to polyethylene wrap according to AWWA C-105. Keep pipe clean during installation. Provide two coats of Koppers Bitumastic No. 50, or approved equal to exposed ferrous metal that cannot be protected with field-applied tape coating. Install pipe and fittings to line and grade indicated. In areas where the line and grades indicated cannot be achieved using standard manufactured bends and fittings, make slight adjustments by deflecting joints according to the limitations of AWWA C-600.

Pipe Zone Embedment. Unless otherwise specified, embed DIP in Class II material as defined in Article 6. Native material or imported material meeting or exceeding Class II requirements may be used. Class I material may be acceptable only in groundwater conditions if approved.

Pipe Cutting: When required, machine cut DIP leaving a smooth cut at right angles to the axis of the pipe. Bevel ends of cut pipe to be used with a push-on joint bell to comply with manufactured spigot end. Do not damage cement lining.

Corrosion Protection: As a precaution against corrosion, coat all flanges, bolts, nuts and other exposed metal surfaces underground with Texaco, Koppers, or equal rustproof compound.

Testing**.** Inspect DIP and test for leakage and deflection in accordance with Section 11.3.3.

11.3. **Sanitary Sewer System.** Furnish labor, materials, equipment and incidentals to install sewer service lines as indicated on the plans in accordance with EPWU Standards.

11.3.1. Sewer Service Connections**.**

Materials. Conform to the material requirements of the City of El Paso's Plumbing Code and all amendments thereto. Fittings, service risers, and laterals are as specified for the material type utilized. Where additional service connections are required on an existing main line, install an approved service saddle compatible to the size and type of both the collection line and service lateral. Encase saddles with Class B (2500 psi) concrete where PVC saddles with rubber seals and stainless steel bands are used in accordance with EPWU Standards to protect the steel bands from corrosion and to add stability.

Tees and Riser. Install tee or wye fittings for future house service connections. Use bell-type fittings and seal on the branch outlet with an approved plug that can be easily removed for service riser or lateral line installation.

Where ground water is encountered, install the tee and a sufficient service line RISER, thereby raising the final bell above the ground water level. In deep trenches, extend the RISER to the depth of the intersecting service line, or to within 6 feet of the surface, whichever is designated in the plans or appropriate for field conditions.

Install a maximum of four service connections at manholes located at the ends of street cul-de-sacs. Connect additional services to the main line at a minimum 24 inch spacing.

Service Connections and Laterals. Provide new sewer service laterals and re-connections of all existing sewer service laterals to new lines installed to replace lines to be abandoned where required on the plans. Verify location of laterals indicated on the plans and ensure service is not interrupted to homes or other establishments.

Install wyes, bends, tees, stacks, and other hardware, where required, for service laterals as shown in the plans or as directed. Unless otherwise specified, provide minimum 4 inch diameter lateral service lines. Although the maintenance of service laterals is the responsibility of private property owners, including the portion within public right-of-way, as established by Public Service Board Rules and Regulations, the Contractor is be responsible for the integrity of the installation or re-connection of all such service lines during the warranty period.

Use proper specials and fittings to suit the actual conditions for connections between new work and existing work, where required. When it is necessary to interrupt service to existing facilities in order to make connection to an existing line, connections may need to be made at some time other than during normal working hours at no additional cost to Department.

Prior to service line installation, coordinate with EPWU through Engineer to have EPWU personnel curb mark the locations of proposed service tees. Lay service lines and/or tees that the branch makes an angle of 45° with the vertical on the side of the main facing the lot to be served.

Install and extend new service lines 6 inches beyond existing or proposed improvements such as pavement, curb and gutter, sidewalk, etc. unless otherwise specified or shown in the plans. For standard subdivisions

having curb and gutter for drainage, install new services lines at a minimum slope of 2 percent with a minimum cover at the terminus of 18 inches. For subdivisions with flat terrain and on-site ponding (no curb and gutter), provide a minimum cover of 3 1/2 feet, unless otherwise directed.

Uniformly support service pipe on bedding having a density of not less than 90% of maximum density per ASTM D-1557. Carefully place and compact backfill on service lines in accordance with the requirements of Article 6.3.4. Plug the terminus of the service line with an approved universal end cap compatible with the pipe size and material.

Utilize a qualified licensed plumber who is bonded and approved by the El Paso City Public Inspection Department to install service risers and lateral extensions. Provide evidence that plumber is licensed and insured in accordance with City of El Paso requirements.

Location Marking and Recording. Maintain as-built records of the horizontal and vertical location of installed sewer service lines. In unpaved areas without curb, mark the plugged ends of risers or laterals using a 1" by 2" by 24" wooden stake set vertically at the plugged terminus, and a sufficient length of plastic metallic marking tape extended vertically from the terminus to within 6 inches of ground surface. An electronic marker disk may be used in lieu of metallic tape. EPWU personnel will mark locations of the installed service line or riser ends by chipping an arrowhead mark on top of the curb directly over the service plug.

11.3.2. **Manhole Structures.** Furnish all labor, materials, equipment and incidentals necessary to provide all manholes as required. Provide manholes for the various sized lines as listed.

- Standard Type "A" 48 inch inside diameter
- Standard Type "B" 72inch inside diameter
- Drop Manhole constructed at the designated locations and in accordance with Utility Standard Details, and as otherwise indicated in the project plans.
- Construct pre-cast concrete sections as specified herein

Quality Assurance. Provide manholes free of visible leakage and test each structure for leaks. Repair all leaks in a manner subject to Engineer's approval.

Submittals**.** Provide complete manufacturer's shop drawings on the manhole section(s), to include the joints, for approval. Revise shop drawings that do not meet specifications and re-submit approval. Include manufacturer's specification data and recommendations on the lifters and joint material. Submit documentation of compliance with ASTM C-478. Failure to provide either the detailed shop drawings, specification data and recommendation on lifters and joint material, or the letter certifying that all material provided meets specification is sufficient grounds to reject material.

Standards**.** Comply with the following applicable requirements:

- ASTM A-48 Specification for Gray Iron Castings
- ASTM A-82 Specification for Steel Wire, Plain, for Concrete Reinforcement
- ASTM A-185 Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
- ASTM A-615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- ASTM C-32 Specification for Sewer and Manhole Brick (Made from Clay or Shale)
- ASTM C-33 Specification for Concrete Aggregates
- ASTM C-144 Specification for Aggregate for Masonry Mortar
- ASTM C-150 Specification for Portland Cement
- ASTM C-309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- ASTM C-478 Specification for Pre-cast Reinforced Concrete Manhole Sections
- ASTM C-923 Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipe

- ASTM D-1557 Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in (457-mm) Drop

11.3.2.1. Manhole Structure Materials.

Frame and Cover: Provide manhole frame and cover of cast iron of the weight, dimensions, and pattern indicated by the EPWU Standard Details. Provide casting made from superior quality, gray cast iron conforming to the requirements of ASTM A-48 with no holes in the cover, but edge notches for embedded rings used for lifting. Imprint "SEWER" or a suitable designation on the cover. Machine mating surfaces to assure a snug fit of the cover and frame.

Manhole Rings. Provide manhole rings used for a maximum 2 foot final grade in conformance to the applicable requirements of ASTM Specifications C-32, Grade MS.

Cement. Provide Portland Cement conforming to ASTM Specifications C-150, Type V.

Mortar Sand. Provide mortar sand conforming to ASTM Specifications C-144.

Concrete Aggregates. Provide concrete aggregates conforming to ASTM Specifications C-33 except that the requirement for gradation will not apply to concrete manhole conical and riser sections.

Steel Reinforcement. Provide billet-steel bars conforming to ASTM Specifications A-615 and welded steel wire fabric conforming to ASTM Specifications A-82 or to ASTM Specifications A-185.

Water. Provide water that is clean, clear, free from oil, acid or organic matter and injurious amounts of alkali, salts or other chemicals or deleterious materials.

Mortar. Provide mortar that is composed of 1 part Portland Cement Type V and 3 parts mortar sand mixed in an approved manner with water to form a workable mixture.

11.3.2.2. Pre-Cast Concrete Manholes. Design manhole riser and conical section for sewer and water installations in the diameters specified or shown. Provide all manhole sections with 5 inch wall thickness and tongue and groove, unless otherwise specified. Rings will be available in various lengths from one foot to four feet. Design the conical sections to be concentric and adapted to the ring at one end and to El Paso Water Utilities standard cast iron frame at the other. Provide the base ring with a flat bottom joint. Steps or rungs are not required. Manufacture manhole section(s) in conformance with ASTM C-478 and any additional specifications listed here forth.

Concrete. Concrete to have a minimum 28 days compressive strength of 4000 psi. Water cement ratio to be 0.5 or less by weight or not more than 5.5 gallons per sack.

Aggregates. Conform to specifications outlined by ASTM C-33 except for lightweight aggregate. Aggregates will be free of deleterious substances causing reactivity with oxidized hydrogen sulfide. Grade both types of aggregates in order to produce a homogeneous concrete mix. Accurately weight all materials at a central batching facility for mixing.

Cement. Provide Portland Cement conforming to ASTM C-150, Type V (sulfate resistant) for sewer applications and sufficient to produce a minimum strength of 4,000 PSI, or other design strengths required.

Placing. Handled all concrete from the mixer or transport vehicle to the place of final deposit in a continuous manner, as rapidly as practicable, and without segregation or loss of ingredients, until (the approved unit operation) is completed. Place concrete in layers not to exceed two feet deep. Compact each layer by mechanical internal or external vibrating equipment. Limit duration of the vibration cycle to the time necessary to produce satisfactory consolidation without causing objectionable segregation.

Quality Assurance. The Engineer reserves the right to inspect the manufacturing process at any time to make tests on materials used, and to have cores cut out of the completed manholes for compressive strength testing and placement of reinforcement.

Curing. For purposes of early re-use of forms, the concrete may be heated in the mold after the initial set has taken place. Do not exceed a temperature of 160° and raise from normal ambient temperature at a rate not to exceed 40° per hour. Do not remove the cured unit from forms until sufficient strength is obtained for the unit to withstand any structural strain that may be subjected during the form stripping operation. After the stripping of forms, further curing by means of water spraying or a membrane curing compound of a clear or white type, conforming to ASTM C-309-58 may be used.

Steel Reinforcement. Use reinforcing steel as outlined in ASTM C-478 and any additional specifications herein. Apply the minimum steel area of 0.12 square inches to both risers and cone sections and the maximum center to center spacing of 6 inches as well. Place reinforcing steel for one line circumferential reinforcement on the tension side of the wall (the inner half part of the wall with a minimum 1-inch cover) for two lines circular reinforcement, refer to ASTM C-478. Sufficiently tie all reinforcing to withstand any displacement during the pouring operation.

Joint Reinforcement. Both tongue and groove will contain a #4 rebar.

Lifters. Design lifters to handle the imposed weights placed per manufacturer's requirements.

Joint Material. Seal all joints using Ram-Nek joint sealer in sufficient quantities by the vendor as part of the manhole section(s) in sizes per manufacturer's recommendations.

11.3.2.3. Cast-In-Place Concrete Manholes**.** In special circumstances, construct cast-in-place concrete manholes as shown in the plans, and provide the wall thickness not less than 6 inches. Ensure that the concrete is of good quality and well vibrated and the method of construction materials and type of forms used are approved by the EPWU.

11.3.2.4. Manhole Connectors**.** At manholes, a water-tight resilient connection will be made between the wall and the pipe by use of an engineering approved manhole waterstop adaptor such as Indiana Seal Manhole Adaptor, Kor-N-Seal, or approved equal, meeting the requirements of ASTM C-923. The connector must be compatible to both the type of pipe wall and manhole wall, and be installed in strict accordance with the recommendations of the connector manufacturer.

11.3.2.5. Installation**.** Construct manholes at the location and details shown on the plans or as. After the excavation has been completed, pour the concrete base or bottom.

The riser work may proceed when the concrete has sufficiently set. Neatly form the invert in the bottom of the manhole with concrete after the manhole rise has been completed. Construct invert with a true curve of as large a radius as the size of the manhole will permit and with a smooth trowel finish.

11.3.3. **Inspection and Testing.** Test all piping as specified herein unless otherwise directed.

Standards. Adhere to the following requirements when inspecting and testing sewer lines and manholes.

- ASTM C-828 Recommended Practice for Low-Pressure Air Test of Vitrified Clay Pipe Lines (4-12 Inches)
- ASTM C-1103 Standard Practice for Joint Testing of Installed Pre-Cast Concrete Pipe Sewer Line
- ASTM D-3034 Specification for Type PSM Poly(Vinyl Chloride)(PVC) Sewer Pipe and Fittings
- ASTM F-679 Specification for Poly(Vinyl Chloride)(PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
- UNI-BELL-6 Standards and Practices for Low-Pressure Air Testing of Installed Sewer Pipe

- UNI-BELL-9 Polyvinyl Chloride (PVC) Large Diameter Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter (Nominal Pipe Sizes 18-48 Inch)

Manufactured Products**.** Provide all testing apparatus including pumps, compressors, hoses, gauges and fittings, mandrels, and other equipment necessary to perform the required tests.

11.3.3.1. **Television Inspection.** Prior to placing lines into operation, completed sewer lines will be inspected by EPWU personnel with a television camera as a condition of final approval of the installation. Thoroughly clean and flush all lines and notify Engineer that the line is ready for television inspection. Correct any defects discovered in the pipe or construction methods at no additional cost. EPWU will bear cost of the initial TV inspection. Any additional inspection(s) required due to failure of the initial inspection is/are the Contractor's responsibility.

11.3.3.2. **Leakage Testing.** To ensure the integrity of the pipe and joints, test all sewer lines installed under these specifications for leakage using the guidelines established by ASTM C-828 and UNI-BELL B6, and the methods and procedures here forth described.

General. Provide all testing apparatus including pumps, compressors, hoses, gauges and fittings and other equipment necessary to perform the required tests. Acceptable equipment can be as manufactured by Cherne Industries Incorporated or approved equal.

Conduct tests in the presence of the Engineer unless otherwise approved. Notify Engineer 48 hours in advance of testing. Record test results on standard utility forms provided by EPWU.

Low pressure air testing may be conducted by Contractor or an approved independent testing firm with the full understanding to all persons conducting an Air Test that an Air Test may be dangerous if conducted improperly.

Test sewer lines after the "pipe zone" backfilling is completed and prior to construction of finished surfacing.

Where house laterals are included as integral part of the project, perform testing on the main and laterals after the risers or laterals have been completed and backfilled.

Thoroughly clean pipes prior to conducting leakage tests. Repair pipelines that exceed the allowable leakage rate and retest at no additional cost to the Department.

11.3.3.2.1. Exfiltration Air Testing. A Low Pressure Air Test is the standard method for testing sewer lines. Seal test pneumatic plugs above ground using a random pipe section pressurized to 5 psig. Plugs should remain intact without bracing or movement out of the section. Test procedure is as follows:

- Seal off each end of the section of pipe to be tested at a manhole connection. Securely brace test plugs.
- Introduce air slowly into the test section through the test plug until an internal pressure of 4.0 psi is reached. Allow internal air temperature to stabilize. Adjust the internal air pressure to 3.5 psi, disconnect the air supply and begin the test.
- Maintain the test pressure through section without losing more than 1.0 psi for a length of time as determined by Table 15. Sections losing more than 1.0 psi fail test and must be repaired and re-tested for acceptance. If the section being tested includes more than one size of pipe, calculate the test time for each size and add to determine the total test time for the section. .

Table 15.
Total Test Time

Nominal Pipe Size (d)	Time (t).
Inches	Minutes/100 ft.
4	0.3
6	0.7

8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
30	4.8
36	6.0
42	7.3

11.3.3.2.2. Infiltration Test. Infiltration testing of sewer lines under groundwater is mandatory. Perform this test prior to initiating any service connections and after backfilling. At testing time, maintain the level of the groundwater over the entire section of the pipe or near its maximum level.

Measure the allowable infiltration for any portion of the sewer system by a weir or current meter placed in the appropriate manhole and do not exceed 50 gallons per inch of internal pipe diameter per mile per day, including manholes.

Provide suitable plugs or other facilities in order to measure the amount of infiltration. If infiltration is excessive, immediately proceed to locate the source of leakage. Once located, seal the source of leakage by grouting, cementing and rebuilding as required, or by approved methods.

11.3.3.2.3. Joint Testing. At Engineer's direction, perform individual joint testing of pipe larger than 24 inches in diameter in accordance with ASTM C-1103 for special conditions not covered by other test methods.

11.3.3.2.4. Inspection of Sewer Manholes. Visually inspect manholes installed under groundwater for infiltration leakage through all joints and the manhole base. Repair all leaks or cracks with an approved hydro-cement grout.

11.3.3.3. **Deflection Testing.** As a condition for acceptance of the pipeline, perform a mandrel test (deflection test) to verify the roundness and proper installation of the flexible pipeline. Within 30 days, but not less than 7 days after the installation and backfilling of the flexible sewer line, including any service connections, in the presence of the ENGINEER, test deflection of the pipe with a mandrel (GO-NOGO device).

Mandrel Fabrication. Provide mandrels of high quality fabrication and precision as commercially available by Cherne Industries Incorporated, or approved equal. Mandrels require Engineer's approval and must be equipped with proven rings and meet the following requirements:

- Fabricate mandrel outside diameter (gauge dimension):

  Mandrel O.D. = Pipeline Base I.D. - (% deflection limit x Pipeline Base I.D.) in accordance with ASTM D-3034, F-679, or UNI-BELL-9

- Design mandrel open preventing debris buildup between channels of adjacent fins. Include a minimum of nine fin sets that are removable from the mandrel core. Assemble gauges of various diameters by substituting fin sets of appropriate dimension. Provide a length of the minimum radius portion of the mandrel not less than one-third of the nominal diameter of the pipe being tested.

Execution. Prior to testing, flush pipe and clean. Flow is not permitted in the pipeline throughout the duration of the deflection test. Manually pull mandrel through the pipeline with a suitable rope or cable that is connected to an eyebolt at one end of the gauge. Attach a similar rope or cable to the eyebolt at the opposite end of the mandrel and apply tension to it. This will ensure that the mandrel maintains its correct position during testing, while providing easy removal of the mandrel should it become lodged in an excessively deflected pipeline. Winching or other methods of forcing the mandrel through the pipeline is unacceptable.

For pipeline tested within 30 days of installation, do not exceed a deflection of 5% of the base inside pipe diameter as established by ASTM Standards D-3034 and F-679 listed in Table 16.

Table 16.
Deflection Gauge Dimensions: SDR35 OR RSC 160

Nominal Size	Average I.D.	Base I.D.	5% Deflection Gauge
6”	5.893	5.742	5.46
8”	7.891	7.665	7.28
10”	9.864	9.563	9.08
12”	11.737	11.361	10.79
15”	14.374	13.898	13.20
18”	17.564	16.976	16.13
21”	20.707	20.004	19.00
24”	23.296	22.480	21.36
27”	26.258	25.327	24.06

For pipeline tested beyond 30 days of installation, do not exceed a deflection of 7.5% of the nominal inside diameter or as established otherwise by the applicable governing body. Adjust mandrel gauge for 7.5% and seek Engineer approval. Make every effort to test for deflection prior to the 30 day expiration.

Maintain a permanent record of all testing with locations where excessive pipeline deflections occur and forward to Engineer after completion of testing on each line.

Replace all sections of pipe that deflect more than 5% (or 7.5%). Lay pipelines with acceptable ovality such that the larger diameter is situated in the vertical direction. All expenses for re-trenching, backfill, compaction, paving, and related work necessary due to failure to satisfy deflection test requirements are Contractor's responsibility.

11.4. **Sewer Line Bypassing and Draining.** This section specifies the requirements for temporary bypassing, draining, flushing and abandonment of sewer lines. Keep excavations free from water during construction. Do not damage property or create a public nuisance when disposing water. Provide hand pumping equipment and machinery in good working condition for emergencies and have workers available for its operation.

11.4.1. Requirements. Provide labor, equipment, materials and supervision to temporarily bypass flow around work during sewer construction and/or during work associated with sewer construction when necessary. Drain and flush all sewers to be abandoned with a minimum of twice the sewer's volumes of water. Drain all sewers lines to be abandoned. Coordinate all work with the Engineer.

11.4.2. Submittals. Twenty-one (21) calendar days prior to commencement of construction activities, the submit for review and approval drawings and complete design data showing methods and equipment proposed to utilize in sewer bypassing and draining. Include the following information:

- Drawings indicating the location of temporary sewer plugs and bypass discharge lines
- Schedule times for bypasses
- Capacities of pumps, prime movers, and standby equipment
- Design calculations proving adequacy of the system and selected equipment

11.4.3. Job Conditions. Existing sewer system map of the project area can be obtained from EPWU and are available for review at their office – 1154 Hawkins Blvd., El Paso, TX. 79925, during regular business hours.

Protection**.** Where bypassing or draining of the contents of a line is required, ensure that service for connecting sewer laterals are not disrupted. Discharge all flow into the nearest downstream manhole and only after consultation with EPWU operations to coordinate the discharge. Do not surcharge sewers or interfere with normal operation of related sewer facilities when bypassing and draining of the contents of a line. Discharging to the ground surface, receiving streams, storm drains, or discharging that result in groundwater contamination or potential health hazards is not permitted. In the event accidental discharging is caused by the Contractor's operations, EPWU is immediately entitled to employ others to stop the discharging without giving written notice to the Contractor.

Contractor is responsible for penalties imposed on the EPWU as a result of any discharge by the actions of Contractor's employees or subcontractors including legal fees and other expenses to the EPWU resulting directly or indirectly from the discharge.

Scheduling**.** Do not shut down the bypassing systems between shifts, on holidays or weekends, or during work stoppages without written permission from the ENGINEER. Submit a detailed outage plan and time schedule for operations when necessary to remove a sewer line or structure from service. Coordinate schedule with the Engineer and meet the restrictions and conditions specified in this section. In the detailed plan, describe the method for preventing accidental discharges, the length of time required to complete said operation, the necessary plan and equipment to be used in order to prevent accidental discharges. Observe the following restrictions:

- Systems or individual equipment items will be isolated, drained, decommissioned, de-energized, or depressurized in accordance with the detailed outage plan and schedule.
- Notify Engineer, in writing, at least one week in advance of the planned operation.

11.4.4. Sewer Line Draining**.** Flush sewers to be abandoned with two pipeline volumes of water and allow to drain fully prior to abandoning.

11.4.5. Sewer Bypassing**.** Accomplish sewer bypassing by pumping or diverting the upstream flow around the proposed work and as directed. Provide temporary pumps, conduits, and other equipment to bypass the sewer flow.

Furnish the necessary labor, equipment and material, and supervision to set up and operate the pumping and bypass system. Equip engines with mufflers and/or enclosed to keep the noise level within local ordinance requirements. Provide pumps and bypass lines of adequate capacity and size to handle the flows.

Unless otherwise directed, bypass flow around proposed work whenever the depth of flow, as measured at the inlet pipe to the upstream manhole adjacent to proposed work, exceeds the crown elevation of the pipe; or whenever the equipment operating in the sewer provides an obstruction that restricts flow and causes the depth of flow to exceed the crown elevation.

11.4.6. Standby Equipment**.** Maintain on site sufficient equipment and materials to ensure continuous and successful operation of the bypass and dewatering systems. Maintain standby pumps fueled and operational at all times. Maintain on site a sufficient number of valves, tees, elbows, connections, tools, sewer plugs, piping and other parts or system hardware to ensure immediate repair or modification of any part of the system as necessary.

11.4.7. Damages**.** Repair, without additional cost to the Department, any damage that may result from negligence, inadequate or improper installation, maintenance, and operation of bypassing and draining equipment, including mechanical or electrical failures.

11.5. **Flowable Backfill.** When indicated on the plans, backfill trenches to the elevations shown with stabilized backfill meeting requirements of Item 401.

11.6. **Cutting and Restoring Pavement.** Where sewers must be installed in streets or other paved areas, the work includes saw cutting of the pavement and base to neat lines and prompt replacement of these materials after sewer excavation and backfill are completed. The replacement materials, as to type and thickness, are shown on the plans. Any work done or damage to base and/or pavement outside the limits shown on the plans will not be measured for payment and must be restored at no additional cost to the Department.

11.7. **Measurement.**

11.7.1. **Sanitary Sewer Mains (PVC).** Longitudinal measurement of sanitary sewers will be made along the centerline of the sewer by the linear foot of the various sizes of sewers in place, in accordance with these specifications, complete and approved. The lengths of sewer mains will be measured center of manholes where the installation involves connection of the sewer into a manhole at each end of the line being

measured. Where the installation involves a connection to an existing sewer line, the measurement will be made from the end of the existing sewer line to the center of the manhole on the work being measured.

11.7.2. **Sanitary Sewer Mains (DIP).** Longitudinal measurement of sanitary sewers will be made along the centerline of the sewer by the linear foot of the various sizes of sewers in place, in accordance with these specifications, complete and approved. The lengths of sewer mains will be measured center of manholes where the installation involves connection of the sewer into a manhole at each end of the line being measured. Where the installation involves a connection to an existing sewer line, the measurement will be made from the end of the existing sewer line to the center of the manhole on the work being measured.

11.7.3. **Sanitary Sewer Manhole.** All sanitary sewer manholes satisfactorily completed in accordance with the plans and specifications will be measured by each of the various manhole types based on a standard 6 foot depth.

11.7.4. **Sanitary Sewer Manhole (Extra Depth).** This measurement will be measured by the linear foot and is the distance from the top of the frame to the invert of the manhole minus 6 feet.

11.7.5. **Adjusting Manhole.** Existing manholes remaining in service and required to be adjusted to proposed grade will be measured by each manhole adjusted.

11.7.6. **Remove Existing Manholes.** Existing manhole structures to be completely abandoned and removed as identified in the plans will be measured for each manhole removed.

11.7.7. **Sewer Service Re-Connections (Service Laterals).** Sewer Service Re-Connections (Service Laterals) will be measured by each sewer service re-connection of a particular size installed and accepted.

11.7.8. **New Sewer Service (Service Laterals).** New Sewer Service (Service Laterals) will be measured by each new sewer service connection of a particular size installed and accepted.

11.7.9. **Abandon and Fill Existing Sanitary Sewer Pipe.** This Item will be measured by the linear foot of existing sanitary sewer main that is abandoned in place.

11.7.10. **Remove Existing Sanitary Sewer Pipe.** This Item will be measured by the linear foot of existing sanitary sewer main pipe that is removed as identified in the plans.

11.7.11. **Flowable Backfill.** This Item will be measured by cubic yard as shown under Item 401, “Flowable Backfill”.

11.7.12. **Cutting and Restoring Pavement.** This will be measured by the square yard as shown under Item 400, “Excavation and Backfill for Structures”.

11.8. **Payment.**

11.8.1. **Sanitary Sewer Mains (PVC).** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will be paid for at the unit price bid for "Sanitary Sewer Pipe (PVC)" of the type and size specified, complete in place.

This price is full compensation for furnishing all required materials and labor; potholing; excavation, including hand-digging, if needed, embedment and backfill; compaction and compaction testing for utilities, all fittings; removal and disposal of existing manholes, except where indicated as being covered under a specific bid item; pipe connections to existing manholes; relocation or replacement of existing water and sewer lines required for placement of new sewer line; pipe concrete caps; plugs (temporary and/or permanent); air/vacuum release valves; blow-off valve assemblies; testing; dewatering of groundwater, if needed; bypassing and any work related to the bypass including traffic control related to bypasses; removal and replacement of storm drains; removal and replacement of drainage structures; placing and joining of pipes and fittings; traffic control required for sewer work outside Project limits; coordination with utility companies, EPWU, and Engineer; locating and protecting of existing utilities; and for all other items of material, labor,

equipment, tools and incidentals necessary to complete the work in accordance with the plans and specifications

11.8.2. **Sanitary Sewer Mains (DIP).** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will be paid for at the unit price bid for "Sanitary Sewer Pipe (DIP)" of the size specified, complete in place.

This price is full compensation for furnishing all required materials and labor; potholing; excavation, including hand-digging, if needed, embedment and backfill; compaction and compaction testing for utilities, all fittings; removal and disposal of existing manholes, except where indicated as being covered under a specific bid item; pipe connections to existing manholes; relocation or replacement of existing water and sewer lines required for placement of new sewer line; pipe concrete caps; plugs (temporary and/or permanent); air/vacuum release valves; blow-off valve assemblies; polyethylene wrap; testing; dewatering of groundwater, if needed; bypassing and any work related to the bypass including traffic control related to bypasses; removal and replacement of storm drains; removal and replacement of drainage structures; placing and joining of pipes and fittings; traffic control required for sewer work outside Project limits; coordination with utility companies, EPWU, and ENGINEER; locating and protecting of existing utilities; and for all other items of material, labor, equipment, tools and incidentals necessary to complete the work in accordance with the plans and specifications.

11.8.3. **Sanitary Sewer Manhole.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will be paid for at the unit price bid for "Sanitary Sewer Manhole (6 foot Depth)" of the size and type specified or indicated on the plans". This price is full compensation for furnishing all required materials, labor, gaskets, rings, covers, concrete collars, pipe penetrations, drop connections, grout, groundwater dewatering, testing, concrete, excavation and backfill, grouting of inverts, coating interior and exterior where required, adjustment of new manhole to both temporary and finished grades, and tools and incidentals necessary to complete the work in accordance with the plans and specifications.

11.8.4. **Sanitary Sewer Manhole (Extra Depth).** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will be paid for at the unit price bid for "Sanitary Sewer Manhole (Extra Depth). This price is full compensation for furnishing all required materials labor, equipment and performing all operations necessary to construct the depth of sanitary sewer manhole in excess of 6 feet; including but not limited to providing an external protective bituminous coating, such as coal-tar epoxy.

11.8.5. **Adjusting Manholes.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will be paid for at the unit price bid for "Adjusting Manhole". This price is full compensation for furnishing all required materials and labor, plugs (temporary and permanent), excavation and backfill, cement stabilized backfill, groundwater dewatering, removal, disposal of materials, and all other incidentals necessary to necessary to complete the work in accordance with the plans and specifications.

11.8.6. **Remove Existing Manholes.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will paid for the at the unit price bid for "Remove Existing Manhole". This payment will be for all labor, materials, plugs (temporary and permanent), excavation and backfill, cement stabilized backfill, groundwater dewatering, removal, disposal of materials, and all other incidentals necessary to complete the work in accordance with the plans and specifications.

11.8.7. **Sewer Service Re-Connections (Service Laterals).** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will paid for the at the unit price bid for "Sewer Service Re-Connection" of the particular size installed. This price is full compensation for furnishing all required materials ,labor and materials for the pipe; excavation and backfill; fittings; cutting; bypassing; coordination; testing; and plugging/capping of abandoned utilities; draining of lines; vertical and horizontal adjustments; connections to existing sewers; and all other incidentals necessary to complete the work in accordance with the plans and specifications.

11.8.8. **New Sewer Service (Service Laterals).** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will be paid at the unit price bid for each "New Sewer Service Lateral" of the particular size installed. This price is full compensation for furnishing all required materials and labor; excavation and backfill; fittings; cutting; bypassing; coordination; testing; and plugging/capping of abandoned utilities; draining of lines; vertical and horizontal adjustments; connections to existing sewers; and all other incidentals necessary to complete the work in accordance with the plans and specifications.

11.8.9. **Abandon and Fill Existing Sanitary Sewer Pipe**. The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Abandon and Fill Existing Sanitary Sewer Pipe" of the size specified. This price is full compensation for furnishing all required materials, labor, and equipment, including but not limited to the following items: coordination, traffic control, potholing, excavation, complete flushing and draining (dewatering) of pipe, flowable backfill, cutting, capping/plugging, complete filling with approved flowable backfill of sanitary sewer mains to be abandoned, proper abandonment of all manhole structures with flowable backfill as indicated on the plans, and all other items for the project not indicated as being covered under the other specific bid items.

11.8.10. **Remove Existing Sanitary Sewer Pipe.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Remove Existing Sanitary Sewer Pipe" of the size specified. This price is full compensation for furnishing all required materials, labor, and equipment, including but not limited to the following items: coordination, traffic control, potholing, excavation and backfill, complete draining (dewatering) of pipe, groundwater dewatering, flowable backfill, cutting, capping, removal of pipe, disposal of materials, and all other items for the project not indicated as being covered under the other specific bid items.

11.8.11. **Flowable Backfill.** Flowable Backfill will be paid for in accordance with Item 401, "Flowable Backfill".

11.8.12. **Cutting and Restoring Pavement.** Cutting and Restoring Pavement will be paid for in accordance with Item 400, "Excavation and Backfill for Structures".

12. CASINGS

12.1. **Description.** Furnish all labor, materials, equipment and incidentals required to construct steel casings and install approved carrier pipes within the casing of various sizes including all necessary field welding, carrier pipes and accessories as shown on the plans and as specified herein.

12.2. **Materials.** Furnish new, unused steel casing pipe suitable for the purpose intended with a minimum yield strength of 36,000 psi. Provide casing that meets ASTM A-53 or approved equal requirements. Coat and line pipe with coal tar epoxy (15 mils min.) in accordance with AWWA C-210. Weld pipe joints in accordance with AWWA C-206. After pipe is welded, repair coating and lining. Unless specified otherwise, provide the steel casing pipe with a minimum wall thickness of 5/16 inches. Provide required vent piping, casing insulators (casing insulated spacers), end seals, pipe supports and skids, and other incidental features required to complete work described in this section and as shown on the plans.

Construct tunnel liner of cold-formed steel plates of the sizes, thickness, and dimensions required, as indicated on the plans, and as manufactured by Commercial Shearing, Contech, or equal.

Provide reinforced concrete pipe for casing where specified or shown that is straight-wall RCP pipe casing conforming to ASTM C-76 Class IV of the size and length specified.

Provide welded half coupling grout holes. Provide tapped holes with a pipe plug screwed in place.

Provide bolts and nuts with liner plates that are not less than 1/2 inch diameter and conform to ASTM A-307 Grade A.

12.2.1. Submittals. Submit complete working drawings that show details of the proposed method of construction and the sequence of operations to be performed during construction. The plan will show the method of jacking, boring, or tunneling, muck removal and disposal, type and method of installation of the primary casing or tunnel liner, access pit size and construction shoring and bracing, and dewatering methods proposed. Drawings should be sufficiently detailed to allow the ENGINEER to judge whether or not proposed materials and procedures will meet the contract requirements.

Include the design criteria used and a certification that the structural design of the casing or tunnel liner meets these design criteria and that the material meets the required ASTM Standards. The tunnel liner must be capable of carrying H-20 vehicle load distributions in accordance with AASHTO as well as the anticipated dead loads and include an appropriate design factor of safety.

Include the layout and design of the access shafts. Provide a certification that the structural design of the shoring and bracing meets the design criteria as submitted. All structural designs must be sealed by a Professional Engineer licensed in the State of Texas and qualified to perform such work.

12.2.2. Standards. Apply all OSHA regulations and all requirements of the specific private and governmental agencies under whose facilities the casings and pipe area to be installed.

Protect the facilities under which the casings and pipe are installed, provide protection at the excavations, and carry out the trench safety procedures in accordance with all required OSHA regulations.

Referenced within this section is the "Standard Specification for Construction of Highways, Streets and Bridges," most current edition of the Texas Department of Transportation (TxDOT).

12.3. **Construction.**

12.3.1. General. Install casings at the locations and to the lines and grades indicated on the plans, of the sizes indicated, using either jacking, boring, tunneling, or approved open-cut methods.

Provide adequate lights, ventilation, signal systems, fire extinguisher, safety equipment, and other equipment required and maintain such equipment in good repair.

Determining soil conditions at the various locations where casings are to be installed, and make such other investigations to obtain that information as deemed necessary subsidiary to this Item.

The methods of construction, whether by tunnel boring machine or by hand digging, is Contractor's option subject to the approval of the governing agencies and Engineer.

Execute work of excavating, lining, grouting and construction of the casing or tunnel so that ground settlement is minimized.

Where casings are installed by open-cut method, all requirements for trenching and backfilling as described in these specifications apply, except as otherwise required by the plans or supplemental specifications.

Locate access shafts or pits at the beginning and end of each casing or tunnel segment to be constructed.

Unless superseded by the requirements of other governing authorities under whose facilities or right-of-way the casing is to be installed, install the face of any shaft at least 20 feet from existing adjacent roadways or structures. Ensure that the size of shafts or pits provide adequate room to meet operational requirements for tunnel construction.

12.3.2. Installation of Casings. Install casings using either jacking, boring, or tunneling methods. Provide equipment of such size and capacity as to allow the placement of the casings to proceed in a safe and expeditious manner.

Install casing pipe from the end which will create a minimum of access and utility relocation problems. Prior to casing installation, pothole utilities and all other permanent structures within the project area in order to identify potential conflicts. In the event a conflict exists, notify Engineer before proceeding with casing installation so a solution can be formulated.

Permissible lateral or vertical variation in the final position of the pipe casing from the established line and grade established is only to the extent of 1 inch in 10 feet, provided that such variation is regular and only in the direction that will not detrimentally affect the function of the carrier pipe. Remove or abandon casing pipe found to be considerably off-grade or alignment and re-install at no additional cost.

Repair any detectable settlement of the roadway overlying the casing or tunnel immediately. Slight settlement of the roadway, should it occur, will result in cessation of casing/tunneling operations, posting of appropriate highway safety signs, and placement of an asphaltic hot-mix overlay to return the roadway to original grade. For over-cutting in excess of 1 inch, pressure grout the entire length of the bore with 7 sack cement per cubic yard of soil mixture. Where applicable, provide hot-mix in accordance with the requirements of TxDOT Specifications. Prime the surface to receive hot-mix as directed. Submit an emergency road repair procedure plan to the Engineer, prior to beginning any casing/tunneling operations. Labor and equipment necessary for this work is the Contractor's responsibility and will be provided at no additional cost.

When installing casing by boring, install casing, excavate and remove material within the casing simultaneously. Ensure the completed casing is free of dents, bends, weld protrusions, or other obstructions to allow the smooth sliding of the carrier pipe through the casing.

12.3.3. Installation by Tunneling**.** Excavate tunnel of sufficient size to permit efficient excavation operations, to provide sufficient working space for placing the tunnel lining, and to allow for construction of the carrier pipe as shown on the plans and indicated on the specifications. Determine adequate tunnel size and section to meet these requirements. Dimensions shown on the plans represent the acceptable approximate dimensions and do not necessarily represent the size and/or section suitable for the construction methods or operational procedures as may be proposed and/or conducted by the Contractor.

Use structural steel plates assembled from the inside of the tunnel and field bolted to provide a full round casing pipe when installing casing pipe by tunneling method. Hold tunnel excavation to the minimum possible diameter required for installation of liner plate.

Minimize excavation limits as required to prevent caving. Pressure grout the annular space between the tunnel liner and the tunnel bank by providing 2 inch diameter plugs in the liner plates at spacing of 5'-0" or as directed. Remove any excess groundwater encountered in a manner to allow the tunneling operation to proceed according to schedule.

12.3.4. Installation of Carrier Pipe in Casing Pipe or Tunnel Liner**.** Install carrier pipe in the casing in accordance with the recommendations of the pipe manufacturer. After the casing or tunnel liner has been installed and approved, push or pull the carrier pipe through the casing by exerting pressure on the barrel of the pipe in such a manner that the pipe joints are always in compression.

Use insulated spacers when specified for providing cathodic protection consisting of pre-manufactured steel bands with plastic lining and plastic runners. Casing spacers must fit snug over the carrier pipe. Position the carrier pipe approximately in the center of the casing pipe, to provide adequate clearance between the carrier pipe bell and the casing pipe. Use casing spacers that are Model C12G-2, coated for the ultimate in strength, toughness and corrosion resistance, or Model A12G-2, painted for unusually heavy pipe, for long casings or whenever maximum strength and toughness are required for carrier pipes 4" - 56" in diameter and as directed. Casing spacers can be as manufactured by Pipeline Seal and Insulator, Inc. (PSI) or approved equal.

If tunnel liner is used, grout the bottom 120 degrees of the liner to the top of the tunnel liner ribs to aid in the installation of the carrier pipe.

Seal ends of pipe after installation of the carrier pipe inside the casing pipe or tunnel liner to prevent water or other material from entering the casing or liner and causing corrosion by one of the following methods:

- Brick and Mortar Method
- Bulkhead and Grout Method
- Synthetic rubber end seal - type PSI, Inc. Standard Pull-On (Model C), or approved equal, appropriate for the size and type of carrier pipe and casing.

Include a precautionary outlet and bonnet box at each end of the casing as shown on the plans when using steel casings.

12.3.5. Grouting. Use ordinary cement-sand grout, as described in Article 5, unless otherwise specified or directed. Fill all excavation outside the casing or tunnel liner with pressure-applied grout or other approved fill unless otherwise directed.

Exercise care in grouting operations to prevent damage to adjacent utilities or other properties. Ensure that pressure used in grouting is not great enough to distort or imperil any portion of the work.

Completely fill with grout all voids outside the limits of the casing or tunnel excavation created by caving or collapse of earth cover over the excavation, or by other cause. All grouting to eliminate voids outside the casing or tunnel limits is subsidiary to this Item.

When hand-tunneling methods are used, place grout behind the tunnel liner at the end of each day or at every 10 feet of tunnel installed whichever spacing is acceptable.

Treat the annular space between the casing and carrier pipe by one of the following methods as directed or specified. Where applicable, fill the annular space according to the regulations specified by the governing agency for the area where the casing is to be installed.

- Leave annular space open for cathodically protected systems where both casing and carrier pipes are metallic material.
- Fill annular space with pneumatically placed sand as the standard method for pipes in all installations other than groundwater.
- Fill annular space with grout. Do not damage or distort pipe using pressure to install grout. Submit method for approval prior to starting work. This method is mandatory for installations in groundwater, optional on all other dry installations.

12.4. **Measurement.** Casings will be measured by the linear foot complete in place. Casing for temporary water and/or sanitary sewer by-pass lines will not be measured for payment and are incidental to pertinent pay items.

12.5. **Payment**. The work performed and the materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Casing” of the type, size and installation method specified. This price is full compensation for coordination; excavation; disposal of excess material; grouting; backfilling; compaction; compaction testing for utilities; furnishing and installing the approved carrier pipe, precautionary outlet with bonnet box, and accessories as per specifications and standard details by means of open cut (where indicated), and bore and jacking methods (where indicated), welding, furnishing and installing steel casing insulators, and all appurtenances described herein to include, but not limited to the following items: locating, protecting, supporting, relocating if required, and repairing damage to any utilities or structures encountered in the process of the work, dewatering and disposal for water where required, paving cut, removal and repair as needed, traffic control plan, excavation for bore pits, and all other items of the project not indicated as being covered under the other specific bid items shown on the Proposal. Such payment is complete compensation for the complete performance of the work in accordance with the plans and the provisions of these specifications.

Special Specification 7032
Water Mains and Service Lines

1. DESCRIPTION

Provide and install a complete water main system in accordance with the plans and specifications and in compliance with the local utility owner's policies, if any, and the Department's Utility Accommodation Policy (UAP)(Title 43, T.A.C., Sections 21.31-21.55). The water mains shall be of the sizes, materials and dimensions shown on the plans and shall include all pipe, all joints and connections to new and existing pipes, all valves, fittings, fire hydrants, pipe joint restraint systems, blocking, and incidentals, as may be required to complete the work.

The abbreviations AWWA, ASA, ASTM, and ANSI, 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
- NSF - National Science Foundation

Where reference is made to specifications of the above organizations, it is to be construed to mean the latest standard in effect on the date of the proposal.

2. MATERIALS

Where specific products or manufacturers are mentioned in this specification, approved equals may be used.

2.1. **Ductile-Iron Pipe and Fittings.**

2.1.1. Ductile-Iron Pipe: 3-Inch through 64-Inch.

All ductile-iron pipe is to be manufactured by process of centrifugal casting and is to conform to AWWA Standard C-151, “American Standard for Ductile-Iron Pipe Centrifugally Cast with push-on or mechanical joints for Water or Other Liquids”, unless otherwise modified or supplemented herein.

Pipe is to conform to the following pressure classes, based on Type 3 bedding conditions, a depth of bury of 6 feet and a working pressure of 150 psi:

Table 1	
3” through 12”	350 psi
16” through 20”	250 psi
24”	200 psi
30” through 64”	150 psi

Dimensions and tolerances for each nominal pipe size shall be in accordance with table 51.5 (push-on) or table 51.5 (mechanical joint) of AWWA Standard C-151 for pipe with a nominal laying length of 20 feet.

All pipe is to have a standard water works cement mortar lining in accordance with AWWA Standard C-104 with outside coating per Section 51.8.1 of AWWA Standard C-151.

Exterior coating is to consist of a nominal one mil thick asphaltic material applied to the outside of the pipe as described in Section 51.8 of AWWA Standard C-151.

Rubber joint gaskets utilized on ductile-iron pipe are to conform with AWWA Standard C-111.

Each length of pipe shall bear identification markings in conformance with Section 51.10 of AWWA Standard C-151.

The Contractor is to use a manufacturer that takes adequate measure during pipe production to assure compliance with AWWA Standard C-151 by performing quality-control tests and maintain results of those test as outlined in Section 51.14 of that standard.

The Engineer may at no cost to the Contractor, subject random lengths of pipe for testing by an independent laboratory for compliance with this specification. Any visible defects or failure to meet quality standards here in will be grounds for rejecting the pipe.

2.1.2. Fittings for Ductile-Iron Pipe.

Unless otherwise modified or supplemented herein, WWA Standard C-110 for Ductile-Iron Fittings, 3-inch through 48-inch for Water and Other Liquids" and AWWA Standard C-153 for Ductile-Iron Compact Fittings, is to govern the design, manufacture, and testing of all fittings under this specification.

For 3 through 24-inch size range, the pressure rating of all fittings is to be a minimum of 250 psi. The working pressure for all fittings of size greater than 24-inch is to be a minimum of 150 psi, unless a change in pressure rating is shown on the plans.

Fittings are to be furnished with the type of end combination specified.

Mechanical joint fittings and anchor type fittings are to be furnished complete, with glands, gaskets, and bolts. Bolts for mechanical joints are to be ASTM A-536 specially alloyed and heat treated ductile iron conforming to ANSI/AWWA Standard CIII/A21.IL.

Flanged fittings are to be faced and drilled in accordance with ASA Specifications B 16.1, Class 125.

Anchor fittings are to be furnished in size and type or length as specified.

The exterior of all fittings is to be provided with a petroleum asphaltic coating in accordance with AWWA Standard C-110. The interior of flanged fittings supplied under this Item is to be either cement-mortar lined in accordance with AWWA Standard C-104 or lined with a petroleum asphaltic material in accordance with AWWA Standard C-110 as specified. The interior of all other fittings supplied under this Item is to be cement-mortar lined in accordance with AWWA Standard C-104.

Fittings for 2-inch size are to be manufacturer's standard design, designed in accordance with applicable design standard of AWWA Standard C-110.

2.2. **Concrete Steel Cylinder Pipe and Fittings: 20-inch and larger.**

The design, component materials, manufacture and testing of all concrete-steel cylinder pipe and fittings is to conform to AWWA Standard C-301 for "Pre-Stressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids". Except where otherwise indicated in the contract documents, all pipe is to be

AWWA Class 150 and is to be designed for an internal working pressure of 150 psi and a minimum external load equivalent to 6-feet of earth cover. Where the depth of bury of the pipe is indicated to be greater than 6-feet in the contract specifications or on the drawings the design of the pipe is to suitable for the earth loads indicated.

All data submitted by the Contractor is to include a tabulated layout schedule with reference to the stationing and grade lines shown on the plans. The Contractor is to provide a design summary for each size of pipe furnished for each pressure and depth of bury.

Each special length of straight pipe is to have plainly marked on the inside of the bell end the class of pipe and identification marks sufficient to show the proper location of the pipe by reference to layout drawings.

Pipe 20 through 42-inch in size is to be furnished in nominal lengths of 20 to 32 feet; pipe 48 through 72-inch in size is to be furnished in nominal lengths of 16-feet except as this requirement is to be modified by design requirements of the particular job.

Each joint of pipe is to be furnished with a rubber gasket and a 12-inch diaper.

2.3. **Steel Pipe, Fittings and Flanges.**

2.3.1. Steel Pipe. Steel pipe with nominal diameters from 6 through 20-in. shall conform to ASTM A 106, A 53 Grade B or A 139 Grade B standard weight class as the minimum

Steel Pipe greater than 20-inches shall conform to AWWA C-200 and AWWA M-11 except as modified herein or as required by the Engineer for special circumstances.

Pipe shall be designed for a minimum of 150 psi working pressure with an additional 50% of the working pressure allowance for surge pressure unless otherwise specified. Pipe design shall be in accordance with AWWA M-11.

Pipe shall be designed to cover conditions as shown on the plans. The design for deflection shall be in accordance with AWWA M-11.

Pipe for use with sleeve-type couplings shall have plain ends at right angles to the axis.

Pipe ends are to be beveled and suitable for field butt welding except as otherwise specified.

Protective coatings and linings are to conform to AWWA Standard C-203, “Coal-Tar Protective Coatings and Linings for Steel Pipelines - Enamel and Tape Hot Applied”.

Pipe length is to be nominal 50-feet lengths except for specials or as otherwise specified on the plans. Contractor is to 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 shall conform to the dimensions of AWWA Standard C-208. Pipe material used in fittings shall be of the same material and thickness as the pipe. The minimum radius of elbows shall be 2.5 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11 1/4 degrees (One cut elbow up to 22 1/2 deg.). If elbow radius is less than 2.5 x pipe diameter, stresses shall be checked per AWWA M-11 and wall thickness or yield strength increased if necessary. Fittings shall be equal in pressure design strength. Specials and fittings, unless otherwise shown on the Plans, shall 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 shall be checked per the requirements of AWWA C-200 Section 5.2.2.1.

2.3.2.1. Rolled-Groove Rubber Gasket Joint: the standard joint shall be rolled-groove rubber gasket joint unless otherwise noted on the plans. Rolled-grooved rubber gasket joints shall conform to AWWA C-200 Standard and as shown in Chapter 8 of AWWA M-11.

The o-ring rubber gasket shall have sufficient volume to approximately fill the area of the groove and shall conform to AWWA C-200.

The joint shall be suitable for a safe working pressure equal to the class of pipe furnished and shall operate satisfactorily with a deflection angle, the tangent of which is not to exceed 1.00/D where D is the outside diameter of the pipe in inches with a pull-out of 1 inch.

Rolled-Groove Rubber Gasket Joints may be furnished only by a manufacturer who has furnished pipe with joints of similar design for comparable working pressure, pipe diameter, pipe length, and wall thickness that has been in successful service for a period of at least 5 years. If requested provide documentation of compliance with this requirement.

2.3.2.2. Lap weld: Lap field welded joints shall be used where tied joints are indicated on the plans. The standard bell shall provide for a 2 1/2-inch lap. The minimum lap shall be 1 inch. The design maximum joint deflection or offset shall be a 1" joint pull.

2.3.2.3. Mechanical Couplings: Mechanical couplings where indicated on the plans shall be Smith Blair Style 411, Baker Style 200, Brico Depend-O-Loc or equal. Insulating mechanical couplings where indicated on the plans shall be double insulated Smith Blair Style 416, Baker Style 216, or equal. Mechanical couplings shall be rated to meet or exceed the working pressures and surge pressure of the pipe.

Couplings for buried service shall have all metal parts painted with epoxy paint and conform to AWWA C-219.

Pipe ends for mechanical couplings shall conform to AWWA C-200 and M-11. The shop applied outside coating shall 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 shall be painted with one shop coat of epoxy conforming to AWWA C-210. The inside lining shall be continuous to the end of the pipe.

2.3.3. Steel Flanges - Steel pipe flanges, where called for on the plans, are to conform to AWWA Standard C-207, “Steel Pipe Flanges” for Class D for operating pressures to 175 psi on 4 inch through 12 inch diameter, and operating pressures to 150 psi on diameters over 12 inches; or flanges shall be AWWA C-207 Class E for operating pressures up to 275 psi; or flanges shall be AWWA C-207 Class F for pressures to 300 psi. (drilling matches ANSI B 16.5 Class 250).

Shop lining and coating shall be continuous to the end of the pipe or back of the flange. Flange faces shall be shop coated with a soluble rust preventive compound.

Gaskets: Full face, 1/8-inch thick, cloth-inserted rubber, Garlock 3000, John Crane Co. Style 777 or equal.

Bolts and Nuts for Flanges

2.3.3.1. Bolts for flanges located indoors and in enclosed vaults and structures shall be carbon steel, ASTM A-307, Grade B for class B and D flanges and nuts shall be ASTM A-563, Grade A heavy hex. Bolts for class E and F flanges shall be ASTM A-193 grade B7 and nuts shall be ASTM A-194, grade 2 H, heavy hex.

2.3.3.2. Bolts for buried and submerged flanges and flanges located outdoors above ground or in open vaults in structures shall be Type 316 stainless steel conforming to ASTM A-193, Grade B8M, Class 1 for class B and D Flanges with ASTM A-194, Grade 8M nuts. For Class E and F flanges the bolts shall be ASTM A-194 grade 2H nuts with bolt and nuts to be zinc plated in accordance with ASTM B-633.

2.3.4. Linings and Coatings.

2.3.4.1. Polyethylene Tape Coating:

2.3.4.1.1. Prefabricated Multi-layer Cold Applied Tape Coating - the coating system for straight-line pipe shall be in accordance with AWWA Standard C-214. The system shall consist of three layers of polyethylene material with a nominal thickness of 80 mills when complete

2.3.4.1.2. Coating Repair: Coating repair shall be made using tape and primer conforming to AWWA Standard C-209, Type II. The tape and primer shall be compatible with the tape system used for straight-line pipe.

2.3.4.1.3. Coating of Fittings, Specials and Joints:

2.3.4.1.3.1. General – Fittings, specials and joints which cannot be machine coated in accordance with above, shall be coated in accordance with AWWA Standard C-209. Prefabricated tape shall be Type II and shall be compatible with the tape system used for straight-line pipe. The system shall consist of 3 layers consisting of the following: Alternate coating methods for fittings specials and field joints would be Shrink sleeves per C-216, or paint per C-210, C-218, or C-222. The field coating shall completely encapsulate the joint bonds on o-ring joints.

2.3.4.1.3.2. Coating Repair – Coating repair for fittings and specials shall be in accordance with the procedure described above for straight-line pipe and as recommended by the manufacturer.

2.3.4.2. Other Coating Systems if specified shall be governed by the appropriate American Water Works Association standard.

2.3.4.3. Cement Mortar per AWWA C-205

2.3.4.3.1. Cement Mortar Lining of Steel Pipe

2.3.4.3.1.1. Except as otherwise provided in AWWA Standard C-205, interior surface of all steel pipe, fittings, and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with AWWA Standard C-205.

2.3.4.3.1.2. The pipe ends shall be left bare where field joints occur as shown on the plans. Ends of the linings shall be left square and uniform. Feathered or uneven edges will not be permitted.

2.3.4.3.1.3. Defective linings as identified in AWWA C-205 shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather edged joints.

2.3.4.3.1.4. Cement mortar lining shall be kept moist during storage and shipping.

2.3.4.3.2. Fittings

2.3.4.3.2.1. Fittings shall be lined and coated per AWWA C-205.

2.3.5. Steel Casing Pipe.

The component materials, manufacture and testing of all steel pipe will conform to AWWA Standard C-200 for “Steel Water Pipe 6-in. and Larger”. The specified pipe size will be the actual inside diameter of the pipe, special or fitting in inches. The diameter and wall thickness of all steel pipe will conform to those shown on the plans.

Pipe will be either Grade A or Grade B, conforming to ASTM Designation A-53.

Pipe ends will be beveled and suitable for field butt welding except as otherwise specified.

Pipe will receive a protective coating conforming to AWWA Standard C-203, “Coal-Tar Protective Coatings and Linings for Steel Pipelines – Enamel and Tape Hot Applied”.

Pipe length will be nominal 40 ft. lengths except for specials or as otherwise specified on the plans. Standard and specials will be within 1/16-in. (plus or minus) of the specified or theoretical lengths.

2.3.6. Stainless Steel Casing Spacer.

The casing spacers are to be constructed of T-304 stainless steel segments which bolt together forming a shell around the carrier pipe. The spacers are to be designed with risers (when needed) and runners to support the carrier within the casing and maintain a minimum clearance of 0.50-inch between the casing ID and the spacer OD. On carrier pipes with an OD less than 16-inches., each spacer is to have four (4) riser and runner combinations - two (2) on each segment. On carrier pipes with an OD of 16-in. and larger, each spacer is to contain six (6) riser and runner combinations - four (4) on the bottom segment and two (2) on the top segment. T-304 stainless steel bolts and nuts are to be supplied with the spacers.

The band is to be manufactured of 8-inch wide, 14 gauge, T-304 stainless steel material. The risers are to be constructed of 10 gauge, T-304 stainless steel having a minimum length of 6-inches.

Abrasion resistant runners, having a minimum length of 7-inches and a minimum width of 1-inch are to be attached to each riser to minimize friction between the casing pipe and the carrier pipe as it’s installed. Runner material is to be of glass reinforced plastic with compression strength of 25,000 psi, flexural strength of 32,000 psi and tensile strength of 22,000 psi. The ends of all runners are to be beveled to facilitate installation over rough weld beads or the welded ends of misaligned or deformed casing pipe.

Interior surfaces of the circular steel shell are to be lined with PVC or EPDM having a minimum thickness of 0.090-inch with a hardness of durometer "A" 85-90.

Spacers will be placed a maximum of 1-foot on each side of the bell joint and every 8 to12-feet apart thereafter.

Physical Properties

2.3.6.1. Band and Risers

2.3.6.1.1. Band - 14 Gauge, T-304 Stainless Steel

2.3.6.1.2. Riser - Minimum 14 Gauge, T-304 Stainless Steel

2.3.6.2. Liner - EDPM or Polyvinyl Chloride

2.3.6.2.1. Thickness - 0.090-in. minimum

2.3.6.2.2. Hardness - Durometer "A" 85-90

2.3.6.2.3. Dielectric Strength - 1/8-in. thick

2.3.6.2.4. 60,000 VPM

2.3.6.2.5. Water Absorption - one (1) percent maximum

2.3.6.2.6. Overlap edges

2.3.6.3. Studs, Nuts and Washers

2.3.6.3.1. T-304 Stainless Steel - 5/16: - 18-in. x 2-in. studs

2.3.6.3.2. 5/16-in. hex nuts

2.3.6.3.3. 5/16-in. washers SAE 2330

2.3.6.4. Runners

1-in. wide or 2-in. wide glass filled polymer runners

Sizes Available:

Length - 7-in.

Effective heights (all lengths) - 1-in. and 1 1/2-in.

Materials Specifications:

Tensile Strength (ASTM D-638) - 22,000 psi

Flexural Strength (ASTM D-790) - 32,000 psi

Compression Strength (ASTM D-695) - 25,000

Deflection Temperature @ 264 psi (ASTM D-648) - 435 F (224 C)

Deformation Under Load, @ 122 F (50C) - 4000 pound Load, - (ASTM D-648) 1.2 percent.

2.3.6.5. Welding. All risers are to be welded by MIG welding. Welds are to be fully passivated.

2.3.7. Quality Assurance Commercial Standards. (All manufacturing tolerances referenced in the below standards apply unless specifically excluded).

ANSI/AWWA C-200 Standard for Steel Water Pipe 6 Inches and Larger.

ANSI/AWWA C-205 Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 inch and Larger-Shop Applied

ANSI/AWWA C-206 Standard for Field Welding of Steel Water Pipe.

ANSI/AWWA C-207 Standard for Steel Pipe Flanges for Water Works Service, 4" - 144".

ANSI/AWWA C-208 Standard for Dimensions for Fabricated Steel Water Pipe Fittings.

ANSI/AWWA C-209 Standard for Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.

ANSI/AWWA C-210 Standard for Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.

ANSI/AWWA C-214 Standard for Tape Coating Systems for the Exterior of Steel Water Pipelines.

ANSI/AWWA C-216 Standard for Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.

ANSI/AWWA C-218 Standard for Liquid Coating the Exterior of Aboveground Steel Water Pipelines and Fittings.

ANSI/AWWA C-219 Standard for Bolted Sleeve-Type Couplings for Plain-End Pipe.

ANSI/AWWA C-222 Standard for Polyurethane Coatings for the Interior and Exterior of Steel Water Pipelines and Fittings.

AWWA M-11 Steel Pipe - A guide for Design and Installation

ASTM A-106 Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.

ASTM A-53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

ASTM E-165 Method for Liquid Penetrant Examination.

ASTM E-709 Guide for Magnetic Particle Examination.

ASME Section V Nondestructive Testing Examination.

ASME Section IX Welding and Brazing Qualification.

AWS B2.1 Standard for Welding Procedure and Welding Qualifications.

2.3.8. Qualifications

2.3.8.1. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.

2.3.8.2. Pipe shall be the product of one manufacturer. All pipe manufacturing including cylinder production, lining, coating and fittings shall be produced by one manufacture. The pipe manufacturer must have a certified quality assurance program. This certified program shall be ISO 9001: 2000 or other equivalent nationally recognized program.

2.4. **Polyvinyl Chloride Pipe and Fittings.**

2.4.1. Polyvinyl Chloride Pipe, 2-inch through 12-inch (ASTM 2241).

2-inch through 12-inch polyvinyl chloride (PVC) pressure pipe is to be made from class 12454A or 12454B compounds as determined by ASTM Standard D-1784 and providing for a hydrostatic test basis (HBD) of 4000 psi.

All PVC pipe shall conform to applicable AWWA standards. The Contractor shall supply the Engineer a manufacturer's affidavit that the materials supplied comply with all applicable requirements of AWWA.

All ASTM 2241 PVC pipe shall have a standard dimension ratio (SDR) of 26 (160 psi pressure class) or an SDR of 21 (200 psi pressure class). All PVC pipe 4" and smaller shall have an SDR of 21. It shall be furnished in nominal 20-foot lengths, and shall be self extinguishing.

Dimensions and tolerances for each nominal pipe size are to be in accordance with PVC Pipe Dimensions as published in the Handbook of PVC Pipe, as published by the Uni-Bell Plastic Pipe Association.

Each pipe shall 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 shall be designed with a retainer ring that locks the gasket into integral bell groove and shall be installed at the point of manufacture. The dimensions and design of the gasket joint provided for the PVC pipe shall meet requirements provided in ASTM D-3139 and ASTM D-2122. The gasket shall be reinforced with a steel band and shall conform to ASTM F-477.

Each length of pipe furnished is to bear identification markings in conformance with Section 2.6 of AWWA C-900.

2.4.2. Polyvinyl Chloride Pipe, 4-inch through 12-inch (C-900).

4-inch through 12-inch polyvinyl chloride (PVC) pressure pipe is to be made from class 1245A or 1245B compounds as determined by ASTM Standard D-1784 and providing for a hydrostatic test basis (HBD) of 4000 psi.

All PVC pipe shall conform to AWWA Standard C-900. The Contractor shall supply the Engineer a manufacturer's affidavit that the materials supplied comply with all applicable requirements of AWWA.

All AWWA C-900 PVC pipe shall have a pressure rating of 150 psi and a dimension ratio of 18 with cast iron equivalent outside diameters unless otherwise specified. It shall have a sustained pressure requirement of 500 psi and a minimum burst pressure of 755 psi. AWWA C-900 PVC pipe installed in High Pressure Zones to have a pressure rating of 200 psi and a dimension ration of 14, a sustained pressure requirement of 650 psi and a minimum burst pressure of 985 psi. It shall be furnished in nominal 20-foot lengths, and shall be self extinguishing.

Dimensions and tolerances for each nominal pipe size are to be in accordance with Section 2.2, Table 1 of AWWA C-900.

Each pipe shall 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 shall be designed with a retainer ring that locks the gasket into integral bell groove and shall be installed at the point of manufacture. The dimensions and design of the gasket joint provided for the PVC pipe shall meet requirements provided in ASTM D-3139 and ASTM D-2122. The gasket shall be reinforced with a steel band and shall conform to ASTM F-477.

Each length of pipe furnished is to bear identification markings in conformance with Section 2.6 of AWWA C-900.

2.4.3. Polyvinyl Chloride (PVC), 14-inch through 36-inch

2.4.3.1. Scope. This product specification covers 14-inch nominal diameter through 36-inch nominal diameter polyvinyl chloride (PVC) potable water transmission pipe with integral bell and spigot joints. The pipe shall be extruded from Class 12454-A or 12454-B PVC compound as defined in ASTM D-1784 and provide for a hydrostatic design basis (HDB) of 4,000 psi. The pipe outside diameters shall conform to dimensions of cast iron pipe (CI). All pipe furnished shall be in conformance with AWWA C-905-97, or latest revision thereof.

Pipe shall be homogenous throughout. It shall be free from voids, cracks, inclusions, and other defects. It shall be as uniform as commercially practical in color, density, and other physical properties. Pipe surfaces shall be free from nicks and scratches. Joining surfaces of spigots and joints shall be free from gouges and imperfections that could cause leakage.

2.4.3.2. Definitions. All definitions are defined according to AWWA C-905-97 Section 1.2 Definitions.

2.4.3.2.1. Dimension Ratio (DR) – The ratio of the pipe outside diameter to the minimum wall thickness. The quotient is rounded to the nearest 0.5 when necessary.

2.4.3.2.2. Pressure Rating (PR) – The nominal pressure rating of transmission pipe is determined from formulas in Section 5: Transmission-Pipe Ratings AWWA C905-97 using a safety factor of 2.0. There is no allowance for surge pressure in the pressure rating.

2.4.3.3. General

2.4.3.3.1. Except as noted on the plans or specifications for specific jobs, all C-905 PVC pipe shall have a pressure rating of 235 PSI and a dimension ratio of 18 or have the highest pressure rating available for each size of pipe.

2.4.3.3.2. Dimensions and tolerances for each nominal pipe size shall be in accordance with Table 2 Dimensions for PVC Transmission Pipe with CI Outside Diameter of Section 3 Pipe Requirements in AWWA C-905-97. All pipe shall be suitable for use as a pressure conduit.

2.4.3.3.3. Pipe shall be gauged full length and furnished in standard laying lengths of 20 feet ± 1 in. unless otherwise noted. Each pipe shall have an integral bell formed on the pipe end, and be designed to be at least as strong as the pipe wall.

2.4.3.3.4. An elastomeric gasket shall be designed with a retainer ring, which locks the gasket into integral bell groove and shall be installed at the point of manufacture. The dimensions and design of the gasket joint provided for the PVC transmission pipe shall meet requirements provided in ASTM D-3139 and ASTM D-2122. The gasket shall be reinforced with a steel band and shall conform to ASTM F-477.

2.4.3.3.5. Each length of pipe furnished shall bear identification markings that will remain legible after normal handling, storage, and installation. Markings shall be applied in a manner that will not weaken or damage the pipe. Markings shall be applied at intervals of not more than 5 ft. on the pipe. The minimum required markings are given in the list below. Marking requirements shall be in conformance with Section 4.7 Marking Requirements of AWWA C-905-97.

2.4.3.3.5.1. Nominal size and OD base (for example, 24 CI).

2.4.3.3.5.2. PVC.

2.4.3.3.5.3. Dimension Ratio (for example, DR 25).

2.4.3.3.5.4. AWWA pressure rating (for example, PR 165).

2.4.3.3.5.5. AWWA designation number for this standard (AWWA C-905).

2.4.3.3.5.6. Manufacturer's name or trademark.

2.4.3.3.5.7. Manufacturer's production code, including day, month, year, shift, plant, and extruder of manufacture.

2.4.4. AWWA C-900 and C-905 Requirements

2.4.4.1. Bundle pipe in pallets for ease of handling and storage. Package pipe bundles to provide structural supports to insure that weight of upper units do not cause deformation to pipe in lower units.

Pipe bundles showing evidence of ultra violet radiation "sunburn" on exposed pipe as may be caused from extended unprotected storage conditions will not be accepted.

2.4.4.2. The pipe must be in compliance with AWWA Standards C-900 or C-905-97 as applicable by performing quality control-control test and maintaining results of those test as outlined in Section 3 of that standard. Submission of product constitutes certification of compliance with standard.

2.4.4.3. Pipe is intended for use as an underground, direct bury pressure pipe for transport of potable water. The expected life of pipe system after installation is 25 to 50 years.

2.4.4.4. Provide a one year warranty for all material sold and delivered for use and incorporation into water system. Warranty takes effect on the date that pipe is accepted by the Department.

2.4.4.5. Test.

2.4.4.5.1. For both C-900 and C-905, water system may at no cost to the Contractor, subject random lengths of pipe for testing by an independent laboratory for compliance with this specification. Any visible defects of failure to meet quality standards here in will be grounds for rejecting entire order.

2.4.4.5.2. For C-905: The Contractor shall ensure that the manufacturer pressure tested all pipe, including the joint, which is marked with the designation number of AWWA C-905-97 at 73.4º F. +/- 3.6ºF (23ºC +/- 2ºC). Each length of pipe shall be proof tested at twice the pressure rating listed in Table 3 Transmission-Pipe Pressure Rating of AWWA C-905-97 Sec. 4.6 Pressure Strength and Hydrostatic Proof

2.4.4.6. References. The documents listed below are referenced in this specification.

2.4.4.6.1. AWWA C-905-97; Polyvinyl Chloride (PVC) Water Transmission Pipe Nominal Diameters 14 inch through 36 inch.

2.4.4.6.2. ASTM D-1784; Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.

2.4.4.6.3. ASTM D-2122; Standard Method of Determining Dimensions of Thermoplastic Pipe and Fittings.

2.4.4.6.4. ASTM D-3139; Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

2.4.4.6.5. ASTM F-477; Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

2.4.5. Bends and Fittings for PVC Pipe 4-inch through 36-inch. All bends and fittings shall conform to the same requirements subparagraphs 2.A.2 Fittings for Ductile-Iron Pipe.

2.4.6. Joint Restraint System for PVC C-900/C-905.

2.4.6.1. Scope. This specification covers pipe joint restraint systems to be used on domestic water mains for PVC C-900 pipe sizes 4-inch through 12-inch diameter and PVC C-905 pipe sizes 16-inch through 24-inch diameter, and for Ductile Iron pipe sizes from 4-inch through 24-inch 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.

2.4.6.2. General Requirements

2.4.6.2.1. Underwriter Laboratories (U.L) and Factory Mutual (FM) certifications are required on all restraint systems.

2.4.6.2.2. Unless otherwise noted, restraint systems to be used on PVC C-900 and C-905 pipe shall meet or exceed A.S.T.M. Standard F1674-96, “Standard Test Methods for Joint Restraint Products for Use with PVC Pipe,” or the latest revision thereof. Restraint systems used on ductile pipe shall meet or exceed U.L. Standard 194

2.4.6.2.3. Non-metallic restrained joint pipe and couplings shall be utilized specifically for C-900 PVC pipe and fittings in sizes 4-inch-12-inch.

2.4.6.2.4. Each restraint system shall be packaged individually and include installation instructions.

2.4.6.3. Specific Requirements.

2.4.6.3.1. Restrainer for PVC C-900/C-905 & Ductile Iron Push-on Type Connections:

2.4.6.3.1.1. Pipe restraints shall be utilized to prevent movement for push-on D.I. or PVC (C-900&C-905) (compression type) bell and spigot pipe connections or where a transition or flexible coupling has been used to join 2 sections of plain-end pipe D.I. or PVC (C-900&C-905). The restrainer may be adapted to connect a plain end D.I. or PVC pipe to a ductile iron mechanical joint (MJ) bell fitting. The restrainer must not be directionally sensitive.

2.4.6.3.1.2. The pipe shall be restrained by a split retainer band. The band shall be cast ductile iron, meeting or exceeding ASTM A-536-80, Grade 65-45-12. The inside face or contact surface of the band shall be of sufficient width to incorporate cast or machined non-directionally sensitive serration to grip the outside circumference of the pipe. The serration shall provide full (360 °) contact and maintain pipe roundness and avoid any localized points of stress. The split band casting shall be designed to “bottom-out” before clamping bolt forces (110ft-lb minimum torque) can over-stress the pipe, but will provide full non-directionally sensitive restraint at the rated pressures.

2.4.6.3.1.3. Bolts and nuts used to attach the split retainer ring shall comply with ANSI B-18.2/18.2.2, SAE Grade 5. Tee-bolts, nuts and restraining rods shall be fabricated from high-strength, low-alloy steel per AWWA C-111-90, ANSI/AWWA C-111/A-21.11.

2.4.6.3.1.4. The split ring type non-directionally sensitive restrainer system shall be capable of a test pressure twice the maximum sustained working pressure listed in section D and be for both D.I. and/or PVC C-900.

2.4.6.3.1.5. Restraint systems sizes 6 through 12-inch shall be capable of use for both ductile iron and/or PVC C-900.

2.4.6.3.1.6. The restraint system may consist of 2 types: the two split retainer rings and for new construction use only the 1 split and 1 solid cast backup ring.

2.4.6.3.2. Compression Ring Fitting Restrainer for Ductile Iron Pipe & PVC C-900.

2.4.6.3.2.1. Compression ring with follower gland type of restrainer may be utilized in conjunction with Mechanical Joint (MJ) bell end ductile iron pipe fittings for restraining PVC C-900 and ductile iron pipe.

2.4.6.3.2.2. The system shall utilize a standard MJ gasket with a color-coded compression ring and replacement gland conforming to ASTM A-536-80, Grade 65-45-12.

2.4.6.3.2.3. Standard MJ fitting Tee-bolts and nuts shall be fabricated from high strength steel conforming to ANSI AWWA C-111/A-21.11 and AWWA C-153/A-21.53-88.

2.4.6.3.2.4. Standard MJ gasket shall be virgin SBR meeting ASTM D-2000 3 BA 715 or 3 BA 515.

2.4.6.3.2.5. The restraint system shall be capable of a test pressure twice the maximum sustained working pressure shown in Table 2 below.

2.4.6.3.3. Non-metallic restrained joint pipe and couplings for PVC C-900 Type Connections:

2.4.6.3.3.1. Gasketed restrained coupling connections shall join two sections of factory grooved PVC (C-900) pipe. The restrainer coupling must not be directionally sensitive.

2.4.6.3.3.2. The coupling shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F-477 and shall be DR-14 Class 200 C-900 PVC in all applications, meeting or exceeding the performance requirements of AWWA C-900, latest revision. The inside face or contact surface of the coupling connection shall be of sufficient 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 shall provide full (360 °) contact

and maintain pipe roundness and avoid and localized points of stress. The coupling shall be designed with an internal stop to align the precision-machined grooves in the coupling and pipe prior to installation of a non-metallic thermoplastic restraint spleen, and will provide full non-directionally sensitive restraint at the rated pressures.

2.4.6.3.3.3. High-strength flexible thermoplastic spleens shall be inserted into mating precision–machined grooves in the pipe and coupling to provide full non-directional restraint with evenly distributed loading.

2.4.6.3.3.4. The non-metallic restrained joint pipe and couplings for PVC C-900 type non-directionally sensitive restrainer system shall be capable of a test pressure twice the maximum sustained working pressure listed in Section D and be for PVC (C-900) pipe sizes 4 through 12-inch.

2.4.6.3.3.5. Non-metallic restrained joint pipe and couplings for PVC C-900 restrained systems sizes 4 through 12-inch shall be capable of use for both Class 150 (DR 18) and 4 through 8-inch for Class 200 (DR 14) PVC C-900 pipe.

2.4.6.3.3.6. The non- metallic restrained joint pipe and couplings for PVC C-900 restraint system shall consist of a pipe and couplings system produced by the same manufacturer meeting the performance qualifications of Factory Mutual (FM) and Underwriters Lab (UL).

2.4.6.3.4. Retainer Gland for Ductile Iron Pipe (only):

2.4.6.3.4.1. Radial bolt type restrainer systems shall be limited to ductile iron pipe in conjunction with Mechanical Joint (MJ) bell end pipe of fittings. The system shall utilize a standard MJ gasket with a ductile iron replacement gland conforming to ASTM A-536-80. The gland dimensions shall conform to Standard MJ bolt circle criteria.

2.4.6.3.4.2. Individual wedge restrainers shall be ductile iron heat treated to a minimum hardness of 370 BHN. The wedge screws shall be compressed to the outside wall of the pipe using a shoulder bolt and twist-off nuts to insure proper actuating of the restraining system.

2.4.6.3.4.3. Standard MJ fitting Tee-bolts and nuts shall be high strength steel conforming to AWWA C111/A21.11and C153/A21.53-88.

2.4.6.3.4.4. Standard MJ gasket shall be virgin SBR meeting ASTM D-2000 3 BA 715 or 3 BA 515.

2.4.6.3.5. Maximum Sustained Working Pressure Requirement

Table 2

Nominal Diameter	PVC C-900 / C-905	Ductile Iron
4 & 6 in.	150 p.s.i. (DR18) / 200 p.s.i. (DR14)	350 p.s.i.
8 in.	150 p.s.i. (DR18) / 200 p.s.i. (DR14)	250 p.s.i.
10 & 12 in.	150 p.s.i. (DR18) / 200 p.s.i. (DR 14)	200 p.s.i.
14 & 16 in.	150 p.s.i. (DR 18) / 200 p.s.i. (DR 21) / 235 p.s.i. (DR 18)	200 p.s.i.
20 & 24 in.	150 p.s.i. (DR18) / 200 p.s.i. (DR 21) / 235 p.s.i. (DR18)	200 p.s.i.

2.4.6.3.6. Tests. The Engineer 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 of failure to meet the quality standards herein will be ground for rejecting the entire order.

2.4.6.3.7. Product List. Other approved equal products from other manufacturers meeting these specifications may be submitted for review.

2.4.6.3.7.1. Slip on Joint Restraint Systems:

Table 3			
Manufacturer	**PVC C-900/C-905**	**Ductile Iron (D.I.)**	**D.I., 16" Above**
Ford / Uni-Flange Corporation	Series 1390C	Series 1390C	1390C
EBBA Iron Sales, Inc.	1500	1700	1700
Romac Industries, Inc. 4-8 inch	Model 611	Model,611	47 OSJ
Star Pipe Products	1100	1100	1100

2.4.6.3.7.2. Compression Ring Systems:

Table 4		
Manufacturer	**PVC C-900**	**Ductile Iron**
Romac Industries, Inc.	Grip Ring-DI	Grip Ring-DI
Tyler Corporation	MJR Gland	MJR Gland
Star Pipe Products	Ring Lock 3500 Series	

2.4.6.3.7.3. Non-metallic restrained joint pipe and couplings for PVC C-900 RJ Type Connections:

Table 5		
Manufacturer	**PVC C-900**	**Ductile Iron**
CertainTeed Corporation, Certa-Lok C-900/RJ	4" – 12"	Class 150 (DR-18)
	4" – 8"	Class 200 (DR-14)

2.4.6.3.7.4. Retainer Gland (MJ):

Table 6		
Manufacturer	**PVC C-900**	**Ductile Iron**
EBBA Iron Sales, Inc.	2000 PV	MEGALUG 1100
Romac Industries, Inc.	Not Approved	Not Approved
Ford/UniFlange	UFR-1500-C 4" – 24"	Series 1400
StarPipe Products	Stargrip 4000	Stargrip 4000
Sigma Corporation	One Lok SLC	One Lok SLD

2.4.6.3.7.5. Restrained Flange Adapters:

Table 7		
Manufacturer	**PVC C-900**	**Ductile Iron**
EBBA Iron Sales, Inc.	2100 Megaflange	2100 Megaflange
Ford/UniFlange	900	200, 400, 420

2.5. **Copper Tubing and Brass Fittings for Copper Service Lines.**

2.5.1. Copper Tubing. All 3/4 in., 1 in., 1-1/2 in. and 2-in. copper tubing for underground service is to be of the type commercially known as Type "K" soft and conform to ASTM Designation B-88 and NSF Standard 61.

3/4 in. and 1-in. copper tubing is to be furnished in 60-foot coils or 100-foot coils as specified, 1-1/2-in. is to be furnished in 20-foot lengths, 40-foot coils or 60-foot coils as specified, and 2-in. is to be furnished in 20-foot lengths or 40-foot coils as specified.

2.5.2. Brass Fittings.

2.5.2.1. General requirements

Unless otherwise modified herein, water works brass goods consisting of corporation stops, curb stops, couplings, connectors, nipples, etc., will be required in underground installations of service lines in the water distribution system.

The brass composition is to conform to ASTM Designation B-62 and the threads are to conform to AWWA Standard C-800-01 for "Threads for Underground Service Line Fittings".

All casting is to have a natural, clean uniform and smooth surface, and be free from internal porosity.

All machining is to be done in a workmanlike manner and within the acceptable tolerances.

Unless otherwise specified each fitting is to be furnished with a 1/16-in. thick fiber gasket.

2.5.2.2. Design Criteria for Curb Stop/Angle Valves Ball Type

All Curb Stop, Corporation and Angle valves shall be ball valves. "Inverted/Ground Key," type angle valves will not be accepted.

Ball angle valves will not have a stop.

Laying dimensions the same as present inverted key style or equal to Mueller H-14258.

Reduced port design will be acceptable provided there is no compromise on flow capacity compared to the "Inverted/ Ground Key" type angle valve.

Pack joints will not be acceptable.

APPROVED MANUFACTURER LIST

In Line FIP X FIP

Table 8 Approved Manufacturers and Models: 2-INCH FIP X FIP	
Manufacturer	**Model**
Ford Meter Box	B11777WR
A.Y. McDonald	6111W
Mueller	B-20200-3
James Jones	J1900

Table 9 Angle Curb Stop Meter Coupling x Compression Approved Manufacturers and Models				
	Size			
Manufacturer	**¾"**	**1"**	**1.5"**	**2"**
A.Y. McDonald	4652BQ	4652BQ		4612BQ
Ford Meter Box	BA43-232WRQ	BA43-344WRQ	BFA43-666WRQ	BFA43777WRQ
Mueller	B24258-R3	B24258-3	B24276-3	B24276-3
James Jones	J1963WSG	J1963WSG	J1975WSGLS	J1975WSGLS
Hays	2520CGJ-R			

Table 10	
F.I.P. X METER SWIVEL NUT/COUPLING Approved Manufacturers and Models:	
Size	
Manufacturer	¾"
A.Y. McDonald	4654B
Ford Meter Box	BA13232WR
Mueller	B24265-R3
James Jones	J-1966WLS
Hays	2521-R

Table 11		
Ball Corporation Valve Approved Manufacturers and Models:		
Manufacturer	**CC X CMP**	**IP X CMP**
A.Y. McDonald	4701BQ	4704 BQ
Mueller	B-25008	B-25028
James Jones	1937 SG	1935 SG
Ford Meter Box	FB-1000Q	FB-1100Q

2.6. **Gate Valves, Tapping Valves and Tapping Sleeves.**

2.6.1. Gate Valves.

2.6.1.1. General Requirements

2.6.1.1.1. Except as otherwise modified or supplemented herein, AWWA Standard C-509-01 or the latest revision thereof, shall govern the design, component materials, construction; manufacture and testing of all resilient seated gate valves. Valves shall be suitable for frequent operation as well as service involving long periods of inactivity. Valves shall be NSF-61 certified.

2.6.1.1.2. Approved manufacturers are shown in Table 12, provided such resilient seat gate valves conform to the provisions contained herein.

Table 12	
APPROVED MANUFACTURER	**PRODUCTS LIST**
Sizes Three through Twelve Inch	
Manufacturer	**Model**
American Flow Control	Series 500
Clow Valve Company	2640
Kennedy Valve	Ken-Seal II
M&H Valve Company	4067
Mueller Company	2360 Series Gate Valve
United States Pipe & Foundry Company	Metroseal 250
Sizes Sixteen through Twenty-Four Inch	
Manufacturer	Model
United States Pipe & Foundry Company	Metroseal 250
Mueller Company	2361 Series Gate Valve
Clow Valve Company	2640
American Cast Iron Pipe Co.	2500

2.6.1.1.3. 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. shall be 200 psig unless otherwise specified.

2.6.1.1.4. The minimum design working water pressure for gate valves with nominal diameters of 16 in., and 20 in. shall be 150 psig unless otherwise specified.

2.6.1.1.5. Valves shall be resilient-seated types, bronze mounted with non-rising stems. The closure member shall be fully encapsulated by an elastomer without thin spots or voids. When open the valve shall have a clear, full-port, unobstructed waterway.

2.6.1.1.6. Gray iron, ductile iron, steel, brass and bronze materials shall meet or exceed the material requirements of Section 2: Materials of AWWA C-509-01.

2.6.1.1.7. Gaskets, O-rings, Coatings, and elastomers shall meet or exceed the material requirements of Section 2: Materials of AWWA C-509-01.

2.6.1.1.8. The gate valves shall be designed and constructed for installation in either a horizontal or vertical position. Valves shall be designed for buried installation with stem in the vertical position and shall be furnished for mounting in a horizontal pipeline, unless otherwise specified.

2.6.1.1.9. Valve components of brass or bronze shall be manufactured to ASTM recognized alloy specifications of low zinc content bronze, as shown in Table 1 of Section 2.2.4. of ANSI/AWWA Standard C-509-01 or the latest revision thereof. Materials for the stem have minimum yield strength of 40,000 psi. A minimum elongation in 2 inches of 12% and shall be made of bronze per ASTM B763, alloy number UNS C99500. A maximum zinc content of 2% as shown in Table 2 Chemical Requirements of ASTM B763-96 or the latest revision thereof. Stem nut material shall be ASTM B-62 UNS C83600 or ASTM B-584 UNS C84400. The stem shall have a visible external marking at the top to indicate low-zinc, high strength material. The marking shall include a red plastic or neoprene washer placed around the top of the stem under the operating nut.

2.6.1.1.10. Valve ends shall be either flanged, tapping valve, mechanical joint, push-on joint or any combination thereof, as specified. All mechanical joint valves shall be supplied with glands, bolts, and gaskets. Valve body bolts and nuts shall meet the strength requirements of ASTM A-307 with dimensions conforming to ANSI B18.2.1. The size of the bolt head shall be equal to the size of the nut and shall be stainless steel in accordance with ASTM 276.

2.6.1.1.11. All gate valves shall open left (counter-clockwise), unless otherwise specified.

2.6.1.1.12. The following parts of the valve shall be made of either gray or ductile iron: bonnet, body, yoke, wrench nut, O-ring packing plate or seal plate, and gland follower. The gate may be made of gray or ductile iron.

2.6.1.1.13. If glands and bushings are used for NRS valves they shall be made of ASTM B-763 bronze UNS C99500. The stem shall be made of cast, forged, or rolled ASTM B-763 bronze UNS C99500. The stem nut material shall be ASTM B-62 bronze UNS C83600 or ASTM B-584 bronze UNS C84400. The gate may be made of bronze ASTM B-763 bronze UNS C99500. Stem seals shall be “O” ring type. The seals shall be designed for dynamic applications.

The design shall 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 shall be in accordance with Section 4.8.3 of the ANSI/AWWA C509-01 Standard or the latest revision thereof.

2.6.1.1.14. Enclosed and buried valves shall be coated inside and outside with a fusion bonded epoxy having a nominal 8 mils dry film thickness, which meets or exceeds AWWA C-550-01 and to the maximum extent possible shall be free of holidays. All coatings in contact with the potable water shall be approved for potable water immersion service per ANSI/NSF Standard 61.

2.6.1.1.15. The Contractor shall submit 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) shall be clearly noted in the valve information. The number of turns to open or close the valve shall be consistent for each valve size for each approved manufacturer.

2.6.1.1.16. Valves furnished under this specification shall be supplied from the approved manufacturer list. To be included on the qualified product list, the manufacturer shall provide an Affidavit of Compliance in accordance with the Section 1.5 of the ANSI/AWWA C-509-01 Standard or latest revision thereof. Records of all tests performed in accordance with Section 6.1 and Section 6.2 of the ANSI/AWWA C-509-01 Standard or latest revision thereof will 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 as outlined in Section 6.2.2 of the ANSI/AWWA C-509-01 Standard, (350 ft-lbs) will also be provided. A copy of the manufacturer's Quality Assurance Program will be submitted. Blueprints and parts list for the valve shall also be provided.

2.6.1.1.17. All gate valve parts shall be designed to withstand the following two pressure requirements, without being structurally damaged. (1) An internal test pressure of twice the rated design working pressure of the valve. (2) 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 shall be capable of withstanding an input torque as follows: 200 ft.-lbs. for a 3-in. nominal diameter. 200 ft.-lbs. for a 4-in. nominal diameter. 300 ft.-lbs. for a 6-in. nominal diameter. 300 ft.-lbs. for a 8-in. nominal diameter. 300 ft.-lbs. for a 10- in. nominal diameter. And 300 ft.-lbs. for a 12-in. nominal diameter. For sizes larger than a 12 in. nominal diameter, refer to the manufacturer's specifications.

2.6.1.1.18. Resilient seats shall be applied to the gate and shall seat against a corrosion resistant surface. The non-metallic seating surface shall 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 shall have a corrosion resistance equivalent to or better than bronze. A non-metallic surface shall be in compliance with ANSI/AWWA C-550. The gate must be fully encapsulated by an elastomer without thin spots or voids. Resilient seats shall be bonded. ASTM D-429 either method A or method B shall prove the method used for bonding or vulcanizing. For method A, the minimum strength shall not be less than 250 psi. For method B, the peel strength shall be 75 lb./in.

2.6.1.1.19. Flanged Ends: The end flanges of flanged valves shall conform to dimensions and drillings of ANSI/AWWA C-110/A21.10 or ANSI B-16.1, Class 125.

2.6.1.1.20. Mechanical Joint Ends: Mechanical joint bell dimensions shall conform to ANSI/AWWA C-111/A21.11.

2.6.1.1.21. Push-on Joints: Push-on joints shall conform to the requirements of ANSI/AWWA C-111/A21.11.

2.6.1.1.22. The tapping valves shall be mechanical joints with tapping flange on the other end. The tapping valves shall be furnished complete with glands, bolts, and gaskets. The tapping valve shall have a clear unobstructed waterway.

2.6.1.1.23. The seat rings shall be of a large diameter to the permit entry of the full diameter tapping machine cutters. The valve end which mates with the tapping sleeve shall have an alignment lip to fit the recess in the tapping sleeve flange for proper alignment. The lip will be dimensioned in accordance with MSS SP-60 for valves 20-inch nominal pipe size and smaller.

2.6.1.1.24. All interchangeable parts shall conform to their required dimensions and shall be free from defects that could prevent proper functioning of the valve. When assembled, valves manufactured in accordance with this standard shall be well fitted and operate smoothly. All like parts of valves of the same model and size produced by the same manufacturer shall be interchangeable.

2.6.1.1.25. All castings shall 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 shall comply with the testing requirements of this specification after repairs have been made. Repairs within the bolt circle of any flange face are not allowed.

2.6.1.1.26. All gate valves shall 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 is to be made in each direction across the gate. All tests are to be performed at the manufacturer's plant.

2.6.1.1.27. All gate valves shall 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 shall be corrected and the test repeated until satisfactory performance is demonstrated. All tests are to be performed at the manufacturer's plant.

2.6.1.1.28. A hydrostatic test pressure equal to twice the rated working pressure of the valve shall be applied to all assembled valves with the gates in the open position. The test shall show no leakage through the metal, pressure containing joints, or stem seals. All tests are to be performed at the manufacturer's plant.

2.6.1.1.29. A test shall be made from each direction at rated working pressure to prove the sealing ability of each valve from both directions of flow. The test shall show no leakage through the metal, pressure containing joints, or past the seat. All tests are to be performed at the manufacturer's plant.

2.6.1.1.30. Markings shall be cast on the bonnet or body of each valve and shall 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, for example "200 W".

2.6.1.1.31. The Engineer 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.

2.6.1.1.32. Table 12 identifies specified manufacturers that are approved.

2.6.1.2. Workmanship

2.6.1.2.1. All parts of the resilient seat gate valve shall be designed and manufactured to the tolerances specified in ANSI/AWWA C-509-01 or latest revision thereof and this specification.

2.6.1.2.2. All parts of the resilient seat gate valve manufactured by a given manufacturer shall be interchangeable with like parts from another resilient seat gate valve of the same model and size and by the same manufacturer.

2.6.1.2.3. All interchangeable parts shall conform to their required dimensions and shall be free from defects that could prevent proper functioning of the valve.

2.6.1.2.4. All castings shall 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 shall comply with the testing requirements of this specification after repairs have been made. Repairs within the bolt circle of any flange face are not allowed.

2.6.1.2.5. The resilient seat gate valves shall be well fitted.

2.6.1.2.6. Operation of the resilient seat gate valve shall be smooth.

2.6.1.2.7. All parts shall be free of structural defects.

2.6.1.2.8. The resilient seat gate valve shall be watertight.

2.6.1.3. Painting

2.6.1.3.1. All exterior and interior surfaces of the valve shall be coated with epoxy, N.S.F. 61 certified. The epoxy shall have a nominal dry film thickness of 8 mils, and shall be in accordance with AWWA C-550, latest revision.

2.6.1.3.2. Coating shall be as close to holiday free as is technologically possible.

2.6.1.4. Testing

2.6.1.4.1. Hydrostatic Test: Hydrostatic Test shall be performed on the valve in accordance with Section 6.1 Proof of Design Testing of ANSI/AWWA C-509-01 or latest revision thereof.

2.6.1.4.2. Torque Test: Torque Test for prototype valves shall be performed on the valve in accordance with Section 6.1 Proof of Design Testing of ANSI/AWWA C-509-01 or latest revision thereof.

2.6.1.4.3. Leakage Test: Leakage Test shall be performed on the valve in accordance with Section 6.1 Proof of Design Testing of ANSI/AWWA C-509-01 or latest revision thereof.

2.6.1.4.4. Pressure Test: Pressure Test shall be performed on the valve in accordance with Section 6.1 Proof of Design Testing of ANSI/AWWA C-509-01 or latest revision thereof.

2.6.1.4.5. Operation Test: Operation Test shall be performed on the valve in accordance with Section 6.2 Production Testing of ANSI/AWWA C-509-01 or latest revision thereof.

2.6.1.4.6. Shell Test: Shell Test shall be performed on the valve in accordance with Section 6.2 Production Testing of ANSI/AWWA C-509-01 or latest revision thereof.

2.6.1.4.7. Seat Test: Seat Test shall be performed on the valve in accordance with Section 6.2 Production Testing of ANSI/AWWA C-509-01 or latest revision thereof.

2.6.1.4.8. An Affidavit of Compliance certifying that all required tests have been performed shall be provided in accordance with Section 6.3 Affidavit of Compliance of ANSI/AWWA C-509-01.

2.6.1.4.9. The Affidavit of Compliance, the results of ASTM testing procedures and requirements for materials, Manufacturer's Quality Assurance Program, and the records of all tests performed on the valve shall be kept and provided by the supplier/manufacturer in a single hard cover bound notebook with the bid or with the shipping documents and shall be approved by the Engineer.

2.6.1.5. Quality Assurance

2.6.1.6. Manufacturers shall have an ASME or I.S.O. 9001 registered commercial quality system. Noncompliance to this registered commercial quality system requirement will result in removal of the manufacturer's product from the approved manufacturer’s list shown in Table 12 of this specification. If on receipt of resilient seat gate valves they are found to be non-compliant the Contractor shall replace the defective resilient seat gate valves according to resilient seat gate valve size with a resilient seat gate valve that meets these specifications at no cost to the Department..

2.6.1.7. References

2.6.1.7.1. American National Standards Institute and American Water Works Association Standard C-509-01 (ANSI/AWWA C-509-01).

2.6.1.7.2. Manufacturers Standardization Society MSS SP-60.

2.6.2. Tapping Valves and Tapping Sleeves.

2.6.2.1. Tapping Sleeves

Band shall conform to the minimum OD size ranges and lengths specified in this specification. The flange shall be manufactured in compliance with AWWA C-223.07, Class D ANSI B.16.1 drilling, recessed for tapping valves MSS_SP60. Mechanical Joint tapping sleeve outlet shall meet or exceed all material specifications as listed below and be suitable for use with standard mechanical joint resilient wedge gate valves per AWWA C-509-94.

2.6.2.1.1. General Requirements

2.6.2.1.1.1. Tapping sleeves 4 inch – 12 inch:

Entire fitting to be stainless steel type 304 (18-8). The body, lug and gasket armor plate to be in compliance with ASTM A-240. The flange shall be cast stainless steel in compliance with ASTM A-743. The MJ outlet shall be one-piece casting made of stainless steel.

The test plug shall be ¾" NTP in compliance with ANSI B2.1 and shall be lubricated or coated to prevent galling. All metal surfaces shall be passivated after fabrication in compliance with ASTM A-380.

The gasket is to provide a 360-sealing surface of such size and shape to provide an adequate compressive force against the pipe after assembly, to affect a positive seal under combinations of joint and gasket tolerances. The materials used shall be vulcanized natural or synthetic rubber with antioxidant ingredients to resist set after installation. No reclaimed rubber shall be used. A heavy-gauge-type 304-stainless armor plate shall be vulcanized into the gasket to span the lug area.

Lugs are to be heliarc welded (GMAW) to the shell. Lug shall have a pass-through-bolt design to avoid alignment problems and allow tightening from either side of the main. Bolts shall not be integrally welded to the sleeve. Finger Lug designs are not approved; it is the intent of these specifications to allow tapping sleeve that has a lug design similar to the approved models.

Bolts and nuts shall be type 304 (18-8) stainless steel and lubricated or Teflon coated to prevent galling or seizing. Bent or damaged unit will be rejected.

Quality control procedures shall be employed to insure that the shell, Lug, (4" and larger nominal pipe diameter) armor plate, gasket and related hardware are manufactured to be free of any visible defects. Each unit, after proper installation, shall have a working pressure rating up to 200 psi, and a test pressure of 250 psi.

The sleeve construction shall provide a positive means of preventing gasket cold flow and/or extrusion.

Each sleeve shall be stenciled, coded or marked in a satisfactory manner to identify the size range. The markings shall be permanent type, water resistant that will not smear or become illegible.

2.6.2.1.1.2. Tapping Sleeves 16 inch and large nominal pipe diameter:

The body shall be in compliance with ASTM A-285 Grade C or ASTM A-36. Test plug shall be ¾" NPT conforming to ANSI B2.1.

The gasket is to provide a watertight sealing surface of such size and shape to provide an adequate compressive force against the pipe. After assembly, the gasket will insure a positive seal under all combinations of joint and gasket tolerances. Gasket shall be formed from vulcanized natural or synthetic rubber with antioxidants ingredients to resist set after installation. No reclaimed rubber shall be used. Bolts and nuts shall be type high strength, corrosion resistant, low alloy per AWWA C-111, ANSA A21.11

Quality control procedures shall be employed to insure that the shell, gasket and related hardware are manufactured to be free of any visible defects. Each unit, after proper installation, shall have a working pressure rating up to 150 psi, and a test pressure of 200 psi.

Unless otherwise noted, unit shall be protected by fusion Epoxy 8-10 mil line and coat per AWWA C-213.

Units for concrete steel cylinder pipe shall 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. (AWWA Manual of Practive M-9)

Each sleeve shall be stenciled, coded or marked in a satisfactory manner to identify the size range. The markings shall be permanent type, water resistant that will not smear or become illegible.

2.6.2.1.2. Standard Ranges

Table 13			
Nominal Dia (in) x Min Length (in)	**Flange Outlet (in)**	**Range**	**Min OD Range (in)****
4 x 16	4	A	4.75 – 4.95
		B	4.90 – 5.10
6 x 16	4	A	6.70 – 7.10
		B	7.00 – 740
		C	7.35 – 7.75
6 x 16	6	A	6.80 – 7.15
		B	7.05 – 7.40
		C	7.40 – 7.75
8 x 16	4 & 6	A	9.00 – 9.45
		B	9.35 – 9.70
		C	9.70 – 10.00
8 x 20	8	A	9.00 – 9.35
		B	9.35 – 9.70
		C	9.70 – 10.00
10 x 16	4 & 6	A	11.03 – 11.47
10 x 20	8	B	11.60 – 12.00
10 x 24	10		
12 x 16	4 & 6	A	13.00 – 13.40
12 x 20	8	B	13.40 – 13.80
12 x 24	10	C	14.10 – 14.50
12 x 32	12		
16 x 12	4 & 6		17.33 – 17.87
16 x 16	8		18.62 – 19.19
16 x 20	10		
16 x 24	12		
16x 36	16*		
20 x 12	4 & 6	A	21.51 – 22.15
20 x 16	8	B	23.46 – 24.16
20 x 20	10		
20 x 24	12		
20x 36	16*		
20 x 40	20*		
24 x 12	4 & 6	A	25.71 – 26.41
24 x 16	8	B	28.14 – 28.84
24 x 20	10		
24 x 24	12		
24 x 36	16*		
24 x 40	20*		
24 x 48	24*		
30 x 12	4 & 6	A	29.78 - 30.48
30 x 16	8	B	31.52 – 32.22
30 x 20	10		
30 x 24	12		
30 x 36	16*		
30 x 40	20*		
30 x 48	24 x 30*		

*Range to be specified when ordered

**Ranges may be broadened by not narrowed. For concrete steel cylinder pipe the OD of the pipe and cylinder shall be supplied with the order.

For pipe larger than 30 inches nominal diameter, tapping sleeves shall be custom fabricated to fit non standard ranges, in conformance with the intent of these specifications.

The Engineer may, at no cost to the Contractor, subject random units to testing by an independent laboratory for compliance with these standards. Any visible defect of failure to meet the quality standards herein will be ground for rejecting the entire order.

Table 14 lists identified specific manufactured items by catalog number that are approved:

Table 14		
Manufacturer	**Model**	**Size Range (in)**
JCM Industries	#432	4 - 12
	#412	16 and larger
Power Seal	#3490AS or 3490MJSS	4 - 12
	3490MJSS	16 and larger
Romac Industries	SST III	4 - 12
	SST III	16 and larger
Ford Meter Box	FTSS	4 - 12
	FTS	16 and larger
Dresser	Style 610/630	4 - 12
	Style 610/630	16 and larger
Cascade	CST-1	4 - 12
Smith Blair	#622	16 and larger

2.7. **Butterfly Valves (150 or 250 PSI Class).**

This covers Class 150 PSI, 3 inches through 72 inches, and Class 250 PSI, 4 inches through 54 inches, rubber-seated butterfly valves. All products furnished shall be in conformance with the American National Standards Institute and American Water Works Association C504 (ANSI/AWWA C504) or latest revision thereof; however, the body construction of the valve shall exceed the ANSI/AWWA C504 by the values specified herein. All coatings in contact with potable water shall be certified to N.S.F. 61. A proof of design certification shall be provided upon request.

2.7.1. Definitions

All definitions are defined according to ANSI/AWWA C504.

2.7.1.1. 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.

2.7.1.2. Butterfly Valve: A valve that uses a disc rotatable through an angle of approximately 90 degrees 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.

2.7.1.3. 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 degrees from full open to full shutoff.

2.7.1.4. Rubber Seat: A rubber ring around the inside of the valve body to affect a seal against the metal seating surface when the disc is closed. Or resilient seats shall be located on the valve disc and shall provide a 360 degrees continuous, uninterrupted seating surface. Seats shall be mechanically retained with a stainless steel retaining ring and stainless steel Nylok cap screws, or an approved equal, which shall pass through both the resilient seat and the retaining ring.

The resilient seat's mating surface shall be to a 360 degrees continuous, uninterrupted stainless steel body seat ring. The retaining ring shall be continuous or investment cast with overlapping sections serrated grooves, and shoulders. Resilient seats shall be field adjustable and replaceable and shall not require hypodermic needles or pressure vessels to replace or adjust.

2.7.2. General Requirements

2.7.2.1. Except as otherwise modified or supplemented herein, AWWA Standard C504 or the latest revision thereof, shall govern the design, component material construction, manufacture and testing of all butterfly valves.

2.7.2.2. Valves shall be Class 150 PSI or Class 250 PSI of the short-body type with a bi-directional shut-off rating, a hydrostatic body shell test and a maximum upstream line velocity rating according to the table listed below unless specified otherwise.

Valve Class	Bi-directional Shut-off Rating	Hydrostatic Body Shell Test	Diameter	Velocity
150 PSI	150 psig	300 psig	3 inch through 20 inch	16 feet per second
150 PSI	150 psig	300 psig	24 inch through 72 inch	8 feet per second
250 PSI	250 psig	500 psig	4 inch through 20 inch	16 feet per second
250 PSI	250 psig	500 psig	24 inch through 54 inch	8 feet per second

2.7.2.3. Valve shall be in the same alignment as a horizontal pipe and shall be for buried service, unless otherwise specified. Valve shall be configured with a horizontal valve shaft and a vertical actuator shaft with standard 2" AWWA operating nut. The actuator shall be side mounted.

2.7.2.4. Valve body shall be of cast iron conforming to ASTM Specification A-26, Class B. Class 250 will also allow the use of Ductile Iron conforming to ASTM A536, grade 65-45-12.

2.7.2.5. Class 150 valve body ends shall be flat-faced flanged in accordance with ANSI B16.1, Class 125. All valves shall conform to AWWA C504, Table 2 of Section 3.1 Valve Bodies, laying lengths for flanged valves and minimum body shell thickness for all body types.

2.7.2.6. Class 250 valve body ends shall be flat-faced flanged in accordance with ANSI B16.1, Class 250. All cast iron valves shall exceed minimum body shell thickness AWWA C504 Class 150B, Table 2 of Section 3.1 Valve Bodies,

2.7.2.6.1. Laying lengths for flanged and wafer valves and minimum body shell thickness for all body types by the following: Sizes 4" through 10" - 15% or greater, Sizes 12" through 24" - 20% or greater, and Sizes 30" through 54" - 50% or greater. Ductile iron valve body thicknesses shall conform to the table below. Ductile iron and cast iron laying lengths shall be as specified in the table below unless otherwise specified.

Ductile Iron Valve Diameter Inch	Ductile Iron Thickness Inch Laying	Ductile Iron Lengths Inch
3	.27	5
4	.40	5
6	.43	5
8	.46	6
10	.54	8
12	.58	8
14	.63	8
16	.68	8
18	.79	8
20	.83	8
24	.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

Valve Diameter Cast Iron	Thickness Cast Iron	Laying Length Cast Iron Inch
6 Inch	Per specification	6
8 Inch through 12 inch	Per specification	8
14 Inch through 30 inch	Per specification	12
36 Inch through 54 Inch	Per specification	15

2.7.2.7. Valve shall be of such design that the disc will seat at 90 degrees with the pipe axis.

2.7.2.8. Valve shall be of such design that the disc will not flutter or vibrate when operated in a throttled position.

2.7.2.9. Valves disc shall be of Cast Iron A-48, class 40 Cast Iron A-126, class B or Ductile Iron ASTM A-536, grade 65-45-12 and shall be of disc design to provide 360 degree uninterrupted seating.

2.7.2.10. The valve seat shall be natural or synthetic rubber applied integrally to the body or disc. For valves 24 inches or larger, the rubber seat shall be capable of mechanical adjustment in the field and shall be field replaceable. Special tools required for seat adjustment shall be provided with the valve. Special tools required for seat replacement shall be furnished with the replacement seat. Mechanical adjustment or attachment of the seat and seat ring does not include welding. The mating seat surface shall be type 304 or type 316 stainless steel, ni-chrome or monel. Sprayed or plate mating seat surfaces are not acceptable.

2.7.2.11. Class 150 psi Valve shafts shall be type 304 stainless steel conforming to ASTM A-276, and Class 250 psi Valve shafts shall be type 630 stainless steel conforming to ASTM A-564 condition H-1100. Both shall have a diameter equal to or greater than that shown for Class 150B in Table 3 of AWWA C504. Shafts shall conform to the requirements of Section 3.3, Valves Shaft of AWWA C504 for one-piece or stub shaft types. Connection between the shaft and disc shall be dowel, taper pins, or torque plugs, which are mechanically secured.

2.7.2.12. The valve assembly shall be furnished with a factory-set, non-adjustable disc shaft thrust bearing that insures the valve disc is centered within the valve body seat at all times.

2.7.2.13. Valve shaft bearings shall be permanent, self-lubricated, bearings, which provides continuous, low-friction maintenance-free operation. Shaft bearing shall be contained in integral hubs of the valve body.

2.7.2.14. Valve shaft seal shall consist of O-ring, V-type, or U-cup type packing where the shaft projects through the valve body for the actuator connection.

2.7.2.15. The valve shall be provided with a fully enclosed, permanently lubricated actuator of the traveling nut or worm gear design. The actuator shall be connected to the valve shaft by means of a key and keyway connection.

2.7.2.16. All actuators shall have adjustable, mechanical stop limits in accordance with AWWA C504 Section 3.8.2. All Class 150 psi and 4" through 54" Class 250 psi valve actuators shall be capable of withstanding 450 ft-lbs of input torque against the open or closed stops without damage.

2.7.2.17. Valves for below ground applications shall be provided with an AWWA wrench nut. The wrench nut shall have an arrow cast thereon, indicating the direction on of opening. The wrench nut shall be suitably fastened to the actuator input shaft. If the shaft is smooth, the wrench nut shall be fastened to the input shaft by means of a minimum 5/16" 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 shall be formed to fit the splined shaft. The actuator shall be designed to produce the specified torque with a maximum input of 150 ft-lbs applied to the wrench nut.

2.7.2.18. Valves for aboveground applications shall be provided with a handwheel. The handwheel shall have an arrow thereon, indicating the direction of the opening. The handwheel shall be suitably fastened to the actuator input shaft. Actuators equipped with handwheels shall be designed to produce the specified torque with a maximum pull of 80 pounds of the handwheel rim.

2.7.2.19. The requirement for either wrench nut or handwheel and the direction of opening will be specified on each purchase order.

2.7.2.20. Valves shall open on left turn (counter-clockwise).

2.7.2.21. The Contractor shall supply, with his valve material submittal, 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) shall be clearly noted in the valve information submitted with the proposal documents.

2.7.2.22. The supplier/manufacturer shall provide Affidavit of Compliance with applicable sections of AWWA C504 to include the following: Results of ASTM testing procedures and requirements for materials will be provided to the Engineer upon request, Manufacturer's Quality Assurance Program, leak-tightness testing and proof of design testing of representative actuators in accordance with AWWA C504 Section 3.8.5.2 as modified herein (450 ft.-lbs.). Compliance assurance will be required in accordance with AWWA C504 Section 5.1.2, Affidavits. Results of performance tests, proof of design test, AWWA C504 Section 5.2.4, hydrostatic test, leakage test, and Affidavit of Compliance shall be provided with the material submittal or with the shipping documents and shall be approved by the Engineer.

2.7.2.23. Valves furnished under this specification shall be supplied by our approved manufacturer list.

2.7.3. Workmanship

2.7.3.1. All parts of the butterfly valve shall be designed and manufactured to the tolerances specified in ANSI/AWWA C509 or latest revision thereof and this specification.

2.7.3.2. All parts of the butterfly valve manufactured by a given manufacturer shall be interchangeable with like parts from another butterfly valve of the same model and size and by the same manufacturer.

2.7.4. Painting

2.7.4.1. All interior and exterior ferrous surfaces of the valve, including the disc, shall be coated with epoxy, N.S.F. 61 certified. The epoxy shall have a nominal thickness of 8 mils, and shall be in accordance with AWWA C550, latest revision.

2.7.4.2. Coating shall be as close to holiday free as is technologically possible.

2.7.5. Testing and Inspection

2.7.5.1. Performance Tests: Performance tests shall be performed on each valve in accordance with Section 5.2.1 Testing of ANSI/AWWA C504 or latest revision thereof.

2.7.5.2. Leakage Tests: Leakage tests shall be performed on each valve in accordance with Section 5.2.2 Testing of ANSI/AWWA C504 or latest revision thereof and at an operating pressure of 250 psig.

2.7.5.3. Hydrostatic Tests: Hydrostatic tests shall be performed on each valve in accordance with Section 5.2.3 Testing of ANSI/AWWA C504 or latest revision thereof, and at a maximum operating pressure of 500 psig for Class 250 valves.

2.7.5.4. Proof-of-Design Tests: Proof-of-Design tests shall be performed on each valve in accordance with Section 5.2.4 Testing of ANSI/AWWA C504 or latest revision thereof.

2.7.5.5. An Affidavit of Compliance certifying that all required tests have been performed shall be provided.

2.7.5.6. The Affidavit of Compliance and the records of all tests performed on the valves shall be kept and provided in a single hard cover bound notebook.

2.7.6. Quality Assurance

2.7.6.1. Manufacturers shall have an ASME or I.S.O. 9001 registered commercial quality system. If on receipt of butterfly valves they are found to be non-compliant the Contractor shall replace the defective butterfly valves according to butterfly valve size with a butterfly valve that meets the Water System Utility Owner's specifications. The defective butterfly valves will be returned to the manufacturer, freight collect, and the manufacturer shall replace the butterfly valve, freight prepaid.

If Water System Utility Owner 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 from the approved manufacturer's list. If the butterfly valve becomes defective during the manufacturer's specified warranty period, a Water System Utility Owner quality assurance and manufacturer review will ensue. If the review determines manufacturing non-conformance the Contractor shall replace the butterfly valve according to size with a butterfly valve that meets these specifications at no cost to the Department or Owner.

2.7.7. References

2.7.7.1. American National Standards Institute and American Water Works Association Standard C504 (ANSI/AWWA C504).

APPROVED MANUFACTURER and PRODUCTS LIST

Manufacturer	Product	
	Class 250 psi	Class 150 psi
Mueller	Linseal XP	Linseal III
Henry Pratt (above ground)	HP-250	2F II (3" thru 20") and XR-70 (24" thru 72")
Henry Pratt (below ground)	HP-250	Ground hog (3" thru 72")
DeZurik	BAW	BAW
CMB Industries, Inc.	K-Flo Model 504 and K-Flo Model 47	K-Flo Model 504 and K-Flo Model 47
Val-Matic	Series 2000	Series 2000

2.8. **Valve Boxes.**

All valve box assemblies are to conform to the details shown on the plans. Each valve box assembly is to be of cast-iron and is to consist of a base, top section, and lid.

Valve boxes are to be of a single size with a nominal diameter of 6-inches.

The valve box lid is to be labeled “water” and is to be so designed so that it will remain firmly seated in place when subjected to vehicular traffic.

The valve box assembly is to be of sufficient toughness and strength to withstand impact loads and shock resulting from vehicular traffic.

The valve box assembly is to be coated with a standard bituminous coating of either coal tar or asphalt base applied to all inside and outside surfaces.

2.9. **Meter Boxes.**

For non-traffic bearing locations, the meter box assembly for 5/8-in. through 1-in. meters box and lid is to be black and constructed our of modified polyethylene material for maximum durability and corrosion resistance. The black material is for maximum UV protection and shall be uniform throughout 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 shall withstand a 20,500 lb loading in a non-deliberate and incidental traffic. Plastic Lid is to have the following:

- “Water Meter” and “{Utility Owners Name}” molded into the lid,
- seat securely and evenly inside the meter box and shall not overlap the top edge of the meter box,
- “Overlap” and 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, if specified in the plans, to help in the protection of the radio antenna,
- a brass worm gear lock that will secure the existing cast iron meter box of like dimensions and secure the plastic meter box,
- a molded receptacle for placement of key, and
- one (1) piece of ½” rebar secured in lid.

Plastic body is to have the following:

- a crush resistant ribbing along the outside of box,
- a flange around the top opening to help prevent setting and aide in adjustment to grade, and
- designed to accommodate all plastic lids.

For traffic bearing locations, the meter box assembly for 5/8-in. through 2-in. meters is to consist of cast-iron rectangular boxes box and a steel checkered plate rectangular with raised lug pattern as shown on the plans.

The castings are to be dipped in coal tar at a temperature of 350ºF and the metal is to be at a temperature of 300ºF prior to dipping. The casting is to be dipped and cured independently and the coating is to have ceased to be "tacky" within 72 hours after dipping.

The steel checkered plate rectangular cover is to be hot dip galvanized after fabrication.

The meter box is to have an ultimate tensile strength of 25,000 psi and is not to be brittle.

The casting is to have an "as cast" clean smooth surface and be free from internal porosity; castings that are made smooth by grinding are unacceptable.

Quality Assurance: If on receipt of meter box(es) or lid(s) they are found to be non-compliant, the Contractor is to replace defective product at no cost to the Department and/or the Water System Utility Owner. Any visible defect of failure to meet specification will be grounds for rejecting entire order.

Approved Plastic Meter Box and Lid Manufacturer (or equal):

DFW Plastics Inc. Model Numbers:

- D-1218-RWSBSM-Complete box
- D-1218-RWSBSM-lid
- D-1218 – body

2.10. **Fire Hydrants.**

2.10.1. General Requirements

2.10.1.1. The Engineer reserves the right to limit the purchase of fire hydrants from manufacturers and to the models specified, as shown on Table 15, provided such fire hydrants conform to the provision contained herein.

2.10.1.2. Each hydrant shall be designed for a minimum working pressure of 200 psig.

2.10.1.3. All parts of the hydrant shall 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:

2.10.1.3.1. 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.

2.10.1.3.2. With the main valve closed, the hydrant inlet capped, and the test pressure applied at the hydrant inlet.

2.10.1.3.3. The design safety factor of the operating mechanism shall not be less than 5 and shall be based on the foot-pounds of torque required for the closing and opening of the hydrant at a working pressure of 200 psig. Hydrants shall be functional and capable of being opened or closed without difficulty following an application of an operating torque of 200 lbf-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-foot bury or less.

2.10.1.4. The length of bury shall be as specified.

2.10.1.5. The fire hydrant shall have 2 hose nozzles and 1 pumper nozzle.

2.10.1.6. The nominal inside diameter of the hose nozzle shall be 2 ½ inches.

2.10.1.7. The nominal inside diameter for the pumper nozzle shall be 4 inches.

2.10.1.8. The outlet-nozzle threads are to conform to the National Fire Protection Association (NFPA) 2003, Standard for Fire Hose Connections.

2.10.1.9. The nominal diameter of the main valve opening shall be 5 ¼ inches.

2.10.1.10. The hydrant shoe shall be provided with a 6 inches mechanical joint connection to fit the connecting pipe.

2.10.1.11. The fire hydrant shall open on left turn (counter-clockwise).

2.10.1.12. The color of the finish paint above the ground line shall be red.

2.10.1.13. The fire hydrant shall have a non-rising stem.

2.10.1.14. No more than one 6" stem extension shall be provided if required to make the base of the fire hydrant grade level.

2.10.1.15. The bonnet section shall be designed so all bearing surfaces and stem threads are sealed in a lubricant reservoir. If oil is used as a lubricant, the reservoir shall be designed to allow for easy filling through a fitting or plug. Where grease is used as a lubricant, the reservoir will be sealed. The reservoir will be adequately sealed with "O" rings or other suitable sealing system approved by the Engineer.

2.10.1.16. The fire hydrant shall have a safety flange or breakaway flange at the ground line as stipulated in Section 3.1 General Design of ANSI/AWWA C-502-05 or latest revision thereof.

2.10.1.17. Fire hydrant nozzle cap chains shall be required and shall be attached permanently to the fire hydrant as stipulated in Section 3.2 Detailed Design of ANSI/AWWA C-502-05 or latest revision thereof.

2.10.1.18. Parts that require lubrication and come into contact with water shall be lubricated with a non-toxic food grade lubricant that does not pose a health hazard to the public if consumed.

2.10.2. Workmanship

2.10.2.1. All foundry and machine work shall be performed in accordance with good standard practice for the class of work involved and in conformance with accepted drawings, if required. When assembled, hydrants manufactured in accordance with this specification shall be well fitted and shall operate smoothly. The body and shaft shall be watertight.

2.10.2.2. All parts shall conform to the required dimensions and shall be free from defects that could prevent proper functioning of the hydrant.

2.10.2.3. All castings shall be clean and sound without defects that will weaken their structure or impair their service.

2.10.3. Paint

2.10.3.1. The exterior surface of the hydrant shall be coated with a coating that shall meet or exceed the requirements of Federal Specification TT-C-494b. A second coat of water based or oil based enamel paint aluminum in color will then be applied from the top of the hydrant to a point 18 to 20 inches below the center line of the pumper nozzle or down to the traffic safety flange connection at the ground line.

2.10.3.2. All interior surfaces, machined surfaces, such as the threaded portion of the stem or stem nut, which must fit closely with the adjacent parts, shall be coated with a coating that shall meet or exceed Federal Specification TT-C-494b. Stem surfaces contained within a lubricant reservoir and not in contact with potable water may be free of coating.

2.10.3.3. The interior and exterior of the hydrant shoe shall be coated with a fusion-bonded epoxy having a nominal dry film thickness of 8 mils, conforming to ANSI/AWWA C-550-05, and certified to NSF 61.

2.10.3.4. Coating shall be as close to holiday free as is technologically possible.

2.10.4. Testing and Inspection

2.10.4.1. Each assembled hydrant shall be subjected to two shop tests under a hydrostatic pressure of 400 psig or twice the rated working pressure, whichever is greater. One test shall be made with the entire interior of the hydrant under pressure and another test made with the main valve closed and the base under pressure from the inlet side. Under the test procedure, there shall 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 shall not exceed 5 fl oz/min. Other leakage or other imperfections found in either test shall be corrected or the hydrant retested. The tests shall be conducted for a sufficient time to allow a check of all points of possible leakage and for a minimum of 30 seconds after all air has been exhausted.

2.10.4.2. Each assembled hydrant shall be operated through a full open-close cycle when not under pressure. The torque required for performing this operation shall not exceed 200 lbf-ft.

2.10.4.3. All fire hydrant tests and inspections shall conform to 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.

2.10.4.4. The manufacturer shall provide an Affidavit of Compliance conforming to Section 1.7 Affidavit of Compliance of ANSI/AWWA C-502-05 or latest revision thereof.

2.10.5. Quality Assurance

2.10.5.1. Manufacturers shall have an ASME or I.S.O. 9001 registered commercial quality system. Noncompliance to this registered commercial quality system requirement will result in removal of the manufacturer's product from the approved manufacturer's list shown in Table 15 of this specification. Fire hydrants, found to be noncompliant, shall be replaced, by the Contractor, with a fire hydrant that meets this specification, according to the hydrant size, at no cost to the Department or Owner.

APPROVED FIRE HYDRANT MAINTENANCE KITS

The Water System Utility Owner will attempt to use fire hydrant maintenance kits in the approved hydrants. Table 16 of this specification provides the product model numbers.

2.10.6. References

2.10.6.1. American National Standards Institute and American Water Works Association Standard C-502-05 (ANSI/AWWA C-502-05).

2.10.6.2. American National Standards Institute and American Water Works Association Standard C-550-05 (ANSI/AWWA C-550-05).

APPROVED MANUFACTURERS

The manufacturers listed in Table 15 are approved.

Table 15	
Manufacturer	**Model**
American Darling	B84B 5-1/4" (w / metal weather cap)
Clow Valve Company	Medallion
Kennedy Valve Company	Guardian
M & H Valve Company	Reliant Model 929
Mueller Company	Super Centurion 250
United States Pipe and Foundry, Inc.	Metropolitan
Waterous	Pacer 100
American AVK Company	Model 2780

The fire hydrant maintenance kits listed are the reference product model numbers.

Table 16	
Manufacturer	**Model**
American Darling	B84B 5-1/4" (w / metal weather cap)
Clow Valve Company	Medallion
Kennedy Valve Company	Guardian
M & H Valve Company	Reliant Model 929
Mueller Company	Super Centurion 250
United States Pipe and Foundry, Inc.	Metropolitan
Waterous	Pacer 100
American AVK Company	Model 2780 Dry

2.11. **Polyethylene Wrapping Material.**

2.11.1. Polyethylene wrapping material is to be used to encapsulate all ductile and cast-iron pipe.

Polyethylene wrapping for ductile and cast iron water mains is to 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.

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 17 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 a minimum of 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 will have a nominal thickness of 4 mils, with tolerances of minus ten percent.

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 D1922).

Dielectric: The film is to have a dielectric strength of 800 volts per mil thickness per ASTM D-149.

Marking Requirements

The polyethylene film supplied shall be clearly marked, at a minimum of every 2-ft along its length, containing the following information.

- Manufacturer's name or trademark
- Year of manufacture
- ANSI/AWWA C-105/A21.5
- Minimum film thickness and material type.
- Applicable range of nominal pipe diameter size(s).
- Warning-Corrosion Protection-Repair any Damage.

The Engineer 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 17	
4 MIL POLYETHYLENE WRAPPING MATERIALS	
SIZE & LENGTH (All sizes lay flat size)	
Pipe Size	**Product Size Width 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

APPROVED MANUFACTURER AND PRODUCTS LIST

Table 18	
Manufacturer	**Product**
Van Leer Flexibles Inc.	Valeron
Manufactured Plastics and Distribution Inc.	Cross Tuff 450 Black

2.12. **Mechanical Couplings.**

Mechanical coupling of Dresser or similar type is to be used to connect plain ends of concrete steel cylinder pipe and plain ends of steel and ductile-iron pipe and to connect new and existing ductile iron water main in conjunction with casing installation in accordance with the details shown on the plans.

The mechanical coupling is to consist of a cylindrical steel middle ring, two (2) steel follower rings, two (2) rubber compound gaskets and a set of steel bolts. The middle ring is to be 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.

The flexible and transition couplings are to be manufactured to fit the type size and class of pipe specified. Bolts are to be high strength low alloy steel meeting the requirements of AWWA Standard C-111.

2.13. **Air Release Assemblies.**

2.13.1. Valve body and cover is to be cast iron fabricated in accordance with ASTM A-48-35 or ASTM A-126 Class B. Non-metallic Valve Body shall be fabricated from fiberglass reinforced nylon. Inlet sizes through 2-in. are to be screwed (National Pipe Taper Thread, NPT).Pipe sizes above 3-in.and above are to have flanged inlets (125 pounds ANSI B16.1). A protective hood or cowl is to be installed on the outlet of flange-bodied valves.

Internal seat trim float arm and pivot pin is to be stainless steel Type 303 or 304 or 316. Floats are to be stainless steel ASTM A-240. Other internal parts are to be stainless steel ASTM A-240 or ASTM A-276.

Non-metallic floats shall be foamed polyethylene with stainless steel type 316 fasteners.

Internal seat or orifice button is to be of Buna-N rubber compounded for water service. Cover gasket is to be composition-type, equal to Armstrong CS-231, Garlock 3000, or Lexide NK-511. Cover bolts are to be alloy steel. Rolling seals shall be furnished for non-metallic valves 2" and below.

Valve body is to have a test pressure rating of 300 psi and working pressure rating of 150 psi.

The air release valve is to be designed to vent accumulated air automatically. The outlet orifice is to be properly sized to facilitate valve operation at pressures up to 150 psi. The air release valve is to be either simple lever or compound lever, depending upon venting volume requirements.

The air and vacuum valve is to be designed with the inlet and outlet of equal cross-sectional area. The valve is to be capable of 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 during the draining cycle. The float is to be guided to minimize premature closure by air and to provide proper alignment for normal closure by floating on the water surface.

Combination valves are to provide for both automatic air release under system pressure and to allow air movement during filling or draining operations. The combination valve may be housed in a single casting. The housing is to be designed to incorporate conventional or kinetic flow principles to properly vent the air without premature closure. Flanged sizes (4-in. and larger) may be furnished in a dual housing. When dual castings are used, a bronze manual isolation valve is to be installed. This will allow the air release valve to be serviced when the system is under pressure.

The Engineer 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 failures to meet the quality standard herein will be grounds for rejecting the entire order.

The following qualified products list identifies specific manufactured items by catalog number that are approved.

Approved Manufacturers and Models:

2.13.2. Air Release Valves (Inlet x Orifice)

Manufacture	1" NPT x 3/16"	2" NPT x 3/16"
Apco Valve Company	200A	200A
G.A. Industries, Inc. (Empire)	920	920
Multiplex Mfg. Co. (Crispin)	P1-10	PL-10A
Val-Matic Mfg. Co.	38	38
PowerSeal Corporation	5401-D	5401-E
ARI Flow Control	S-050 1T	D-040 2T

2.13.3. Air & Vacuum Valves (Inlet x Orifice)

Manufacture	2" NPT x 3/16"	4" flg. with cowl
Apco Valve Company	144	152
G.A. Industries, Inc. (Empire)	930	930-C
Multiplex Mfg. Co. (Crispin)	AL20	AL41
Val-Matic Mfg. Co.	102	104
PowerSeal Corporation	5402-B	5402-D
ARI Flow Control	SD-040 2T	K060 C-HF

2.13.4. Combination Air Valves (Inlet x Orifice)

Manufacture	1"NPT X 5/64"	2"NPT x 3/32"	4"flg. x 3/32 w/ cowl
Apco Valve Company	143C	145C	149C
G.A. Industries, Inc. (Empire)	945 (1" NPT)	945	960C
Multiplex Mfg. Co. (Crispin)	U10	UL20 (1/4")	UL41 (1/4")
Val-Matic Mfg. Co.	201C	202C	204C
PowerSeal Corporation	5403-A	5403-B	5403-D
ARI Flow Control	D-040 2T	D-040 D-060 C-HF	D-060 C-HF

2.14. **Blow-off Assemblies and Jumper Connections.**

The materials required for both permanent and temporary 2-in. and 4-in. blow-off assemblies and 4-in. jumper connections are shown on the plans.

2.15. **Backfill.**

2.15.1. Where services ¾" – 2" copper are installed, initial backfill shall be sand conforming to the following requirements: Natural sand or sand produced from crushed gravel or crushed rock maximum ¼-inch; 95 percent shall pass No. 4 sieve, free from clay and organic material, with a maximum 8 percent passing the No. 200 sieve. Larger services utilizing ductile iron pipe or PVC (C-900) pipe shall be backfilled the same as mains.

Bedding and Initial Backfill for Water Mains.

2.15.1.1. Well graded gravels or crushed stone meeting the following requirements:

Modified Grade 5 gravel:

Retained on ½" sieve	0%
Retained on 3/8" sieve	0 – 5 %
Retained on No. 4 sieve	20 - 80%
Retained on No 10 sieve	75 - 100 %
Retained on No 20 sieve	98 - 100%

The quantity and thickness of lifts and compaction of initial backfill materials is to be in accordance with subsection 3. D. 1 of this specification.

2.15.2. Secondary Backfill for Water Mains. Secondary Backfill shall consist of approved materials that are excavated from the trench and are free of brush, debris, large rock or stones and earth clods 6" or larger. Secondary backfill material shall be primarily composed of compactable soil materials.

2.16. **Asphalt.**

All asphaltic concrete used in the replacement of pavement over the trench line is to conform to Item 341, "Dense-Graded Hot-Mix Asphalt (QC/QA), Type "C", except when the use of 6-in. of asphalt treated base is directed., unless otherwise specified on the plans.

2.17. **Concrete.**

All concrete used as the trench cap and in sidewalks and blocking mains is to conform to Item 421, "Hydraulic Cement Concrete". Class "A" concrete is to be used in sidewalks and for blocking concrete steel cylinder mains; Class "D" concrete is to be used for the trench cap and for blocking all other types, unless otherwise specified on the plans.

2.18. **Reinforcing Steel.**

All bar reinforcement is to be Grades 40 or 60, conforming to the requirements of Item 440, "Reinforcing Steel".

2.19. **Affidavit of Compliance.**

Unless otherwise directed, the Contractor is to furnish a manufacturer's affidavit of compliance for each of the materials used in this project. The affidavit is to certify that factory inspection and all specified tests have been made and that the material furnished complies with the requirements outlined herein.

3. CONSTRUCTION METHODS

3.1. **Excavation.**

Excavation (trenching) as required to complete the water main installation is to be performed 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 shall 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 and/or Inspector's direction. In special cases, where trench flaring is required, the trench walls shall remain vertical to a depth of at least 1foot above the top of the pipe.

The trench bottom shall be square or slightly curved to the shape of the trenching machine cutters. The trench shall 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 shall be dug after the trench bottom has been graded and bedding installed. The pipe shall rest upon the new bedding material for its full length

Where over-excavation occurs, the under-cut trench shall be restored to grade at no cost to the Department and replaced with a material conforming to the requirements of the bedding material or a material approved by the Engineer.

The depth of cut indicated on cut sheets, as furnished by the engineer, is from the off-set or cut hub elevation to the invert.

3.1.2. Width of Trench.

Minimum Width of Trench. The minimum width of pipe trenches, measured at the crown of the pipe, shall be not less than 12 inches greater than the exterior diameter of the pipe, exclusive of bells. The minimum base width of such trench shall be not less than 12 inches greater than the exterior diameter of the pipe, exclusive of special structures or connections. Such minimum width shall 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 shall be the outside diameter of the pipe (exclusive of bells or collars) plus 24 inches. A trench wider than the outside diameter plus 24 inches 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 shall be submitted to the Engineer and approved in writing. Whenever such maximum allowable width of trench is exceeded, except as provided for on the drawings, or in the specifications, or by the written approval of the Engineer, the Contractor, at his expense, shall encase the pipe in concrete from trench wall to trench wall, or other pipe bedding material approved by the Engineer. Any excavation wider than this maximum width or subsequent Surface or Paving work, will be done at the Contractor's expense.

3.1.3. 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, "Excavation and Backfill for Structures".

3.1.4. 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 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 specified in Section 3.A.4., "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.A.6, "Unstable Conditions at Grade", at no cost to the Department.

3.1.6. 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 the a depth no less than 6-inches below pipe. Before the pipe is laid the grade is to be restored by backfilling with an approved material in layers of 3-in. prior to compaction. The layers are to be slightly moistened and thoroughly compacted so as 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.

3.1.7. Trench Excavation Protection.

All trench excavation required on this project is to be accomplished as required by the provisions of Item 402, “Trench Excavation Protection”.

3.1.8. 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 in order 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 Contractor is to make explorations and excavations for such purposes at his expense.

3.1.9. Protection and Restoration of Underground Structures and Facilities.

The Contractor is to 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 which are disturbed are to be restored by the Contractor at his expense. Materials and methods used for restoration are to be in accordance with the Local City Codes, of the local municipality, for Building, Electrical, and Plumbing and the requirements of the utility agency involved.

In the event that a sanitary sewer is broken by the Contractor's operations the release of sewage into the trench is to 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” is to be effectively stopped. The “tin-horn” is to remain in place until such time as permanent repairs can be made. It is to be the responsibility of the Contractor to determine sufficiently in advance of his trenching operations the size of all sanitary sewer lines and services which will require this treatment.

All sanitary sewer lines crossing the excavation, whether bridged or replaced, are to have proper support consisting of sound timber supports having a minimum 2-in. nominal thickness and a minimum 6-in. nominal width placed with the width horizontal and extending a minimum of 12-in. into the trench wall on either side.

In all cases where a sewer pipe is replaced or bridged, the backfill material is to be thoroughly compacted to the bottom of the pipe and compacted by hand from this point to a distance of 6-in. above the top of the sewer line being replaced.

The locations of all sewer lines crossing excavations, whether replaced or bridged are to be properly marked, and care is to be taken to avoid damage to the pipe through the use of a hydratamping machine or other mechanical equipment. The Contractor is to be liable for the failure of such lines due to negligence or poor workmanship.

3.1.10. Backfill Material Derived from Excavation.

3.1.10.1. All excavated materials which the Engineer determines are suitable for reuse as trench backfill is to be separated where practicable from the general excavation material, or as directed.

3.1.11. Trench Restoration

The surface of the backfilled trench shall be restored to match the previous existing conditions. This shall include final grading, placement of topsoil and seeding, placement of sod (such as at homes or businesses that had maintained lawns), or other unprepared and prepared surfaces. Trenches in alleys actively being used by vehicles (such as trash pickup, vehicle parking, etc.) shall be restored by grading and compacting to 98% or higher with a minimum of 4 inches of flex-base materials for the entire width of the alley. Alleys not actively used by vehicles shall be graded and compacted to 98% or higher, then spread grass seed for entire width of the alley.

3.1.12. 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 will minimize interference with the traveling public.

3.1.13. Fence.

Removing and replacing chain-link and/or wire fence as required. The existing fence materials may be reused unless, the existing materials were damaged during removal and should not be reused. The Contractor is to provide new material for the replacement work at his expense.

3.1.14. 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 prior to the replacement of concrete over the new trench alignment.

Transverse “dummy” 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.

3.1.15. Dewatering.

Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding areas.

3.1.15.1. The contractor shall 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.

3.1.15.2. 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.

3.1.15.3. Dewatering devices shall 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 shall order immediate shutdown, and remedial measures will be the responsibility of the Contractor.

3.1.15.4. Upon completion of the dewatering work, the Contractor shall remove all equipment and leave the construction area in a neat, clean, condition that is acceptable to the Engineer.

3.1.15.5. The Contractor shall maintain ground water table at least 12 inches below the finished excavation subgrade.

3.1.15.6. Dewatering Performances. Performances of the dewatering system for lowering ground water shall be measured by observation wells on piezometers installed in conjunction with the dewatering system, and these shall be documented at least daily. The Contractor shall maintain a log of these readings and submit them to the Engineer.

No direct payment shall be made for costs associated with dewatering. All costs in connection therewith shall be included in the applicable contract price for the item to which the work pertains.

3.2. **Pipe Laying.**

3.2.1. General Requirements.

All water mains shall be constructed in accordance with the specifications herein outlined and in conformity with the required lines, grades, and details shown on the plans and as directed by the Engineer. Successful passage of the pressure testing and disinfection, as described under TCEQ 30 TAC 290.44 Criteria, shall be required for the acceptance of the mains.

Water Main Crossings: Where water mains are constructed in the vicinity of sanitary sewer mains, sanitary sewer force mains, sanitary sewer manholes and other sanitary sewer facilities, including non-potable waters such as wastewater effluent used in “reuse” applications, the requirements of the TCEQ 30 TAC 290.44 (e) & (f) shall be met.

The Contractor is to start his work at a tie-in point, unless otherwise indicated on the plans. Pipe is to be laid with bell ends facing the direction of lying, unless otherwise authorized or directed. Under no circumstances is pipe to be laid in water and no pipe is to 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 is to be installed to the required lines and grades with fittings, valves, and hydrants placed at the required locations.

Spigots are to be centered in bells or collars, all valves and hydrant stems are to be set plumb, and fire hydrant nozzles are to face as shown on the plans or as directed. No valve or other control on the existing system is to be operated for any purpose by the Contractor unless approved.

The Contractor is to maintain a neat and orderly work area. Complete cleanup is to be maintained at all times as closely behind the pipe laying operations as possible, but in no case is such cleanup be permitted to lag more than 1,000-ft. behind the pipe laying, unless otherwise directed.

3.2.2. Crossing other Underground Lines.

New water mains crossing other utilities (not including sanitary sewer or ”reuse” facilities) are to have a minimum of 30-in. of cover over the top of the pipe unless otherwise waived or modified. Excavation around other utilities is to be done by hand for at least 12-in. all around. Any damage to the protective wrap on gas lines or electrodes is to be reported immediately to owner of the gas utility, contact information as shown in the plans. Any damage to other utilities shall be immediately reported to the utility owner.

3.2.3. Pipe Grade.

Water mains 16" or smaller shall have a minimum of 48 inches of cover from the proposed final finish ground/street elevation and 60 inches of cover when the main is installed in a parkway or under the pavement where there are no existing/proposed curb or existing drainage facilities. Water mains 20" and above shall have a minimum of 60 inches of cover over the top of the pipe from the proposed final finish ground/street elevation unless otherwise waived or modified by the Engineer.

Pipe grades are to be as required on the plans, or as directed. Grades are to be met as specified by Section 3.A, “Excavation”. Care is to be taken to insure that the pipe barrel has uniform contact with the bedding material for its full length except at couplings. The coupling is not to be in contact with the original trench bottom prior to backfill. Bedding material is to be placed under the coupling and compacted by hand prior to backfilling so as to provide an even bearing surface under the coupling and pipe. Change in grade is to be made only at joints.

3.2.4. Bedding and Bedding Materials.

Prior to placing pipe in a trench, the trench is to have been excavated to the proper depth as required in Section 3.A, “Excavation”. Approved materials are to be smoothly worked by hand across the entire width of the trench bottom to provide supporting bedding for the pipe.

Structures to Support Pipe: Where as the bottom of a trench at subgrade consist of material that is notably unstable by the Engineer and cannot be removed and replaced with approved material may be properly compacted in place to support the pipe. The Contractor shall also 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 done. Coordinate with Engineer for approval of extra compensation prior to beginning work.

3.2.5. Lowering Materials into Trench.

Proper implements, tools and facilities satisfactory to the Engineer are to be approved and used by the Contractor for the safe and convenient execution of work. All pipe, fittings, valves, and hydrants are to 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 main materials and protective coatings and lining. Under no circumstances are water main materials to be dropped or dumped into the trench. Take

care to avoid damaging polywrap films. Use of chains or slings is not allowed unless entire sling is wrapped with a protective nylon web sock.

3.2.6. Installing Pipe.

Every precaution is to be taken to prevent foreign material from entering the pipe while it is being placed in the line. Under adverse trench conditions, extended period of time and/or otherwise required by the Engineer, a manufactured cap/plug is to be used to prevent any foreign type material entering. Leave the cap/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 is to be centered on the pipe already in place, forced into place, brought to correct line and grade, completed in accordance with the requirements specified herein. The pipe is to be secured in place with approved backfill material tamped around it. Pipe and fittings which do not allow a sufficient and uniform space for joints will be rejected and are to be replaced with pipe and fittings of proper dimensions. Precautions are to be taken to prevent dirt or other foreign matter from entering the joint space.

At times when pipe laying is not in progress the open end of pipe in the trench is to be closed by a watertight plug or other means approved. Pipe in the trench which cannot temporarily be jointed is to be capped or plugged at each end to make it watertight. This provision is to apply during all periods when pipe laying is not in progress.

Should water enter the trench, the seal is to remain in place until the trench is completely dry. The Contractor is to provide plug & caps of various sizes required.

3.2.6.1. Steel Pipe: Steel pipe shall be installed as specified within "Water Main." The Contractor shall furnish all steel piping including fittings, couplings, specials, pipe supports, eyebolts, nuts, and accessories which are shown on the plans and as required for proper connection to existing piping. The Contractor's attention is directed to the fact that the exact location and elevation of existing piping must be determined in the field prior to fabrication of connecting piping.

All steel pipe and specials may be either mill pipe or fabricated pipe and, in either case, shall be fabricated to the sizes, dimensions and shapes as indicated on the plans and as shown on the plans. Unless otherwise indicated on the plans, all steel pipe, bends, or specials shall have an outside diameter minimum wall thickness and unit weights as shown on plans.

3.2.6.1.1. Ends of Sections: Ends of pipe sections, bends, and specials shall be beveled for field welding, unless shown otherwise on the plans.

3.2.6.1.2. Seams: All piping shall be made from steel plate rolled into cylinders or sections thereof, with not more than two longitudinal butt welds, or shall be spirally formed and butt welded. Girth seams shall be butt welded and not be closer than 6 feet apart except in specials and bends.

3.2.6.1.3. Length tolerance: Standard and special section shall be within 1/16 inch (plus or minus) of the specified or theoretical lengths.

3.2.6.1.4. Welded Joints: Except where ends are shown on the plans to be joined by mechanical couplings, all joints for steel pipe installed on a bridge structure and in open trench shall be welded.

Welders appointed to do welding on steel pipe shall be certified with 4F and 5G certification. All welds shall be sound, free from embedded scale and slag, shall have a tensile strength across the weld not less than that of the thinner of the connective sections, and be water tight. Use butt welds for all welded joints in line-pipe assemblies and in the fabrication of bends and other specials. Welds are subject to Pre-Manufacturing inspection and available to the Engineer by request.

Welding for field joints shall conform to the applicable requirements of the AWWA "Standard Specification for Field Welding of Steel Water Pipe Joints, C-206." Parties involved in the construction of main(s) shall pay special attention to the AWWA "Standard Specification for Field Welding of Steel Water Pipe Joints, C-206, Control of Temperature Stresses." After welding, the joints shall be prepared, primed and painted, or wrapped in accordance with this specification.

Repair leaks in welds by chipping our defective material and re-welding. Hammering is not permitted.

3.2.6.2. PVC (C-900 and C-905): Lay PVC mains to the depths and grades shown on 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.

All mains consisting of PVC (C-905) joint restraints shall be installed as specified in accordance with manufacturer's recommendations. Joint restraints shall be non-directional and installed as shown on the Joint Restraint Standard Detail Drawing or as shown on the plan drawings. The Contractor may be required to restrain additional joints depending on the size of main and at the direction of the Inspector or Engineer.

PVC (C-905) shall be field cut 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 accordance with Uni-Bell recommendations.

Tracer Wire: Tracer wire shall be utilized for location purposes and tapped to the pipe. Tracer wire shall be of solid core (14 gauge insulated), and shall be taped to the main in minimum 10 inch increments. The tracer wire shall also come up to the top of valve extensions and fire hydrant stems, as directed by the Inspector.

3.2.6.3. Ductile Iron Pipe: Excavations at Bells and Collars: Ductile Iron pipe shall be installed as specified within these specifications. Bell holes of sufficient size shall 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 shall be 6 inches in all directions. Subject to the above provisions, the length of excavation for bell holes below grade of the trench bottom shall be kept to a minimum.

Except as otherwise shown on the plans or as directed by the Engineer, anti-corrosion embedment shall be provided for all ductile iron pipe, fittings, and valves and at all valves, fittings, or outlets for nonferrous or reinforced concrete steel cylinder pipe. The embedding material shall conform to the requirements as set forth in Section 2.O.1.a Backfill.

The preparation of the trench shall be as set forth elsewhere in these specifications. After the subgrade has been prepared, the pipe shall be laid to grade in accordance with these specifications. The pipe, fitting, or valve shall be firmly embedded in and surrounded by an insulating blanket of the embedding material. The minimum thickness of this blanket shall be 6 inches in every direction.

Where ductile-iron pipe is to be installed in a bore, the pipe shall 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 shall then be applied to the pipe. Following the application of the prime coat, the pipe shall be wrapped with Scotchrap, Trantex V-10 polyvinyl tape, or an approved equal. The tape shall not be applied until the prime coat is completely dry.

The tape shall be spirally and tightly wrapped on each section of the pipe with a 50% lap. The wrap shall be made to the bell on the bell end and to a point 6 inches from the spigot end. The joint shall be protected with tape 6 inches in width on pipe 12" or less in size and with tape 8 inches in width on pipe greater than 12" in size.

Ductile-iron pipe to be installed in a trench shall be protected in the following manner. Each pipe joint shall be covered with a 4 mil thick polyethylene sleeve that is 2 feet longer than the pipe joint. The sleeve shall cover the full length of the pipe joint, lap over 1 foot 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 foot intervals. After assembling the joint, the polywrap tube from the previously installed pipe shall be pulled over the joint and secured by the Contractor. The polywrap tube from the new joint shall be pulled over the first tube and secured by the Contractor to provide a double seal.

Cast-iron and Ductile-iron fittings and valves shall be completely wrapped in 8 mil thick polyethylene film with a minimum of one 1 foot overlap on each end and appropriately taped. Laps shall cover joints with adjoining pipe joints or fittings when installed. Fire Hydrant barrel from the surface to the valve shall be wrapped as specified herein.

Any damaged areas in the polyethylene film shall be repaired by covering the area with a sheet of polyethylene film large enough to lap over the damaged area 1 foot minimum in any direction and appropriately taped. Extreme care shall be taken at service tap locations to insure that the tape extends beyond the corporation and onto the service line pipe 1 foot.

Prior to placing pipe in the trench, a cushion of approved materials shall be placed in the trench as required by in the trenching specifications contained herein. Backfill material shall be carefully placed on the pipe so as to avoid any damage to the polyethylene sleeve.

The Contractor shall use care to protect and reserve 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 feet of the service shall be wrapped and taped to achieve a complete seal. In addition, a sand envelope shall extend over and around the connection to a depth of eight inches above the main.

All bolts and nuts destined for underground service on valves, fire hydrants, cast-iron mechanical joint fittings, pipe joints, and other ferrous metal appurtenances shall be packed in an approved protective coating material after installation. After the joint has been made and bolts drawn to the proper tension, the joint including glands, flanges, bolt heads, and nuts shall be covered with an Engineer approved protective coating. Such protective coating shall be supplemental to anti-corrosive sand embedment as set forth elsewhere in these specifications. Coating and wrapping of joints will be considered incidental to the installation, and no separate payment will be made for this item. Asphaltic material such as Talcote, and other asphaltic type coatings, shall not be used.

All cuts made on ductile-iron pipe shall be done with a power saw or approved mechanical cutter. The cuts shall be made at right angles to the pipe axis and shall be smooth. The edges of the cut shall 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 angle of about 30 degrees.

3.2.7. Defective or Damaged Material.

Pipe and accessories are to be inspected for defects prior to being lowered into the trench. Any pipe section, fitting, or special which 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, etc.) will be rejected. The Contractor shall, at his expense, replace or recondition each rejected section. Reconditioning procedures must be acceptable to the Engineer. Any defective, damaged, or unsound material is to be repaired or replaced as directed.

Should a damaged piece of pipe furnished by the Contractor be placed in the water main, the Contractor is to furnish, at his expense, all labor and materials required for removing and replacing the defective pipe and restoring the street to its condition just prior to 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 is to be at the expense of the Contractor.

3.2.8. Holes at Bells and Collars.

Bell holes of sufficient size are to 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 is to be 6-in. in all directions. Bell holes for concrete steel cylinder pipe are to be of sufficient size to properly joint 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 is to be kept to a minimum.

3.2.9. Deviations in Line or Grade.

Wherever obstructions, not shown on the plans, are encountered during the progress of the work and such obstructions interfere to such an extent that an alteration on the plan is required, the Engineer is to 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 obstruction. Any deviation from the line is to be accomplished by the use of appropriate bends unless such requirements are specifically waived by the Inspector.

Whenever it is necessary to deflect pipe from a straight line the deflection is to be as directed. In no case are the amounts shown in Table 19, “Maximum Deflections of Ductile-Iron Pipe”, for ductile-iron pipe, and Table 20, “Maximum Defections of Concrete-Steel Cylinder Pipe”, for concrete pipe to be exceeded.

Table 19

Maximum Deflections of Ductile-Iron Pipe

Norm Pipe Dia	Max Joint Open	Max Defl Angle	Max Deflection in Inches with Pipe Length of:		Approx Rad of Curve in Ft Produced by Succession of Joints with Pipe Lgth of:	
(Inch)	(Inch)	Deg/Min	18ft	20ft	18ft	20ft
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 20

Maximum Deflections of Concrete-Steel Cylinder Pipe

Normal Pipe Diameter (Inches)	Maximum Deflection Angle Deg/Min	Maximum Deflection (Inches)		Approx Radius of Curve (Feet)	
		16' Lay Length	20' Lay Length	16' Lay Length	20' Lay Length
16	2/20	-	9.8	-	500
20	1/52	-	7.8	-	600
24	1/34	-	6.6	-	750
30	1/16	-	5.3	-	900
36	1/02	-	4.3	-	1100
42	0/54	-	3.8	-	1300
48	0/47	2.6	-	1170	-
54	0/44	2.5	-	1237	-
60	0/54	3.0	-	1024	-

3.2.10. Cutting Pipe.

The cutting of pipe for inserting valves, fittings or closure pieces is to be accomplished so as to produce a smooth end at right angles to the axis of the pipe. Strictly follow the recommendations of the pipe manufacturer. Under no circumstances is a workman not equipped with proper safety goggles and helmet and other required safety attire permitted to engage in this work.

Asbestos-Cement (AC): No field cutting will be allowed on asbestos-cement pipe. Repairs to AC pipe shall 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 are to be done with a torch or power saw. The cuts are to be made at right angles to the pipe axis and are to be smooth. The edges of the cut are to 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 angle of about 30°.

Field Cut PVC (C-900 and C-905) 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 accordance with Uni-Bell recommendations.

To facilitate future repair work on water mains, no sections less than 3 feet in length between fittings is allowed.

3.2.11. Coating and Wrapping Underground Pipe.

3.2.11.1. Steel Pipe.

Steel pipe, bends and special are to be prepared, primed, painted or wrapped in the field as follows.

3.2.11.1.1. Exterior Surface Above Ground: Exterior surfaces of new pipe and appurtenances installed are to be thoroughly cleaned to bare metal by high speed wire brushing, scraping or other suitable methods approved

by Engineer, given a single coat of industrial grade rust inhibitive primer and two finish coats of aluminum paint.

3.2.11.1.2. Exterior Surfaces Underground: Exterior surface of steel pipe, bends and specials installed in open trench are to be thoroughly cleaned to bare metal by high speed wire brushing, scraping or other suitable methods approved by Engineer, given a single coat rust inhibitive primer and wrapped with polyvinyl tape in accordance with AWWA C-203-91 “Protective Coatings for Steel Water Pipelines,” (Appendix C).

3.2.11.1.3. The procedure for coating flanged joints and mechanical coupling joints when used with steel pipe is to be as specified.”

3.2.11.1.4. Interior Surfaces: The interior surfaces of steel pipe, fittings and specials are to be cleaned by sandblasting and then primed and coated in the shop with coal tar enamel.

3.2.11.2. Ductile-Iron Pipe.

3.2.11.2.1. Open Trench: Ductile-iron pipe to be installed in a trench is to be protected in the following manner. Each pipe joint is to be covered with a 4 mil thick polyethylene sleeve that is 2-ft. longer than the pipe joint. The sleeve is to 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 2 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 is to be pulled over the joint and secured by the contractor. The polywrap tube from the new joint is to be pulled over the first tube and secured to provide a double seal.

Cast iron and ductile-iron fittings are to be completely wrapped in 8 mil thick polyethylene films with a minimum of 1-ft. overlap on each end and appropriately taped. Laps are to cover joints with adjoining pipe joints or fittings when installed. Fire hydrant barrel from the surface to the valve is to be wrapped as specified herein.

Any damaged areas in the polyethylene film are to 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 insure that tape extends beyond corporation and onto service line pipe 1 foot.

Prior to placing pipe in the trench, a cushion of approved materials is to be placed in the trench as required by Section 3.D., Backfill material is to be carefully placed on the pipe so as to avoid any damage to the polyethylene sleeve.

Use care to protect and preserve polyethylene wrap around ductile iron water mains when installing service corporations. The required method is to wrap pipe tape around pipe over 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 polywrap. All exposed pipe, the corporation and the first 3 feet of the service shall be wrapped and taped to achieve a complete seal. In addition, a sand envelop shall extend over and around the connection to a depth of eight inches above the main.

3.2.11.2.2. In Casing: Where ductile-iron pipe is installed in a bore, the pipe is to be to thoroughly clean down to the coal-tar enamel pipe coating by approved methods. Where damaged, a prime coat compatible to the polyvinyl tape to be used is to then be applied to the pipe. Following application of prime coat, wrap pipe with Scotchrap, trantex V-10 polyvinyl tape, or approved equal. Tape shall not be applied until prime coat is completely dry.

Tape is to be spirally and tightly wrapped on each section of pipe with 50% lap. Wrap shall be made to bell on bell end and to a point 6 inches from spigot end. Protect joint with tape 6 inches in width on pipe 12 inches or less in size and 8 inches on width on pipe greater than 12 inches in size.

3.2.12. 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 are to 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 are to be covered with an approved coating. Such protective coating is supplemental to anti-corrosive sand embedment. Asphaltic coatings such as Talcote, or other asphaltic type coatings, are not allowed. Coating and wrapping of joints is to be considered subsidiary to the installation and will not be paid for directly.

3.2.12.1. 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, shall be cleaned, primed, painted or wrapped as specified for the pipe adjacent to the weld.

3.2.13. Joint Assembly.

3.2.13.1. Rubber Ring Joints: The installation of pipe and the assembly of rubber ring joints for ductile-iron pipe, concrete-steel cylinder pipe and asbestos cement pipe, is to conform to 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 by means of suitable pushing or pulling devices.

3.2.13.2. Mechanical Couplings: The installation of mechanical couplings is to be assembled and installed according to the standards recommended by the manufacturer. Prior to the installation of the mechanical coupling, the pipe ends are to be cleaned by wire brush or other acceptable method to provide a smooth bearing surface for the rubber compression gasket. The pipe is to be marked to align the end of the coupling which will center it over the joint. After positioning, the nuts are to be drawn up finger tight. Uniform pressure on the gaskets is to be applied by tightening alternate bolts on the opposite side of the circle in incremental amounts. Final tensioning is to be accomplished with a torque wrench and in a manner similar to the tightening procedure. The coupling is to then be left undisturbed for 24 hours to allow the gaskets to “pack-in”. Final torque check is to then be made prior to coating and wrapping the joint. Table 21, Torque for Mechanical Couplings, sets forth the proper torque for various sized mechanical couplings and is included for the convenience of the Contractor.

3.2.13.3. Restrained Joints: Install restraint joints as shown on plans or as directed by the Engineer. Install in accordance with manufacturer’s recommendations.

Table 21
Torque for Mechanical Couplings

Coupling Size	Bolt Diameter	Torque
2” to 24”	5/8”	75 ft/lb
2” to 24”	3/4”	90 ft/lb
30” and 36” (1/4”x7” Middle Rings)	5/8”	65 ft/lb
30” thru 36” (3/8” & heavier Middle Rings)	5/8”	70 ft/lb
30” to 48”	3/4”	80 ft/lb
48” to 72”	3/4”	70 ft/lb

3.2.14. Gray Iron and Ductile Iron Fittings.

3.2.14.1. Fittings: Fittings 6-in. through 12-in. in size are to be either mechanical joint, push-on joint short body, or push-on joint compact body unless otherwise stated on the plans. Fittings shall be installed with the thrust blocking or joint restraint shown in standard drawing DD-839 series. Fittings 16-in. through 24-in. in size are to be mechanical joint type unless otherwise specified on the plans. Adaptors are to be used where necessary to provide a transition between asbestos-cement pipe and the fittings. Restraint or thrust blocking is to be provided as specified on the plans or as directed. Anti-corrosion embedment incidental to all installed cast-iron fittings shall be provided as specified in and no separate payment will be made for this embedment.

3.2.14.2. Cleaning Ductile Iron: All lumps, blisters, and excess coal-tar coating is to be removed from the ends of ductile-iron pipe fittings. The outside of the spigot and the inside of the bell is to be wire-brushed and wiped clean, dry, and free from oil and grease before the pipe is laid. The interior of the pipe is to be blown clean with compressed air or swabbed out clean and dry as directed. Immediately prior to placing any pipe in the trench the interior is to be cleaned by an approved brush or swab or with compressed air to remove all dirt and foreign materials. All pipe and fittings are to be inspected by the Contractor for defects while suspended above ground.

3.2.15. Corrosion Protection for Ferrous Pipe, Fittings, and Valves

Except as otherwise shown on plans or as direct, anticorrosion embedment is to be provided for all ductile-iron pipe, fittings, and valves and at all valve fittings or outlets for nonferrous or reinforced concrete steel cylinder pipe. The embedding material is to be Modified Grade 5 gravel washed sand which conforms to the requirements set forth in Section 2.O.

Prepare the trench in accordance with applicable provisions of Section 3.A. After subgrade has been prepared, lay pipe to grade in accordance with the plans and specifications. Pipe, fitting or valve are to be firmly embedded in and surrounded by an insulating blanket of embedding material. The minimum thickness of this blanket is to be 6 inches in every direction

3.2.16. Tie-in to Existing Mains.

The Contractor is to make all ties to existing mains shown on plans or as directed. Contractor is responsible for; shutdowns and isolation of existing main, coordinating with the Water System Utility Owner on site prior to cutting pipe for connection, dewatering the excavation, customer notification of shutdown, proper material and all other requirements as directed by the Engineer to provide completion in a safe and secure manner. Tie-ins are to be done during normal work hours, (8 am – 5 pm). During construction, planned shutdown and tie-in shall be coordinated through and approved by the Engineer. Planned shutdown and tie-in is to be accomplished at a time which will be at the least inconvenience to customers. No additional compensation will be provided for tie-ins accomplished after normal working hours. Tie-in to existing mains of asbestos cement (AC) pipe, the Contractor shall observe and comply with all federal, state and local laws, ordinances and regulations regarding the management of asbestos containing materials. At the minimum, work involving AC pipe should be overseen by a person who has received asbestos training and is familiar with the National Emissions Standards for Hazardous Air Pollutants (NESHAP). If greater than 260 linear feet of pipe is to be removed, written notification to the Texas Department of Health (TDH) 10 days prior commencing with the removal of AC pipe is required. At each location shown in the plans and/or identified by the Contractor to involve AC pipe, the Contractor will be required to coordinate with the Department's Evergreen Contractor for the removal of the necessary amount of AC pipe required to make the connection without creating any friable material. The Department's Evergreen Contractor will remove whole sections of AC pipe so that the Contractor can make the tie-in at the nearest joint. The Department's Evergreen Contractor will remove the AC pipe, store it in a secure Engineer approved location, and then dispose of it. Prior to requiring the services of the Department's Evergreen Contractor, the Contractor shall notify the Engineer and the Owner of the Utility of the work schedule a minimum of two weeks in advance of requiring such services in order not to delay the overall project. Delays or claims made by the Contractor, resulting

from the failure to provide advanced notification and schedule coordination with the Department's Evergreen Contractor, will not be a basis for additional compensation.

3.2.17. Abandonment of Old Mains and Valves.

The Contractor is to 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 occasioned by cutting or removal of outlets are to be blocked off by manually forcing cement grout or concrete into and around the openings in sufficient quantity to provide a permanent substantially watertight seal.

Valves abandoned in the execution of the work are to have the valve box and extension packed with sand to within 8-in. of the finished surface. The remaining 8-in. are to 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 are to be salvaged and returned to the Water System Company. Abandoning old mains and valves is to be considered subsidiary to the installation and will not be paid for directly.

3.2.18. Jacking, Boring, or Tunneling Pipe.

3.2.18.1. Jacking: Suitable pits or trenches shall 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 shall be securely sheeted and braced. Jacking operations shall in no way interfere with the operation of railroads, streets, highways or other facilities and shall not weaken or damage such facilities. Barricades and lights shall be furnished as directed by the Engineer to safeguard traffic and pedestrians.

The pipe to be jacked shall be set on guides to support the section of pipe being jacked and to direct it in the proper line and grade. Embankment material shall 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 ⅓ of the circumference of the pipe, shall conform to the contour and grade of the pipe. A clearance of not more than 2 inches may be provided for the upper half of the pipe.

The distance that the excavation shall extend beyond the end of the pipe shall depend on the character of the material, but it shall not exceed 2 feet in any case.

The pipe shall be jacked from downstream end. Permissible lateral or vertical variation in the final position of the pipe from line and grade will 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 shall be removed and replaced at the Contractor's expense. Jacking pits shall be backfilled immediately upon completion of jacking operations.

Excavation for "Boring" pits and installation of shoring shall be as outlined under "Jacking." Boring operations may include a pilot hole which shall be bored the entire length of crossing and shall 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 shall apply as specified under "Jacking."

3.2.18.2. 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 shall be as specified under "Jacking." The lining of the tunnel shall be of the material shown on the plans.

Access holes for grouting annular space shall be spaced a maximum of 10 feet.

3.2.18.3. Joints: Joints for pipe for "Jacking," "Boring," or "Tunneling," shall be as specified in "Water Mains", or as shown on the project plans or shop drawings as per pipe manufacturer's recommendation.

3.2.18.4. Grouting of Bores or Tunnels: Annular Space between casing pipe and limits of excavation (borehole) shall be pressure grouted, unless otherwise specified on the plans.

3.2.19. Cutting-in Valves.

The work involved in cutting a valve into an existing main is to consist of excavation and backfilling with approved selected material; hauling and disposition of surplus excavation and other materials; installation of the valve, valve box assembly, all pipe cut used to complete cut-in; reaction blocking; polyethylene wrapping where required.

3.2.20. Tapping Sleeves and Valves.

Size on size taps is not permitted. The work involved in the installation of a tapping sleeve and valve is to 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 feet of a joint or existing tap. The use of a shell type cutter shall be required with tapping sleeves and valves. Whenever working on potable or recycled water system, disinfect the shell cutter with bleach prior to start of work. The cutting edge is to be sharp and round. Inspector will reject defective cutters.

Air test tapping sleeves to 50 psi prior to tapping main line.

Place valve box in such a manner to prevent shock or stress from being transmitted to valve. Center valve box over valves operating nut with box cover flush with finished pavement surface or located at another level as directed by Engineer. Valve boxes located in street or other areas subject to vehicular traffic shall be provided with concrete collars as shown on plans. Form collars around such valve boxes and finish off neatly and in a workmanlike manner.

3.2.21. Cutting-in Tees.

The work involved in cutting in a tee is to consist of excavation, shut-down 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 accordance with this specification.

3.2.22. Pipe Joint Restraint System.

Pipe joint restraints shall be utilized 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 ductile iron mechanical joint (MJ) bell fitting. Joint restraint is to be non-directional and installed to fully restrain system.

3.2.23. 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 shown on the plans. The pipe is to be supported by pre-cast concrete blocks of the same strength as the concrete for encasement and securely tied down to prevent floatation. Encasement concrete is to be placed to a depth and width conforming to details and sections shown on the plans.

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 shall be constructed in accordance with details and sections shown on the plans. Strap/Tie Downs shall be No. 4 rebar diameter minimum or better as determined by the Engineer.

Concrete Saddles. When shown on the plans or when directed, pipe to receive concrete saddle is to be backfilled in accordance with Section 3.D. of this specification to the spring line and concrete placed for a depth and width conforming to details and sections shown on the plans.

Concrete Collars. When shown on the plans or when directed, concrete collars are to be constructed in accordance with details and sections shown on the plans.

3.3. **Fire Hydrants and Miscellaneous Appurtenances.**

3.3.1. Fire Hydrants.

Hydrants are to be connected to the main as shown on the plans or as directed by the Engineer. They are to be installed in a manner which will provide complete accessibility and in a sage location where there is a minimum possibility of damage from vehicles or injury to pedestrians.

When the hydrant is placed directly behind the curb, the hydrant barrel is to be set so that no portion of the hydrant will be less than 12 inches nor 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 is to be within 6-in. of the sidewalk. Setting final grade of fire hydrants to match proposed or existing field conditions is the responsibility of the contractor.

Hydrants are to be set in accordance with plans and details are to be set plumb and are to have their nozzles parallel with or at right angles to the curb with the pumper nozzle facing the curb. Drainage and concrete pad are to be provided at the base of the hydrant as shown on the plans. No fire hydrant drainage system or pit is to be connected to a storm sewer or to a sanitary sewer.

3.3.1.1. Restrained Joints: Restrained mechanical joints that require field welding or groove cuts into the pipe barrel for restrain will not be accepted. Restrained joints shall be furnished for pipe at all changes in direction at indicated on plans, details, or as directed. Restrained mechanical joints shall be locked mechanical joints. Joints shall be capable of test pressure twice the maximum sustained working pressure of 350 psi for ductile iron pipe and PVC.

3.3.1.2. Replacing and Relocating Existing Fire Hydrants: When existing fire hydrants are to be replaced or relocated, the work is to be accomplished by either of the following:

3.3.1.2.1. Cutting or installing a tee of the size and type indicated on plans or as directed.

3.3.1.2.2. Using a tapping sleeve and valve of the size and type indicated on plans to install a new fire hydrant to an existing or new water main. Size on size taps is not permitted.

3.3.1.2.3. 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.

3.3.1.3. Salvage the existing fire hydrant and other materials as designated in the field by the Inspector and deliver to Water System Utility Owner at a location determined by the Engineer. Fire hydrant branches are to be abandoned by cutting and capping fire hydrant cast iron tee at the service main and surface restored to its original condition.

3.3.1.4. 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 18-20 inches below center line of the pumper nozzle and apply to all exposed metal surfaces above the hydrant base flange. The payment for fire hydrant painting is to be included in the unit cost for installing the fire hydrant.

3.3.1.5. Pipe, fittings, and valves used in the placement of fire hydrants and connections to the main are to be considered subsidiary to the fire hydrant installation and not a part of the main construction and will not be paid for directly.

3.3.2. Valve Boxes, Adjustments.

Valves are to be provided with valve boxes, manholes, or valve pits as shown on the plans.

The valve box is to be placed in such a manner to prevent shock or stress from being transmitted to the valve. It is to be centered and set plumb over the operating nut of the valve with the box cover flush with the surface of the finished pavement or at such other level as may be directed. Valve boxes located in streets or other areas subjected to vehicular traffic are to be provided with concrete collars as shown on the plans. Collars around such valve boxes are to be formed and finished off neatly.

Valve box is to be located so that the valve operating nut is readily accessible for operation through the opening in the valve box. The valve box is to be set flush with the surface of the finished pavement or at such other elevations as may be specified. Pits are to be constructed to permit minor valve repairs and to afford protection to the valve and pipe from impact where they pass through the pit walls.

Existing valve boxes located within the limits of new street construction which are in conflict are to be adjusted to match proposed finish grades.

Valve boxes installed as part of a new valve and mainline construction project are considered “new valves.” Adjustments to “new valves” are incidental to the installation of the valve. No separate pay will be given to adjust “new valves” to finished grade.

3.3.3. Air Release Assembly.

Air release valves and appurtenant items are to be installed at the locations shown on the plans unless otherwise directed.

Install air release assemblies in open trench in accordance with plans and details. Assemblies include the valve, valve box, tapping saddle, pipe fittings, accessories and appurtenances. It also includes service line and tap to main. Air release assemblies installed in parkways or easements and outside of street pavement shall be installed in accordance with plans.

Air release assemblies installed on steel pipe attached to bridge structure includes the outlet on the steel pipe, valve, valve box, pipe fittings, security enclosure, accessories and appurtenances.

3.3.4. Blow-offs.

Permanent and temporary blow-off assemblies are to be installed at the locations shown on the plans or where otherwise directed. The permanent blowoff is to consist of all galvanized pipe, valve, and fittings of the various sizes detailed on the plans, 6-in. valve box assembly including the 6-in. valve box and concrete collar around the valve box where subjected to vehicular traffic. The temporary blowoff is to consist of all

galvanized pipe, valve, and fittings of the various sizes detailed on the plans. Valve box is to be raised on installed to finished grade in accordance with details.

3.3.5. Buried Gate and Butterfly Valves

Valve installation shall include; valve, reaction blocking when required conforming to plans, cast iron boot, valve box extension (Ductile Iron Riser Pipe), valve box, concrete collar where subjected to vehicular traffic, and valve box lid. Valves constructed in terrace shall be constructed with No. 3 bars all around.

The valve box shall be placed in such a manner to prevent shock or stress being transmitted to the valve. All valves located 6 feet and deeper shall 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 feet and 13 feet. Adjustable valve box and valve key extension systems shall 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 Engineer. Valve boxes located in streets or other area subject to vehicular traffic shall be provided with concrete collars as shown in plans. Collars around such valve boxes shall be formed and finished off neatly and in a workmanlike manner.

Valve pits shall be located so that the valve operating nut is readily accessible for operation through the opening in the valve box. The valve box shall be set flush with the finished pavement surface or at other finish elevations as may be specified. Pits shall be constructed in such a manner to permit minor valve repairs and provide protection to the valve and pipe from impact where penetrating through pit walls. In a High Pressure Distribution System as specified in this specification, all valves 6 inches and larger, shall be supported on a concrete pad in accordance with plans.

3.3.6. Anchorage and Blocking.

Suitable reaction blocking or anchorage is to be provided at all dead ends, plugs, caps, tees, crosses, valves and bends as shown on the plans. All mechanical restraints are to be bidirectional. Anchor blocks are to 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 utilized in conjunction with blocking when shown on the plans or as directed.

Thrust blocking is to be a minimum of Class "A" (3,000 psi), concrete placed between solid ground and the fitting except as otherwise shown on the plans. The area of bearing in contact with solid ground is to be that shown on the plans or as directed.

All thrust blocking placed in conjunction with mains and appurtenances constructed in accordance with standard details provided in the construction drawings. In all cases, the design of thrust blocking shall be of sufficient size to withstand a soil pressure of 3000 psf, unless specified otherwise in the job plans or specifications. The maximum soil pressure value that will be allowed for the design of thrust blocking shall be 5000 psf. When soil pressure bearing values of 4000 psf or 5000 psf are recorded for design of thrust blocks, copies of soil tests made for determining the bearing value of the soil is question shall be submitted to the Engineer for verification.

The blocking is to be placed so that pipe and fitting joints will be accessible. Pipe polywrap is to be placed between the pipe or fitting and the concrete.

The reaction block on the unused branch of a tee is to be poured separately from the block across the back of the tee. If they are poured simultaneously, a rigid partition is to be placed between the blocks.

Valves 12-in. and larger in size are to 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.

3.4. **Backfill.**

3.4.1. Initial Backfill.

Initial backfill is defined as backfill having a thickness in its compacted state from the surface of the bedding to a point 1 foot above the top of pipe. The first lift of initial backfill is to be inspected and approved prior to placement of the second lift. The second lift of initial backfill material is to extend from the spring line of the pipe with a minimum of one foot above the top of the pipe. The second lift is to be evenly spread in a similar manner as the first lift.

For diameters 24 inches and larger, simultaneously spread initial backfill material alongside, under the lower quadrant of pipe and over the pipe in 12 inch lifts to a point sufficient to a minimum of 1 foot above the top of pipe.

Consolidate initial backfill material to assure it is incorporated. A handheld vibrator, commonly used for concrete work, can be used for this purpose. The vibrator shall be inserted every 3 feet on each side of pipe.

3.4.2. Secondary Backfill.

Secondary backfill is defined as backfill from 1 foot above the top of pipe to the top if the trench. Secondary back fill is to be constructed in accordance with details shown on plans and these specifications.

Secondary backfill material shall be placed in maximum 12 inch loose lifts or as directed.

3.4.3. Sand Backfilling of Cross Trenches and Open Holes.

Blow-offs, tie-ins, air release valves, and service lines, meter boxes, or other specials are to 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 is to be considered subsidiary to trenching and backfilling and will not be paid for directly.

3.4.4. Trench Backfill Across Traffic Arteries.

Any trench in or across traffic arteries is to be backfilled immediately after the pipe is installed unless the Engineer determines unusual conditions exist that render immediate backfilling unfeasible.

3.4.5. Flowable Backfill.

Instead of normal backfill materials, the Contractor is to backfill the trench with flowable backfill with fly ash material at the locations shown on the plans and/or at locations directed. The flowable backfill material and operation is to be in accordance with Item 401, “Flowable Backfill”.

3.5. **Flushing and Testing Mains.**

3.5.1. Flushing.

Immediately upon completion of pipe lying, the Contractor is to flush all mains. This flushing is to be at the direction of the Engineer and is to 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 is to continue until the Engineer determines all dust, debris, or foreign matter that may have entered during pipe laying operations has been flushed out. The new line is to then be left under system pressure for testing.

To avoid damage to pavement and inconvenience to the public, fire hoses are to be used to direct flushing water from the main into suitable drainage channels or sewers.

3.5.2. Operation of Valves.

No valve in the distribution system is to be operated by the Contractor without prior permission. The Contractor is to notify the utility owner when a valve is to be operated and is to only operate the valve in the presence of the Engineer's representative.

3.5.3. Hydrostatic Tests.

Except in high pressure sections of the water distribution system where test pressures will exceed 150 psi, all new mains are to be hydrostatically field tested at a maximum test pressure of 150 psi before approval by Engineer. Where designated as "high pressure area," all new mains shall be hydrostatically field tested at a maximum test pressure of 200 psi before acceptance by the Engineer. All joints which are found to leak either by observation or during any test are to be made watertight by the Contractor. In case repairs are required, the hydrostatic field test is to be repeated until the pipe installation conforms to the specified requirements and is acceptable. The expense for tests which meet specified requirements is to be made in accordance with the unit price for the hydrostatic pressure test. No payment is to be made for tests which fail to meet specified test leakage requirements.

After the new main has been laid and backfilled as specified, but prior to chlorination and replacement of pavement, it is to be filled with water for a minimum of 24 hours and then subjected to a hydrostatic pressure test. The specified test pressure is to 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 are to be furnished by the Contractor. Unless otherwise specified, the Water System Company will furnish water for filling lines and making tests through existing mains.

Before applying the specified test pressure, all air is to be expelled from the main. To accomplish this, taps are to be made, if necessary, at the points of highest elevation and afterwards tightly plugged at no cost to the Department or the Water System Utility Owner. At intervals during the test, the entire route of the new main is to be inspected to locate any leaks or breaks. If any are found, they are to be stopped or repaired. The test is to be repeated until satisfactory results are obtained.

The hydrostatic test is to be made so that the maximum pressure at the lowest point does not exceed the specified test pressure. The duration of each pressure test is to be a minimum of 4 hours for new mains in excess of 1,000-ft. and a minimum of 1 hour for new mains less than 1,000-ft after the main has been brought up to test pressure. The test pressure is to be measured by means of a tested and properly calibrated pressure gauge acceptable to Engineer. All pressure tests are to 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 listed in Table 22 or 23, Hydrostatic Test Leakage Allowances, the Contractor is to, 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 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 is to notify the Engineer prior to beginning the test, and the Water System Company's Inspector is to be present during the pressure test.

PVC pipe leakage allowances shall conform to DI leakage allowances listed on Tables 22 and 23, Hydrostatic Test Leakage Allowances.

Table 22														
Hydrostatic Test Leakage Allowance (Maximum) @ 150 psi														
Pipe	**100**	**200**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**2000**	**3000**	**4000**	**5000**
6"DI*	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*	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*	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*	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*	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*	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*	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	27.05
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*	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*	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
Table 22														
Hydrostatic Test Leakage Allowance (Maximum) @ 150 psi														
Pipe	**100**	**200**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**2000**	**3000**	**4000**	**5000**
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*	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					
60"CSC	0.24	0.48	0.72	0.96	1.20	1.44	1.68	1.92	2.16					

* DI Pipe includes mechanical and push-on joints.

** GPH for CSC Pipe are manufacturer's maximum.

Note: Leakage allowances may be determined for footages not specifically listed by interpolation and/or by the combination of various tabular data.

Table 23										
Hydrostatic Test Leakage Allowances (Maximum) @ 200 psi										
Nom	Allowable Leakage in Gallons Per Hour (GPH) **									
Dia-Ty	Pipe Length in Feet									
Pipe	100	200	300	400	500	600	700	800	900	1000
6"DI*	0.13	0.25	0.38	0.51	0.64	0.76	0.89	1.02	1.14	1.27
8"DI*	0.17	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70
12"DI*	0.26	0.51	0.77	1.02	1.28	1.53	1.79	2.04	2.3	2.55
16"DI*	0.34	0.68	1.02	1.36	1.7	2.04	2.38	2.72	3.06	3.40
20"DI*	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	0.4	0.47	0.55	0.63	0.71	0.79
24"DI*	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*	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*	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*	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	0.5	0.66	0.83	1.00	1.16	1.33	1.49	1.66
48"DI*	1.02	2.04	3.06	4.08	5.1	6.11	7.13	8.15	9.17	10.19
48"CSC	0.19	0.38	0.7	0.76	0.95	1.13	1.32	1.51	1.7	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

* DI Pipe includes mechanical and push-on joints.

** GPH for CSC Pipe are manufacturer's maximum.

Note: Leakage allowances may be determined for footages not specifically listed by interpolation and/or by the combination of various tabular data.

3.6. **Disinfection of New Mains Utilizing Machine Chlorination.**

After the new mains have successfully passed the pressure test specified herein, Section 3.E.3, "Hydrostatic Tests" the Contractor shall disinfect mains as shown on the plans or otherwise directed as "Machine Chlorination". This disinfection is to include chlorination, flushing, and placing the mains in service. All other disinfection requirements shall also be accomplished by the Contractor.

3.6.1. Operation of Valves.

During and after the disinfection of mains, the Contractor will be notified by the Engineer sufficiently in advance 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.

3.6.2. Contractor's Personnel and Equipment.

The Contractor is to supply labor and equipment necessary to make all excavations required for chlorination, equipment connections, subsequent flushing, and placing the mains in service.

3.6.3. Safeguarding and Backfilling Open Holes.

The Contractor is to be responsible for safeguarding any open holes excavated or left open for flushing and disinfection purposes. Following completion of disinfection, the Contractor is to backfill such holes in accordance with appropriate provisions of Section 3.D, “Backfill”.

3.6.4. Disinfection of Mains Utilizing Dry Calcium Hypochlorite.

Mains are to be disinfected with dry calcium hypochlorite (HTH) where shown on the plans or as directed and shall not exceed a total length of 800 feet. This method will also be followed for main repairs. Contractor shall utilize appropriate safety measures to protect personnel during disinfection operation.

3.6.5. Dosage.

The Contractor is to disinfect the new or replaced mains with calcium hypochlorite (HTH) of 70 percent available chlorine. Sufficient calcium hypochlorite (HTH) is to be used to obtain a minimum chlorine concentration of 50 ppm. The following Table 24, Chlorine Dosage, is included for the convenience of the Contractor:

Table 24
Chlorine Dosage

Diameter of Pipe Inches	Ounces Per Foot To Obtain 50 ppm Chlorine Dosage
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 ounce, and a standard measuring cup holds approximately 8 ounces.

3.6.6. Filling the Main.

Those sections of main to which dry calcium hypochlorite (HTH) has been applied is to be filled slowly to allow for the even distribution of the disinfecting material. The manipulation of valves is to be under the direction of the Engineer in accordance with Section 3.F.1, “Operation of Valves”.

3.6.7. Holding Time.

The length of time that sections of main disinfected with calcium hypochlorite (HTH) is to be allowed to stand undisturbed will depend upon the particular job and Texas Commission on Environmental Quality (TCEQ) criteria.

When circumstances permit a shutdown with no customers out of service, the required minimum detention time will be 24 hours 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 hours and the chlorine dosage will be 300 ppm.

When customers are out of service during a shutdown with some leakage past valves, the required minimum detention time will be 30 minutes with a 500 ppm chlorine dosage.

3.6.8. Flushing.

Following the expiration of the specified holding time, the treated section of main is to be flushed thoroughly by the Contractor in accordance with the applicable provisions of Section 3.E, “Flushing and Testing Mains”. Flushing is to 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 in order to minimize erosion or impact to residents.

3.6.9. Preventing Reverse Flow.

Valves are to 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.

3.6.10. Supervision.

All disinfection is to be done as directed by the Engineer.

3.6.11. Additional Treatment.

Should the new main fail to meet minimum public health standards for bacteriological quality after flushing, further treatment is to be as directed. If further disinfection is required, chlorination is to be done in accordance with Section 3.F, “Disinfection of New Mains Utilizing Machine Chlorination”. In no case, however, is the new line to be acceptable as complete and satisfactory until the bacteriological quality of the water taken from the main meets the Standards of the TCEQ.

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.

3.6.12. Safeguarding and Backfilling Open Holes.

The requirements for safeguarding and backfilling all holes excavated or left open for chlorinating and sampling is to be as specified in Section 3.F.3, “Safeguarding and Backfilling Open Holes”.

3.7. **Service Supply Lines.**

Service supply lines and fittings, meter boxes and appurtenances shall conform to material specifications and shall be installed by the contractor as specified herein, or as directed by the engineer and in accordance with plans.

3.7.1. 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 Customers lot or property is

designated as “Customer’s yard piping”. Services 2” and smaller are designated “small services”; services 4” and larger are designated “large services”.

3.7.2. Service Relays: New transfer main(s) to which services are to be relayed and are on the same side of the streets as the Customer’s meter are defined as “short relays”. New transfer main(s) to which services are to be relayed and are on the opposite side of the street from the Customer’s meter are defined as “long relays”.

Service Reconnects: New transfer main(s) to which services are to 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 to the new main shall be defined as a “long relay”.

3.7.3. Service Relocates: Service Relocates are defined as services that are relocated from an alley to a side or front street. New transfer main(s) to which services are to be relocated and are on the same side of the street as the Customer’s new meter box location, are designated as “short relocates”. New transfer main(s) to which services are to be relocated and are on the opposite side of the street from the Customer’s new meter box location, are designated as “long relocates”.

3.7.4. 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 shall be designated as "new services." New laid main(s) 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." New laid main(s) to which new services on the opposite side of the street from the Customer's new meter box location, are designated as "new long services."

3.7.5. New Un-metered Services: New Un-metered 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 un-metered 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 un-metered short services." Where the new main or the existing water main to which new un-metered 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 un-metered long service". New un-metered long services and new un-metered short services will not include "Customer's yard piping" and no meter will be set.

3.7.6. Tap Holes: Tap holes are defined as excavations at existing mains, which are required in association with replacements of water service lines by pulling, boring or jacking operations.

All backfill material shall be as specified for main and service line trench excavation.

For service lines and tap holes, payment for bedding, initial backfill and secondary backfill shall be included in the various sizes of each service placed.

3.7.7. Service Line Installation: Unless otherwise notified, service relays, service reconnects, service relocates and new services shall be installed as described herein, and in plans. Unless otherwise indicated, existing meter and meter box relocation shall be included in the service line installation.

All service line installation shall include a dielectric union to be installed within the meter box on the outlet side of the meter, as shown in plans.

Cutting, excavation, backfill and replacement of pavement shall be done as specified herein and in accordance with applicable sections of this specification and the contract documents. The minimum trench width for small service lines shall be 8 inches, while the minimum trench width for large service Lines shall be the nominal pipe diameter plus 16 inches, except when specified otherwise by the Engineer. For ¾” to 2” Service lines, minimum bury depth shall be 3 feet. For services greater than 2”, minimum depth of bury shall be 4 feet.

All service lines shall be installed in accordance with plans, and specifications.

The Contractor shall use precaution to protect and preserve the polyethylene wrap around Ductile-Iron (DI) water mains when installing service corporations. The required method is, wrap pipe tape around the pipe, over the polywrap, in the area to be tapped. The tap shall be made through the tape and polywrap. It is not necessary to remove and replace polywrap. All exposed pipe, corporation and the first three feet of the service, shall be wrapped and taped to achieve a complete seal. In addition, a sand envelope shall extend over and around the connection to a depth of 8 inches above the main.

Small service lines shall be embedded in sand in accordance with specification

Where approved by the Inspector, the Contractor may lay the new service line from the corporation stop to the curb stop or angle valve. Upon completion, the Contractor shall isolate the new service line by closing the curb stop or angle valve until the meter box is set.

3.7.8. Splicing: A long service line single splice may be permitted by means of a 3-part compression or flared coupling only when approved in advance by the Engineer, provided the location of the splice is not under pavement or concrete. The segment added is required to be the same material as the existing service line, unless otherwise directed by the Engineer. Splicing short service lines will not be permitted.

3.7.9. Boring or Jacking Service Lines: Service lines which 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 shall not extend more than one additional foot into the traffic side of the street.

3.7.10. Tapping Asbestos Cement (AC) Water Mains: All necessary service line tapping of AC pipe shall be completed during the period immediately before or after hydrostatic pressure testing operations so that subsequent flushing will maximize the elimination of contaminants associated with the tapping process.

Tapping of AC pipe must be done in accordance with manufacturers' recommendation and done only with tap machine having a built in flush valve and the flush valve must be open during the entire procedure.

3.7.11. Abandonment of Service Lines: The Contractor shall accomplish all cutting, capping, and plugging necessary to isolate new service lines transferred to new and existing mains from those abandoned, including service lines designated on the plans as "tap plug" and "tap kill." The corporation stop for an abandoned service line tapped on a ferrous main shall be removed, and the tap at the main shall be plugged with an appropriately sized brass plug. For a non-ferrous main, the corporation stop shall not be removed from the main. Instead, the corporation stop shall be closed and the flared nut shall 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 shall salvage copper service line tubing, brass fittings, and other materials as directed by the Inspector and return them to the Owner.

3.7.12. Tapping PVC (C-900): Tapping of PVC must be done in accordance 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 which will retain the coupon.

The shell cutters must be designed for C-900 pipe, thus having sufficient root depth to handle the heavier walled pipe.

3.7.13. Small Service Lines: Copper tubing shall be used for ¾" through 2" service lines. Brass fittings for ¾" and 1" service lines shall be of the flared or compression type for the use with Type 'K' soft annealed copper tubing. Brass fittings for 1½" and 2" lines shall be of the flared or compression type for use with type 'K' soft annealed copper tubing, except as modified by this specification.

Copper tubing shall be cut squarely by using an approved cutting tool and by avoiding excessive pressure on the cutting wheels which might bend or flatten the pipe walls. Following the copper tubing cut, but before flaring, a reamer shall be used to remove the inside rolled lip from the tubing. Flared ends shall be expanded

by the use of a flaring tool using care to avoid splitting, crimping, or overstressing the metal. Pipe adjacent to the fittings shall be straight for at least 10 inches. Bending of tubing shall be accomplished by using an appropriate sized bending tool. No kinks, dents, flats, or crimps will be permitted, and should such occur, the damaged section shall be cut out and replaced. When compression fittings are used, the copper tubing shall be cut squarely prior to insertion into the fitting Final assembly shall be in accordance with the manufacturers recommendations.

3.7.14. Small Service Lines on New Mains: Installation of new copper service lines shall consist of all excavation through miscellaneous material encountered; trench excavation protection; drilling and tapping the new main with 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, herein; 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; cutting and replacing pavements, curbing and sidewalks of all types over the limits of the main line trench and the completed service line trench.

3.7.15. Reconnecting Service Lines: Both old and new water mains at existing service line connections as shown on the plans shall be exposed. The old main shall be exposed for the purpose of gaining access to the existing service corporation stop and the new main for the purpose of installing the new corporation stop. The new main shall be exposed for the purpose of being drilled and tapped with an approved tapping machine, a new corporation stop installed under pressure, and the trench extended laterally to expose a sufficient 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 shall "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 shall then immediately open the stop and restore water service to the Customer. Where it is not possible to obtain sufficient length in the existing service to tie directly to the new main, at the direction of the Engineer, the Contractor shall splice the necessary length of new tubing and tie it to the existing service by means of 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 shall be as specified in this specification.

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.

3.7.16. Relaying Service Lines: The existing or new mains shown on plans shall be exposed opposite location stakes placed on site at the direction of the Engineer. The existing or new main shall; be drilled and tapped with 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 shall be reset and the meter box and base shall be installed at its staked location and perpendicular to the corporation stop in the water main. The meter box location shall not vary more than 24 inches in any direction from its staked location. The service line shall be installed with sufficient slack to compensate for soil movement. Where the location of the existing meter is not changed, the new service line shall be extended from the main to the existing meter, a 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 shall be reset to correct grade. Long service relays may be placed under the street pavement by boring or jacking rather than trenching.

3.7.17. Single Service Line - Dual Meters: The single service line - dual meter installation shall consist of a 1" copper service line reducing to two ¾" copper service lines at a tee which shall be set in line with the front edge of meter boxes for ⅝" and ¾" meters. A single service line with dual meters shall be installed in those new residential developments where new ⅝" and ¾" meters are required and in main replacement work where it is necessary to change the location of existing ⅝" and ¾" meters. Single service line - dual meter materials and installation requirements shall conform to requirements established herein.

3.7.18. Small Service Lines on Existing Mains: The work involved in the installation of new copper service lines on existing mains shall 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.

3.7.19. Large Service Lines: DI pipe and cast-iron fittings used for metered service lines and non-metered fire service lines larger than 2" shall be installed in accordance with the applicable provisions of this specification, except where otherwise approved by the Engineer.

3.7.20. Large Service Lines on New Mains: Work involved in the installation of a new metered service lines and non-metered fire service lines shall 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.

3.7.21. Large Service Lines on Existing Mains: The work involved in the installation of the new metered service lines and non-metered fire service lines shall 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.

3.7.22. 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 shall move existing meters and meter boxes and reconnect and adjust customer's yard piping as part of transferring service lines. A dielectric coupling PVC schedule 80 shall be installed within the meter box between the meter and the customer's yard piping.

Round and oval meter boxes with round covers shall be salvaged and returned to the Owner by the Contractor. The Contractor shall 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 shall 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 shall install a number one meter box (2 pieces) as shown in the Specification and 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. In lieu of the new meter, the Contractor shall furnish and install a meter template in accordance with plans

Meter and meter box configuration, shall have the meter set horizontal, approximately 6 inches 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 shall be flush with the existing ground surface. All excess soil above the meter coupling, meter flange and meter nuts inside the meter box shall be removed so that the meter register is clearly visible. The Contractor shall exercise special precautions during excavation at the existing meter location in order to minimize the disturbance of the customer's yard piping. However, if the existing meter elevation is low, the Contractor shall 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 shall be installed by the customer in accordance with the Uniform Plumbing Code and shall be placed beyond the outlet side of the meter, but not within the Owner's meter box. The pressure reducing valve shall be the property of the water user who will be responsible for its installation, maintenance, and replacement as required.

The meter box adjustment shall not exceed 10 linear feet from the existing box.

3.7.23. Water Service for Fire Lines

3.7.23.1. Start of Work: Three working days notice will be given to the Inspector prior to start of a project after permit has been issued. The Contractor shall start his work at a tie-in or point designated by the Engineer. Pipe shall 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 shall be installed to the required lines and grades with fittings, valves, and hydrants placed at the required locations. Spigots shall be centered in bells or collars, all valves and hydrant stems shall be set plumb, and fire hydrant nozzles shall face as shown on the plans or as directed by the Engineer. No valve or other control on the existing system shall be operated for any purpose by the Contractor unless a representative of the Water System Utility Owner is present.

3.7.23.2. Crossing Other Underground Lines: New fire line services crossing any other utilities shall have a minimum of 48 inches of cover over the top of the pipe unless otherwise waived or modified by the Engineer. Excavation around other utilities shall be done by hand for at least 12 inches all around. Any damage to other utilities shall be reported to their proper governing entity.

3.7.23.3. Pipe Grade: Fire line services shall have a minimum of 48 inches of cover for mains 16” and below, and 60 inches for mains 20” and above, over the top of the pipe unless otherwise waived or modified by the Engineer. Pipe grades shall be as required by the plans or as directed by the Engineer. Grades shall be met as specified. Precautions shall be taken to insure that the pipe barrel has uniform contact with the Modified Grade 5 for its full length except at couplings. Couplings shall not be in contact with the original trench bottom prior to backfilling. Bedding and initial backfill material shall be placed under the coupling and compacted by hand prior to backfilling so as to provide an even bearing surface under the coupling and pipe. Changes in grade shall be made only at joints.

3.7.23.4. Modified Grade 5 Materials: Prior to placing pipe in a trench, the trench shall have been excavated to the proper depth as required of these specifications. Approved new materials or Engineer approved materials selected from suitable fines derived from the excavation shall be smoothly worked across the entire width of the trench bottom to provide a supporting cushion.

3.7.23.5. Structures to Support Pipe: Where as the bottom of a trench at subgrade consist of material that is notably unstable by the Engineer and cannot be removed and replaced with approved material may be properly compacted in place to support the pipe. The Contractor shall also construct a foundation for the pipe consisting of piling, concrete beams, or other supports in accordance with plans prepared by the Engineer.

3.7.23.6. Lowering Materials into Trench: Proper implements, tools, and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient completion of work. All pipe, fittings, valves, and hydrants shall 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 shall water service materials, pipes, fittings, etc., be dropped or dumped into the trench. Extreme care shall be taken to avoid damaging polywrap films. No chains or slings shall be allowed unless the entire sling is wrapped with a protective nylon web sock.

3.7.23.7. Laying of Pipe: Every precaution shall be taken to prevent foreign material from entering the pipe during its installation. Under adverse trench conditions or otherwise required by the Engineer, a heavy, tightly woven canvas bag of suitably sized shall be placed over each of the pipe.

The Canvas bag shall be left in place until a connection is made to the adjacent pipe. The interior of each pipe shall be inspected for defects, and the pipe shall be rejected if any defects are found.

After placing a length of pipe in the trench, the jointed end shall be centered on the pipe already in place, forced into place, brought to correct line and grade, and completed in accordance with the requirements of these Specifications. The pipe shall be secured in place with approved backfill material tamped around it. Pipe and fittings which do not allow a sufficient and uniform space for joints shall be rejected and shall be replaced with pipe and fittings of proper dimensions. Precautions shall 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 shall be closed by a watertight plug or other means approved by the Engineer. Pipe in the trench which cannot temporarily be joined shall be capped or plugged at each end to make it watertight. This provision shall apply during all periods when pipe laying is not in progress. Should water enter the trench, the seal shall remain in place until the trench is pumped completely dry. The Contractor shall provide all plugs and caps of the various sizes required.

3.7.23.8. 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 Inspector shall 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 shall be accomplished by the use of appropriate bends unless such requirement is specifically waived by the Engineer.

Whenever it is necessary to deflect pipe from a straight line, the deflection shall be as directed by the Inspector and as described herein. In no case shall the amounts exceed those shown in Table 19 "Maximum Deflections of Ductile-Iron Pipe" for ductile-iron pipe

3.7.23.9. Cutting Pipe: The cutting of pipe for inserting valves, fittings, or closure pieces shall 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 shall be strictly followed by the Contractor. Under no circumstances, shall a workman not equipped with proper safety goggles, helmet and all other required safety attire be permitted to engage in this work.

3.7.23.10. Asbestos-Cement (AC): No field cutting will be allowed on asbestos cement pipe. Installation of fire line services to AC pipe mains shall accomplished according to paragraph 3.B.16.

Joint Assembly:

3.7.23.10.1. Rubber Ring Joints: The installation of pipe and the assembly of rubber ring joints for Ductile-Iron pipe shall conform to the pipe manufacturer's assembly instructions. The method of inserting spigot ends of pipe in bells or collars known as "stabbing" shall 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.

3.7.23.10.2. Mechanical Couplings: Mechanical couplings shall 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.

Prior to the installation of the mechanical coupling, the pipe ends shall be cleaned by wire brush or other acceptable method to provide a smooth bearing surface for the rubber compression gasket. The pipe shall be marked to align the end of the coupling which will center it over the joint. After positioning, the nuts shall be drawn up finger tight. Uniform pressure on the gaskets shall be applied by tightening alternate bolts on the opposite side of the circle in incremental amounts. Soap and final tensioning shall be accomplished with a torque wrench and in a matter similar to the tightening procedure after 15 minutes.

3.7.23.10.3. Restrained Joints: Restrained Joints shall be installed as shown on the plans or as directed by the Inspector. Installation shall conform to the manufacture's recommendations.

3.8. **Installation of the Nonmetallic Pipe Detection System.**

The nonmetallic pipe detection system is to be installed concurrently with the proposed pipe placement. Tracer wire shall be utilized for location purposes and taped directly to the pipe. The tracer wire shall be solid core (14 gauge insulated), and shall be taper to the main in 10-inhc increments. Wire shall also come up to the top of valve extensions and fire hydrant stems, as directed by the Engineer.

4. MEASUREMENT

This Item will be measured as follows: "Pipe Water Main (DI)", "Pipe Water Main (PVC)", "Pipe Water Main (PVC Casing) (Open Cut)", and "Pipe Water Main (Steel Casing) (Open Cut)" for water pipe of the various sizes shown on the plans, will be measured by the linear 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.

"Fire Lines" will be measured by the linear 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.

"Jacking or Boring (Water Main)" will be measured by the linear 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 will be measured by the linear foot of pipe installed from end to end of pipe to the limits shown on the plans

Casing or liners used in bores and tunnels, where required by the plans, of the size and material required will be measured by the linear foot actually installed in accordance with plans.

"Butterfly Valve and Box (Complete)" will be measured as each assembly of the various sizes installed.

"Gate Valve and Box (Complete)" will be measured as each assembly of the various sizes installed to finished grade.

"Cut-in Gate Valve and Box (Complete)" will be measured as each assembly of the various sizes installed to finished grade.

"Tapping Sleeve, Valve and Box (Complete)" will be measured as each assembly of the various sizes installed.

"Cut-in Tee (Complete)" will be measured as each assembly of the various sizes of cast-iron tees cut-in to the existing water main.

"Adjust Existing Valve Box" will be measured as each assembly adjusted to correspond to finish grade.

"Concrete Encasement, Concrete Cradles, Concrete Saddles and Concrete Collars" for pipe will be measured by the cubic yard as dimensioned on the plans, 6' in depth measured from the outside pipe diameter (0.0) or as directed. Reinforcing if required will not be measured for payment.

"Fire Hydrant with 6-in. Valve and Box" will be measured as each fire hydrant installed. Also included will be sufficient pipe, valve and fittings.

"Relocate Fire Hydrant" will be measured as each fire hydrant relocated.

"Permanent Blow-off (Complete)" will be measured as each assembly of the various sizes installed.

"Temporary Blow-off (Complete)" will be measured as each assembly of the various sizes installed.

"Automatic Air Release Valve (Complete)" will be measured as each assembly of the size installed.

"Trench Excavation Protection" and "Joint Trench Excavation Protection" will be measured by the linear foot along the centerline of trench where the depth of trench exceeds 5-ft.

"Tie-In (Complete)" will be measured as each of the various sizes and types completed.

"New Short Service" will be measured as each of the various sizes and types of new service lines installed.

"New Long Service" will be measured as each of the various sizes and types of new service lines installed.

"New Unmetered Short Service" will be measured as each of the various sizes and types of new unmetered service lines installed.

"New Unmetered Long Service" will be measured as each of the various sizes and types of new unmetered service lines installed.

"Reconnect Short Service" will be measured as each of the various sizes of service lines reconnected.

"Reconnect Long Service" will be measured as each of the various sizes of service lines reconnected.

"Relay Short Service" will be measured as each of the various sizes of service lines re-laid.

"Relay Long Service" will be measured as each of the various sizes of service lines re-laid.

"Relocate Short Service" will be measured as each of the various sizes of service lines relocated.

"Relocate Long Service" will be measured as each of the various sizes of service lines relocated.

"Relocate Existing Meter and Existing Meter Box" will be measured as each assembly relocated and customer's service reconnected.

"Relocate Existing Meter and New Meter Box" will be measured as each assembly relocated and customer's service reconnected.

"Cut and Replace Concrete Sidewalk, Driveway, Etc." will be measured by the square yard of surface area of the concrete sidewalk cut and replaced, but not to exceed the minimum trench width specified in Section 3.A.2, "Width of Trench" or as shown on plans.

"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-inch depth, Type C) pavement, but not to exceed the minimum trench width specified in Section 3.A.2, "Width of Trench" or as shown on the plans.

"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 minimum trench width specified in Section 3.A.2, "Width of Trench" or as shown on plans.

"Concrete Curb" will be measured by the linear foot of the concrete curb cut and replaced, but not to exceed the minimum trench width specified in Section 3.A.2, "Width of Trench" or as shown on plans.

"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 minimum trench width specified in Section 3.A.2, "Width of Trench" or as shown on plans.

"Hydrostatic Pressure Test" will be measured as each successful test conducted.

"Excavation" will not be measured for payment, but is to be considered subsidiary to the pipe installation.

"Flowable Backfill" will be measured by the cubic yard in accordance with Item 401, "Flowable Backfill", but not to exceed the minimum trench width specified in Section 3.A.2, "Width of Trench" or as shown on the plans.

"Installation of the Nonmetallic Pipe Detection System" will not be measured for payment, but is to be considered subsidiary to the pipe installation.

"Removing and Replacing Chain-Link and/or Wire Fence" will be measured by the linear foot of fence removed and replaced, regardless of the type or height of the fence, complete in place.

"Ductile Iron and Gray Iron Fittings" will be considered incidental to the pipe installation and a "No-Pay" item.

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 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.

Payment for "Pipe Water Main (DI)", "Pipe Water Main (PVC)", "Pipe Water Main (PVC Casing)(Open Cut)", and "Pipe Water Main (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 payment is also to include selected bedding, excavation, backfill materials, polyethylene sleeve, all required fittings associated with the installation of the water main pipe of the various sizes, and hauling and disposition of surplus excavated materials.

Payment for "Fire Lines" installed will be made at the unit price bid for pipe of various sizes installed. Such payment shall include excavation 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 surface. All replacement mains shall include tie-in costs for existing fire lines.

Payment for "Jacking or Boring (Water Main)", Jacking, Boring or Tunneling will be paid for at the contract unit price bid per linear foot of jacking, boring or tunneling, which price shall 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 used in bores or tunnels shall be paid for at the contract unit price bid for "Carrier Pipe for Jacking, Boring or Tunneling" per linear foot of pipe installed and measured as prescribed above.

Casings or liners used in bores or tunnels shall be paid for at the contract unit price bid for "Casing or Liner for Jacking, Boring or Tunneling" per linear foot of casing or liner installed and measured as prescribed above.

Payment for “Gate Valve and Box (Complete)” and “Tapping Sleeve, Valve and Box (Complete)” will be made at the unit price bid for each such assembly of the various sizes installed. This payment is also to include 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. For butterfly valves only, such payment is also to include mechanical or transition couplings, and coated and wrapped steel pipe nipples required to complete the connection.

Payment for “Cut-in Gate Valve and Box (Complete)” will be made at the unit price bid for each such assembly of the various sizes installed. This payment is to include backfill, installation of valve, valve box assembly, all pipe cut and used to complete cut-in, reaction blocking, and polyethylene sleeve where required.

Payment for “Cut-in Tee (Complete)” will be made at the unit price bid for each of the various sizes of cast iron tees cut-in to ductile and cast iron mains. This payment is also to include necessary tie-ins, protective coating for bolts, nuts, ferrous surfaces, selected embedment material, anti-corrosion embedment when specified, backfill, pipe, fittings, polyethylene sleeve when required, concrete reaction blocking, and site restoration.

Payment for “Adjust Existing Valve Box” will be made at the unit price bid for each valve box adjusted to finish grade.

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. Reinforcing, if required, shall not be measured for payment.

Payment for “Fire Hydrant with 6-in Valve and Box” and “Relocate Fire Hydrant” will be made at the unit prices bid for each such assemblies installed.

These payments are to include 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, asphaltic material for ferrous surfaces, concrete reaction blocking, concrete pad restoration of existing fire hydrant sites and installing a new fire hydrant as directed.

Payment for “Permanent Blow-off (Complete)” and “Temporary Blow-off (Complete)” will be made at the unit price bid 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 linear 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.

Payment for “Automatic 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 payment is also to include 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.

Payment for “Trench Excavation Protection” and “Joint Trench Excavation Protection” is to be made on the basis of the unit price bid for each linear foot of “Trench Excavation Protection” and “Joint Trench Excavation Protection” in place. Payment is to include 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 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.

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 payment is to include 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.

Payment for “New Short Service” and “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. Such payment shall also include 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 ductile iron pipe (4-in. and larger).

Payment for “New Unmetered Short Service” and “New Unmetered Long Service” will be made at the unit price bid for each new un-metered service line of the various sizes and types installed. This payment is to include 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.

Payment for “Reconnect Short Service” and “Reconnect Long Service” will be made at the unit price bid for each service line of the various sizes and types reconnected. This payment is to include 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.

Payment for “Relay Short Service” and “Relay Long Service” will be made at the unit price bid for each service line of the various sizes and types relaid. This payment is to include 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.

Payment for “Relocate Short Service” and “Relocate Long Service” will be made at the unit price bid for each service line of the various sizes relocated. This payment is to include 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.

Payment for “Relocate Existing Meter and Existing Meter Box” will be made at the unit price bid for each assembly relocated. This payment is also to include excavation protection, hauling and disposition of surplus excavated materials, 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 existing meter box, and the existing yard piping.

Payment for “Relocate Existing Meter and New Meter Box” will be made at the unit price bid for each assembly relocated. This payment is also to include 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 new meter box, and the existing yard piping.

Payment for the number one meter box installation in sidewalks and driveways shall be paid in the amount difference between the standard meter box and the number one meter box.

Payment for “Cut and Replace Concrete Sidewalk, Driveway, Etc.” will be made at the unit price bid.

Payment for “Cut and Replace Asphalt Pavement” will be made at the unit price bid Payment for “Cut and Replace Asphalt Pavement with 6-in. of Asphalt Treated Base” will be made at the unit price bid.

Payment for “Cut and Replace Concrete Sidewalk (Asphalt)” will be made at the unit price bid.

Payment for “Concrete Curb” will be made at the unit price bid.

Payment for “Hydrostatic Pressure Test” will be made at the unit price bid for each successful test. Such payment includes all materials and equipment required to conduct test.

Payment for “Flowable Backfill” will be made at the unit price bid for each cubic yard of flowable backfill placed, but not to exceed the minimum trench width specified in Section 3.A.2. “Width of Trench”.

Payment for “Removing and Replacing Chain-Link and/or Wire Fence” will be by the unit price bid per linear foot of fence removed and replaced.

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 nonmetallic 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 shall be considered subsidiary to the various bid items.

No direct payment will be made for furnishing and installing ductile and gray iron fittings. This work and materials shall be considered subsidiary to the various pay items

No direct payment will be made for furnishing and installing the Joint Restraint System for PVC C-905. This work and materials shall 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.

Special Specification 7103

Water Mains, Sewer Lines and Appurtenances Replacements

1. DESCRIPTION

Furnish and install or replace water pipe, water valves, water meters and boxes, water service connections, fire hydrant assemblies, pipe fittings, encasement pipes for water lines, sewer pipe , manholes and supporting materials in conformance to the City of Fort Worth requirements and details shown on the plans. Obtain necessary permit(s), provide testing as necessary, and request inspection of the completed water and sewer lines prior to being placed in service.

1.1. **Prequalification.**

In addition to TxDOT's prequalification, water and sewer utility improvements included in this project must be performed by a contractor who is prequalified by the Fort Worth Water Department at the time of the bid opening. Reference the following City of Fort Worth specifications for bidder prequalification requirements:

- 00 45 11 Bidders Prequalifications
- 00 45 12 Prequalification Statement
- 00 45 13 Bidder Prequalification Application

2. MATERIALS

Furnish all materials in accordance with the requirements shown on the plans or pick-up and deliver materials furnished by utility companies to the project site. See Section 5: Measurements, Section A: Water and Section B: Sewer in this document.

3. CONSTRUCTION

Protect all water mains, sewer lines, vaults and appurtenances at all times during construction. Promptly repair, at no cost to the authority, any damage to the existing water or sewer system and/or any interruption to the services such as line stoppages or breakage caused by Contractor's operation. Follow "Location of Existing Utilities Handout" per City of Fort Worth Requirements

3.1. **Specifications.** Perform the work in such a manner consistent with current City of Fort Worth standards and specifications. Reference the following attached Specifications for the work to be performed:

3.1.1. Division 00 - General Conditions

- 00 45 11 Bidders Prequalifications
- 00 45 12 Prequalification Statement
- 00 45 13 Bidder Prequalification Application
- 00 61 19 Maintenance Bond

3.1.2. Division 01 - General Requirements

- 01 25 00 Substitution Procedures
- 01 32 33 Preconstruction Video
- 01 33 00 Submittals
- 01 60 00 Product Requirements

- 01 71 23 Construction Staking and Survey

3.1.3. Division 02 - Existing Conditions

- 02 41 13 Selective Site Demolition
- 02 41 14 Utility Removal/Abandonment
- 02 41 15 Paving Removal

3.1.4. Division 03 - Concrete

- 03 30 00 Cast-In-Place Concrete
- 03 34 13 Controlled Low Strength Material (CLSM)
- 03 34 16 Concrete Base Material for Trench Repair
- 03 80 00 Modifications to Existing Concrete Structures

3.1.5. Division 32 – Exterior Improvements

- 32 01 17 Permanent Asphalt Paving Repair
- 31 01 18 Temporary Asphalt Paving Repair
- 31 01 29 Concrete Paving Repair
- 32 12 16 Asphalt Paving
- 32 13 13 Concrete Paving
- 32 13 20 Concrete Sidewalks, Driveways and Barrier Free Ramps
- 32 13 73 Concrete Paving Joint Sealants
- 32 16 13 Concrete Curb and Gutters and Valley Gutters
- 32 91 19 Topsoil Placement and Finishing of Parkways
- 32 92 13 Hydro-Mulching, Seeding, and Sodding

3.1.6. Division 33 - Utilities

- 33 01 30 Sewer and Manhole Testing
- 33 01 31 Closed Circuit Television (CCTV) Inspection
- 33 04 10 Joint Bonding and Electrical Isolation
- 33 04 11 Corrosion Control Test Stations
- 33 04 12 Magnesium Anode Cathodic Protection System
- 33 04 30 Temporary Water Services
- 33 04 40 Cleaning and Acceptance Testing of Water Mains
- 33 04 50 Cleaning of Sewer Mains
- 33 05 10 Utility Trench Excavation, Embedment, and Backfill
- 33 05 13 Frame, Cover and Grade Rings
- 33 05 14 Adjusting Manholes, Inlets, Valve Boxes, and Other Structures to Grade
- 33 05 16 Concrete Water Vaults
- 33 05 17 Concrete Collars
- 33 05 22 Steel Casing Pipe
- 33 05 24 Installation of Carrier Pipe in Casing or Tunnel Liner Plate
- 33 05 26 Utility Markers/Locators
- 33 05 30 Location of Existing Utilities
- 33 11 05 Bolts, Nuts, and Gaskets
- 33 11 10 Ductile Iron Pipe
- 33 11 11 Ductile Iron Fittings
- 33 11 12 Polyvinyl Chloride (PVC) Pressure Pipe
- 33 11 13 Concrete Pressure Pipe, Bar-Wrapped, Steel Cylinder Type
- 33 12 10 Water Services 1-inch to 2-inch
- 33 12 20 Resilient Seated Gate Valve

- 33 12 25 Connection to Existing Water Mains
- 33 12 40 Fire Hydrants
- 33 12 50 Water Sample Stations
- 33 12 60 Standard Blow-off Valve Assembly
- 33 31 20 Polyvinyl Chloride (PVC) Gravity Sanitary Sewer Pipe
- 33 31 50 Sanitary Sewer Service Connections and Service Line
- 33 39 10 Cast-in-Place Concrete Manholes
- 33 39 20 Precast Concrete Manholes
- 33 39 60 Epoxy Liners for Sanitary Sewer Structures

3.1.7. Technical Specifications listed are included for this Project by reference and can be viewed/downloaded from the City's Buzzsaw site at:

https://projectpoint.buzzsaw.com/client/fortworthgov/Resources/02%20-%20Construction%20Documents/Specifications

3.2. **Permits, Testing, Inspection, Construction Staking and Submittals.**

3.2.1. **Permits.** Acquire all necessary permits from the City of Fort Worth to perform the work. The cost of applying for the permits will be subsidiary to the listed bid items. Please contact the following entities as needed:

- Fort Worth Water Department – Field Operations: 817-392-8296
- Fort Worth Transportation and Public Works – 817-392-8100

3.2.2. **Testing.** Provide testing for water mains and sewer lines in conformance to the City of Fort Worth requirements or as directed by the Engineer. Perform the following tests as a minimum:

- For Water Mains: hydrostatic test, poly pigging, and sterilization test
  - Reference Specification – 33 04 40 – "Cleaning and Acceptance Testing of Water Mains"
- For Sewer Lines: Low pressure air test, deflection (Mandrel) test, vacuum test, and Closed Circuit Television (CCTV) Inspection.
  - Reference Specification – 33 01 30 Sewer and Manhole Testing, 33 01 31 Closed Circuit Television (CCTV) Inspection.

All testing requirements for water and sewer lines will be subsidiary to the listed bid items.

3.2.3. **Inspection.** All water mains, sewer lines, and their appurtenances will be inspected by a representative of the City. Those representatives' decision of acceptability of the installation will be final. The City will hold two (2) final inspections, one at water and sewer line completion and the other at roadway completion for final utility grade adjustments according to Specification Section 33 05 14

3.2.4. **Construction Staking.** The construction staking and survey must be done by the Contractor according to the following City of Arlington specification section:

- Section C 1.12 - Construction Staking

3.2.5. **Submittals.** The Contractor must review, approve, and submit all Shop Drawings, Product Data, and Samples required by the Contract Documents according to Section A 3.9 Shop Drawings, Product Data and Samples of the City of Arlington specifications, with reasonable promptness and in such sequence as to cause no delay in the Work or in the Work of the City or any separate Contractor.

4. MEASUREMENT

Water main and sewer line replacement items will be measured as follows:

Table 1
Section A: Water

City of Fort Worth Bid Item Description	Unit	City of Fort Worth Item Number	City of Fort Worth Spec Number
Water Line Grouting	CY	0241.1001	02 41 14
Remove 12” Water Line	LF	0241.1015	02 41 14
Remove 16” Water Line	LF	0241.1016	02 41 14
Remove 20” Water Line	LF	0241.1018	02 41 14
16" Pressure Plug	EA	0241.1106	02 41 14
20" Pressure Plug	EA	0241.1108	02 41 14
4"-12” Pressure Plug	EA	0241.1118	02 41 14
16" Water Abandonment Plug	EA	0241.1206	02 41 14
20” Water Abandonment Plug	EA	0241.1208	02 41 14
4”-12” Water Abandonment Plug	EA	0241.1218	02 41 14
Remove 12” Water Valve	EA	0241.1305	02 41 14
Salvage 16” Water Valve	EA	0241.1351	02 41 14
Salvage Fire Hydrant	EA	0241.1510	02 41 14
Remove Concrete Water Vault	EA	0241.1602	02 41 14
Cathodic Protection	LS	3304.0002	33 04 12
Temporary Water Servicecop	LS	3304.0101	33 04 30
Manhole Adjustment, Minor	EA	3305.0109	33 05 14
Trench Safety	LF	3305.0109	33 05 10
42” Casing By open Cut	LF	3305.1007	33 05 22
24” Water Carrier Pipe	LF	3305.2007	33 05 24
12” PVC Water Pipe, CSS Backfill	LF	3311.0462	33 11 12
*24” DIP Water or 24” Concrete AWWA C303 Water Pipe, CSS Backfill	LF	3311.0652 or 3311.0682	33 11 10 or 33 11 13
20” DIP Water, CSS Backfill	LF	9999.0001	33 11 10
*16" DIP WATER PIPE or 16” Concrete AWWA C303 Water Pipe, CSS Backfill	LF	3311.0551 or 9999.0001	33 11 10 or 33 11 13
6” PVC Water Pipe, CSS Backfill	LF	3311.0162	33 11 12
Ductile Iron Water Fittings w/Restraint (12” & Smaller)	Ton	3311.0001	33 11 11
*Ductile Iron Water Fittings w/Restraint (16” & Larger) or C303 FITTINGS	LS	3311.0001 or 3311.0021	33 11 11 or 33 11 13
Fire Hydrant Extension	EA	3305.0101	33 05 14
Fire Hydrant	EA	3312.0001	33 12 40
Water Sampling Station	EA	3312.0002	33 12 50
Connection to Existing 16" Water Main	EA	3312.0106	33 12 25
Connection to Existing 20" Water Main	EA	3312.0107	33 12 25
Connection to Existing 4”-12” Water Main	EA	3312.0117	33 12 25
2” Water Service, Meter Reconnect	EA	3312.2201	33 12 10
2" Water Service	EA	3312.2203	33 12 10
6" Gate Valve	EA	3312.3002	33 12 20
12" Gate Valve	EA	3312.3005	33 12 20
16" Gate Valve w/ Vault	EA	3312.3006	33 12 20
20" Gate Valve w/Vault	EA	3312.3007	33 12 20

City of Fort Worth Bid Item Description	Unit	City of Fort Worth Item Number	City of Fort Worth Spec Number
24" Gate Valve w/Vault	EA	3312.3008	33 12 20
16” Cut-in Gate Valve w/ Vault	EA	3312.3106	33 12 20
20” Cut-in Gate Valve w/ Vault	EA	3312.3108	33 12 20
8" Blow-Off Valve w/Vault	EA	3312.6003	33 12 60

Table 2
Section B: Sewer

City of Fort Worth Bid Item Description	Unit	City of Fort Worth Item Number	City of Fort Worth Spec Number
Remove 4’ Sewer Manhole	EA	0241.2201	02 41 14
Pre-CCTV Inspection	LF	3301.0001	33 01 31
Post-CCTV Inspection	LF	3301.0002	33 01 31
Manhole Vacuum Testing	EA	3301.0101	33 01 30
Manhole Adjustment, Minor	EA	3305.0109	33 05 14
Trench Safety	LF	3305.0109	33 05 10
Concrete Collar	EA	3305.0112	33 05 17
Vacuum Excavation	EA	3305.0115	33 05 30
8” Sewer Pipe	LF	3331.4115	33 11 10 33 31 20
8” DIP Sewer Pipe, CSS Backfill	LF	3331.4120	33 11 10 33 31 20
Epoxy Manhole Liner	LF	3339.0001	33 39 60
4’ Manhole	EA	3339.1001	33 39 10 33 39 20
4’ Extra Depth Manhole	LF	3339.1003	33 39 10 33 39 20

5. PAYMENT

The work performed and materials furnished in accordance to this item and measured as provided by under “Measurement” will be paid for at the unit price bid for the various items specified in the plans. This price is for full compensation for furnishing all labor, tools, equipment, testing, and incidentals necessary to satisfactorily complete the work as detailed on the plans including excavation, embedment, and backfill.

Special Specification 7111
Sanitary Sewer

1. DESCRIPTION

1.1. **Scope of Work.** Provide and install complete sanitary sewer construction and adjustments in conformity with the details shown on the plans, as described in this specification, 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. **Other Utilities.** The data furnished on the plans regarding the size and location of all other utility lines has been obtained from field surveys, the City and the various utility companies. The Department does not assume responsibility for the accuracy of the information presented nor does it warrant that all of the utility lines have been shown.

1.3. **Definitions.**

1.3.1. **Sanitary Sewer Main.** Sanitary Sewer Main is defined as that portion of the sanitary sewer system which collects the effluent from the service laterals, including stub outs from the nearest manhole, to the point of final destination.

1.3.2. **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 effluent being carried by the system to the sanitary sewer main, including the connection into the sanitary sewer main system.

1.3.3. **Television Inspection.** Television Inspection is defined as furnishing all labor, materials, equipment, tools, logging and incidentals necessary to provide the televising and videotaping of sewer lines utilizing a color closed circuit television inspection unit to determine the condition of the lines.

All new sewer mains will not carry flow until the Engineer approves and accepts the mains for service.

1.3.4. **By–Pass Pumping.** By–Pass Pumping is defined as furnishing all labor, materials, equipment, tools, appliances and incidentals necessary to perform all operations in connection with by–pass pumping of sewage flow for the purpose of preventing interference with the construction of the sanitary sewer manholes and mains as well as providing reliable sewer service to the areas being served.

The Contractor will be required to provide adequate pumping equipment and force mains to maintain reliable sanitary sewer service in all sanitary sewer lines involved. In case of equipment failure, the Contractor will have on the jobsite backup pumps and force mains. Under no circumstances will the flow be interrupted or stopped such that damage is done to either private or public property; or sewage flows or overflows into a storm sewer or natural waterway.

The Contractor must provide by–pass pumping of sewage around each segment of pipe that is to be televised or replaced and will be responsible for all required bulkheads, pumps, equipment, piping, and other related appurtenances to accomplish the sequence of pumping. A qualified person must man the pumps, on-site, at all times during the by–pass procedure.

All piping, joints and accessories must be designed to withstand the maximum by–pass system pressure, or a minimum of 50 psi, whichever is greater. During by–pass pumping, no sewage will be leaked, dumped, or spilled in or onto any area outside of the existing sanitary sewer system. When by–pass pumping operations are complete, all piping will be drained into the sanitary sewer before disassembly.

2. MATERIALS

All materials must conform to the requirements of this Item, the plans and the following Items:

- Item 400, "Excavation and Backfill for Structures,"
- Item 401, "Flowable Backfill,"
- Item 421, "Hydraulic Cement Concrete,"
- Item 440, "Reinforcement for Concrete," and
- Item 465, "Junction Boxes, Manholes and Inlets."

2.1. **Sanitary Sewer Pipe.** Materials for sanitary sewer pipe will be of the specific type that is called for on the plans. Install materials as specified by the manufacturer.

2.1.1. **Rigid Pipe.** Reinforced concrete, ductile–iron pipe, cast iron pipe, and concrete steel cylinder pipe, for the purpose of this Item, will be known as rigid pipe.

2.1.2. **Flexible Pipe.** Pipe consisting of materials other than those listed above.

Any flexible conduit with a deflection of the inside diameter greater than 5% after installation, will not be accepted. A Go, No–Go deflection Testing Mandrel will be furnished, built and used in testing pipe deflection for acceptance, in accordance with the detail drawing as shown on the plans, unless directed otherwise. The working room for flexible pipe will be a minimum of 6 in. Pipe stiffness is to be in accordance with ASTM 3034 SDR 26 [115 psi] or ASTM 2241 SDR 26 [160 psi].

When the trench width is greater than the outside diameter of the pipe plus 2 ft. the pipe will be covered with Class B concrete, in accordance with Item 421, or as shown on the plans.

2.1.3. **Fiberglass Reinforced Sewer Pipe, Non–Pressure Type.** Fiberglass reinforced sewer pipe, non–pressure type, will be a factory–formed conduit of polyester resin, continuous roving glass fibers and silica sand built up in laminates and must conform to the requirements of ASTM D–3262 including the appendix and subsequent specifications, and accordance to ~~City of Seguin~~ Utility Owner material specifications.

2.1.3.1. **Coupling Joints.** Joints for pipe and fittings will be confined compression rubber gasket bell and spigot type joints conforming to the material and performance requirements of ASTM D–4161.

2.1.3.2. **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 pipes 15 in. or larger in diameter, lateral openings 6 in. or greater in size will be made using PVC sewer saddles conforming to ASTM D–2661 or Inserta Tee connections conforming to ASTM D–3034 or approved equal minimum pipe stiffness will not be less than 150 psi for direct bury applications.

2.1.4. **PMS PVC Pipe.** Poly Vinyl Chloride (PVC) pipe will be made from class 12454–B materials as prescribed in ASTM D–1784. For pipes 4 in. to 15 in. in diameter PMS pipe, fittings and joints must conform to ASTM D–3034 and D–3212 as well as ASTM D–2241 and ASTM D–3139 where applicable, with the exception that solvent cement joints will not be used. All pipe that is 18 in. to 27 in. in diameter will meet requirements of ASTM F–679.

2.1.4.1. **Water Main Crossings.** Gravity or force main sewers constructed in the vicinity of water mains will comply with the requirements of the "Design Criteria for Domestic Wastewater Systems," 30 TAC 217.53, as adopted by The Texas Commission on Environmental Quality August 28, 2008.

Mechanical or compression joints, concrete jointing collars, or non–reinforced rubber adaptors will be used only as approved by the Owner.

2.1.5. **Steel Casing Pipe.** The component materials, manufacture and testing of all steel pipe will conform to AWWA Standard C–200 for "Steel Water Pipe 6 inch and Larger." The specified pipe size will be the actual inside diameter of the pipe, special or fitting in inches. The diameter and wall thickness of all steel pipe will conform to those shown on the plans.

Pipe will be either Grade A or Grade B, conforming to ASTM Designation A–53.

Pipe ends will be beveled and suitable for field butt welding except as otherwise specified.

Pipe will receive a protective coating conforming to AWWA Standard C–203, "Coal–Tar Protective Coatings and Linings for Steel Pipelines — Enamel and Tape Hot Applied."

Pipe length will be nominal 40 ft. lengths except for specials or as otherwise specified on the plans. Standard and specials will be within 1/16 in. (plus or minus) of the specified or theoretical lengths.

2.1.6. **Stainless Steel Casing Spacer.** The Casing Spacers are to be constructed of T–304 stainless steel segments which bolt together forming a shell around the carrier pipe. The spacers are to be designed with risers (when needed) and runners to support the carrier within the casing and maintain a minimum clearance of 0.50 in. between the casing ID and the spacer OD. On carrier pipes with an OD less than 16 in., each spacer is to have four (4) riser and runner combinations — two (2) on each segment. On carrier pipes with an OD of 16 in. and larger, each spacer is to contain six (6) riser and runner combinations — four (4) on the bottom segment and two (2) on the top segment. T–304 stainless steel bolts and nuts are to be supplied with the spacers.

The band is to be manufactured of 8 in. wide, 14 gauge, T–304 stainless steel material. The risers are to be constructed of 10 gauge, T–304 stainless steel with a minimum length of 6 in.

Abrasion resistant runners, with a minimum length of 7 in. and a minimum width of 1 in. are to be attached to each riser to minimize friction between the casing pipe and the carrier pipe as it's installed. Runner material is to be of glass reinforced plastic with compression strength of 25,000 psi, flexural strength of 32,000 psi and tensile strength of 22,000 psi. The ends of all runners are to be beveled to facilitate installation over rough weld beads or the welded ends of misaligned or deformed casing pipe.

Interior surfaces of the circular steel shell are to be lined with PVC or EPDM with a minimum thickness of 0.090 in. with a hardness of Durometer "A" 85–90.

Spacers will be placed a maximum of 1 ft. on each side of the bell joint and every 8 to12 ft. apart thereafter.

2.1.7. **Physical Properties.**

2.1.7.1. **Band and Risers.**

- Band - 14 Gauge, T–304 Stainless Steel
- Riser - Minimum 14 Gauge, T–304 Stainless Steel

2.1.7.2. **Liner – EDPM or Polyvinyl Chloride.**

- Thickness - 0.090 in. minimum
- Hardness - Durometer "A" 85–90
- Dielectric Strength - 1/8 in. thick
- 60,000 VPM
- Water Absorption - 1% maximum
- Overlap edges

2.1.7.3. **Studs, Nuts and Washers.**

- T–304 Stainless Steel - 5/16: 18 in. x 2 in. studs
- 5/16 in. hex nuts
- 5/16 in. washers SAE 2330

2.1.7.4. **Runners.** 1 in. wide or 2 in. wide glass filled polymer runners.

Sizes Available:

- length – 7 in.
- effective heights (all lengths) – 1 in. and 1-1/2 in.

Materials Specifications:

- Tensile Strength (ASTM D–638) - 22,000 psi
- Flexural Strength (ASTM D–790) - 32,000 psi
- Compression Strength (ASTM D–695) - 25,000 psi
- Deflection Temperature @ 264 psi (ASTM D–648) - 435°F (224°C)
- Deformation Under Load, @ 122°F (50°C) – 4,000 lb. Load, - (ASTM D–648) 1.2%

2.1.7.5. **Welding.** All risers are to be welded by MIG welding. Welds are to be fully passivated.

2.2. **Manholes.** Manholes must be Fiberglass Sanitary Sewer Manholes ASTM D 3753.

2.2.1. **Manhole Structures.** Cast in place concrete structures or pre–cast concrete structures, as detailed on the plans, will be installed where any pipe intercepted is larger than 24 in. in diameter.

2.2.2. **Pre–Cast Reinforced Concrete Manhole Sections.** Manhole sections are to conform to the requirements of ASTM Designation C–478. The pre–cast sections will have rubber gasket compression joints conforming to the material and performance requirements of ASTM C–443.

2.2.3. **Throat Rings.** Adjustment throat rings will be made of either HDPE or reinforced concrete rings with a maximum thickness of 2 in. HDPE is preferred. The internal diameter must not be less than 30 in., and the width must be a minimum of 5 in. Concrete must conform to the provisions of Class A concrete in accordance with Item 421. If concrete throat rings are to be installed they must be used in conjunction with a UV stabilized polyethylene liner. I/I barrier must meet the following ASTM standards: ASTM D–790/1505 Density of Polyethylene Materials, ASTM D1238 Melt Flow index, ASTM 638 Tensile Strength @ Yield (50mm/mm), ASTM 790 Flexural Modulus, ASTM 648 Heat Deflection temperature @lgepal, ASTM 1693 EsCR, 100% legpal/10% legpal.

2.2.4. **Rings and Covers.** Manhole rings and covers must be 30 in. Ergo XL Assembly, or approved equal unless stated otherwise on the plans. Rings and covers must be 32 in. diameter with 30 in. clear opening.

2.3. **Concrete.** All concrete is to meet the requirements of Item 421. Unless otherwise shown on the plans or required by this specification, all concrete will be Class A.

2.4. **Mortar.** Mortar is to be composed of one (1) part Hydraulic Cement, two (2) parts sand and enough water to produce a workable mixture. When used to plaster manholes, it may be composed of one (1) part cement to three (3) parts sand. Lime up to 10% may be used. It will have a consistency such that it can be easily handled and spread.

2.5. **Reinforcing Steel.** Reinforcing steel and the placing thereof is to conform to the requirements of Item 440; except where welded wire is called for on the plans, the material will be welded wire flat sheets meeting ASTM. A–185. Welded wire rolls will not be used.

2.6. **Cement Stabilized Backfill.** Cement stabilized backfill is to be in accordance with Item 400.

2.7. **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 will be Mix Design Type B in accordance with Item 401, or an acceptable mix as approved.

2.8. **Grout.** When shown on the plans for various applications, the grout is to be a cement/sand/water mixture as approved. It will have a consistency such that it will flow into and completely fill all voids.

2.9. **Sewer Main Television Inspection.** The Contractor will 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 Contractor will 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.

Television inspection will be done one manhole section at a time. Also the flow in the section being televised will be by–passed 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 will be reduced to allowable levels by temporarily plugging or blocking the flow or by–pass pumping, as approved by the Engineer.

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 Engineer. If the length of sewer line cannot be televised because of obstructions, the Contractor must clean the system as is necessary. If, as determined by the Engineer, the obstruction is attributed to a collapsed main or pipe deflection, televising will be suspended and the remaining televising of the sewer line will be continued upon successful correction of the blockage by the Contractor at his expense.

2.9.1. **Log Formats.** Each DVD will be permanently labeled with the following:

- project name;
- date televised;
- station to station location and size of sanitary sewer;
- street/easement location;
- name of contractor;
- date DVD submitted; and
- DVD numbers.

2.9.2. **Videotape Quality.** If the Contractor produces a DVD of such poor quality that the Engineer is unable to evaluate the condition of the sanitary sewer main or locate the sanitary sewer service lateral connections, the Contractor will be required to re–televise the sanitary sewer main and provide a new DVD of good quality at no additional cost.

2.9.3. **Equipment Required For TV Inspections.** The Contractor will be required to have all materials, equipment and labor necessary to complete all videotaping on jobsite before isolating the sewer manhole segment and beginning videotaping operations. A camera with rotating or panning lens capabilities is required. The television inspection equipment will 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 will be centered in the conduit being televised. The speed of the camera through the conduit will not exceed 40 ft. per minute.

The television unit will 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.

2.9.4. **DVD Logs.** The Contractor is to provide, with each completed DVD, a TV inspection report which is a written log of all pipe defects, sags, points of root intrusion, offset points, service connection locations and condition recorded on a footage basis. This log is to also denote the section being televised, flow and camera direction, position of taps or failures, pipe condition and weather conditions.

2.10. **By–Pass Pumping.** The Contractor will provide and maintain adequate pumping equipment, force mains and other necessary appurtenances in order to maintain reliable sanitary sewer service in all sanitary sewer lines as required for construction. The Contractor must have backup pump(s), force main(s) and appurtenances ready to deploy immediately. Appurtenances and discharge point must be approved by the Engineer.

Any spillage, backups and/or overflows, etc. as the result of inadequate equipment are the sole responsibility of the Contractor.

The Contractor will demonstrate that the pumping system is in good working order and is sufficiently sized to successfully handle flows by performing a test run for a period of 24 hr. before beginning the work.

The Contractor will be required to have all materials, equipment and labor necessary to complete the repair or replacement on the jobsite before isolating the sewer manhole or line segment and beginning by–pass pumping operations.

2.11. **Bedding and Backfill.** Backfilling for sanitary sewers is divided into 3 separate zones: (a) bedding: the material in trench bottom in direct contact with the bottom of the pipe; (b) initial backfill: the backfill zone extending from the surface of the bedding to a point 1 ft. above the top of the pipe; and (c) 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 will be as described.

2.11.1. **Bedding Material.** The existing material at the bearing level will be removed and replaced to a minimum depth of 6 in. or 1/8 in. of the outside diameter of the pipe, whichever is greater, with bedding material. The bedding material will 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 following requirements, shown below in Table 1, unless modified by the Engineer:

Table 1
Bedding Material Requirements

Sewer Gravel	Percent
Passing 1-1/2 in. sieve	100
Passing 1 in. sieve	95–100
Passing 3/8 in. sieve	25–60
Passing No. 4 sieve	0–10
Passing No. 8 sieve	0–5

2.11.1.1. **Stable Material.** Existing stable material present during excavation including:

- trench bottom free of water, muck, 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.

2.11.1.2. **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.

2.11.2. **Initial Backfill.** Initial backfill must consist of gravel which conforms to the requirements for bedding material.

2.11.3. **Secondary Backfill.** Secondary backfill will 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 will be sifted out and removed before the material is used in the secondary backfilling zone. Secondary backfill material will be primarily composed of compactable soil material.

3. CONSTRUCTION

All construction must conform to the requirements of this Item, the plans and the following Items:

- Item 104, “Removing Concrete,”
- Item 360, “Concrete Pavement,”
- Item 400, “Excavation and Backfill for Structures,”
- Item 402, “Trench Excavation Protection,”
- Item 403, “Temporary Special Shoring,”
- Item 440, “Reinforcement for Concrete,”
- Item 465, “Junction Boxes, Manholes and Inlets,”
- Item 479, “Adjusting Manholes and Inlets,”
- Item 529, “Concrete Curb, Gutter, and Combined Curb and Gutter,”
- Item 530, “Intersections, Driveways, and Turnouts,” and
- Item 531, “Sidewalks.”

3.1. **Excavation.** Excavation will be performed in accordance with Item 400.

3.2. **Trench Excavation Protection.** Excavation greater than 5 ft. in depth is to be protected as specified in Item 402 and Item 403.

3.3. **Trenching.** Trench walls will 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 and approved by the Engineer. In special cases, where trench flaring is required, the trench walls will remain vertical to a depth of at least 1 ft. above the top of the pipe.

The trench bottom will be square or slightly curved to the shape of the trenching machine cutters. The trench will 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 will be dug after the trench bottom has been graded and bedding installed. The pipe will rest upon the new bedding material for its full length.

Where over–excavation occurs, the under–cut trench will be restored to grade at the Contractor’s expense by replacement with a material conforming to the requirements of the bedding material or a material approved by the Engineer.

3.3.1. **Minimum Width of Trench.** The minimum width of pipe trenches, measured at the crown of the pipe, will be not less than 12 in. greater than the exterior diameter of the pipe, exclusive of bells. The minimum base width of such trench will be not less than 12 in. greater than the exterior diameter of the pipe, exclusive of special structures or connections. Such minimum width will be exclusive of trench supports and not greater than the width at the top of the trench.

3.3.2. **Maximum Width of Trench.** The maximum allowable width of trench for pipelines measured at the top of the pipe will 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 Engineer and approved in writing. Whenever such maximum allowable width of trench is exceeded, except as provided for on the drawings, or in the specifications, or by the written approval of the Engineer, the Contractor, at his expense, will encase the pipe in concrete from trench wall to trench wall, or other pipe bedding material approved by the Engineer. Any excavation wider than this maximum width or subsequent surface or paving work, will be done at the Contractor's expense.

3.3.3. **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 then be met by the addition of a layer of approved bedding material as directed.

3.3.4. **Excavation Below Grade.** Any part of the bottom of the trench excavated below the limits specified in Section 3.3.2., "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 3.3.4., "Unstable Conditions at Grade."

3.3.5. **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 the a depth at least 6 in. below 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 so as 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.

3.4. **Bedding and Backfill.** Before laying the pipe, the normal or select bedding material will be shaped to conform to the outside diameter of the pipe as shown on the plans Bedding material will 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 will be inserted every 3 ft. on each side of the pipe.

For sewer lines up to 24 in. in diameter initial backfill material will be placed in two lifts above the bedding material the pipe is set on. The first lift will 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 will be subject to inspection and approval before placement of second lift, which will extend from the spring line of the pipe to a minimum of 1 ft. above the top of the pipe. The second lift will be evenly spread in a similar manner as the first lift.

For diameters 24 in. and larger, initial backfill material will be evenly and simultaneously spread alongside, under the lower quadrant the pipe and over the pipe in 12 in. lifts to a point sufficient to a minimum of 1 ft. above the top of the pipe. Consolidate the Initial Backfill material as specified for bedding.

The secondary backfill material will be placed in maximum 12 in. loose lifts or as directed by the Engineer.

3.5. **Pipe Installation.**

3.5.1. **General.** All sanitary sewer mains must be constructed in accordance with this specification and in conformance with the required lines, grades, and details shown on the plans and as directed. Successful passage of the air test, as described under 30 TAC 217.57 Criteria, will be required for the acceptance of the mains.

After the trench has been carefully graded and all bell holes excavated, approval is required before placing the pipe.

All sewers are to be laid in straight alignment, so that a light can be seen from one manhole to the other even for the smaller size of sewers. The pipe is to be laid accurately to line and grade, with the spigot end downstream entering the bell to full depth and in such a manner as not to drag earth into the annular space.

Pipes and fittings are to be fitted together and matched so that they will form a sewer with a smooth and uniform invert. Special care is to be taken to provide uniform bearing for the entire length of pipe.

3.5.1.1. **Water Main Crossings.** Where gravity or force main sewers are constructed in the vicinity of water mains, the requirements of the 30 TAC 217.53 (d) will be met.

Contractor must maintain service to sewer lateral connections, whether connected to the existing or proposed sewer lines, at all times for the duration of the construction, unless directed otherwise by the Engineer.

3.5.2. **Pipe and Fittings.** Proper and suitable tools and appliances for the safe and convenient handling of the pipe and fittings are to be provided and used. Care is to be taken to prevent any damage to the pipe coating. All pipe and fittings will be examined for defects right before placing into the trench and no materials are to be laid that are known to be defective.

Any defective pipe discovered after being laid is to be removed and replaced with acceptable pipe at the Contractor's expense. Wherever the pipe requires cutting, it is to be done with a standard wheel pipe cutter for pipe 12 in. and smaller. Cutting methods for larger pipes are to be as approved. Each cut is to be smooth and at right angles to the axis of the pipe.

3.5.2.1. **Pipe Laying.** The Contractor will be required to commence construction and laying of pipe at the downstream end of the sanitary sewer outfall line and proceed non–stop in a forward upstream direction.

No pipe should be laid within 10 ft. of any point where excavation is in progress. Pipe laying will proceed upgrade with the tongue or spigot pointing in the direction of flow. Pipes will be lowered into the trench without disturbing the prepared foundation or the trench sides.

The drilling of lifting holes in the field will not be permitted. Pipes will 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 will not be permitted. Pipes will 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 will be permitted during or after the pulling operation.

Should coupled joints of pipe be out of line or off grade, they will be removed one joint at a time 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 will not be permitted.

3.5.2.2. **Laser Beams.** The use of laser beams for vertical control will be required provided the Contractor makes available to the Engineer, 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.

No pipe should be installed in tunnels except as provided on the plans, or with the permission of the Engineer. If the Contractor finds it necessary to install pipe in tunnels not provided on the plans, he must submit to the Engineer, before commencement of work, a detailed outline of procedures, methods, and use of materials depending on existing soil conditions.

No horizontal or vertical curves will 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 will 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.

3.5.3. **Service Connections (Sanitary Sewer Laterals).**

3.5.3.1. Sanitary sewer laterals fittings and appurtenances must conform to the Sanitary Sewer specifications and will be installed by the Contractor as specified, or as directed.

3.5.3.2. **Service Line 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 will be connected using the appropriate size tee/wye placed in line with the main line. For mains larger than 12 in., Insert a Tee conforming to ASTM 3034–88 or approved or equal may be used.

3.5.3.3. Connection to the Customers end of the lateral will be performed using a PVC coupling SDR 26 or approved equal. All Cleanouts at jobsites will have installed an approved heavy duty sanitary sewer cap.

3.5.3.4. **Service Connections.**

3.5.3.4.1. Provide reconnections of all existing sewer service laterals to new lines installed or to provide connections of new laterals to existing sanitary sewer mains. Locate laterals and insure service is not interrupted to homes or other establishments.

3.5.3.4.2. Wyes, bends, tees, stacks, and other hardware required are to be installed for service laterals as shown on the plans or as directed.

3.5.4. **Coating and Wrapping Underground Steel Pipe.** Exterior surfaces of all steel pipe fittings and specials which are to be installed underground and which are not to be encased in concrete will be cleaned to bare metal by wire brushing with a power driven wire brush, sand blasting, or other approved methods. A prime coat compatible to the polyvinyl tape to be used will then be applied to the pipe. Following the application of the prime coat, the pipe will be wrapped with Scotchrap, Trantex V–10 polyvinyl tape, or approved equal. The tape will not be applied until the prime coat in completely dry.

The tape will be spirally and tightly wrapped on each section of the pipe with a 50% lap. The joint will be protected with tape 8 in. in width on pipe greater than 12 in. in size.

Each section of pipe will be cleaned, primed, and wrapped to within 6 in. of each end. The priming and wrapping will be completed, and the bare pipe wrapped with tape lapped 3 in. over the originally taped sections.

3.6. **Manhole Construction.**

Access to manholes will be maintained throughout construction by raising or lowering manhole tops as necessary (not a separate pay item).

Footings or bases of manholes will be a minimum of 6 in. in depth below the bottom of the pipe.

All invert channels of manholes are to be constructed and shaped accurately so as to be smooth, uniform and cause minimum resistance to flow. The bench is to be finished smooth with a slope of 1/2 in./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 not required for new 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 a minimum of 36 in.

On new monolithic sewer manhole and pipe systems and new pipe systems connecting to existing manholes, pipes entering a manhole above the lowest sewer are to project 2 in. from the inside wall. Such pipes are to be installed with a joint a minimum of 6 in. and a maximum of 18 in. from the outside manhole wall. A concrete cradle is to be provided for the pipe extending from the manhole wall a minimum distance of 36 in.

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.

Voids between exterior pipe walls and manhole walls at all pipe connections in manholes are to be filled with a non-shrink grout, concrete or mortar as approved or as shown on the plans and inspected before backfilling.

Throat rings will be mortared between all bearing surfaces enough to provide a minimum, in place, mortar thickness of 1/4 in. No more than 4 throat rings may be used on any manhole or no more than 21 in. from the top of the cone to the top of the ring and cover.

3.6.1. **Manhole Ring Encasement**. All manhole rings are to be encased with non-reinforced Class B concrete in accordance with Item 421, except for manholes in existing or new roadways. 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 or proposed roadways and where directed or shown on the plans, the exterior exposed surfaces of the ring, mortar, throat rings, and manhole surface are to be coated with a 1/8 in. minimum thickness of Trowel Mastic No. 710–23 asbestos fiber as manufactured by Flintkote, or equal before placement of concrete.

3.7. **Jacking, Boring, or Tunneling Pipe.**

3.7.1. **Jacking.** Suitable pits or trenches will 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 will in no way interfere with the operation of railroads, streets, highways or other facilities and will not weaken or damage such facilities. Barricades and lights must be furnished as directed by the Engineer to safeguard traffic and pedestrians.

The pipe to be jacked will be set on guides to support the section of pipe being jacked and to direct it in the proper line and grade. Embankment material will 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, will 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 will 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.

Generally, the pipe should be jacked from downstream end. Permissible lateral or vertical variation in the final position of the pipe from line and grade will 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 will be removed and replaced at the Contractor's expense. Jacking pits will be backfilled immediately upon completion of jacking operations.

3.7.2. **Boring.** Excavation for "Boring" pits and installation of shoring will be as outlined under "Jacking." Boring operations may include a pilot hole which must be bored the entire length of crossing and will 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 should apply as specified under "Jacking."

3.7.3. **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 will be as specified under "Jacking." The lining of the tunnel will be of the material shown on the plans. Access holes for grouting annular space should be spaced a maximum of 10 ft.

3.7.4. **Joints.** Joints for pipe for "Jacking," "Boring," or "Tunneling," will be as specified in "Sanitary Sewers," or as shown on the project plans or shop drawings as per pipe manufacturer's recommendation.

3.7.5. **Grouting of Bores or Tunnels.** Annular Space between casing pipe and limits of excavation (borehole) will be pressure grouted, unless otherwise specified on the plans.

3.8. **Concrete Encasement, Cradles, Saddles and Collars.**

3.8.1. **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 with the details and sections shown on the plans. The pipe is to be supported by pre–cast concrete blocks of the same strength as the concrete for encasement and securely tied down to prevent floatation. Encasement concrete is to be placed to a depth and width conforming with details and sections shown on the plans.

3.8.2. **Concrete Cradles.** When shown on the plans or when directed, concrete cradles are to be constructed in accordance with details and sections shown on the plans. The trench is to be prepared and the pipe supported in the same manner as described in this specification. The Strap or Tie Downs will be No. 4 rebar diameter minimum or better as determined by the Engineer.

3.8.3. **Concrete Saddles.** When shown on the plans or when directed, pipe to receive concrete saddle is to be backfilled in accordance with Section 3.4., “Bedding and Backfill,” to the spring line and concrete placed for a depth and width conforming with details and sections shown on the plans.

3.8.4. **Concrete Collars.** When shown on the plans or when directed, concrete collars are to be constructed in accordance with details and sections shown on the plans.

3.9. **Adjust or Abandon Manholes.** Existing manholes are to be adjusted or abandoned in accordance with Item 479.

3.9.1. Manholes will be lowered below subgrade before placing base materials and openings should be protected by hatch covers.

Existing manhole rings and covers which are determined by the Engineer to be in an unacceptable condition, will be removed and replaced with new rings and cover. Contractor must take all necessary measures to prevent damage to existing or new rings, cover, or cone 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 will be replaced (as approved by the Engineer) by the Contractor at his expense. The Contractor must upgrade the cone and ring to meet 30 TAC 217.55 (l).

Manholes should be adjusted after the base material has been laid and before placing of the surface course. Manholes that are going to be adjusted on an existing surface course not being replaced will be in accordance to the ”Manhole Ring and Valve Encasement Detail.” All manholes will then be raised, or lowered a sufficient height so as to be level with the finished surface course. Adjustment in height will be made by addition or removal of “throat rings” above the manhole “cone” where feasible. A minimum of two and a maximum of six throat rings will be used at each manhole. Material excavation from around the manholes will be replaced with concrete in accordance with Standard Drawings, and select materials from

the excavation (as shown on the plans or specified by the Engineer). All excess materials will be disposed of by the Contractor at his own expense in an approved location.

3.9.2. 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.

3.10. **Cut and Replace 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.

When allowed by the construction sequence 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.

As an alternate when shown by the plans, or as directed, pavement repair may be accomplished by a temporary asphalt cap of the depth and class as shown on the plans instead of a permanent repair.

3.11. **Cut and Replace Concrete Sidewalks, Driveways, and Curbs.** Existing concrete sidewalks, driveways, and curbs 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. Replacement is to be in accordance with the plans and with Item 529, Item 530, and Item 531.

As an alternate when shown by the plans, or as directed, concrete sidewalk repair may be accomplished by a temporary asphalt (4 in. depth, Type C) pavement instead of a permanent repair.

3.12. **Removing and Replacing Chain-Link and/or 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.

3.13. **Abandon Sewer Lines.** When shown on the plans, existing sewer lines, including any washouts and voids, are to be abandoned by injecting the line with a flowable cement based grout of at least 100 psi. The grout mix design and method of installation are to be approved before beginning operation.

Abandonment of sanitary sewer lines will be accomplished by installing the grout material with enough pressure and in numerous locations. The method of installation will be able to meet the requirement of completely filling the existing sanitary sewer line and any voids adjacent to the sanitary sewer line. The method will adequately provide for the removal and legal disposal of existing sewer materials in the system. The 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.

Sanitary sewer pipes smaller than 15 in. in diameter are generally not required to be grouted, unless it is required by the plans. Pipes to be abandoned will be grouted only if required by the plans.

3.14. **Television Inspection.** Immediately upon cleaning the sanitary sewers, all new sewer mains are to be televised and videotaped to determine the condition of the line and to locate service connections. The Engineer and Contractor will observe the TV inspection in progress. The Contractor is to submit 1 copy of a color DVD of the recordings and logs of the televised inspection to the Engineer.

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 Engineer. If the length of sewer line cannot be televised because of obstructions, the Contractor will clean the system as is necessary. If, as determined by the Engineer, the obstruction is attributed to a collapsed main or pipe deflection, televising will be suspended and

the remaining televising of the sewer line will be continued upon successful correction of the blockage by the Contractor at his expense.

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 method(s) used for securing passage of the camera are at the discretion of the Contractor, as approved by the Engineer.

3.14.1. **Post–Construction Television Inspection.** TV inspection is to be done 1 manhole (structure) section at a time the flow in the section being televised will be by–passed 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 will be reduced to allowable levels by temporarily plugging or blocking the flow or by–pass pumping, as approved.

3.14.2. **Obstructions and Hindrances**. All sections of the new sewer main are to be televised. Contractor is to insure the main is clean and clear of obstructions before performing televising activities. Any abnormalities such as, but not limited to, misaligned joints, cracked or defected pipe, rolled gaskets, will be repaired by the Contractor at his expense. Sections requiring repair will be re–televised to verify condition of repair.

3.14.3. **By–Pass Pumping.** The Contractor will furnish all labor, supervision, tools, equipment, appliances, and materials to perform all operations in connection with by–pass 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.

The Contractor will be required to provide adequate pumping equipment and force mains to maintain reliable sanitary sewer service in all sanitary sewer lines involved in this project. The Contractor must notify the Inspector should a surcharge occur during the televising process which results in overflows of sewage. In case of by–pass equipment failure, the Contractor will discontinue work and release sewer flows until equipment failure is corrected. The location of the pump(s), force main(s), and discharge points will be approved by the Engineer. Under no circumstances will the flow be interrupted or stopped, such that damage is done to either private or public property, or sewage flows or overflows into a storm sewer or natural waterway

The Contractor must provide by–pass pumping of sewage around each segment(s) of pipe that is to be televised and will be responsible for all required bulkheads, pumps, equipment, piping, and other related appurtenances to accomplish the sequence of pumping. A qualified person must man the pumps, on–site, at all times during the by–passing procedure

All piping, joints, and accessories must be designed to withstand the maximum by–pass system pressure, or a minimum of 50 psi, whichever is greater. During by–pass pumping, no sewage will be leaked, dumped, or spilled into or onto any area outside of the existing sanitary sewer system. When by–pass pumping operations are complete, all piping will be drained into the sanitary sewer before disassembly. The Contractor must demonstrate that the pumping system is in good working order and can successfully handle flows during cleaning and televising operations, before commencing with the cleaning and televising of the system.

3.14.4. **Video Equipment Operations.** The Contractor is to be responsible for the TV inspection equipment with an accurate footage counter which displays on the monitor the distance of the camera from the centerline of the starting manhole.

The camera height is to be adjusted such that the camera lens is always centered (1/2 ID or higher) in the pipe being televised. In no case will the television camera be pulled or propelled through the line at a speed greater than 40 ft. per minute.

3.14.5. **Post Repair TV Inspection.** Upon completion of any repairs required by the Inspector, Engineer, the Contractor will re–televise the sewer and submit these DVDs to the Inspector. These DVDs are to be permanently labeled as described in Section 2.9., “Sewer Main Television Inspection,” 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.

3.14.6. **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.

3.15. **By–Pass Pumping.** The Contractor must provide by–pass pumping of sewage and wet weather flows around each segment(s) of pipe that is to be replaced. The Contractor will be required to provide in writing a sequence of by–pass pumping for review and approval by the Inspector. Refer to the construction plans for the construction phasing and diversion requirements. The Contractor will also provide the Inspector a sketch showing the location of by–pass pumping equipment for each line segment(s) around which flows are being by–passed. The Contractor will be responsible for all required bulkheads, pumping, equipment, piping, etc., to accomplish the sequence of pumping. The Contractor must cease by–pass pumping operations and return flows to the new and/or existing sewer when directed by the Inspector. All piping(s), joints and accessories must be designed to withstand at least twice the maximum system pressure, or a minimum of 50 psi whichever is greater. During by–pass pumping, no sewage will be leaked, dumped, or spilled in or unto, any area outside of the existing sanitary sewer system. When by–pass pumping operations are complete, all pumping will be drained into the sanitary sewer before disassembly.

3.15.1. **Pump Condition.** The Contractor must demonstrate that the pumping system is in good working order and can successfully handle flows 24 hr. a day.

3.15.2. **Pump Operation.** The Contractor will plug off and pump down the sewer manhole and line segment in the immediate work area and will maintain the sanitary sewer system so that surcharging does not occur. Where work required the line to be locked beyond working hours, the Contractor must operate the by–pass pump and man the operation 24 hr. a day.

The Contractor must complete the repair, replacement, rehabilitation as quickly as possible, satisfactorily meet all tests, and repair all deficiencies as specified before discontinuing by–pass pumping operations and returning flow to the sewer manhole or line segment.

The Contractor must notify the Engineer, should a surcharge occur during the rehabilitation process resulting in the overflow of sewage. If the Contractor is unable to regain control of the situation, the rehabilitation operation should be suspended or terminated until the overflows have been controlled. Any damage to the materials, equipment and/or adjacent properties due to such surcharge will be repaired at the Contractor's expense.

The Contractor will ensure that no damage will be caused to private property as a result of by–pass pumping operations. Ingress and egress to adjacent properties will be maintained at all times. Ramps, steel plates or other methods will be employed by the Contractor to facilitate traffic over surface piping. High traffic commercial properties may require alternate methods.

If sewage accidentally drains into the storm drainage system or is spilled within the project, the Contractor will immediately stop overflow, notify the inspector, and take necessary action to clean up and disinfect the spillage using an HTH, or equal, chemical to the satisfactory of the Engineer. If sewage is spilled onto public or private property, the contractor must wash down, clean up and disinfect the spillage to the satisfaction of the Engineer.

The Contractor must locate by–pass pumping suction and discharge lines so as to not cause undue interference with the use of streets, private driveways and alleys. In cases where the suction and or discharge lines are required to be buried for vehicle/pedestrian traffic, cost for this work is incidental and includes complete restoration of any surface features disturbed. Force main piping may be laid inside of storm drainage pipes to avoid surface interference with vehicular or pedestrian traffic. Flows will not be allowed to spill from said force mains into said drainage pipes. The use of existing storm drain systems will be approved by the Engineer. Force mains laid in storm sewers will be pressure pipe and fittings.

The Contractor will not intentionally damage or remove portions of existing storm sewer system structures or sanitary sewer structures for the purpose of installing by–pass pumping system without specific approval from the Inspector. If a structure is damaged, it must be reconstructed or replaced to the satisfaction of the Engineer at the Contractor's expense.

The Department will not be responsible for any damage to the by–pass pumping system sustained by the Contractor directly or indirectly as a result of storm water runoff within streets, ditches and/or storm sewer systems. The Contractor will be responsible for any and all damage that results directly or indirectly from the interference of storm water runoff to by–pass pumping equipment, piping and/or appurtenances. It is the intent of these specifications to require the Contractor to establish adequate by–pass pumping as required regardless of the flow conditions.

4. TESTING.

4.1. **Manhole Testing.** Successful passage of a vacuum test is required for acceptance of standard sanitary sewer manholes.

4.1.1. Hydrostatic testing is to be conducted by plugging with Inspector–approved plugs 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 is to be filled to the top of the cone and observed. A loss of water within the next 30 min. period is to be considered an unsuccessful test. The Engineer is to be notified when the 30 min. test is going to be conducted.

4.1.2. **Vacuum Testing.** Manholes will be tested after installation and before backfilling with all connections (existing and/or proposed) in place. Lift holes will be plugged with an approved non-shrink grout before testing. Drop–connections and gas sealing connections will be installed before testing.

4.1.2.1. **Test Procedure.** The lines entering the manhole will be temporarily plugged with the plugs braced to prevent them from being drawn into the manhole. The plugs will be installed in the lines beyond drop connections, gas sealing connections, etc. The test head will be inflated in accordance with the manufacturer's recommendations. A vacuum of 10 in. of mercury will be drawn, and the vacuum pump will be turned off. With the valve closed, the level vacuum will 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), after two (2) min. with all valves closed the manhole will have passed the vacuum test.

4.1.2.2. **Approval.** Manholes will be approved in relation to vacuum test requirements if they meet the criteria above.

4.1.2.3. Any manhole which fails the initial test must be repaired with a non–shrink grout or other suitable material based on the material the manhole is constructed of. Manholes will be repaired on the exterior surface only before backfilling. The manhole will be retested as described above until a successful test is made. After a successful test, the temporary plugs will be removed.

4.1.2.4. **Repairs to existing manholes.** Any existing manhole which fails to pass the vacuum test will be closely examined by the Owner and the Contractor to determine if the manhole can be repaired. Thereafter, the Contractor will either repair or remove and replace the manhole as directed. The manhole will then be retested. The Owner may elect to simply remove and replace the existing manhole with a new manhole.

4.2. **Low Pressure Air Testing.** The Contractor will conduct low pressure air tests on completed sections of sewer main. The air test results will be used to evaluate materials and construction methods on the pipe line sections. Successful air tests will be mandatory for the acceptance of the lines. Copies of test results are to be made available to the Inspector upon request.

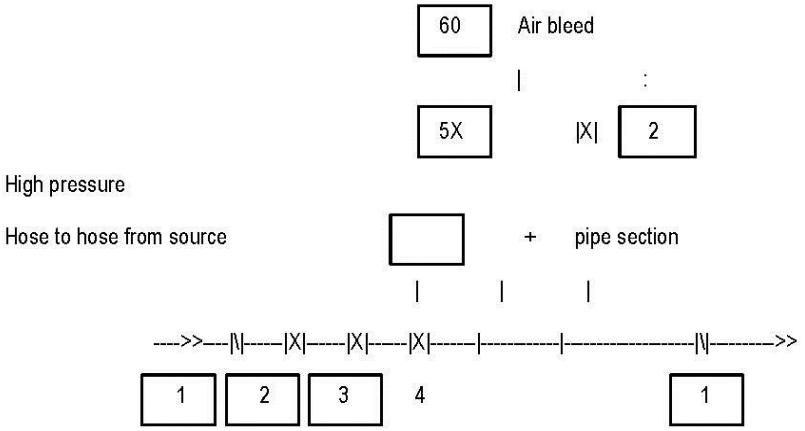
4.2.1. **Materials for Air Testing.** The Contractor is to furnish all materials and equipment for air testing including the Air Compressor.

Compressor Air Supply. Any source which will provide at least 300 cu. ft. per minute at 100 psi.

The equipment for air testing will 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 shown in Figure 1, Air Testing Equipment Assembly Order and as follows:

- hose connection;
- shut off valve;
- throttle valve;
- pressure reduction valve;
- gauge cock; and
- monitoring pressure gauge.

Figure 1
Air Testing Equipment Assembly Order



4.2.2. **Test Procedures.** The procedure for the low pressure air test will 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 will be as outlined in this section. For sections of pipe less than 36 in. average inside diameter, the following procedure will apply unless the pipe is to be joint tested. The pipe will 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 will be computed from the following equation:

$$T = \frac{0.085\ x\ D\ x\ K}{Q}$$

T = Time for pressure to drop 1.0 psi gauge in sec.

K = 0.000419xDxL, but not less than 1.0

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 cubic feet per minute per square foot internal surface will be used since a K value of less than 1.0 should not be used.

There are minimum testing times for each pipe diameter as shown below in Table 2.

Table 2
Minimum Testing Times for Each Pipe Diameter

Pipe Diameter (Inches)	Minimum Time (Seconds/Ft)	Length for Minimum Time (Feet)	Time for Longer Length (Seconds/Ft)
6	340	398	0.855
8	454	298	1.520
10	567	239	2.374
12	680	199	3.419
15	850	159	5.324
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 seconds 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 will continue for the entire test duration as outlined above or until failure. Lines with a 27 in. average inside diameter and larger may be air tested at each joint. Pipe greater than 36 in. diameter must be tested for leakage at each joint. If the joint test is used, a visual inspection of the joint will 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 will be 10 sec.

4.2.3. **Deflection Testing.** Deflection test will be performed on all flexible pipes.

For pipelines with inside diameters less than 27 in., a rigid mandrel will be used to measure deflection. For pipelines with an inside diameter 27 in. and greater, a method approved by the Engineer or Inspector will be used to test for vertical deflections. Other methods will provide a precision of $\pm$ 0.2% deflection. The test will be conducted after the final backfill has been in place at least 30 days. No pipe will exceed a deflection of 5%. If a pipe should fail to pass the deflection test, the problem must be corrected and a second test will be conducted after the final backfill has been in place an additional 30 days. The tests will be performed without mechanical pulling devices. The design 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.

4.2.3.1. **Mandrel Sizing.** The rigid mandrel will have an outside diameter (O.D.) equal to 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 two minimum wall thicknesses for O.D. controlled pipe and the average inside diameter for I.D. controlled pipe, all dimensions will be per appropriate standard. Statistical or other "tolerance packages" will not be considered in mandrel sizing.

4.2.3.2. **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 will have nine or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the mandrel will have a length of at least 75% of the inside diameter of the pipe. A proving ring will be provided and used for each size mandrel in use.

4.2.3.3. **Method Options.** Adjustable or flexible mandrels are prohibited. A television inspection is not a substitute for the deflection test. A deflectometer may be approved for use on a case by case basis. Mandrels with removable legs or runners may be accepted on a case by case basis.

4.2.4. **T.V. Camera Testing.** After the vacuum tests on the manholes and the air tests on the sewer lines are performed by the Contractor, the Contractor will perform a T.V. Camera Test with their forces and equipment

on the completed sewer lines. The T.V. test will be observed by the Department and Contractor personnel as the camera is run through the sewer lines.

Any sections in the sewer lines found by the camera such as broken pipe, misaligned pipe joints (that could result in a leak), etc. as determined to be damaged or abnormal are to be repaired or replaced by the Contractor at his expense.

5. MEASUREMENT

5.1. **Sewer Excavation and Non–stabilized Backfill.** Sewer excavation and non–stabilized backfill will be measured in accordance with Item 400, "Excavation and Backfill for Structures" but will not be measured for payment and will be considered subsidiary to the sewer line installation.

5.2. **Trench Excavation Protection.** Trench excavation protection will be measured by the foot along the centerline of the trench where the depth exceeds 5 feet.

5.3. **Sanitary Sewers.** Sanitary sewers will be measured 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 shown on the plans, in accordance with this specification, complete and accepted.

Plugging existing sewer lines will be considered subsidiary to the pipe installation.

5.4. **Sanitary Sewer Cleanouts.** One way cleanouts will be measured by each installed.

5.5. **Sanitary Sewer Laterals.** The sanitary sewer laterals will be measured from the centerline of the sewer main to the connection at or within the customer's property line or premises. Wyes, tees, and bends of any kind will not be paid for separately for laterals but will be measured for payment by each lateral to be installed.

5.6. **Jack, Boring or Tunneling.** Jacking, Boring or Tunneling will be measured by the foot of bore or tunnel as measured from face to face of jacking pits.

5.7. **Carrier Pipe.** Carrier pipe used in bores and tunnels or backed into place will be measured by the foot of pipe installed from end to end of pipe to the limits shown on the plans.

5.8. **Casing or Liners.** Casing or liners for open cut, split casing, bores and tunneling, where required on the plans, of the size and material required will be measured by the foot actually installed in accordance with the plans.

5.9. **Vertical Stacks.** Vertical Stacks will be measured by the foot. Footage will be measured from the finish grade elevation (centerline) minus invert elevation minus 8 ft.

5.10. **Manhole Structures.** Manhole structures will be measured by each manhole structure complete in place.

Rings and watertight covers, concrete ring encasement and I&I barriers will not be measured for payment, but will be considered subsidiary to the manhole.

5.11. **Adjusted or Abandoned Manholes.** Manholes adjusted or abandoned will be measured by each manhole.

The excavation and backfill required and I&I barrier for adjusting manholes will not be measured for payment, but will be considered subsidiary to this Item.

5.12. **Flowable Backfill.** Flowable Backfill will be measured by the cubic yard.

5.13. **Select Bedding Material.** Select Bedding Material will be measured by the cubic yard when directed to be used for Rigid Pipe installations as dimensioned on the plans.

Select bedding material is always required for flexible pipe installation. Select bedding material will not be measured for payment, but will be considered subsidiary to this Item.

5.14. **Concrete Encasement, Cradles, Saddles and Collars.** Concrete encasement, cradles, saddles and collars for pipe will be measured by the cubic yard complete in place. Reinforcing if required will not be measured.

5.15. **Concrete Curb, Sidewalks, and Driveways.** For concrete curbs, sidewalks, and driveways required to be removed and replaced due to placement of sewer lines, removal of the existing concrete and pavement replacement will be measured by the foot or by the square yard as shown on the plans.

5.16. **Cut and Replace Pavement.** The work to be done in the cutting and replacement of pavement will be measured by the square yard as shown on the plans.

5.17. **Removing and Replacing Chain–Link and/or Wire Fence.** Removing and Replacing Chain–Link and/or Wire Fence will be measured by the foot of fence removed and replaced, regardless of the type or height of the fence, complete in place. The existing fence materials may be reused unless, the existing materials were damaged during removal and should not be reused, the Contractor is to provide new material for the replacement work at his expense.

5.18. **Abandon Sewer Lines.** Abandon Sewer Lines will be measured by foot complete in place.

5.19. **Television Inspection.** Television Inspection will be measured by the foot of main televised for TV inspection according to the size ranges specified on the plans. The foot measurement will be determined as the distance from the center of sewer manhole to the center of sewer manhole.

5.20. **Hydrostatic Pressure Test.** Hydrostatic testing of manholes will not be measured for payment.

5.21. **By–pass Pumping.** By–pass Pumping will be measured by the "Lump Sum" as the work progresses. No additional measurement or payment will be made for conditions caused by the Contractor during construction.

5.22. **Removal of Existing Sanitary Sewer Manholes.** Removal of Existing Sanitary Sewer Manholes will be measured for payment by each sanitary sewer manhole removed.

The excavation, backfill required, hauling, disposing and surface restoration will not be measured for payment, but will be considered subsidiary to this Item.

5.23. **Removal of Existing Sanitary Sewer Lines.** Removal of Existing Sanitary Sewer Lines" will be measured by foot of sanitary sewer lines removed of the various sizes and types.

The excavation, backfill required, hauling, disposing and surface restoration will not be measured for payment, but will be considered subsidiary to this Item.

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 will be included in the unit price bid for the sanitary sewer pipe installation. Select bedding and stabilized backfill will be paid for under their own items of work.

6.2. **Trench Excavation Protection.** Payment will be made at the unit price bid for "Sanitary Sewer (Trench Excavation Protection)" in place. Payment will include 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/diversion of water to provide adequate/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 will be made at the unit price bid for “Sanitary Sewer” of the size, and type (when a specific type is required) specified on the plans complete in place.

Sanitary sewer service connections will be paid for at the unit price bid for “Sanitary Sewer (Open Cut)” or “Sanitary Sewer (Bore)” of the size specified per foot complete in place.

6.4. **Sanitary Sewer Cleanouts.** Payment will be made at the unit bid price for “Sanitary Sewer (Cleanout)” of the size and type (when a specific type is required) specified on the plans, complete in place.

6.5. **Sanitary Sewer Laterals.** Payment will be made at the unit price bid for “Sanitary Sewer (Lateral Pipe)” of the size and type (when a specific type is required) specified on the plans per each complete in place.

6.6. **Jacking, Boring or Tunneling.** “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), labor, tools, equipment and incidentals necessary to complete the work, including excavation, grouting, backfilling, safety fencing, restoration to original ground conditions, and disposal of surplus materials.

6.7. **Carrier Pipe.** Carrier pipe of the size and type specified on the plans will be paid for at the contract unit price bid for "Carrier Pipe for Jacking, Boring or Tunneling," “Carrier Pipe (Open Cut),” or “Carrier Pipe (Bore)” per foot of pipe installed and measured as prescribed above, complete in place.

6.8. **Casing or Liners.** Casings or liners of the size, type and installation method specified on the plans will be paid for at the contract unit price bid for "Casing or Liner (Open Cut)" or “Casing or Liner (Bore)” per foot of casing or liner installed and measured as prescribed above, complete in place.

6.9. **Vertical Stacks.** Payment will be made at the unit price bid per foot, complete in place.

6.10. **Manhole Structures.** Payment for Manhole structures, including the stack, rings, watertight covers, steps and concrete ring encasement, I&I Barriers, will be made at the unit price bid for “Sanitary Sewer Manhole Structure (Complete)” of the type specified.

6.11. **Abandon or Adjust Manholes.** Manholes abandoned or adjusted will be paid for at the unit price bid for “Sanitary Sewer (Abandon Manhole)” or “Sanitary Sewer (Adjust Manhole).”

6.12. **Flowable Backfill.** Payment for “Flowable Backfill” will be made at the unit price bid for “Sanitary Sewer (Flowable Backfill),” but not to exceed the minimum trench width specified in Section 3.3.1., “Width of Trench.”

6.13. **Select Bedding Material.** Payment for “Select Bedding Material” for rigid pipe installations will be made at the unit price bid for “Sanitary Sewer (Select Bedding).” The select bedding for flexible pipes will not be paid for directly but will be subsidiary to the flexible pipe.

Payment for additional excavation must be approved by the Engineer.

6.14. **Concrete Encasement, Cradles, Saddles and Collars.** Payment will be made at the unit price bid for “Sanitary Sewer (Concrete Encasement, Concrete Cradles, Concrete Saddles and Concrete Collars).”

6.15. **Concrete Curbs, Driveways, and Sidewalks.** Payment for replacement of curbs, driveways, and sidewalks will be made at the unit price bid for “Sanitary Sewer (Cut and Replace Concrete Sidewalk),” “Sanitary Sewer (Cut and Replace Concrete Sidewalk)(Asphalt),” “Sanitary Sewer (Cut and Replace Concrete Driveway),” and “Sanitary Sewer (Concrete Curb).”

6.16. **Cut and Replace Pavement.** Payment will be made at the unit price bid for “Sanitary Sewer (Cut and Replace Pavement)” of the type and replacement material shown on the plans.

Any work done due to damage to curbs, sidewalks and driveways outside the limits shown on the plans or approved in advance will not be measured for payment but is to be replaced at the Contractor's expense.

6.17. **Remove and Replace Chain–Link and/or Wire Fence.** Payment will be made at the unit price bid for "Sanitary Sewer (Remove and Replace Fence)."

Any removal or damage to existing fences outside the limits shown on the plans or not approved in advance will not be measured for payment but is to be restored at the Contractor's expense.

6.18. **Abandon Sewer Lines.** Payment will be made at the unit price bid for "Sanitary Sewer (Abandon Pipe)" of the size shown on the plans.

6.19. **Television Inspection.** 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 "Sanitary Sewer (Television Inspection)" of the various size ranges specified on the plans. This price will include all labor, materials, equipment, tools, logging, and all incidentals necessary to complete the work.

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. No additional payment will be made for additional setups required due to obstructions encountered during televising.

6.20. **Hydrostatic Pressure Test.** No direct payment will be made for hydrostatic testing manholes.

6.21. **By–Pass Pumping.** The work performed and material furnished in accordance with this Item and measured as provided under "Measurement" will be paid for the unit price bid for "Sanitary Sewer (By–Pass Pumping)." Partial payments of this "Lump Sum" bid will be 40% paid when initial set–up and operation of the by–pass system begins, and the remaining 60% paid when the by–pass pumping operations for the entire job are completed.

Vacuum testing of new manholes will not be a pay item. The cost of this work will be included in the bid price for the new manhole.

6.22. **Removal of Existing Sanitary Sewer Manholes.** Payment will be made at the unit price bid for "Rmv Existing Sanitary Sewer Manholes."

6.23. **Removal of Existing Sanitary Sewer Lines.** Payment will be made at the unit price bid for "Rmv Existing Sanitary Sewer Lines" regardless of size and type specified on the plans per foot.

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.

Special Specification 7112
Water Mains and Service Lines

1. DESCRIPTION

Provide and install a complete water main system in accordance with the plans and specifications and in compliance with the Department's Utility Accommodation Policy (UAP)(Title 43, T.A.C., Sections 21.31-21.55). The water mains must be of the sizes, materials and dimensions shown on the plans and must include all pipe, all joints and connections to new and existing pipes, all valves, fittings, fire hydrants, pipe joint restraint systems, blocking, and incidentals, as may be required to complete the work.

The abbreviations AWWA, ASA, ASTM, and ANSI, as used in this specification, refer to the following adjustments 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 to be construed to mean the latest standard in effect on the date of the proposal.

2. MATERIALS

All materials used in this project are to be new and unused unless otherwise specified on the plans, specifications or the proposal.

2.1. **Ductile-Iron Pipe and Fittings.**

2.1.1. **Ductile-Iron Pipe: 3 Inch through 64 Inch.** All ductile-iron pipe is to be manufactured by process of centrifugal casting and is to conform to AWWA Standard C-151, "American Standard for Ductile-Iron Pipe Centrifugally Cast with push-on or mechanical joints for Water or Other Liquids," unless otherwise specified.

Pipe is to conform, in accordance with Table 1, to the following pressure classes based on Type 3 bedding conditions, a depth of bury of 6 ft. and a working pressure of 150 psi:

Table 1
Pipe Pressure Classes

Pipe Size	Pressure Class (psi)
3" through 12"	350
16" through 20"	250
24"	200
30" through 64"	150

Dimensions and tolerances for each nominal pipe size must be in accordance with table 51.5 (push-on) or table 51.5 (mechanical joint) of AWWA Standard C-151 for pipe with a nominal laying length of 20 ft.

All pipe is to have a standard water works cement mortar lining in accordance with AWWA Standard C-104 with outside coating per Section 51.8.1 of AWWA Standard C-151.

Exterior coating is to consist of a nominal one mil thick asphaltic material applied to the outside of the pipe as described in Section 51.8 of AWWA Standard C-151.

Rubber joint gaskets utilized on ductile-iron pipe are to conform to AWWA Standard C-111, latest revision.

Each length of pipe must bear identification markings in conformance with Section 51.10 of AWWA Standard C-151.

Manufacturer is to take adequate measure during pipe production to assure compliance with AWWA Standard C-151 by performing quality-control tests and maintain results of those tests as outlined in Section 51.14 of that standard.

The Engineer may at no cost to the Contractor, subject random lengths of pipe for testing by an independent laboratory for compliance with this specification. Any visible defects or failure to meet quality standards will be grounds for rejecting the pipe.

2.1.2. **Fittings for Ductile-Iron Pipe.** Unless otherwise modified or supplemented, the latest revision of AWWA Standard C-110 for Ductile-Iron Fittings, 3 in. through 48 in. for Water and Other Liquids and AWWA Standard C-153 for Ductile-Iron Compact Fittings, is to govern the design, manufacture, and testing of all fittings under this specification.

For 3 in. through 24 in. size range, the pressure rating of all fittings is to be a minimum of 250 psi. The working pressure for all fittings of sizes greater than 24 in. is to be a minimum of 150 psi, unless a change in pressure rating is shown on the plans.

Fittings are to be furnished with the type of end combination specified.

Mechanical joint fittings and anchor type fittings are to be furnished complete, with glands, gaskets, and bolts. Bolts for mechanical joints are to be ASTM A-536 specially alloyed and heat treated ductile iron conforming to ANSI/AWWA Standard CIII/A21.IL.

Flanged fittings are to be faced and drilled in accordance with ASA Specifications B 16.1, Class 125.

Anchor fittings are to be furnished in size and type or length as specified.

The exterior of all fittings is to be provided with a petroleum asphaltic coating in accordance with AWWA Standard C-110. The interior of flanged fittings supplied under this Item is to be either cement-mortar lined in accordance with AWWA Standard C-104 or lined with a petroleum asphaltic material in accordance with the latest revision of AWWA Standard C-110 as specified. The interior of all other fittings supplied under this Item is to be cement-mortar lined in accordance with the latest revision of AWWA Standard C-104.

Fittings for 2 in. size are to be manufacturer's standard design, designed in accordance with applicable design standard of AWWA Standard C-110.

2.2. **Concrete Steel Cylinder Pipe and Fittings: 20 Inch and larger.** The design, component materials, manufacture and testing of all concrete-steel cylinder pipe and fittings is to conform to AWWA Standard C-301 for "Pre-Stressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids." Except where otherwise indicated in the contract documents, all pipe is to be AWWA Class 150 and is to be designed for an internal working pressure of 150 psi and a minimum external load equivalent to 6 ft. of earth cover. Where the depth of bury of the pipe is indicated to be greater than 6 ft. in the contract specifications or on the drawings the design of the pipe is to suitable for the earth loads indicated.

All data submitted by the Contractor is to include a tabulated layout schedule with reference to the stationing and grade lines shown on the plans. The Contractor is to provide a design summary for each size of pipe furnished for each pressure and depth of bury.

Each special length of straight pipe is to have plainly marked on the inside of the bell end the class of pipe and identification marks sufficient to show the proper location of the pipe by reference to layout drawings.

Pipe 20 in. through 42 in. in size is to be furnished in nominal lengths of 20 to 32 ft.; pipe 48 in. through 72 in. in size is to be furnished in nominal lengths of 16 ft. except as this requirement is to be modified by design requirements of the particular job.

Each joint of pipe is to be furnished with a rubber gasket and a 12 in. diaper.

2.3. **Steel Pipe, Fittings and Flanges.**

2.3.1. **Steel Pipe.** Steel pipe with nominal diameters from 6 in. through 20 in. must conform to ASTM A 106, A 53 Grade B or A 139 Grade B standard weight class as the minimum.

Steel Pipe greater than 20 in. must conform to AWWA C-200 and AWWA M-11 except as modified or as required by the Engineer for special circumstances.

Pipe must be designed for a minimum of 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.

Pipe for use with sleeve-type couplings must have plain ends at right angles to the axis.

Pipe ends are to be beveled and suitable for field butt welding except as otherwise specified.

Protective coatings and linings are to conform to AWWA Standard C-203, “Coal-Tar Protective Coatings and Linings for Steel Pipelines - Enamel and Tape Hot Applied.”

Pipe length is to be nominal 50 ft. lengths except for specials or as otherwise specified on the plans. Manufacturer is to 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 conform to the dimensions of AWWA Standard 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 11.25° (One cut elbow up to 22.5°). If elbow radius is less than 2.5 x pipe diameter, stresses must be checked per 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 per the requirements of AWWA C-200 Section 5.2.2.1.

2.3.2.1. **Rolled-Groove Rubber Gasket Joint.** The standard joint must be rolled-groove rubber gasket joint unless otherwise noted on the plans. Rolled-grooved rubber gasket joints must conform to AWWA C-200 Standard and as shown in Chapter 8 of AWWA M-11.

The O-ring rubber gasket must have sufficient volume to approximately fill the area of the groove and must conform to 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 is not to exceed 1.00/D where D is the outside diameter of the pipe in inches with a pull-out of 1 in.

Rolled-Groove Rubber Gasket Joints may be furnished only by a manufacturer who has furnished pipe with joints of similar design for comparable working pressure. Pipe diameter, pipe length, and wall thickness that has been in successful service for a period of at least 5 yrs.

2.3.2.2. **Lap weld.** Lap field welded joints must be used where tied joints are indicated 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.

2.3.2.3. **Mechanical Couplings.** Mechanical couplings where indicated on the plans must be Smith Blair Style 411, Baker Style 200, Brico Depend-O-Loc or equal. Insulating mechanical couplings where indicated 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 conform to AWWA C-219.

Pipe ends for mechanical couplings must conform to AWWA C-200 and 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 conforming to AWWA C-210. The inside lining must be continuous to the end of the pipe.

2.3.3. **Steel Flanges.** Steel pipe flanges, where called for on the plans, are to conform to AWWA Standard C-207, "Steel Pipe Flanges" for Class D for operating pressures to 175 psi on 4 in. through 12 in. diameter, and operating pressures to 150 psi on diameters over 12 in.; or Flanges must be AWWA C-207 Class E for operating pressures up to 275 psi; or Flanges must be AWWA C-207 Class F for pressures to 300 psi. (drilling matches ANSI B 16.5 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.

Gaskets: Full face, 1/8 in. thick, cloth-inserted rubber, Garlock 3000, John Crane Co. Style 777 or equal.

2.3.3.1. Bolts for flanges located indoors and in enclosed vaults and structures must be carbon steel, ASTM A-307, Grade B for class B and D flanges and nuts must be ASTM A-563, Grade A heavy hex. Bolts for class E and F flanges must be ASTM A-193 grade B7 and nuts must be ASTM A-194, grade 2 H, heavy hex.

2.3.3.2. Bolts for buried and submerged flanges and flanges located outdoors above ground or in open vaults in structures must be Type 316 stainless steel conforming to ASTM A-193, Grade B8M, Class 1 for class B and D Flanges with ASTM A-194, Grade 8M nuts. For Class E and F flanges the bolts must be ASTM A-194 grade 2H nuts with bolt and nuts to be zinc plated in accordance with ASTM B-633.

2.3.4. **Linings and Coatings.**

2.3.4.1. **Polyethylene Tape Coating.**

2.3.4.1.1. **Prefabricated Multi-layer Cold Applied Tape Coating.** The coating system for straight-line pipe must be in accordance with AWWA Standard C-214. The system must consist of three layers of polyethylene material with a nominal thickness of 80 mills when complete

2.3.4.1.2. **Coating Repair.** Coating repair must be made using tape and primer conforming to AWWA Standard C-209, Type II. The tape and primer must be compatible with the tape system used for straight-line pipe.

2.3.4.1.3. **Coating of Fittings, Specials and Joints.**

2.3.4.1.3.1. Fittings, specials and joints which cannot be machine coated in accordance with above, must be coated in accordance with AWWA Standard C-209. Prefabricated tape must be Type II and must be compatible with the tape system used for straight-line pipe. The system must consist of 3 layers consisting of the following: Alternate coating methods for fittings specials and field joints would be Shrink sleeves per C-216, or paint per C-210, C-218, or C-222. The field coating must completely encapsulate the joint bonds on O-ring joints.

2.3.4.1.3.2. Coating Repair. Coating repair for fittings and specials must be in accordance with the procedure described above for straight-line pipe and as recommended by the manufacturer.

2.3.4.2. **Other Coating Systems.** Other Coating Systems if specified must be governed by the appropriate American Water Works Association standard.

2.3.4.3. **Cement Mortar per AWWA C-205.**

2.3.4.3.1. **Cement Mortar Lining of Steel Pipe.**

2.3.4.3.1.1. **Cement-mortar.** Except as otherwise provided in AWWA Standard C-205, interior surface of all steel pipe, fittings, and specials must be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with AWWA Standard C-205.

2.3.4.3.1.2. **Pipe Ends.** The pipe ends must be left bare where field joints occur as shown on the Plans. Ends of the linings must be left square and uniform. Feathered or uneven edges will not be permitted.

2.3.4.3.1.3. **Defective linings.** Defective linings as identified in 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 in order to avoid feather edged joints.

2.3.4.3.1.4. **Storage and Shipping.** Cement mortar lining must be kept moist during storage and shipping.

2.3.4.3.2. **Fittings.** Fittings must be lined and coated per AWWA C-205.

2.3.5. **Steel Casing Pipe.** The component materials, manufacture and testing of all steel pipe will conform to AWWA Standard C-200 for “Steel Water Pipe 6-in. and Larger.” The specified pipe size will be the actual inside diameter of the pipe, special or fitting in inches. The diameter and wall thickness of all steel pipe will conform to those shown on the plans.

Pipe will be either Grade A or Grade B, conforming to ASTM Designation A-53.

Pipe ends will be beveled and suitable for field butt welding except as otherwise specified.

Pipe will receive a protective coating conforming to AWWA Standard C-203, “Coal-Tar Protective Coatings and Linings for Steel Pipelines – Enamel and Tape Hot Applied.”

Pipe length will be nominal 40 ft. lengths except for specials or as otherwise specified on the plans. Standard and specials will be within 1/16 in. (plus or minus) of the specified or theoretical lengths.

2.3.6. **Stainless Steel Casing Spacer.** The Casing Spacers are to be constructed of T-304 stainless steel segments which bolt together forming a shell around the carrier pipe. The spacers are to be designed with risers (when needed) and runners to support the carrier within the casing and maintain a minimum clearance of 0.50 in. between the casing ID and the spacer OD. On carrier pipes with an OD less than 16 in., each spacer is to have four (4) riser and runner combinations - two (2) on each segment. On carrier pipes with an OD of 16-in. and larger, each spacer is to contain six (6) riser and runner combinations - four (4) on the bottom segment and two (2) on the top segment. T-304 stainless steel bolts and nuts are to be supplied with the spacers.

The band is to be manufactured of 8 in. wide, 14 gauge, T-304 stainless steel material. The risers are to be constructed of 10 gauge, T-304 stainless steel having a minimum length of 6 in.

Abrasion resistant runners, having a minimum length of 7 in. and a minimum width of 1 in. are to be attached to each riser to minimize friction between the casing pipe and the carrier pipe as it's installed. Runner material is to be of glass reinforced plastic with compression strength of 25,000 psi, flexural strength of 32,000 psi and tensile strength of 22,000 psi. The ends of all runners are to be beveled to facilitate installation over rough weld beads or the welded ends of misaligned or deformed casing pipe.

Interior surfaces of the circular steel shell are to be lined with PVC or EPDM having a minimum thickness of 0.090-in. with a hardness of durometer "A" 85-90.

Spacers will be placed a maximum of 1 ft. on each side of the bell joint and every 8 to 12 ft. apart thereafter.

2.3.6.1. **Physical Properties.**

2.3.6.1.1. **Band and Risers.**

- Band - 14 Gauge, T-304 Stainless Steel
- Riser - Minimum 14 Gauge, T-304 Stainless Steel

2.3.6.1.2. **Liner - EDPM or Polyvinyl Chloride.**

- Thickness - 0.090 in. minimum
- Hardness - Durometer "A" 85-90
- Dielectric Strength - 1/8 in. thick
- 60,000 VPM
- Water Absorption – 1% maximum
- Overlap edges

2.3.6.1.3. **Studs, Nuts and Washers.**

- T-304 Stainless Steel - 5/16: 18 in. x 2 in. studs
- 5/16 in. hex nuts
- 5/16 in. washers SAE 2330

2.3.6.1.4. **Runners.** 1 in. wide or 2 in. wide glass filled polymer runners

Sizes Available:

- Length – 7 in.
- Effective heights (all lengths) – 1 in. and 1-1/2 in.

Materials Specifications:

- Tensile Strength (ASTM D-638) - 22,000 psi
- Flexural Strength (ASTM D-790) - 32,000 psi
- Compression Strength (ASTM D-695) - 25,000 psi
- Deflection Temperature @ 264 psi (ASTM D-648) - 435°F (224°C)
- Deformation Under Load, @ 122°F (50°C) - 4000 lb. Load, - (ASTM D-648) 1.2%

2.3.6.1.5. **Welding.** All risers are to be welded by MIG welding. Welds are to be fully passivated.

2.3.7. **Quality Assurance Commercial Standards.** (All manufacturing tolerances referenced in the below standards apply unless specifically excluded).

- ANSI/AWWA C-200 Standard for Steel Water Pipe 6 Inches and Larger.

- ANSI/AWWA C-205 Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 Inch and Larger-Shop Applied
- ANSI/AWWA C-206 Standard for Field Welding of Steel Water Pipe.
- ANSI/AWWA C-207 Standard for Steel Pipe Flanges for Water Works Service, 4 Inch – 144 Inch.
- ANSI/AWWA C-208 Standard for Dimensions for Fabricated Steel Water Pipe Fittings.
- ANSI/AWWA C-209 Standard for Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
- ANSI/AWWA C-210 Standard for Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
- ANSI/AWWA C-214 Standard for Tape Coating Systems for the Exterior of Steel Water Pipelines.
- ANSI/AWWA C-216 Standard for Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
- ANSI/AWWA C-218 Standard for Liquid Coating the Exterior of Aboveground Steel Water Pipelines and Fittings.
- ANSI/AWWA C-219 Standard for Bolted Sleeve-Type Couplings for Plain-End Pipe.
- ANSI/AWWA C-222 Standard for Polyurethane Coatings for the Interior and Exterior of Steel Water Pipelines and Fittings.
- AWWA M-11 Steel Pipe - A guide for Design and Installation
- ASTM A-106 Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
- ASTM A-53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
- ASTM E-165 Method for Liquid Penetrant Examination.
- ASTM E-709 Guide for Magnetic Particle Examination.
- ASME Section V Nondestructive Testing Examination.
- ASME Section IX Welding and Brazing Qualification.
- AWS B2.1 Standard for Welding Procedure and Welding Qualifications.

2.3.8. **Qualifications.**

- The pipe and fittings must be designed, constructed and installed in accordance with the best practices and methods and must comply with these specifications as applicable.
- Pipe must be the product of one manufacturer. All pipe manufacturing including cylinder production, lining, coating and fittings must be produced by one manufacture. The pipe manufacturer must have a certified quality assurance program. This certified program must be ISO 9001: 2000 or other equivalent nationally recognized program.

2.4. **Polyvinyl Chloride Pipe and Fittings.**

2.4.1. **Polyvinyl Chloride Pipe, 4 Inch through 12 Inch.** 4 in. through 12 in. polyvinyl chloride (PVC) pressure pipe is to be made from class 1245A or 1245B compounds as determined by ASTM Standard D-1784 and providing for a hydrostatic test basis (HBD) of 4000 psi.

All PVC pipe must conform to AWWA Standard C-900. The Manufacturer must supply the Engineer an affidavit that the materials supplied comply with all applicable requirements of AWWA.

All AWWA C-900 PVC pipe must have a pressure rating of 150 psi and a dimension ratio of 18 with cast iron equivalent outside diameters unless otherwise specified. It must have a sustained pressure requirement of 500 psi and a minimum burst pressure of 755 psi. AWWA C-900 PVC pipe installed in High Pressure Zones to have a pressure rating of 200 psi and a dimension ration of 14, a sustained pressure requirement of 650 psi and a minimum burst pressure of 985 psi. It must be furnished in nominal 20 ft. lengths, and must be self-extinguishing.

Dimensions and tolerances for each nominal pipe size are to be in accordance with Section 2.2, Table 1 of AWWA C-900.

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 pipe must meet requirements provided in ASTM D-3139 and ASTM D-2122. The gasket must be reinforced with a steel band and must conform to ASTM F-477.

Each length of pipe furnished is to bear identification markings in conformance with Section 2.6 of AWWA C-900.

2.4.2. **Polyvinyl Chloride (PVC), 14 Inch through 36 Inch.**

2.4.2.1. **Scope**. This product specification covers 14 in. nominal diameter through 36 in. nominal diameter polyvinyl chloride (PVC) potable water transmission pipe with integral bell and spigot joints. The pipe must be extruded from Class 12454-A or 12454-B PVC compound as defined in ASTM D-1784 and provide for a hydrostatic design basis (HDB) of 4,000 psi. The pipe outside diameters must conform to dimensions of cast iron pipe (CI). All pipe furnished must be in conformance with American Water Works Association (AWWA) Standard C-905-97.

Pipe must be homogenous throughout. It must be free from 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 from nicks and scratches. Joining surfaces of spigots and joints must be free from gouges and imperfections that could cause leakage.

2.4.2.2. **Definitions.** All definitions are defined according to AWWA C-905-97 Section 1.2 Definitions:

- Dimension Ratio (DR) – The ratio of the pipe outside diameter to the minimum wall thickness. The quotient is rounded to the nearest 0.5 when necessary.
- Pressure Rating (PR) – The nominal pressure rating of transmission pipe is determined from formulas in Section 5: Transmission-Pipe Ratings AWWA C905-97 using a safety factor of 2.0. There is no allowance for surge pressure in the pressure rating.

2.4.2.3. **General.** Except as noted on the plans or procurement specifications for specific jobs, all C-905 PVC pipe must have a pressure rating of 235 PSI and a dimension ratio 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 Table 2 Dimensions for PVC Transmission Pipe with CI Outside Diameter of Section 3 Pipe Requirements in AWWA C-905-97. All pipe 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. unless otherwise noted. 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, which 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 meet requirements provided in ASTM D-3139 and ASTM D-2122. The gasket must be reinforced with a steel band and must conform to ASTM F-477.

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 not more than 5 ft. on the pipe. The minimum required markings are

given in the list below. Marking requirements must be in conformance with Section 4.7 Marking Requirements of AWWA C-905-97:

- Nominal size and OD base (for example, 24 CI);
- PVC;
- Dimension Ratio (for example, DR 25);
- AWWA pressure rating (for example, PR 165);
- AWWA designation number for this standard (AWWA C-905);
- Manufacturer's name or trademark; and
- Manufacturer's production code, including day, month, year, shift, plant, and extruder of manufacture.

2.4.3. **AWWA C-900 and C-905 Requirements.** Bundle pipe in pallets for ease of handling and storage. Package Pipe bundles to provide structural supports to insure that weight of upper units do not cause deformation to pipe in lower units.

Pipe bundles showing evidence of ultra violet radiation "sunburn" on exposed pipe as may be caused from extended unprotected storage conditions will not be accepted.

The pipe must be in compliance with AWWA Standards C-900 or C-905-97 as applicable by performing quality control-control test and maintaining results of those test as outlined in Section 3 of that standard. Submission of product constitutes certification of compliance with standard.

Pipe is intended for use as an underground, direct bury pressure pipe for transport of potable water. The expected life of pipe system after installation is 25 to 50 yr.

Provide a 1 yr. warranty for all material sold and delivered for use and incorporation into water system. Warranty take effect on the date that pipe is accepted by the Department.

Provide user reference and claims history for further investigation, prior to the Engineer rendering final decision on the acceptance of product furnished.

2.4.3.1. Table 2 identifies the approved manufactures and products for C-900 Polyvinyl Chloride (PVC) pressure pipe for 4 in. through 12 in.

Table 2
Approved Manufacturers for C-900 Polyvinyl Chloride (PVC) pressure Pipe, 4 in. through 12 in.

Manufacturer	Type
PW Eagle	C900 PVC
J–M Manufacturing Company	C900 PVC
Certain Teed Corporation	C900 PVC
Diamond Plastics Corporation	C900 PVC Lok–21 PVC
North American Pipe Corporation	C900 PVC
VinylTech Corporation	C900 PVC
JM Eagle	C900 PVC
Northern Pipe Products, Inc.	C900 PVC
Underground Solutions	Fusible C900 PVC
Pipelife Jet Stream	C900 PVC

2.4.3.2. **Test.**

- For both C-900 and C-905, water system may at no cost to manufacturer, subject random lengths of pipe for testing by an independent laboratory for compliance with this specification. Any visible defects of failure to meet quality standards here in will be grounds for rejecting entire order.
- For C-905: The manufacturer must pressure test all pipe, including the joint, which is marked with the designation number of AWWA C-905-97 at 73.4ºF +/- 3.6ºF (23ºC +/- 2ºC). Each length of pipe must be

proof tested at twice the pressure rating listed in Table 3 Transmission-Pipe Pressure Rating of AWWA C-905-97 Sec. 4.6 Pressure Strength and Hydrostatic Proof.

2.4.3.2.1. **References.** The documents listed below are referenced in this specification:

- AWWA C-905-97; Polyvinyl Chloride (PVC) Water Transmission Pipe Nominal Diameters 14 Inch through 36 Inch.
- ASTM D-1784; Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.
- ASTM D-2122; Standard Method of Determining Dimensions of Thermoplastic Pipe and Fittings.
- ASTM D-3139; Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- ASTM F-477; Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

2.4.4. **Bends and Fittings for PVC Pipe 4 Inch through 36 Inch.** All bends and fittings must conform to the same requirements in accordance with Section 2.1.2., "Fittings for Ductile-Iron Pipe."

2.4.5. **Joint Restraint System for PVC C-900/C-905.**

2.4.5.1. **Scope.** This specification covers pipe joint restraint systems to be used on domestic water mains for PVC C-900 pipe sizes 4 in. through 12 in. diameter and PVC C-905 pipe sizes 16 in. through 24 in. diameter, and for Ductile Iron pipe sizes from 4 in. through 24 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.

2.4.5.2. **General Requirements.**

- Underwriter Laboratories (U.L) and Factory Mutual (FM) certifications are required on all restraint systems.
- Unless otherwise noted, restraint systems to be used on PVC C-900 and C-905 pipe must meet or exceed A.S.T.M. Standard F1674-96, "Standard Test Methods for Joint Restraint Products for Use with PVC Pipe," or the latest revision thereof. Restraint systems used on ductile pipe must meet or exceed U.L. Standard 194
- Non-metallic restrained joint pipe and couplings must be utilized specifically for C-900 PVC pipe and fittings in sizes 4 in. – 12 in.
- Each restraint system must be packaged individually and include installation instructions.

2.4.5.3. **Specific Requirements.**

2.4.5.3.1. **Restrainer for PVC C-900/C-905 & Ductile Iron Push-on Type Connections.** Pipe restraints must be utilized to prevent movement for push-on D.I. or PVC (C-900&C-905) (compression type) bell and spigot pipe connections or where a transition or flexible coupling has been used to join 2 sections of plain-end pipe D.I. or PVC (C-900&C-905). The restrainer may be adapted to connect a plain end D.I. or PVC pipe to a ductile iron mechanical joint (MJ) bell fitting. The restrainer must not be directionally sensitive.

The pipe must be restrained by a split retainer band. The band must be cast ductile iron, meeting or exceeding ASTM A-536-80, Grade 65-45-12. The inside face or contact surface of the band must be of sufficient 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 and 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 over-stress the pipe, but will provide full non-directionally sensitive restraint at the rated pressures.

Bolts and nuts used to attach the split retainer ring must comply with ANSI B-18.2/18.2.2, SAE Grade 5. Tee-bolts, nuts and restraining rods must be fabricated from high-strength, low-alloy steel per AWWA C-111-90, ANSI/AWWA C-111/A-21.11.

The split ring type non-directionally sensitive restrainer system must be capable of a test pressure twice the maximum sustained working pressure listed in Section 2.4.5.3.4., “Fitting Restraint for Ductile Iron Pipe (only)” and be for both D.I. and/or PVC C-900.

Restraint systems sizes 6 in. through 12 in. must be capable of use for both ductile iron and/or PVC C-900.

The restraint system may consist of 2 types: the two split retainer rings and for new construction use only the 1 split and 1 solid cast backup ring.

2.4.5.3.2. **Compression Ring Fitting Restrainer for Ductile Iron Pipe & PVC C-900.** Compression ring with follower gland type of restrainer may be utilized in conjunction with Mechanical Joint (MJ) bell end ductile iron pipe fittings for restraining PVC C-900 and ductile iron pipe.

The system must utilize a standard MJ gasket with a color-coded compression ring and replacement gland conforming to ASTM A-536-80, Grade 65-45-12.

Standard MJ fitting Tee-bolts and nuts must be fabricated from high strength steel conforming to ANSI AWWA C-111/A-21.11 and AWWA C-153/A-21.53-88.

Standard MJ gasket must be virgin SBR meeting 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 listed in Section 2.4.5.3.4., “Fitting Restraint for Ductile Iron Pipe (only)”.

2.4.5.3.3. **Non-metallic restrained joint pipe and couplings for PVC C-900 Type Connections.** Gasketed restrained coupling connections must join two sections of factory grooved PVC (C-900) pipe. The restrainer coupling or must not be directionally sensitive.

The coupling must incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F-477 and must be DR-14 Class 200 C-900 PVC in all applications, meeting or exceeding the performance requirements of AWWA C 900, latest revision. The inside face or contact surface of the coupling connection must be of sufficient 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 and maintain pipe roundness and avoid and localized points of stress. The coupling must be designed with an internal stop to align the precision-machined grooves in the coupling and pipe prior to installation of a non-metallic thermoplastic restraint spleen, and will 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 C-900 type non-directionally sensitive restrainer system must be capable of a test pressure twice the maximum sustained working pressure listed in Section 2.4.5.3.4., “Fitting Restraint for Ductile Iron Pipe (only)” and be for PVC (C-900) pipe sizes 4 in. through 12 in.

Non-metallic restrained joint pipe and couplings for PVC C-900 restrained systems sizes 4 in. through 12 in. must be capable of use for both Class 150 (DR 18) and 4 in. through 8 in. for Class 200 (DR 14) PVC C-900 pipe.

The non- metallic restrained joint pipe and couplings for PVC C-900 restraint system must consist of a pipe and couplings system produced by the same manufacturer meeting the performance qualifications of Factory Mutual (FM) and Underwriters Lab (UL).

2.4.5.3.4. **Fitting Restraint for Ductile Iron Pipe (only).** Radial bolt type restrainer systems must be limited to ductile iron pipe in conjunction with Mechanical Joint (MJ) bell end pipe of fittings. The system must utilize a standard MJ gasket with a ductile iron replacement gland conforming to ASTM A-536-80. The gland dimensions must conform to Standard MJ bolt circle criteria.

Individual wedge restrainers must be ductile iron heat treated to a minimum hardness of 370 BHN. The wedge screws must be compressed to the outside wall of the pipe using a shoulder bolt and twist-off nuts to insure proper actuating of the restraining system.

Standard MJ fitting Tee-bolts and nuts must be high strength steel conforming to AWWA C111/A21.11and C153/A21.53-88.

Standard MJ gasket must be virgin SBR meeting ASTM D-2000 3 BA 715 or 3 BA 515.

2.4.5.3.5. Maximum Sustained Working Pressure Requirement in accordance with Table 3.

Table 3
Maximum Sustained Working Pressure Requirement

Nominal Diameter	PVC C–900/C–905	Ductile Iron
4 & 6 in.	200 psi	350 psi
8 in.	200 psi	250 psi
10 & 12 in.	200 psi	200 psi
14 & 16 in.	200 psi/235 psi	200 psi
20 & 24 in.	200 psi/235 psi	200 psi

2.4.5.3.6. **Tests.** The Engineer 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 of failure to meet the quality standards will be grounds for rejecting the entire order.

2.4.5.3.7. **Product List.** Other approved equal products from other manufacturers meeting these specifications may be submitted for review.

2.4.5.3.7.1. Slip-on joint restraint systems, in accordance with Table 4.

Table 4
Slip on Joint Restraint Systems

Manufacturer	PVC C–900/C–905	Ductile Iron (D.I.)	D.I., 16" Above
Ford/Uni–Flange Corporation	Series 1390C	Series 1390C	1390C
EBBA Iron Sales, Inc.	1500	1700	1700
Romac Industries, Inc. 4–8 inch	Model 611	Model 611	47 OSJ
Star Pipe Products	1100	1100	1100
Tyler Union	3000	3000	3000
Sigma Corporation	PV–LOK (PVP)/PTP	PV–LOK (PVP)/PTP	SLDH SLDH

2.4.5.3.7.2. Compression ring systems, in accordance with Table 5.

Table 5
Compression Ring Systems

Manufacturer	PVC C–900	Ductile Iron
Romac Industries, Inc.	Grip Ring–DI	Grip Ring–DI
Tyler Corporation	MJR Gland	MJR Gland
Star Pipe Products	Ring Lock 3500 Series	

2.4.5.3.7.3. Non-metallic restrained joint pipe and couplings for PVC C-900 RJ Type connections, in accordance with Table 6.

Table 6
Non–Metallic Restrained Joint Pipe and Couplings for PVC C–900 RJ Type Connections

Manufacturer	PVC C–900	Ductile Iron
CertainTeed Corporation, Certa–Lok C–900/RJ	4"—12"	Class 150 (DR–18)
	4"—8"	Class 200 (DR–14)

2.4.5.3.7.4. Fitting restraint (MJ), in accordance with Table 7.

Table 7
Fitting Restraint (MJ)

Manufacturer	PVC C–900	Ductile Iron
EBBA Iron Sales, Inc.	2000 PV	MEGALUG 1100
Romac Industries, Inc.	Not Approved	Not Approved
Ford/UniFlange	UFR–1500–C 4" – 24"	Series 1400
Star Pipe Products	Stargrip 4000	Stargrip 4000
Sigma Corporation	One Lok SLC	One Lok SLD
Tyler Union	TUFGRIP 2000F	TUFGRIP 1000F

2.4.5.3.7.5. Restrained flange adapters, in accordance with Table 8.

Table 8
Restrained Flange Adapters

Manufacturer	PVC C–900	Ductile Iron
EBBA Iron Sales, Inc.	2100 Megaflange	2100 Megaflange
Ford/UniFlange	900	200, 400, 420

2.5. **Copper Tubing and Brass Fittings for Copper Service Lines.**

2.5.1. **Copper Tubing**. All 3/4 in., 1 in., 1-1/2 in. and 2-in. copper tubing for underground service is to be of the type commercially known as Type "K" soft and conform to ASTM Designation B-88 and NSF Standard 61.

3/4 in. and 1-in. copper tubing is to be furnished in 60 ft. coils or 100 ft. coils as specified, 1-1/2 in. is to be furnished in 20 ft. lengths, 40 ft. coils or 60 ft. coils as specified, and 2 in. is to be furnished in 20 ft. lengths or 40 ft. coils as specified.

2.5.2. **Brass Fittings.**

2.5.2.1. **General.** Water works brass goods consisting of corporation stops, curb stops, couplings, connectors, nipples, etc., will be required in underground installations of service lines in the water distribution system, unless otherwise modified.

The brass composition is to conform to ASTM Designation B-62 and the threads are to conform to AWWA Standard C-800-01 for "Threads for Underground Service Line Fittings."

All casting is to have a natural, clean uniform and smooth surface, and be free from internal porosity.

All machining is to be done in a workmanlike manner and within the acceptable tolerances.

Unless otherwise specified, each fitting is to be furnished with a 1/16 in. thick fiber gasket.

2.5.2.2. **Design Criteria for Curb Stop/Angle Valves Ball Type.** All Curb Stop, Corporation and Angle valves must be ball valves. "Inverted/Ground Key," type angle valves will not be accepted.

Ball angle valves will not have a stop.

Laying dimensions the same as present inverted key style or equal to Mueller H-14258.

Reduced port design will be acceptable provided there is no compromise on flow capacity compared to the "Inverted/Ground Key" type angle valve.

Pack joints will not be acceptable.

2.5.2.2.1. **Manufacturer Lists.** Approved manufacturer lists for In Line FIP X FIP, angle curb stop meter coupling x compression, FIP x meter swivel nut/coupling, and ball corporation valve, in accordance with Tables 9, 10, 11, and 12, respectively.

Table 9
2-Inch FIP x FIP

Manufacturer	Model
Ford Meter Box	B11777WR
A.Y. McDonald	6111W
Mueller	B–20200–3
James Jones	J1900

Table 10
Angle Curb Stop Meter Coupling x Compression

Manufacturer	Size			
	3/4"	1"	1.5"	2"
A.Y. McDonald	4652BQ	4652BQ		4612BQ
Ford Meter Box	BA43–232WRQ	BA43–344WRQ	BFA43–666WRQ	BFA43777WRQ
Mueller	B24258–R3	B24258–3	B24276–3	B24276–3
James Jones	J1963WSG	J1963WSG	J1975WSGLS	J1975WSGLS
Hays	2520CGJ–R			

Table 11
FIP x Meter Swivel Nut/Coupling

Manufacturer	Size
	3/4"
A.Y. McDonald	4654B
Ford Meter Box	BA13232WR
Mueller	B24265–R3
James Jones	J–1966WLS
Hays	2521–R

Table 12
Ball Corporation Valve

Manufacturer	CC x CMP	IP x CMP
A.Y. McDonald	4701BQ	4701BQ
Mueller	B–25008	B–25008
James Jones	1937 SG	1937 SG
Ford Meter Box	FB–1000Q	FB–1000Q

2.6. **Gate Valves, Tapping Valves and Tapping Sleeves.**

2.6.1. **Gate Valves.**

2.6.1.1. **General.** Except as otherwise specified, AWWA Standard C-509-01 or the latest revision thereof, must govern the design, component materials, construction; manufacture and testing of all resilient seated gate valves. Valves must be suitable for frequent operation as well as service involving long periods of inactivity. Valves must be NSF-61 certified.

The Engineer reserves the right to limit the purchase of resilient seat gate valves from manufacturers and to the models specified, as shown in Table 13, provided such resilient seat gate valves conform to the provision.

Table 13
Resilient Seat Gate Valves

Sizes 3" through 12"	
Manufacturer	**Model**
American Flow Control	Series 500
Clow Valve Company	2640
Kennedy Valve	Ken–Seal II
M&H Valve Company	4067
Muller Company	2360 Series Gate Valve
United States Pipe & Foundry Company	Metroseal 250
Sizes 16" through 24"	
Manufacturer	**Model**
United States Pipe & Foundry Company	Metroseal 250

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., and 20 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, ductile iron, steel, brass and bronze materials must meet or exceed the material requirements of Section 2: Materials of AWWA C-509-01.

Gaskets, O-rings, Coatings, and elastomers must meet or exceed the material requirements of Section 2: Materials of AWWA C-509-01.

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 of low zinc content bronze, as shown in Table 1 of Section 2.2.4. of ANSI/AWWA Standard C-509-01 or the latest revision thereof. Materials for the stem have minimum yield strength of 40,000 psi. A minimum elongation in 2 in. of 12% and must be made of bronze per ASTM B763, alloy number UNS C99500. A maximum zinc content of 2% as shown in Table 2 Chemical Requirements of ASTM B763-96 or the latest revision thereof. Stem nut material must be ASTM B-62 UNS C83600 or ASTM B-584 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 of ASTM A-307 with dimensions conforming to ANSI B18.2.1. 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 open right (clockwise), unless otherwise specified.

The following parts of the valve must be made of either gray or ductile iron: bonnet, body, yoke, wrench nut, O-ring packing plate or seal plate, and gland follower. The gate may be made of gray or ductile iron.

If glands and bushings are used for NRS valves they must be made of ASTM B-763 bronze UNS C99500. The stem must be made of cast, forged, or rolled ASTM B-763 bronze UNS C99500. The stem nut material

must be ASTM B-62 bronze UNS C83600 or ASTM B-584 bronze UNS C84400. The gate may be made of bronze ASTM B-763 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 Section 4.8.3 of the ANSI/AWWA C509-01 Standard or the latest revision.

Enclosed and buried valves must be coated inside and outside with a fusion bonded epoxy having nominal 8 mils dry film thickness, which meets or exceeds 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 per ANSI/NSF Standard 61.

The Contractor must submit 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. The number of turns to open or close the valve must be consistent for each valve size for each approved manufacturer.

Valves furnished under this specification will be approved by the Utility Owner. The manufacturer will provide an Affidavit of Compliance in accordance with the Section 1.5 of the ANSI/AWWA C–509–01 Standard or latest revision thereof, to include compliance with the Utility Owner. Records of all tests performed in accordance with Section 6.1 and Section 6.2 of the ANSI/AWWA C–509–01 Standard or latest revision thereof will 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 as outlined in Section 6.2.2 of the ANSI/AWWA C–509–01 Standard, (350 ft. lbs.) will also be provided. A copy of the manufacturer's Quality Assurance Program will be submitted. Blueprints and parts list for the valve will also be provided.

All gate valve parts must be designed to withstand the following two pressure requirements, without being structurally damaged. (1) An internal test pressure of twice the rated design working pressure of the valve. (2) 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.-lbs. for a 3 in. nominal diameter. 200 ft. lbs. for a 4 in. nominal diameter. 300 ft. lbs. for a 6 in. nominal diameter. 300 ft. lbs. for a 8 in. nominal diameter. 300 ft. lbs. for a 10 in. nominal diameter. 300 ft. lbs. for a 12 in. nominal diameter. 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 compliance 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 D-429 either 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./in.

Flanged Ends: The end flanges of flanged valves must conform to dimensions and drillings of ANSI/AWWA C-110/A21.10 or ANSI B-16.1, Class 125.

Mechanical Joint Ends: Mechanical joint bell dimensions must conform to ANSI/AWWA C-111/A21.11.

Push-on Joints: Push-on joints must conform to the requirements of ANSI/AWWA C-111/A21.11.

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 which mates with the tapping sleeve must have an alignment lip to fit the recess in the tapping sleeve flange for proper alignment. The lip will 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 from defects that could prevent proper functioning of the valve. When assembled, valves manufactured in accordance with this standard 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 of 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 is to be made in each direction across the gate. All tests are to be performed at the manufacturer's plant.

All gate valves 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 are to 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 are to be performed at the manufacturer's plant.

A test must be made 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, pressure containing joints, or past the seat. All tests are to 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, for example "200 W."

The Engineer 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 will be grounds for rejecting the entire order.

Table 13 identifies specified manufacturers that are approved.

2.6.1.2. **Workmanship.** All parts of the resilient seat gate valve must be designed and manufactured to the tolerances specified in ANSI/AWWA C-509-01 or latest revision thereof and this specification.

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 from 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 of 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.

2.6.1.3. **Painting.** All exterior and interior surfaces of the valve must be coated with epoxy, N.S.F. 61 certified. The epoxy must have a nominal dry film thickness of 8 mils, and must be in accordance with AWWA C-550, latest revision.

Coating must be as close to holiday free as is technologically possible.

2.6.1.4. **Testing.**

2.6.1.4.1. **Hydrostatic Test.** Hydrostatic Test must be performed on the valve in accordance with Section 6.1 Proof of Design Testing of ANSI/AWWA C-509-01 or latest revision.

2.6.1.4.2. **Torque Test.** Torque Test for prototype valves must be performed on the valve in accordance with Section 6.1 Proof of Design Testing of ANSI/AWWA C-509-01 or latest revision.

2.6.1.4.3. **Leakage Test.** Leakage Test must be performed on the valve in accordance with Section 6.1 Proof of Design Testing of ANSI/AWWA C-509-01 or latest revision.

2.6.1.4.4. **Pressure Test.** Pressure Test must be performed on the valve in accordance with Section 6.1 Proof of Design Testing of ANSI/AWWA C-509-01 or latest revision.

2.6.1.4.5. **Operation Test.** Operation Test must be performed on the valve in accordance with Section 6.2 Production Testing of ANSI/AWWA C-509-01 or latest revision.

2.6.1.4.6. **Shell Test.** Shell Test must be performed on the valve in accordance with Section 6.2 Production Testing of ANSI/AWWA C-509-01 or latest revision.

2.6.1.4.7. **Seat Test.** Seat Test must be performed on the valve in accordance with Section 6.2 Production Testing of ANSI/AWWA C-509-01 or latest revision.

2.6.1.4.8. **Compliance.** An Affidavit of Compliance certifying that all required tests have been performed must be provided in accordance with Section 6.3 Affidavit of Compliance of ANSI/AWWA C-509-01.

The Affidavit of Compliance, the results of ASTM testing procedures and requirements for materials, Manufacturer's Quality Assurance Program, and the records of all tests performed on the valve must be kept and provided by the supplier/manufacturer in a single hard cover bound notebook with the bid or with the shipping documents and must be approved by the Engineer.

2.6.1.5. **Quality Assurance.** Manufacturers must have an ASME or I.S.O. 9001 registered commercial quality system or is in the process of achieving this certification by June 2001. Noncompliance to this registered commercial quality system requirement by June 2001 will result in removal of the manufacturer's product from Attachment I of this specification. If on receipt of resilient seat gate valves they are found to be non-compliant the manufacturer will replace the defective resilient seat gate valves according to resilient seat gate valve size with a resilient seat gate valve that meets the City of Sequin's specifications. The defective

resilient seat gate valve will be returned to the manufacturer, freight collect, and the manufacturer will replace the resilient seat gate valve, freight prepaid.

2.6.1.6. **References.**

- American National Standards Institute and American Water Works Association Standard C-509-01 (ANSI/AWWA C-509-01).
- Manufacturers Standardization Society MSS SP-60.

2.6.2. **Tapping Valves and Tapping Sleeves.**

2.6.2.1. **Tapping Sleeves.** Band must conform to the minimum OD size ranges and lengths specified in this specification. The flange must be manufactured in compliance with AWWA C-207, Class D ANSI B.16.1 drilling, recessed for tapping valves MSS_SP60. Mechanical Joint tapping sleeve outlet must meet or exceed all material specifications as listed below and be suitable for use with Standard mechanical joint x mechanical joint (mjxmj) resilient wedge gate valves per AWWA C-509-94.

2.6.2.1.1. **Tapping sleeves, 4 Inch – 12 Inch.** Entire fitting to be stainless steel type 304 (18-8). The body, lug and gasket armor plate to be in compliance with ASTM A-240. The flange must be cast stainless steel in compliance with ASTM A-743. The MJ outlet must be one-piece casting made of stainless steel. The test plug must be 3/4 in. NTP in compliance with ANSI B2.1 and must be lubricated or coated to prevent galling. All metal surfaces must be passivated after fabrication in compliance with ASTM A-380.

The gasket is to provide a 360-sealing surface of such size and shape to provide an adequate compressive force against the pipe after assembly, to affect a positive seal under combinations of joint and gasket tolerances. The materials used must be vulcanized natural or synthetic rubber with antioxidants and antioxidant ingredients to resist set after installation. No reclaimed rubber will be used. A heavy-gauge-type 304-stainless armor plate must be vulcanized into the gasket to span the lug area.

Lugs are to be heliarc welded (GMAW) 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; it is the intent of these specifications to allow tapping sleeve that has a lug design similar to the approved models.

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.

Quality control procedures will be employed to insure that the shell, Lug, (4 in. and larger nominal pipe diameter) armor plate, gasket and related 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/or 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.

2.6.2.1.2. **Tapping Sleeves 16 Inch and large nominal pipe diameter.** The body must be in compliance with ASTM A-285 Grade C or ASTM A-36. Test plug must be 3/4 in. NPT conforming to ANSI B2.1.

The gasket is to provide a watertight sealing surface of such size and shape to provide an adequate compressive force against the pipe. After assembly, the gasket will insure a positive seal under all combinations of joint and gasket tolerances. Gasket must be formed from vulcanized natural or synthetic rubber with antioxidants ingredients to resist set after installation. No reclaimed rubber will be used. Bolts and nuts must be type high strength, corrosion resistant, low alloy per AWWA C-111, ANSA A21.11

Quality control procedures will be employed to insure that the shell, gasket and related 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 noted, unit must be protected by fusion Epoxy 8-10 mil line and coat per 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. (AWWA Manual of Practive M-9)

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.

2.6.2.1.3. Standard ranges of tapping sleeves in accordance with Table 14.

Table 14
Tapping Sleeves Standard Ranges

Nominal Dia (in.) x Min. Length (in.)	Flange Outlet (in.)	Range	Min OD Range (in.)[1]
4 x 16	4	A	4.75—4.95
		B	4.90—5.10
6 x 16	4	A	6.70—7.10
		B	7.00—7.40
		C	7.35—7.75
6 x 16	6	A	6.80—7.15
		B	7.05—7.40
		C	7.40—7.75
8 x 16	4 & 6	A	9.00—9.45
		B	9.35—9.70
		C	9.70—10.00
8 x 20	8	A	9.00—9.35
		B	9.35—9.70
		C	9.70—10.00
10 x 16	4 & 6	A	11.03—11.47
10 x 20	8	B	11.60—12.00
10 x 24	10		
12 x 16	4 & 6	A	13.00—13.40
12 x 20	8	B	13.40—13.80
12 x 24	10	C	14.40—14.50
12 x 32	12		
16 x 12	4 & 6		17.33—17.87
16 x 16	8		18.62—19.19
16 x 20	10		
16 x 24	12		
16 x 36	16[2]		
20 x 12	4 & 6	A	21.51—22.15
20 x 16	8	B	23.46—24.16
20 x 20	10		
20 x 24	12		

Nominal Dia (in.) x Min. Length (in.)	Flange Outlet (in.)	Range	Min OD Range (in.)[1]
20 x 36	16[2]		
20 x 40	20*		
24 x 12	4 & 6	A	25.71—26.41
24 x 16	8	B	28.14—28.84
24 x 20	10		
24 x 24	12		
24 x 36	16[2]		
24 x 40	20[2]		
24 x 48	24[2]		
30 x 12	4 & 6	A	29.78—30.48
30 x 16	8	B	31.52—32.22
30 x 20	10		
30 x 24	12		
30 x 36	16[2]		
30 x 40	20[2]		
30 x 48	24 X 30[2]		

1. Ranges may be broadened but not narrowed. For concrete steel cylinder pipe the OD of the pipe and cylinder will 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 nonstandard ranges, in conformance with the intent of these specifications.

The Engineer may at no cost to the Contractor, subject random units to testing by an independent laboratory for compliance with these standards. Any visible defect of failure to meet the quality standards will be grounds for rejecting the entire order.

Table 15 lists identified specific manufactured items by catalog number that are approved:

Table 15
Approved Tapping Sleeves and Manufacturers

Manufacturer	Model	Size Range (in.)
JCM Industries	#432	4—12
	#412	16 and larger
Power Seal	#3490AS or 3490MJSS	4—12
	3490MJSS	16 and larger
Romac Industries	SST III	4—12
	SST III	16 and larger
Ford Meter Box	FTSS	4—12
	FTS	16 and larger
Dresser	Style 610/630	4—12
	Style 610/630	16 and larger
Cascade	CST–1	4—12
Smith Blair	#622	16 and larger
Total Pipe Solution	Triple Tap TS	4—12

2.7. **Valve Boxes.** All valve box assemblies are to conform to the details shown on the plans. Each valve box assembly is to be of cast-iron and is to consist of a base, top section, and lid.

Valve boxes are to be of a single size with a nominal diameter of 6 in.

The valve box lid is to be labeled “water” and is to be so designed so that it will remain firmly seated in place when subjected to vehicular traffic.

The valve box assembly is to be of sufficient toughness and strength to withstand impact loads and shock resulting from vehicular traffic.

The valve box assembly is to be coated with a standard bituminous coating of either coal tar or asphalt base applied to all inside and outside surfaces.

2.8. **Meter Boxes.** For non-traffic bearing locations, the meter box assembly for 5/8 in. through 1 in. meters box and lid is to be black and constructed our of modified polyethylene material for maximum durability and corrosion resistance. The black material is for maximum UV protection and must be uniform throughout 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 a 20,500 lb. loading in a non-deliberate and incidental traffic.

Plastic Lid is to have the following:

- “Water Meter” and Utility Owner molded into the lid.
- Seat securely and evenly inside the meter box and must not overlap the top edge of the meter box.
- “Overlap” and securely and evenly on the existing Utility Owner 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 Utility Owner cast iron meter box of like dimensions and secure the plastic meter box.
- A molded receptacle for placement of Utility Owner key.
- One (1) piece of 1/2 in. rebar secured in lid.

Plastic body is to have the following:

- A crush resistant ribbing along the outside of box.
- A flange around the top opening to help prevent setting and aide in adjustment to grade.
- Designed to accommodate all plastic lids.

For traffic bearing locations, the meter box assembly for 5/8 in. through 2 in. meters is to consist of cast-iron rectangular boxes box and a steel checkered plate rectangular with raised lug pattern as shown on the plans.

The castings are to be dipped in coal tar at a temperature of 350ºF and the metal is to be at a temperature of 300ºF prior to dipping. The casting is to be dipped and cured independently and the coating is to have ceased to be “tacky” within 72 hr. after dipping.

The steel checkered plate rectangular cover is to be hot dip galvanized after fabrication.

The meter box is to have an ultimate tensile strength of 25,000 psi and is not to be brittle.

The casting is to have an “as cast” clean smooth surface and be free from internal porosity; castings that are made smooth by grinding are unacceptable.

2.8.1. **Quality Assurance.** If on receipt of meter box(es) or lid(s) they are found to be non-compliant, the Contractor is to replace defective product at no cost to the Department. Any visible defect of failure to meet specification will be grounds for rejecting entire order.

2.8.2. Approved Plastic Meter Box and Lid Manufacturer: DFW Plastics Inc.

Model Numbers:

- D-1218-RWSBSM-Complete box

- D-1218-RWSBSM-lid
- D-1218 – body

2.9. **Fire Hydrants.**

2.9.1. **General.** The Engineer reserves the right to limit the purchase of fire hydrants from manufacturers and to the models specified, as shown on Table 16, provided such fire hydrants conform to the provision contained.

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.
- 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-pounds 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.

The fire hydrant must have 2 hose nozzles and 1 pumper nozzle.

The nominal inside diameter of the hose nozzle must be 2-1/2 in.

The nominal inside diameter for the pumper nozzle must be 4 in.

The outlet-nozzle threads are to conform to the National Fire Protection Association (NFPA) 2003, Standard for Fire Hose Connections.

The nominal diameter of the main valve opening must be 5-1/4 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 will be sealed. The reservoir will be adequately sealed with "O" rings or other suitable sealing system approved by the Engineer.

The fire hydrant must have a safety flange or breakaway flange at the ground line as stipulated in Section 3.1 General Design of ANSI/AWWA C-502-05 or latest revision.

Fire hydrant nozzle cap chains must be required and must be attached permanently to the fire hydrant as stipulated in Section 3.2 Detailed Design of ANSI/AWWA C-502-05 or latest revision.

Parts that require lubrication and come into contact with water must be lubricated with a non-toxic food grade lubricant that does not pose a health hazard to the public if consumed.

2.9.2. **Workmanship.** All foundry and machine work must be performed in accordance with good standard practice for the class of work involved and in conformance with accepted drawings, 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 from 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.

2.9.3. **Paint.** The exterior surface of the hydrant must be coated with a coating that must meet or exceed the requirements of Federal Specification TT-C-494b. A second coat of water based or oil based enamel paint aluminum in color will then be applied from the top of the hydrant to a point 18 to 20 in. below the center line of the pumper nozzle or down to the traffic safety flange connection at the ground line.

All interior surfaces, machined surfaces, such as the threaded portion of the stem or stem nut, which must fit closely with the adjacent parts, must be coated with a coating that must meet or exceed 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 having a nominal dry film thickness of 8 mils, conforming to ANSI/AWWA C-550-05, and certified to NSF 61.

Coating must be as close to holiday free as is technologically possible.

2.9.4. **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 made with the entire interior of the hydrant under pressure and another test made with the main valve closed and the base under pressure from the inlet side. Under the test procedure, there must 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 fl. oz./min. Other leakage or other imperfections found in either test must be corrected or the hydrant retested. The tests must be conducted for a sufficient time to allow a check of all points of possible leakage and for a minimum of 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 200 lb. ft.

All fire hydrant tests and inspections must conform to 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 conforming to Section 1.7 Affidavit of Compliance of ANSI/AWWA C-502-05 or latest revision thereof.

2.9.5. **Quality Assurance.** Manufacturers must have an ASME or I.S.O. 9001 registered commercial quality system or is in the process of achieving this certification by June 2001. If on receipt of fire hydrants they are

found to be noncompliant the Contractor must replace the defective fire hydrants according to fire hydrant size with a fire hydrant that meets this specification.

The Utility Owner will attempt to use fire hydrant maintenance kits in the approved hydrants. Table 16 of this specification provides the product model numbers. The fire hydrant maintenance kits listed are the reference product model numbers.

Table 16
Approved Fire Hydrant Maintenance Kits

Manufacturer	Model
American Darling	B84B 5–1/4" (w/metal weather cap)
Clow Valve Company	Medallion
Kennedy Valve Company	Guardian
M & H Valve Company	Reliant Model 929
Mueller Company	Super Centurion 250
United State Pipe and Foundry, Inc.	Metropolitan
Waterous	Pacer 100
American AVK Company	Model 2780 Dry

2.9.6. **References.**

- American National Standards Institute and American Water Works Association Standard C-502-05 (ANSI/AWWA C-502-05).
- American National Standards Institute and American Water Works Association Standard C-550-05 (ANSI/AWWA C-550-05).

2.10. **Polyethylene Wrapping Material.** Polyethylene wrapping material is to be used to encapsulate all ductile and cast-iron pipe.

Polyethylene wrapping for ductile and cast iron water mains is to 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.

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 17 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 a minimum of 4 ft. over the actual pipe length to allow for overlap. Table 18 contains the approved polyethylene wrapping manufacturers and products.

Table 17
4 Mil Polyethylene Wrapping Materials

SIZE & LENGTH (All sizes lay flat size)	
Pipe Size	**Product Size Width 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

Table 18
Approved Polyethylene Wrapping Manufacturer and Products

Manufacturer	Product
Van Leer Flexibles Inc.	Valeron
Manufactured Plastics and Distribution Inc.	Cross Tuff 450 Black

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 will 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 D1922).
- Dielectric: The film is to have a dielectric strength of 800 volts per mil thickness per ASTM D-149.

2.10.1. **Marking Requirements.**

The polyethylene film supplied must be clearly marked, at a minimum of every 2 ft. along its length, containing the following information:

- Manufacturer's name or trademark;
- Year of manufacture;
- ANSI/AWWA C-105/A21.5;
- Minimum film thickness and material type;
- Applicable range of nominal pipe diameter size(s); and
- Warning-Corrosion Protection-Repair any Damage.

The Engineer 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 will be grounds for rejecting the entire order.

2.11. **Mechanical Couplings.** Mechanical coupling of Dresser or similar type is to be used to connect plain ends of concrete steel cylinder pipe and plain ends of steel and ductile-iron pipe and to connect new and existing ductile iron water main in conjunction with casing installation in accordance with the details shown on the plans.

The mechanical coupling is to consist of a cylindrical steel middle ring, two (2) steel follower rings, two (2) rubber compound gaskets and a set of steel bolts. The middle ring is to be 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.

The flexible and transition couplings are to be manufactured to fit the type size and class of pipe specified. Bolts are to be high strength low alloy steel meeting the requirements of AWWA Standard C-111.

2.12. **Air Release Assemblies.** Valve body and cover is to be cast iron fabricated 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. are to be screwed (National Pipe Taper Thread, NPT).Pipe sizes above 3-in.and above are to have flanged inlets (125 pounds ANSI B16.1). A protective hood or cowl is to be installed on the outlet of flange-bodied valves.

Internal seat trim float arm and pivot pin is to be stainless steel Type 303 or 304 or 316. Floats are to be stainless steel ASTM A-240. Other internal parts are to be stainless steel ASTM A-240 or ASTM A-276.

Non-metallic floats must be foamed polyethylene with stainless steel type 316 fasteners.

Internal seat or orifice button is to be of Buna-N rubber compounded for water service. Cover gasket is to be composition-type, equal to Armstrong CS-231, Garlock 3000, or Lexide NK-511. Cover bolts are to be alloy steel. Rolling seals must be furnished for non-metallic valves 2 in. and below.

Valve body is to have a test pressure rating of 300 psi and working pressure rating of 150 psi.

The air release valve is to be designed to vent accumulated air automatically. The outlet orifice is to be properly sized to facilitate valve operation at pressures up to 150 psi. The air release valve is to be either 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 is to be designed with the inlet and outlet of equal cross-sectional area. The valve is to be capable of 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 during the draining cycle. The float is to 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 are to 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 is to be designed to incorporate conventional or kinetic flow principles to properly vent the air without premature closure. Flanged sizes (4 in. and larger) may be furnished in a dual housing. When dual castings are used, a bronze manual isolation valve is to 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 Engineer 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 failures to meet the quality standard will be grounds for rejecting the entire order.

The following qualified products list, Table 19, Table 20, and Table 21, identifies specific manufactured items by catalog number that are approved.

Table 19
Air Release Valves (Inlet x Orfice)

Manufacturer	1" NPT x 3/16"	2" NPT x 3/16"
Apco Valve Company	200A	200A
G.A. Industries, Inc. (Empire)	920	920
Multiplex Mfg. Co. (Crispin)	P1–10	PL–10A
Val-Matic Mfg. Co.	38	38
PowerSeal Corporation	5401–D	5401–E
ARI Flow Control	S–050 1T	D–040 2T

Table 20
Air & Vacuum Valves (Inlet x Orfice)

Manufacturer	2" NPT x 3/16"	4" flg. with cowl
Apco Valve Company	144	152
G.A. Industries, Inc. (Empire)	930	930–C
Multiplex Mfg. Co. (Crispin)	AL20	AL41
Val-Matic Mfg. Co.	102	104
PowerSeal Corporation	5402–B	5402–D
ARI Flow Control	D–040 2T	K060 C–HF

Table 21
Combination Air Valves (Inlet x Orfice)

Manufacturer	1" NPT x 5/64"	2" NPT x 3/32"	4" flg. x 3/32" w/cowl
Apco Valve Company	143C	145C	149C
G.A. Industries, Inc. (Empire)	945 (1" NPT)	945	960C
Multiplex Mfg. Co. (Crispin)	U10	UL20 (1/4")	UL41 (1/4")
Val-Matic Mfg. Co.	201C	202C	204C
PowerSeal Corporation	5403–A	5403–B	5403–D
ARI Flow Control	D–040 2T	D–040 D–060 C–HF	D–060 C–HF

2.13. **Blow-off Assemblies and Jumper Connections.** The materials required for both permanent and temporary 2 in. and 4 in. blow-off assemblies and 4 in. jumper connections are shown on the plans.

2.14. **Backfill.**

2.14.1. **3/4 Inch – 2 Inch Copper.** Where services 3/4 in. – 2 in. copper 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% must pass No. 4 sieve, free from clay and organic material, with a maximum 8 percent passing the No. 200 sieve. Larger services utilizing ductile iron pipe or PVC (C-900) pipe must be backfilled the same as mains.

2.14.2. **Bedding and Initial Backfill for Water Mains.**

Well graded gravels or crushed stone meeting the following requirements for 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 75 - 100%
- Retained on No 20 sieve 98 - 100%

The quantity and thickness of lifts and compaction of initial backfill materials is to be in accordance with Section 3.4.1., "Initial Backfill."

2.14.3. **Secondary Backfill for Water Mains.** Approved materials excavated from the trench free of brush, debris, large rock or stones and earth clods 6 in. or larger. Secondary backfill material must be primarily composed of compactable soil materials.

2.15. **Asphalt.** All asphaltic concrete used in the replacement of pavement over the trench line is to conform to Item 341, "Dense-Graded Hot-Mix Asphalt, " Type "C," except when the use of 6 in. of asphalt treated base is directed, unless otherwise specified on the plans.

2.16. **Concrete.** All concrete used as the trench cap and in sidewalks and blocking mains is to conform to Item 421, "Hydraulic Cement Concrete." Class "A" concrete is to be used in sidewalks and for blocking concrete steel cylinder mains; Class "D" concrete is to be used for the trench cap and for blocking all other types, unless otherwise specified on the plans.

2.17. **Reinforcing Steel.** All bar reinforcement is to be Grades 40 or 60, conforming to the requirements of Item 440, "Reinforcement for Concrete."

2.18. **Affidavit of Compliance.** Unless otherwise directed, the Contractor is to furnish a manufacturer's affidavit of compliance for each of the materials used in this project. The affidavit is to certify that factory inspection and all specified tests have been made and that the material furnished complies with the requirements .

3. CONSTRUCTION

3.1. **Excavation.** Excavation (trenching) as required to complete the water main installation is to be performed in accordance with Item 400, "Excavation and Backfill for Structures," 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 and/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, the under-cut 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 by the Engineer.

The depth of cut indicated on cut sheets, as furnished by the engineer, is from the off-set or cut hub elevation to the invert.

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, 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.

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 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 Engineer and approved in writing. Whenever such maximum allowable width of trench is exceeded, except as provided for on the drawings, or in the specifications, or by the written approval of the Engineer, the Contractor, at his expense, must encase the pipe in concrete from trench wall to trench wall, or other pipe bedding material approved by the Engineer. Any excavation wider than this maximum width or subsequent Surface or Paving work, will be done at the Contractor's expense.

3.1.3. **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, "Excavation and Backfill for Structures."

3.1.4. **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 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 specified in Section 3.1.3., "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 3.1.5., "Unstable Conditions at Grade," at no cost to the Department.

3.1.6. **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 the a depth no less than 6 in. below pipe. Before the pipe is laid the grade is to be restored by backfilling with an approved material in layers of 3 in. prior to compaction. The layers are to be slightly moistened and thoroughly compacted so as 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.

3.1.7. **Trench Excavation Protection.** All trench excavation required on this project is to be accomplished as required by the provisions of Item 402, “Trench Excavation Protection.”

3.1.8. **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 in order 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 Contractor is to make explorations and excavations for such purposes at his expense.

3.1.9. **Protection and Restoration of Underground Structures and Facilities.** The Contractor is to 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 which are disturbed are to be restored by the Contractor at his expense. Materials and methods used for restoration are to be in accordance with the Utility Owner and the requirements of the utility agency involved.

In the event that a sanitary sewer is broken by the Contractor's operations the release of sewage into the trench is to 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” is to be effectively stopped. The “tin-horn” is to remain in place until such time as permanent repairs can be made. It is to be the responsibility of the Contractor to determine sufficiently in advance of his trenching operations the size of all sanitary sewer lines and services which will require this treatment.

All sanitary sewer lines crossing the excavation, whether bridged or replaced, are to have proper support consisting of sound timber supports having a minimum 2 in. nominal thickness and a minimum 6-in. nominal width placed with the width horizontal and extending a minimum of 12 in. into the trench wall on either side.

In all cases where a sewer pipe is replaced or bridged, the backfill material is to be thoroughly compacted to the bottom of the pipe and compacted by hand from this point to a distance of 6 in. above the top of the sewer line being replaced.

The locations of all sewer lines crossing excavations, whether replaced or bridged are to be properly marked, and care is to be taken to avoid damage to the pipe through the use of a hydratamping machine or other mechanical equipment. The Contractor is to be liable for the failure of such lines due to negligence or poor workmanship.

3.1.10. **Backfill Material Derived from Excavation.** All excavated materials which the Engineer determines are suitable for reuse as trench backfill is to be separated where practicable from the general excavation material, or as directed.

3.1.11. **Trench 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 lawns), 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 a minimum of 4 in. of flex-base materials for the entire width of the alley. Alleys not actively used by vehicles must be graded and compacted to 98% or higher, then spread grass seed for entire width of the alley.

3.1.12. **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. 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 will minimize interference with the traveling public.

3.1.13. **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 prior to the replacement of concrete over the new trench alignment.

Transverse “dummy” 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.

3.1.14. **Dewatering.** Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding areas.

3.1.14.1. 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.

3.1.14.2. 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.

3.1.14.3. Should the pumping system draw fines from the soil, the Engineer will order immediate shutdown, and remedial measures will be 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 Engineer.

The Contractor must maintain ground water table at least 12 in. below the finished excavation subgrade.

3.1.14.4. **Dewatering Performances.** Performances of the dewatering system for lowering ground water must be measured by observation wells on piezometers installed I 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 Engineer.

3.2. **Pipe Laying.**

General. The Contractor is to start his work at a tie-in point, unless otherwise indicated on the plans. Pipe is to be laid with bell ends facing the direction of lying, unless otherwise authorized or directed. Under no circumstances is pipe to be laid in water and no pipe is to 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 is to be installed to the required lines and grades with fittings, valves, and hydrants placed at the required locations.

Spigots are to be centered in bells or collars, all valves and hydrant stems are to be set plumb, and fire hydrant nozzles are to face as shown on the plans or as directed. No valve or other control on the existing system is to be operated for any purpose by the Contractor unless approved.

The Contractor is to maintain a neat and orderly work area. Complete cleanup is to be maintained at all times as closely behind the pipe laying operations as possible, but in no case is such cleanup be permitted to lag more than 1,000-ft. behind the pipe laying, unless otherwise directed.

The Contractor is to maintain service to water connections, whether connected to the existing or proposed water lines, at all times for the duration of the construction, unless directed otherwise by the Engineer.

3.2.1. **Crossing other Underground Lines.** New water mains crossing other utilities are to have a minimum of 30 in. of cover over the top of the pipe unless otherwise waived or modified. Excavation around other utilities is to be done by hand for at least 12 in. all around. Any damage to the protective wrap on gas lines or electrodes is to be reported immediately to CenterPoint Energy, phone (888) 876–5786. Any damage to other utilities must be reported to their proper governing entity.

3.2.2. **Pipe Grade.** Water mains 16 in. or smaller must have a minimum of 48 in. of cover from the proposed final finish ground/street elevation and 60 in. of cover when the main is installed in a parkway or under the pavement where there are no existing/proposed curb or existing drainage facilities. Water mains 20 in. and above must have a minimum of 60 in. of cover over the top of the pipe from the proposed final finish ground/street elevation unless otherwise waived or modified by the Engineer.

Pipe grades are to be as required on the plans, or as directed. Grades are to be met as specified by Section 3.1., “Excavation.” Care is to be taken to insure that the pipe barrel has uniform contact with the bedding material for its full length except at couplings. The coupling is not to be in contact with the original trench bottom prior to backfill. Bedding material is to be placed under the coupling and compacted by hand prior to

backfilling so as to provide an even bearing surface under the coupling and pipe. Change in grade is to be made only at joints.

3.2.3. **Bedding and Bedding Materials.** Prior to placing pipe in a trench, the trench is to have been excavated to the proper depth as required in Section 3.1., "Excavation." Approved materials are to be smoothly worked by hand across the entire width of the trench bottom to provide supporting bedding for the pipe.

Structures to Support Pipe: Where as the bottom of a trench at subgrade consist of material that is notably unstable by the Engineer and cannot be removed and replaced with approved material may be properly compacted in place to support the pipe. The Contractor must also 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 done. Coordinate with Engineer for approval of extra compensation prior to beginning work.

3.2.4. **Lowering Materials into Trench.** Proper implements, tools and facilities satisfactory to the Engineer are to be approved and used by the Contractor for the safe and convenient execution of work. All pipe, fittings, valves, and hydrants are to 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 main materials and protective coatings and lining. Under no circumstances are water main materials to be dropped or dumped into the trench. Take care to avoid damaging polywrap films. Use of chains or slings is not allowed unless entire sling is wrapped with a protective nylon web sock.

3.2.5. **Installing Pipe.** Every precaution is to be taken to prevent foreign material from entering the pipe while it is being placed in the line. Under adverse trench conditions, extended period of time and/or otherwise required by the Engineer, a manufactured cap/plug is to be used to prevent any foreign type material entering. Leave the cap/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 is to be centered on the pipe already in place, forced into place, brought to correct line and grade, completed in accordance with the requirements specified. The pipe is to be secured in place with approved backfill material tamped around it. Pipe and fittings which do not allow a sufficient and uniform space for joints will be rejected and are to be replaced with pipe and fittings of proper dimensions. Precautions are to be taken to prevent dirt or other foreign matter from entering the joint space.

At times when pipe laying is not in progress the open end of pipe in the trench is to be closed by a watertight plug or other means approved. Pipe in the trench which cannot temporarily be jointed is to be capped or plugged at each end to make it watertight. This provision is to apply during all periods when pipe laying is not in progress.

Should water enter the trench, the seal is to remain in place until the trench is completely dry. The Contractor is to provide plug & caps of various sizes required.

3.2.5.1. **Steel Pipe.** Steel pipe must be installed as specified within "Water Main." The Contractor must furnish all steel piping including fittings, couplings, specials, pipe supports, eyebolts, nuts, and accessories which are shown on the plans and as required for proper connection to existing piping. The Contractor's attention is directed to the fact that the exact location and elevation of existing piping must be determined in the field prior to 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 indicated on the plans and as shown on the plans. Unless otherwise indicated on the plans, all steel pipe, bends, or specials must have an outside diameter minimum wall thickness and unit weights as shown on plans.

3.2.5.1.1. **Ends of Sections.** Ends of pipe sections, bends, and specials must be beveled for field welding, unless shown otherwise on the plans.

3.2.5.1.2. **Seams.** All piping must be made from 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.

3.2.5.1.3. **Length tolerance.** Standard and special section must be within 1/16 in. (plus or minus) of the specified or theoretical lengths.

3.2.5.1.4. **Welded Joints.** Except where ends are 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 certified with 4F and 5G certification. All welds must be sound, free from embedded scale and slag, must have a tensile strength across the weld not less than that of the thinner of the connective sections, and be water tight. Use butt welds for all welded joints in line-pipe assemblies and in the fabrication of bends and other specials. Welds are subject to Pre-Manufacturing inspection and available to the Engineer by request.

Welding for field joints must conform to the applicable requirements of the AWWA "Standard Specification for Field Welding of Steel Water Pipe Joints, C-206." Parties involved in the construction of main(s) must pay special attention to the AWWA "Standard Specification for Field Welding of Steel Water Pipe Joints, C-206, 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 our defective material and re-welding. Hammering is not permitted.

3.2.5.2. **PVC (C-900 and C-905).** Lay PVC mains to the depths and grades shown on 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.

3.2.6. **Defective or Damaged Material.** Pipe and accessories are to be inspected for defects prior to being lowered into the trench. Any pipe section, fitting, or special which 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 his expense, replace or recondition each rejected section. Reconditioning procedures must be acceptable to the Engineer. Any defective, damaged, or unsound material is to be repaired or replaced as directed.

Should a damaged piece of pipe furnished by the Contractor be placed in the water main, the Contractor is to furnish, at his expense, all labor and materials required for removing and replacing the defective pipe and restoring the street to its condition just prior to 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 is to be at the expense of the Contractor.

3.2.7. **Holes at Bells and Collars.** Bell holes of sufficient size are to 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 is to be 6 in. in all directions. Bell holes for concrete steel cylinder pipe are to be of sufficient size to properly joint 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 is to be kept to a minimum.

3.2.8. **Deviations in Line or Grade.** Wherever obstructions, not shown on the plans, are encountered during the progress of the work and such obstructions interfere to such an extent that an alteration on the plan is required, the Engineer is to 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 obstruction. Any deviation from the line is to be accomplished by the use of appropriate bends unless such requirements are specifically waived by the construction inspector.

Whenever it is necessary to deflect pipe from a straight line the deflection is to be as directed. In no case are the amounts shown in Table 22, "Maximum Deflections of Ductile-Iron Pipe," for ductile-iron pipe, and Table 23, "Maximum Defections of Concrete-Steel Cylinder Pipe," for concrete pipe to be exceeded.

Table 22
Maximum Deflections of Ductile–Iron Pipe

Normal Pipe Diameter	Max Defl Angle	Max Deflection in in. with Pipe Length of:		Approx. Rad of Curve in ft. Produced by Succession of Joints with Pipe Length of:	
(in.)	Deg/Min	18'	20'	18'	20'
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

Table 23
Maximum Deflections of Concrete–Steel Cylinder Pipe

Normal Pipe Diameter	Max Deflection Angle	Maximum Deflection (in.)		Approx. Radius of Curve (ft.)	
(in.)	Deg/Min	16' Lay Length	20' Lay Length	16' Lay Length	20' Lay Length
16	2/20	—	9.8	—	500
20	1/52	—	7.8	—	600
24	1/34	—	6.6	—	750
30	1/16	—	5.3	—	900
36	1/02	—	4.3	—	1100
42	0/54	—	3.8	—	1300
48	0/47	2.6	—	1170	—
54	0/44	2.5	—	1237	—
60	0/54	3.0	—	1024	—

3.2.9. **Cutting Pipe.** The cutting of pipe for inserting valves, fittings or closure pieces is to be accomplished so as to produce a smooth end at right angles to the axis of the pipe. Strictly follow the recommendations of the pipe manufacturer. Under no circumstances is a workman not equipped with proper safety goggles and helmet and other required safety attire permitted to engage in this work.

Asbestos-Cement (AC): No field cutting will be allowed on asbestos-cement pipe. Repairs to AC pipe 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 are to be done with a torch or power saw. The cuts are to be made at right angles to the pipe axis and are to be smooth. The edges of the cut are to 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 angle of about 30°.

Field Cut PVC (C-900 and C-905) 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 accordance with Uni-Bell recommendations.

To facilitate future repair work on water mains, no sections less than 3 ft. in length between fittings is allowed.

3.2.10. **Coating and Wrapping Underground Pipe.**

3.2.10.1. **Steel Pipe.** Steel pipe, bends and special are to be prepared, primed, painted or wrapped in the field as follows:

- Exterior Surface Above Ground: Exterior surfaces of new pipe and appurtenances installed are to be thoroughly cleaned to bare metal by high speed wire brushing, scraping or other suitable methods

approved by Engineer, given a single coat of industrial grade rust inhibitive primer and two finish coats of aluminum paint.

- Exterior Surfaces Underground: Exterior surface of steel pipe, bends and specials installed in open trench are to be thoroughly cleaned to bare metal by high speed wire brushing, scraping or other suitable methods approved by Engineer, given a single coat rust inhibitive primer and wrapped with polyvinyl tape in accordance with AWWA C-203-91 “Protective Coatings for Steel Water Pipelines,” (Appendix C).
- The procedure for coating flanged joints and mechanical coupling joints when used with steel pipe is to be as specified.
- Interior Surfaces: The interior surfaces of steel pipe, fittings and specials are to be cleaned by sandblasting and then primed and coated in the shop with coal tar enamel.

3.2.10.2. **Ductile-Iron Pipe.**

3.2.10.2.1. **Open Trench.** Ductile-iron pipe to be installed in a trench is to be protected in the following manner. Each pipe joint is to be covered with a 4 mil thick polyethylene sleeve that is 2 ft. longer than the pipe joint. The sleeve is to 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 2 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 is to be pulled over the joint and secured by the contractor. The polywrap tube from the new joint is to be pulled over the first tube and secured to provide a double seal.

Cast iron and ductile-iron fittings are to be completely wrapped in 8 mil thick polyethylene films with a minimum of 1 ft. overlap on each end and appropriately taped. Laps are to cover joints with adjoining pipe joints or fittings when installed. Fire hydrant barrel from the surface to the valve is to be wrapped as specified.

Any damaged areas in the polyethylene film are to 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 insure that tape extends beyond corporation and onto service line pipe 1 ft.

Prior to placing pipe in the trench, a cushion of approved materials is to be placed in the trench as required by Section 3.4., “Backfill.” Backfill material is to be carefully placed on the pipe so as to avoid any damage to the polyethylene sleeve.

Use care to protect and preserve polyethylene wrap around ductile iron water mains when installing service corporations. The required method is to wrap pipe tape around pipe over 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 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 envelop must extend over and around the connection to a depth of 8 in. above the main.

3.2.10.2.2. **In Casing.** Where ductile-iron pipe is installed in a bore, the pipe is to be to thoroughly clean down to the coal-tar enamel pipe coating by approved methods. Where damaged, a prime coat compatible to the polyvinyl tape to be used is to 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.

Tape is to be spirally and tightly wrapped on each section of pipe with 50% lap. Wrap must be made to bell on bell end and to a point 6 in. from spigot end. Protect joint with tape 6 in. in width on pipe 12 in. or less in size and 8 in. on width on pipe greater than 12 in. in size

3.2.11. **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 are to 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 are to be covered with an approved coating. Such protective coating is supplemental to anti-corrosive sand embedment. Asphaltic coatings such as Talcote is not allowed. Coating and wrapping of joints is to be considered subsidiary to the installation and will not be paid for directly.

3.2.11.1. **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.

3.2.12. **Joint Assembly.**

3.2.12.1. **Rubber Ring Joints.** The installation of pipe and the assembly of rubber ring joints for ductile-iron pipe, concrete-steel cylinder pipe and asbestos cement pipe is to conform to 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 by means of suitable pushing or pulling devices.

3.2.12.2. **Mechanical Couplings.** The installation of mechanical couplings is to be assembled and installed according to the standards recommended by the manufacturer. Prior to the installation of the mechanical coupling, the pipe ends are to be cleaned by wire brush or other acceptable method to provide a smooth bearing surface for the rubber compression gasket. The pipe is to be marked to align the end of the coupling which will center it over the joint. After positioning, the nuts are to be drawn up finger tight. Uniform pressure on the gaskets is to be applied by tightening alternate bolts on the opposite side of the circle in incremental amounts. Final tensioning is to be accomplished with a torque wrench and in a manner similar to the tightening procedure. The coupling is to then be left undisturbed for 24 hr. to allow the gaskets to “pack-in.” Final torque check is to then be made prior to coating and wrapping the joint. Table 24, Torque for Mechanical Couplings, sets forth the proper torque for various sized mechanical couplings and is included for the convenience of the Contractor.

Table 24
Torque for Mechanical Couplings

Coupling Size	Bolt Diameter	Torque
2” to 24”	5/8”	75 ft./lb.
2” to 24”	3/4"	90 ft./lb.
30” and 36” (1/4” x 7” Middle Rings)	5/8”	65 ft./lb.
30 thru 36” (3/8” & heavier Middle Rings)	5/8”	70 ft./lb.
30” to 48”	3/4"	80 ft./lb.
48” to 72”	3/4"	70 ft./lb.

3.2.12.3. **Restrained Joints.** Install restraint joints as shown on plans or as directed by Engineer. Install in accordance with manufacturer’s recommendations.

3.2.13. **Gray Iron and Ductile Iron Fittings.**

3.2.13.1. **Fittings.** Fittings 6 in. through 12 in. in size are to be either mechanical joint, push-on joint short body, or push-on joint compact body unless otherwise stated on the plans. Fittings must be installed with the thrust blocking or joint restraint shown in standard drawing DD-839 series. Fittings 16 in. through 24 in. in size are to be mechanical joint type unless otherwise specified on the plans. Adaptors are to be used where necessary to provide a transition between asbestos-cement pipe and the fittings. Restraint or thrust blocking is to be provided as specified on the plans or as directed. Anti-corrosion embedment incidental to all installed cast-iron fittings must be provided as specified in and no separate payment will be made for this embedment.

3.2.13.2. **Cleaning Ductile Iron.** All lumps, blisters, and excess coal-tar coating is to be removed from the ends of ductile-iron pipe fittings. The outside of the spigot and the inside of the bell is to be wire-brushed and wiped

clean, dry, and free from oil and grease before the pipe is laid. The interior of the pipe is to be blown clean with compressed air or swabbed out clean and dry as directed. Immediately prior to placing any pipe in the trench the interior is to be cleaned by an approved brush or swab or with compressed air to remove all dirt and foreign materials. All pipe and fittings are to be inspected by the Contractor for defects while suspended above ground.

3.2.14. **Corrosion Protection for Ferrous Pipe, Fittings, and Valves.** Except as otherwise shown on plans or as direct, anticorrosion embedment is to be provided for all ductile-iron pipe, fittings, and valves and at all valve fittings or outlets for nonferrous or reinforced concrete steel cylinder pipe. The embedding material is to be Modified Grade 5 gravel washed sand which conforms to the requirements set forth in Section 2.14.2., "Bedding and Initial Backfill for Water Mains."

Prepare the trench in accordance with applicable provisions of Section 3.1., "Excavation." After subgrade has been prepared, lay pipe to grade in accordance with plans and specification. Pipe, fitting or valve are to be firmly embedded in and surrounded by an insulating blanket of embedding material. The minimum thickness of this blanket is to be 6 in. in every direction

3.2.15. **Tie-in to Existing Mains.** The Contractor is to make all ties to existing mains as shown on plans or as directed. Contractor is responsible for: shutdowns and isolation of existing main, coordinating with Utility Owner on site prior to cutting pipe for connection, dewatering the excavation, customer notification of shutdown, proper material and all other requirements as directed by Engineer to provide completion in a safe and secure manner. Tie-ins are to be done as noted on the construction plans. During construction, planned shutdown and tie-in must be coordinated through and approved by the Engineer. Planned shutdown and tie-in is to be accomplished at a time which will be at the least inconvenience to customers. No additional compensation will be provided for tie-ins accomplished after normal working hours. Tie-in to existing mains of asbestos cement (AC) pipe, the Contractor must observe and comply with all federal, state and local laws, ordinances and regulations regarding the management of asbestos containing materials. At the minimum, work involving AC pipe should be overseen by a person who has received asbestos training and is familiar with the National Emissions Standards for Hazardous Air Pollutants (NESHAP). If greater than 260 linear ft. of pipe is to be removed, written notification to the Texas Department of Health (TDH) 10 days prior commencing with the removal of AC pipe is required. At each location shown in the plans and/or identified by the Contractor to involve AC pipe, the Contractor will be required to coordinate with TxDOT's Evergreen Contractor for the removal of the necessary amount of AC pipe required to make the connection without creating any friable material. TxDOT's Evergreen Contractor will remove whole sections of AC pipe so that the Contractor can make the tie-in at the nearest joint. TxDOT's Evergreen Contractor will remove the AC pipe, store it in a secure Engineer approved location, and then dispose of it. Prior to requiring the services of TxDOT's Evergreen Contractor, the Contractor must notify the Engineer and the Owner of the Utility of the work schedule a minimum of two weeks in advance of requiring such services in order not to delay the overall project. Delays or claims made by the Contractor, resulting from the failure to provide advanced notification and schedule coordination with TxDOT's Evergreen Contractor, will not be a basis for additional compensation.

3.2.16. **Abandonment of Old Mains and Valves.** The Contractor is to 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 occasioned by cutting or removal of outlets are to be blocked off by manually forcing cement grout or concrete into and around the openings in sufficient quantity to provide a permanent substantially watertight seal.

Valves abandoned in the execution of the work are to have the valve box and extension packed with sand to within 8 in. of the finished surface. The remaining 8 in. are to 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 are to be salvaged and returned to the Water System Company. Abandoning old mains and valves is to be considered subsidiary to the installation and will not be paid for directly.

3.2.17. **Jacking, Boring, or Tunneling Pipe.**

3.2.17.1. **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 by the Engineer 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 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 must depend on the character of the material, but it must not exceed 2 ft. in any case.

The pipe must be jacked from downstream end. Permissible lateral or vertical variation in the final position of the pipe from line and grade will 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.

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."

3.2.17.2. **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 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.

3.2.17.3. **Joints.** Joints for pipe for "Jacking," "Boring," or "Tunneling," must be as specified in "Water Mains," or as shown on the project plans or shop drawings as per pipe manufacturer's recommendation.

3.2.17.4. **Grouting of Bores or Tunnels.** Annular Space between casing pipe and limits of excavation (borehole) must be pressure grouted, unless otherwise specified on the plans.

3.2.18. **Cutting-in Valves.** The work involved in cutting a valve into an existing main is to consist of excavation and backfilling with approved selected material; hauling and disposition of surplus excavation and other materials; installation of the valve, valve box assembly, all pipe cut used to complete cut-in; reaction blocking; polyethylene wrapping where required.

3.2.19. **Tapping Sleeves and Valves.** Size on size taps is not permitted. The work involved in the installation of a tapping sleeve and valve is to 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 must be required with tapping sleeves and valves. Whenever working on potable or recycled water system, disinfect the shell cutter with bleach prior to start of work. The cutting edge is to be sharp and round. Inspector will reject defective cutters.

Air test tapping sleeves to 50 psi prior to tapping main line.

Place valve box in such a manner to prevent shock or stress from being transmitted to valve. Center valve box over valves operating nut with box cover flush with finished pavement surface or located at another level

as directed by Engineer. Valve boxes located in street or other areas subject to vehicular traffic must be provided with concrete collars as shown on plans. Form collars around such valve boxes and finish off neatly and in a workmanlike manner.

3.2.20. **Cutting-in Tees.** The work involved in cutting in a tee is to consist of excavation, shut-down 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 accordance with this specification.

3.2.21. **Pipe Joint Restraint System.** Pipe joint restraints must be utilized 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 ductile iron mechanical joint (MJ) bell fitting. Joint restraint is to be non-directional and installed to fully restrain system.

3.2.22. **Concrete Encasement, Cradles, Saddles and Collars.**

3.2.22.1. **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 shown on the plans. The pipe is to be supported by pre-cast concrete blocks of the same strength as the concrete for encasement and securely tied down to prevent floatation. Encasement concrete is to be placed to a depth and width conforming to details and sections shown on the plans.

3.2.22.2. **Concrete Cradles.** When shown on the plans or when directed, concrete cradles are to be constructed in accordance with details and sections shown on the plans. The trench is to be prepared and the pipe supported in the same manner as described in this specification. The Strap or Tie Downs will be No. 4 rebar diameter minimum or better as determined by the Engineer.

3.2.22.3. **Concrete Saddles.** When shown on the plans or when directed, pipe to receive concrete saddle is to be backfilled in accordance with Section 3.4., “Backfill,” to the spring line and concrete placed for a depth and width conforming to details and sections shown on the plans.

3.2.22.4. **Concrete Collars.** When shown on the plans or when directed, concrete collars are to be constructed in accordance with details and sections shown on the plans.

3.3. **Fire Hydrants and Miscellaneous Appurtenances.**

3.3.1. **Fire Hydrants.** Hydrants are to be connected to the main as shown on the plans or as directed by the Engineer. They are to be installed in a manner which will provide complete accessibility and in a sage location where there is a minimum possibility of damage from vehicles or injury to pedestrians.

When the hydrant is placed directly behind the curb, the hydrant barrel is to be set so that no portion of the hydrant will be less than 12 in. or 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 is to be within 6-in. of the sidewalk. Setting final grade of fire hydrants to match proposed or existing field conditions is the responsibility of the contractor.

Hydrants are to be set in accordance with plans and details are to be set plumb and are to have their nozzles parallel with or at right angles to the curb with the pumper nozzle facing the curb. Drainage and concrete pad are to be provided at the base of the hydrant as shown on the plans. No fire hydrant drainage system or pit is to be connected to a storm sewer or to a sanitary sewer.

3.3.1.1. **Restrained Joints.** Restrained mechanical joints that require field welding or groove cuts into the pipe barrel for restrain will not be accepted. Restrained joints must be furnished for pipe at all changes in direction at indicated on plans, details, 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 ductile iron pipe and PVC.

3.3.1.2. **Replacing and Relocating Existing Fire Hydrants.** When existing fire hydrants are to be replaced or relocated, the work is to be accomplished by either of the following:

- Cutting or installing a tee of the size and type indicated on plans or as directed.
- Using a tapping sleeve and valve of the size and type indicated on plans to install a new fire hydrant to an existing or new water main. Size on size taps is not permitted.
- Relocating the existing fire hydrant by closing the existing fire hydrant, extending the fire hydrant branch and installing the existing fire hydrant as specified.

Salvage the existing fire hydrant and other materials as designated in the field by the Construction Inspector and deliver to Water System material storage yard located at 816 Fred Byrd Drive. Fire hydrant branches are to 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 18-20 in. below center line of the pumper nozzle and apply to all exposed metal surfaces above the hydrant base flange. The payment for fire hydrant painting is to be included in the unit cost for installing the fire hydrant.

Pipe, fittings, and valves used in the placement of fire hydrants and connections to the main are to be considered subsidiary to the fire hydrant installation and not a part of the main construction and will not be paid for directly.

3.3.2. **Valve Boxes, Adjustments.** Valves are to be provided with valve boxes, manholes, or valve pits as shown on the plans.

The valve box is to be placed in such a manner to prevent shock or stress from being transmitted to the valve. It is to be centered and set plumb over the operating nut of the valve with the box cover flush with the surface of the finished pavement or at such other level as may be directed. Valve boxes located in streets or other areas subjected to vehicular traffic are to be provided with concrete collars as shown on the plans. Collars around such valve boxes are to be formed and finished off neatly.

Valve box is to be located so that the valve operating nut is readily accessible for operation through the opening in the valve box. The valve box is to be set flush with the surface of the finished pavement or at such other elevations as may be specified. Pits are to be constructed to permit minor valve repairs and to afford protection to the valve and pipe from impact where they pass through the pit walls.

Existing valve boxes located within the limits of new street construction which are in conflict are to be adjusted to match proposed finish grades.

Valve boxes installed as part of a new valve and mainline construction project are considered “new valves.” Adjustments to “new valves” are incidental to the installation of the valve. No separate pay will be given to adjust “new valves” to finished grade.

3.3.3. **Air Release Assembly.** Air release valves and appurtenant items are to be installed at the locations shown on the plans unless otherwise directed.

Install air release assemblies in open trench in accordance with plans and details. Assemblies include the valve, valve box, tapping saddle, pipe fittings, accessories and appurtenances. It also includes service line and tap to main. Air release assemblies installed in parkways or easements and outside of street pavement must be installed in accordance with plans.

Air release assemblies installed on steel pipe attached to bridge structure includes the outlet on the steel pipe, valve, valve box, pipe fittings, security enclosure, accessories and appurtenances.

3.3.4. **Blow-offs.** Permanent and temporary blow-off assemblies are to be installed at the locations shown on the plans or where otherwise directed. The permanent blow-off is to consist of all galvanized pipe, valve, and fittings of the various sizes detailed on the plans, 6 in. valve box assembly including the 6-in. valve box and concrete collar around the valve box where subjected to vehicular traffic. The temporary blow off is to consist of all galvanized pipe, valve, and fittings of the various sizes detailed on the plans. Valve box is to be raised on installed to finished grade in accordance with details.

3.3.5. **Gate Valves.** Gate valve installation must include; valve, reaction blocking when required conforming to plans, cast iron boot, valve box extension (Ductile Iron Riser Pipe), valve box, concrete collar where subjected to vehicular traffic, and valve box lid. Gate Valves constructed in terrace must be constructed with No. 3 bars all around.

The valve box must be placed in such a manner 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 by the Engineer. Valve boxes located in streets or other area subject to vehicular traffic must be provided with concrete collars as shown in plans. Collars around such valve boxes must be formed and finished off neatly and in a 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 finish elevations as may be specified. Pits must be constructed in such a manner to permit minor valve repairs and provide protection to the valve and pipe from impact where penetrating through pit walls. In a High Pressure Distribution System as specified in this specification, all valves 6 in. and larger, must be supported on a concrete pad in accordance with plans.

3.3.6. **Anchorage and Blocking.** Suitable reaction blocking or anchorage is to be provided at all dead ends, plugs, caps, tees, crosses, valves and bends as shown on the plans. All mechanical restraints are to be bidirectional. Anchor blocks are to 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 utilized in conjunction with blocking when shown on the plans or as directed.

Thrust blocking is to be a minimum of Class "A" (3,000 psi), concrete placed between solid ground and the fitting except as otherwise shown on the plans. The area of bearing in contact with solid ground is to be that shown on the plans or as directed.

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 in the job plans or specifications. The maximum soil pressure value that will be allowed for the design of thrust blocking will 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 is question will be submitted to the Engineer for verification.

The blocking is to be placed so that pipe and fitting joints will be accessible. Pipe polywrap is to be placed between the pipe or fitting and the concrete.

The reaction block on the unused branch of a tee is to be poured separately from the block across the back of the tee. If they are poured simultaneously, a rigid partition is to be placed between the blocks.

Valves 12 in. and larger in size are to 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.

3.4. **Backfill.**

3.4.1. **Initial Backfill.** Initial backfill is defined as backfill having 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 is to be inspected and approved prior to placement of the second lift. The second lift of initial backfill material is to extend from the spring line of the pipe with a minimum of 1 ft. above the top of the pipe. The second lift is to 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 a point sufficient to a minimum of 1 ft. above the top of pipe.

Consolidate initial backfill material to assure it is incorporated. A handheld vibrator, commonly used for concrete work, can be used for this purpose. The vibrator must be inserted every 3 ft. on each side of pipe.

3.4.2. **Secondary Backfill.** Secondary backfill is defined as backfill from 1 ft. above the top of pipe to the top if the trench. Secondary back fill is to be constructed in accordance with details shown on plans and these specifications.

Secondary backfill material must be placed in maximum 12 in. loose lifts or as directed.

3.4.3. **Sand Backfilling of Cross Trenches and Open Holes.** Blow-offs, tie-ins, air release valves, and service lines, meter boxes, or other specials are to 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 is to be considered subsidiary to trenching and backfilling and will not be paid for directly.

3.4.4. **Trench Backfill Across Traffic Arteries.** Any trench in or across traffic arteries is to be backfilled immediately after the pipe is installed unless the Engineer determines unusual conditions exist that render immediate backfilling unfeasible.

3.4.5. **Flowable Backfill.** Instead of normal backfill materials, the Contractor is to backfill the trench with flowable backfill with fly ash material at the locations shown on the plans and/or at locations directed. The flowable backfill material and operation is to be in accordance with Item 401, “Flowable Backfill.”

3.5. **Flushing and Testing Mains.**

3.5.1. **Flushing.** Immediately upon completion of pipe lying, the Contractor is to flush all mains. This flushing is to be at the direction of the Engineer and is to 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 is to continue until the Engineer determines all dust, debris, or foreign matter that may have entered during pipe laying operations has been flushed out. The new line is to then be left under system pressure for testing.

To avoid damage to pavement and inconvenience to the public, fire hoses are to be used to direct flushing water from the main into suitable drainage channels or sewers.

3.5.2. **Operation of Valves.** No valve in the distribution system is to be operated by the Contractor without prior permission. The Contractor is to notify the owner when a valve is to be operated and is to only operate the valve in the presence of the Engineer’s representative.

3.5.3. **Hydrostatic Tests.** Except in high pressure sections of the water distribution system where test pressures will exceed 150 psi, all new mains are to be hydrostatically field tested at a maximum test pressure of 150 psi before approval by Engineer. Where designated as “high pressure area,” all new mains must be

hydrostatically field tested at a maximum test pressure of 200 psi before acceptance by the Engineer. All joints which are found to leak either by observation or during any test are to be made watertight by the Contractor. In case repairs are required, the hydrostatic field test is to be repeated until the pipe installation conforms to the specified requirements and is acceptable. The expense for tests which meet specified requirements is to be made in accordance with the unit price for the hydrostatic pressure test. No payment is to be made for tests which fail to meet specified test leakage requirements.

After the new main has been laid and backfilled as specified, but prior to chlorination and replacement of pavement, it is to be filled with water for a minimum of 24 hr. and then subjected to a hydrostatic pressure test. The specified test pressure is to 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 are to be furnished by the Contractor. Unless otherwise specified, the Water System Company will furnish water for filling lines and making tests through existing mains.

Before applying the specified test pressure, all air is to be expelled from the main. To accomplish this, taps are to be made, if necessary, at the points of highest elevation and afterwards tightly plugged at no cost to the Department. At intervals during the test, the entire route of the new main is to be inspected to locate any leaks or breaks. If any are found, they are to be stopped or repaired. The test is to be repeated until satisfactory results are obtained.

The hydrostatic test is to be made so that the maximum pressure at the lowest point does not exceed the specified test pressure. The duration of each pressure test is to be a minimum of 4 hr. for new mains in excess of 1,000 ft. and a minimum of 1 hr. for new mains less than 1,000 ft. after the main has been brought up to test pressure. The test pressure is to be measured by means of a tested and properly calibrated pressure gauge acceptable to Engineer. All pressure tests are to 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 listed in Table 25 or 26, Hydrostatic Test Leakage Allowances, the Contractor is to, 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 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 is to notify the Engineer prior to beginning the test, and the Water System Company's Inspector is to be present during the pressure test.

PVC pipe leakage allowances must conform to DI leakage allowances listed on Tables 25 and 26, Hydrostatic Test Leakage Allowances.

Table 25
Hydrostatic Test Leakage Allowance (Maximum) @ 150 psi

Pipe	100	200	300	400	500	600	700	800	900	1,000	2,000	3,000	4,000	5,000
6"DI[1]	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[1]	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[1]	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[1]	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[1]	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[1]	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[1]	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	27.05
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[1]	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[1]	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[1]	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					
60"CSC	0.24	0.48	0.72	0.96	1.20	1.44	1.68	1.92	2.16					

1. DI Pipe includes mechanical and push–on joints.
2. GPH for CSC Pipe are manufacturer's maximum.

Note: Leakage allowances may be determined for footages not specifically listed by interpolation and/or by the combination of various tabular data.

Table 26
Hydrostatic Test Leakage Allowance (Maximum) @ 200 psi

Nominal Dia-Ty Pipe	Allowable Leakage in Gallons Per Hour (GPH)[1] Pipe Length in Feet									
	100	200	300	400	500	600	700	800	900	1,000
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	1.40	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	2.4	2.55	3.06	3.57	4.08	3.59	5.10
24"CSC	0.10	0.19	0.29	0.358	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	0.474	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. GPH for CSC Pipe are manufacturer's maximum.
2. DI Pipe includes mechanical and push–on joints.

Note: Leakage allowances may be determined for footages not specifically listed by interpolation and/or by the combination of various tabular data.

3.6. **Disinfection of New Mains Utilizing Machine Chlorination.** After the new mains have successfully passed the pressure test specified in Section 3.5.3., "Hydrostatic Tests," the Contractor will disinfect those mains shown on the plans or otherwise indicated as "Machine Chlorination." This disinfection is to 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.

3.6.1. **Operation of Valves.** During and after the disinfection of mains, the Contractor is to be notified by the Engineer sufficiently in advance 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.

3.6.2. **Contractor's Personnel and Equipment.** The Contractor is to supply labor and equipment necessary to make all excavations required for chlorination, equipment connections, subsequent flushing, and placing the mains in service.

3.6.3. **Safeguarding and Backfilling Open Holes.** The Contractor is to be responsible for safeguarding any open holes excavated or left open for flushing and disinfection purposes. Following completion of disinfection, the Contractor is to backfill such holes in accordance with appropriate provisions of Section 3.4., "Backfill."

3.6.4. **Disinfection of Mains Utilizing Dry Calcium Hypochlorite.** Mains are to be disinfected with dry Calcium Hypochlorite (HTH) where shown on the plans or as directed and must not exceed a total length of 800 ft.

This method will also be followed for main repairs. Contractor must utilize appropriate safety measures to protect personnel during disinfection operation.

3.6.5. **Dosage.** The Contractor is to disinfect the new or replaced mains with Calcium Hypochlorite (HTH) of 70 percent available chlorine. Sufficient Calcium Hypochlorite (HTH) is to be used to obtain a minimum chlorine concentration of 50 ppm. The following Table 27, Chlorine Dosage, is included for the convenience of the Contractor:

Table 27
Chlorine Dosage

Diameter of Pipe in In.	Oz./Ft. To Obtain 50 ppm Chlorine Dosage
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.

3.6.6. **Filling the Main.** Those sections of main to which dry Calcium Hypochlorite (HTH) has been applied is to be filled slowly to allow for the even distribution of the disinfecting material. The manipulation of valves is to be under the direction of the Engineer in accordance with Section 3.5.2., “Operation of Valves.”

3.6.7. **Holding Time.** The length of time that sections of main disinfected with Calcium Hypochlorite (HTH) is to be allowed to stand undisturbed will depend upon the particular job and Texas Commission on Environmental Quality (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.

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.

3.6.8. **Flushing.** Following the expiration of the specified holding time, the treated section of main is to be flushed thoroughly by the Contractor in accordance with the applicable provisions of Section 3.5., “Flushing and Testing Mains.” Flushing is to 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 in order to minimize erosion or impact to residents.

3.6.9. **Preventing Reverse Flow.** Valves are to 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.

3.6.10. **Supervision.** All disinfection is to be done as directed by the Engineer.

3.6.11. **Additional Treatment.** Should the new main fail to meet minimum public health standards for bacteriological quality after flushing, further treatment is to be as directed. If further disinfection is required, chlorination is to be done in accordance with Section 3.6., "Disinfection of New Mains Utilizing Machine Chlorination." In no case, however, is the new line to be acceptable as complete and satisfactory until the bacteriological quality of the water taken from the main meets the Standards of the TCEQ.

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.

3.6.12. **Safeguarding and Backfilling Open Holes.** The requirements for safeguarding and backfilling all holes excavated or left open for chlorinating and sampling is to be as specified in Section 3.6.3, "Safeguarding and Backfilling Open Holes."

3.7. **Service Supply Lines.** Service supply lines and fittings, meter boxes and appurtenances must conform to material specifications and must be installed by the contractor as specified, or as directed by the engineer and in accordance with plans.

3.7.1. **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 Customers 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."

3.7.2. **Service Relays.** New transfer main(s) to which services are to be relayed and are on the same side of the streets as the Customer's meter are defined as "short relays." New transfer main(s) to which services are to be relayed and are on the opposite side of the street from the Customer's meter are defined as "long relays."

New transfer main(s) to which services are to 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 to the new main must be defined as a "long relay."

3.7.3. **Service Relocates.** Service Relocates are defined as services that are relocated from an alley to a side or front street. New transfer main(s) to which services are to be relocated and are on the same side of the street as the Customer's new meter box location, are designated as "short relocates." New transfer main(s) to which services are to be relocated and are on the opposite side of the street from the Customer's new meter box location, are designated as "long relocates."

3.7.4. **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 must be designated as "new services." New laid main(s) 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." New laid main(s) to which new services on the opposite side of the street from the Customer's new meter box location, are designated as "new long services."

3.7.5. **New Un-metered Services.** New Un-metered 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 un-metered 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 un-metered short services." Where the new main or the existing water main to which new un-metered 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 un-metered long service." New un-

metered long services and new un-metered short services will not include "Customer's yard piping" and no meter will be set.

3.7.6. **Tap Holes.** Tap holes are defined as excavations at existing mains, which are required in association with 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 must be included in the various sizes of each service placed.

3.7.7. **Service Line Installation.** Unless otherwise notified, service relays, service reconnects, service relocates and new services must be installed as described, and as shown on the plans. Unless otherwise indicated, 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 in plans.

Cutting, excavation, backfill and replacement of pavement must be done as specified and in accordance with applicable sections of this specification and 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. to 2 in. Service lines, minimum bury depth must be 3 ft. For services greater than 2 in., minimum depth of bury must be 4 ft.

All service lines must be installed in accordance with plans, and 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 through 16.

The Contractor must use precaution to protect and preserve the polyethylene wrap around Ductile-Iron (DI) water mains when installing service corporations. The required method is, 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, 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 specification.

Where 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.

3.7.8. **Splicing.** A long service line single splice may be permitted by means of a 3-part compression or flared coupling only when approved in advance by the Engineer, provided the location of the splice is not under pavement or concrete. The segment added is required to be the same material as the existing service line, unless otherwise directed by the Engineer. Splicing short service lines will not be permitted.

3.7.9. **Boring or Jacking Service Lines.** Service lines which 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 one additional foot into the traffic side of the street.

3.7.10. **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 associated with the tapping process.

Tapping of AC pipe must be done in accordance with manufacturers' recommendation and done only with tap machine having a built in flush valve and the flush valve must be open during the entire procedure.

3.7.11. **Abandonment of Service Lines.** The Contractor must accomplish all cutting, capping, and plugging necessary to isolate new service lines transferred to new and existing mains from those abandoned, including service lines designated 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 must 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 must salvage copper service line tubing, brass fittings, and other materials as directed by the Inspector and return them to the Owner.

3.7.12. **Tapping PVC (C-900).** Tapping of PVC must be done in accordance 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 which will retain the coupon.

The shell cutters must be designed for C-900 pipe, thus having sufficient root depth to handle the heavier walled pipe.

3.7.13. **Small Service Lines.** Copper tubing must be used for 3/4 in. through 2 in. service lines. Brass fittings for 3/4 in. and 1 in. service lines must be of the flared or compression type for the use with Type 'K' soft annealed copper tubing. Brass fittings for 1-1/2 in. and 2 in. lines must be of the flared or compression type for use with type 'K' soft annealed copper tubing, except as modified by this specification.

Copper tubing must be cut squarely by using an approved cutting tool and by avoiding excessive pressure on the cutting wheels which might bend or flatten the pipe walls. Following the copper tubing cut, but before flaring, a reamer must be used to remove the inside rolled lip from the tubing. Flared ends must be expanded by the use of a flaring tool using 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 must be accomplished by using an appropriate sized bending tool. No kinks, dents, flats, or crimps will be permitted, and should such occur, the damaged section must be cut out and replaced. When compression fittings are used, the copper tubing must be cut squarely prior to insertion into the fitting Final assembly must be in accordance with the manufacturers recommendations.

3.7.14. **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 with 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; cutting and replacing pavements, curbing and sidewalks of all types over the limits of the main line trench and the completed service line trench.

3.7.15. **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 for the purpose of gaining access to the existing service corporation stop and the new main for the purpose of installing the new corporation stop. The new main must be exposed for the purpose of being drilled and tapped with an approved tapping machine, a new corporation stop installed under pressure, and the trench extended laterally to expose a sufficient 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 must "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 sufficient 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 by means of 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 in this specification.

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.

3.7.16. **Relaying Service Lines.** The existing or new mains shown on plans must be exposed opposite location stakes placed on site at the direction of the Engineer. The existing or new main must; be drilled and tapped with 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 its staked location and perpendicular to the corporation stop in the water main. The meter box location must not vary more than 24 in. in any direction from its staked location. The service line must be installed with sufficient slack to compensate for soil movement. Where the location of the existing meter is not changed, the new service line must be extended from the main to the existing meter, a 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.

3.7.17. **Single Service Line - Dual Meters.** The single service line - dual meter installation must consist of a 1 in. copper service line reducing to two 3/4 in. copper service lines at a tee which must 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 must 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 the requirements of this specification.

3.7.18. **Small Service Lines on Existing Mains.** The work involved in the installation of new copper service lines on existing mains must 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.

3.7.19. **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.

3.7.20. **Large Service Lines on New Mains.** Work involved in the installation of a new metered service lines and non-metered fire service lines must 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.

3.7.21. **Large Service Lines on Existing Mains.** The work involved in the installation of the new metered service lines and non-metered fire service lines must 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.

3.7.22. **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 must move existing meters and meter boxes and reconnect and adjust customer's yard piping as part of transferring service lines. A dielectric coupling PVC 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 must 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 must 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 must install a number one meter box (2 pieces) as shown in the specification and 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. In lieu of the new meter, the Contractor must furnish and install a meter template in accordance with plans

Meter and meter box configuration, must 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 must be flush with the existing ground surface. All excess soil above the meter coupling, meter flange and meter nuts inside the meter box must be removed so that the meter register is clearly visible. The Contractor must exercise special precautions during excavation at the existing meter location in order 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. Adjustment of meter to proper grade is incidental to the construction and will not be paid for separately.

Where required, pressure reducing valves must 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 must 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 linear ft. from the existing box.

3.7.23. **Water Service for Fire Lines.**

3.7.23.1. **Start of Work.** Three working days' notice will be given to the assigned Inspector prior to 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 by the Engineer. No valve or other control on the existing system must be operated for any purpose by the Contractor unless a representative of the Utility Owner is present.

3.7.23.2. **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 done by hand for at least 12 in. all around. Any damage to other utilities must be reported to their proper governing entity.

3.7.23.3. **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 in. 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 by the Engineer. Grades must be met as specified. Precautions must be taken to insure that the pipe barrel has uniform contact with the Modified Grade 5 for its full length except at couplings. Couplings must not be in contact with the original trench bottom prior to backfilling. Modified Grade 5 material must be placed under the coupling and compacted by hand prior to backfilling so as to provide an even bearing surface under the coupling and pipe. Changes in grade must be made only at joints.

3.7.23.4. **Modified Grade 5 Materials.** Prior to placing pipe in a trench, the trench must have been excavated to the proper depth as required of these specifications. 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.

3.7.23.5. **Structures to Support Pipe.** If the bottom of a trench at subgrade consist of material that is notably unstable as determined by the Engineer and cannot be removed and replaced with approved material, subgrade may be properly compacted in place to support the pipe. The Contractor must also construct a foundation for the pipe consisting of piling, concrete beams, or other supports in accordance with plans prepared by the Engineer.

3.7.23.6. **Lowering Materials into Trench.** Proper implements, tools, and facilities satisfactory to the Engineer will 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 will 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 will be allowed unless the entire sling is wrapped with a protective nylon web sock.

3.7.23.7. **Laying of Pipe.** Every precaution must be taken to prevent foreign material from entering the pipe during its installation. Under adverse trench conditions or otherwise required by the Engineer, a heavy, tightly woven canvas bag of suitable sized will be placed over each of the pipe.

The Canvas bag must be left in place until a connection is made to the adjacent pipe. The interior of each pipe must be inspected for defects, and the pipe must be rejected if any 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 the requirements of these Specifications. The pipe must be secured in place with approved backfill material tamped around it. Pipe and fittings which do not allow a sufficient and uniform space for joints must 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.

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 must 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.

3.7.23.8. **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 will be accomplished by the use of appropriate bends unless such requirement is specifically waived by the Engineer.

Whenever it is necessary to deflect pipe from a straight line, the deflection will be as directed by the Construction Inspector and as described. In no case will the amounts exceed those shown in Table 22, "Maximum Deflections of Ductile-Iron Pipe" for ductile-iron pipe.

3.7.23.9. **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 must be strictly followed by the Contractor. Under no circumstances, will a workman not equipped with proper safety goggles, helmet and all other required safety attire be permitted to engage in this work.

3.7.23.10. **Asbestos-Cement (AC).** No field cutting will be allowed on asbestos cement pipe. Installation of fire line services to AC pipe mains must be accomplished according to Section 3.2.15., “Tie-in to Existing Mains.”

3.7.23.10.1. **Joint Assembly.**

3.7.23.10.1.1. **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" must 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.

3.7.23.10.1.2. **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.

Prior to 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 must be drawn up finger tight. Uniform pressure on the gaskets must be applied by tightening alternate bolts on the opposite side of the circle in incremental amounts. Soap and final tensioning must be accomplished with a torque wrench and in a matter similar to the tightening procedure after 15 min.

3.7.23.10.1.3. **Restrained Joints.** Restrained Joints must be installed as shown on the plans or as directed by the Construction Inspector. Installation must conform to the manufacture’s recommendations.

3.8. **Installation of the Nonmetallic Pipe Detection System.** The nonmetallic pipe detection system is to be installed concurrently with the proposed pipe placement. Tracer wire must be utilized for location purposes and taped directly to the pipe. The tracer wire must be solid core (14 gauge insulated), and must be taper to the main in 10 in. increments. Wire must also come up to the top of valve extensions and fire hydrant stems, as directed by the Engineer.

3.9. **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 done in accordance with this specification. This subsection applies solely to the construction of high pressure water systems and must govern when in conflict with of subsections of this specification.

3.9.1. **High Pressure Systems.** Each water distribution system that furnishes water in Pressure Zone 9 through 16 must 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.

3.9.2. **Locations of High Pressure Levels.** Geographically, boundaries of Pressure Zones 9 through 16 conform to the surface contour tabulation shown in Table 28, High Pressure Levels. Most of the area within Pressure Zones 9 through 16 is located north of Loop 1604 between IH-35 North and Bandera Road.

Table 28
High Pressure Levels

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	1125	1000	870	780	720
10	1290	1160	1040	940	880
11	1400	1270	1150	1050	1000
12	1520	1390	1270	1170	1120
14	1630	1500	1380	1280	1230
15	1860	1730	1600	1510	1460
16	1990	1860	1740	1640	1590

4. MEASUREMENT

This Item will be measured as follows: “Pipe Water Main (DI),” “Pipe Water Main (PVC),” “Pipe Water Main (PVC Casing) (Open Cut),” and “Pipe Water Main (Steel Casing) (Open Cut)” for water pipe of the various sizes shown on the plans, will be measured by the linear 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.

“Fire Lines” will be measured by the linear 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.

“Jacking or Boring (Water Main)” will be measured by the linear 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 will be measured by the linear foot of pipe installed from end to end of pipe to the limits shown on the plans

Casing or liners used in bores and tunnels, where required by the plans, of the size and material required will be measured by the linear foot actually installed in accordance with plans.

“Butterfly Valve and Box (Complete)” will be measured as each assembly of the various sizes installed.

“Gate Valve and Box (Complete)” will be measured as each assembly of the various sizes installed to finished grade.

“Cut-in Gate Valve and Box (Complete)” will be measured as each assembly of the various sizes installed to finished grade.

“Tapping Sleeve, Valve and Box (Complete)” will be measured as each assembly of the various sizes installed.

“Cut-in Tee (Complete)” will be measured as each assembly of the various sizes of cast-iron tees cut-in to the existing water main.

“Adjust Existing Valve Box” will be measured as each assembly adjusted to correspond to finish grade.

“Concrete Encasement, Concrete Cradles, Concrete Saddles and Concrete Collars” for pipe will be measured by the cubic yard as dimensioned on the plans, 6 ft. in depth measured from the outside pire diameter (0.0) or as directed. Reinforcing if required will not be measured for payment.

“Fire Hydrant with 6 in. Valve and Box” will be measured as each fire hydrant installed. Also included will be sufficient pipe, valve and fittings.

“Relocate Fire Hydrant” will be measured as each fire hydrant relocated.

“Replace Fire Hydrant” will be measured as each fire hydrant replaced.

“Permanent Blow-off (Complete)” will be measured as each assembly of the various sizes installed.

“Temporary Blow-off (Complete)” will be measured as each assembly of the various sizes installed.

“Automatic Air Release Valve (Complete)” will be measured as each assembly of the size installed.

“Trench Excavation Protection” and “Joint Trench Excavation Protection” will be measured by the linear foot along the centerline of trench where the depth of trench exceeds 5 ft.

“Tie-In (Complete)” will be measured as each of the various sizes and types completed.

“New Short Service” will be measured as each of the various sizes and types of new service lines installed.

“New Long Service” will be measured as each of the various sizes and types of new service lines installed.

“New Unmetered Short Service” will be measured as each of the various sizes and types of new unmetered service lines installed.

“New Unmetered Long Service” will be measured as each of the various sizes and types of new unmetered service lines installed.

“Reconnect Short Service” will be measured as each of the various sizes of service lines reconnected.

“Reconnect Long Service” will be measured as each of the various sizes of service lines reconnected.

“Relay Short Service” will be measured as each of the various sizes of service lines re-laid.

“Relay Long Service” will be measured as each of the various sizes of service lines re-laid.

“Relocate Short Service” will be measured as each of the various sizes of service lines relocated.

“Relocate Long Service” will be measured as each of the various sizes of service lines relocated.

“Relocate Existing Meter and Existing Meter Box” will be measured as each assembly relocated and customer's service reconnected.

“Relocate Existing Meter and New Meter Box” will be measured as each assembly relocated and customer's service reconnected.

“Cut and Replace Concrete Sidewalk, Driveway, Etc.” will be measured by the square yard of surface area of the concrete sidewalk cut and replaced, but not to exceed the minimum trench width specified in Section 3.1.2, “Width of Trench” or as shown on plans.

"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 minimum trench width specified in Section 3.1.2., "Width of Trench" or as shown on the plans.

"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 minimum trench width specified in Section 3.1.2., "Width of Trench" or as shown on plans.

"Concrete Curb" will be measured by the linear foot of the concrete curb cut and replaced, but not to exceed the minimum trench width specified in Section 3.1.2., "Width of Trench" or as shown on plans.

"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 minimum trench width specified in Section 3.1.2., "Width of Trench" or as shown on plans.

"Hydrostatic Pressure Test" will not be measured for payment, but is to be considered subsidiary to the various related bid items.

"Excavation" will not be measured for payment, but is to be considered subsidiary to the pipe installation.

"Flowable Backfill" will be measured by the cubic yard in accordance with Item 401, "Flowable Backfill," but not to exceed the minimum trench width specified in Section 3.1.2., "Width of Trench" or as shown on the plans.

"Installation of the Nonmetallic Pipe Detection System" will not be measured for payment, but is to be considered subsidiary to the pipe installation.

"Removing and Replacing Chain-Link and/or Wire Fence" will be measured by the linear foot of fence removed and replaced, regardless of the type or height of the fence, complete in place. The existing fence materials may be reused unless, the existing materials were damaged during removal and should not be reused, the Contractor is to provide new material for the replacement work at his expense.

"Ductile Iron and Gray Iron Fittings" will be measured by the weight to the nearest one-hundredth of a ton of the various sizes of fittings 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 prices bid for the items of work after 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.

Payment for "Pipe Water Main (DI)", "Pipe Water Main (PVC)," "Pipe Water Main (PVC Casing)(Open Cut)," and "Pipe Water Main (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 payment is also to include selected bedding, excavation, backfill materials (except for cement stabilized backfill), polyethylene sleeve, and hauling and disposition of surplus excavated materials.

Payment for "Fire Lines" installed will be made at the unit price bid for pipe of various sizes installed. Such payment will include excavation selected embedment material, backfill (except for cement stabilized backfill), compaction of trench backfill, testing of compaction, tie-in, polyethylene sleeve where required, hauling, disposing of surplus excavated material, and restoration of surface. All replacement mains will include tie-in costs for existing fire lines.

Payment for “Jacking or Boring (Water Main),” Jacking, Boring or Tunneling will be paid for at the contract unit price bid per linear foot of jacking, boring or tunneling, which price 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 (except for cement stabilized backfill), restoration to original ground conditions, and disposal of surplus materials.

Carrier pipe used in bores or tunnels will be paid for at the contract unit price bid for "Carrier Pipe for Jacking, Boring or Tunneling" per linear foot of pipe installed and measured as prescribed above.

Casings or liners used in bores or tunnels will be paid for at the contract unit price bid for "Casing or Liner for Jacking, Boring or Tunneling" per linear foot of casing or liner installed and measured as prescribed above.

Payment for “Gate Valve and Box (Complete)” and “Tapping Sleeve, Valve and Box (Complete)” will be made at the unit price bid for each such assembly of the various sizes installed. This payment is also to include 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. For butterfly valves only, such payment is also to include mechanical or transition couplings, and coated and wrapped steel pipe nipples required to complete the connection.

Payment for “Cut-in Gate Valve and Box (Complete)” will be made at the unit price bid for each such assembly of the various sizes installed. This payment is to include backfill, installation of valve, valve box assembly, all pipe cut and used to complete cut-in, reaction blocking, and polyethylene sleeve where required.

Payment for “Cut-in Tee (Complete)” will be made at the unit price bid for each of the various sizes of cast iron tees cut-in to ductile and cast iron mains. This payment is also to include necessary tie-ins, protective coating for bolts, nuts, ferrous surfaces, selected embedment material, anti-corrosion embedment when specified, backfill, pipe, fittings, polyethylene sleeve when required, concrete reaction blocking, and site restoration.

Payment for “Adjust Existing Valve Box” will be made at the unit price bid for each valve box adjusted to finish grade.

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. Reinforcing, if required, will not be measured for payment.

Payment for “Fire Hydrant with 6 in Valve and Box” and “Relocate Fire Hydrant” and “Replace Fire Hydrant” will be made at the unit prices bid for each such assemblies installed. These payments are to include 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, asphaltic material for ferrous surfaces, concrete reaction blocking, concrete pad restoration of existing fire hydrant sites and installing a new fire hydrant as directed.

Payment for “Permanent Blow-off (Complete)” and “Temporary Blow-off (Complete)” will be made at the unit price bid 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 linear 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.

Payment for “Automatic 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 payment is also to

include 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.

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 29, “Weights of Ductile-Iron and Gray Cast-Iron Fittings.” Such payment will also include 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 inspectors discretion.

Payment for “Trench Excavation Protection” and “Joint Trench Excavation Protection” is to be made on the basis of the unit price bid for each linear foot of “Trench Excavation Protection” and “Joint Trench Excavation Protection” in place. Payment is to include 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 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.

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 payment is to include 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.

Payment for “New Short Service” and “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. Such payment will also include 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 ductile iron pipe (4 in. and larger).

Payment for “New Unmetered Short Service” and “New Unmetered Long Service” will be made at the unit price bid for each new un-metered service line of the various sizes and types installed. This payment is to include 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.

Payment for “Reconnect Short Service” and “Reconnect Long Service” will be made at the unit price bid for each service line of the various sizes and types reconnected. This payment is to include 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.

Payment for “Relay Short Service” and “Relay Long Service” will be made at the unit price bid for each service line of the various sizes and types relaid. This payment is to include 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.

Payment for “Relocate Short Service” and “Relocate Long Service” will be made at the unit price bid for each service line of the various sizes relocated. This payment is to include 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.

Payment for “Relocate Existing Meter and Existing Meter Box” will be made at the unit price bid for each assembly relocated. This payment is also to include excavation protection, hauling and disposition of surplus excavated materials, 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 existing meter box, and the existing yard piping.

Payment for “Relocate Existing Meter and New Meter Box” will be made at the unit price bid for each assembly relocated. This payment is also to include 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 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.

Payment for “Cement Stabilized Backfill” will be made at the unit price bid for each cubic yard of cement stabilized backfill placed, but not to exceed the minimum trench width specified in the plans, as per Item 400, “Cement Stabilized Backfill.”

Payment for “Cut and Replace Concrete Sidewalk, Driveway, Etc.” will be made at the unit price bid.

Payment for “Cut and Replace Asphalt Pavement” will be made at the unit price bid.

Payment for “Cut and Replace Asphalt Pavement with 6 in. of Asphalt Treated Base” will be made at the unit price bid.

Payment for “Cut and Replace Concrete Sidewalk (Asphalt)” will be made at the unit price bid.

Payment for “Concrete Curb” will be made at the unit price bid.

No direct payment will be made for “Hydrostatic Pressure Test”. Such test includes all materials and equipment required to conduct the test. This work and materials will be considered subsidiary to the various related bid items.

Payment for “Flowable Backfill” will be made at the unit price bid for each cubic yard of flowable backfill placed, but not to exceed the minimum trench width specified in the plans, as per Item 401, “Flowable Backfill.”

Payment for “Removing and Replacing Chain-Link and/or Wire Fence” will be by the unit price bid per linear foot of fence removed and replaced.

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 nonmetallic 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 C-905. 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.

Table 29
Weights of Gray Iron and Ductile Iron Fittings (lbs.)

BENDS							
1/4 Bend (90°)				1/8 Bend (45°)			
Size (in.)	MJ Compact (C153)	MJ (C110)	FLG SB	Size (in.)	MJ Compact (C153)	MJ (C110)	FLG SB
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	1105	1085	24	441	777	730
30	979	1740	1755	30	775	1393	1355
36	1501	2507	2135	36	1140	2163	1755
42	2277	3410	3055	42	1652	2955	2600
48	3016	4595	4095	48	2157	4080	3580
BENDS							
1/16 Bend (22.5°)				1/32 Bend (11.25°)			
Size (in.)	MJ Compact (C153)	MJ (C110)	FLG SB	Size (in.)	MJ Compact (C153)	MJ (C110)	FLG SB
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	1500	1385	30	603	1410	1395
36	963	2182	1790	36	830	2195	1805
42	1354	3020	2665	42	1210	3035	2680
48	1790	4170	3665	48	1523	4190	3695

Table 29 (continued)
Weights of Gray Iron and Ductile Iron Fittings (lbs.)

TEES				
Size (in.)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
3	3	26	56	53
4	3	31	78	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	536	573
	8	240	565	555
	12	283	615	590
	16	326	676	635
20	6	344	750	773
	8	273	766	720
	12	427	799	816
	16	503	975	950
	20	566	1068	1005

TEES				
Size (in.)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
24	6	466	1035	1089
	8	487	1047	1060
	12	539	1075	1125
	16	625	1109	1070
	20	729	1504	1510
	24	785	1617	1685
30	8	739	1808	—
	12	800	1842	1801
	16	959	1885	—
	20	1026	1941	—
	24	1228	2496	2475
	30	1373	2531	2615
36	24	1548	2710	2255
	30	1901	3545	3000
	36	2012	3686	3160
42	24	2272	3690	3245
	30	2512	4650	4125
	36	3048	5119	5360
	42	3225	6320	5580
48	24	2934	4995	4385
	30	3147	5140	4455
	36	4046	6280	5555
	42	4249	8130	7195
	48	4469	8420	7385

Table 29 (continued)
Weights of Gray Iron and Ductile Iron Fittings (lbs.)

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	1117	1085
	20	598	1274	1230

CROSSES				
Size (in.)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
24	6	566	1025	—
	8	578	1085	1045
	12	610	1153	1110
	16	663	1256	1200
	20	975	1733	1675
	24	907	1906	1835
30	8	650	1795	—
	12	870	1925	1865
	16	900	1950	—
	20	1220	2060	—
	24	1497	2776	2675
	30	1808	3188	3075
36	24	1853	2928	2980
	30	2580	3965	—
	36	2698	4370	4370
42	24	2415	3910	—
	30	2920	5040	—
	36	3788	5835	—
	42	3908	6493	7145
48	24	3435	5210	—
	30	4145	5495	—
	36	4873	6790	—
	42	5465	8815	—
	48	5588	9380	—

Table 29 (Continuation)
Weights of Gray Iron and Ductile Iron Fittings (lbs.)

CAPS			PLUGS	
Size (Inches)	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	1322	1200	1222
48	1076	1737	1550	1597

Table 29 (Continuation)
Weights of Gray Iron and Ductile Iron Fittings (lbs.)

SOLID SLEEVES				
Size (Inches)	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	1005
36	725	960	947	1374
42	877	1209	1187	1628
48	1406	1516	1472	2033

Table 28 (Continuation)
Weights of Gray Iron and Ductile Iron Fittings (lbs.)

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	1027
30	20	599	1085
30	24	492	1204
36	20	1042	1459
36	24	785	1580
36	30	655	1868
42	24	1356	2060
42	30	1112	2370
42	36	1116	2695
48	30	1722	3005
48	36	1650	3370
48	42	1429	3750

Table 29 (Continuation)
Weights of Gray Iron and Ductile Iron Fittings (lbs.)

2" TAPPED TEES AND CROSSES		
Size (Inches)	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 (Inches)	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	—	1025
20 x 24	—	1245

Special Specification 7334
Water and Sanitary Sewer

1. DESCRIPTION

Furnish, install, or replace water and sanitary sewer pipes, valves, meters and boxes, service connections, fire hydrant assemblies, pipefittings, encasement pipes manholes, supporting materials in conformance with the City of Santa Rosa (CITY) requirements, and details shown on the plans. Provide testing as required and request inspection of completed utility lines and appurtenances before being placed in service.

2. QUALIFICATION

Water and sewer utility improvements included in this project must be performed by a Contractor who meets the following qualifications and must demonstrate the following:

- Firm with at least five yr. of experience in the construction of public water or sanitary sewer projects.
- Firm with equipment capable of performing the work.

3. MATERIALS

Furnish all materials in compliance with the requirements shown on the plans or pickup materials furnished by the utility companies, and deliver to the project site. See Article 6, “Measurement,” Table 1—Section A: Water.

Submit two copies of information to CITY from all manufacturers for materials and equipment to be used on the project. This information must include:

- Product specifications sufficient to allow the CITY to determine whether the materials and equipment conform to the design concepts and project specifications.
- Information on all warranties provided by the manufacturer.
- All submittals must be stamped by the manufacturer indicating that the manufacturer has checked the submittal for compliance with the Specifications. Unstamped or certified submittals must be returned to the manufacturer unprocessed.
- Submittals must be provided to CITY before or at the preconstruction meeting. Construction will not be allowed to proceed until all submittals have been approved or a written waiver is issued by the CITY.

4. TESTING AND INSPECTION

4.1. **Testing.** Provide testing in conformance with City of Santa Rosa requirements or as directed by the city Engineer or designated representative. Perform the following testing as minimum:

- For water mains: hydrostatic test and disinfection or sterilization test.
- For sewer lines: low-pressure air test, deflection (mandrel) test, vacuum test, and closed circuit television (CCTV) inspection.

4.2. **Inspection.** All water mains, sewer lines, and their appurtenances must be inspected by a representative of CITY and their decision of acceptability, based on the plans and specifications, on the installation will be final. CITY must hold a minimum of two final inspections; one upon completion of utility installation and one upon roadway completion.

For all tie-ins to CITY utility system, especially any tapping sleeves and valves, a CITY representative must be present unless noted otherwise in writing by CITY.

5. CONSTRUCTION

Protect all water and sewer mains, vaults, and appurtenances at all times during the construction. Promptly repair, at no additional cost to CITY, any damage to the existing water or sewer systems and any interruption to the services, such as line stoppages or breakage caused as a result of Contractor's operations.

5.1. **Specifications.** Perform the work in such a manner consistent with the City of Santa Rosa standards and specifications.

5.2. **Trash Collection.** When Contractor is working in an area and street is impassable to local trash collection, Contractor must be responsible for coordinating with local franchise trash collection service, up to and including, collecting trash in the morning and transporting it to the nearest street intersection that is not affected by the construction work zone.

5.3. **Notice.** Contractor must notify all residences and businesses in the affected area a minimum of 24 hr. before any disruption in utility service. Residents must be notified either in person or by placing a notice on the door of the dwelling. The notice must contain the reason for the disruption of service, the time the utility is to be turned off, and the approximate length of time until the service is restored.

6. MEASUREMENT

Utility items will be measured as follows:

Table 1
Section A: Water

TxDOT Description Code	Bid Item Description	Unit
7XXX-XXX	Testing	LS

7. 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 prices bid for the various Items specified on the plans. Any permissible deviation from these Standard Specifications must be noted in the general provisions, special Contract requirements and bid Item definitions, or construction plans.

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