Project Manual

City of San Angelo

West Concho Avenue Widening

San Angelo, Texas

July 2017

PSC Project # 01375516

PARKHILLSMITH&COOPER

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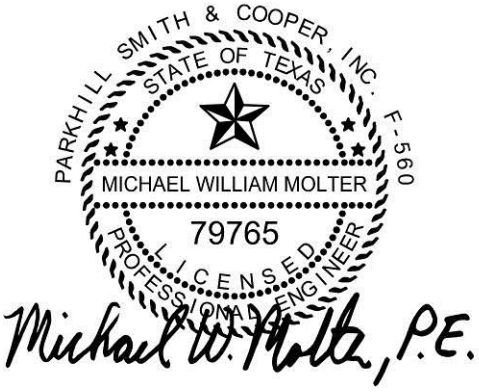

7/17/17

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Proposal Form

TECHNICAL SPECIFICATIONS

Specifications listed below from the City of San Angelo Standard Specifications for Construction, are for the Street and Utilities portion of the "West Concho Avenue Widening" project in the City of San Angelo and bound herein. Prepared by: Michael W. Molter, P.E. #79,765

Item 421 Portland Cement Concrete
Item 433 Joint Sealants and Fillers
Item 437 Concrete Admixtures
Item 440 Reinforcing Steel
Item 529 Concrete Curb, Gutter and Combined Curb and Gutter

Specifications listed below from TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges adopted by Texas Department of Transportation November 1, 2014, are for the Street and Utilities portion of the "West Concho Avenue Widening" project in the City of San Angelo and should be referred to as if bound herein. Prepared by: Michael W. Molter, P.E. #79,765

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Specifications listed below from TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges adopted by Texas Department of Transportation November 1, 2014, are for the Traffic Signal Work and Traffic Signing portion for new traffic signal as part of the "West Concho Avenue Widening" project in the City of San Angelo and should be referred to as if bound herein. Prepared by: Jeryl D. Hart, JR., P.E. #42,546

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DIVISIONS 00 – 01

Not Used

DIVISION 02 – EXISTING CONDITIONS

Section 02225 Trenching and Backfilling
Section 02667 Water Utilities
Section 02675 Disinfecting of Water Utility Distribution

DIVISIONS 03 -16

Not Used

PROPOSAL

_____, 2018

TO: The City of San Angelo
San Angelo, Texas

Gentlemen:

Pursuant to the foregoing Notice to Bidders, the undersigned Bidder hereby proposes to do all work and furnish all necessary superintendence, labor, machinery, equipment, tools, and materials, and whatever else may be necessary to complete all work upon which he bids, as provided by the attached specifications and shown on the plans, and binds himself on acceptance of this proposal to execute a Contract and Bonds according to the accompanying forms, for performing and completing the said work within the time stated, and furnishing all required guarantees, for the following prices to-wit:

WEST CONCHO AVENUE IMPROVEMENTS
(S. KOENIGHEIM AVENUE TO S. RANDOLPH AVENUE)
BASE BID

	CITY OF SAN ANGELO			
No.	**Item Desc. Code**	**Quantity & Unit**	**Description of Item and Unit Prices**	**Total Amount**
1.	104-6001	2950 SY	Removing concrete (pavement), complete, per square yard: _____Dollars and _____Cents ($_____)	$_____
2.	104-6029	1060 LF	Removing concrete (curb or curb and gutter), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
3.	104-6036	470 SY	Removing concrete (sidewalk or ramp), complete, per square yard:_____ and _____Cents ($_____)	$_____
4.	105-6015	430 SY	Removing stab base and asphalt paving (8" - 10"), complete, per square yard: _____Dollars and _____Cents ($_____)	$_____
5.	107-001	500 SY	Seeding for erosion control, complete, per square yard: _____Dollars and _____Cents ($_____)	$_____

	CITY OF SAN ANGELO			
No.	**Item Desc. Code**	**Quantity & Unit**	**Description of Item and Unit Prices**	**Total Amount**
6.	110-6001	260 CY	Excavation (roadway), complete, per cubic yard: _____Dollars and _____Cents ($_____)	$_____
7.	132-6001	10 CY	Embankment (final) (ORD COMP) (TYA), complete, per cubic yard: _____Dollars and _____Cents ($_____)	$_____
8.	160-001	500 SY	Furnishing and placing topsoil, complete, per square yard: _____Dollars and _____Cents ($_____)	$_____
9.	351-6013	21 CY	Flexible pavement structure repair (4"), complete, per cubic yard: _____Dollars and _____Cents ($_____)	$_____
10.	360-6047	2765 SY	Concrete pavement (cont. reinforcement - CRCP) (6"), complete, per square yard: _____Dollars and _____Cents ($_____)	$_____
11.	433-001	6030 LF	Cleaning and sealing joints (CL 5), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
12.	500-6001	1 LS	Mobilization, complete, per lump sum: _____Dollars and _____Cents ($_____)	$_____
13.	502-6001	3 MO	Barricades, signs and traffic handling, complete, per Month: _____Dollars and _____Cents ($_____)	$_____
14.	506-6036	30 LF	Sandbags for erosion control (6"), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
15.	506-6038	470 LF	Temporary sediment control fencing (installation), complete, per linear foot: _____ and _____Cents ($_____)	$_____

	CITY OF SAN ANGELO			
No.	**Item Desc. Code**	**Quantity & Unit**	**Description of Item and Unit Prices**	**Total Amount**
16.	506-6039	470 LF	Temporary sediment control fencing (removal), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
17.	529-6001	1210 LF	Concrete curb (Type I), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
18.	530-6001	1090 SY	Intersections (concrete), complete, per square yard: _____Dollars and _____Cents ($_____)	$_____
19.	530-6004	85 SY	Driveways (concrete), complete, per square yard: _____Dollars and _____Cents ($_____)	$_____
20.	531-6001	605 SY	Concrete sidewalks (4”), complete, per square yard: _____Dollars and _____Cents ($_____)	$_____
21.	531-6004	8 EA	Curb ramps (Type 1), complete, per each: _____Dollars and _____Cents ($_____)	$_____
22.	531-6010	2 EA	Curb ramps (Type 7), complete, per each: _____Dollars and _____Cents ($_____)	$_____
23.	636-6001	12.5 SF	Aluminum sign (Type A), complete, per square foot: _____Dollars and _____Cents ($_____)	$_____
24.	644-6023	7 EA	Install SM RD SN SUP&AM TYFRP(1)UA(P), complete, per each: _____Dollars and _____Cents ($_____)	$_____
25.	644-6075	5 EA	Relocate SM RD SN SUP& AM (sign only), complete, per each: _____Dollars and _____Cents ($_____)	$_____
26.	644-6076	6 EA	Remove SM RD SN SUP&AM, complete, per each: _____Dollars and _____Cents ($_____)	$_____

	CITY OF SAN ANGELO			
No.	**Item Desc. Code**	**Quantity & Unit**	**Description of Item and Unit Prices**	**Total Amount**
27.	662-6034	1000 LF	WRK zone pavement marking non-removal (Y) 4" SLD, complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
28.	662-6051	50 LF	WRK zone pavement marking removal (reflective) Type II-A-A, complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
29.	662-6058	150 EA	WRK zone pavement marking removal (TRAF BTN) Type Y, complete, per each: _____Dollars and _____Cents ($_____)	$_____
30.	666-6167	200 LF	Reflective pavement marking Type II (W) 4" (BRK), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
31.	666-6176	18 LF	Reflective pavement marking Type II (W) 8" (DOT), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
32.	666-6178	95 LF	Reflective pavement marking Type II (W) 8" (SLD), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
33.	666-6182	780 LF	Reflective pavement marking Type II (W) 24" (SLD), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
34.	666-6184	4 LF	Reflective pavement marking Type II (W) (arrow), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
35.	666-6192	2 LF	Reflective pavement marking Type II (W) (word), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____

	CITY OF SAN ANGELO			
No.	**Item Desc. Code**	**Quantity & Unit**	**Description of Item and Unit Prices**	**Total Amount**
36.	666-6207	961 LF	Reflective pavement marking Type II (Y) 4" (SLD), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
37.	677-6001	1000 LF	ELEM EXT PAV MRK & MRKS (4"), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
38.	2667-001	170 LF	Water lines (18"), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
39.	2667-002	30 LF	Water lines (10"), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
40.	2667-003	160 LF	Water lines (8"), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
41.	2667-004	60 LF	Water lines (6"), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
42.	2667-005	8 EA	Water valves (18"), complete, per each: _____Dollars and _____Cents ($_____)	$_____
43.	2667-006	2 EA	Water valves (10"), complete, per each: _____Dollars and _____Cents ($_____)	$_____
44.	2667-007	4 EA	Water valves (8"), complete, per each: _____Dollars and _____Cents ($_____)	$_____
45.	2667-008	2 EA	Water valves (6"), complete, per each: _____Dollars and _____Cents ($_____)	$_____
46.	2667-009	2.856 TON	Water fittings, complete, per ton: _____Dollars and _____Cents ($_____)	$_____

	CITY OF SAN ANGELO			
No.	**Item Desc. Code**	**Quantity & Unit**	**Description of Item and Unit Prices**	**Total Amount**
47.	2667-010	1 EA	Relocate fire hydrant, complete, per each: _____Dollars and _____Cents ($_____)	$_____
48.	2667-011	11 EA	Irrigation pipe sleeve, complete, per each: _____Dollars and _____Cents ($_____)	$_____
49.	ST.01.1	1 EA	Vehicular directional sign, complete, per each: _____Dollars and _____Cents ($_____)	$_____
50.	ST.11.1	0 EA	Large downtown gateway, large footprint sign, complete, per each: _____Dollars and _____Cents ($_____)	$_____
51.	CTING	1 LS	Contingency, complete, per lump sum: $86,300 Dollars and 00 Cents ($86,300.00)	$ 86,300.00
			TOTAL BID CITY OF SAN ANGELO BID ITEMS 104-6001 – 2667-010 INCLUSIVE	**$_____**

	TXDOT			
No.	**Item Desc. Code**	**Quantity & Unit**	**Description of Item and Unit Prices**	**Total Amount**
1.	104-6029	120 LF	Removing concrete (curb or curb and gutter), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
2.	104-6036	50 SY	Removing concrete (sidewalk or ramp), complete, per square yard: _____ and _____Cents ($_____)	$_____
3.	105-6015	140 SY	Removing stab base and asphalt paving (8”-10”), complete, per square yard: _____Dollars and _____Cents ($_____)	$_____

	TXDOT			
No.	**Item Desc. Code**	**Quantity & Unit**	**Description of Item and Unit Prices**	**Total Amount**
4.	351-6013	46 CY	Flexible pavement structure repair (4”), complete, per cubic yard: _____Dollars and _____Cents ($_____)	$_____
5.	402-6001	145 LF	Trench excavation protection, complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
6.	416-6030	42 LF	Drill shaft (TRF SIG POLE) (24”), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
7.	416-6031	12 LF	Drill shaft (TRF SIG POLE) (30”), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
8.	416-6034	22 LF	Drill shaft (TRF SIG POLE) (48”), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
9.	420-6012	1 CY	CL B CONC (MISC), complete, per cubic yard: _____Dollars and _____Cents ($_____)	$_____
10.	464-6005	145 LF	RC pipe (Class III) (24”), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
11.	465-2001	2 EA	Inlet (Compl) (Curb) Type 1, complete, per each: _____Dollars and _____Cents ($_____)	$_____
12.	465-2008	8 EA	Inlet EXT (TY E), complete, per each: _____Dollars and _____Cents ($_____)	$_____
13.	465-6225	1 EA	JCT Box (COMPL) (SPL), complete, per each: _____Dollars and _____Cents ($_____)	$_____
14.	496-6002	1 EA	Remove STR (inlet), complete, per each: _____Dollars and _____Cents ($_____)	$_____

	TXDOT			
No.	**Item Desc. Code**	**Quantity & Unit**	**Description of Item and Unit Prices**	**Total Amount**
15.	496-6007	80 LF	Remove STR (pipe), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
16.	500-6001	1 LS	Mobilization, complete, per lump sum: _____Dollars and _____Cents ($_____)	$_____
17.	502-6001	2 MO	Barricades, signs and traffic handling, complete, per month: _____Dollars and _____Cents ($_____)	$_____
18.	506-6036	70 LF	Sandbags for erosion control (6”), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
19.	529-6001	110 LF	Concrete curb (Type I), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
20.	530-6001	160 SY	Intersection (concrete), complete, per square yard: _____Dollars and _____Cents ($_____)	$_____
21.	531-6001	60 SY	Concrete sidewalks (4”), complete, per square yard: _____Dollars and _____Cents ($_____)	$_____
22.	531-6004	4 EA	Curb ramps (Type 1), complete, per each: _____Dollars and _____Cents ($_____)	$_____
23.	618-6023	61 LF	Conduit (PVC) (SCH 40) (2"), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
24.	618-6029	98 LF	Conduit (PVC) (SCH 40) (3"), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____

	TXDOT			
No.	**Item Desc. Code**	**Quantity & Unit**	**Description of Item and Unit Prices**	**Total Amount**
25.	618-6054	426 LF	Conduit (PVC) (SCH 80) (3") bore, complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
26.	618-6070	15 LF	Conduit (RM) (2"), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
27.	620-6008	45 LF	ELEC CONDR (No. 8) insulated, complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
28.	620-6009	325 LF	ELEC CONDR (No. 6) bare, complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
29.	620-6010	357 LF	ELEC CONDR (No. 6) insulated, complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
30.	624-6010	5 EA	Ground box Type D (162922) w/apron, complete, per each: _____Dollars and _____Cents ($_____)	$_____
31.	628-6124	1 EA	ELC SRV Type D 120/240 060(NS)GS(L)SP(O) complete, per each: _____Dollars and _____Cents ($_____)	$_____
32.	636-6001	47.5 SF	Aluminum signs (Type A), complete, per square foot: _____Dollars and _____Cents ($_____)	$_____
33.	644-6027	1 EA	Install SM RD SN SUP&AM TY S80(1)SA(P), complete, per each: _____Dollars and _____Cents ($_____)	$_____
34.	644-6075	1 EA	Relocate small road sign SUP&AM (sign only), complete, per each: _____Dollars and _____Cents ($_____)	$_____

	TXDOT			
No.	**Item Desc. Code**	**Quantity & Unit**	**Description of Item and Unit Prices**	**Total Amount**
35.	644-6076	1 EA	Remove small road sign SUP&AM, complete, per each: _____Dollars and _____Cents ($_____)	$_____
36.	666-6182	840 LF	Reflective pavement marking Type II (W) 24" (solid), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
37.	672-6012	15 EA	Traffic button TY I-C, complete, per each: _____Dollars and _____Cents ($_____)	$_____
38.	672-6016	15 EA	Traffic button TY W, complete, per each: _____Dollars and _____Cents ($_____)	$_____
39.	677-6007	300 LF	ELEM EXT PAV MRK & MRKS (24") (crosswalk), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
40.	680-6003	1 EA	Install highway traffic sign (system), complete, per each: _____Dollars and _____Cents ($_____)	$_____
41.	680-6004	1 EA	Removing traffic signals, complete, per each: _____Dollars and _____Cents ($_____)	$_____
42.	682-6001	8 EA	VEH SIG SEC (12")LED(GRN), complete, per each: _____Dollars and _____Cents ($_____)	$_____
43.	682-6003	8 EA	VEH SIG SEC (12")LED(YEL), complete, per each: _____Dollars and _____Cents ($_____)	$_____
44.	682-6005	8 EA	VEH SIG SEC (12")LED(RED), complete, per each: _____Dollars and _____Cents ($_____)	$_____

	TXDOT			
No.	**Item Desc. Code**	**Quantity & Unit**	**Description of Item and Unit Prices**	**Total Amount**
45.	682-6018	8 EA	PED SIG SEC (LED)(COUNTDOWN), complete, per each: _____Dollars and _____Cents ($_____)	$_____
46.	684-6009	872 LF	TRF SIG CBL (Type A) (12 AWG) (4 CONDR), complete per linear foot: _____Dollars and _____Cents ($_____)	$_____
47.	684-6012	1226 LF	TRF SIG CBL (Type A) (12 AWG) (7 CONDR), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
48.	684-6021	137 LF	TRF SIG CBL (Type A)(12 AWG)(16 CONDR), complete, per linear foot: _____Dollars and _____Cents ($_____)	$_____
49.	686-6033	1 EA	INS TRF SIG PL AM(S)1 ARM (32) LUM, complete, per each: _____Dollars and _____Cents ($_____)	$_____
50.	686-6279	1 EA	INS TRF SIG PL AM(S)2 ARM(65-44')LUM, complete, per each: _____Dollars and _____Cents ($_____)	$_____
51.	687-6001	7 EA	PED POLE ASSEMBLY, complete, per each: _____Dollars and _____Cents ($_____)	$_____
52.	688-6001	8 EA	PED DETECT PUSH BUTTON (APS), complete, per each: _____Dollars and _____Cents ($_____)	$_____
53.	6077-6001	1 EA	Radio Set-Up System - Ubiquiti System including Ubiquiti NBE-M5-19, cables, brackets, antenna, installation, and setup, complete, per each: _____Dollars and _____Cents ($_____)	$_____

	TXDOT			
No.	**Item Desc. Code**	**Quantity & Unit**	**Description of Item and Unit Prices**	**Total Amount**
54.	6083-6001	1 EA	VIVDS SET-UP SYSTEM - GridSmart Camera System including camera, processor, communication cables, brackets, installation and setup, complete, per each: _____Dollars and _____Cents ($_____)	$_____
55.	6525	1 EA	MV Priority Control Unit w/Cable - GTT Opticom Preemption System including processor(s), cable, 3 receiver units, brackets, installation and setup, complete, per each: _____Dollars and _____Cents ($_____)	$_____
			TOTAL BID TXDOT BID ITEMS 104-6029 – 6525 INCLUSIVE	**$_____**

TOTAL BID SAN ANGELO BID ITEMS 104-6001 – 2667-010	
TOTAL BID PROPOSAL TXDOT BID ITEMS 104-6029 – 6525	
TOTAL BID –BID ITEMS 104-6001 – 6525 INCLUSIVE	

_____
Contractor

(Seal if Bidder is a Corporation)

By_____

_____
Address

NOTE: Fill in all blank spaces in this and accompanying forms and include proper bid security.

CITY OF SAN ANGELO

ITEM 421

PORTLAND CEMENT CONCRETE

421.1. DESCRIPTION.

This Item shall govern for Portland Cement Concrete to be used in concrete pavement, concrete structures and other concrete construction.

421.2. MATERIALS.

The concrete shall be composed of Portland Cement, (with or without) fly ash, fine and coarse aggregates and water.

(1) Cement. Portland Cement shall conform to TxDOT Item 524, "Hydraulic Cement".

(2) Mixing Water. Water for use in concrete and for curing shall be free from oils, acids, organic matter or other deleterious substances and shall not contain more than 1000 parts per million of chlorides as CI nor more than 1000 parts per million of sulfates as SO_4.

Water from municipal supplies approved by the State Health Department will not require testing, but water from other sources will be sampled and tested before use in concrete. Tests shall be made in accordance with AASHTO T26.

Water used in white Portland Cement Concrete shall be free from iron and other impurities which may cause staining or discoloration.

(3) Coarse Aggregate. Coarse aggregate shall be washed and shall consist of durable particles of gravel, crushed blast furnace slag, crushed stone, or combinations thereof and shall be free from frozen material or injurious amounts of slat, alkali, vegetable matter, or other objectionable material either free or as an adherent coating. When white Portland cement is specified, the coarse aggregates used in the concrete shall be light colored. Quality shall be reasonably uniform throughout. Coarse aggregate shall not contain more than 0.25 percent by weight of clay lumps, nor more than one (1) percent by weight of shale, nor more than five (5) percent by weight of laminated and/or friable particles when tested in accordance with Test Method Tex-413-A. Coarse aggregate from each source shall have a wear of not more than 40 percent when tested in accordance with Test Method Tex-410-A.

When tested in accordance with Test Method Tex-401-A, the coarse aggregate, including combinations of aggregates when used, shall conform to the gradation requirements shown in Table 1.

TABLE 1
COARSE AGGREGATE GRADATION CHART

Aggregate Grade No.	Nominal Size Inches	Percent Retained on Each Sieve								
		2-1/2 in.	2 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 8
1	2	0	0-20	15-50		60-80			95-100	
2	1-1/2		0	0-5		30-65		70-90	95-100	
3	1-1/2		0	0-5		10-40	40-75		95-100	

The loss by decantation in accordance with Test Method Tex-406-A plus the allowable weight of clay lumps, shall not exceed one (1) percent, or the value shown on the Plans, whichever is smaller. In the case of aggregates made primarily from the crushing of stone, if the material finer than the 200 sieve is definitely established to be the dust of fracture, essentially free from clay or shale, as established by Part III of Test Method Tex-406-A, the percent may be increased to 1.5.

(4) Fine Aggregate. Fine aggregate shall be washed and consist of clean, hard, durable and uncoated particles of natural or manufactured sand or a combination thereof, with or without a mineral filler. When white Portland Cement is specified the fine aggregate used in the concrete shall be light colored. It shall be free from frozen material or injurious amounts of salt, alkali, vegetable matter or other objectionable material and it shall not contain more than 0.5 percent by weight of clay lumps. When the aggregate is subjected to the color test for organic impurities in accordance with Test Method Tex-408-A, the test result shall not show a color darker than standard.

Unless otherwise shown on the Plans, the acid insoluble residue of fine aggregate used in concrete subject to direct traffic shall be not less than 60 percent by weight when tested in accordance with Test Method Tex-612-J.

When tested in accordance with Test Method Tex-401-A, the fine aggregate or combinations of aggregates, including mineral filler, shall conform to the gradation requirements shown in Table 2.

TABLE 2
FINE AGGREGATE GRADATION CHART

Aggregate Grade No.	Percent Retained on Each Sieve							
	3/8 in.	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
1	0	0 to 5	0 to 20	15 to 50	35 to 75	65 to 90	90 to 100	97 to 100

Where manufactured sand is used in lieu of natural sand, the percent retained on the No. 200 sieve shall be 94 to 100.

Where the sand equivalent value is greater than 85, the retainage on the No. 50 sieve may be 65 to 94 percent.

Fine aggregate will be subjected to the Sand Equivalent Test (Test Method Tex-203-F / ASTM D 2419). The sand equivalent shall not be less than 80 unless otherwise shown on the Plans.

For all classes of concrete, the fineness modulus shall be between 2.30 and 3.10 as determined by Test Method Tex-402-A.

(5) Mineral Filler. Mineral filler shall consist of stone dust, clean crushed sand, or other approved inert material. When tested in accordance with Test Method Tex-401-A, it shall conform to the following gradation:

Retained on No. 30 Sieve	0 percent
Retained on No. 200 Sieve	0-35 percent

(6) Admixtures. Admixtures and their use shall conform to the requirements of TxDOT Item 437, "Concrete Admixtures". Calcium chloride will not be permitted.

(7) Mortar and Grout. Unless otherwise specified or approved by the City, mortar and grout shall consist of one part Portland cement, two parts finely graded sand and sufficient water to provide the desired consistency. Mortar may contain admixtures.

Post tensioning grout shall be in accordance with TxDOT Item 426, "Prestressing".

Mortar shall have a consistency such that the mortar can be easily handled and spread by trowel. Grout shall have a consistency such that the grout will flow into and completely fill all voids.

When required to prevent color difference, white cement shall be added to produce the color required. When shown on the Plans or in the specifications, or when required by the City, latex adhesive conforming to the requirements of TxDOT Departmental Material Specification D-9-8110 shall be added to the mortar.

421.3. STORAGE OF MATERIALS.

(1) Cement, and Mineral Filler. All cement and mineral filler shall be stored in well-ventilated weatherproof buildings or approved bi**n**s, which will protect them from dampness or absorption of moisture. Each shipment of packaged cement shall be kept separated to provide easy access for identification and inspection.

(2) Aggregates. The method of handling and storing concrete aggregates shall prevent contamination with foreign materials. If the aggregates are stored on the ground, the sites for the stockpiles shall be clear of all vegetation and shall be level. The bottom six-inch layer of aggregate shall not be disturbed or used without re-cleaning.

(3) Admixtures. Admixtures shall be stored in accordance with TxDOT Item 437, "Concrete Admixtures".

421.4. MEASUREMENT OF MATERIALS.

Except as noted below, the measurement of materials used in batches of concrete shall be by weight.

Water may be measured by volume or by weight.

Cement shall be weighed separately from other materials. Weighing of sacked cement will not be required. When sacked cement is used, the quantity of cement per batch shall be based upon using full bags of cement. Batches involving use of fractional bags will not be permitted except for small hand mixed batches of approximately five (5) cubic feet or less and when an approved method of volumetric measurement is used.

Where two (2) or more sizes or types of aggregates are used, each type and/or size shall be measured separately.

When determining aggregate batch weights, proper allowance shall be made for the water content in the aggregate (free water and/or absorption).

Admixtures shall be measured and dispensed in accordance with TxDOT Item 437, "Concrete Admixtures".

Measuring materials by volumetric methods may be used where permitted by the specifications. When a mixer using volumetric batching of materials is used, an accurate method of measuring by volume shall be provided. Continuous volumetric mixers shall be calibrated to assure correct measurement of materials.

The amount of each ingredient in the batch shall be measured to within plus or minus one percent of required amount except that water shall be measured to within plus or minus one gallon and admixture tolerances shall be in accordance with TxDOT Item 437, "Concrete Admixtures".

421.5. EQUIPMENT.

(1) Weighing and Measuring Equipment. Weighing and measuring equipment shall conform to TxDOT Item 520, "Weighing and Measuring Equipment".

(2) Mixing Equipment.

(a) General. All equipment, tools, and machinery used for hauling materials and performing any part of the work shall be maintained in such condition as to insure completion of the work under way without excessive delays for repairs or replacement.

The mixer shall be of an approved type and size that will produce uniform distribution of the material throughout the mass and shall be capable of producing concrete meeting the requirements of these specifications.

For all mixers, an adequate water supply and an accurate method of measuring the water shall be provided.

Delivery of concrete to the work site and the discharge from the hauling equipment, agitating, or non-agitating, shall be in accordance with the requirements shown on the Plans or in the governing specifications.

Specific requirements for batch plants, mixers and other equipment shall be in accordance with Item 360, "Concrete Pavement", or TxDOT Item 522, "Portland Cement Concrete plants", or other specifications.

421.6. MIXING.

(1) General. Mixed concrete, which does not conform to specification requirements, shall not be placed. Mixing shall be in accordance with TxDOT Item 522, "Portland Cement Concrete plants", except that mixing with continuous volumetric mixers will be in accordance with Section 421.6.(2) and except as set out in Section 421.6.(3).

(2) Continuous Volumetric Mixers. Mixing shall be in accordance with mixer manufacturer's recommendations unless otherwise revised by the City.

(3) Mixing of concrete by hand methods or by the use of a small motor driven mixer will be permitted for small placements of approximately two (2) cubic yards or less when authorized by the City. Hand mixed batches shall not exceed a two-sack batch in volume. For such placements the mix may be proportioned by approved volumetric methods.

421.7. CLASSIFICATION AND MIX DESIGN.

The Contractor shall furnish the mix design, using a coarse aggregate factor acceptable to the City, for the class(s) of concrete specified, to conform with the requirements contained herein and in accordance with Construction Bulletin C-11. The Contractor shall perform, at his entire expense, the work required to substantiate the design. Sampling and testing of concrete will be the responsibility of the City. Complete concrete design data shall be submitted to the City for approval.

The Contractor shall determine and measure the batch quantity of each ingredient, including all water, not only for batch designs but also for all concrete produced for the project. The mixes shall conform to these specifications and other requirements shown on the Plans.

The Contractor may accept a design from the City; however, this acceptance will not relieve the Contractor of the responsibility of providing concrete meeting the requirements of these specifications.

Mix designs from previous or concurrent jobs may be used without trial batches if it is shown that no substantial change in any of the proposed ingredients has been made.

No charge will be made for existing designs furnished by the City. The cost to the City of preparing a new mix design will be charged to the Contractor and deducted from the payment for the work.

Concrete for pneumatically placed concrete shall be in accordance with Item 431, "Pneumatically Placed Concrete".

The Contractor shall have the option of using chemical admixtures with all classes of concrete in accordance with Item 437, "Concrete Admixtures", except where the use of specific admixtures is required or prohibited in this or other items. For example, a mid-range water reducer can help maintain the water/cement ratio below the maximum allowed and provide a better workability to the concrete mix than if a mid-range water reducer was not used.

When a retarding admixture is required for hot weather concreting, the amount to be used will be as required in TxDOT Item 437, "Concrete Admixtures", subject to change by the City when required. When used for extended retardation, the amount to be used will be established by several trial batches with varying retarder content and simulating the placing conditions to be encountered and tested in accordance with Tex-440-A.

When entrained air is required, the concrete shall be designed to entrain five (5) percent air when Grade 1 or 2 coarse aggregate is used, six (6) percent when Grade 3 or 4 coarse aggregate is used, and seven (7) percent for Grades 5,6 or 7 unless otherwise specified by the City. Concrete as placed shall contain the proper amount of entrained air as required herein with a tolerance of plus or minus 1-1/2-percentage points. Acceptance of concrete with occasional variations between 1-1/2 and three (3) percentage points over the specified amount will be based on strength tests as required by the City. When the quantity of entrained air is found to be more than three (3) percentage points over or two (2) percentage points under those values given herein, the concrete will be rejected.

Entrained air will be required for bridge slabs, top slabs of direct traffic culverts, concrete pavement, dense and regular concrete overlays, piers, bents, precast piling (non-prestressed), drilled shafts placed in water, bridge railing, concrete traffic barrier and for other items of work as may be specified, on the Plans or in other specifications.

TABLE 3
SLUMP REQUIREMENTS

Concrete Designation	Desired Slump Inches	Max Slump Inches
A. Structural Concrete		
(1) All drilled shafts	6	7
(2) Thin-Walled Section (9" or less)	4	5
(3) Slabs, Concrete Overlay, Caps, Columns, piers, Wall sections over 9", etc.	3	4
(4) Prestressed Concrete Members	4	5
(5) Concrete traffic Barrier (cast-in-place or precast), Concrete Bridge Railing	4	5
(6) Dense concrete overlay	¾	1
(7) Concrete placed underwater	6	7
(8) Concrete with High Range Water Reducer	-	8
B. Concrete Pavement	1-1/2	3 max 1 min
C. Riprap, curb, gutter, slipformed and extruded concrete	As Approved by the City	

Note: No concrete will be permitted with a slump in excess of the maximums shown. When high-range water reducing admixtures are used, the slump shall not exceed eight (8) inches.

421.8. QUALITY OF CONCRETE.

The concrete shall be uniform, workable and of a consistency acceptable to the City. The cement content, maximum allowable water/cement ratio, the desired and maximum slump, the proper amount of entrained air and the strength requirement for all classes of concrete shall be the responsibility of the Contractor to provide concrete meeting these requirements.

During the progress of the work, a certified testing laboratory technician will cast test cylinders and/or beams, perform slump and entrained air tests and will make temperature checks, as required, to ensure compliance with the specifications.

Unless otherwise shown on the Plans, the Contractor shall furnish and properly maintain all test molds. The test molds shall meet the requirements of Test Methods Tex-418-A / ASTM C 39 and Tex-448-A / ASTM C 78 and, in the opinion of the City, must be satisfactory for use at the time of use. In addition, the Contractor shall be responsible for furnishing personnel to remove the test specimens from the molds and transport them to the proper curing location at the schedule designated by the City and in accordance with the governing specification. For all concrete items

the Contractor shall have a wheelbarrow, or other container acceptable to the City, available to use in the sampling of the concrete.

All labor and equipment furnished by the Contractor will be considered subsidiary to the various bid items and will not be paid for directly.

A strength test is defined as the average of the breaking strength of two (2) cylinders or two (2) beams as the case may be. Each specimen will be tested in accordance with Test Methods Tex-418-A / ASTM C 39 or Tex-448-A / ASTM C 78.

Slump tests will be performed in accordance with Test Method Tex-415-A / ASTM C 143. Entrained air tests will perform in accordance with Test Method Tex-416-A / ASTM C 231.

If the required strength or consistency of the class of concrete being produced cannot be secured with the minimum cement specified or without exceeding the maximum water/cement ratio, the Contractor will be required to furnish different aggregates, use a water reducing agent, an air entraining agent or increase the cement content in order to provide concrete meeting these specifications.

All test specimens, beams or cylinders, representing tests for removal of forms and/or falsework shall be cured using the same methods and under the same conditions as the concrete represented.

"Design Strength" beams and cylinders shall be cast and cured in accordance with Test Method Tex-447-A / ASTM C 31.

When the specified concrete strength is by 28-day compressive strength tests, job control testing will be by 7-day compressive strength tests. The minimum strength requirement for 7-day tests will be 70 percent of the specified minimum 28-day compressive strength. If the required 7-day strength is not obtained with the quantity of cement specified in Table 4, changes in the batch design will be made as specified in this article. For an occasional failure of the 7-day compressive test, the concrete may be tested at 28-days for final evaluation. Strength test requirements for Type II cement will govern when Type I/II cement is used.

TABLE 4

CLASSES OF CONCRETE

Class of Concrete	Cement per C.Y. Min. (sacks)	Min. Comp. Strength 28 day psi	Min. Flexural Strength 7 day psi	Max. Water / Cement Ratio Gal/sk	Coarse Aggregate Grade No.	General Usage (information only)
A	5.0	3,000	425 390 (c)	6.5	1-2- 3-4- 8 (a) (d)	Drilled Shafts; Culverts, except Top Slab of Direct Traffic Culverts; Inlets; Manholes, Headwalls; Approach Slabs; Curb; Gutter, Conc. Retards; Sidewalks; Driveways; Conc. Pavement; Back-up Walls; Anchors
B	4.0	2,000	280	8.0	2-3-4-5-6-7	Riprap, Small Roadside Signs and Anchors
C	6.0	3,600	510 470 (c)	6.0	1-2-3-4-5 (d)	Drilled Shafts; Bridge Substructure; Bridge Railing; Culverts, except Top Slab of Direct Traffic Culverts; Wing Walls; Approach Slab; Concrete Traffic Barrier (cast-in-place)
D	2.0 to 3.0	1,000 to 1,500	215±	11.0±	2-3-4-5-6-7	Riprap Fill Voids Fills
E	6.0	3,000	425	6.0	2-3-4-5	Seal Concrete
S	6.5	4,000	570 525 (c)	5.0	2-3-4-5	Bridge Slab; Top Slab of Direct Traffic Culvert; Bridge Substructure
P	5.0	3,500	555 (b)	6.25	2-3	Concrete Pavement
DC	8.75	5,500	720	3.6	6	Dense Concrete Overlay
CO	7.0	4,600	640	4.5	6	Concrete Overlay

(a) Grade 8 aggregate for use in extruded curbs, unless the City approves a larger size.
(b) Minimum running average for concrete pavement (in accordance with Construction Bulletin C-II).
(c) When Type II or Type I/II cement is used.
(d) Unless otherwise permitted by the City, Grade I coarse aggregate may be used only in massive foundations with four (4) inch minimum clear spacing between reinforcing steel bars. Grade I aggregate may be used in drilled shafts.

421.9. MEASUREMENT AND PAYMENT.

The work performed, materials furnished and all labor, tools, equipment and incidentals necessary to complete the work under this Item will not be measured or paid for directly, but will be considered subsidiary to the various bid items of the contract.

CITY OF SAN ANGELO

ITEM 433

JOINT SEALANTS AND FILLERS

433.1. DESCRIPTION.

This Item shall govern the material requirements for joint sealants, backing materials and joint fillers.

433.2. MATERIALS.

The materials for this item shall conform to the following:

(1) Joint Sealant Materials. Joint sealant material shall be the class indicated on the Plans or in the governing specifications. The various classes of sealant described herein shall be in accordance with TxDOT Material Specification D-9-6310. Copies of specification D-9-6310 are available from TxDOT, Director of Materials and Tests, 125 E. 11th Street, Austin, TX 78701-2483.

(2) Storage. Class 1 and 2 sealants shall be stored at temperatures between 40ºF and 100ºF. Class 4 and 5 sealants shall be stored in sealed containers at a temperature of 100ºF or below and the material must be used within two (2) months of receipt on the project.

(3) Classes of Joint Sealants.

(a) Class 1. Two Component, Synthetic Polymer, Non-sag. The components shall be proportioned and mixed in accordance with the manufacturer's recommendations.

(b) Class 2. Two Component, Synthetic Polymer, Self-leveling. The components shall be proportioned and mixed in accordance with the manufacturer's recommendations.

(c) Class 3. Hot Poured Rubber. This sealant shall be a rubber asphalt compound which when heated shall melt to the proper consistency for pouring and shall solidify on cooling to ambient temperatures.

(d) Class 4. Non-sag Low Modulus Silicone. The material shall be a single component formulation not requiring addition of a catalyst.

(e) Class 5. Self-leveling Low Modulus Silicone. The material shall be a single component formulation not requiring addition of a catalyst.

(f) Class 6. Preformed Joint Sealant (PJS). The preformed joint sealant shall be an extruded elastomeric material having a multi-channeled shape.

(g) Class 7. Self-leveling, Rapid Curing, Low Modulus Silicone. The material shall be a two component, rapid curing, self-leveling, low modulus formulation. The components shall be proportioned and mixed in accordance with the manufacturer's recommendations.

The size shown on the Plans shall be the nominal width of the sealant. The uncompressed depth of the seal shall be equal to or greater than the width.

All preformed joint sealants installed by the Contractor shall have been pre-qualified for compliance with the requirements. Each size and configuration of seal produced by a manufacturer must be approved by the City prior to use on City of San Angelo projects. For a sealant manufacturer to pre-qualify and obtain approval of a sealant, detailed dimensions and configuration of each size of sealant and certified test results indicating compliance with TxDOT Material Specification D-9-6310 and any requirements shown on the Plans and specifications shall be submitted to the City.

Submission shall be done sufficiently in advance of work to allow for testing and evaluation of the material.

The City will confirm by visual inspection that the sealant proposed for installation is the same size, configuration and manufacture as shown on Plans. The City will examine the sealant for any undue distortions, such as dissymmetry, warping, thick webs or uneven width, which are likely to impair the performance of the joint. If the magnitudes of the distortions are sufficient to create doubt as to the performance of the sealant, the City may direct that the sealant be replaced or that samples representing the worst of the lot be subjected to further testing to verify their performance.

(4) Backer Rods and Backing Materials. These materials shall be capable of holding the fluid sealant in open joints in place. In all cases these materials shall be of such a type that will not bond to the sealant. The backing materials shall meet the requirements of the sealant manufacturer. They shall be compressible type materials, such as closed-cell, resilient foam or sponge rubber stock of vinyl, butyl or neoprene, or expanded polyethylene or polyurethane.

The diameter of the backer rod shall be at least 25 percent larger than the joint reservoir width.

(5) Joint Fillers. Joint fillers shall be of the size, shape and type indicated on the Plans and shall conform to the following requirements.

(a) Timber Boards. Timber boards shall be obtained from redwood, cypress, gum, southern yellow pine or Douglas fir timber. They shall be sound heartwood and shall be free from sapwood, knots, clustered bird's eye, checks and splits. Occasional sound or hollow bird's-eye, when not in clusters, will be permitted provided the board is free from any other defects that will impair its usefulness as a joint filler. All boards, except redwood and cypress, shall have a creosote or pentachlorophenol treatment conforming to TxDOT Item 492 "Timber Preservative and Treatment", Table 1. When oven dried at 230ºF to a constant weight, the weight of the board per cubic food (minus treatment) shall not be less than 20 pounds or more than 35 pounds.

(b) Asphalt Boards. Asphalt boards shall consist of two (2) suitable asphalt-impregnated liners filled with a mastic mixture of asphalt and vegetable fiber and/or mineral fiber. Asphalt boards shall be smooth, flat and sufficiently rigid to permit installation. When tested in accordance

with Test Method Tex-524-C, the horizontal deflection shall not be more than one inch in 3-1/2 inches.

(c) Preformed Fiber Material.

i. Preformed Bituminous Fiber Material. Preformed bituminous fiber material shall meet the requirements of ASTM D1751.

ii. Preformed Non-bituminous Fiber Material. Preformed non-bituminous fiber material shall meet the requirements of ASTM D1751, except that the requirements pertaining to bitumen content, density and water absorption shall be voided.

(d) Rebonded Neoprene Filler. Rebonded neoprene filler shall consist of ground closed-cell neoprene particles, rebonded and molded into sheets of uniform thickness of the dimensions shown on the Plans, meeting the requirements of ASTM D1752, Type 1. Certification that the material meets these requirements shall be furnished to the City.

433.3. MEASUREMENT.

The work performed, materials furnished and all labor, tools, equipment and incidentals necessary to complete the work.

433.4. PAYMENT.

This Item will be paid for by the linear feet as measured in place.

CITY OF SAN ANGELO

ITEM 437

CONCRETE ADMIXTURES

437.1 DESCRIPTION.

This Item shall govern for the admixtures used in Portland Cement Concrete, in accordance with the Plans, specifications and requirements herein.

437.2 MATERIALS.

Admixtures shall be in a liquid state and conform to the following requirements:

Chemical Admixtures – ASTM C494
Air Entraining Admixtures – ASTM C260

437.3 APPROVAL OF ADMIXTURES.

The City reserves the right to perform any or all of the tests required by ASTM C260 and ASTM C494 as a check on the tests reported by the manufacturer. In case of any variance, the City test will govern. Any change in formulation of an admixture shall require retesting, and shall be approved by the City.

A change in formulation discovered by any of the tests prescribed herein, or other means, and not reported and retested, may be just cause to remove a manufacturer from the pre-certified list for City projects.

All documentation and correspondence shall be submitted to the City Engineer, San Angelo, Texas.

437.4 DISPENSING EQUIPMENT.

Each admixture shall be measured and dispensed by a separate readily adjustable dispenser. When set to a predetermined volume, the dispenser shall fill to the preset amount and hold it without leakage until the operator releases the content by some positive means. Unless otherwise shown on the Plans, completely automatic dispensing will not be required, except for use with a fully automatic Plant.

The calibrated container shall be constructed in such a manner that the level of the admixture is visible at all times. A strip gauge with one (1) ounce increments for air-entraining admixtures and ten (10) ounce increments for water reducing and/or retarding admixtures, shall be attached securely to the measuring apparatus. This strip shall be a material possessing weather-resistant qualities. The accuracy required for these systems shall be plus or minus three (3) percent. The equipment shall visibly show the total amount to be dispensed for ready check by the City.

For individual concrete placements of less than two (2) cubic yards at the placement site, the City may waive the requirements for mechanical dispensing equipment.

437.5 CONSTRUCTION USE OF ADMIXTURES.

When used in accordance with the governing specification, the Contractor will be allowed to use any admixture, which has been approved. The Contractor shall submit to the City one (1) copy of the invoice showing the admixture or admixtures to be used on the project. Prior to using an admixture in the work, trial mixes shall be made and tested in the field using the materials and equipment to be used on the project. If more than one (1) admixture is used, they shall be used in such manner that the desirable effects of teach are realized.

Mix designs from previous or concurrent jobs may be used without trial batches if it is shown that no substantial change in any of the proposed ingredients has been made.

The volume of liquid admixtures shall be taken into account when determining the water/cement ratio of the mix.

The dosage rate for air-entraining admixtures shall be adjusted as necessary to produce the required air content in the concrete. The air content shall be in accordance with Item 421, "Portland Cement Concrete", unless otherwise shown on the Plans.

When a retarding admixture is required for extended retardation, the amount to be used shall be established by several trail batches with varying retarder contend and simulating the placing conditions to be encountered. When water reducing or retarding agents are used at the option of the Contractor, reduce dosage of the admixture will be permitted.

Accelerators will be used only to meet special requirements and will require the written approval of the City on each specific project. Accelerating admixtures will not be permitted in bridge decks, top slab of direct traffic culverts, nor when Type II cement is specified.

All accelerating admixtures dosages will be based on trial mixes and approved by the City.

High range water reducers will be used only to meet special requirements and will require written approval of the City on each specific project. A Work Plan for control shall be submitted by the Contractor for approval and an evaluation of the concrete containing the admixture will be performed by the City. Recommended guidelines for developing a Work Plan are shown in TxDOT Construction Bulletin C-11.

Suitable measures shall be taken to prevent admixtures from freezing. Admixtures shall be agitated as required to prevent separation or sedimentation of solids. Air agitation of entraining agents will not be permitted.

Air entraining agents shall be charged into the mixer with the first one-third (1/3) of the mix water. Retarding or water reducing admixtures, except for high-range water reducers, shall be charged into the mixer during the last one-third of the mix water. Each admixture shall be dispensed separately but at the same time as the mixing water. No admixture shall be dispensed on dry aggregates.

Alternate charging sequences based on trial batches may be used subject to approval by the City.

High range water reducing admixtures shall be used and/or dispensed in accordance with the approved Work Plan.

Should the desired effects of an admixture not be achieved in the concrete, the City may take a sample of the admixture being used for further testing. Further use of the admixture will not be allowed until the results of such rest confirm that the admixture has not been changed or altered in any way.

437.6 MEASUREMENT AND PAYMENT.

The work performed, materials furnished and all labor, tools, equipment, and incidentals necessary to complete the work under this Item will not be measured or paid of directly, but will be considered subsidiary to the various bid Item of the contract.

CITY OF SAN ANGELO

ITEM 440

REINFORCING STEEL

440.1. DESCRIPTION.

This Item shall govern for the furnishing and placing of deformed and smooth reinforcing steel, of the sizes and details shown on the Plans and in accordance with this Item. All reinforcing steel to be epoxy coated will be designated on the Plans. Epoxy coating of reinforcing steel shall be in accordance with "Epoxy Coating of Reinforcing Steel" of this Item.

440.2. MATERIALS.

Unless otherwise shown on the Plans or specified herein, the reinforcing steel shall be Grade 60 and all bar reinforcement shall be deformed, conforming to one of the following:

(1) ASTM A615, Grades 40 or 60, open hearth, basic oxygen, or electric furnace new billet steel.

(2) ASTM A617, Grades 40 or 60, axle-steel.

(3) ASTM **A**616, Grade 60, rail steel will be permitted in concrete pavement only. ASTM A616 bars shall be furnished as straight bars only and bending is prohibited. Bend tests will not be required.

(4) ASTM A706, Grade 60, weldable reinforcing steel.

(5) Smooth Bars. Smooth bars for concrete pavement shall have a minimum yield strength of 60 ksi.

All other smooth bars, larger than No. 4, may be steel conforming to the above or may be furnished in any steel that meets the physical requirements of ASTM A36.

(6) Spiral reinforcement shall be either smooth or deformed bars, or wire, of the minimum size or gage shown on the Plans, or as specified herein.

Bars for spiral reinforcement shall comply with ASTM A675, Grade 80 (reference to ASTM A29 is voided) A615 or A617, Grade 40, unless otherwise shown on the Plans. Smooth wire shall comply with ASTM A82 and deformed wire shall comply with ASTM A496.

In cases where the provisions of the Item are in conflict with the provisions of the ASTM Specification, the provisions of this Item shall govern.

Reinforcing steel to be structurally welded shall comply with ASTM A706 or shall have a carbon equivalency (C.E.) of not more than 0.55%. A report of chemical analysis, showing the percentages of all elements necessary to establish the carbon equivalency, will be required for all reinforcing steel that is to be structurally welded. The above requirements do not pertain to miscellaneous welds on reinforcing steel as defined in Item 448, "Structural Field Welding".

Carbon equivalency will be calculated using the following formula:

$$C.E. = \%C + \frac{\%MN}{6} + \frac{\%Cu}{40} + \frac{\%Ni}{20} + \frac{\%Cr}{10} - \frac{\%Mo}{50} - \frac{\%V}{10}$$

The nominal size, area and weight of reinforcing steel bars covered by this specification are as follows:

Bar Size Number	Nominal Diameter In.	Nominal Area Sq. In.	Weight Per Linear Foot
2	0.250	0.05	0.167
3	0.375	0.11	0.376
4	0.500	0.20	0.668
5	0.625	0.31	1.043
6	0.750	0.44	1.502
7	0.875	0.60	2.044
8	1.000	0.79	2.670
9	1.128	1.00	3.400
10	1.270	1.27	4.303
11	1.410	1.56	5.313
14	1.693	2.25	7.65
18	2.257	4.00	13.60

Smooth round bars shall be designated by size number through No. 4. Smooth bars above No. 4 shall be designated by diameter in inches.

(7) Wire for fabric reinforcement shall conform to ASTM A82 or A496. Wire fabric shall conform to ASTM A185 or A497.

When wire is ordered by size numbers, the following relation between size number, diameter in inches and area shall apply unless otherwise specified. Where deformed wire is required, the size number shall be preceded by “D”, and for smooth wire the prefix shall be “W”.

Size Number	Nominal DAMETER IN.	Nominal Area Sq. In.
31	0.628	0.310
30	0.618	0.300
28	0.597	0.280
26	0.575	0.260
24	0.553	0.240
22	0.529	0.220
20	0.505	0.200
18	0.479	0.180
16	0.451	0.160
14	0.422	0.140
12	0.391	0.120
10	0.357	0.100
8	0.319	0.080
7	0.299	0.070
6	0.276	0.060
5.5	0.265	0.055
5	0.252	0.050
4.5	0.239	0.045
4	0.226	0.040
3.5	0.211	0.035
3	0.195	0.030
2.5	0.178	0.025
2	0.160	0.020
1.5	0.138	0.015
1.2	0.124	0.012
1	0.113	0.010
0.5	0.080	0.005

Note: Fractional sizes between the sizes listed above are also available and acceptable for use.

Welded wire fabric will be designated as shown in the following example:

> 6 x 12 - W16 x W8; indicated six (6) inch longitudinal wire spacing and 12 inch transverse wire spacing with smooth Number 16 wire longitudinally and smooth Number 8 wire transversely.

(8) Epoxy Coating. The epoxy coating material and the material used for the repair of the coating shall comply with the TxDOT Departmental Materials Specification D-9-8130, "Epoxy Powder Coating For Reinforcing Steel". Copies of the Departmental Materials Specifications are available from the TxDOT, Division of Materials and Tests, 125 East 11th Street, Austin, Texas 78701-2483. An eight-ounce sample of epoxy powder and manufacturer's certifications will be required for each lot of epoxy powder used to coat materials for City projects.

440.3. BENDING.

The reinforcement shall be bent cold, true to the shapes shown on the Plans. Fabrication shall preferably be done in the shop. Field fabrication, if permitted, shall be done with equipment approved by the City. Misfabricated, damaged or broken bars shall be rejected and replaced at the Contractor's expense. Damaged or broken bars imbedded in a previous concrete placement may be repaired with the approval of the City.

Unless otherwise shown on the Plans, the inside diameter of bar bends, in terms of the nominal bar diameter (d), shall be as follows:

Bends of 90º and greater in stirrups, ties and other secondary bars that enclose another bar in the bend shall be:

#3, #4, #5	4d
#6, #7, #8	6d

All bends in main bars and in secondary bars not covered above shall be:

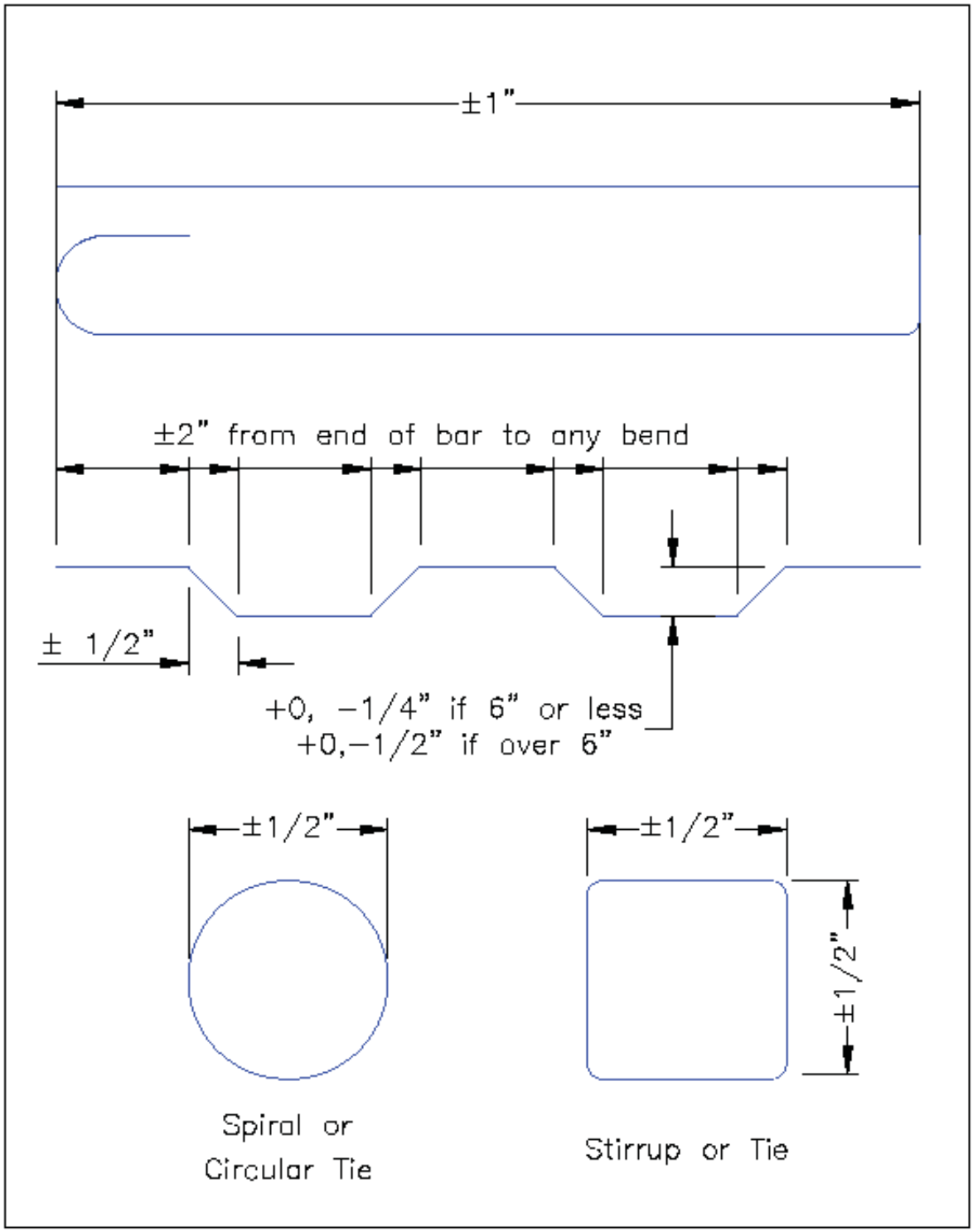
#3 thru #8	6d
#9, #10, #11	8d
#14, #18	10d

Where bending of Grade 60 bars, sizes No. 14 or No. 18 is required, bend testing shall be performed on representative specimens as described for smaller bars in the applicable ASTM Specification. The required bend shall be 90º degrees around a pin having a diameter of ten (10) times the nominal diameter of the bar.

440.4. TOLERANCES

Fabricating tolerances for bars, from Plan dimensions, shall not be greater than shown in Figure 1.

FIGURE 1



440.5. STORING.

Steel reinforcement shall be stored above the surface of the ground upon platforms, skids, or other supports and shall be protected from damage and deterioration as approved by the City. When placed in the work, reinforcement shall be free from dirt, paint, grease, oil, or other foreign materials. Reinforcement shall be free from defects such as cracks and laminations. Rust, surface seams, surface irregularities or mill scales will not be cause for rejection, provided the minimum cross-sectional area of a hand wire brushed specimen meets the requirements for the size of steel specified.

440.6. SPLICES.

Splicing of bars, lap spliced or welded, shall be as shown on the Plans or specified herein. Additional splices will require written approval of the City.

Splices not provided for on the Plans will be permitted in slabs 15 inches or less in thickness, columns, walls and parapets, but will not be included for measurement, subject to the following:

Unless otherwise approved by the City, splices will not be permitted in bars 30 feet or less in Plan length. For bars exceeding 30 feet in Plan length, the distance center to center of splices shall not be less than 30 feet minus one splice length, with no more than one individual bar length less than ten (10) feet. The specified concrete cover and proper spacing shall be maintained at such splices and the lap spliced bars placed in contact and securely tied together.

TABLE 1

MINIMUM LAP REQUIREMENTS FOR BAR SIZES THROUGH NO. 11

SIZE	LAP LENGTH	
	UNCOATED	COATED
No. 3	1’-0”	1’-6”
No. 4	1’6”	2’-3”
No. 5	1’-10”	2’-9”
No. 6	2’-3”	3’-4”
No. 7	3’-0”	4’-6”
No. 8	3’-9”	5’-7”
No. 9	4’-8”	7’-0”
No. 10	5’-7”	8’-4”
No. 11	6’-7”	9’-10”

Spiral steel shall be lapped a minimum of one turn.
Bar sizes No. 14 and No. 18 may not be lapped.

Welded splices shall conform to the requirements of the Plans and TxDOT Item 448, "Structural Field Welding". End preparation for butt welding reinforcing bars shall be done in the field. Delivered bars shall be of sufficient length to permit weld preparation.

Welded wire fabric shall be spliced using a lap length that will include the overlap of a minimum of two (2) cross wires plus two (2) inches on each sheet or roll. Splices using bars, which develop equivalent strength and lapped in accordance with Table 1 will be permitted.

For box culvert extensions with less than one (1) foot of fill, the existing longitudinal bars shall have a lap with the new bars as shown in Table 1. For extensions with more than one (1) foot of fill, a minimum of six-inch lap will be required.

440.6. MECHANICAL COUPLERS.

(1) General. When shown on the Plans, mechanical splices may be made in the reinforcing steel bars using one of the following types:

Sleeve-Filler Type
Sleeve-Threaded Type
Sleeve-Swaged Type
Sleeve-Wedge Type

A pre-qualified manufacturer shall produce all couplers furnished by the Contractor. Pre-qualification shall be in accordance with TxDOT Departmental Material Specification D-9-4510. Sleeve-wedge type couplers will not be permitted on coated reinforcing.

(2) Project Samples. For purposes of sampling couplers for use on an individual project, a lot of couplers shall be defined as 500 couplers, or fraction thereof, for each size and type. Prior to use on the project, three (3) test specimens shall be assembled using couplers selected at random from each lot received on the project. All test specimens shall be assembled from materials consigned to the project and shall be assembled in the presence of the City. A test specimen shall consist of a coupler connecting two (2) 21 inch, or longer, bars using the same splice materials, position, equipment and procedures to be used to make splices in the work. The assembled test specimens shall be submitted to the Division of Materials and Tests for testing. Each lot of couplers shall be identified with tags or markings identifying the lot from which the samples were taken.

(3) Testing. Project samples will be tested to 125% of specified yield strength and for total slip requirements. When a test representing a lot of couplers fails to meet the requirements, four (4) additional couplers from that lot will be tested. If all four (4) tests meet the requirements, the lot will be accepted for use in the work. If any of the four (4) tests fail to meet the requirements, that lot of couplers will be rejected and not used in the work.

(4) Construction Methods. All coupling devices shall be installed in accordance with the manufacturer's recommendations. Protection of threaded male or female connections shall be provided and the threaded connections shall be clean when making the connection. Damaged threads shall not be repaired.

(5) Alternate Equivalent Strength. Alternate equivalent strength arrangements to be accomplished by substituting larger bar sizes, or more bars, will be considered if approved by the City, in writing, prior to the fabrication of the systems.

440.7. PLACING.

Unless otherwise shown on the Plans, dimensions shown for reinforcement are to be the centers of the bars. Reinforcement shall be placed as near as possible in the position shown on the Plans. In the plane of the steel parallel to the nearest surface of concrete, bars shall not vary from Plan placement by more than one-twelfth (1/12) of the spacing between bars. In the Plane of the steel perpendicular to the nearest surface of concrete, bars shall not vary from Plan placement by more than 1/4-inch. Cover of concrete to the nearest surface of steel shall meet the above requirements but shall never be less than one (1) inch.

For bridge slabs, the clear cover tolerance for the top mat of reinforcement shall be -0, + 1/2 inch.

The reinforcement shall be accurately located in the forms, and firmly held in place, before and during concrete placement, by means of bar supports, adequate in strength and number in order to prevent displacement and to keep the steel at the proper distance from the forms. Bars shall be supported by standard bar supports with plastic tips, plastic bar supports approved by the City or precast mortar or concrete blocks when supports are in contact with removable or stay-in-place forms. Bright basic bar supports may be used to support reinforcing steel placed in slap overlays on concrete panels or on existing concrete slabs. Bar supports in contact with soil or subgrade shall be as approved by the City.

For bar supports with plastic tips, the plastic protection shall have a minimum thickness of 3/32 of an inch and extend upward on the wire to a point at least one-half (1/2) inch above the formwork.

All accessories such as tie wires, bar chairs, supports or clips used with epoxy coated reinforcement shall be of steel, fully coated with epoxy or plastic. Plastic supports approved by the City may also be used with epoxy coated reinforcement.

Mortar or concrete blocks shall be cast to uniform dimensions with adequate bearing area. A suitable tie wire shall be provided in each block for anchoring to the steel. The blocks shall be accurately cast to the thickness required in molds approved by the City. The surface placed adjacent to the form shall be a true Plane, free of surface imperfections. The blocks shall be cured by covering with wet burlap or mats for a period of 72 hours. Mortar for blocks shall contain approximately one (1) part Portland Cement to three (3) parts sand. Concrete for blocks shall contain nine (9) sacks of Portland Cement per cubic yard of concrete.

Individual bar supports shall be placed in rows at four (4) foot maximum spacing in each direction. Continuous type bar supports shall be placed at four (4) feet maximum spacing. Continuous bar supports will be required when permanent metal deck forms are used.

Individual bar supports shall be placed in rows at four-foot maximum spacing in each direction. Continuous type bar supports shall be placed at four (4) feet maximum spacing. Continuous bar supports will be required when permanent metal deck forms are used.

The exposure of the ends of longitudinals, stirrups and spacers used to position the reinforcement in concrete pipe and precast box culverts or sewers shall not be cause for rejection.

Reinforcing steel for bridge slabs, top slabs or direct traffic culverts and the top slabs of prestressed box beams shall be tied at all intersections except that where the spacing is less than one (1) foot in each direction, alternate intersections only need to be tied. For reinforcing steel cages for other structural members, the steel shall be tied at a sufficient number of intersections to provide a rigid cage of steel. Mats of wire fabric shall be fastened securely at the ends and edges.

Before concrete placement, all mortar, mud, dirt, etc., shall be cleaned from the reinforcement. Concrete shall not be placed until authorized by the City.

If the reinforcement is not adequately supported or tied to resist settlement, floating upward, overturning of truss bars, or movement in any direction during concrete placement, concrete placement will be halted until corrective measures are taken.

440.8. EPOXY COATING OF REINFORCING STEEL.

(1) General. When shown on the Plans, coating with epoxy of reinforcing bars, plain wire, deformed wire or welded wire fabric to be used as reinforcement for concrete shall conform to the requirements herein.

(2) Surface Preparation. The reinforcing steel shall be free of surface contaminants such as oil, grease or paint when received at the manufacturer's Plant and prior to cleaning and coating. The surface of steel to be coated shall be cleaned by abrasive blast cleaning. All traces of grit and dust from the blast cleaning shall be removed prior to coating. Other methods of cleaning may be submitted to the City for approval.

(3) Application of Coating. The applicator shall notify the City at least 30 days before the date of production. The coating shall be applied as recommended by the manufacturer of the coating material.

The coating shall be applied to the cleaned surface as soon as possible after cleaning and before oxidation of the surface discernible to the unaided eye occurs. The coating shall be a smooth uniform coat and shall have a thickness of from 7 to 12 mils, after curing. The thickness of the coating shall be measured using magnetic thickness testing gages in accordance with Test Method Tex-728-I.

The coating film shall be fully cured. Sufficient checks shall be made to assure that each coated production lot is supplied in a fully cured condition.

(4) Continuity of Coating. The applicator shall check the coating for continuity after curing. The coating shall be free from holes, voids, cracks, contamination and damaged areas discernible to the unaided eye.

For reinforcing bars a 67-1/2 volt D.C. in-line holiday detector, such as Tinker and Rasor Model M-1 or approved equivalent, shall be used to check the coating for holidays. There shall be no more

than two (2) holidays (pinholes not visually discernible) in any linear foot of a coated reinforcing bar.

Holiday checks to determine acceptability of wire or welded wire fabric shall be made at the manufacturer's Plant with a 67-1/2 volt D.C. in-line holiday detector. For wire, there shall not be more than an average of two (2) holidays per linear foot of wire. For welded wire fabric, there shall not be more than an average of four (4) holidays per linear foot of wire in welded wire fabric when the wire spacings are four (4) inches or more, or six (6) holidays per linear foot of wire when the spacings are less than four (4) inches. Uncoated areas at cut ends shall not be counted, nor shall sharp edges (weld spurs) at intersections be counted as holidays. When measuring the number of holidays, at least one-half (1/2) inch of wire must be included on each side of the intersections being checked.

(5) Repair of Coating. Material for repair of the coating shall comply with the requirements in "Epoxy Coating" of this Item. Repairs shall be made in accordance with procedures recommended by the manufacturer of the epoxy coating powder. Areas to be patched shall receive at least the same coating thickness as required for the original coating.

All visible damage to the coating shall be repaired.

Sawed and sheared ends, cuts, breaks and/or other damage shall be repaired promptly before additional oxidation occurs. Areas to be repaired shall be clean and free from surface contaminants. Repairs shall be made in the shop or in the field as required.

The acceptable amount of patched area at the applicator shall not exceed one-quarter (1/4) inch total length in any linear foot.

(6) Sampling and Testing. Sampling and testing of coated reinforcement shall be in accordance with Test Method Tex-739-I.

(7) Identification and Documentation. Identification of all reinforcing shall be maintained throughout the coating and fabrication process and until delivery to the project site.

For all production of coated reinforcing steel to be used on City projects, the manufacturer shall furnish to the City two copies of a written certification that the coated reinforcing steel meets the requirements of this specification and two copies of the manufacturer's control tests.

(8) Handling. All systems for handling coated reinforcement shall have padded contact areas. Bundling bands shall be padded or suitable banding shall be used to prevent damage to the coating. Bundles of coated reinforcement shall be lifted with a strong back, spreader bar, multiple supports, or a platform bridge. The bundled reinforcement shall be transported with care and stored on protective cribbing. The coated reinforcement shall not be dropped or dragged.

(9) Construction Methods. Flame cutting will not be permitted on coated reinforcement. Saw or shear cutting will be permitted with permission of the City. Cut ends shall be coated as specified in "Repair of Coating" of this Item.

Welding or mechanical coupling of coated reinforcing steel will not be permitted except where specifically shown on the Plans. The epoxy coating shall be completely removed a minimum of six (6) inches beyond the weld limits prior to welding and two (2) inches beyond the limits of the coupler prior to assembly. After welding or coupling, the steel shall be cleaned of all oil, grease, moisture, dirt, welding contamination (slag and/or acid residue) and rust to a near white finish. The existing epoxy shall be checked for damage. Any damaged or loose epoxy shall be removed back to sound epoxy coating.

After proper cleaning, the splice area shall be coated with epoxy repair material to a thickness of 7 to 12 mils. A second application of repair material shall be applied to the bar and coupler interfaces to insure complete sealing of the joint.

440.9. MEASUREMENT AND PAYMENT.

Except as specified below, the work performed, materials furnished, and all labor, tools, equipment and incidentals necessary to complete the work under this Item will not be measured or paid for directly, but will be considered subsidiary to the various bid items of the contract.

The quantities of reinforcing steel shown on the Plans are estimates and are for the Contractor's information.

Compensation for adjustment of reinforcing steel quantities will be as follows:

(1) When the reinforcing steel quantity for a complete structure element has been erroneously included in or omitted from the quantities shown on the Plans, the quantity for that element will be added or deducted for payment. A complete structure element will be the smallest portion of a total structure for which a corresponding quantity of concrete is included on the Plans. Additional payment or reduction in payment for quantities revised in this manner will be made accordingly, in accordance with TxDOT Item 4.3.

(2) When the Plan quantity for reinforcing steel for a complete structure element is in error by five (5) percent or more, a recalculation will be made and payment will be increased or reduced accordingly in accordance with contract documents..

(3) When quantities for reinforcing steel are revised by a change in design, the change in quantities will be calculated. Additional payment or reduction in payment for quantities revised in this manner will be made accordingly, in accordance with contract documents.

The party to the contract requesting the adjustment shall present to the other one (1) copy of the description and location, together with calculations of the quantity for the structure element involved. When this quantity is certified correct by the City, it will become the basis for additional or reduced payment.

CITY OF SAN ANGELO

ITEM 529

CONCRETE CURB, GUTTER AND COMBINED CURB AND GUTTER

529.1. DESCRIPTION.

This Item shall govern for construction of concrete curb, gutter and combined curb and gutter, with or without reinforcing steel, composed of Portland Cement concrete on approved subgrade, foundation material or finished surface in accordance with the lines and grades established by the City and in conformance with the details shown on the Plans.

As used in this Item, the word "curb" refers to concrete curb, concrete gutter and combined concrete curb and gutter.

529.2. MATERIALS.

All materials shall conform to the pertinent requirements of the following Item:

Item 421, "Portland Cement Concrete"

Concrete used in conventionally formed and slipformed construction shall be Class "A" concrete or concrete as specified for concrete pavement. Unless otherwise shown on the Plans, concrete for extruded construction shall be Class "A", except that the coarse aggregates shall meet the requirements of Grade 8. Other grades of coarse aggregate may be substituted, if approved by the City.

529.3. CONSTRUCTION METHODS.

(1) Conventionally Formed Concrete. Prior to curb construction, the subgrade, foundation or pavement surface shall be shaped to the line, grade and cross section shown on the Plans and, if considered necessary by the City, hand tamped and sprinkled. When directed by the City, the subgrade or foundation material shall be sprinkled. When directed by the City, the subgrade or foundation material shall be sprinkled lightly immediately before concrete is deposited thereon.

Forms shall be of wood, metal or other approved material, of a section satisfactory to the City, straight, free of warp and of the depth required. They shall be securely staked to line and grade, and maintained in a true position during the placing of concrete.

The reinforcing steel, if required, shall be placed as shown on the Plans. Care shall be exercised to keep all steel in its proper location during concrete placement.

Unless other methods are shown on the Plans or approved by the City, the concrete shall be placed into the forms and then struck off with a template, which is approximately 1/4" to 3/8" less than the dimension of the finished curb. After the concrete has been struck off and after it has become sufficiently set, the surface shall be plastered with a mortar consisting of one part of Portland

Cement and two (2) parts fine aggregate. The mortar shall be applied with a template made to conform to the finished curb dimensions as shown on the Plans. Exposed edges shall be rounded by the use of an edging tool to the radius shown on the Plans. All exposed surfaces shall be brushed to a smooth and uniform surface.

Curbs, gutters and combined curb and gutters shall be placed in sections of 50-foot maximum length unless otherwise approved by the City.

Joints shall be of the type and spacing shown on the Plans. Preferably on ten (10) foot spaces if not shown on Plans.

Hand finishing will be permitted.

The completed work shall be cured with an approved curing compound.

(2) Extruded or Slipformed Concrete. The concrete shall be placed with self-propelled equipment approved by the City. When placement is directly on subgrade or foundation materials, the foundation shall be hand-tamped and sprinkled if considered necessary by the City. If the concrete is placed directly on the surface material or pavement, such surface shall be thoroughly cleaned. If required by Plan details, the cleaned surface shall then be coated with an approved adhesive or other coating as specified at the rate of application shown.

The reinforcing steel, if required, shall be placed as shown on the Plans. Care shall be exercised to keep all steel in its proper location during concrete placement.

The line shall be maintained from a guideline set by the Contractor based on the alignment data shown on the Plans. The outline shall strictly conform to the details shown on the Plans. The forming tube of the extrusion machine or the form of the slipform machine shall be readily adjustable vertically during the forward motion of the machine to provide required variable heights necessary to conform to the established grade line. To provide a continual check on the grade, a pointer or gauge shall be attached to the machine in such a manner that a comparison can be made between the extruded or slipform work and the guideline. Other methods may be used, if approved in writing by the City.

Concrete shall be fed into the machine in such a manner and at such consistency that the finished work will present a well-compacted mass with a surface free from voids and honeycomb, and true to the required shape, line and grade.

Any additional surface finishing specified and/or required shall be performed immediately after extrusion or slipforming. Expansion joints shall be at the beginning and ending of radius and every 100' between radii.

Hand finishing will be permitted.

All exposed surfaces shall be cured with an approved curing compound.

529.4. MEASUREMENT.

This Item will be measured by the linear foot, complete in place.

529.5. 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 "Concrete Curb", "Concrete Gutter" or "Concrete Curb and Gutter" of the type specified. This price shall be full compensation for furnishing all materials required; for surface preparation of base; and for all manipulations, labor, tools, equipment, and incidentals necessary to complete the work.

SECTION 02225 - TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Excavating trenches for utilities from 5 feet outside building to existing municipal utilities.
   2. Compacted fill from top of utility bedding to subgrade elevations.
   3. Backfilling and compaction.

B. Related Sections:
   1. Section 02667 "Water Utilities."

1.2 REFERENCES

A. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
B. ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
C. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb. Rammer and 18 inch Drop.
D. ASTM D2167 - Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
E. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
F. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

1.3 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

1.4 FIELD MEASUREMENTS

A. Verify that survey bench mark, control point, and intended elevations for the Work are as shown on drawings.

1.5 COORDINATION

A. Verify work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

A. Trench backfill in areas paved by this project shall be rock crusher fines. Trench backfill in areas not paved by this project may be rock crusher fines or the most granular material from the excavated trench spoils. Only the material passing through the 2-inch screen size, and free of organic material shall be used.

PART 3 - EXECUTION

3.1 PREPARATION

A. Identify required lines, levels, contours, and datum locations.
B. Protect plant life, lawns, and other features remaining as a portion of final landscaping.
C. Protect bench marks, fences, paving, and curbs from excavating equipment and vehicular traffic.
D. Maintain and protect above and below grade utilities which are to remain.
E. Cut out soft areas of subgrade not capable of compaction in place. Backfill and compact to density equal to or greater than requirements for subsequent backfill material.

3.2 EXCAVATING

A. Excavate subsoil required for utilities.
B. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.
C. Do not interfere with 45 degree bearing splay of foundations.
D. Hand trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
E. Remove lumped subsoil, boulders, and rock.
F. Correct areas over excavated in accordance with Paragraph 3.1.E. of this section.
G. Excavate trenches to indicated gradients, lines, depths, and elevations.
H. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
I. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
    1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.3 BACKFILLING

A. Backfill trenches to contours and elevations with unfrozen fill materials.
B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
C. Place and compact materials in equal continuous layers not exceeding 8 inches compacted depth.
D. Employ a placement method that does not disturb or damage existing or planned facilities.
E. Maintain optimum moisture content of fill materials to attain required compaction density.
F. Transport surplus fill materials to designated stockpile area as noted on the Plans.
G. Place backfill on subgrades free of mud, frost, snow, or ice.
H. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

I. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
    1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
J. Place and compact final backfill of satisfactory soil to final subgrade elevation.
K. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs

3.4 TOLERANCES

A. Top Surface of Backfilling Under Paved Areas: Plus or minus 1/2 inch from required elevations.
B. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.5 FIELD QUALITY CONTROL

A. Compaction testing will be performed in accordance with ASTM D1557, ASTM D2922, and ASTM D 3017, and at the discretion of the Engineer the following: ASTM D 1556, ASTM D 2167.
B. Backfill loose lifts = 12-inch maximum. Density requirements: Top 4 feet of trench below subgrade = 95 percent ASTM D 1557. Trench levels below 4 feet = 90 percent ASTM D 1557.
C. If tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.
D. Frequency of Tests: One test per 150 linear feet of trench, at lift level chosen by Engineer's Representative.

3.6 PROTECTION OF FINISHED WORK

A. Protect finished Work.
B. Reshape and re-compact fills subjected to vehicular traffic during construction.

3.7 MEASUREMENT AND PAYMENT

A. The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly, but is subsidiary or is included in payment for other bid items.

END OF SECTION

SECTION 02667 - WATER UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes valves, fire hydrants, pipe, and fittings for site water line including domestic water line and fire protection water line.
B. Related Sections:
   1. Section 02225 "Trenching and Backfilling."
   2. Section 02675 "Disinfecting of Water Utility Distribution."

1.2 REFERENCES

A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
B. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
C. ASTM B 88 - Seamless Copper Water Tube.
D. ASTM D 1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
E. ASTM D 1785 - Poly (VinylChloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
F. ASTM D 2241 - Poly (VinylChloride) (PVC) Plastic Pipe(SDR-PR).
G. ASTM D 2466 - Poly (VinylChloride) (PVC) Plastic Pipe Fittings, Schedule 40.
H. ASTM D 2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and fittings.
I. ASTM D 2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
J. ASTM D 3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.
K. ASTM D 3139 - Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.
L. ASTM D 3035 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter.
M. AWS A5.8 - Brazing Filler Metal.
N. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
O. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other liquids.
P. AWWA C111- Rubber-Gasket Joints for Ductile Iron and Grey-Iron Pressure Pipe and Fittings.
Q. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
R. AWWA C500 - Gate Valves, 3 through 48 in NPS, for Water and Sewage Systems.
S. AWWA C502 - Dry Barrel Fire Hydrants.
T. AWWA C504 - Rubber Seated Butterfly Valves.
U. AWWA C508 - Swing-Check Valves for Waterworks Service, 2 in through 24 in NPS.
V. AWWA C509 - Resilient Seated Gate Valves 3 in through 12 in NPS, for Water and Sewage Systems.
W. AWWA C600 - Installation of Ductile-Iron Water Mains and Appurtenances.
X. AWWA C606 - Grooved and Shouldered Type Joints.
Y. AWWA C900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch, for Water.

Z. AWWA C901 - Polyethylene (PE) Pressure Pipe, Tubing, and Fittings, 2 inch through 3 inch, for Water
AA. UL 246 - Hydrants for Fire - Protection Service.

1.3 SUBMITTALS FOR REVIEW

A. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.

1.4 SUBMITTALS AT PROJECT CLOSEOUT

A. Record actual locations of piping mains, valves, connections, and invert elevations.
B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with standards of local municipality.
B. Valves: Manufacturer's name and pressure rating marked on valve body.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site in such a manner as to prevent damage.
B. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

A. Types and classes of pipe to be used at the various locations shall be as scheduled on the Proposal and the drawings, and shall be as specified below:

Pipe Size	Type Pipe
1- to 2-inch Diameter	Seamless Tube Type K Copper, ASTM B-88 or Polyethylene Plastic Tubing, ASTM D-2737, 160 psi
3-inch Diameter	ASTM D-2241, SDR 26, 160 psi or ASTM D-1785 Schedule 40
4-inch to 12-inch Diameter	PVC Pipe, AWWA C-900, or Ductile Iron Pipe, Diameter Pressure Rating 150 psi
16-inch Diameter	Ductile Iron Pipe, Pressure Rating 150 psi

B. The pipe shall be of the best quality in materials and workmanship. All pipe shall be subjected to thorough inspection at the job site before being placed in the trench. Any piece found to be defective shall be rejected and removed from the project.

C. Ductile Iron Pipe

1. All ductile iron pipe shall be new and manufactured in the U.S.A. in accordance with current AWWA Specification C 151.
2. Pipe shall be designed for a minimum working pressure of 150 pounds per square inch. Thickness of ductile iron pipe shall be designed in accordance with Specification AWWA C 150, based on 150 pounds per square inch, working pressure for 10 feet of cover and laying condition Type 2.
3. Standard Bell and Spigot, Mechanical Joint (Type III), or boltless single gasketed joint pipe similar to that known as "Bell-Tite," "Fastite," "Tyton," or approved equal, may be used for the line and at other specific locations as approved by the Engineer. Flange joints where noted shall be 150 psi rated.
4. Ductile iron pipe shall be asphalt coated outside and cement lined and seal coated inside in accordance with AWWA Specification C 104 (ANSI A21.4). Lining shall be standard cement lining.

D. PVC Pipe

1. PVC pipe shall conform to the requirements of AWWA C900 pressure pipe, 4-inch through 12-inch for water distribution pressure class 150, DR18. PVC pipe shall be of the rubber gasketed push on joint type and shall meet the requirements of ASTM D 1784 and ASTM D 2241.
2. All PVC pipe shall be approved by the National Sanitation Foundation Testing Laboratories, or other accredited laboratory for use in the transportation of potable water and shall bear the seal of approval of the National Sanitation Foundation Testing Laboratories (NSF).
3. When non-metallic pipelines are to be installed the Contractor shall furnish and lay, above the pipeline, a continuous strip of metallic identification tape.
4. Tape Material:
    a. The metallic identification tape shall be at least 2 inches in width and shall be of corrosive resistant metal of sufficient thickness to be stable and reflect electronic signals to electronic pipeline detector when buried to a depth of 24 inches below normal ground level.
    b. The metallic tape shall be colored blue on one side and shall have 1-inch-high letters painted continuously on the same side of the tape which read, “CAUTION: BURIED WATER LINE BELOW” or other words to this effect.
    c. The marking tape shall be “Detectable Warning Tape,” as manufactured by the Omega Marking Company, or equal approved by the Engineer.

E. Schedule 40 and 80 PVC Pipe

1. The Schedule 40 and 80 PVC Pipe shall be manufactured in accordance with the latest edition of ASTM D 2241, D1785 and shall conform to NSF standard #14 and ANSI/NSF Standard 61, using a PVC Compound having a minimum cell classification 12454B as defined by ASTM D 1784. The bell ends shall conform to ASTM D 2672, “Joints for PVC Pipe using Solvent Cements” when installed per ASTM D 2855.

2.2 PIPE FITTINGS

A. General

1. Pipe fittings shall be ductile iron of a type and design especially suitable for use with the type of piping with which they are installed. Fittings for PVC pipe shall also be of ductile iron. Pressure rating of fittings shall not be less than that of the pipe.

2. All mechanical joint fittings shall be ductile iron with retainer gland. The fittings shall be produced in accordance with ANSI/AWWA C153/A21.53 and ANSI/AWWA C111/A21.11 and be cement lined and seal coated in accordance with ANSI/AWWA C104/A21.14. The retaining gland set screws shall be square-heads with Type C knurled cup points manufactured of 4140 grade alloy steel and heat treated to Rockwell "C" 45/53 core hardness.
3. All flanged fittings shall be faced and drilled in accordance with the standard drilling for ANSI B16.1 Class 125 flanges. Bolts for flanged joints shall be of the length and diameter required by the ANSI Specification. Bolts and nuts shall be of best quality mild steel and shall be provided with hexagonal heads. Suitable 1/8 inch thick rubber ring gaskets shall be provided for all flanged joints.

B. Ductile Iron Pipe Fittings
1. Fittings shall be ductile iron and shall conform to AWWA C 110. Flanged fittings shall be used for fire hydrant valve leads or where indicated on the plans. All other fittings shall be ductile iron mechanical joint or push-on joint unless otherwise shown on the drawings. All fittings shall have a pressure rating equal to that of the pipe with which they are used but in no case less than 250 psi.
2. Unless otherwise indicated, all ductile iron fittings shall have an external bituminous coating and shall be cement-lined in accordance with the specifications for coating and lining the pipe.
3. All ductile iron fittings shall be cast from the same quality of metal used in casting the ductile iron pipe and shall be subjected to the same test requirements. Marking and weighing shall be as required for the ductile iron pipe.
4. Where flanged fittings are used the flanges shall be of the same material as the fitting. Where bell or mechanical joint fittings are used, the bells shall be cast integrally with the fitting. Screwed-on bells will not be acceptable.

C. Schedule 40 and 80 Fittings
1. Schedule 40 and Schedule 80 fittings shall conform to ASTM D 2467, D1784, NSF Standard 61 and/or 41 Plastic Fittings for potable water. The PVC material shall meet or exceed cell classification 12454, as manufactured by Spears Manufacturing Company or an approved equal.

2.3 PIPE JOINTS

A. Push-on Joints: Push-on joints shall be as specified in AWWA Standard C 111.
B. Mechanical Joints: Mechanical joints shall be as specified in AWWA Standard C 111.
C. Flanged Joints: Flanged joints shall meet the requirements of AWWA C110 and be faced and drilled in accordance with ANSI B16.1. Bolts shall be of the length and diameter required by the ANSI Specification for Class 125 flanges. Bolts and nuts shall be of best quality mild steel and shall be provided with hexagonal heads, except where other types of bolts are specified. Suitable gaskets shall be used in all flanged joints.
D. Miscellaneous Joints: Miscellaneous types of joints shall be made as specified in other paragraphs or as recommended by the manufacturer. All joints shall be made using materials and methods as required to produce joints that will function satisfactorily under the various conditions encountered.

2.4 VALVES

A. General: Valves that are 12-inch and smaller shall be gate valves and valves that are 14-inch and larger shall be butterfly valves, unless otherwise noted on the plans or specified herein. All valves shall be designed for a working pressure of at least 150 psi.

B. Gate Valves

1. All gate valves shall be resilient seat, iron body, bronze mounted throughout and shall meet all requirements of AWWA C 509. The valves shall be of the type of joint used in the piping. All valves shall open by turning to the left, and unless otherwise specified, shall have non-rising stem and be furnished with a two-inch operating nut when valves are outside of buildings, and shall be furnished with hand wheels when inside of buildings or valve vault. Gate valves shall be furnished with O-ring stem packing.
2. All gate valves shall be designed to withstand a working pressure of 150 pounds per square inch. All valves shall be Mueller Company A-2370 or approved equal.
3. Valves required in lines smaller than 3 inches in diameter shall be 150 psi water pressure, heavy duty, brass or bronze gate valves, double disc or wedge type, Crane, Walworth or approved equal. Valves in copper lines shall have solder-joint ends.
4. All interior cast iron surfaces shall be epoxy coated in accordance with the appropriate paragraphs of this section.

C. Tapping Sleeves and Valves

1. Tapping sleeves shall be designed for a working pressure of 150 psi, and shall be mechanical joint, or as required to make the connection. Tapping sleeves shall be Mueller, ductile iron, with duck-tipped gaskets or approved equal.
2. All interior cast iron surfaces shall be epoxy coated in accordance with the appropriate paragraphs of this section.
3. Tapping valves shall be resilient seat Mueller mechanical joint valves designed for a working pressure of 150 psi or approved equal.

D. Valve Boxes and Extension Stems

1. Extension stems shall be furnished on buried valves where the top of the operating nut is more than 36-inches below finished grade. Top of the extension stem shall not be more than 9-inches below the top of the valve box.
2. Buried valves shall be provided with cast iron valve boxes. The boxes shall be designed to fit over a section of 6-inch C900 PVC riser pipe which will be used as an extension from the top of the valve to within 8-inches of the ground surface. The box shall have a heavy cast iron cover. The box shall have a flange type base, with the base being approximately 4 inches larger in diameter than the outside diameter of the barrel of the box. The necessary length of 6-inch C900 PVC riser pipe required for the extension shall be considered as a part of the box.

E. Internal Epoxy Coating for Valves

1. All interior wetted ferrous surfaces of all types of valves will be coated with an epoxy. The coating shall be a two part, thermal setting epoxy protective coating and shall function as a physical, chemical and electrical barrier between the base metal to which it is applied and the surroundings. The coating shall be nontoxic and shall not impart taste of water. The coating must be formulated from material deemed acceptable per the Food and Drug Administration document title 21 of the Federal Regulations on food additives, Section 121.2514 is entitled, Resin and Polymeric Coatings. The coating shall have a satin finish and shall be suitable for field overcoating and touch-up with the same coating material without sanding or special surface preparation, or application of heat in excess of room temperature. The

coating shall have a successful record of performance in valves, pipe or other allied equipment for a minimum of two years. The coating adhesion to the substrate shall exceed the cohesion of the coating film as demonstrated by the following test:

a. Prepare test panel and apply coating as per manufacturer's recommendation.
b. After sample has properly cured as per manufacturer's recommendation, scribe an "X" through the coating to the metal substrate using a sharp knife or scalpel.
c. A the juncture of the two scribes, use the point of the knife to attempt to lift off the coating. The coating should not lift off the substrate or between coats readily, but should break up leaving coating material on the substrate of this damaged area.
d. No disbondment of the film shall be noted as tested above after immersion in tap water for 1500 hours at 100° F.

2. A falling sand abrasion test using ASTM D-968 shall produce an abrasion coefficient of 25.30 liters per mil. As an alternative, a Taber Abrader Test should find 3.5-3.7 milligrams of coating loss per 100 cycles when using a CSFS #10 wheel (1000 gram weight).

2.5 FLEXIBLE COUPLINGS AND FLANGED COUPLING ADAPTERS

A. Flanged coupling adapters and flexible couplings shall be provided at the locations shown on the drawings and at other location required for installation of the piping system. Flanged coupling adapters shall be provided with anchoring studs. Epoxy coated steel construction shall be used for couplings larger than 12-inch. Couplings smaller than 12-inch shall be cast iron.

2.6 FIRE HYDRANTS

A. Fire hydrants shall conform to the requirements of AWWA C-502 dry-barrel type. The fire hydrants shall be designed for a bury length of 5’-0”; however, the length may vary according to field conditions and the Contractor will be required to add extensions to position the top of the flange at the elevation noted on the plans or as directed by the Engineer. Extensions shall be considered incidental to the fire hydrant installation and no direct payment shall be given.
B. The hydrants shall have a 5-1/4 inch valve opening, two 2-1/2 inch hose nozzles and one 4-1/2 inch pumper nozzle. A swivel flange shall be used to face the hydrant nozzles in any position.
C. Hose threads shall be National Standard Threads
D. The hydrants shall be sized for 6-inch mains and shall have an inlet connection compatible with the type pipe used. All gaskets, nuts, bolts and other jointing materials shall be considered part of the fire hydrant installation.
E. Operating nut shall be standard 1-1/2 inch pentagon opening counterclockwise. The hydrant shall close with the pressure.
F. Hydrants shall be painted in accordance with the standards of the local municipality.
G. Fire hydrants shall be located at points shown on the plans, the exact location of the hydrant to be established by the Engineer. All hydrants shall be set plumb to the grade as established by the Engineer, and shall have their nozzles parallel with and/or at right angles to the curb, with the pumper nozzle facing the curb in accordance with the details shown on the plans.

H. The hydrants shall be supported in such a manner as not to cause a strain on the fire hydrant lead or branch. The bowl of the hydrant shall be well braced against unexcavated earth at the end of the trench with concrete backing. The concrete backing shall be placed so as not to interfere with the hydrant drains and so that the joints or flanges are accessible.

I. Each hydrant shall be connected to the main with a 6-inch PVC branch controlled by an independent 6-inch resilient seat gate valve. Each hydrant shall be set upon a stone or concrete slab not less than four inches thick and not less than one square foot of surface area. Where solid rock exists in the bottom of the trench and same is excavated to the proper depth to form a foundation for the hydrant, the slab of stone or concrete may be omitted.

J. There shall be placed round the base of the hydrant not less than seven cubic feet of sound broken stone or clean gravel or other suitable material to provide reservoir capacity so that the hydrant will completely drain when closed. The gravel or broken stone shall reach from the bottom of the trench to at least six inches above the waste opening in the hydrant. Each hydrant shall be operated by the Contractor to prove to the inspector that the drain hole has not been plugged with concrete or other material.

K. The hydrants shall have a breakable safety flange, located approximately 2 inches above the ground, and breakable stem coupling and barrel which breaks cleanly upon impact. The main valve shall also remain closed without loss of water.

L. The hydrants shall be AWWA improved type hydrants and shall be Mueller Centurion Hydrants or approved equal, and shall have self-oiling reservoirs, and shall be internally epoxy coated as described in VALVES AND VALVE BOXES paragraph of this section.

PART 3 - EXECUTION

3.1 WATER SERVICE CONNECTIONS

A. Requirements of installing services on public right-of-way, from the main line to the meter box.

1. Service Taps: Tapping saddles shall be Smith-Blair Taper Seal Style 313 or DMD Dresser Style 194 or approved equal. Service taps on PVC water lines shall be made using hinge type or double strap saddles. Tapping saddles shall support the full circumference of the pipe and shall have a bearing area of sufficient width along the pipe axis to prevent pipe distortion when the saddle is tightened.
2. Polyethylene Plastic Tubing: Service lines shall be constructed with polyethylene plastic tubing as specified in ASTM D-2737 with a rating of 160 psi unless otherwise noted on the plans. The service line shall be that pipe from the water distribution line to the water meter. The pipe shall be sized to match the nominal water meter size.
3. Copper Tubing: Service lines may be constructed with seamless copper water tube ASTM B 88, Type K, of the sizes required.
4. Meter Boxes, Meter Stop and Corporation Stop: Meter boxes shall be corrugated metal pipe with locking cast iron lids as specified on the plans. Meter stops, corporation stops and service clamps for service connections of various sizes shall be as specified on the plans. Corporation and meter stops shall be compatible with pipe material furnished.

3.2 EXCAVATION, TRENCHING AND BACKFILLING

A. The trench shall be excavated to the lines and grades as established by the Engineer and as shown on the plans. The depth of cover for all pipe lines on which the grades and elevations are not shown on the plans, shall be 42 inches. The amount of cover may vary over or under 42 inches as directed by the Engineer.

B. The minimum width of the trench shall be the outside diameter of the pipe plus 12 inches and the maximum width shall be the outside diameter of the pipe plus 18 inches. The trenching equipment shall be maintained on a sufficiently level road bed to provide substantially vertical trench walls. The maximum horizontal offset of the trench wall from bottom of trench to the top of the trench (undercutting) shall be 4 inches.

C. The trench shall be excavated to an even grade so that the bottom of the pipe will rest on the bottom of trench throughout the entire length of the pipe. In order to obtain a true even grade, the trench shall be fine graded by hand. On lines that are to be laid to established grades, batter boards shall be set at fifty foot intervals and the trench graded to the established grade.

D. Any part of the trench excavated below grade shall be corrected by filling with approved material and thorough compacting.

E. If large rock, rock fragments or other unyielding material is encountered in the bottom of the trench it shall be removed to a depth of 3 inches below grade, refilled with selected material, and thoroughly compacted.

F. Bell holes of ample dimensions shall be dug at each joint to permit the jointing of pipe to be made properly, and of sufficient depth to prevent the bell of the pipe from resting on undisturbed materials.

G. Wherever necessary to prevent caving, the trench shall be adequately braced and sheeted.

H. In all trench excavation, where the depth of excavation is 5 feet or more the trench wall shall be shored, sheeted or braced in accordance with OSHA requirements.

I. Trench digging machinery may be used to make the trench excavations except in places where operation of same would cause damages to trees, buildings or other existing structures either above or below ground; in such instances hand methods shall be employed.

J. All excavated material shall be piled in a manner that will not endanger the work or existing structures and that will cause the least amount of obstructions to walks and driveways.

K. There will be no classification of the excavated materials and the term excavation shall include all materials encountered in excavating the trenches or structural excavations.

L. The Contractor shall take all necessary precautions for protecting paved areas from being damaged by the trenching and backfilling equipment. Any damage done to any paved area outside of the area set forth in the plans as a result of the construction work shall be repaired by the Contractor at his own expense.

M. Where the lines are located behind curbs, the Contractor shall take special precautions to protect trees and shrubs. Care shall be exercised to cause as little damage to lawns as possible. Where lines cross under curbs, gutters or curbs and gutters, tunneling will be required.

N. As soon as practicable after laying and jointing of the pipe, the completion of bedding, and the completion of structures, the trench shall be backfilled in accordance with the trench backfill detail in the plans.

O. All pipe shall be backfilled in accordance with the specifications and the details shown on the plans. All bedding and backfill material shall be crushed and shall have at least two broken faces. Pea gravel <u>will not be allowed.</u>

P. The pipe shall be laid on a six inch thick cushion of crushed rock bedding material. ASTM C 33 Grade No. 8, or as approved by the Engineer. After the pipe is laid, the bedding material shall be placed simultaneously on both sides of the pipe and shall be shovel sliced around the pipe haunches. The bedding material shall be placed in 6-inch maximum lifts in accordance with the details shown on the plans. This material shall be thoroughly consolidated and compacted by tamping.

Q. Under pavements and slabs the backfill material used above the pipe bedding to the approved base course shall be either one) Rock Crusher Fines, or two) Cement Stabilized Backfill.

R. Rock Crusher Fines used for backfill operations shall be sharp grained particles of crushed stone and shall meet the following gradation:

Sieve Size	Percent Passing
2 inch	100
#4	35 - 100
#10	20 - 100
#40	5 - 35
#200	4 - 10

S. All crushed stone shall be installed in accordance with the details shown on the plans and consolidated in place by rolling.

T. Crushed stone screening (crusher fines) shall be wetted uniformly throughout with sufficient moisture to assure proper compaction before placing the material in the pipe trench. The material shall be placed in 12-inch loose lifts and compacted in place using approved compaction equipment. All approved backfill material placed in the top four feet of a trench located in a public right-of-way, parking lot or in a location where, in the opinion of the Engineer, excessive settlement would jeopardize a future structure shall be backfilled in 12-inch loose lifts and compacted to ninety-five percent (95%) density as determined by ASTM D 1557. All other approved backfill material shall be placed in 12-inch loose lifts and compacted to ninety percent (90%) density as determined by ASTM D 1557. All areas in the public rights-of-way where grass will be planted shall have topsoil placed in the top 12 inches.

U. Portland cement stabilized backfill shall consist of caliche base material, blow sand or native soil stabilized by the addition of Portland cement. Crushed stone or concrete aggregate shall NOT be used.

V. The Contractor shall submit a mix design prepared by an approved Commercial Laboratory that will produce a minimum seven day compressive strength of 150 psi. In no case shall the minimum cement content of the mix be less than 1 sack per cubic yard.

W. Cement used in Portland cement stabilized backfill shall be Type I or Type II conforming to the requirements of ASTM C 150.

X. Caliche used for Portland cement stabilized backfill shall be crushed material conforming to Texas State Department of Highways and Transportation 1982 Standard Specifications for Construction of Highways, Streets and Bridges Item 248 Type F, Grade 2.

Y. Blow sand used for Portland cement stabilized backfill shall be clean, free from organic matter, clay lumps, rock and other deleterious matter.

Z. Native soil used for Portland cement stabilized backfill shall be clean, free from clods and organic matter, and rock in excess of 2 inches.

AA. Portland cement stabilized caliche backfill or Portland cement stabilized native soil backfill may be constructed using either the "dry" method or the "wet" method.

1. The dry method of stabilized backfill construction consists of dry mixing of the cement and caliche, sand or soil to produce a homogenous mixture then adding and mixing sufficient water for proper compaction and hydration of the cement. The water content of the mixture will be approximately one to two percent above the optimum moisture for soil compaction. The mixing may be accomplished by using batch mixers or on the job site by "blade mixing" or other suitable method to produce the desired backfill material. The mixed material shall be placed in lifts of up to a maximum of 12 inches and compacted to 95% in accordance with ASTM D 1557 density by use of suitable compacting equipment.
2. In the "wet" method of cement stabilized backfill construction, the materials shall be mixed in an approved concrete batching plant or mixer to the consistency of concrete and placed as concrete would be placed. The slump of the backfill material shall be such that all voids will be filled, approximately 4 to 6 inches. The backfill shall be consolidated by rodding or by the use of mechanical vibrators.
3. The mix design used must be for the method of placement chosen.
4. Portland cement stabilized blow sand backfill shall be mixed and placed by the "wet" method as described above.

BB. The minimum number of compaction tests to be conducted on backfilled material shall be as follows: one test per 40 cubic yards of backfill, or one test per 150 linear feet of trench.

CC. The Contractor will be required to locate all known utility lines, including consumer service lines, far enough in advance of the trenching to make proper provisions for protecting the lines and to allow for any deviations that may be required from the established lines and grades.

DD. The Contractor shall not be allowed to disrupt the service on any utility lines except consumers service lines, which may be taken out of service for short periods of time if the Contractor obtains permission from the Engineer and from the Owner of the premises being served by the utility.

EE. The Contractor shall immediately notify the proper utility company of any damage to utility lines, in order that service may be established with the least possible delay. Any damage to existing lines and the repair of consumer lines which are authorized to be cut or temporarily taken out of service shall be repaired or replaced by the Contractor at his own expense, and as directed by an official representative of the utility company involved.

FF. All utility lines shall be properly supported to prevent settlement or damage to the line both during and after construction.

GG. Any permanent relocations of existing utility lines shall be done by the proper utility company without expense to the Contractor.

HH. Metallic Tape

1. The Contractor shall backfill over non-metallic pipelines to a depth which is less than 24 inches and not more than 12 inches from the top of the cut of the ditch section in which the pipeline is laid. Contractor shall stop the backfilling material at a generally uniform level. All machine tamping, jetting and other compaction activities shall be accomplished up to this point of height in the backfilling before the marking tape is placed in the trench.
2. The Contractor shall then lay the marking tape in the pipe trench and tape shall be held in position by the spot placement of backfill materials over it to keep it from sliding to the sides and/or from being blown about in the ditch by the wind. The tape shall be laid with the painted side which shall also be the side with the identification lettering on it, in the “up” position. The tape shall be laid in the flat position and kept there until backfill is accomplished.

3. The Contractor shall then complete the backfilling operation in such a manner that the marking tape is not cut, crimped, ruptured or separated by the backfilling work.
4. No separate payment item will be provided for furnishing and placing the marking tape. This item shall be considered subsidiary to the non-metallic pipe being placed.

3.3 PIPE INSTALLATION - WATER LINES

A. General: All pipe and accessories shall be unloaded, handled, laid, jointed, tested for defects and for leakage and disinfected in the manner herein specified.

B. Inspection: The pipe, fittings, valves, and accessories shall be inspected upon delivery and during the progress of the work and any material found to be defective will be rejected by the Engineer, and the Contractor shall remove such defective material from the site of the work.

C. Responsibility for Materials: The Contractor shall be responsible for all material furnished by him and he shall replace at his own expense all such material that is found to be defective in manufacture or has become damaged in handling after delivery.

D. Handling Pipe and Accessories:
1. All pipe, fittings, valves, and other accessories shall, unless otherwise directed, be unloaded at the point of delivery, hauled to and distributed at the site of the work by the Contractor. In loading and unloading, they shall be lifted by hoists or slid, or rolled on skidways in such a manner as to avoid shock or damage to the materials. Under no circumstances shall they be dropped. Pipe handled on skidways must not be skidded or rolled against pipe already on the ground.
2. The pipe, fittings and accessories shall be placed along the site in such a manner as to be kept as free as possible from dirt, sand, mud and other foreign matter.

E. Alignment and Grade
1. All pipe shall be laid and maintained to the lines and grades shown on the plans or as established on the ground by the Engineer.
2. Wherever it is necessary to deflect pipe from a straight line either in a vertical or horizontal plane to avoid obstructions, to plumb valves, or where vertical or horizontal curves are shown or permitted, the degree of deflection at each joint shall not exceed one-half the maximum deflection recommended by the manufacturer of the particular kind of pipe being laid and the degree of deflection shall be approved by the Engineer.

F. Manner of Handling Pipe and Accessories Into Trench: After the trench grade has been completed, all bell holes dug and the grade inspected, the pipes and accessories may be placed in the trench. All pipe, fittings, and valves shall be carefully lowered into the trench piece by piece by means of derricks, ropes, or other suitable tools or equipment, in such a manner so as to prevent damage to the material in any way. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.

G. Cleaning and Inspecting:
1. Before lowering into the trench, the pipe shall be again inspected for defects and the pipe, while suspended, shall be lightly hammered to detect cracks. Any defective, damaged or unsound pipe and materials shall be rejected.
2. All foreign matter or dirt shall be removed from the inside of the pipe and from all bells, spigots or parts of the pipe used in forming the joint, before the pipe is lowered into the trench, and it shall be kept clean by approved means during and after laying.

H. Laying and Jointing PVC Pipe:

1. PVC pipe shall be handled and installed in strict accordance with the recommendations of the manufacturer. Special care shall be exercised in handling PVC pipe, in preparing the trench for pipe laying, and in compacting and bedding under and around each side of the pipe.
2. The ring groove shall be clean before installation of the rubber ring. The ring shall be carefully installed in the groove as recommended by the manufacturer. The spigot end of the pipe shall be wiped clean and lubricated using the recommended lubricant. The spigot end shall be carefully inserted into the bell end until the reference mark on the spigot end is flush with the end of the bell.
3. Cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or the cement lining.
4. The jointing shall be completed for all pipe laid each day, in order not to leave open joints in the trench overnight. At times when pipe laying is not in progress, the open ends of pipe shall be closed by approved means, and no trench water shall be permitted to enter the pipe.
5. No pipe shall be laid in water, or when the trench conditions or weather is unsuitable for such work, except by permission of the Engineer.
6. Flanged joints shall be used where shown on the plans. Mechanical joint, or other approved joints shall be installed with materials furnished by the manufacturer and in accordance with the manufacturer's specifications.
7. Flanged joints where used shall be bolted with Flange bolts of best quality mild steel and of the size and length required by American Standards Association; bolts and nuts shall be provided with standard hexagonal heads. Gasket rings shall be used and shall be made of best quality rubber composition sheet packing 1/16 inch thick, or a brand and quality approved by the Engineer.
8. The pipe and fittings shall be properly aligned and free to move in any direction while bolting, and the bolts shall be gradually tightened at a uniform rate around the entire flange.

I. Setting Valves, Valve Boxes and Fittings:

1. Valves and fittings shall be set at the locations shown on the plans or at locations as established by the Engineer, and shall be set and jointed to the pipe in the manner heretofore specified for pipe installations. All valves buried in the ground shall have a valve box set over the valve with a concrete pad around the valve box as shown on the drawings. All valves shall be thoroughly inspected and checked for operation before installation. Concrete blocking shall be provided for all buried valves.
2. Valve boxes shall be firmly supported and maintained centered and plumb over the wrench nut of the valve, with box cover flush with the surface of the ground or at such level as directed.

J. Setting Fire Hydrants:

1. Fire hydrants shall be located at points shown on the plans, the exact location of the hydrant to be established by the Engineer. All hydrants shall be set plumb to the grade as established by the Engineer, and shall have their nozzles parallel with and/or at right angles to the curb, with the pumper nozzle facing the curb in accordance with the details shown on the plans.
2. The hydrants shall be supported in such a manner as not to cause a strain on the fire hydrant lead or branch. The bowl of the hydrant shall be well braced against unexcavated earth at the end of the trench with concrete backing. The concrete backing shall be placed so as not to interfere with the hydrant drains and so that the joints or flanges are accessible.

3. Each hydrant shall be connected to the main with a 6-inch PVC branch controlled by an independent 6-inch resilient seat gate valve. Each hydrant shall be set upon a stone or concrete slab not less than four inches thick and not less than one square foot of surface area. Where solid rock exists in the bottom of the trench and same is excavated to the proper depth to form a foundation for the hydrant, the slab of stone or concrete may be omitted.
4. There shall be placed around the base of the hydrant not less than seven cubic feet of sound broken stone or clean gravel, or other suitable material to provide reservoir capacity so that the hydrant will completely drain when closed. The gravel or broken stone shall reach from the bottom of the trench to at least six inches above the waste opening in the hydrant. Each hydrant shall be operated by the Contractor to prove to the inspector that the drain hole has not been plugged with concrete or other material.

K. Plugging Dead Ends: Standard plugs shall be inserted into the bells of all dead ends and pipes, tees, or crosses and spigot ends shall be capped. Plugs or caps shall be jointed to the pipe or fittings in the same manner used in jointing the pipe. All plugs and caps shall have horizontal to thrust blocks.

L. Tunneling Under Utility Lines, Etc.: Where pipes, conduits or concrete curbs, gutters or other obstructions are encountered in the construction, the cost of tunneling under such obstructions shall be included as a part of the cost of the pipe line, or other pay items, complete in place.

3.4 ANCHORAGE OF BENDS, TEES AND PLUGS, ETC.

A. Reaction or thrust blocking shall be applied to all pipe lines at all tees, plugs, caps and bends. Concrete shall be used for blocking the pipe and fittings and shall have a minimum 28 day compressive strength of 2,500 psi but shall otherwise conform to Item 421, Class B of the 2014 TxDOT Standard Specifications. The blocking shall be placed between solid ground and the fitting to be anchored in accordance with the details on the plans. The blocking shall be so placed that the pipe and fitting joints will be accessible for repair.

3.5 DISINFECTION OF PIPE LINES

A. The Contractor shall furnish all labor, equipment, and materials necessary for the disinfection of the new pipe lines which shall be disinfected before being placed in service. The lines shall be disinfected by the application of a chlorinating agent. The chlorinating agent may be a liquid chlorine, liquid chlorine gas-water mixture, or a calcium hypochlorite solution, which shall be fed into the lines through a suitable solution-feed device, or other methods approved by the Engineer. The chlorinating agent shall be applied at or near the point from which the line is being filled. The water being used to fill the line shall be controlled to flow into the section to be disinfected very slowly, and the rate of application of the chlorinating agent shall be in such proportion to the rate of water entering the pipe that the chlorine dose applied to the water entering the line shall be at least 50 parts per million. The treated water shall be retained in the pipe lines for a period of not less than 24 hours. At the end of the retention period, all treated water shall be thoroughly flushed from the lines until the replacement water in the lines shall have chlorine residual of not more than 0.5 parts per million; the Engineer will designate blowoff valves in the area around the project site that may be used to purge the lines. Where it is necessary to place the new lines in service in less than 24 hours, the concentration of chlorine may be increased to 300 ppm and the lines flushed and placed in

service in three hours. Disinfection procedures shall conform to AWWA C 651, latest revision.

B. After final flushing and before any section of water line is placed into service, the Contractor shall collect samples as directed by the Engineer in accordance with AWWA C 651, latest revision. A minimum of one bacteriological sample shall be collected for each 1,000 feet of completed water line to check efficiency of disinfection procedures and shall be repeated if contamination persists. The samples shall be submitted by the Contractor to an independent testing lab. The samples shall be tested in accordance with AWWA C 651, latest revision.

3.6 HYDROSTATIC TESTS

A. All water pipe lines constructed under this contract, prior to acceptance, shall be tested as described in the following paragraphs. This test shall apply to all newly laid pipe or any valved sections thereof. The Contractor shall bear all costs of providing all equipment, materials, labor and other incidentals required to test pipe lines. Water of sufficient pressure to test the pipe lines will not be available and the Contractor shall provide suitable means for developing the required pressure in lines.

B. Each valved section of the line shall be tested for leakage as soon as practical after laying. Sufficient backfill shall be placed prior to testing to prevent any movement of the pipe, but all joints shall be left exposed. The Contractor shall furnish water for filling the line and shall furnish the necessary means for pressuring the line. Duration of the test shall be not less than four hours. The line shall be carefully checked for any evidence of leakage. The cause of any leaks shall be found and corrected and the line retested.

C. The pipeline shall be tested so that the pressure at the lowest point in the test section is at least 100% but not greater than 120% of the pipe pressure class of the pipe, and the minimum pressure at the highest point in the test section is not less than 85% of the pipe pressure class of the pipe. The maximum allowable leakage for push-on joints is the number of gallons per hour as determined by the following formula:

$$L = \frac{ND(P)^{1/2}}{7400}$$

Where:

L = Allowable leakage in gallons per hour
N = Number of rubber-ring gasket joints in the length of the pipe tested
D = Nominal diameter of the pipe in inches
P = Average of the maximum and minimum pressures within the test section in psi.

3.7 CLEANING UP

A. After the construction work is completed and before final acceptance by the Owner, the Contractor shall remove all rubbish, excess materials, excess materials from excavations and other debris from the site of the work, and all trench surfaces shall be bladed as heretofore specified. The cost of cleanup shall be included in the proposal prices for the various units of work.

3.8 MEASUREMENT

A. This Item will be measured by Lump Sum.

3.9 PAYMENT

A. 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 "Water Utilities." This price is full compensation for furnishing and installing all components; performing work as shown in Section 02675 "Disinfecting Water Utility Distribution;" furnishing and operating equipment; and labor, tools, and incidentals.

END OF SECTION

SECTION 02675 - DISINFECTING OF WATER UTILITY DISTRIBUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Disinfection of potable water distribution system.
   2. Testing and reporting results.
B. Related Sections:
   1. Section 02667 "Water Utilities."

1.2 REFERENCES

A. AWWA B300 - Standard for Hypochlorites.
B. AWWA B301 - Standard for Liquid Chlorine.
C. AWWA B302 - Standard for Ammonium Sulfate.
D. AWWA B303 - Standard for Sodium Chlorite.
E. AWWA C651 - Standards for Disinfecting Water Mains.

1.3 SUBMITTALS FOR INFORMATION

A. Test Reports: Indicate results comparative to specified requirements.
B. Certificate: Certify that cleanliness of water distribution system meets or exceeds specified requirements.

1.4 PROJECT RECORD DOCUMENTS

A. Submit test results to Engineer.
B. Disinfection report:
   1. Type and form of disinfectant used.
   2. Date and time of disinfectant injection start and time of completion.
   3. Test locations.
   4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
   5. Date and time of flushing start and completion.
   6. Disinfectant residual after flushing in ppm for each outlet tested.
C. Bacteriological report:
   1. Date issued, project name, and testing laboratory name, address, and telephone number.
   2. Time and date of water sample collection.
   3. Name of person collecting samples.
   4. Test locations.
   5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
   6. Coliform bacteria test results for each outlet tested.
   7. Certification that water conforms, or fails to conform, to bacterial standards of the local health department.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with AWWA C651.
B. Water Treatment Firm: Company specializing in disinfecting potable water systems specified in this Section with minimum three years experience.
C. Testing Firm: Company specializing in examining potable water systems, approved by the State of Texas.
D. Submit bacteriologist's signature and authority associated with testing.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable code or regulation for performing the work of this Section.
B. Provide certificate of compliance from authority having jurisdiction indicating approval of water system.

PART 2 - PRODUCTS

2.1 DISINFECTION CHEMICALS

A. Chemicals: AWWA B300, Hypochlorite, AWWA B301, Liquid Chlorine, AWWA B302, Ammonium Sulfate, and AWWA B303, Sodium Chlorite.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that piping system has been cleaned, inspected, and pressure tested.
B. Perform scheduling and disinfecting activity with start-up, testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

3.2 EXECUTION

A. Provide and attach required equipment to perform the work of this Section.
B. Introduce treatment into piping system.
C. Maintain disinfectant in system for 24 hours.
D. Flush, circulate, and clean until required cleanliness is achieved; use municipal domestic water.
E. Replace permanent system devices removed for disinfection.
F. Pressure test system to 150 psi. Repair leaks and re-test.

3.3 FIELD QUALITY CONTROL

A. Test samples in accordance with AWWA C651.

3.4 MEASUREMENT AND PAYMENT

A. The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly, but is subsidiary or is included in payment for other bid items.

END OF SECTION