

ADDENDUM NO. 3
TO
CITY OF FRESNO
PUBLIC WORKS STANDARD SPECIFICATIONS
ADOPTED MARCH 4, 1970
RESOLUTION NO. 70-36
UPDATED VERSION APPROVED JANUARY, 2013

This addendum is attached to and made a part of the above-entitled standard specifications.

The following City Standard Drawings have been amended as indicated below:

- P-31: Width of Detectable Warning Devices changed to 4' Min.
Note No. 10 revised.
- P-32: Removed offset pattern. Revised bump spacing. Revised note No. 1.
- S-1 House branch material changed to SDR35.
P-trap removed, replaced with two way cleanout.
On note 6 "AND SECTION 17-5 OF CITY STANDARD
SPECIFICATIONS" was added.
Threaded solid cap was added.
Note 7 added regarding connection direction.
- S-2 Dimensions of manhole concrete collar and asphalt cover revised.
Overall dimensions revised to 42" and 30".
Pipe opening revised from 24"x39" to 24"x44".
Changed "Lateral" to "Lateral for 8" and larger".
Added 8" dimension of base via "A" dimension.
General Note 4 added.
"See Drawing S-5B" reference added.
Replaced "AR4000 or AR8000" with "PG 64-10 asphalt".
Replaced "Class A" with "6 sack".
Added "In Street Installation" and "Non-street Installation".
- S-3 Dimensions of manhole concrete collar and asphalt cover revised.
Overall height dimensions revised to 42" and 30".
"See Drawing S-5" replaced by "See Drawing S-5A"
Note 1 "Pipe" was replaced by "Riser Sections" and "Class II R.C.P."
was deleted.
Note 3 added.
Note 4 added.
Replaced "AR4000 or AR8000" with "PG 64-10 asphalt".
Replaced "Class A" with "6 sack".

Added "In Street Installation" and "Non-street Installation".
 Replaced "Slope from above spring line to 2/3 diameter of pipe to side of manhole" with "Slope to start from the spring line of the sewer pipe and slope up to manhole barrel".
 Remove base design flow configuration.
 Replaced "Enlarged base to top of pipe surface to provide solid footing for precast manhole components" by "Enlarged base to pipe crown to provide solid footing for precast manhole components"
 Clearance between pipe and base of manhole was replaced from 4" to 8"
 MPR's was changed to MFR's

- S-4 Dimensions of manhole concrete collar and asphalt cover revised.
 Note 4 added – Manhole coverings note.
 Note 5 added.
 Replaced "AR4000 or AR8000" with "PG 64-10 asphalt".
 Replaced "Class A" with "6 sack".
 Added "In Street Installation" and "Non-street Installation".
 Replaced "See Drawing S-5" with "See Drawing S-5B".
 Replaced "Slope from above spring line to 2/3 diameter of pipe to side of manhole" with "Construct bench as shown- Trowel Finish".
 Clearance between pipe and base of manhole was replaced from 4" to 8"
 Pitch "1:12 MIN." was replaced with "1:12"
 Replaced "Enlarged base to top of pipe surface to provide solid footing for precast manhole components" by "Enlarged base to pipe crown to provide solid footing for precast manhole components"
 Note 1 "Pipe" was replaced by "Riser Sections" and "Class II R.C.P." was deleted.
 Remove base design flow configuration.
 Old Note 2 "All reinforcing steel to be No.4 bars grade 60 steel, spaced 12" O.C. both ways in top, bottom & walls" was deleted.
- S-5A Replaced Drawing "S-5" with "S-5A".
 Replaced frame weight "191 lbs" with "180 lbs".
 Scale 1"=1'-0" was deleted
- S-5B Added drawing S-5B "Pamrex Ductile Iron Frame and Cover for Sewer Pipe 27" or Larger".
- S-7 Added "Minimum Thickness 5/8"" for steel casing.
 Added spacing formula for steel casing.
 Replaced "In Jacked Steel Casing" in drawing title with "In Jacked Steel Casing and Non Jacked Steel Casing".
 On Note 6 P.C. was replaced by P.C.C.

S-8 Replaced "Elastomeric sleeve coupling with stainless steel bands" with "FERNCO stainless steel shield repair coupling bands or equal"

The following City Standard Drawings are new as indicated below:

S-11 Replaced "S-11" with "S-11A and S-11B".

S-12 New sheet added – "Manhole Base Design Flow Configuration Supplement to S-3 and S-4".

In addition to the standard drawings, changes that have been made to the Standard Specifications are as follows:

Section 17-2.2.1 Revise pipe size "18-30" to "18-48".
Revise Min. Wall Thickness "T-1 only" to "PS-46"
Add row in table to include pipe size "21-54", ASTM "F1803" and min. wall thickness "PS-46".

Section 17-2.2.4 "T-1 only" was replaced by "PS-46".

Section 17-3.2.8 Dimensions have been switched, giving priority to the English measurement standard instead of the metric.

Section 17-4 Dimensions have been switched, giving priority to the English measurement standard instead of the metric.

Section 17-5.1 Dimensions have been switched, giving priority to the English measurement standard instead of the metric.

Section 17-5.2 Dimensions have been switched, giving priority to the English measurement standard instead of the metric.

Section 17-5.3 Dimensions have been switched, giving priority to the English measurement standard instead of the metric.
Revise last sentence of paragraph 5 to "Jetting and Flooding of trenches from the top is not permitted".
Deleted paragraph 6 "Jetted backfill".

Section 17-5.4 Dimensions have been switched, giving priority to the English measurement standard instead of the metric.

Section 17-6 Revise last sentence of paragraph 2 "45%" to "45°".
Add "Y branches must join the sewer main with flow in the same direction" at end of last paragraph.

Section 17-7	<p>Revise second sentence of first paragraph.</p> <p>Add "New connections must comply with drawing S-1, S-8 & S-9" to end of second paragraph.</p> <p>Delete paragraph eight (8) completely.</p> <p>Fifth paragraph "for use with his/her product" was deleted.</p> <p>Dimensions have been switched, giving priority to the English measurement standard instead of the metric.</p>
Section 17-8.2	<p>Dimensions have been switched, giving priority to the English measurement standard instead of the metric.</p> <p>Delete paragraph three (3) completely.</p>
Section 17-8.3	<p>Replace "C-76" with "C-478" at end of 1st paragraph.</p>
Section 17-8.4	<p>Dimensions have been switched, giving priority to the English measurement standard instead of the metric.</p> <p>Replace "2/3 the diameter" with "half" in 1st paragraph.</p> <p>Add new sentence at end of 2nd paragraph.</p> <p>Replace entire 3rd paragraph.</p>
Section 17-8.5	<p>Dimensions have been switched, giving priority to the English measurement standard instead of the metric.</p>
Section 17-8.6	<p>"Jiffy Rings" definition was added.</p>
Section 17-8.7	<p>S-11 was replaced with S-11A and S-11B.</p>
Section 17-11	<p>Dimensions on PVC Gravity Sewer Pipe table have been switched, giving priority to the English measurement standard instead of the metric.</p>
Section 17-12	<p>Replace "A tape cassette" with "An electronic copy" in 2nd paragraph.</p> <p>Replace "VHS format" with "DVD or in Mpeg file format", in 2nd paragraph.</p> <p>On requirement 1, "Testing" was replaced by "Video Inspection"</p> <p>On requirement 2, "testing" was replaced by "Inspection" and "test" by "Inspection".</p> <p>Replace "video tape" with "DVD" in Item 4 under Requirements for Sewer Video Inspections".</p> <p>On requirement 5, "Testing" was replaced by "Inspection" and "test" by "Inspected".</p> <p>Requirement 6, was changes to "In order to facilitate review a log of</p>

the Inspections performed shall correlate from manholes, stationing, etc., between the Sewer Plans and the DVD produced" Add items 7 through 13 under Requirements for Sewer Video Inspections".
Section with "INSPECTION OF NEW CONSTRUCTION-SEWER INFRASTRUCTURE MAIN SEWER LINES AND MANHOLES" (Including fees) was added.

Reviewed and Approved:



Robert N. Andersen, P.E.
Assistant Director



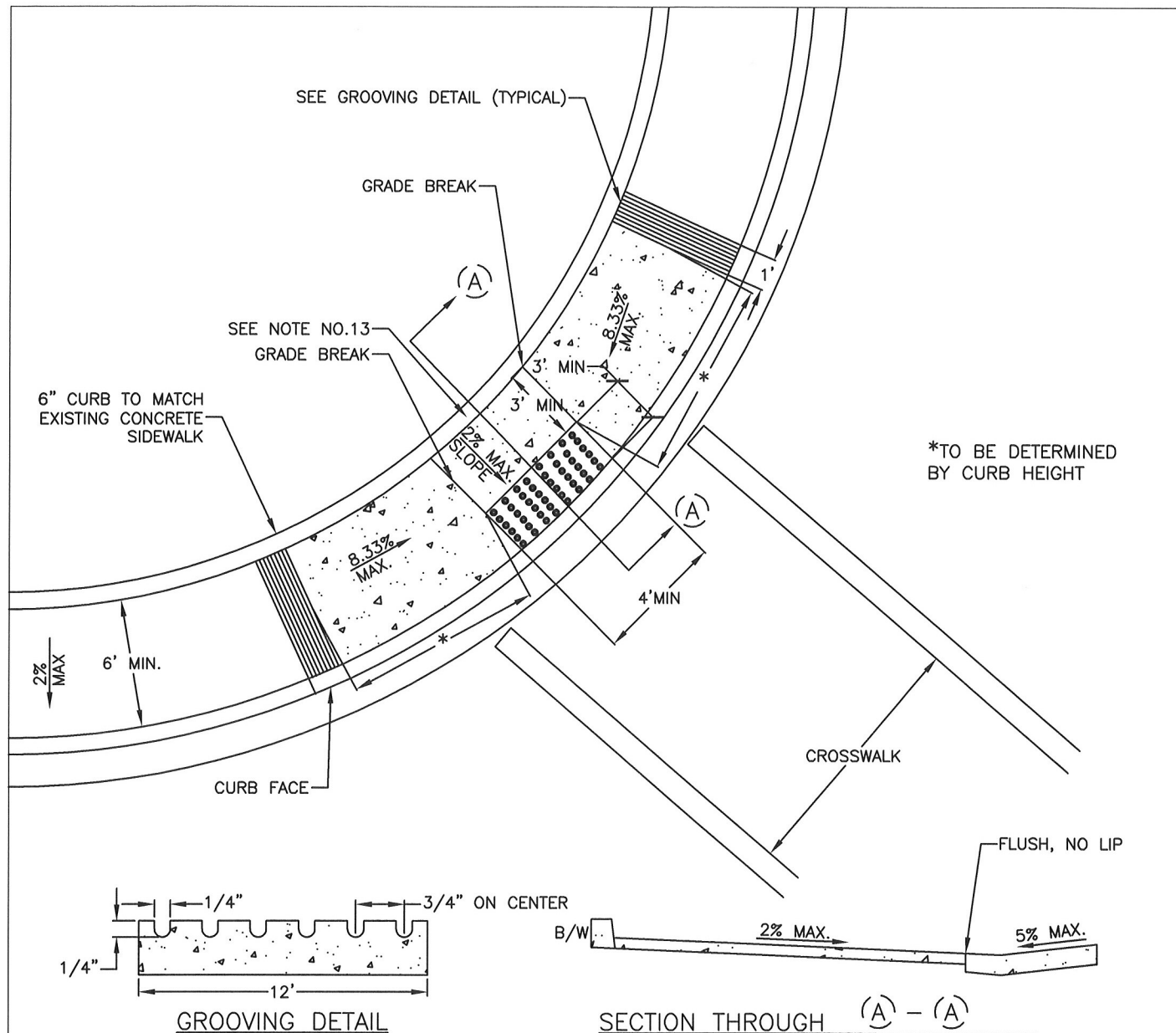
Date



Scott Mozier, P.E.
Public Works Director

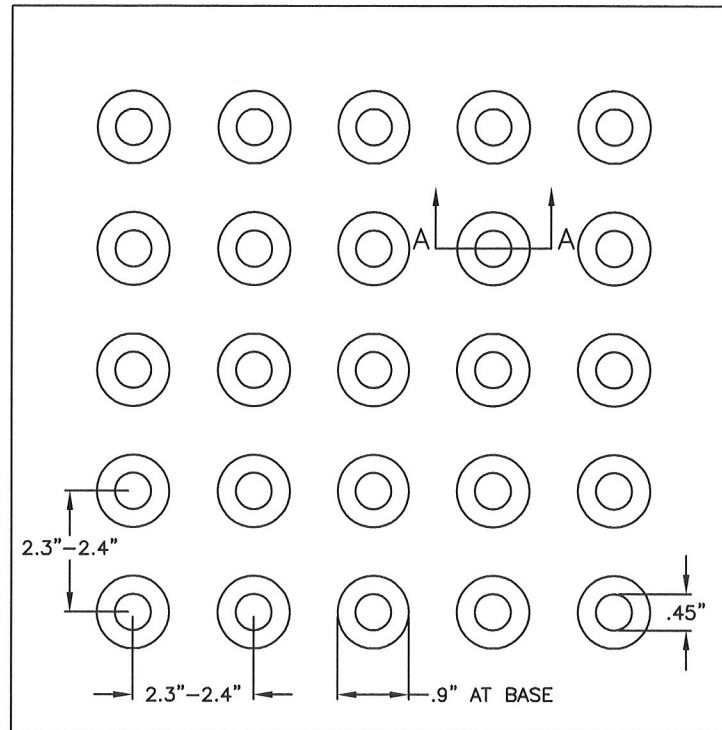


Date



NOTES:

1. TRANSITIONS FROM RAMPS AND LANDING TO WALK, GUTTERS OR STREETS SHALL BE FLUSH AND FREE OF ABRUPT CHANGES.
2. SURFACE OF CURB RAMP AND FLARED SIDES SHALL HAVE BROOM FINISH TRANSVERSE TO PATH OF TRAVEL AND SHALL BE OF CONTRASTING FINISH TO THAT OF ADJACENT SIDEWALK.
3. RAMP SLOPE SHALL NEVER EXCEED 8.33%.
4. THE SLOPE OF ADJOINING GUTTERS, ROAD SURFACE OR ACCESSIBLE ROUTE WITHIN 4' OF THE BOTTOM OF THE RAMP SHALL NOT EXCEED 5% SLOPE.
5. PROVIDE GROOVED BORDER 12" WIDE AT THE LEVEL SURFACE OF THE SIDEWALK ALONG THE TOP AND EACH SIDE APPROX. 3/4" ON CENTER, 1/4" DEEP; 1/4" WIDE.
6. THE LOWER LANDING AREA LEADING INTO VEHICULAR WAY SHALL TERMINATE WITHIN THE MARKED CROSSING.
7. PROVIDE LEVEL LANDING OF AT LEAST 48" ON UPPER END AND OVER FULL WIDTH OF RAMP.
8. RAMP AND LOWER LANDING SHALL BE MINIMUM OF 4' WIDE AND SHALL LIE GENERALLY IN A SINGLE SLOPED PLANE WITH A MINIMUM OF SURFACE WARPING AND CROSS SLOPE.
9. CURB RAMPS SHALL BE LOCATED OR PROTECTED TO PREVENT THEIR OBSTRUCTION BY PARKED CARS.
10. ON THE BOTTOM LANDING WITH A 2% MAX. SLOPE, WHERE WALK ADJOINS A VEHICULAR WAY, DETECTABLE WARNING DEVICES SHALL BE REQUIRED ON THE FULL WIDTH AND 36" DEPTH, IN-LINE PATTERN PER P.W. STD. P-32.
11. THE DETECTABLE WARNING SHALL CONTRAST VISUALLY WITH ADJOINING SURFACES, EITHER LIGHT-ON-DARK OR DARK-ON-LIGHT. THE MATERIAL USED SHALL BE AN INTEGRAL PART OF THE WALKING SURFACE.
12. THIS RAMP TYPE SHALL ONLY BE USED WHEN NECESSARY DUE TO R/W OR PHYSICAL CONSTRAINTS. IT MAY BE UTILIZED FOR DIAGONAL OR DUAL RAMP APPLICATIONS.
13. MODIFIED RAMPS PLACED ON SIGNALIZED INTERSECTIONS SHALL HAVE A PEDESTRIAN POST FOR BUTTON PLACEMENT AT THE LOWER LANDING AREA FOR ADA REQUIREMENTS.

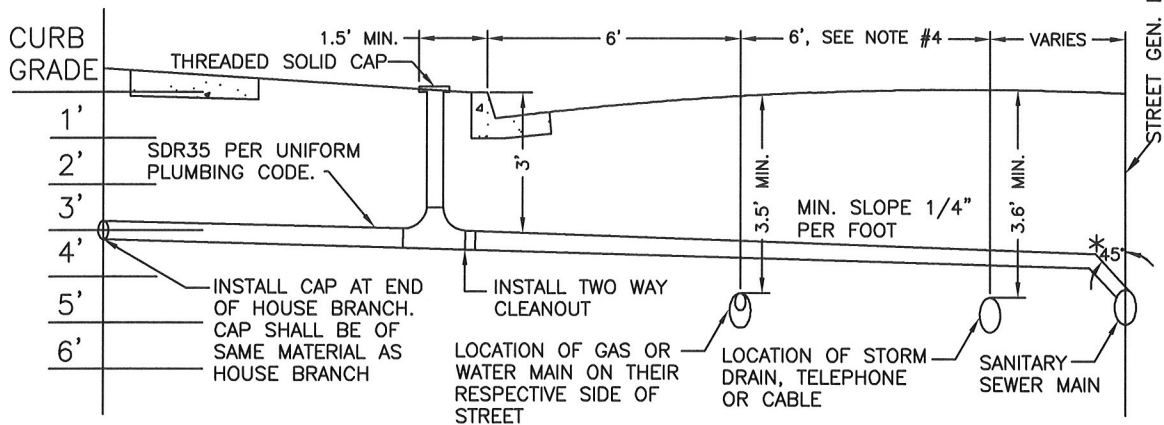
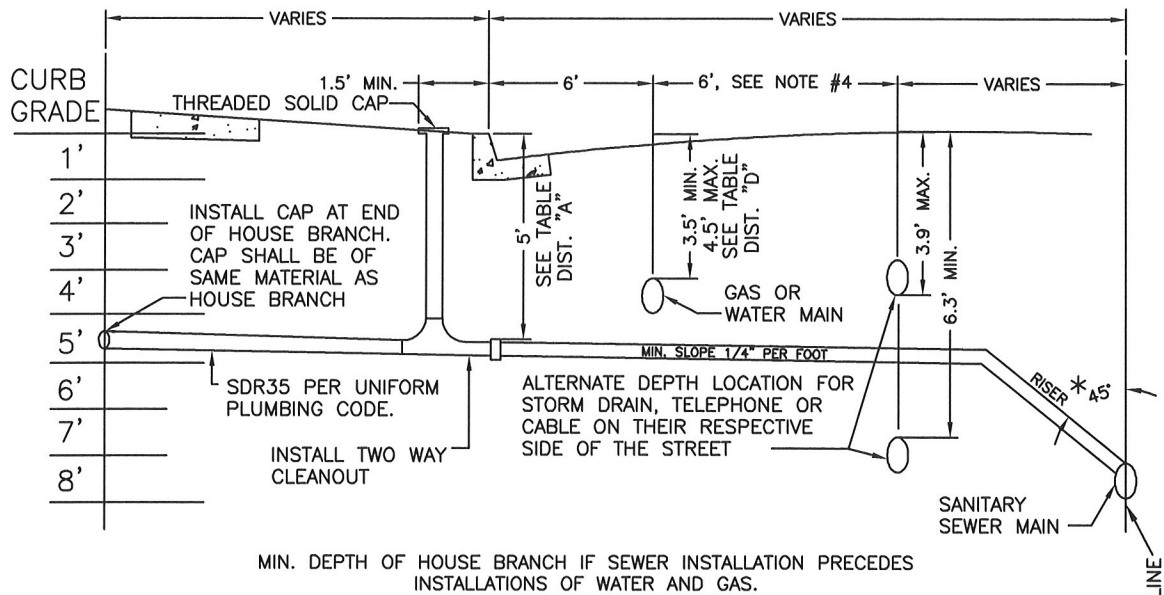


IN-LINE PATTERN A-A



NOTES:

1. THE DETECTABLE WARNING SHALL VISUALLY CONTRAST PER THE 2013 CALIFORNIA BUILDING CODE. THE MATERIAL USED SHALL BE AN INTEGRAL PART OF THE WALKING SURFACE. THE COLOR SHALL BE YELLOW.
2. THE DOMES MAY BE CONSTRUCTED IN A VARIETY OF METHODS, INCLUDING CAST-IN-PLACE OR STAMPED OR IT MAY BE PART OF A PREFABRICATED SURFACE TREATMENT.
3. ONLY APPROVED DSA/AC DETECTABLE WARNING PRODUCTS AND DIRECTIONAL SURFACES SHALL BE INSTALLED AS PROVIDED IN THE CALIFORNIA CODE OF REGULATIONS (CCR), TITLE 24, PART 1, ARTICLES 2, 3 AND 4. REFER TO CCR TITLE 24, PART 12, CHAPTER 12-11A AND B FOR BUILDING FACILITY ACCESS SPECIFICATIONS FOR PRODUCT APPROVAL FOR DETECTABLE WARNING PRODUCTS AND DIRECTIONAL SURFACES.
4. DETECTABLE WARNING PRODUCTS AND DETECTABLE SURFACES SHALL BE EVALUATED BY AN INDEPENDENT ENTITY, SELECTED BY THE DEPARTMENT OF GENERAL SERVICES, DIVISION OF THE STATE ARCHITECT-ACCESS COMPLIANCE FOR ALL OCCUPANCIES, INCLUDING TRANSPORTATION AND OTHER OUTDOOR ENVIRONMENTS. SEE GOVERNMENT CODE SECTION 4460.



DEPTH SCHEDULE		
DISTANCE	"A"	"D"
6" WATER OR GAS MAIN	4.5'	3.5'
8" WATER OR GAS MAIN	4.8'	3.8'
10" WATER OR GAS MAIN	5.2'	4.2'
12" WATER OR GAS MAIN	5.5'	4.5'

"A" & "D" DIMENSIONS ARE SET TO ALLOW 1.0' CLEARANCE BETWEEN SEWER AND GAS OR WATER LINES.

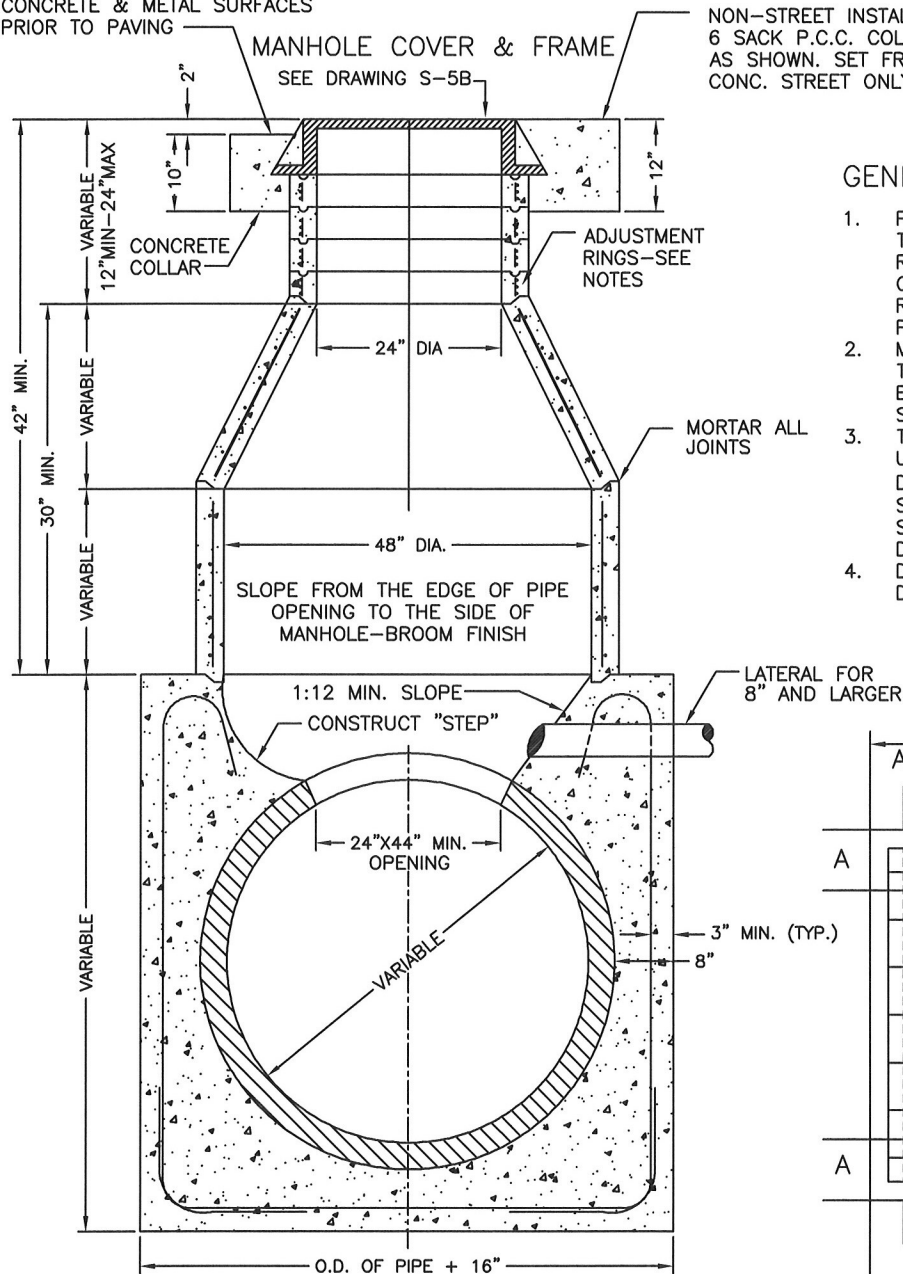
*SPECIAL APPROVAL REQUIRED FOR DEVIATION FROM 45 DEGREE STANDARD ANGLE.

NOTES:

1. WATER MAINS AND TELEPHONE DUCTS SHALL OCCUPY ONE SIDE OF STREET; GAS MAINS AND STORM SEWERS TO OCCUPY OTHER SIDE.
2. IN NEW SUBDIVISIONS, EXTEND HOUSE BRANCHES ABOUT 1' BEYOND PROPERTY LINE.
3. IN ALL OTHER CASES, EXTEND HOUSE BRANCHES ABOUT 1' BEYOND PROPERTY LINE OR AS DIRECTED BY CITY ENGINEER.
4. REFER TO DWG. P-47 FOR LOCATION OF UNDERGROUND FACILITIES IN ARTERIAL AND COLLECTOR STREETS.
5. MINIMUM VERTICAL CLEARANCE BETWEEN THE HOUSE BRANCH AND WATER MAIN SHALL BE 1'.
6. FOR TRENCH BACKFILL SEE DWG. P-48, S-10, W-29 AND SECTION 17-5 OF CITY STANDARD SPECIFICATIONS
7. SEWER WYE'S MUST JOIN THE SEWER MAIN WITH FLOW IN THE SAME DIRECTION.

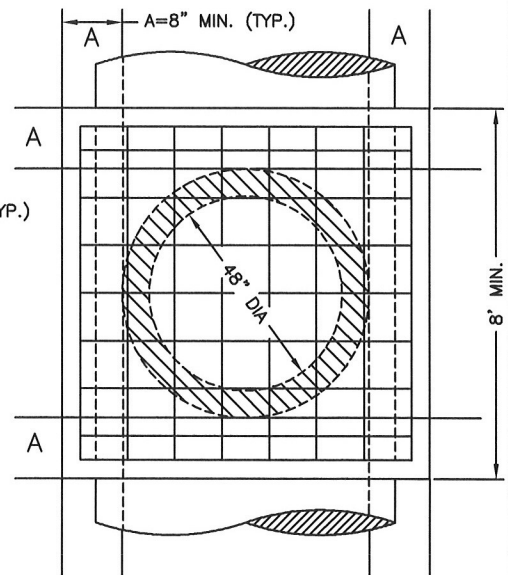
IN STREET INSTALLATION
TO BE PAVED WITH A.C. (PG
64-10 ASPHALT) TACK-COAT
CONCRETE & METAL SURFACES
PRIOR TO PAVING

NON-STREET INSTALLATION
6 SACK P.C.C. COLLAR AROUND C.I. FRAME -
AS SHOWN. SET FRAME IN CONC. BED FOR
CONC. STREET ONLY.



GENERAL NOTES:

1. PRECAST PIPE, ADJUSTMENT RINGS & TAPERED SECTIONS SHALL BE CLASS 2 R.C.P. IN ACCORDANCE WITH ASTM C-478, ELLIPTICAL SINGLE LINE REINFORCEMENT WILL NOT BE PERMITTED.
2. MANHOLE COATINGS ARE REQUIRED BY THE CITY. APPROVED PRODUCTS SHALL BE APPLIED PER MANUFACTURERS SPECS.
3. THIS STANDARD DRAWING SHALL BE USED FOR SEWER PIPES WITH DIAMETERS GREATER THAN 42" OR IN SITUATIONS WHERE THE MANHOLE SUB-STRUCTURE IS REQUIRED AS DIRECTED BY THE CITY ENGINEER.
4. DESIGN FLOW CONFIGURATION SEE DRAWING S-12.



NOTES FOR MANHOLE SUB-STRUCTURE:

1. ALL CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH OF 3000 P.S.I AT 28 DAYS.
2. ALL REINFORCING STEEL TO BE NO. 4 BARS GRADE 60 STEEL, SPACED 12" O.C. BOTH WAYS IN TOP, BOTTOM & WALLS.
3. MINIMUM WALL THICKNESS IS 8".
4. SEE PLAN FOR FLOW LINE ELEVATION & PIPE SIZE.

SPECIAL SEWER MANHOLE
FOR SEWER PIPES WITH DIAMETER GREATER THAN
42"

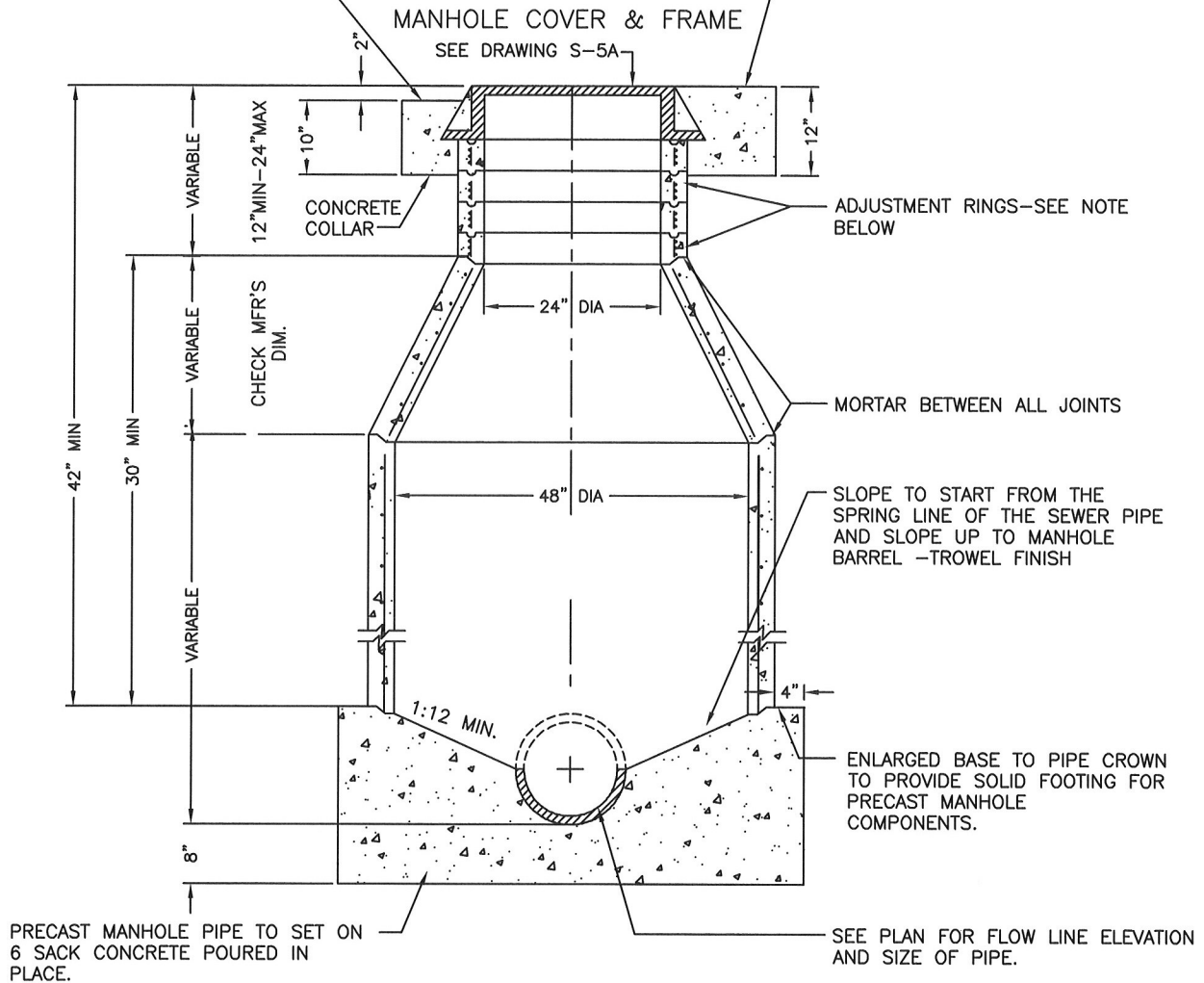
REF. & REV.
JUNE 2014

CITY OF FRESNO

S-2

IN STREET INSTALLATION
TO BE PAVED WITH A.C. (PG
64-10 ASPHALT) TACK-COAT
CONCRETE & METAL SURFACES
PRIOR TO PAVING

NON-STREET INSTALLATION
6 SACK P.C.C. COLLAR AROUND
C.I. FRAME - AS SHOWN. SET
FRAME IN CONC. BED FOR CONC.
STREET ONLY.
COLLAR TO BE FLUSH.



MANHOLE DETAILS

NOTES:

1. PRECAST RISER SECTIONS, ADJUSTMENT RINGS AND TAPERED SECTIONS SHALL BE IN ACCORDANCE WITH ASTM C-478. ELLIPTICAL SINGLE LINE REINFORCEMENT WILL NOT BE PERMITTED.
2. THIS STANDARD DRAWING SHALL BE USED FOR SEWER PIPES WITH DIAMETERS OF UP TO 27".
3. DESIGN FLOW CONFIGURATION SEE DRAWING S-12.
4. MANHOLE COATINGS ARE REQUIRED BY THE CITY. APPROVED PRODUCTS SHALL BE APPLIED PER MANUFACTURER'S SPECS FOR SEWER PIPE WITH DIAMETER OF 12" OR GREATER.

48" SEWER MANHOLE

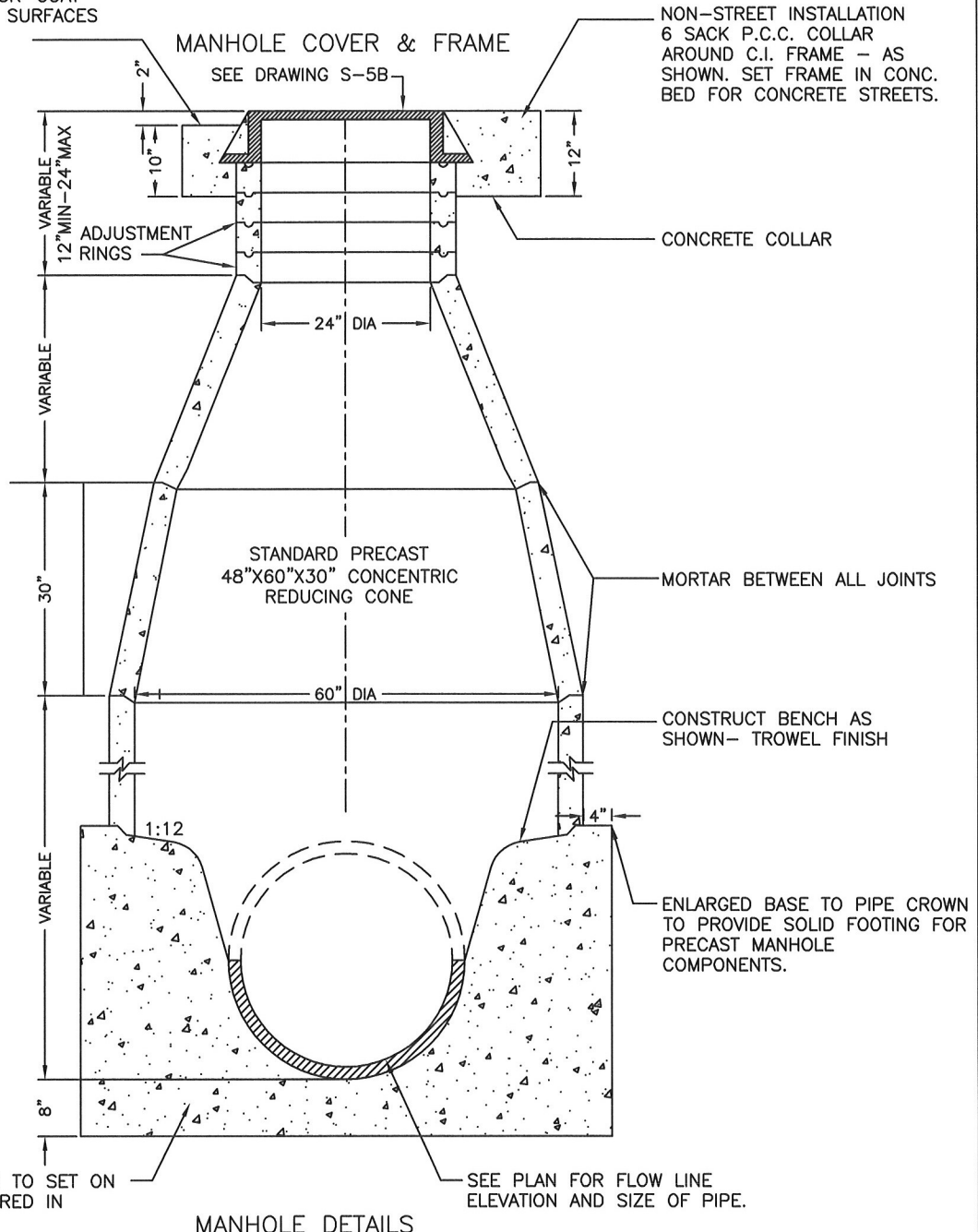
SEWER PIPES W/DIA. UP TO AND INCLUDING 27"
WITH PRECAST SECTIONS & CAST IRON FRAME & COVER

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CITY OF FRESNO

S-3

IN STREET INSTALLATION
TO BE PAVED WITH A.C. (PG
64-10 ASPHALT) TACK-COAT
CONCRETE & METAL SURFACES
PRIOR TO PAVING



GENERAL NOTES:

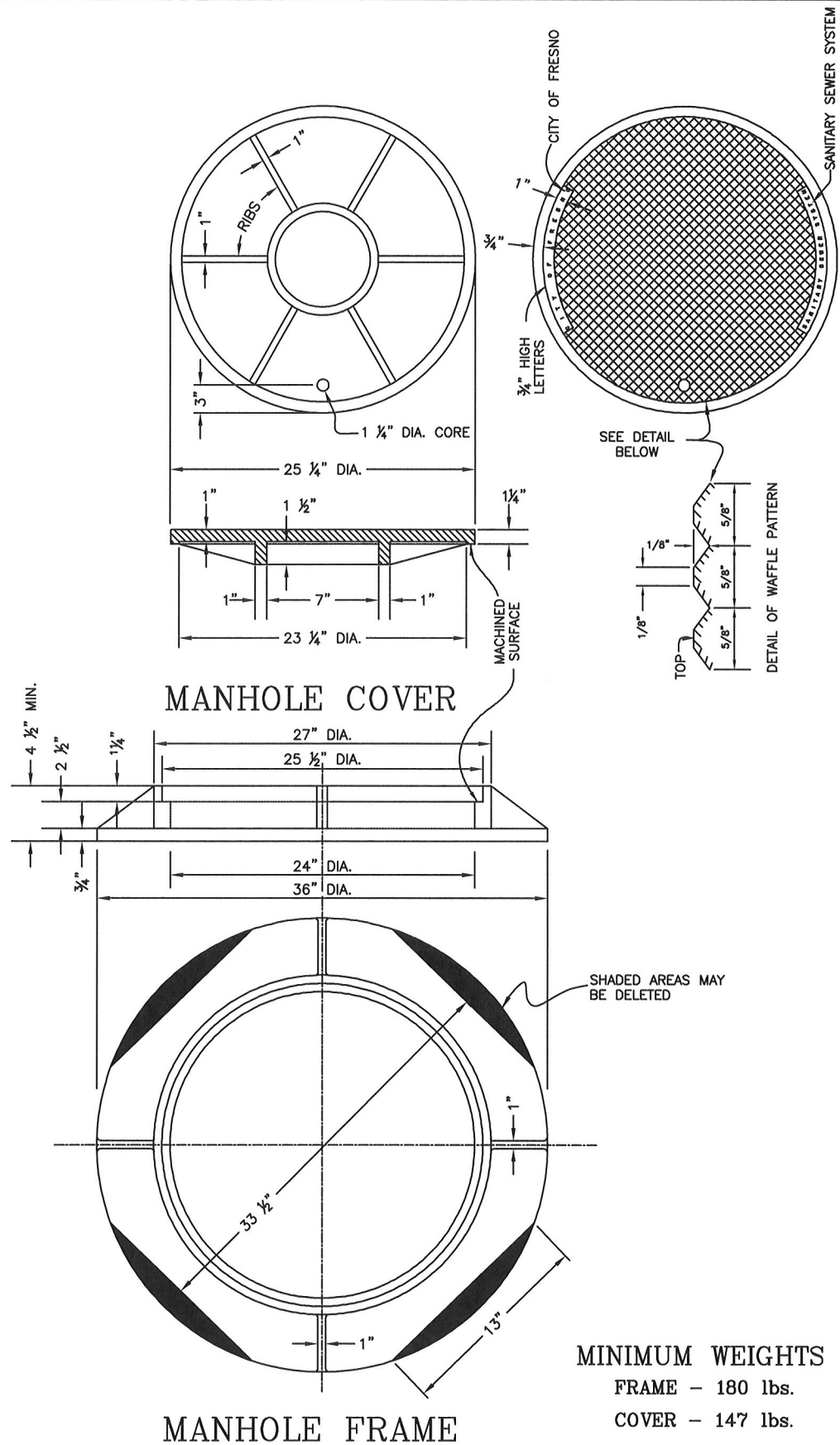
1. PRECAST RISER SECTIONS, ADJUSTMENT RINGS AND TAPERED SECTIONS SHALL BE IN ACCORDANCE WITH ASTM C-478.
2. THIS STANDARD DRAWING SHALL BE USED FOR SEWER PIPES WITH DIAMETERS OF 30" THROUGH 42".
3. MANHOLE COATINGS ARE REQUIRED BY THE CITY. APPROVED PRODUCTS SHALL BE APPLIED PER MANUFACTURER SPECS.
4. WHEN PIPE IS CUT, ALL EXPOSED REINFORCING STEEL TO BE COATED WITH 2" OF CONCRETE.
5. DESIGN FLOW CONFIGURATION SEE DRAWING S-12.

60" SEWER MANHOLE
SEWER PIPES W/DIA. OF 30" THRU & INCLUDING 42"
WITH PRECAST SECTIONS & CAST IRON FRAME & COVER

REF. & REV.
JUNE 2014

CITY OF FRESNO

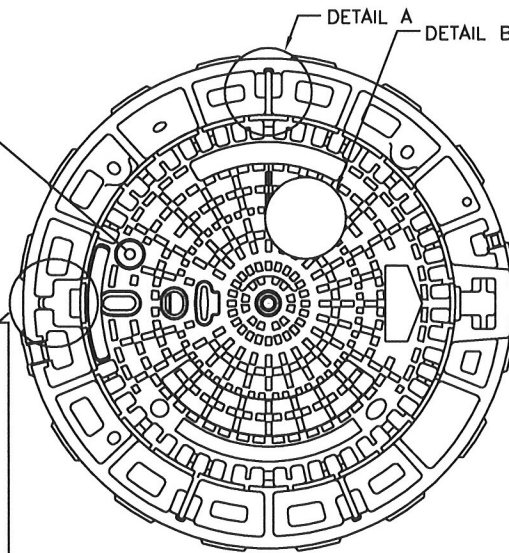
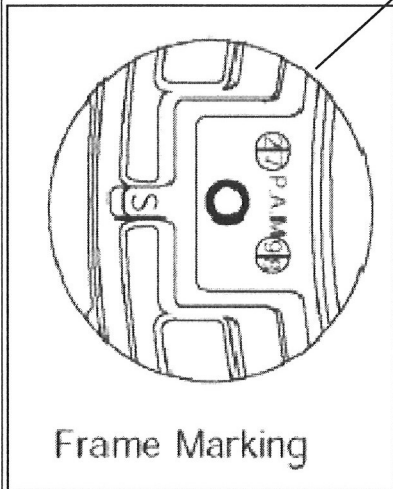
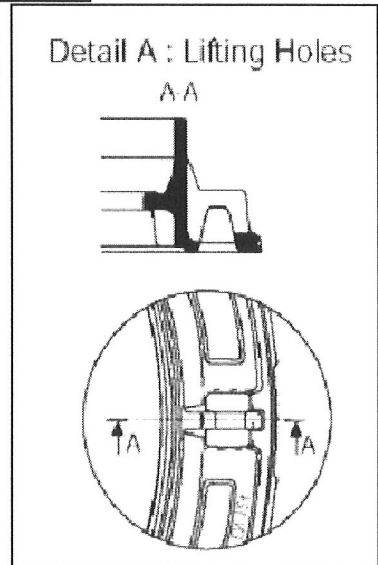
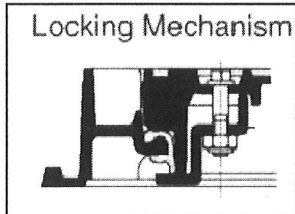
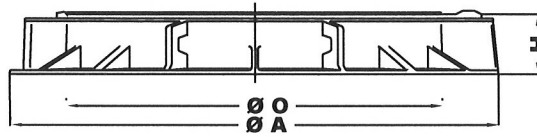
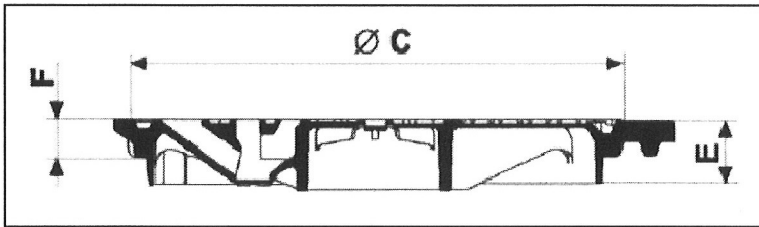
S-4



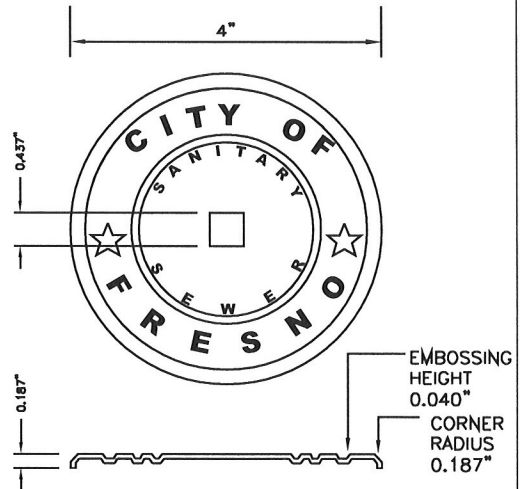
CAST IRON MANHOLE
 FRAME AND COVER

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 JUNE 2014

CITY OF FRESNO
 S-5A



Detail B



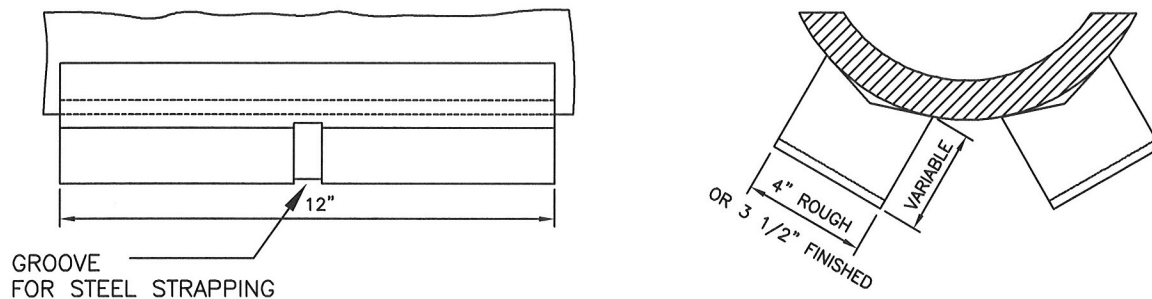
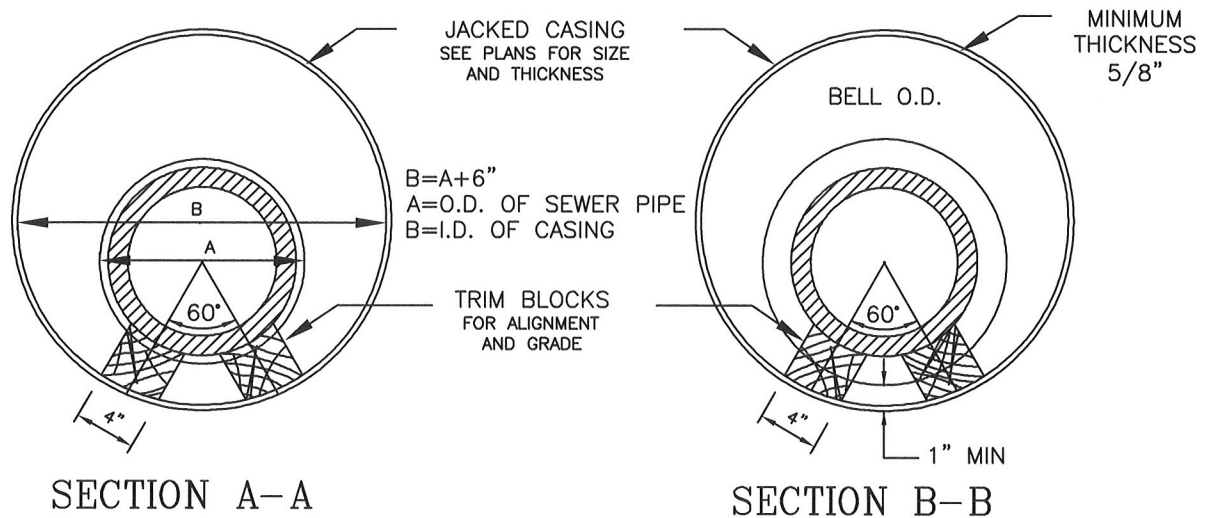
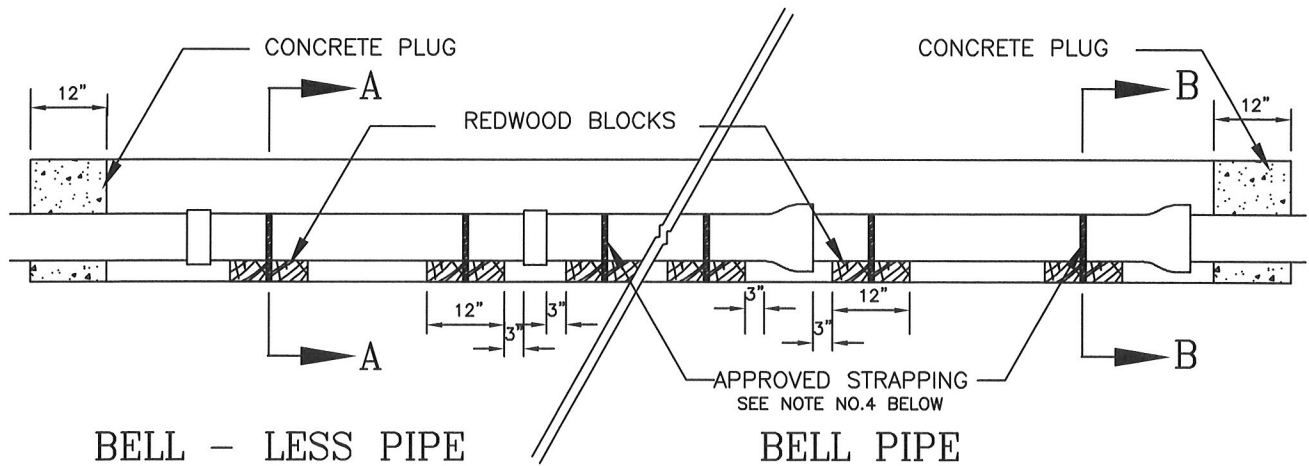
DIMENSIONS (INCHES)					
A	C	E	F	H	O
33 1/2	26 1/2	3 1/2	2	4	24

1. MANHOLE COVER AND FRAME SHALL BE CALLED PAMREX OR APPROVED EQUAL.
2. COVER AND FRAME SHALL BE MANUFACTURED FROM DUCTILE IRON.
3. COVERS SHALL BE HINGED AND INCORPORATE A 90 DEGREE BLOCKING SYSTEM TO PREVENT ACCIDENTAL CLOSURE.
4. COVERS SHALL BE ONE MAN OPERABLE USING STANDARD TOOLS AND SHALL BE CAPABLE OF WITHSTANDING A TEST LOAD OF 120,000 LBS.
5. FRAMES SHALL BE CIRCULAR, INCORPORATE A SEATING RING AND A FITTED PLUG IN THE HINGE HOUSING, AND BE AVAILABLE IN A 24 INCH CLEAR OPENING.
6. THE FRAME DEPTH SHALL NOT EXCEED 4 INCHES, AND THE FLANGE SHALL INCORPORATE BEDDING SLOTS, BOLT HOLES, AND LIFTING EYES.
7. ALL COMPONENTS SHALL BE BLACK COATED.
FRAME WEIGHT: 73 LBS.
COVER WEIGHT: 122 LBS.
TOTAL WEIGHT: 195 LBS.

PAMREX DUCTILE IRON
FRAME AND COVER
FOR SEWER PIPE 27" OR LARGER

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CITY OF FRESNO
S-5B



REDWOOD BLOCK DETAIL

NOTES:

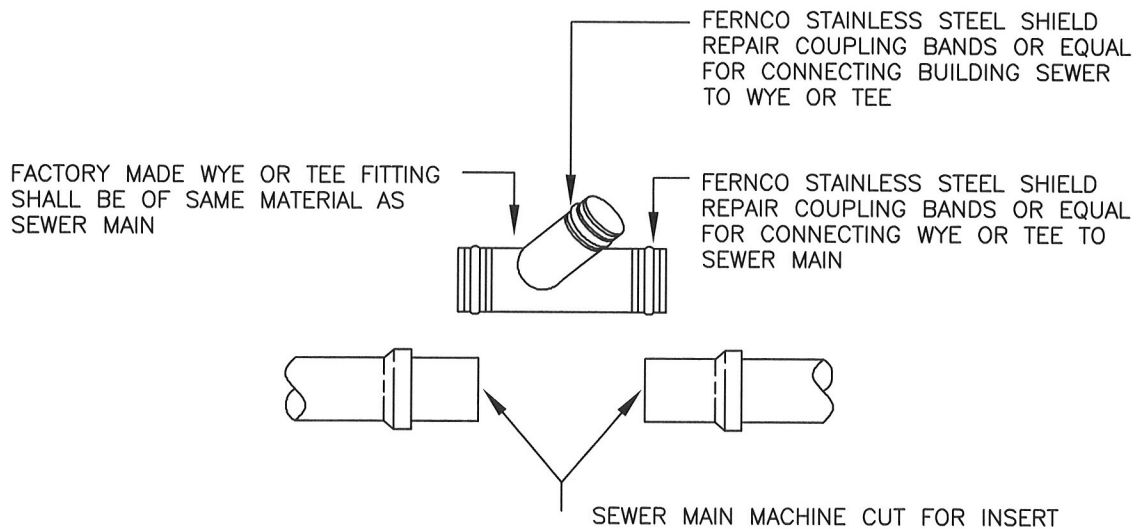
1. REDWOOD BLOCKS SHALL BE CONSTRUCTION GRADE.
2. REDWOOD BLOCKS SHALL BE VEED TO FIT CONTOUR OF PIPE.
3. WHEN JACKING, CASING GRADE SHALL BE SET SO CENTER LINE OF CASING SHALL COINCIDE WITH CENTER LINE OF SEWER PIPE.
4. REDWOOD BLOCKS SHALL BE STRAPPED TO THE PIPE WITH STEEL STRAPPING OR APPROVED WIRE BANDS.
5. PLUG ENDS OF CASING WITH 12 INCHES MINIMUM OF CONCRETE.
6. CONCRETE SHALL BE CLASS "B" P.C.C.

INSTALLATION OF SEWER PIPE
IN JACKED STEEL AND NON JACKED STEEL CASING

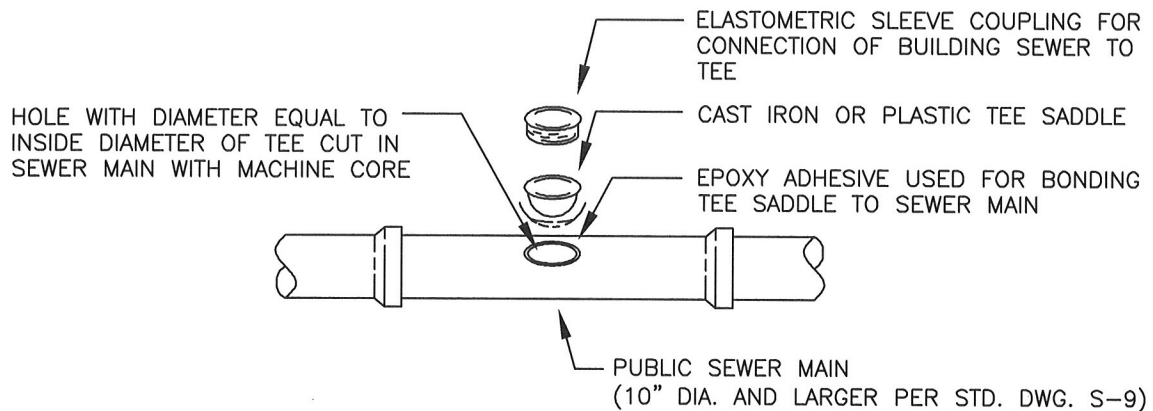
REF. & REV.
JUNE 2014

CITY OF FRESNO

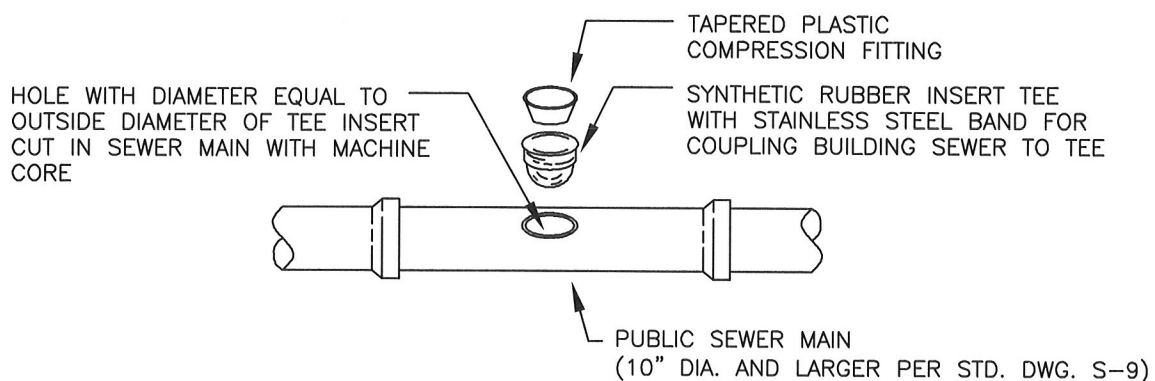
S-7



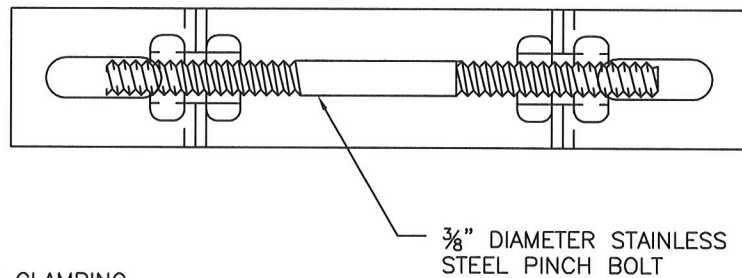
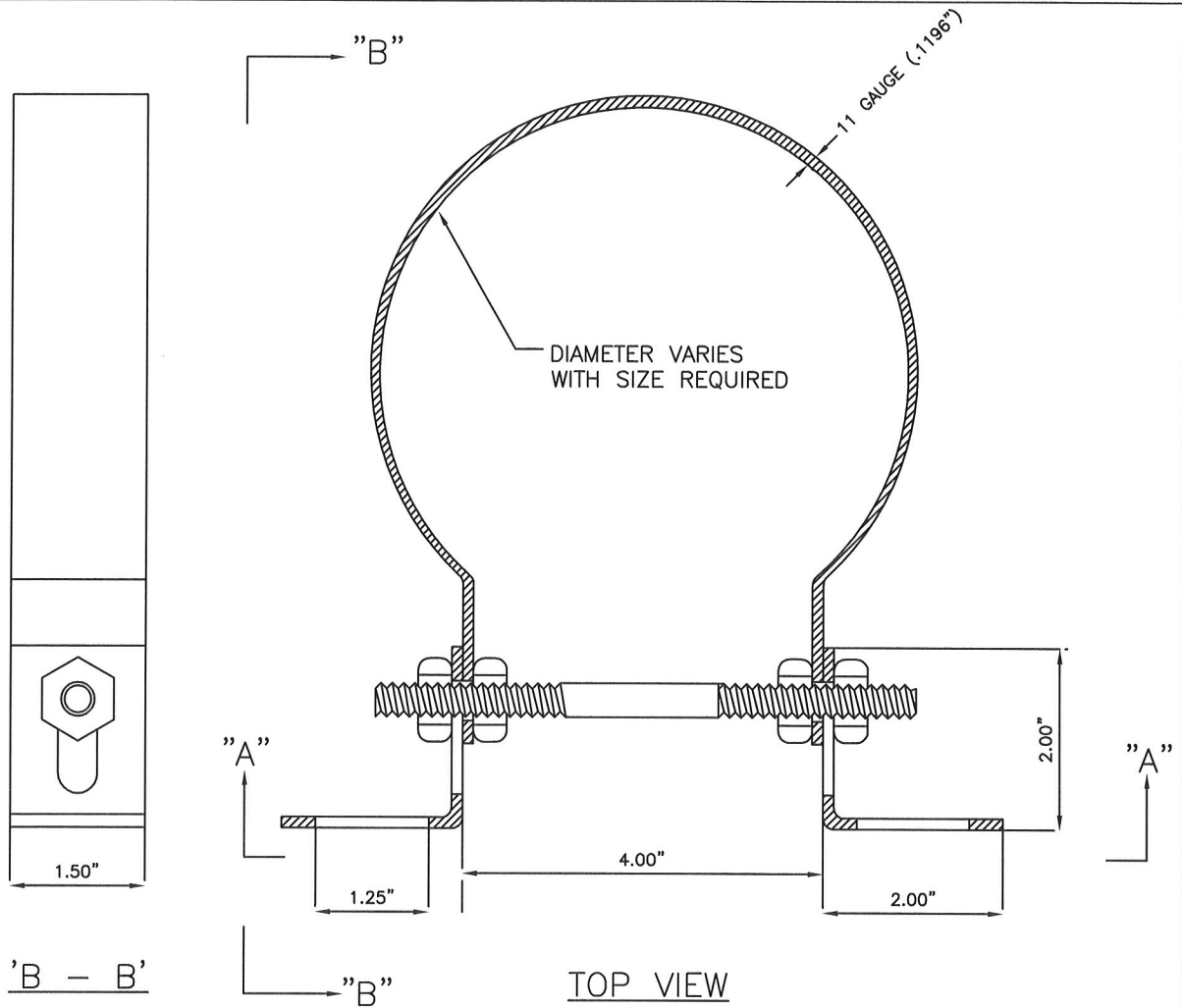
METHOD 1: INSERTION OF FACTORY MADE WYE OR TEE



METHOD 2: EPOXY BONDED SADDLE TEE



METHOD 3: COMPRESSION TEE



STAINLESS STEEL ADJUSTABLE CLAMPING
BRACKET AS MANUFACTURED BY:

RELINER-DURAN, INC.
53 MT. ARCHER RD.
LYME, CT 06371
(860)434-0277 FAX: (860)434-3195
OR APPROVAL EQUAL

SPECIFICATIONS:

- 1) CLAMP AND BRACKETS IS TYPE 304 STAINLESS STEEL, 11 GAUGE (.1196").
- 2) 3/8" Ø PINCH BOLT AND NUTS IS TYPE 18-8 STAINLESS STEEL.

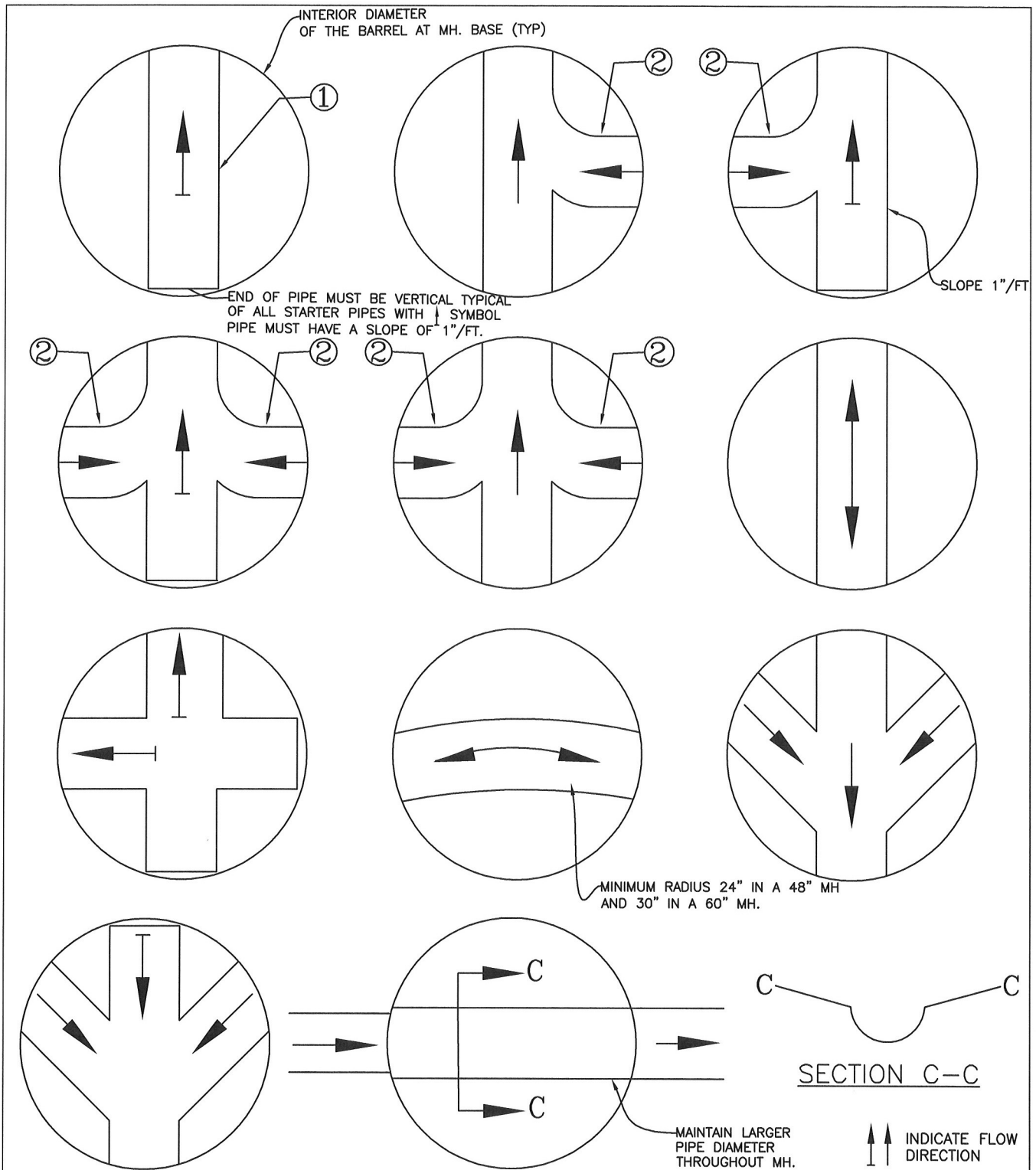
STAINLESS STEEL ADJUSTABLE
CLAMPING BRACKETS

REF. & REV.
JUNE 2014

CITY OF FRESNO

S-11B

2 OF 2



- ① ALL STRAIGHT PIPE TO BE LAID THROUGH MANHOLES WITH TOP HALF REMOVED TO PROVIDE AT LEAST A 44" OR 56" LONG OPENING. ROUGH BROKEN EDGES SHALL BE MORTARED SMOOTH. THIS INCLUDES UPPER ENDS OF LINE MANHOLE.
- ② ALL TURNS MUST BE MADE SUCH THAT THE PIPES. THE CENTER LINE OF THE FLOW CHANNEL BEND RADIUS IS MINIMUM 24" IN A 48" MANHOLE AND MINIMUM 30" IN A 60" MANHOLE. TURNS TO BE CONSTRUCTED TO FORM A SMOOTH FLOW LINE OF SAME SHAPE AND PATTERN AS BOTTOM WALL PIPE.

NOTE:

WHEN PIPE IS CUT, ALL EXPOSED REINFORCING STEEL TO BE COATED WITH 2" OF CONCRETE.

MANHOLE BASE DESIGN FLOW CONFIGURATION
SUPPLEMENT TO S-3 & S-4

REF. & REV.
JUNE 2014

CITY OF FRESNO

S-12

SECTION 17 – SANITARY SEWER PIPE AND APPURTENANCES

17-1 GENERAL

Sewer pipe, manholes, stub-outs, house branches, and service laterals shall be furnished in accordance with the requirements established in these City Standard Specifications. Also included is the testing and internal inspection of all Sewer lines.

No public Sewer may be smaller than eight inches (8") in diameter.

17-2 MATERIALS

Sewer pipe and fittings shall be vitrified clay, unplasticized polyvinyl chloride (PVC), or PVC lined reinforced concrete pipe, as specified herein.

17-2.1 Vitrified Clay Pipe (VCP)

17-2.1.1 General

Vitrified clay Sewer pipe for sanitary Sewers and house connection Sewers shall conform to the following requirements.

17-2.1.2 Manufacturing Requirements

Vitrified clay pipe shall be mechanical compression joint pipe, Band Seal, Wedge Lock, Speed Seal or approved equal. Vitrified clay pipe and fittings shall be extra strength, first quality, sound and well burned throughout their entire thickness and shall comply with the current revisions of ASTM Designation C-700.

17-2.1.3 Installation

Pipe shall be installed in accordance with the current revisions of ASTM Practice C-12.

17-2.1.4 Testing

Pipe shall be in accordance with the current revisions of ASTM Method C-301.

17-2.2 Polyvinyl Chloride (PVC) Pipe

17-2.2.1 General

Polyvinyl Chloride (PVC) sewer pipe for sanitary Sewers, and house connection Sewers shall conform to the following requirements:

Pipe Size (inches)	A.S.T.M.	Min. Wall Thickness
4-15	D 3034	SDR35
18-48	F 679	PS46
21-54	F 1803	PS46

17-2.2.2 Manufacturing Requirements

A. Identification Marks

All pipe, fittings, and couplings shall be clearly marked at intervals not to exceed 5 feet as follows:

1. Normal pipe diameter
2. PVC cell classification
3. Company, plant, shift, ASTM, SDR, and date designation

For fittings and couplings, the SDR designation is not required.

B. Cell Classification

PVC pipe shall be made of PVC compound having a cell classification of 12454-B, 13364-A, or 13364-B conforming to ASTM D 1784. The fittings shall be made of PVC compound having a cell classification of 12454-B, 12454-C, or 13343-C. Additives and fillers, including but not limited to stabilizers, antioxidants, lubricants, colorants, etc., shall not exceed 10 parts by weight per 100 of PVC resin in the compound.

17-2.2.3 Jointing Systems

A. General

All pipe shall have a home mark on the spigot end to indicate proper penetration when the joint is made. The socket and spigot configurations for the fittings and couplings shall be compatible to those used for the pipe.

B. Elastomeric Gasket Joins

Pipe shall be manufactured with a socket configuration which will prevent improper installation of the gasket and will ensure that the gasket remains in place during the joining operation.

PVC pipe shall be joined with rubber gaskets. Rubber gaskets shall be manufactured from a synthetic elastomer and shall comply in all respects with the physical requirements specified in ASTM F 477. The compound shall contain not less than 50% by volume of first-grade rubber. The remainder of the compound shall consist of pulverized fillers free of rubber substitutes, reclaimed rubber, and deleterious substances. The Contractor shall retest within 60 Days prior to installation, any pipe gasket that is more than 180 Days old from the date of manufacture to ensure compliance with the requirements of the Specifications.

The Contractor shall not install any pipe gasket that is more than 2 years old from the date manufacture.

Gaskets shall be extruded or molded and cured in such a manner as to be dense, homogenous and of smooth surface, free of pitting, blisters, porosity and other imperfections. The tolerance for any diameter measured at any cross section shall be $\pm 1/32$ inch.

When required by the Engineer, the Contractor shall furnish test samples of gaskets from each batch used in the Work. Gasket material shall meet the following requirements:

Property	Value	ASTM Test Method
Tensile strength, psi min.	1500	D 412
Elongation at break (% min.)	350	D 412
Shore durometer, Type A (Pipe manufacturer shall select value suitable for type of joint)	40 to 65'	D 2240
Compression set (constant deflection) max. % of original deflection	16	D 395 Method B
Tensile strength after oven aging (96 hours, 158oF) % of tensile strength before aging	80	D 573
Increase in shore durometer hardness after over aging. Maximum increase over original Shore durometer	10	D 2240
Physical requirements after exposure to ozone concentration (150 pphm. 70 hours, 104oF, 20% strain)	No Cracks	D 1149

No more than one splice will be permitted in a gasket. A splice shall be made by applying a suitable cement to the ends and vulcanizing the splice in a full mold. The splice shall show no separation when subjected to the following tests:

1. Elongation Test

The part of the gasket which includes the splice shall withstand 100 percent elongation with no visible separation of the splice. While in the stretched position, the gasket shall be rotated in the spliced area minimum of 180° in each direction in order to inspect for separation.

2. Bend Test

The portion of the unstretched gasket containing the splice shall be wrapped a minimum of 180° and maximum of 270° around a rod of a diameter equal to the cross section diameter of the gasket.

Solvent cements are not allowed for joining pipe.

17-2.2.4 Test Requirements

- A. General

Pipe, fittings, and couplings shall meet the requirements of the section titled "Requirements" of ASTM D 3033, D 3034, F 679 (PS46). During production of the pipe, the manufacture shall perform the specified tests for each pipe marking. A certification by the manufacture indicating compliance with the specification requirements shall be delivered with the pipe. The certification shall include the test result data. The PVC compound shall also meet the chemical resistance requirements of 17-2.2.4 D.

- B. Acceptance

The basis for acceptance will be the inspection of pipe, fittings, and couplings; the tests specified in subsection 17-2.2.4A; and compliance with the Specifications. When the pipe is delivered to the work site, the Engineer may require additional testing to determine conformance with the requirements of pipe flattening, impact resistance, pipe stiffness, and extrusion quality. Installation time shall conform to subsection 17-2.2.4 E.

C. Selection of Pipe

When testing is required by the Engineer, one test pipe shall be selected at random by the Engineer from each 1200 feet or fraction thereof of one test pipe per lot. A lot shall be defined as pipe having the same identification marking. The length of specimen for each selected pipe shall be a minimum of eight feet (8').

D. Chemical Resistance and Physical Testing

The Engineer may at any time direct the manufacturer to obtain compound samples and prepare test specimens in accordance with ASTM D 1987. These specimens shall comply with the minimum property values shown below and also with the applicable ASTM requirements.

Property	ASTM Test Method	Value (Initial and After 112-Days Exposure)		
		Cell Class	Cell Class	Cell Class
		12454	13343	13364
Minimum Yield Strength (psi)	D 638	7,000	6,000	6,000
Impact Strength (Ft.-lbs/in.) Notch Min.	D 256 Method A (Size ½" x c" x 2-½")	0.65	1.5	1.5
Weight Change %	D 543			
Unconditioned		±1.5 max	±1.5 max	±1.5 max
Conditioned		±1.0 min	±1.0 min	±1.0 min

Tensile and impact exposure specimens shall be immersed in the following solutions for a period of 112 Days. At 28-Day intervals, selected specimens shall be removed, washed, surfaced dried, and tested.

Chemical Solution	Concentration
Sulphuric Acid (H ₂ SO ₄)	20% ¹
Sodium Hydroxide (NaOH)	5%
Ammonium Hydroxide (NH ₄ OH)	5% ¹
Nitric Acid (HNO ₃)	1% ¹
Ferric Chloride (FeCl ₃)	1%

Sodium Hypochlorite	1%
Soap	0.1%
Detergent (Linear alkyl benzyl sulfonate or LAS)	0.1%
Bacteriological	BOD not less than 700 ppm

¹ Volumetric percentages of concentrated reagents of C.P. grade. Weight change specimens shall be 2 inches in diameter and may be molded discs or discs cut from the pipe wall. They shall be conditioned in a mechanical convection oven for 7 Days at $110\text{EF} \pm 4\text{EF}$, then cooled in a desiccator for 3 hours at $73\text{E} \pm 4\text{EF}$, weighed, and then immersed in the above solutions. At 28-Day intervals selected specimens shall be removed, washed, surface dried and weighed. These same specimens shall be reconditioned in a mechanical convection oven for 7 Days at $110\text{E} \pm 4\text{EF}$, then cooled in a desiccator for 3 hours at $73\text{EF} \pm 4\text{EF}$ and weighed again. If any specimen fails to meet these requirements at any time, the material will be rejected.

E. Installation Time Limit

The Contractor shall retest within 60 Days prior to the installation of all pipe and fittings that are more than 180 Days old from the date of manufacture to ensure compliance with the requirements of the Specifications. The Contractor shall not install any pipe that is more than 2 years old from the date of manufacture.

17-2.3 PVC – Lined Reinforced Concrete Pipe

17-2.3.1 General

These Specifications shall apply to reinforced concrete pipe manufactured with a plastic lining for use in sanitary Sewers.

All reinforced concrete pipe used for sanitary Sewers shall be 3600 PVC T-lock lined.

The size, type, and D-load of the concrete pipe to be furnished shall be as shown on the Plans, or as specified under the item of Work for the project of which the pipe is a part and shall be for pipe installed by open-cut method of construction.

17-2.3.2 Manufacturing Requirements

Reinforced concrete pipe shall be manufactured and tested in conformance with the requirements of ASTM C-76, except as modified herein and to the "D" load, class and size as shown on the Plans with the following addition:

The joints shall be O-ring rubber gasket type, the gasket will be enclosed on all four surfaces in an annular space formed by shoulders on the bell end spigot or in a groove on the spigot. The pipe shall be self-centering and the gasket or gaskets shall not be required to support the weight of the pipe.

Portland cement shall comply with ASTM C-150, Type II, low alkali.

17-2.4 Ductile Iron Pipe

Sewer pipe of ductile iron shall comply with ASTM A746 (State Standard Specification for Ductile Iron Gravity Sewer Pipe) and shall be used only in special locations shown on the Plans or as specified in the Special Conditions.

17-2.5 Prohibited Pipe Material

The following pipe materials are not allowed for use in the construction of sanitary Sewers:

1. Asbestos Cement Pipe
2. High Density Polyethylene
3. (HDPE) High Density Polyethylene Plastic Pipe
4. (PE) Polyethylene Solid Wall Pipe
5. Concrete Truss Pipe
6. Cement or Mortar Lined Ductile Iron Pipe
7. Concrete Pipe (unlined or nonreinforced)

17-3 TRENCH AND STRUCTURE EXCAVATION, AND BACKFILL

17-3.1 General

This Work shall consist of all excavation and backfill necessary for the construction of pipelines, structures and other facilities, and the restoration of

surfaces disturbed by such Work, all as set forth in the Plans and Specifications and as directed by the Engineer.

Excavations for appurtenance structures, such as manholes, transition structures, junction structures, vaults, etc., shall be deemed to be in the category of trench excavation.

17-3.2 Trench and Structure Excavation

Excavations shall be made to the depths and widths required accommodating construction of conduits and structures to specified dimensions and to the lines and grades indicated on the Plans. Unless otherwise indicated on the Plans, excavations for pipe construction may be open cut.

The Contractor shall be responsible for locating and protecting subsurface obstructions in the field, and shall notify the Engineer immediately if conflicts occur. Reference is made to Section 5, "UTILITIES," of these City Standard Specifications relative to existing Utilities, and the protection thereof. The location of subsurface obstructions found in the field may necessitate a variance in the depth or alignment of proposed facilities.

The Contractor shall perform all excavations in accordance with the Trench Construction Safety Orders issued by the Division of Industrial Safety of the Department of Industrial Relations of the State of California.

When a trench or structure Site is to be located in an existing oiled earth or pavement area, the existing surfacing to be removed shall be cut by methods approved by the Engineer along neat lines on each side of the trench or around the structure Site. Existing surfacing, when removed, shall be kept separated from the material that is to be returned to the excavation. Failure to comply with this requirement shall be grounds for rejection of the contained material for use as backfill.

Material excavated from the trench shall be placed so as to offer minimum obstructions to traffic.

All existing gas pipes, water pipes, conduits, Sewers, drains, fire hydrants, and other structures which are not, in the opinion of the Engineer, required to be changed in location shall be carefully supported and protected from injury by the Contractor; and in case of injury, they shall be restored by him/her, without additional compensation, to as good a condition as that in which they were found.

The Contractor shall provide, without additional compensation, suitable temporary channels for the water that may flow along or across the site of the Work when necessary.

If all excavated material cannot be stored on the Roadway in such a manner as to maintain access to property along side of the Work, the surplus material shall be removed from the Work and stored until needed for backfill at which time it shall be brought back. If the surplus material is to be stored on other than private property, prior approval must be obtained from the Engineer for the site to be used. The cost of removing and returning material shall be at the Contractor's expense.

17-3.2.1 Trench Widths

Trenches shall conform to the dimensions in Table 17-3.1, unless otherwise specified in the Special Provision, indicated on the Plans, and as may be approved by the Engineer.

TABLE 17-3.1		
TRENCH WIDTHS		
Size of Pipe (I.D.)	Maximum Width at Top of Pipe Greater Than O.D. of Barrel	Minimum Width at Springline Each Side of Pipe
Less than 18"	24"	6"
18" to 24" inclusive	30"	8"
27" to 39" inclusive	36"	9"
42" to 60" inclusive	Pipe O.D.	12"
Over 60"	requires design by the Project Civil Engineer	

The width of the trench shall not be greater than the maximum indicated in Table 17-3.1, at and below the level of the top of the pipe. The width of the trench above that level may be as wide as necessary for sheeting and bracing, and for proper installation of the Work.

If the maximum trench width as specified in Table 17-3.1 is exceeded at the top of the pipe the Contractor shall provide, at no additional cost to the City, the necessary additional load bearing capacity by means of bedding, having a higher bedding factor than that specified, higher strength pipe, a concrete cradle, cap or encasement, or by other means approved in writing by the Engineer.

17-3.2.2 Trench Grade

Alignment and elevation stakes shall be furnished to the Contractor at set intervals and agreed upon offsets. Where elevation stakes are furnished, the Engineer will also furnish the Contractor with cut sheets.

For all pipe 12 inches or greater in diameter, the Contractor shall excavate for and provide an initial granular bedding at least 4 inches thick or 1/12 the O.D. of the pipe whichever is greater. This bedding material shall be placed at a uniform density with minimum compaction and fine graded as specified below.

Bell or coupling holes shall be dug after the trench bottom has been graded. Such holes shall be of sufficient width to provide ample room for caulking, banding, or bolting. Holes shall be excavated only as necessary to permit accurate work in the making of the joints and to ensure that the pipe will rest upon the prepared bottom of the trench, and not be supported by any portion of the joint.

Depressions for joints, other than bell-and-spigot, shall be made in accordance with the recommendations of the joint manufacturer for the particular joint used.

17-3.2.3 Fine Grading

Unless otherwise specified in the plans and/or special provisions, the bottom of the trench shall be accurately graded to provide uniform bearing and support for each section of the pipe at every point along its entire length, except for portions of the pipe where it is necessary to excavate for bells and for proper sealing of the pipe joints.

17-3.2.4 Over-Excavation

Except at locations where excavation of rock, hardpan, or other unsuitable material from the bottom of the trench is required, care shall be taken not to excavate below the depth indicated.

Unauthorized excavation below the specified grade line shall be refilled at the Contractor's expense with an approved granular material compacted to a uniform density of not less than 95 percent of the maximum density as determined by ASTM D-1557 and D-3017.

Whenever rock or hardpan material is encountered in the trench bottom, it shall be over-excavated to a minimum depth of six inches below the O.D. of the pipe. This over-excavation shall be filled with an approved granular material placed with the minimum possible compaction.

17-3.2.5 Excavation for Manholes, Valves, Inlets, Catch Basins and Other Accessories

Structures shall be over-excavation at least twelve inches (12") beyond dimensions of structures as shown on the Plans. If the native material is such that it will not stand without sloughing or if precast structures are used, the Contractor shall over-excavate to place the structure and this over-excavation shall be backfilled with the same material required for the adjoining pipe line trench.

17-3.2.6 Pavement and Concrete Cutting and Removal

Where trenches lie within the portland cement concrete section of Streets, alleys, driveways, or sidewalks, etc., such concrete shall be sawcut to neat, vertical true lines in such a manner that the adjoining surface will not be damaged. The minimum depth of cut shall be 1 ½ inches or 1/4 of the thickness, whichever is greater.

No ripping or rooting will be permitted outside limits of cuts. Surfacing material removed shall be hauled from the Site immediately, and will not be permitted in the backfill.

17-3.2.7 Grading and Stockpiling

All grading in the vicinity of trench excavation shall be controlled to prevent surface water from flowing into the trenches. Any water accumulated in the trenches shall be removed by pumping or by other approved methods.

During excavation, material suitable for backfilling shall be piled in an orderly manner, a sufficient distance back from the edges of trenches, to avoid overloading and to prevent slides or cave-ins. Material unsuitable for backfilling, or excess material, shall be hauled from the Site and disposed of by the Contractor.

The Contractor shall, prior to final acceptance of the Work, submit a letter to the City stating the location of each disposal site for all excess or unsuitable material and certify that he has obtained the property owner's permission for the disposal of all such materials.

17-3.2.8 Open Trench

Except where otherwise noted in the special provisions, or approved in writing by the Engineer, trenches shall be excavated only as far in advance of pipe laying as can be backfilled in the same Day. The

maximum total length of open trench shall be 600 feet (185 meters), except where approved in writing by the Engineer.

Any excavated area shall be considered open trench until all aggregate subbase material for pavement replacement has been placed and compacted. With the approval of the Engineer, pipe laying may be carried on at more than one separate location, the restrictions on open trench applying to each location. Trenches across Streets shall be completely backfilled as soon as possible after pipe laying.

Substantial steel plates with adequate trench bracing shall be used to bridge across trenches at Street crossings where trench backfill and temporary patches have not been completed during regular work hours. Safe and convenient passage for pedestrians shall be provided. The Engineer may designate a passage to be provided at any point she/he deems necessary. Access to hospitals, fire stations and fire hydrants must be maintained at all times.

17-4 INSTALLATION OF PIPE

Proper facilities shall be provided for stringing and lowering sections of pipe into the trench. The pipe shall be laid carefully to lines and grades given.

The grade line shown on the Plans indicates the flow line or invert of the pipe and all cuts, unless otherwise indicated, refer to this line.

After the trench for pipe has been brought to the proper line and grade, the pipe shall be laid in the following manner:

Pipe laying shall begin at existing sewer locations and shall proceed upgrade with the bell or groove end of the pipe placed upstream. Each section of pipe shall be laid true to line and grade and in such a manner as to form a watertight, concentric joint with the adjoining pipe. Existing Sewer lines and flow therein shall remain operational at all times. Any rerouting or blockage of Sewer flows during construction by the Contractor, shall require approval by the Engineer.

Sewer pipe and fittings shall be laid and jointed in compliance with the manufacturer's recommendation and shall be carefully adjusted to grade by scraping of filling and tamping the trench bottom. Each joint of pipe must be fully pressed into place so that there will be no unevenness or settlement of one length of pipe with the other at the joint.

Circular reinforced concrete pipe with elliptical reinforcement shall be placed with the minor axis of the reinforcement in a vertical position.

The Contractor shall furnish and use, for grade and alignment control, a laser beam system which complies with OSHA requirements. The laser system shall have good visibility when used with suitable target material. The laser system must be of the self-leveling type so that the laser beam is automatically compensated for minute grade disturbances.

The laser system must also have an early warning system that instantly warns the pipe layer when the laser is off grade. The laser system is to be provided by the Contractor and shall have a minimum accuracy of ± 0.01 foot per one hundred feet (100') on line; and a minimum visible range of one thousand feet (1000'). When conditions are such that this method is impractical, such as on short pipe runs, the Contractor shall have an engineer on the ground to set grade of each joint of pipe by means of an engineer's level.

The grade line shown on the Plans indicates the flow line or invert of the pipe and all cuts, unless otherwise indicated, refer to this line.

Each joint of pipe must be fully pressed into place so that there will be no unevenness or settlement of one length of pipe with the other at the joint.

The interior of the pipe shall be kept free from dirt, excess mortar and other foreign material as the laying progresses. Pipe shall not be laid when the condition of the trench or the weather is unsuitable, in the opinion of the Engineer, because of water or mud which may interfere with proper jointing. All open ends of pipe and fittings shall be adequately and securely closed whenever the Work is discontinued. Any pipe which shows undue settlement or is damaged shall be taken up and replaced or re-laid at the Contractor's expense.

All pipe shall be laid to true line and grade. Occasional variations as follows will be permitted: Above grade, 1/4 inch (5mm); below grade, not to exceed 1/2 inch (10mm); alignment not to exceed 2 inches (50mm) if gradual and regular over a distance of 20 feet (6m).

17-5 FOUNDATION, BEDDING, BACKFILLING AND COMPACTION OF TRENCHES

17-5.1 Foundation and Bedding

The material upon which the conduit or structure is to be placed shall be accurately finished to the grade or dimensions shown on the Plans or as directed by the Engineer.

The bottom portion of the trench shall be brought to grade so that the conduit or structure will be continuously in contact with the material on which it is being placed.

Trenches bottoming in hardpan shall be excavated a minimum of 6 inches (150mm) below the grade established for the bottom of the pipe and any couplings and then backfilled to the pipe grade with select material, thoroughly compacted. No additional payment will be made for such over-excavation and refill.

Whenever the bottom of the trench is soft, yielding or unsuitable as a foundation for the pipe, such material shall be removed to a minimum of 12 inches (300mm), or to a depth determined by the Engineer, below the bottom of the pipe or structure, and for a width equal to at least $\frac{1}{2}$ diameter on each side of the pipe, and the space backfilled with sufficient clean granular material of the type directed by the Engineer to ensure a proper foundation. No additional payment will be made for over-excavation or placement of clean foundation material unless so indicated in the Specifications or approved by the Engineer.

The maximum width of the trench at the top of the pipe shall not be greater than that specified in Table 17-3.1, unless otherwise specified on the approved Plans or Specifications for the Project.

Trenches shall be excavated to the depths required for the foundation of Sewer pipes and their appurtenances shown on Plans and where conditions make it necessary to such depths as may be directed by the Engineer. The bottom of the trench shall be excavated or backfilled so that the barrel of the pipe shall have uniform bearing for its entire length, except for the area necessary for bell holes. All adjustment of pipe to line and grade must be made by scraping away or filling and tamping. The use of blocks as support is forbidden. An additional depth and width shall be hand dug at joint or bell locations of sufficient depth to relieve the bell of any load and to allow ample space for making the joint.

Where the pipe is to be laid on sand having less than optimum moisture, as determined by the Engineer, the Contractor shall apply sufficient water and compact the sand prior to placing the pipe.

17-5.2 Pipe Embedment Zone

Pipe Embedment Zone shall be defined as that material supporting, surrounding, and extending to 12 inches (0.3m) above the top of the pipe. Material used for backfilling within the Pipe Embedment Zone shall consist of the following select natural material or processed product Class II or Class III material as defined herein and shall be compacted to a minimum 90% as determined by ASTM D1557 (latest editions).

Class II: ($E' = 3000$ psi)*Washed concrete sand conforming to Section 90 1.02C(4)c of the State Standard Specifications.

Class III: ($E' = 2000$ psi)* Select natural sand and coarse silty sand conforming to the following particle size gradation and sand equivalent:

Sieve Size	Percent Passing
3/4 inches (19 mm)	100
4.75mm (#4)	> 50
(#200)	35 Maximum
Sand Equivalent	20 Minimum

* E' = modulus of subgrade reaction

17-5.3 Initial Backfill

Initial backfill shall be the material between the top of the bedding material and 12 inches (300mm) above the top of the pipe.

Initial Backfill shall consist of placing and firmly compacting selected granular backfill material under the haunches of the pipe and up to the spring-line of the pipe, and then filling to a level 12 inches (300mm) above the top of pipe.

Initial backfill shall be placed immediately after the pipe has been laid to line and grade in the trench, inspected and passed by the Engineer. The material shall be carefully placed so as not to disturb or damage the pipe or its placement, and shall be brought up evenly on both sides. Initial backfill material shall be backfilled to one foot (1') above the top of the pipe, in layers not to exceed eight inches (8") in depth and tamped by hand or pneumatic tampers to a relative compaction of 90% as determined by ASTM D1557.

The method of compacting and obtaining density requirements for all pipe trenches shall be such that the backfill material shall be completely compacted around the lower haunches of the pipe, such that line and grade of the pipe is not disturbed, and the pipe is not damaged.

Where the City's water system is utilized for construction water, the Contractor shall obtain a water meter from the Water Division (fire hydrant meter are required for all users). The Contractor shall obtain the permission of the Water Division Engineer as to which hydrants are to be utilized. Jetting and Flooding of trenches from the top is not permitted.

17-5.4 Final Backfill

Final Backfill shall be the material above the Initial Backfill and consist of sound earthen material which is free of all rocks, hardpan, paving material, organic

matter, broken concrete, wood or other deleterious material. Unless otherwise specified, this may be selected native material with no piece larger than 2 inches (50mm).

Backfilling of trenches shall be accomplished and constructed per City Standard Drawing No. S-10 with the type of replacement noted on the plans or in the Specifications. Surface restoration shall be accomplished and constructed per City Standard Drawing No. P-48.

Backfilling of trenches above the initial backfill as indicated in Section 17-5.3, above, shall be as follows:

Where mechanical compaction is used, the moisture content shall be such that the specified compaction can be obtained and the backfill shall be placed in lifts the height of which shall not exceed that which can be effectively compacted depending on the type of material, type of equipment and methods used, and under no circumstances shall exceed 4 feet.

All backfill shall have a relative compaction of 90% to within twenty-four inches (24") of the surface and the top twenty-four inches (24") shall have a relative compaction of 95%. Test Method ASTM D 1557 shall be used to determine relative compaction, using the dry random sampling method (dry weight basis).

No free water will be allowed in the top twenty-four inches (24") of backfill.

Backfill, around Utilities that are exposed during trench excavation, shall be placed in accordance with the above bedding, backfill, and compaction methods.

17-6 CONNECTION OF SERVICE LATERALS (HOUSE BRANCHES)

Service laterals shall be furnished and installed by the Contractor at the locations shown on the Plans. Installation shall conform to the requirements Subsection 17-2, "Materials," of these City Standard Specifications, and shall be installed in accordance with Standard Drawing No. S-1, S-8 and S-9 of the City Standard Drawings.

The Contractor shall place as many "Y" or "T" branches of the size designated as directed. The "Y" or "T" branches, unless otherwise specified, shall be inclined at any angle not greater than 45° from the horizontal.

"T" branches are not allowed on Sewer mains six inches (6") to ten inches (10") in diameter.

Each "Y" branch, or the end of the Sewer which does not terminate in a manhole, shall be closed at the bell with a cap made for that purpose. "Y" branches must join the Sewer main with flow in the same direction.

17-7 INSTALLATION OF SEWER HOUSE BRANCHES

Sewer House Branches shall be constructed in accordance with Standard Drawing Nos. S-1, S-8 and S-9 of the City Standard Drawings. Sewer House Branch must connect to Sewer main at least five feet (5') away from the outside edge of a manhole.

Sewer House Branches 4 inches (100mm) and 6 inches (150mm) in diameter may be connected to all Sewer mains less than 18 inches (460mm) in diameter at prefabricated wye or Tee fittings conforming to City Standard Drawing S-8 and S-9. Sewer House Branches 4 inches (100mm) and 6 inches (150mm) in diameter may also be connected directly to existing Sewer mains 18 inches (460mm) to 27 inches (685mm) in diameter, providing that a machine core is utilized to connect to the main Sewer. Direct connection to mains larger than 27 inches (685mm) in diameter shall only be approved in special cases where approved by the Engineer. Connection to these Sewer mains by means other than a machine core will not be allowed. House Branch Sewers 8" (200mm) in diameter or greater connecting to Sewer mains shall require the construction of a manhole at the point of connection. New connections must comply with drawing S-1, S-8 and S-9.

House branches shall be constructed at locations shown on the Plans or as may be directed by the Engineer and shall extend from the outlet of the "Y" or "T" branch at the Sewer main to the right-of-way line of the Street or alley, where the house branch shall be promptly closed at the bell end with a plug manufactured for that purpose.

The slope and general arrangements of the house branches shall be as shown on the Plans.

Plugs used to seal the ends of house branches shall be of a type approved by the manufacturer of the pipe.

Excavations for laying house branches shall be made in such a manner that at no time will the Street be closed to traffic. Whenever house branches are to be installed in major Streets that have been resurfaced within the last five (5) years, or in pavement that is in good condition and free of cracking, they shall be installed by boring methods rather than open cuts trenches.

Where curb and gutter exists, or is to be constructed concurrently with Sewer facilities, the location of each Sewer service shall be permanently indicated by inscribing the letter "S" two inches (2") in height in the curb directly above the line when the service is perpendicular to the Street centerline. Otherwise, the "S" mark for skewed or angling services shall be placed at a right angle to the end of the service. When Sewer services are installed in an existing Street, the curb mark shall be placed at the

time the service is installed to assure proper location. In cases where a concrete curb does not exist, the Contractor shall mark the location of the terminus of the house branch by driving a one-half inch (1/2") iron pipe or rod in the end of the trench before backfilling. The pipe or rod shall extend to within six inches (6") of ground surface.

In new subdivisions when the Sewer services are installed before the curb is constructed, it shall be the Contractor's responsibility to establish the exact location of each Sewer service and to furnish this information to the Engineer.

17-8 MANHOLE CONSTRUCTION AND DROP SEWER CONNECTIONS

17-8.1 General

Manholes shall be constructed in accordance with Standard Drawings S-2 through S-5 of the City Standard Drawings and as specified herein or directed by the Engineer.

Manholes shall be complete structures in place and backfilled including the furnishing and placing of all materials involved. Precast concrete pipe manholes shall consist of a poured in place concrete base section, reinforced concrete pipe section(s), cast iron frame and cover and a poured in place concrete collar with paving patch. Invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent pipe invert, or flow channels may be provided by use of the bottom half of the specified main pipe. The floor and wall of the manhole outside the channels shall be smooth and shall slope 1:12 towards the channels.

The top of the manhole base section shall be keyed to receive the tongue end of the riser section. The key shall be formed in the freshly poured concrete by using a template manufactured to the dimensions of the riser section. If the riser is cast in-place monolithically with the base section by using a slip form or other means, the key may be omitted between the base and riser. If the base and riser sections are not poured monolithically, but separately, a key shall be provided in the base section. In either case, a key will be required in the top of the riser section to receive the tongue end of the tapered cone.

The joints between the base and all precast elements of the manhole, including adjustment rings and manhole frame, shall be filled with cement mortar, or approved equal, prior to joining the elements.

The interior of the manhole shall be troweled smooth with a wooden trowel, removing excess mortar extruded out of joints for the entire height of the manhole, from the manhole frame to the floor. All excess mortar and any other debris shall be removed from the manhole.

17-8.2 Design and Spacing

Sewer lines shall be laid straight between manholes, unless otherwise specified in the Plans and/or Specifications. The installation of lamp holes or clean-outs on public Sewer mains is forbidden.

Manholes are to be installed at the end of each line; at all changes in grade, size, or alignment; at all intersections; and at distances not greater than 600 feet.

A grade drop of 0.1 foot (30mm) min. shall be provided through manholes, when grade permits.

Manholes shall not be installed in sidewalks, flow channels of gutters, or in depressions subject to storm waters or other infiltration.

Flat-top manholes are not permitted. Minimum depth of manhole above the manholes base shall be 42 inches (1.08 m).

17-8.3 Materials

Pre-cast concrete pipe manholes shall consist of a poured in-place concrete base section, reinforced-concrete pipe section(s), a reinforced concrete taper section, grade rings and cast-iron frame and cover. Precast sections shall be manufactured in conformity to Class II, ASTM Designation: C-478-(Latest Revision) for their respective diameters.

Elliptical single-line reinforcement will not be permitted. Single line circular reinforcement will be permitted and the minimum steel area shall equal the minimum steel area required for the inter-cage reinforcement.

Tapered sections shall conform to the requirements for pipe of the size equal to the largest internal diameter of the tapered sections.

Concrete for the base section shall be Class A. Precast manhole bases are not allowed.

17-8.4 Installation

The inside of the manhole shall be formed to the flow line of the Sewer. The formed flow channel depth shall extend above spring line up to half of the pipe. The bench shall slope a minimum 1:12.

Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. Where the pipe size of the

entering and leaving pipe is different, the larger diameter must be maintained in the manhole.

A channel shall be formed in the bottom of all new starting manholes (a terminal manhole at the upstream end of a sewer main) and it shall extend completely through the manhole. The upstream end of the new flow channel shall terminate at the manhole wall, and the end of the flow channel shall be vertical with no fillet between the flow channel bottom and the manhole wall.

Stub-outs shall be installed in manholes at the locations and sizes shown on the Plans. All stub-outs shall be sealed with a plug of a type approved by the manufacturer of the pipe.

All manholes shall be completed to finish grade with concrete collar and paving patches (where indicated) as shown on the City Standard Drawings and as herein specified. In undeveloped areas where no Street or alley surfacing is to be done in conjunction with or immediately after Utility installation, the manhole cover shall be finished off to a level 1 inch (25mm) above ground elevation and shall be provided with 12 inches (300mm) of grade rings. In existing Street areas where surfacing exists and no new Street regrading is contemplated in conjunction with or immediately after Utility installation, such as new subdivisions, manholes shall initially terminate with the top of the cone 6 inches (150mm) below subgrade and shall be brought to Street or alley surface with grade adjustment rings and completed after Street paving is accomplished. Unless specifically otherwise indicated in the Specifications, it will be the responsibility of the Sewer Contractor to return and install the manhole covers to finish grade as specified and shown on the City Standard Drawings.

The Contractor is aware that connections to existing Sewers will be "wet" and the Contractor shall make whatever arrangements are necessary to complete the manhole connections under the "wet" conditions.

Where necessary, manholes shall be equipped with an approved water-tight insert placed under the manhole cover to prevent rainwater or other inflow.

No steps shall be installed in manholes unless otherwise noted on the Plans.

17-8.5 Removal

Manholes abandoned in place shall be broken out within 2 inches (0.6m) of the finished grade.

The manhole frame and cover will be delivered to the City Corporation Yard. The Sewer mains entering the manholes shall be sealed with concrete and the manhole backfilled with sandy soil and compacted to a relative compaction of 90% using optimum moisture and tested in accordance with ASTM D1557.

Manholes to be removed shall have the base removed with the barrel and taper. The manhole frame and cover will be delivered to the City Corporation Yard. After the complete manhole has been removed the excavation will be backfilled in accordance with backfill requirements. Before backfilling, all Sewer pipes that have entered the manhole will be sealed with concrete.

17-8.6 Adjustments

Where existing manholes need to be raised or lowered to meet a new Street grade, they will be left in place and marked until the Street has been paved. After the paving material has been compacted they will be dug out and the ring and cover removed and lowered or raised to grade by use of concrete around the frame but left two (2) inches below the-finished surface in asphalt concrete Streets and the top two inches filled with A.C. and rolled. In concrete surfaced Streets the concrete will be brought to the surface.

"Jiffy Rings" (manhole adjusting riser rings that feature a turnbuckle linkage pivoted at each end, that provide the ultimate means to expand a manhole riser) for raising manholes will be allowed.

17-8.7 Drop Sewer Connections

Drop Sewer connections at manholes shall be constructed in accordance with City Standard Drawings S-11A and S-11B, and only at locations approved by the Engineer and shown on the approved Plans.

17-8.8 Payment

If existing manholes are to be removed and replaced they shall be included in the bid price of new manholes unless otherwise specified in the Specifications.

The bid price of adjusting manholes to the new Street grade shall include surface restoration.

17-9 THIMBLES

Thimbles shall be installed in the manholes at the locations and of the size shown on the Plans. All thimbles shall be sealed with a plug of a type approved by the manufacturer of the pipe for use with his/her product.

17-10 DEFLECTION TEST OF PVC SEWER LINES

PVC Sewer pipe, which is designated as flexible in nature, shall be tested for excessive deflection. This test shall be performed after backfilling and compaction but prior to the placement of aggregate base or asphalt-concrete surfacing, and prior to

television inspection as specified in Subsection 17-12, "TELEVISION INSPECTION OF INTERIOR OF INSTALLED PIPE," of these Specifications.

The Contractor shall demonstrate that the maximum pipe deflection does not exceed 5 percent by pulling a properly sized rigid ball or a mandrel through the main line pipe. A "rubber flush ball" does not meet this requirement for deflection testing.

Failure of the deflection test shall be grounds for rejection of the section tested, until correction of the reason for the failure and successful retesting of the section.

17-11 LEAKAGE TEST OF SEWER LINES AND SERVICE LATERALS

After completing the installation, backfill and compaction of a section of Sewer line with service laterals, and after all other underground Utilities (including gas, electric, telephone, cable television, water and Storm Drain) are in and compacted, but prior to the placement of aggregate base or asphalt-concrete pavement, the Contractor shall, at his/her expense, conduct a leakage test using low pressure air. The test shall be performed using the following procedures and under the Supervision of the inspecting Engineer.

Each section of Sewer between two successive manholes shall be tested by plugging all pipe outlets with suitable test plugs.

All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 170 MPa (25 pounds per square inch) gauge pressure. The sealed pipe shall be pressurized to 35 MPa (5 psig). The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.

To commence the leakage test, air shall be slowly added until the internal pressure is raised to 27 MPa (4.0 psig). The compressor used to add air to the pipe shall have a blow-off valve set at 35 MPa (5 psig) to assure that at no time the internal pressure in the pipe exceeds 35 MPa (5 psig). The internal pressure of 27 MPa (4 psig) shall be maintained for at least two minutes to allow the air temperature to stabilize after which the air supply shall be disconnected and the pressure reduced to 24 MPa (3.5 psig). The time in minutes that is required for the internal air pressure to drop from 24 MPa (3.5 psig) to the lower pressure indicated in the appropriate table below shall be measured and the results compared with the values tabulated below.

Gauges used to measure test pressures shall read from 0 MPa (0 psig) to 69 MPa (10 psig) maximum with 3.5 MPa ($\frac{1}{2}$ psig) increments. If required, the Contractor shall supply necessary fittings to accept a City supplied gauge.

All gauging and testing shall be done outside the manholes and no one shall be allowed to enter the manholes while the line is pressurized.

PVC Gravity Sewer Pipe

Minimum Acceptable Time Required for Pressure decrease from 24 MPa (3.5 psig) to 20 MPa (3.0 psig):

Pipe Diameter	Test Time (Minutes) (Seconds)	
4" (100 mm)	2	32
6" (150 mm)	3	50
8" (200 mm)	5	6
10" (250 mm)	6	22
12" (300 mm)	7	39
15" (380 mm)	9	30

Vitrified Clay Sewer Pipe

Minimum Acceptable Time Required for Pressure decrease from 3.5 to 2.5 psig:

Pipe Diameter (Inches)	Test Time (Minutes) (Seconds)		Minimum Distance Between Manholes (Feet)	K Value
4	2	0	430	0.428
6	2	45	380	0.592
8	3	45	320	0.702
10	4	46	260	1.100
12	5	40	215	1.58
15	7	0	170	2.470
18	8	36	145	3.560
21	10	6	125	4.850
24	11	6	105	6.34
27	12	42	95	8.020

30	14	1	85	9.900
33	15	0	75	12.000
36	16	41	70	14.300
39	18	5	65	16.700
42	19	24	60	19.400

The above-tabulated values shall be used for the respective diameter pipes except where the distance between successive manholes is less than the above-tabulated values, in which case, the following formula will be used to determine the test time.

$$T = KL$$

T = test time in seconds

K = value from table

L = distance between successive manholes in feet

Failure of the leakage test will be grounds for rejection of the section tested, until discovery and correction of the reason for the failure and successful retesting of the section.

17-12 TELEVISION INSPECTION OF INTERIOR OF INSTALLED PIPE

The Contractor shall furnish closed circuit television inspection for an interior inspection of the newly installed Sewer mains. The television check of the Sewer mains shall be made after leakage and deflection tests have been performed and prior to placing of Street aggregate base or asphalt paving. Any broken pipe, separation of joints, or any pipe exceeding the permitted tolerances for line and grade shall be replaced or repaired.

Any pipe repaired or replaced as a result of television inspection shall be retested for leakage and deflection. An electronic copy of the television inspection (standard DVD or in Mpeg file format) shall be provided the City at no additional cost to the City. The Contractor shall be responsible for all costs associated with furnishing the television inspection and making final repairs to the Sewer mains and reinspection utilizing the closed circuit television equipment.

At the request of the Contractor, the City may at its option perform the closed circuit television inspection or reinspection on the Contractor's installation at a cost designated in the City's Master Fee Resolution for such Television Inspection work.

Requirements for Sewer Video Inspections:

1. The Video Inspection Company is to certify as to their ability to adequately perform the video inspection.
2. The City Inspector will provide 24 hour notice of inspection schedule and will be present to monitor the inspection.
3. A flush truck will be required to be on-site to aid in the video inspection.
4. A DVD shall be submitted to the City as proof of inspection and be certified to comply with Plan requirements or pointing out by station any defects found.
5. Lateral lines to be documented by stationing from center line of manhole and the inspection firm shall provide a map of the inspected lines.
6. In order to facilitate review a log of the inspections performed shall correlate from manholes, stationing, etc., between the Sewer Plans and the DVD produced.
7. Joints- Shall have a perspective view, and have each joint inspected by turning the camera 90 degrees to the joint and inspecting all 360 degrees of the connection.
8. Laterals- Shall have a perspective view identifying clock position to the main and a view into the lateral to identify any rolled gasket in the lateral connection.
9. Sags- A guide shall be used that is 1" in diameter to identify sags and must be visible during the entire inspection. Give a perspective view of the start of the sag, a view of the guide at the deepest part of the sag and the end of the sag.
10. Downstream Access Point- A perspective view of the channel from the mainline at the downstream access point must be shown. Provide a snapshot of the bottom of the channel and the shelves looking downstream.
11. Debris- if debris is found during the inspection, the inspection needs to be terminated and restarted once the debris has been removed and more water dumped into the main.
12. Video Inspection shall be performed in the direction of flow.
13. Liner Job (e.g. Cured in Place Pipe) - The bottom of the pipe needs to be free of water and the camera lens shall have a visible view of the pipe.

17-12 TELEVISION INSPECTION OF INTERIOR OF INSTALLED PIPE (ADDITIONAL INFORMATION)

INSPECTION OF NEW CONSTRUCTION-SEWER INFRASTRUCTURE MAIN SEWER LINES AND MANHOLES

Before new construction of sewer infrastructure (main sewer line, manholes, etc.) is approved by the City, a video of the construction is reviewed to ensure specific guidelines are followed. If these are not met, the approval is put on hold until the problem is fixed. A follow up video inspection is then required which will be reviewed and approved if in compliance. The video can be done by private contractors while the final review and approval is done by the City.

The City of Fresno is also available to do the video inspection and will charge a fee to recover the cost of the labor and equipment utilized on the video inspection and cleaning of debris if necessary. If using the City's resources, provide billing information and project identification. The costs for utilizing the City's services are as follow:

Television Inspection/Sewer (Master Fee Schedule)

CCTV Inspection, per hour (one hour minimum)	\$135.39*
CCTV Standby, per 15-minute period	\$ 33.60*
Cleaning of minor debris for inspection, per hour (30 minutes minimum)	\$141.09*

*This price is changed periodically in the Master Fee- Schedule update.

Ensuring proper construction of main sewer lines and manholes prevents future maintenance issues that could increase the potential for blockages and possible sanitary sewer overflows.

Guidelines for Inspecting New Construction

- Ensure access area is free of construction debris. Standby charges may apply if work is scheduled and staff is unable to access the area to be inspected.
- Clean mainlines and manholes of all debris prior to inspection.
- After cleaning, water is to be dumped in to the upstream manhole via flusher nozzle or hydrant. If flusher nozzle is used by running it upstream, it needs to be pulled back without pressure to keep water in the line.

CCTV Inspections

- Joints-Need to have a perspective view and have the joint inspected by turning the camera 90 degrees to the joint and inspecting all 360 degrees of the connection.
- Laterals-Need to have a perspective view identifying clock position to the main and a view into the lateral to identify any rolled gasket in the lateral connection.
- Sags-A guide needs to be used that is 1" in diameter to identify sags and should be visible during the entire inspection. Give a perspective view of the start of the sag, a view of the guide at the deepest part of the sag and the end of the sag.
- Downstream Access Point-Give a perspective view of the channel from the mainline at the downstream access point. Make sure to have the bottom of channel and the shelves in the snapshot.
- Debris-If debris is found during the inspection, then, the inspection needs to be terminated and restarted once the debris has been removed and more water dumped into the main.

Manhole Inspections

- A top view snapshot of each manhole.
- A full frame view of the channel work from the top down for each manhole.
- Each snapshot needs to be identified by manhole/station number any inspections submitted that have debris will not be accepted.
- Any joints, laterals, or connections that have not been inspected will not be accepted.
- Any manholes that have not been inspected will not be accepted.
- All media to be provided in DVD format.

17-13 MEASUREMENT

Measurement for Sewer main installation and service lateral installation shall be by the lineal feet of pipe installed, and shall be actual horizontal length installed, measure through wye fittings.

Measurement for wye or Tee fittings shall be per each wye or Tee fitting installed.

Measurement for manholes shall be per each manhole installed.

17-14 PAYMENT

The unit price bid per lineal foot for Sewer mains shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all the Work involved therein as shown on the Plans, as set forth in the Specifications, and as

directed by the Engineer. This shall include, but not be limited to, furnishing and installing the pipe, trenching, backfilling, compacting, testing and internal inspection.

The unit price bid per lineal foot for service laterals (house branches) shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all the Work involved therein as shown on the Plans, as set forth in the Specifications, and as directed by the Engineer. This shall include, but not be limited to, furnishing and installing the pipe, trenching, backfilling, compacting, testing.

The unit price bid per each for wye or tee fittings shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all the Work involved therein as shown on the Plans, as set forth in the Specifications, and as directed by the Engineer, in excess of the cost of installing the main line pipe and service lateral. This shall include, but not be limited to, furnishing and installing the wye or tee fitting and plug, trenching, backfilling, compacting, testing and internal inspection.

When the contract does not include a pay item for wye fittings as above specified, and unless otherwise provided in the Specifications, full compensation for wye or tee fittings shown on the Plans shall be considered as included in the prices bid for other Sewer pipeline items of Work and no separate payment will be made therefore.

The unit price bid per each for manholes shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all the Work involved therein as shown on the Plans, as set forth in the Specifications, and as directed by the Engineer. This shall include, but not be limited to, furnishing and installing the manhole and stub-outs, backfilling and compaction, returning and adjusting manhole lids and frames to final grade following Street or alley construction or reconstruction, and connection to all pipes, wet or otherwise.

No separate pay item will be included in the Proposal, nor direct payment made for trench or structure excavation, backfilling, compaction, or placement of temporary pavement. The cost of these features of the Work shall be included in the unit price bid per linear foot for furnishing and laying pipe or installing structures.