



Design Standards and Specifications For Water and Sewer

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CITY OF LUBBOCK, TEXAS
WATER UTILITIES DEPARTMENT

SECTION 201

MINIMUM DESIGN STANDARDS FOR WATER DISTRIBUTION SYSTEM

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SECTION 201

MINIMUM DESIGN STANDARDS FOR WATER DISTRIBUTION SYSTEM

201-1.0 General: All water distribution system design shall be in accordance with the requirements of the City of Lubbock Standard Specifications for Water Distribution Mains.

201-2.0 Design Flow: The design of the water distribution system shall be based on the following:

Maximum hour flow	1,000 g.p.c.d.
Maximum day flow	650 g.p.c.d.
Average day flow	240 g.p.c.d.
Population per household	2.5 persons
Fire flow (residential)	1,000 g.p.m.*
Fire flow (industrial or commercial)	3,500 g.p.m.

*May be from more than one fire hydrant providing the additional hydrants are accessible to any possible fire location. Also, must comply with Fire Department regulations, and in no case be less

than ISO recommendations.

The water distribution system shall provide fire protection service from the street and domestic water from the alley or comparable easements adjacent to the property. The size of the lines in the alleys or easements shall be adequate to provide for a maximum size water meter of one and one-half (1-1/2) inches per lot for each seventy-five (75) feet of frontage. The property owner may acquire a maximum water tap and meter of one and one-half (1-1/2) inches or the equivalent in two (2) or more meters per lot of each seventy-five (75) feet of frontage.

201-3.0 Pressure Requirements: The distribution system in all areas shall be so designed to have a maximum static head of 346 feet (150 psi) and a minimum static head of 100 feet (43 psi). Distribution systems shall also be designed to maintain a 20 psi residual pressure during required fire flow and a 40 psi residential residual during peak residential flows.

201-4.0 Fire Hydrant Spacing: The Texas State Board of Insurance requires fire hydrants to be spaced no greater than 300 feet in mercantile and industrial area, and 600 feet in residential areas. Each building in the city limits shall be within 500 feet of a fire hydrant.

In all cases the following criteria shall be adhered to:

1. A hydrant shall be placed in the end of each cul-de-sac over 300 feet in length (measured from the center of the intersecting street).
2. Fire hydrants shall be located at intersections wherever possible.
3. On divided highways, hydrants shall be placed on each side of said highway wherever possible.
4. Fire hydrants shall be placed so that they are readily visible from the street and shall be no closer than 2 feet nor further than 5 feet from back of curb/sidewalk. No bushes, ground cover over 6 inches in height, or other obstructions shall be placed within a five foot radius in all directions of the hydrant or fire department connection.
5. Fire hydrants shall be installed and maintained so that the center of the lowest water outlet shall be 18 inches from the ground.
6. Where fire hydrants are placed in a location exposed to vehicular traffic, adequate protection for said hydrant shall be installed. Where fire hydrants are vulnerable to vehicular damage, appropriate crash posts shall be provided. No obstructions shall exist within a 5-foot working area of each required access. Crash posts shall be 4-inch, cement-filled pipe minimum 3 feet in height with 2 feet of piping below grade.
7. To insure adequate water supply for fire protection during construction, all required fire hydrants shall be in operation before framing is started or combustibles are stored on any construction site. The streets and fire access roadways shall be able to support fire apparatus in wet weather.
8. Fire hydrants shall be installed with the 4" nozzle facing the required access way.
9. In addition to the above requirements, fire hydrant spacing shall in no case be greater than that determined on the basis of required fire flow demand per the type, size, occupancy and density of structure as per the Uniform Fire Code and Appendices and according to ISO requirements as follows:

STANDARD HYDRANT DISTRIBUTION

Fire Flow Required GPM	Average Area Per Hydrant Square Feet
1,000 or less	160,000
1,500	150,000
2,000	140,000
2,500	130,000
3,000	120,000
3,500	110,000
4,000	100,000
4,500	95,000
5,000	90,000
5,500	85,000
Fire Flow Required GPM	Average Area Per Hydrant Square Feet
6,000	80,000
6,500	75,000
7,000	70,000
7,500	65,000
8,000	60,000
8,500	57,500
9,000	55,000
10,000	50,000
11,000	45,000
12,000	40,000

201-5.0 Pipe Size and Spacing: Distribution mains shall be located and sized in accordance with the current City of Lubbock Water System Master Plans and with adherence to the recommendations of the Insurance Services Offices (ISO). Where not specifically indicated in the current Water System Master Plan, twelve-inch (12") mains shall be required every mile. Ten inch (10") mains shall be required at the half-mile with eight inch (8") and six inch (6") mains installed at 660 feet spacing.

201-6.0 Valve Spacing: With consideration for good practice and recommendations of the Insurance Services Offices and NFPA, valves shall be provided in the distribution system so that no single accident, break or repair will necessitate shutting down a length of pipe greater than 500 feet. On arterial feeders (12" in diameter but less than 20" in diameter) valves may be spaced no greater than 800 feet as the arterial feeder traverses undeveloped land or is not intersected by other distribution mains. Transmission Mains (20" and larger) shall normally be equipped with valves at mile intervals unless intersected by arterial mains or other distribution mains, or more valves are required by the Water Department.

201-7.0 Hydraulic Design: All distribution mains shall be designed to have a maximum velocity of no greater than ten feet per second. Distribution mains shall be designed using a Hazen-Williams friction coefficient "C" equal to 140.

201-8.0 Pipe Materials: All pipe used in distribution system shall be cement-lined ductile iron pipe, C-900 PVC, or Concrete Cylinder. The City of Lubbock shall specify the pipe class as required for specific project conditions. See City of Lubbock Standard Specifications for Water Main

Construction for details on pipe and installation.

201-9.0 Layout (Typical): Water mains shall be typically located five feet west of the center-line of north-south alleys or streets. In east-west alleys or streets the water main shall be typically located five feet north of the center-line.

At street intersections, valves shall be located at property lines unless flanged fittings are required. At alley intersections with street, valves shall be located at property lines of the alleys.

Fire hydrant gate valves shall be placed at the main.

In all instances the water mains shall extend to the extremities of the property or the subdivision served, and further when required to tie into existing mains adjacent to the development.

A main serving one lot shall be extended all the way across the frontage for that lot.

Mains serving a subdivision shall extend to the boundary of plat.

201-10.0 Bedding and Cover: The need for pipe bedding shall be determined by the designer for the project involved, but in all cases, shall be not less than manufacturer recommendations.

201-11.0 Pipe Restraints and Reaction Blocking: The size of required pipe restraints and reaction blocks shall be determined by the designer for the project based on the allowable soil pressure and the anticipated working pressure plus water hammer of the line.

201-12.0 Flanged Outlets: All side outlets for valve attachments on lines 12" and larger shall be flanged.

**CITY OF LUBBOCK, TEXAS
WATER UTILITIES DEPARTMENT**

SECTION 202

CHECK LIST FOR WATER MAIN CONSTRUCTION PLANS

202-1.0 Plan Requirements: All water main construction plans shall be checked for conformance with City of Lubbock minimum design standards prior to submittal to the Water Utilities Department for approval. Two sets of prints shall be submitted for review and comment. Upon completion of review, one set shall be returned to the originator for changes. After the changes have been made, the original set, one set of reproducibles and four sets of plans shall be submitted for final approval and acceptance. The original shall be signed and returned to the originator. All drawings shall be approximately 24-inch by 36-inch in size.

Should circumstances warrant changes from the approved plans or specifications, a written approval must be obtained from the Water Utilities Department. Copies of the approval shall be given to the

contractor and the developer.

The developer and the developer's engineer shall be responsible for recording "As Built" information on a set of record drawings kept on the construction site. The City of Lubbock Water Utilities Department shall monitor this process to assure that changes in construction (as approved in writing) and other pertinent details, such as valve tie down dimensions and tap locations and sizes, are kept up to date on the record drawings. "As Built" reproducible mylar drawings, certified by the developer's engineer and the City of Lubbock Water Utilities Department, shall be presented to the City within 30 days of completion of the construction. A Certificate of Acceptance of Utility Construction shall not be issued until such "As Built" plans are provided to the City of Lubbock Water Utilities Department. Also, where the construction is phased and a lapse of more than 30 days occurs between phases, then "As Built" reproducibles shall be presented to the City of Lubbock Water Utilities Department, reflecting the completed construction prior to issuance of the Certificate of Acceptance of Utility Construction or the issuance of Building Permits.

Final construction plans should not be submitted for Water Department approval for work that will not be installed within one (1) year of the approval date, as in some cases the Water Utilities Department may require resubmittal of the plans for approval under revised standards and under other system requirements.

202-2.0 Plan Details: The following details shall be shown on the plans:

A. General:

Title Block (lower right hand corner preferred)

Scale

Date and revisions

Name of Professional Engineer of the Firm

Professional Engineer's Seal

Drawings Number (s)

Statement: All work shall be constructed to the City of Lubbock
Standard Specifications.

Approved: _____

Name

Date

Job. No.

B. Plan:

Bench Marks - City datum

North Arrow

Property Lines: Indicate lots to be served by solid line:

other property lines dotted

Ownership or Subdivision Information

Street names and easements with width dimensions

Existing Utility Lines: (buried), location and depth

Water

Gas

Telephone

Storm Drain

Irrigation Ditches

Sanitary Sewers

Other pertinent details (houses, curbs, water courses, etc.)

Proposed Water Mains

- Size
- Length
- Material and type of joints
- Location dimensions
- Fittings
 - Tees
 - Crosses
 - Reducers
 - Bends
 - Plugs
 - Blow-offs
 - Thrust Blocks
- Valves
- Fire Hydrants

C. Profile:

Ground surface existing (dotted) and proposed (solid)
Station numbers, existing and proposed utilities where crossed,
proposed water main control elevation and grades.

D. Plan, profile and complete details for off-site transmission mains,
pump stations, special valves and vaults, tanks, etc.

E. Detail Sheet - as required

- Standard Bedding Detail (cross-section)
- Thrust Block and Joint Restraint Tables
- Fire Hydrant
- Tapping Details
- Air Valves
- Blow-offs
- Crossings

F. Overall Layout Sheet (scale 1"=100') showing following information:

- Lot lines
- Streets and street names
- Water line, sizes and material
- Valves
- Fire Hydrants
- Connections to existing system

**CITY OF LUBBOCK, TEXAS
WATER UTILITIES DEPARTMENT**

SECTION 301

MINIMUM DESIGN CRITERIA FOR SANITARY SEWERS

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**CITY OF LUBBOCK, TEXAS
WATER UTILITIES DEPARTMENT**

SECTION 301

MINIMUM DESIGN STANDARDS FOR SANITARY SEWERS

301-1.0 General: All sewer system designs shall take into account the requirements of the City of Lubbock Specifications for sewer main and service line construction.

301-2.0 Design Flow: The design shall include consideration of providing service for the entire area

tributary to the outfall point. Estimates of residential sewage contribution shall be based on 100 gallons per capita per day average flow. Peak factors are determined by population. Example: Peak Flow = 100 gal./cap. x P.F. x population. Minimum residential population density shall be figured on a basis of 2.5 persons per house, 6 houses per acre, and 70 percent of total land area developed as residential, unless detailed analysis of the area to be served indicates differently. Institutional, Commercial and Industrial sewage contribution estimates shall be reviewed with the Water Utilities Department.

301-3.0 Hydraulic Design: The minimum velocity at the design flow rate shall be 2.0 feet per second. Maximum allowable velocity shall be 10 feet per second. Where actual flow will be much below normal for several years, the minimum velocity shall be achieved by suitable grades at the partial design flow rate. Care shall be taken to design invert elevations at manholes in such a manner that the energy gradient is consistently falling in the direction of flow.

301-4.0 Design Details: Sanitary sewer mains shall be 6 inch diameter or larger. Service connections shall be 4 inch diameter or larger. The following minimum grades shall apply: When pipe is flowing half full.

<u>Sewer Diameter</u>	<u>Minimum Grade (percent)</u>	
	<u>N=0.013</u>	<u>N=0.001</u>
4 inch	2.0 or 1/4 inch per foot	
6 inch	0.60	0.30
8 inch	0.40	0.22
10 inch	0.28	0.18
12 inch	0.22	0.14
15 inch	0.15	0.10
18 inch	0.12	0.08

Manholes shall be a minimum of 48 inch diameter and shall be provided at every change in direction, grade, or connection with other sewer main; maximum spacing shall be 500 feet for lines 15 inches or smaller, or 600 feet for lines 18 inches or larger. Sewer lines shall be straight and not curved between manholes both in line and grade. Cleanouts on sewer main line will not be permitted. Drop manholes shall be provided for a sewer entering a manhole at an elevation 30 inches or more above the manhole invert. Where the difference in elevation is less than 30 inches, the invert shall be filleted to prevent solids deposition.

Sewer main shall ordinarily have a minimum of 4 feet of cover to finished ground surface. Where this will provide less than 5 feet of elevation difference between the finished lot grade at building line and the top of the sewer main, it shall be indicated on the plans that the lot is served by a "shallow sewer" and appropriate elevation information shall be given. Where pipe has less than 4 feet of cover, provisions shall be made to protect the pipe from impact loading when located in street.

Tees shall be provided in the sewer main for service connections at each lot or building site. These tees shall ordinarily be located 5.0 feet from the centerline of the lot. Riser connections may be installed.

Sewers constructed or extended to serve an end lot shall be constructed across the entire front (or rear) of the lot being served and terminate in a manhole, unless otherwise approved by the Water Utilities Department in writing. Manholes shall be stubbed out with suitable size pipe wherever future extension of the sewer is anticipated.

301-5.0 Location Details: Unless approved otherwise by the Water Utilities Engineering Department, sanitary sewer mains shall be located five (5) feet east of the centerline of north-south alleys or streets. In east-west alleys or streets the sanitary sewer main shall be typically located five (5) feet south of the centerline. Where necessary to locate the sanitary sewer main along back lot lines or in other remote areas, the maintenance manholes shall be located to provide reasonable access for maintenance crews and equipment.

301-6.0 Relation to Water Mains: Sewers shall be located a minimum of 9 feet horizontally from existing or proposed water mains (centerline distance). Where sewer lines cross water mains, the sewer pipe shall be a minimum of 18 inches clear distance vertically below the water main. If this clear distance is not feasible, the crossing must be designed and constructed so as to protect the water main. Minimum protection shall consist of the installation of an impervious and structural sewer.

For example:

- a. One length of ductile iron pipe at least 18 feet long centered over the water main. Joints between the sewer pipe and this joint of ductile iron pipe shall be encased in a concrete collar at least 6 inches thick and extending at least 12 inches either side of each of the joints.
- b. Vitrified clay sewer pipe with concrete encasement which is integrally reinforced with wire mesh. Encasement shall be at least 6 inches thick and shall extend a distance of 10 feet either side of the water main.

In all cases, suitable backfill or other structural protection shall be provided to preclude settling and/or failure of the higher pipe.

301-7.0 Easements: When the Water Utilities Department determines it is not feasible to construct a public sanitary sewer in a dedicated street, the installation may be made in an easement or right-of-way. The conditions under which such an exception will be allowed will be determined for each individual case. The minimum width of easement or right-of-way required by the Water Utilities Department for a public sanitary sewer is ten-foot (10') exclusive, twenty-foot (20') if shared with a public water main, or other utilities.

301-8.0 Soil Analysis: Where the soils are unstable the contractor or engineer may be required to submit a report showing the types and characteristics of the soils to be encountered, water table elevations along the proposed sewer, recommended methods of dewatering for sewer main construction, and the recommended methods of backfilling and compacting to be used.

**CITY OF LUBBOCK, TEXAS
WATER UTILITIES DEPARTMENT**

SECTION 302

CHECK LIST FOR SANITARY SEWER WATER MAIN CONSTRUCTION PLANS

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**CITY OF LUBBOCK, TEXAS
WATER UTILITIES DEPARTMENT**

SECTION 600

STANDARD SPECIFICATIONS FOR WATER MAIN CONSTRUCTION

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**CITY OF LUBBOCK, TEXAS
WATER UTILITIES DEPARTMENT**

SECTION 600

STANDARD SPECIFICATIONS FOR WATER MAIN CONSTRUCTION

600-1.0 General: All water main construction within the City of Lubbock water system or for future connections to the City of Lubbock water system shall be accomplished in accordance with the requirements of these specifications.

600-1.1 Approved Plans: Water main construction shall be done in accordance with engineered construction plans for the work, prepared under the direction of a Professional Engineer and approved by the City of Lubbock Water Utilities Department. Plans shall conform with the City of Lubbock's Minimum Design Standards for Water Mains and shall show all information called for on the "City of Lubbock Check List for Water Main Construction Plans."

600-1.2 Notice to Proceed: The contractor is issued a Notice to Proceed following approval of Council and execution of Contract Documents. The Water Utilities Department shall be notified 48 hours before the planned construction is to commence and also before starting up when construction is interrupted for any reason.

600-1.3 Inspection: All work shall be inspected by a representative of the Water Utilities Department who shall have the authority to halt construction when, in his opinion, construction is being performed contrary to these specifications or other approved plans. Whenever any portion of these specifications is violated, the Director of Water Utilities, by written notice, may order that portion of construction which is in violation of these specifications or other approved plans, specifications and material to cease until such violation is corrected. A copy of the order shall be filed with the Contractor's license application for future review. If deficiencies are not corrected, performance shall be required of the Contractor's Surety.

600-1.4 Warranty and Acceptance: At the completion of all or designated portions of work under construction, an inspection shall be made to determine compliance with these specifications or approved plans, specifications and materials. Upon such determination, a certificate of compliance shall be issued. The letter of acceptance shall constitute the initiation of the warrantee period. The Contractor shall warrant the accepted work to be free of defects in workmanship or material defects for a period of one year.

The determination of the necessity during the warranty period for the Contractor to repair or replace the work in whole or in part shall rest entirely with the Director of Water Utilities.

600-1.5 Specifications: All standard specifications, i.e., ASA, AWWA, etc., made a portion of these

specifications by reference shall be the latest edition and revision thereof.

600-2.0 Materials: All pipe for water main construction shall be ductile iron, C-900 PVC, or concrete cylinder pipe. The following are approved materials for water main construction.

600-2.1 Ductile Iron Pipe

Ductile iron pipe to be furnished shall conform to the following standard specifications or latest revision:

ANSI/AWWA C150/A21.50-81

ANSI/AWWA C104/A21.4-80

ANSI/AWWA C151/A21.51-81

All ductile iron pipe shall be cement lined in accordance with AWWA C104-80 (ANSI A21.4) specifications. The external surface shall be coated with an asphalt base paint.

All joints for ductile iron pipe shall be of the rubber gasket bell and spigot type, except where connecting flanged fittings, and shall otherwise conform to the base specifications to which the pipe is manufactured. The joint shall be the latest approved type of rubber gasket joint for ductile iron pipe. All joints of ductile iron pipe and fittings shall be sealed with a continuous ring rubber gasket meeting standards specified by AWWA C111-72 (ANSI A21.11) or its latest revision.

600-2.2 PVC Pipe

Polyvinyl chloride (PVC) pipe shall be manufactured in accordance with AWWA C-900 specification and shall be pressure class 150 PSI. Pipe shall be furnished with bell and spigot joint with rubber gasket joint conforming to the above specification. Spigot ends shall be beveled and reference marked to facilitate joining and insure proper seating depth.

600-2.3 Concrete Cylinder Pipe

Prestressed Concrete Embedded Cylinder Pipe (PCECP) shall be manufactured in accordance with the latest revision of AWWA C-301.

Pretensioned Concrete Cylinder Pipe (PCCP) shall be manufactured in accordance with the latest revision of AWWA C303-78.

Concrete Cylinder Pipe shall withstand a minimum pressure of 150 p.s.i. longitudinally and helically.

The joints of the pretensioned concrete cylinder pipe and fittings shall be sealed with a continuous ring rubber gasket meeting standards specified in AWWA C303-78.

A portland cement mortar shall be used to fill the annular space both inside and outside of joints in the pretensioned concrete cylinder pipe. Portland cement used in the mortar shall conform to "Standard Specifications and Tests for Portland Cement," A.S.T.M. serial designations C150 and C77. Sand for the mortar shall conform to A.S.T.M. designation C33-52T for fine aggregate. The exterior joints on pretensioned concrete cylinder pipe shall be poured with a heavy duty diaper. The width of the diaper shall be nine (9) inches. The band shall be provided with 3/8 inch x 0.20 steel straps on each side.

600-2.4 Cast Iron Fittings

Fittings shall be mechanical joint or rubber gasket AWWA Class D bell with transition gasket for the type pipe used. Flanged fittings, where required, shall be 125 pound American Standard. All fittings shall be lined with cement or coal tar and coated with an asphaltic paint. Fittings shall conform to AWWA C104, AWWA C104, AWWA C110 and AWWA C111 latest revision.

600-2.5 Fabricated Cast Iron Tapping Sleeves for Use on 4" through 2" Pipe

General: The manufacturer of the tapping sleeves shall be experienced in their design and construction and shall have given successful service for a period of at least five (5) years.

Service: The tapping sleeves will be installed on the following types of pipe (1) Cast Iron (2) Ductile Iron (3) Asbestos Cement (4) C-900 PVC. The operating pressure for all four types of water pipe is 150 psi.

Material: The tapping sleeves shall be cast iron, mechanical joint and conform to the latest revision of A.S.T.M. Standard Designations. The tapping sleeve shall withstand a working pressure of 200 psi.

Gaskets: The gaskets shall be duck tipped and shall be totally resistant to cold flow and creep.

600-2.6 Fabricated Steel Tapping Sleeves for use on 14" through 20" Pipe

General: The manufacturer of the tapping sleeves shall be experienced in their design and construction, shall be regularly engaged in their manufacture, and shall have produced tapping sleeves of the sizes specified herein which have given successful service for a period of at least five (5) years.

Materials used in the manufacture of these tapping sleeves and the accessories shall be new and shall conform to the latest applicable standards of the American Society for Testing and Materials.

Service: The tapping sleeves will be installed on the following types of pipe---(1) Cast Iron (2) Ductile Iron (3) Asbestos Cement pipe (4) C-900-PVC pipe. The operating pressure for all three types of water pipe is 150 psi.

Material: All steel plate used in fabrication of the tapping sleeves shall conform to A.S.T.M. Standard Designation A-36 or A-285, Grade C.

Flanges: Flanges shall be fabricated from steel plate, and all dimensions shall conform to AWWA Standard C-207, "Steel Pipe Flanges," Class D. Flanges shall be machined to a flat face with finish of 250 micro-inches or machined to a flat surface with a serrated finished in accordance with AWWA Standard C-207, "Steel Pipe Flanges." In addition, the machined face shall also be recessed for tapping valves in accordance with the M.S. Standard SP-60.

Gaskets: Gaskets shall be compounded from new materials, and the shape of cross-section of gasket shall provide adequate seal for the design pressure. Gaskets shall be shop glued to the groove provided in the body section.

Fasteners: Bolts and hex nuts shall be stainless steel, Usalloy, Dresserloy, Corten or an approved equal for corrosion control.

Testing Outlet: A 3/4" NPT by welded coupling shall be attached to the outlet nozzle of each tapping sleeve assembly complete with a 3/4" square head pipe plug.

Painting: All surfaces of the saddle shall be clean, dry, and free from grease and dirt before painting. All surfaces of tapping sleeve except face of flange, bolts and nuts, shall be given a shop coat of a two-part thermosetting epoxy. Face of flanges shall be shop coated with a rust preventive compound, such as Dearborn Chemical "No-Ox-Id," Houghton "Rust-Veto 344," or Rust-Oleum "R-9". Bolts and nuts shall be shipped bare, no paint, or protective coating.

Certification: The manufacturer shall furnish a sworn statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the Certification shall be sent to the Engineer, City of Lubbock Water Utilities Department.

600-2.7 Gate Valves (Double Disc)

Gate valves 12" and smaller shall be double disc, parallel seat, iron body, bronze mounted throughout. In line valves, 12" and smaller, shall be flanged or mechanical joint as shown on plans. All side outlets on lines 12" and larger shall be flanged. Valves connected to flange outlets shall be flanged on both ends or combination flange and mechanical joint. The valves shall have non-rising stems, shall open by turning to the left (counter-clockwise), and shall be furnished with a 2" operating nut. Valves shall comply with the latest revision of AWWA C-500 standards. Valves shall be Mueller, M & H, Darling, or Clow.

All parts for valves furnished must be standard and completely interchangeable with valves of the same brand. The successful bidder may be required to furnish the owner with a letter stating what type of valve he proposes to use and a letter from the manufacturer stating the parts are standard and interchangeable as herein specified.

600-2.8 Gate Valves (Resilient Seat)

Gate valves 12" and smaller shall be cast or ductile iron with resilient seats. In line valves, 12" and smaller, shall be flanged or mechanical joint as shown on the plans. All side outlets on lines 12" and larger shall be flanged. Valves connected to flange outlets shall be flanged on both ends or combination flange and mechanical joint. The valves shall have non-rising stems, shall open by turning to the left (counter-clockwise), and shall be furnished with a 2" operating nut. Valves shall comply with the latest revision of AWWA C-509 standards. Valves shall be Mueller, M & H, Darling, Clow, or Tyler.

All parts for valves furnished must be standard and completely interchangeable with valves of the same brands. The successful bidder may be required to furnish the owner with a letter stating what type of valve he proposes to use and a letter from the manufacturer stating the parts are standard and interchangeable as herein specified.

600-2.9 Butterfly Valves (14" and Larger)

Butterfly valves shall conform to AWWA Specifications C504-74 for Class 150-B. Valve bodies shall be cast iron and may be either short body or long body lengths. The butterfly valves are for vault installation and shall be equipped with a hand wheel, a 2-inch, operating nut, a locking device, and a position indicator. The valves shall be designed for positive stop in the closed position. The valves shall be manually operated with enclosed worm gear or traveling nut operation and shall be designed to operate at maximum torque with a maximum pull of 80 pounds. The valve shall open by turning to the left (counter-clockwise). The design water pressure differential shall be 150 psi upstream and 0 psi downstream.

Valves installed in vaults shall be painted with heavy-duty machinery paint with color and type to be approved by Engineer.

600-2.10 Pressure Regulating Valves

Service: The function of this valve is to reduce an existing high pressure to a preadjusted lower downstream pressure for varying rates of flow without causing shock or water hammer on the system.

Valve Description: The pressure reducing valve shall be hydraulically operated with a free floating guided piston having a seat diameter equal to the size of the valve. The valve shall be fully bronze-mounted and all packing shall have either leather or rubber seals to provide tight closure and prevent metal to metal friction. An indicator rod shall be furnished as an integral part of the valve to show the position of the piston within the valve body. The valve shall be designed to provide as access opening in the valve body for removing the piston and other internal parts without removing the main valve body from the line.

Material: Cast iron for valve body, flanges and covers shall conform to A.S.T.M. Standard Designation A-126, Class B. Bronze casting or parts for internal trim shall conform to A.S.T.M. Standard Designation B-62.

Valve Ends: All valves shall be furnished with flanged ends sized and drilled in accordance with A.N.S.I.B16.1, Class 125, Specifications. Flanges shall be machined to a flat face with a finish of 250 micro-inches or machined to a flat surface with a serrated finish in accordance with AWWA Standard C-207.

Pilot Valve: The pilot valve for controlling operation of the main valve shall be a single seated, diaphragm operated and spring loaded type. The pilot valve shall be attached to the main valve with piping and isolation valves so arranged for easy access in making adjustments and also for its removal from the main valve while the main valve is under pressure.

Needle Valve: The needle valve shall be all bronze and included with the main valve to control the speed of piston travel.

Operating Pressure: The maximum operating pressure shall be 150 psi gauge.

Testing: The body of the pressure reducing valve shall be given a hydrostatic test of 50% more than the operating pressure specified herein. A second test of check seating of the cylinder shall be made at the operating pressure.

Painting: All surfaces of the valve shall be clean, dry, and free from grease and dirt before painting. All cast iron surfaces, except the machined face of the flange, shall be evenly coated with a suitable primer to inhibit rust, or a black asphalt varnish in accordance with Federal Specification TT-V-51e. The face of flanges shall be shop coated with a rust preventive compound, such as Dearborn Chemical "No-Ox-Id," Houghton "Rust-Veto 344," or Rust-Oleum "R-9."

Certification: The manufacturer shall furnish a sworn statement that the inspection and all of the specified tests have been made, and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the Certification should be sent to the Engineer, City of Lubbock Water Utilities Department.

600-2.11 2-inch Combination Air and Vacuum Release Valves

General: All combination air and vacuum release valves shall be shop assembled and shipped as a complete unit ready for field installation. The large orifice of combination air valve shall allow air to escape during pipeline filling and enter during drainage of the pipeline. It shall close water tight when liquid enters the valve. The small orifice shall release small pockets of air after the pipeline is filled and under pressure.

Valve Body and Cover: The combination air valve shall be the single body type. The valve body and cover shall be designed to operate under a maximum working pressure of 150 psi. Material shall be one of the following:

1. Cast Iron - A.S.T.M. A48-Class 35
2. Cast Steel - A.S.T.M. A27 GR U60-30
3. Ductile Iron - A.S.T.M. A536 GR 65-45-12

Bosses for tapping pipe threads shall be cast integrally with each valve body and cover.

Internal Parts: Float shall be stainless steel. Lever frame shall be Delrin or approved equal. All other internal parts shall be fabricated from bronze.

Valve Seat: Valve seat shall be fabricated from oil resistant synthetic rubber equal to Buna-N or Nitrile.

Size of Orifices: The diameter of the large orifice of the combination air valve shall be two (2) inches and the small orifice diameter shall be three thirty-seconds (3/32) inch.

Inlet: Inlet shall be two (2) inches in diameter with tapered iron pipe thread conforming to AWWA C-800.

Guard Valve and Connecting Pipe: Guard valve to be used with air valve shall be bronze ball valve with female iron pipe thread ends, Ford B-11-777, Mueller H15204 or equal, approved by the Engineer.

Connections between the air valve and the guard valve shall be made using brass nipples with tapered iron pipe threads conforming to AWWA Standard C-800.

Operating Pressure: The maximum operating pressure shall be 150 psi.

Testing: Each shop assembled valve shall be given a hydrostatic test of two (2) times the rated operating pressure and during the test, air shall be injected into the body chamber of the valve to check its ability to release entrained air to the atmosphere under operating pressure.

Painting: All surfaces of the valve shall be clean, dry and free from grease before painting. All exterior and interior surfaces, except the stainless steel trim and the seating surface of the flange face shall be evenly coated with a suitable primer, or a black asphalt varnish in accordance with Federal Specification TT-V51C or Military Specification C-450-C, Type II.

Certification: The manufacturer shall furnish a sworn statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the Engineer, City of Lubbock

Water Utilities Department.

600-2.12 Swing Check Valves 4-Inch through 20-Inch Nominal Diameter

General: Swing check valves shall be manufactured in accordance with AWWA Standard C-508, "Swing-Check Valves for Ordinary Waterworks Service", with the following additional requirements or exceptions.

Valve Description: All valves shall be iron body, fully bronze-mounted, metal to metal seating, and the disc shall be swing type.

Installation: Valves in vaults shall be installed in a horizontal position with exterior lever and adjustable spring, or exterior lever and adjustable weight operation.

Valves which are buried shall be installed in a horizontal position and shall be gravity operated with no external levers or weights.

Service: All valves shall be suitable for frequent operation as well as service involving long periods of inactivity. The operating pressure for all sizes shall be 150 psi gauge.

Bolting Material: Bolts and hex nuts used for attaching top cap to the body shall be the manufacturer's standard, either fabricated from a low-alloy steel for corrosion resistance or electroplated with zinc or cadmium. The hot-dip process in accordance with ASTM Standard Designation A-135 is not acceptable for the threaded portions of the bolts and nuts.

Gasket Material: Flat gasket, either ring type or full faced type, required at the body and cap connection, shall be fabricated from compressed asbestos sheet with a rubber compound binder. Use of a homogeneous rubber or vegetable fiber sheets is not acceptable.

End Connection: All check valves shall be furnished with flanged ends. The size and drilling shall be in accordance with A.N.S.I.-B16.1 Class 125 Specifications; flanges shall be machined to a flat face with a finish of 250 micro-inches or machined to a flat surface with a serrated finish in accordance with AWWA Standard C-207.

Testing: Each valve after shop assembly shall be given the operation and hydrostatic tests in accordance with the referenced Specification.

Painting: All surfaces of the valve shall be clean, dry and free from grease before painting. All ferrous surfaces, exterior and interior, except the seating surfaces of flange faces, shall be evenly coated with a suitable primer to inhibit rust or black asphalt varnish in accordance with Federal Specification TT-V-51e. Flange faces shall be shop coated with a rust preventive compound, such as Dearborn Chemical "No-Ox-Id", Houghton "Rust-Veto 344", or Rust Oleum "R-9".

Certification: The manufacturer shall furnish a sworn statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the Certification shall be sent to the Engineer, City of Lubbock Water Utilities Department.

600-2.13 Fire Hydrants

Fire hydrants shall be standard AWWA C-502 hydrants, iron body, bronze mounted throughout

including drain seat ring, and shall be designed for a working pressure of 150 pounds per square inch. The fire hydrants shall be the traffic model type and shall have a 5-1/4" valve opening, two 2-1/2 inch hose nozzles and one 4-inch steamer nozzle, with 4 threads per inch and a crest to crest dimension of 4.995 inches. The hydrants shall be for 6-inch mains and shall have a M.J. Connection, and shall be for 4-1/2 foot bury unless otherwise shown on plans. The hydrants shall be Clow Medallion, American Darling model B-84-B, Dresser style 129-09 or Mueller Centurion. Operating nuts shall be 1-1/2 inch pentagons measured to a point. The hydrants shall be painted orange.

600-2.14 Valve Boxes, Frame and Cover

All valve boxes for butterfly valves and gate valves larger than 12" shall be poured concrete or precast construction. The valve boxes shall be constructed with the dimensions as called for on the plans. The valve box cover opening shall be centered over operating nut.

Manhole frames and covers shall be of good quality gray iron casting of a pattern similar to that shown on the plans and with a clear opening of not less than 22 inches. The frame and cover shall be designed with a full bearing rings so as to provide a continuous seat between frame and cover. The cover shall be furnished with lifting ring cast into the cover in such manner as to prevent leaking through. The cover shall be marked "City of Lubbock Water", and shall be type No. 40-5 as manufactured by Western Iron Works or approved equal.

Valve boxes for 12-inch or smaller valve shall be cast iron. The boxes shall be designed to fit over a section of 6" clay tile pipe which will be used as an extension from the top of the valve. The box shall have a heavy cast iron cover marked "Water". The box shall have a flange type base approximately 4" larger in diameter than the outside diameter of the barrel of the box. The cover shall be type No. 70 as manufactured by Western Iron Works or approved equal.

600-2.15 Blowoffs: Temporary or permanent blowoffs may be fabricated from two inch pipe with a two inch gate valve on the connecting pipe and with four feet, six inches of cover. Valve to be iron bodied bronze mounted with two inch square operating nut complete with valve box.

600-2.16 Encasement

Encasement pipe shall be corrugated steel or smooth steel pipe. Smooth steel pipe shall have a minimum wall thickness of 1/4". Corrugated pipe shall comply with AASHO specifications.

600-2.17 Gravel for Embedment

Gravel for embedment shall consist of processed natural gravel. The particles shall have irregular surfaces. The material shall be graded within the following limits.

<u>Maximum Retained</u>	<u>Percent</u>
No. 4 Sieve	5-15
No. 10 Sieve	50-90
No. 40 Sieve	90-100

The material shall be sufficiently free from clay, dust, blow sand, caliche or slag so as to prevent shrinkage after jetting and drying.

600-2.18 Concrete

Concrete to be used in the valve chambers, concrete cradling, concrete blocking for fittings, etc., shall be made with portland cement which conforms to "Standard Specifications and Test for Portland Cement", A.S.T.M. Serial Designation C150-41 and C77-40. Concrete aggregates shall consist of natural washed and screened sand, and washed and screened gravel or clean crushed stone conforming to "Standard Specifications for Concrete Aggregate", A.S.T.M. Serial Designation C-33-63. The aggregates shall be well graded from coarse to fine and shall be free from injurious amounts of clay, soft or flaky materials, loam or organic impurities. All aggregates shall be approved by the Engineer before use.

Water used in mixing concrete shall be clear, clean, free from oil, acid or organic matter and free from injurious amounts of alkali, salts or other chemicals.

The concrete mix shall be based on the water-cement ratio, and shall be as follows for the different classes of concrete. All concrete (Class A) for manholes, valve chamber and other reinforced concrete structures shall contain not more than 7.0 gallons of water per sack of cement. All concrete (Class B) for pipe cradling, blocking or fittings, and other non-reinforced concrete shall contain not more than 9 gallons of water per sack of cement. Surface moisture or moisture carried by the aggregates shall be included as part of the mixing water. Class A concrete shall have a minimum 28 day compressive strength of 3000 psi and Class B shall have 2500 psi compressive strength at 28 days.

The proportioning of the constituents of the concrete shall be such as to produce a dense, and workable mixture, and the designed mix shall be approved by the Engineer before any concrete is placed.

600-2.19 Forms

The forms shall be of wood or metal and shall be of sufficient strength to support the concrete without bulging between supports and sufficiently water tight to hold the concrete mortar. The forms shall be so constructed that the finished concrete shall be of the form and dimensions shown on the plans. The walls for all reinforced concrete work shall be formed inside and outside. All form work for exposed surfaces shall be of such material and so constructed as to produce a wall with a smooth, even surface when the concrete is poured. All forms shall be oiled before use. No forms shall be removed without permission of the Engineer. However, in general, wall forms may be removed after the concrete has been in place for 24 hours and on roof slabs after the concrete has been in place for 10 days. Immediately upon removal of the forms any honey-combed sections shall be repaired as directed by the Engineer.

600-2.20 Reinforcing Steel

Reinforcing steel used in concrete shall be deformed bars conforming to "Specifications for Billet-Steel Bars for Concrete Reinforcement", A.S.T.M. A-15 grade 40 or grade 50.

600-3.0 Details of Construction

These general and detailed specifications govern the excavation, trenching, backfilling, handling and installation of various kinds of pipe, construction of manholes, installing fittings, valves, air valves and other work required for the construction of the water distribution mains and accessories all as shown on the plans and as called for herein. The Contractor shall furnish all material, equipment, labor and superintendence necessary to complete the construction of all the work as shown on the

plans and as called for in these specifications.

600-3.1 Surface Preparation

One or more acceptable types of pipe may be used. As such, the Contractor shall have the option of installing any of the acceptable types, provided only one type is used throughout any single size designation or run of pipe.

3.1.1 WITHIN EASEMENTS, CULTIVATED OR AGRICULTURAL AREAS

All vegetation, such as brush, sod, heavy growth or grass or weeds, decayed vegetable matter, rubbish and other unsuitable material within the area of excavation and trench side storage shall be stripped and disposed of.

Topsoil shall be removed from the area to be excavated and stockpiled, or, the Contractor may elect to import topsoil to replace that lost during excavation. Topsoil shall be removed to a depth of 8 inches or the full depth of the topsoil, whichever is less.

3.1.2 WITHIN UNPAVED ROADWAY AREA

The Contractor shall strip that cover material from graveled roadways or other developed, but unpaved traffic surfaces to the full depth of the existing surfacing. The surfacing shall be stockpiled to the extent that it is acceptable for restoration purposes.

3.1.3 WITHIN PAVED AREA

The removal of pavement, sidewalks, driveways or curb and gutter shall be performed in a neat and workmanlike manner. The width of the cut shall exceed the width of the trench at the subgrade by at least 12 inches on each side of the trench.

Concrete pavement, sidewalks, driveways or curb and gutter shall be cut with a power saw to a depth of 2 inches prior to breaking. The concrete shall be cut vertically in straight lines and avoiding acute angles.

Any overbreak, separation or other damage to the existing bitumen or concrete outside the designated cut lines shall be replaced at the Contractor's expense. Excavated paving materials shall be removed from the jobsite and shall not be used as fill or backfill.

Crossings under sidewalks, curbs and gutters or other utility lines may be made by tunneling only if approved by the City Inspector.

600-3.2 Barricades and Safety Measures

The Contractor shall, at his own expense, furnish and erect such barricades, fences, lights, and danger signals, and shall take such other precautionary measures for the protection of persons, property and the works as may be necessary. All safety measures shall meet the requirements of The Texas Manual on Uniform Traffic Control Devices.

The Contractor will be held responsible for all damage to the work due to failure of barricades, signs, and lights to protect it, and when damage is incurred, the damaged portion shall be immediately removed and replaced by Contractor at his own cost and expense. The Contractor's responsibility for maintenance of barricades, signs, and lights shall not cease until the days of issuance to Contractor of

City's certificate of acceptance of the project.

Rules and regulations of local, state and Federal authorities regarding safety provisions shall be observed.

OSHA's regulations for excavations, trenching, and shoring shall be included in the Special Specifications.

600-3.3 Protection of Existing Underground Utilities:

The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures, both known and unknown, may be determined. If required, the Contractor shall excavate and locate existing underground utilities ahead of trench excavation in order that necessity for grade changes may be ascertained in advance. The Contractor shall be held responsible for the repair of such structures when broken or otherwise damaged because of carelessness on his part. Hand excavation shall be used where necessary. The Contractor shall notify local utilities whenever working near gas mains or services or near electrical or telephone cables or when the presence of these utilities is suspected in the area of construction.

600-3.4 Excavation and Trenching

In order to obtain a true, even grade, the trench shall be fine-graded. The material for fine grading shall be free of rocks, roots, grass or any other debris. The depth of the fine grading material shall not exceed three (3) inches. Where the trench is excavated in excess of three (3) inches below grade, the material shall be compacted to 95% Proctor Density or shall be replaced with bedding material. If the material being excavated is rock or other unyielding material, it shall be removed to a depth of three (3) inches below grade and replaced with bedding material to grade. The grade shall be such that the pipe will rest firmly on the bedding material throughout the entire length of the pipe cylinder.

The minimum width of the trench shall be the outside diameter of the pipe plus twelve (12) inches and the maximum width shall be the outside diameter of the pipe plus eighteen (18) inches. The trench shall be cut so that the maximum horizontal offset of the trench walls from the bottom to the top of the trench (undercutting) shall be six (6) inches.

Bell holes of ample dimensions shall be dug at each joint to permit the proper jointing of the pipe and to permit the bottom of the pipe to rest firmly on the bottom of the trench throughout the entire length of the pipe cylinder.

Trench digging machinery may be used to make the trench excavation except in places where its operation would cause damage to trees, buildings, telegraph lines or other existing structures either above or below ground, in such instances hand methods shall be employed to excavate the trench at no additional cost to the owner.

Where necessary to prevent caving, the trench shall be adequately braced and shored. The unit price bid per linear foot of pipe shall include the cost of furnishing, installing, and removing the bracing and shoring.

The Contractor shall take all necessary precautions for protecting paved streets and drives from being damaged by the trenching and backfilling equipment.

All excavated material shall be placed in a manner that will not endanger the work or damage existing

structures.

There will be no classification of the excavated materials and the term excavation shall include all materials encountered in excavating the trench.

600-3.5 Pipe Installation

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

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 and replace such defective material.

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.

Handling Pipe and Accessories: 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 skids shall not be skidded or rolled against pipe already on the ground.

In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Coated and wrapped pipe shall be handled in such manner that a minimum amount of damage to the coating will result. Damaged coating shall be repaired in a manner satisfactory to the Engineer.

Pipe shall be placed on the site of the work parallel with the trench alignment and pipe with bell ends shall be placed with the bell ends facing in the direction in which the work will proceed. 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.

Pipe Laying:

Alignment and Grade: All pipe shall be laid to the alignment as established on the ground by the Engineer. Where grade is being maintained, as shown on the plans, the use of batter board or laser beam will be required to fine grade the trench.

Whenever 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 recommended by the manufacturer of the particular kind of pipe being laid and the degree of deflection shall be approved by the Engineer.

Field cuts on concrete pipe shall be made at all points where, in the opinion of the Engineer, it is necessary to preserve alignment or proper stationing for field connections. Proper care shall be taken to preserve the interior and exterior linings. After the spiral winding has been exposed, the winding shall be tack welded before being cut. In cutting the spiral winding sufficient length shall be allowed to permit a later winding of at least one-half turn on the bell or spigot ring. Where steel cylinder pipe

is cut, the work shall be done in such a way as to allow a snug fit with the bell or spigot ring. A continuous weld shall be run on both the inside and the outside of the ring. The free end of the spiral shall then be wrapped around the ring and its end shall be welded to the ring by running a weld along each side of the rod for a distance of at least six inches. The entire cutting operation shall be done under the direction of a representative of the pipe manufacturer.

Whenever the deflection in a joint exceeds the maximum deflection recommended by the manufacturer, the Engineer may require that the joint be welded. Joints on pipe installed in encasement pipe shall be tack welded or completely welded.

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 as to prevent damage to the material in any way. Under no circumstance shall pipe or accessories be dropped or dumped into the trench.

Cleaning and Inspection: Before lowering into the trench, the pipe shall be again inspected for defects and cast iron pipe while suspended shall be lightly hammered to detect cracks. Any defective, damaged, or unsound pipe or other incidental materials shall be rejected.

All foreign matter or dirt shall be removed from the inside of the pipe, 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. The open end of the pipe in the trench shall be plugged when pipe is not being laid.

Laying and Jointing Concrete Pressure Pipe: Just before making the joint, the gasket and the inside surface of the bell shall be lubricated with film of soft vegetable soap compound (flax soap) to facilitate telescoping the joint. The rubber gasket shall be stretched uniformly as it is placed in the spigot groove to insure a uniform volume of rubber around the circumference of the groove.

Metal spacers of proper thickness shall be held on the inside shoulder of the bell to provide the proper space between abutting ends of 27 inch and larger pipe. The joint shall be telescoped by pulling directly along the center line of the pipe so that the spigot enters squarely into the bell. After the spigot has been telescoped into the bell, the bell end of the pipe being laid shall be moved in accordance with the plans to secure proper grade and alignment. After the joint is in place, a thin metal feeler gauge shall be used to check the position of the rubber gasket around the circumference of the joint.

After the spigot has been telescoped into the bell, the joint checked and found satisfactory, a burlap wrapper shall be placed around the pipe covering the joint. The burlap-type wrapper shall be hemmed at each edge to allow threading with a steel strap to securely fasten the wrapper around the pipe by means of a stretcher and sealer. The length shall be that required to encircle the pipe, leaving enough space between the ends at the top to allow the cement mortar to be poured. The entire joint shall be poured with cement mortar and rodded or agitated to eliminate voids and settlement. Any joint showing shrinkage or excessive cracking shall be cleaned and remade. In hot weather, additional measure may be required to obtain the best quality of joint, such as additional wet burlap, curing membrane, or immediate careful and well-controlled backfilling of the joint with damp earth.

Where size permits, the inside joint recess shall be filled from the inside with mortar and finished off smooth with the inside of the pipe by hand troweling after the pipe has been backfilled. The inside joint recess on pipe smaller in diameter shall be filled by buttering the bell end with mortar

immediately prior to placing the pipe together. After the joint is engaged, the interior of the smaller diameter pipe shall be swabbed to smooth and clean the joints.

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.

Laying and Jointing Ductile Iron Pipe: The gasket seat in the socket, the rubber gasket and the plain end of the pipe to be laid should be wiped clean. After placing a length of pipe in the trench, the plain end of the pipe should be then aligned and started into the socket so that it is in contact with the gasket. Sufficient force then must be exerted on the entering pipe so that the plain end is moved past the gasket and makes contact with the base of the socket. The joint may be deflected but never to exceed manufacturer's recommendations.

Unless otherwise directed, pipe shall be laid with bells facing in the direction of laying; and for lines on appreciable slopes, bells shall, at the discretion of the Engineer, face up grade.

Cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat workmanlike manner without damage to the pipe or the cement lining.

The jointing shall be completed for all pipe laid each day, in order not to leave open joints in the trench over night. At the 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.

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.

Laying and Jointing PVC Pipe: The trench bottom should be constructed to provide firm, stable, and uniform support for the full length of the pipe. Bell holes should be provided at each joint to permit proper joint assembly and pipe support. Any part of the trench bottom excavated below grade should be backfilled to grade and should be compacted as required to provide firm pipe support. When an unstable condition is encountered which will provide inadequate pipe support, additional trench depth should be excavated to a depth not less than three inches (3") below the pipe subgrade over the entire width of the trench and shall be replaced with granular material conforming to specifications for gravel for pipe embedment as stated herein. Such material shall be thoroughly compacted over the entire trench width to the grade established for the bottom of the pipe. Ledge rock, boulders, and large stones should be removed to provide four (4) inches of pipe cushion.

Laying and Jointing Asbestos-Cement Pipe

The pipe shall be lowered in the trench with the couplings and rings on the pipe and shall be placed with care on the previously prepared trench bottom. The couplings shall be assembled as recommended by the manufacturer's recommendations.

Joints made between asbestos-cement pipe and cast iron pipe or fittings shall be made by entering the special machine 3'3" pipe or machine adapter into standard cast iron bell. The joint shall then be finished in accordance with specifications herein for cast iron pipe fittings.

When it is necessary to cut pipe, it shall be done with a cutting device approved by the Engineer, in such a manner as to make a clean even cut. No cutting with axe or chisel will be permitted.

Proper implements, tools, and equipment should be used for placement of the pipe in the trench to

prevent damage. Under no circumstances should the pipe or accessories be dropped into the trench. All foreign matter or dirt should be removed from the pipe interior. Pipe joints should be assembled with care to the depth recommended by the manufacturer.

600-3.6 Backfilling

All trenches and bell holes for all types of pipe, valves, and fittings regardless of the location shall be backfilled with selected backfill material free from rocks, boulders, or other unsuitable material. The backfill material shall be thoroughly compacted with mechanical or hand tamps to midpoint of the pipe.

In existing paved streets the backfill above the midpoint of the pipe shall be compacted with mechanical or hand tamps to 7-1/2 inches below existing paving. In areas where paved streets are not existing the backfill to a point twelve (12) inches above the pipe shall be placed by hand and shall be carefully selected material free of rocks, boulders, clods, organic material, or other debris and lightly compacted prior to placing remaining backfill. The balance of the backfill may be placed in the ditch by hand or by mechanical equipment. No backfill material shall be dropped directly on exposed pipe.

The backfill shall be consolidated by forcing water into the backfill at two (2) feet above the level of compacted material until the water level rises to within eighteen (18) inches of the natural ground surface. Care shall be taken not to flood the ditch or saturate the pipe embedment. The water shall be forced into the backfill at location not more than ten (10) feet apart.

Maintenance of Backfilled Trench: After the trench has been backfilled in the above method, the right-of-way shall be cleared of all rocks larger than one and one-half (1-1/2) inches in diameter and leveled so that the surface will have the same slope and appearance as it possessed before the Contractor began work. All surplus material shall be loaded and wasted at the Contractor's expense, at a location approved by the Engineer.

The above shall include all excavated materials and all rocks or hard lumps which still remain after blading the area back to the original ground grade. Furrows which tend to gather after blading shall be removed, together with excavated material which has drifted or otherwise covered private property.

As the construction work progresses, the contractor will be required to keep the jetting of the backfill and clean up just as close behind the pipe laying and backfilling as possible.

Following the completion of the backfilling the Contractor shall maintain the street and trench surfaces, in a satisfactory manner until final completion and acceptance of the work. The maintenance to include blading from time to time as necessary, filling depressions caused by settlement, sprinkling to settle dust, brooming or flushing at the request of the Engineer and other work required to keep the streets and roads in satisfactory condition for traffic. The Contractor shall maintain and be responsible for all paving cuts until such time as City Forces shall repair cuts with asphalt.

600-3.7 Setting Valves, Valve Boxes and Fittings

Valves and fittings shall be set at the locations shown on the plans or at locations as established by the Engineer, and shall be joined to the pipe in the manner heretofore specified for pipe installation. The valves and fittings shall be adequately blocked for thrust with concrete. Valves shall be set vertically and in concrete valve boxes.

600-3.8 Underground and Overhead Utilities and Structure

The approximate location of all known water mains, gas mains, storm sewers, and sanitary sewers are shown on the plans. However, the consumer service lines from these utilities are not known.

The Contractor will be required to locate all utility lines, including customer 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.

The Contractor will not be allowed to disrupt the service on any utility lines except customer service lines, which may be taken out of service for short period of time provided the Contractor obtains permission from the Engineer and from the owner of the premises being served by the utility.

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 customer lines which are authorized to be cut shall be at his own expense, and as directed by an official representative of the utility company involved.

All utility lines shall be properly supported to prevent settlement or damage to the line both during and after construction. The cost of supporting utility lines shall be included in the unit price bid per foot of pipe.

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

Where pipes, conduits, or concrete curbs or gutters are encountered, the cost of tunnelling shall be included as a part of the cost of the pipe line.

600-3.9 Removing Pavement

General: Wherever it is necessary to make cuts in existing pavements, sidewalks, driveways, or curbs and gutters, the cuts shall be made in such a manner as to cause the least possible damage to adjoining surfaces.

Removal of Asphalt Paving: In removing asphalt pavement, the asphalt surface shall be cut along each side of the trench ahead of the trenching machine and the surfacing and base removed with the trenching machine as the trench is excavated. The width of surface removed by the Contractor is not to exceed the outside diameter of the pipe plus thirty-six (36") inches. Any areas removed or damaged in excess of the above widths will be charged against the Contractor's estimate at the estimated cost per square foot as determined by paving engineer for payment to the City for replacing the excessive width. No separate payment will be made for cutting and removing asphalt paving and caliche base, the cost of this work shall be included as a part of the cost of the pipe line complete in place.

Removal of Concrete Paving: Removal of any sidewalks, concrete pavement, concrete base, concrete curbs and gutters (where allowed) shall be made by cutting the concrete to a straight line on each side of the trench and removing the concrete ahead of the trenching. Normally, tunnelling will be required under curb and gutters. The width of surface removed by the Contractor of concrete paving is not to exceed the outside diameter of the pipe plus thirty-six (36") inches. Any areas removed or damaged in excess of the above widths will be charged against the Contractor's estimate at the estimated cost per square foot as payment to the City for replacing the excessive width. Care shall be taken to preserve any reinforcement encountered as well as possible. Cutting of steel reinforcement will be

allowed only at the approximate center of the pavement cut. Payment for removal of concrete paving shall be included in the unit price bid per foot of pipe installed.

600-3.10 Concrete Cradling and Blocking

Where concrete cradling is used, the concrete shall conform to the concrete specifications.

Before placing the concrete, all loose earth shall be removed from the trench. The concrete shall be placed in the trench by the use of chutes extending to within three (3) feet of the bottom of the trench and shall be deposited uniformly on each side of the pipe in such a manner as not to disturb the grade and alignment of the pipe. The concrete shall be of such consistency that it will flow without separation of the aggregates.

At locations shown on the plans or as directed by the engineer, the contractor will be required to cradle the pipe or block the fittings.

600-3.11 Anchorage of Bends and Plugs, Etc.

Concrete shall be used for blocking the pipe, plugs, and fittings and shall conform to the concrete specifications.

The blocking shall be placed, as directed by the engineer, between solid ground and the fitting to be anchored: the area of bearing on pipe and on the ground in each instance shall be that required by the engineer. The blocking shall be so placed that the pipe and fitting joints will be assessable for repair. The soil bearing value for thrust backing shall be recommended by the pipe manufacturer, and in the absence of such recommendation, the allowable bearing value shall not exceed 3000 lbs. per square foot.

600-3.12 Hydrostatic Tests

Pressure During Test: After the pipe has been laid, the line shall be subjected to a hydrostatic pressure test and leakage test. The line shall be tested at 50 p.s.i. pressure.

Duration of Pressure Test: The duration of each pressure test shall be as directed by the engineer but shall not exceed for (4) hours.

Procedure: Each valved section of pipe shall be slowly filled with water at the specified test pressure measured at the point of lowest elevation. Pressure shall be applied and maintained by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, and all necessary apparatus except meters shall be furnished by the contractor, and the contractor shall furnish all necessary labor for connecting the pump, meter, and gages. The water for filling and making tests on these mains may be obtained at a location designated by the engineer. No charge will be made for water used for this purpose.

As the line is being filled and before applying the test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevation. After the test, the taps shall be tightly plugged.

During the time the test pressure is on the pipe, the line shall be carefully checked at regular intervals for breaks or leaks. Any joints showing appreciable leaks shall be repaired and any cracked or defective pipes or fittings shall be removed and replaced with sound material in the manner provided

and the test shall be repeated until satisfactory results are obtained.

Leakage Test: After all defects have been satisfactorily repaired and all visible leaks stopped, a leakage test shall be made on each valved section of the lines to determine the quantity of water lost by leakage. The contractor shall furnish all labor, material, and equipment (except meters) required for making the test. The leakage shall be determined by measuring the quantity of water supplied to each valved section of the lines, during the test period, when the various sections of the lines are under pressure. No pipe installation will be accepted until or unless the leakage as determined by above test is less than the amount set forth below.

The allowable leakage (gallons per hour) shall not be greater than determined by the following formula:

$$L = \frac{ND P}{7400}$$

L = Gallons Per Hour D = Nominal Pipe Diameter (in.)
N = Number of Joints P = Test Pressure (PSI)

If individual sections show leakage greater than the limits specified above, the contractor shall at his own expense locate and repair the defective joints until the leakage is within the specified allowance.

600-3.13 Sterilization of Pipe Lines

The contractor shall furnish all labor, equipment and material necessary for the chlorination of the new pipe lines which shall be sterilized before being placed in service. The lines shall be sterilized by the application of the 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, and through a corporation stop or other approved connection inserted in the horizontal axis of the newly laid pipe. The water being used to fill the line shall be controlled to flow into the section to be sterilized very slowly, and the rate of application of the chlorinating agent shall be in such proportion 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 twenty-four (24) hours.

Samples shall be taken from the line and will be tested for bacteriologic growth by the Texas Department of Health Laboratory. Samples will be taken twice in a forty-eight (48) hour period not less than twenty-four (24) hours apart.

The sampling riser shall be located at a location farthest from the point of chlorination. The riser shall be above ground and equipped with a faucet for control of flow during sampling.

600-3.14 Clean-up

After the construction is completed and before final acceptance by the City, the contractor shall remove all rubbish, excess materials from the excavation and other debris from the site of the work and all trench surfaces shall be bladed as heretofore specified. The cost of clean-up shall be included in the bid price per foot of pipe installed.

600-3.15 Paving Repair

The contractor shall contact the Street Department at (806) 767-2606 and notify them of proposed street/alley cuts. Paving repair shall comply with the latest revision of the “Pavement Cut Repair Specifications” of the Street Department. A copy of these specifications can be obtained at the Street Department located at 600 Municipal Drive.

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**CITY OF LUBBOCK, TEXAS
WATER UTILITIES DEPARTMENT**

SECTION 602

STANDARD SPECIFICATIONS FOR SANITARY SEWER MAIN CONSTRUCTION

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**CITY OF LUBBOCK, TEXAS
WATER UTILITIES DEPARTMENT**

SECTION 602

STANDARD SPECIFICATIONS FOR SANITARY SEWER MAIN CONSTRUCTION

602-1.0 General: All sanitary sewer main construction within the City of Lubbock sanitary sewerage system or for future connections to the City of Lubbock sanitary sewerage system shall be

accomplished in accordance with the requirements of these specifications.

602-1.1 Approved Plans: Sanitary sewer main construction shall be done in accordance with engineered construction plans for the work, prepared under the direction of a Professional Engineer and approved by the City of Lubbock Water Utilities Department prior to construction. Plans shall conform with the City of Lubbock's Minimum Design Standards for Sanitary Sewer and shall show all information called for on the "City of Lubbock Check List for Sanitary Sewer Main Construction Plans."

602-1.2 Inspection: All work shall be inspected by a representative of the Water Utilities Department, hereinafter called "City Inspector," who shall have the authority to halt construction when, in his opinion, construction is being performed contrary to these specifications or other approved plans, specifications and materials. Whenever any portion of these specifications is violated, the Director of Water Utilities, by written notice, may order that portion of construction which is in violation of these specifications or other approved plans, specifications and material to cease until such violation is corrected.

602-1.3 Guarantees and Acceptance: All equipment and materials incorporated in the project and all construction shall be guaranteed against defective materials and workmanship. Prior to final acceptance, the Contractor shall furnish to the Owner, a written general guarantee which shall provide that the Contractor shall remedy any defects in the work, and pay for any and all damages of any nature whatsoever resulting in such defects, when such defects appear within one year from date of final acceptance of the work as a result of defective materials or workmanship, at no cost to the Owner (City of Lubbock).

The determination of the necessity during the warranty period for the Contractor to repair or replace the work in whole or in part shall rest with the Director of Water Utilities.

602-1.4 Specifications: All standard specifications and quality standards; i.e., ASA, AWWA, ASTM, etc., which are made a portion of these specifications by reference shall be the latest edition and revision thereof.

602-2.0 Materials: Materials approved for sewer line construction are as described in the following paragraphs.

602-2.1 Vitrified Clay Pipe and Fittings

Vitrified clay sewer pipe and fittings shall conform to the requirements of the latest revision of A.S.T.M. Specifications C-700 for Clay Sewer Pipe.

The Diameters of every acceptable hub or socket shall be ample to permit the insertions of the spigot to the full depth of the socket and to provide an annular space around the entire circumference of sufficient size to permit the proper jointing of the pipe. Any projection on the end of a spigot or on the shoulder of a socket may be removed by chipping, if this can be done without injury to the pipe.

Pipes intended to be straight shall have a maximum deviation 1/8 inch per foot of length as measured from a chord across the concave side. Acceptable pipe shall be laid with the curvature in a horizontal plane.

All clay pipe shall be tested and inspected in accordance with A.S.T.M. specifications at the factory and shall be inspected by the Engineer prior to installation. The Engineer shall inspect the pipe for roundness, cracks, broken sockets, broken blisters, glaze faults and dimension variations and shall

reject all pipe that does not conform to the A.S.T.M. specifications.

602-2.2 Polyvinyl Chloride Pipe (Gravity Flow)

PVC pipe shall conform to the requirements of the latest revisions of A.S.T.M F-679 and D-3034 for SDR 35 sewer pipe. The pipe shall be jointed with an integral bell, bell and spigot type rubber gasketed joint. Each integral bell joint shall consist of a formed bell complete with a single rubber gasket. Gaskets shall conform to ASTM F477. The length of joints shall be 20 feet ± one inch.

PVC pipe shall be installed in accordance with the manufacturer's recommendations and shall not exceed five percent (5%) deflection. PVC pipe exceeding 5% deflection shall be replaced by the contractor at his expense. The minimum pipe stiffness factor shall be 46 p.s.i.

602-2.3 Polyvinyl Chloride Pipe (Force Main)

PVC (Pressure Rated Pipe) shall conform to the requirements of ASTM D2241 for SDR 26, 1PS, 160 p.s.i. pipe. The pipe shall be joined with an integral bell, bell and spigot type rubber gasketed joint. Each integral bell joint shall consist of a formed bell complete with a single rubber gasket. Gaskets shall conform to ASTM F477. The length of joints shall be 20 feet ± one inch.

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602-2.4 Polyvinyl Chloride Pipe Spiral Wound

PVC (spiral wound) pipe and fittings shall conform to the requirements of the latest revision of A.S.T.M. F 794 for large diameter ribbed gravity sewer pipe.

PVC Spiral Wound Pipe shall be installed in accordance with the manufacture's recommendations and shall not exceed five percent (5%) deflection. PVC Spiral Wound Pipe exceeding 5% deflection shall be replaced by the Contractor at his expense. The minimum pipe stiffness factor shall be 46 p.s.i.

602-2.5 Polyethylene Pipe

The pipe shall be made of high density, high molecular weight polyethylene pipe material meeting the requirements of ASTM F 894 - latest revision.

Rubber gaskets shall comply in all respects with the physical requirements specified in the non-pressure requirements of ASTM Specifications C-443.

Polyethylene pipe shall be installed in accordance with the manufacturer's recommendations and shall not exceed five percent (5%) deflection. Polyethylene pipe exceeding 5% deflection shall be replaced by the contractor at his expense.

602-2.6 Ductile Iron Pipe

The pipe shall conform to ANSI/ASTM specifications A746-77 or latest revision for Ductile Iron Sewer Pipe and shall have a 30 mil thickness epoxy lining on the interior and exterior coating of coal tar pitch conforming to requirements of Federal Specifications WW-P-421.

All joints for Ductile Iron shall be of the rubber gasket bell and spigot, except when otherwise shown on the plans and where connecting to flanged fittings, and shall conform to the base specifications to

which the pipe is manufactured.

Fittings shall be A.W.W.A. Standard Class "D" bell and spigot type or an approved gasket joint for the particular type of pipe used and designed for the pressures of the pipe except as shown on the plans. Flanged fittings where required, shall be 125 pound American Standard. All fittings shall be lined with 30 mil thickness epoxy lining on the interior and exterior shall be coated with an asphalt paint.

602-2.7 Precast Reinforced Concrete Manholes

Manhole barrel, cone, and extension sections shall be constructed of precast concrete. A plant inspection may be required for production facility inspection and to review record-keeping for material certification. The manufacturer must provide certification that all materials used for manufacturing meet with the following ASTM Specifications.

Aggregates	ASTM C- 33
Cement	ASTM C-150
Sampling Specimens	ASTM C- 39
Reinforcing	ASTM C-185
Sand and Mortar	ASTM C-144

Precast concrete sections for manholes shall conform to ASTM C-478 specifications. Compressive strength test results must verify concrete strengths meet or exceed 4,000 psi. Aggregate shall be crushed limestone and shall conform to ASTM C-33 specifications.

Joints, excepting grade rings, shall be tongue and groove or an equivalent male and female type joint as approved by the Engineer. All joints shall be effectively jointed to prevent leakage and infiltration. All connections between wall sections shall be joined with Conseal Joint Sealant or approved equal to provide a watertight manhole. This sealant will be provided by supplier and will be considered an essential part of each shipment.

All cones and adjusting rings shall maintain a clear 24" opening. Adjusting rings shall be reinforced with the same percentage of steel as risers and tops and will also meet ASTM C-478 specifications. Adjusting rings, as well as all precast concrete manhole products, shall be smooth, uniform in size and dimensions, consistent in components throughout and free of voids or honeycombs.

All manholes shall be designed to withstand H-20 AASHTO loading. They shall also have lifting holes that do not protrude through manhole wall; one full inch of concrete thickness must remain between lift hole and outside wall of manhole.

602-2.8 Manhole Frames and Cover

Manhole frames and covers shall be of good quality gray iron casting and conform to A.S.T.M. Designation A48 (latest revision), having a clear opening of not less than 22 inches. The casting shall be designed with a full bearing ring so as to provide a continuous seat between frame and cover. The cover shall be furnished with lifting ring cast into the cover in such manner as to prevent water leaking through. Frame and cover shall have a weight of not less than 275 pounds. The manhole ring and cover shall be Western Iron Works #40 or approved equal. The cover shall include lettering, City of Lubbock, Texas sanitary sewer.

602-2.9 Concrete and Mortar

Cement - Portland cement shall conform to A.S.T.M. C-150 specifications.

Aggregate - Fine and coarse aggregate to be used in concrete shall conform to A.S.T.M. C-33 specifications.

Mortar and Sand - Sand to be used in cement mortar shall conform to ASTM C-144 specifications.

All concrete (Class A) for manhole bottoms, piers and other reinforced concrete structures shall contain not more than 7.0 gallons of water per sack of cement. All concrete (Class B) for pipe cradling, blocking of fittings, and other non-reinforced concrete shall contain not more than 9.0 gallons of water per sack of cement. Surface moisture or moisture carried by the aggregates shall be included as part of the mixing water. Class A concrete shall have a minimum 28 day compressive strength of 3,000 p.s.i. and Class B shall have 2,500 p.s.i.

602-2.10 Reinforcing Steel

All reinforcing steel shall conform to current A.S.T.M. specifications A-15, A-16, or A-305. Wire mesh shall be woven or electrically welded, cold-drawn mild steel wire fabric. Reinforcing bars shall be in the deformed bar type.

All reinforcement shall be permanently marked with grade, identification marks or shall, on delivery, be accompanied by a manufacturer's guarantee.

602-2.11 Forms

Forms for all concrete work shall be of wood or approved metal forms. Wood sheeting forming surfaces exposed to sight or weather shall be plywood or plywood lined of a quality to produce smooth surface, free from excessive form marks and shall meet the approval of the Engineer before use. The same type of form shall be used for all exposed portions of the work.

Forms shall be constructed true to lines, grades and sections shown on the plans and shall be mortar-tight and sufficiently rigid to prevent displacement of sagging between supports. Wall forms shall be set plumb and true and rigidly braced to maintain them in correct position and alignment. Temporary openings for cleaning and inspection shall be provided at the base of vertical forms or other places where necessary. Such openings shall be neatly and securely closed before concrete is placed.

Form ties approved by the Engineer shall be adjustable in length and of such type as to leave no metal closer than 1 inch of the surface, and shall not be fitted with lugs, cones, washers, or other devices acting as a spreader which will leave a hole larger than 7/8 inch in diameter or depth back of the exposed surface of the concrete. Wire ties will not be permitted.

602-2.12 Curing Compound

Compounds used to form an air tight membrane over a fresh concrete surface shall be in accordance with Texas Highway Department Item 531.2.

602-2.13 Embedment

The embedment shall be crushed stone with irregular surfaces and comply with the following

gradation requirements.

% By Weight

Retained on 1" Sieve	0
Retained on 7/8" Sieve	0 - 2
Retained on 3/4" Sieve	15 - 35
Retained on 5/8" Sieve	55 - 100
Retained on 3/8" Sieve	95 - 100
Retained on No. 10 Sieve	99 - 100

602-3.0 Gravity Flow Sanitary Sewer Pipe Installation

3.01 SCOPE

The work covered by this Specification consists of constructing gravity flow sanitary sewers, including appurtenances normally installed as a part of this system. Construction may include surface preparation; trench excavation; shoring, dewatering; lay, align and join pipe installation of appurtenances; bedding and backfilling; surface restoration and other related work.

3.02 QUALITY STANDARDS

The latest published revision of the quality standards in effect shall apply.

AASHTO T 99: Moisture-Density Relations of Soils, using a 5.5 lb. Rammer and a 12 inch Drop

ASTM A 746: Ductile Iron Gravity Sewer Pipe
(ANSI)

ASTM C 12: Installing Vitrified Clay Pipe Lines

AWWA C 600: Installation of Gray and Ductile
Cast Iron
(ANSI) Water mains and Appurtenances

AWWA M 23: Polyvinyl Chloride (PVC) Pipe Design and Installation

UNI B 5: Recommended Practice for Installation of Polyvinyl Chloride (PVC) Sewer Pipe

ACPA : Concrete Pipe Installation Manual (Published by American Concrete Pipe Association)

NCSPA Installation
Manual : Installation Manual for Corrugated Steel
Drainage Structures
(Published by National Corrugated Steel
Pipe Association)

LCP-4781 : Semi-Rigid Truss Pipe Handbook

(Published by Armco, Construction Products Division)

Vitrified Clay Pipe Handbook (Published by National Clay Pipe Institute)

3.03 MATERIALS

The Contractor shall install sanitary sewer pipe of the type, diameter, wall-thickness and protective coating that is defined in the Special Provisions or designated by the City of Lubbock Water Utilities Department.

602-3.1 Surface Preparation

One or more acceptable types of pipe may be used. As such, the Contractor shall have the option of installing any of the acceptable types, provided only one type is used throughout any single size designation or run of pipe.

3.1.1 WITHIN EASEMENTS, CULTIVATED OR AGRICULTURAL AREAS

All vegetation, such as brush, sod, heavy growth or grass or weeds, decayed vegetable matter, rubbish and other unsuitable material within the area of excavation and trench side storage shall be stripped and disposed of.

Topsoil shall be removed from the area to be excavated and stockpiled, or, the Contractor may elect to import topsoil to replace that lost during excavation. Topsoil shall be removed to a depth of 8 inches or the full depth of the topsoil, whichever is less.

3.1.2 WITHIN UNPAVED ROADWAY AREA

The Contractor shall strip that cover material from graveled roadways or other developed, but unpaved traffic surfaces to the full depth of the existing surfacing. The surfacing shall be stockpiled to the extent that it is acceptable for restoration purposes.

3.1.3 WITHIN PAVED AREA

The removal of pavement, sidewalks, driveways or curb and gutter shall be performed in a neat and workmanlike manner. The width of the cut shall exceed the width of the trench at the subgrade by at least 12 inches on each side of the trench.

Concrete pavement, sidewalks, driveways or curb and gutter shall be cut with a power saw to a depth of 2 inches prior to breaking. The concrete shall be cut vertically in straight lines and avoiding acute angles.

Any overbreak, separation or other damage to the existing bitumen or concrete outside the designated cut lines shall be replaced at the Contractor's expense. Excavated paving materials shall be removed from the jobsite and shall not be used as fill or backfill.

Crossings under sidewalks, curbs and gutters or other utility lines may be made by tunneling only if approved by the City Inspector.

602-3.2 Barricades and Safety Measures

The Contractor shall, at his own expense, furnish and erect such barricades, fences, lights, and danger signals, and shall take such other precautionary measures for the protection of persons, property and the works as may be necessary. All safety measures shall meet the requirements of The Manual on Uniform Traffic Control Devices.

The Contractor shall be held responsible for all damage to the work due to failure of barricades, signs, and lights to protect it, and when damage is incurred, the damaged portion shall be immediately removed and replaced by Contractor at his own cost and expense. The Contractor's responsibility for maintenance of barricades, signs, and lights shall not cease until the days of issuance to Contractor of City's certificate of acceptance of the project.

Rules and regulations of local, state and Federal authorities regarding safety provisions shall be observed.

OSHA's regulations for excavations, trenching, and shoring shall be included in the Special Specifications.

602-3.3 Protection of Existing Underground Utilities:

The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures, both known and unknown, may be determined. If required, the Contractor shall excavate and locate existing underground utilities ahead of trench excavation in order that necessity for grade changes may be ascertained in advance. The Contractor shall be held responsible for the repair of such structures when broken or otherwise damaged because of carelessness on his part. Hand excavation shall be used where necessary. The Contractor shall notify local utilities whenever working near gas mains or services or near electrical or telephone cables or when the presence of these utilities is suspected in the area of construction.

602-3.4 Trench Excavation:

The Contractor shall excavate as necessary to attain the lines and grades at the locations shown on the Plans or as staked in the field. All trench excavations shall be open cut, unless otherwise shown on the Plans or approved by the City's Inspector. There will be no classification of materials excavated.

The Contractor shall protect adjoining private and public property and facilities, including underground and overhead utilities, curbs, sidewalks, driveways, structures and fences. Disturbed or damaged facilities or property shall be suitably restored or replaced at the Contractor's expense.

Excavated materials unsuitable for backfill or not required for backfill shall be disposed of by the Contractor.

The Contractor shall prevent surface water from flowing into excavations. Water shall not be permitted to rise in trenches that have not been backfilled. Any pipe having its alignment or grade changed as a result of a flooded trench shall be re-laid at the Contractor's expense.

Repose of excavation and use of shoring, sheathing, or trenching boxes shall conform to current OSHA regulations and all state and local safety requirements.

3.4.1 TRENCH DIMENSIONS

3.4.1.1 Width

The width of the trench shall provide adequate working room for installation, joining and proper compaction along both sides of the pipe. Trenches shall conform to the following dimensions, unless otherwise shown on the Plans.

NOMINAL SIZE OF PIPE	MAXIMUM TRENCH WIDTH AT TOP OF PIPE	MINIMUM TRENCH WIDTH AT PIPE SPRINGLINE
Less than 18"	Pipe O.D. + 18"	Pipe O.D. + 12"
18" thru 36"	Pipe O.D. + 24"	Pipe O.D. + 18"
37" thru 60"	Pipe O.D. + 30"	Pipe O.D. + 24"

The width of the trench above the top of the pipe may be as wide as necessary for shoring, bracing or proper installation of the pipe. Excavation in paved areas shall be confined to a minimum practical width.

The Contractor may be required to take remedial actions defined by the Water Utilities Engineer if the maximum trench width exceeds that shown in the table. The specified remedy shall be at the expense of the Contractor.

3.4.1.2 Depth

Trench depth shall be shown on the Plans as depth of bury or invert grade. Pipe trenches shall be excavated to provide a trench bottom that is firm for its full length and width. Care shall be taken to prevent excavation below the required depth.

3.4.2 TRENCH GRADING AND FINE GRADING

3.4.3. EXCAVATION FOR STRUCTURES AND APPURTENANCES

602-3.5 Dewatering:

All pipe trenches and excavation for structures and appurtenances shall be kept free of water during pipe laying and other related work. The method of dewatering shall provide for a dry foundation at the final grades of the excavation. Water shall be disposed of in a manner that does not inconvenience the public or result in a menace to public health. Pipe trenches shall contain enough backfill to prevent pipe flotation before dewatering is discontinued. Dewatering shall continue until such time as

it is safe to allow the water to rise in the excavation.

602-3.6 Laying, Aligning and Joining Pipe:

Sanitary sewer pipe shall be installed in accordance with the manufacture's recommendations for installing the type of pipe used, unless otherwise shown on the Plans or as directed by the Water Utilities Department.

Proper equipment, implements, tools and facilities shall be provided and used by the Contractor for safe and convenient installation of the type of pipe being installed.

3.6.1 RESPONSIBILITY FOR MATERIAL

The Contractor shall be responsible for all materials intended for the Work that are delivered to the construction site and accepted by him. Payment shall not be made for materials found to be defective or damaged in handling after delivery and acceptance. Defective or damaged materials shall be removed and replaced with acceptable materials at the Contractor's expense.

The Contractor shall be responsible for the safe and proper storage of such materials, until incorporated into the Work.

3.6.2 HANDLING

Pipe and accessories furnished by the Contracting Agency shall be unloaded and distributed at the site by the Contractor. Each pipe shall be unloaded adjacent to or near the intended laying location.

Pipe, fittings, specials, valves and appurtenances shall be unloaded and stored in a manner that precludes shock or damage. Such materials shall not be dropped.

Pipe shall be handled so as to prevent damage to the pipe ends or to any coating or lining. Pipe shall not be skidded or rolled against adjacent pipe. Damaged coatings or linings shall be repaired by the Contractor, at his expense in accordance with the recommendations of the manufacturer, and in a manner satisfactory to the City's Inspector.

3.6.3 LAYING PIPE

The pipe and pipe coatings shall be inspected for damage or defects before being placed in the trench. Damaged or defective pipe shall not be installed. Damage to the coatings, linings, or pipe shall be repaired in accordance with pipe manufacturer's recommendations.

After the trench has been properly fine graded, the pipe shall be laid in accordance with the following specifications. Each length of pipe shall be inspected for defects and shall be thoroughly cleaned before being lowered into the trench. Pipe laying shall proceed up-grade with the spigot ends pointing in the direction of flow. All pipe shall be laid true to the lines and grades as established by the Engineer, batter boards or laser beam shall be used and each length of pipe set to grade. Bell holes shall be dug at each joint of sufficient depth to allow the entire length of the barrel of the pipe to rest on the bottom of the trench and to allow ample space for properly jointing the pipe.

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, then open ends of the pipe shall be properly plugged. No pipe shall be laid in water, or when trench conditions or weather is unsuitable for such work. If the pipe is disturbed from line and grade after being laid, the pipe shall be removed from trench, the joints cleaned and the pipe relaid.

The Water Utilities Department shall be notified at least 24 hours in advance of when pipe is to be laid in any trench. No pipes shall be covered or authorized for cover until they have been inspected by the City's Inspector.

602-3.7 Backfilling Around Pipe:

The backfill around the pipe and to a point 12" above the top of the pipe shall be carefully placed and shall be loose top soil or finely divided caliche free of organic matter, rocks or hard clods larger than two inches.

The remainder of the backfill that is above twelve inches (12") higher than the top of the pipe at all locations, except under highway crossings and railroad crossings, shall be backfilled with loose excavated material in 12" maximum layers and compacted by forcing water into the backfill at the level of the top of pipe until the water level rises to within eighteen inches of the natural ground surface. The water shall be forced into the backfill at locations not more than ten feet apart.

In areas to be capped with concrete, the remainder of the backfill that is above twelve inches (12") higher than the top of the pipe shall be backfilled with select excavated material in 6 inch to 12 inch layers and compacted to 95% standard proctor density. The moisture content shall be attained by prewetting and thoroughly mixing before applying appropriate layers to accomplish desired compaction. All surplus material shall be loaded and wasted at the Contractor's expense, at locations approved by the Engineer.

Following the completion of the backfilling the Contractor shall maintain the street and trench surfaces, in a satisfactory manner until final completion and acceptance of the work. The maintenance to include blading from time to time as necessary, filling depressions caused by settlement, sprinkling to settle dust, brooming or flushing at the request of the Engineer and other work required to keep the streets and roads in satisfactory condition for traffic. The Contractor shall maintain and be responsible for all paving cuts until such time as City Forces shall repair cuts with asphalt.

602-3.8 Surface Restoration:

All streets, alleys, driveways, sidewalks, curbs or other surfaces broken, cut or damaged by the Contractor shall be resurfaced in kind or as shown on the Plans.

602-3.9 Clean Up:

All rubbish, unused materials and other non-native materials shall be removed from the jobsite. All excess excavation shall be disposed of as specified by the City's Inspector, and the right-of-way shall be left in a state of order and cleanliness.

602-3.10 Manhole Construction:

3.10.1 SCOPE

The work covered by this Subsection consists of constructing precast; pre-assembled or field assembled manholes for sanitary sewers. Construction consists of excavation; shoring; dewatering; subgrade preparation; construction of base; placement and assembly of risers, cone, or tops; installation of ring, cover and adjusting rings; backfilling; surface restoration and other related work.

3.10.2 QUALITY STANDARDS

The latest published revision of:

ASTM C 891: Installation of Underground Precast Concrete Utility Structures shall apply.

3.10.3 MATERIALS

The Contractor shall install manholes of the dimensions shown on the Plans.

3.10.4 MANHOLE BASE

Field poured concrete bases shall be at least 12 inches thick and not less than 1 (one) foot greater diameter than the outside diameter of the manhole riser section. Concrete shall be minimum 3000 psi. Concrete placement shall conform to ACI and good construction practices. Concrete shall be consolidated and struck-off to a horizontal surface within the forms or pouring rings.

Field poured concrete bases shall be reinforced as detailed on the Plans or as shown in the Standard Details.

Precast reinforced concrete bases shall be of the size and shape detailed on the Plans or as shown in the Standard Details.

3.10.5 MANHOLES BARRELS

Manhole barrels shall be assembled of precast riser sections. Riser sections shall be placed vertically with tongues and grooves properly keyed.

Invert channels shall be smooth and semi-circular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels may be formed directly in the concrete of the manhole base or may be half-pipe laid in concrete. The floor of the manhole outside the channel shall be smooth and shall slope toward the channel not less than one inch per foot, nor more than two inches per foot.

Free drop inside the manhole shall not exceed 30" measured from the invert of the inlet pipe to the invert of the outlet pipe. Where the drop exceeds 30", drop manholes shall be constructed as detailed on the Plans or as shown in the Standard Details.

All connections between the riser or base sections and the sewer pipe shall be joined in such a manner as to make the manholes watertight. Preformed rubber waterstop gaskets cast into the riser or base section methods. Preformed flexible plastic sealing compounds similar or equal to "Ramnek" or "Kent Seal" are also acceptable, provided acceptable watertightness is

achieved.

3.10.9 TOP OR CONE SECTIONS

Flat top sections may be used on shallow lines where standard cone sections will not conform to specified elevations.

Cone shaped top section shall be assembled on top of the manhole barrel with tongues and grooves properly keyed.

Adjusting rings or brick may be used for adjusting the top elevation, except that the total height of the adjusting rings shall not exceed 12 inches at any manhole. Each manhole shall have a minimum of 6 inches of grade adjustment.

Rings shall be set to the elevations shown on the Plans or established by the City's Inspector. Concrete shall be placed around and under the ring to provide a seal and properly seat the ring at the required elevation. Concrete shall be rounded-off in accordance with the Standard Details.

3.10.10 WATERTIGHTNESS

The finished manhole is expected to be as watertight as the pipe system it is incorporated into. Infiltration or exfiltration shall not exceed the limits established in Subsection 602-3.14.

All connections between riser sections, bases and tops shall be sealed with preformed flexible plastic joint sealing compound. Application of primer and sealing compound shall be accomplished in conformance with the manufacturer's recommendations. Grade of materials, quantity of materials and application temperatures recommended by the manufacturer shall govern. Sealing compound similar or equal to "Ramnek" or "Kent Seal" shall be used.

3.10.11 BACKFILLING

Backfilling around manholes shall conform to the requirements as specified for backfilling. Bedding material shall be placed up to a point equal to that required for the adjacent pipe.

3.10.12 SURFACE RESTORATION

Surface restoration shall conform to the requirements of Subsection 602-3.8.

3.10.13 QUALITY CONTROL

Inspection, testing, approval and acceptance shall conform to the requirements of Subsection 602-3.13.

Materials not inspected by the City's Inspector or damaged by an action of the Contractor may be subsequently rejected and replaced at the Contractor's expense.

3.10.14 CLEAN UP

All rubbish, unused materials and other non-native materials shall be removed from the jobsite. All excess excavation shall be disposed of as specified, and the right-of-way shall be left in a state of order and cleanliness.

602-3.11 Connection to City Sewerage System:

Flow of any kind into the existing sewerage system shall not be allowed until the sewer has been satisfactorily completed and accepted for use by the Water Utilities Department.

602-3.12 Tees for Service Connections:

The Contractor shall place wyes and tees for service connections where required by the approved construction plans. Watertight plugs shall be installed in each branch pipe or stub. Tee locations shall be marked with a piece of two inch by four inch lumber extended from the end of the pipe to above ground level. Service lines shall be installed to property line.

602-3.13 Inspection, Testing, Approval and Acceptance of Gravity Flow Sanitary Sewers:

3.13.1 SCOPE

The work covered by this Specification consists of the inspection, testing, approval and acceptance of gravity flow sanitary sewers, including appurtenances normally installed as part of the system. The work may include leakage testing, deflection testing of flexible pipe system and television inspection of the interior of the finished sewer system.

3.13.2 QUALITY STANDARDS

The latest published revision of the Quality Standards in effect at the time of bid shall apply.

ASTM C 969: Infiltration and Exfiltration Acceptance Testing of Installed Sewer Lines

ASTM C 828: Low Pressure Air Test of Sewer Lines.

UNI B 6: Recommended Practice for Low-Pressure Air
Testing of Installed Sewer Pipe.
(Published by Uni-Bell Plastic Pipe Association)

3.13.3 MATERIALS

Water used for exfiltration tests shall be potable or as otherwise approved by the City's Inspector.

Equipment necessary for any of the tests shall be of the type, quality and capacity to perform the operations required and to execute the tests specified, and shall be furnished by the Contractor along with all labor and materials including water.

3.13.4 INSPECTION

The City's Inspector shall inspect and approve all work accomplished. Deflection testing shall be performed at the discretion of the City's Inspector.

3.13.5 CLEANING

Prior to testing any section of sewer, the Contractor shall remove all foreign matter from the

interior of the system. Flushing a cleaning ball, pressure jetting or other appropriate cleaning method approved by the City's Inspector may be used. Watertight plugs or other methods approved by the City's Inspector shall then be used to prevent dirt or debris from entering the system.

3.13.6 TESTING

Testing shall be conducted by the Contractor and at this own expense.

All testing shall be accomplished in the presence of the City's Inspector or his authorized representative. The City's Inspector shall be notified 24 hours in advance of the testing.

Testing shall not commence on any portion of the pipeline, until all field placed concrete in contact with the pipe, fittings or appurtenances is adequately cured.

The Contractor shall have the option of conducting a water exfiltration test, a low-pressure air test, or an infiltration test if the pipeline is continuously subjected to an exterior hydrostatic head.

The sewer line being tested may be filled with water for a period long enough to allow water absorption in the pipe wall. The saturation period shall be a minimum of 4 hours and not more than 72 hours.

3.13.6.1 Exfiltration Test

Each section of the pipeline shall be tested between successive manholes or other structures. The lower end of the section shall be closed with a watertight device. The inlet end of the section to be tested shall be filled with water to a point 4 feet above the pipe invert at the centerline of the upper manhole or structure. If the ground water level is above the pipe invert, the water level in the upper manhole shall be 4 feet above the adjacent ground water level. Ground water level shall be determined by the City's Inspector.

The allowable leakage by exfiltration shall not exceed 200 gallons/inch diameter/mile/day. The leakage shall be measured by checking the drop in the water level in the upper manhole or structure over a period of 4 hours. The Contractor shall repair obvious or concentrated leaks and whatever repairs are necessary to reduce exfiltration leakage to an acceptable rate. The Contractor shall repeat the 4 hour exfiltration test after repairs until an acceptable leakage rate is attained. All repairs required shall be at the Contractor's expense.

3.13.6.2 Low-Pressure Air Test

The low-pressure air test shall be conducted in accordance to the provisions of UNI-B-6, "Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe," published by Uni-Bell Plastic Pipe Association.

The Contractor shall repeat the low-pressure air test after repairs until an acceptable pressure drop for the test is attained. All repairs required shall

be at the Contractor's expense.

3.13.6.3 Infiltration Test

Infiltration tests are acceptable only if the pipeline is continuously subjected to an external hydrostatic head (ground water level) of at least 2 feet above the top of the pipe at the upstream manhole or structure. Ground water level shall be determined by the City's Inspector.

Infiltration test shall be made by sealing the inlet and outlet ends of this pipeline and measuring the volume of water that infiltrates into the section being tested. Flow measurement may be measured by collecting the discharge into a volumetric measuring container, weir or other approved method.

The allowable infiltration shall not exceed 200 gallons/inch diameter/mile/day. The test shall be continued over a period of at least 4 hours. Time shall be allowed to soak lines and manholes in advance of performing test. The Contractor shall repair obvious or concentrated leaks and whatever repairs that are necessary to reduce the infiltration to an acceptable rate.

The Contractor shall repeat the 4 hour infiltration test after repairs until an acceptable infiltration rate is attained. All repairs required shall be at the Contractor's expense.

Whenever the rate of infiltration is found to exceed the prescribed amount, the Contractor shall be notified in writing. The Contractor may then be required, by the Water Utilities Department, to provide at his own expense, electronic or photographic visual inspection of the interior of the conduit. The Contractor shall make appropriate repairs by methods approved by the Water Utilities Department and shall continue to test the conduit until it is proven satisfactory.

3.13.7 GENERAL

Final acceptance of the sewer line shall be based on an inspection covering all items in this specification. The inspection shall be done in an appropriate manner by representatives of the Water Utilities Department. The Contractor shall remedy, at his own expense, any poor alignment or any other defects in workmanship or materials revealed by final inspection. Final acceptance will be based on reinspection of the sewer after the appropriate repairs and corrections are completed.

3.13.8 T.V. INSPECTION

Where determined necessary by the City's Inspector, the sewer shall be inspected by T.V. camera prior to final acceptance of the pipeline. The costs incurred in making the initial inspection by T.V. camera shall be borne by the Contracting Agency.

T.V. equipment expressly designed for pipeline inspection purposes and operated by experienced and qualified personnel shall be pulled through the entire pipeline. The T.V. operator shall maintain a log of all inspections and note location, type and extent of any

deficiencies. The T.V. operator shall also photograph all deficiencies and not less than one "typical" location per each 500 feet of pipeline inspected.

The Contractor shall bear all costs incurred in correcting deficiencies found during the T.V. inspection, including cost of additional T.V. inspection required to verify correction of noted deficiencies.

T.V. inspection conducted solely for the Contractor's benefit shall be at the Contractor's expense.

3.13.9 DEFLECTION TEST

Where determined necessary by the City's Inspector, sewer pipe shall be subjected to a deflection test. Deflection tests shall be conducted in the presence of the City's Inspector and after the pipe has been installed and backfilled.

The deflection test shall be conducted by pulling a mandrel (go-no go device) through the pipe. The mandrel shall be designed and sized for each size of pipe and shall be at least 1.5 pipe diameters in length. The mandrel shall be constructed with an odd number of runners placed parallel to the pipe centerline and equally spaced around the perimeter of the mandrel. Mandrels for 8 inch pipe shall be constructed with at least 9 runners, and more runners shall be utilized for larger pipe sizes. Test mandrel shall be furnished by the Contractor. All test equipment, calibration data and procedures shall be subject to the approval of the City's Inspector.

Ring or diametric deflection of the installed pipe shall not exceed 5% of the design internal diameter of the pipe. Pipe sections that restrict free passage of the mandrel shall be removed and replaced or excavated, rebedded, backfilled and retested.

All such repairs, replacement, remedial work and retesting performed by the Contractor shall be at his expense.

The deflection test may be conducted concurrently with the T.V. inspection of the pipe interior, subject to approval by the City's Inspector.

3.13.10 ACCEPTANCE

Flow of any kind into the existing sewerage system shall not be allowed until the sewer has been satisfactorily completed and accepted for use by the Water Utilities Department.

Portions of the work completed may be placed in operation after all cleaning, testing and inspection requirements have been fulfilled. Such partial use or partial acceptance shall be subject to approval of City Inspector.

602-3.14 Inspection, Testing, Approval and Acceptance of Manholes:

3.14.1 SCOPE

The work covered by this Specification consists of the inspection, testing, approval and acceptance of manholes. The work may include leakage testing.

3.14.2 QUALITY STANDARDS

UNI- B-6: Recommended Practice for Low-Pressure Air
Testing of Installed Sewer Pipe
(Published by Uni-Bell Plastic Pipe Association)

ASTM C 969: Infiltration and Exfiltration Acceptance Testing of Installed Concrete Pipe
Manholes.

3.14.3 MATERIALS

Water used for exfiltration tests shall be potable or as otherwise approved by the City's Inspector.

Equipment necessary for any of the tests shall be of the type, quality and capacity to perform the operations required to execute the tests specified, and shall be furnished by the Contractor along with all labor and materials including water.

3.14.4 INSPECTION

The City's Inspector shall inspect and approve all work accomplished.

3.14.5 CLEANING

Prior to testing any manhole, the Contractor shall remove all foreign matter from the interior of the manhole. Chunks of concrete, mortar, or other debris (including dirt that may have intruded into the interior of the manholes) shall be removed by mechanical means. Small gravel or grit may be removed by flushing, pressure jetting or other appropriate cleaning methods approved by the City's Inspector. After cleaning, the manhole cover shall be positioned to prevent dirt or debris from entering the manhole. Other means of preventing intrusion of dirt or debris may be employed if approved by the City's Inspector.

3.14.6 TESTING

All manholes shall be tested for leakage by an exfiltration test.

Manholes may also be tested for infiltration when, in the opinion of the City's Inspector, high ground water levels indicate the possibility of excessive infiltration leakage at the manhole.

3.14.6.1 Exfiltration Test

All inlet and outlet pipes in the manhole shall be plugged with a watertight device. The manhole shall be filled with water to a point 4 feet above the outlet pipe invert, measured at the centerline of the manhole. If the ground water level is above the pipe invert, the test level shall be 4 feet above the adjacent ground water level. Ground water level shall be determined by the City's Inspector.

The allowable leakage shall not exceed 0.1 gallon/foot diameter/foot of head during a 4 hour test. The manhole may be allowed to remain saturated to allow absorption into the manhole wall for 4 to 72 hours prior to testing.

The Contractor shall repeat the 4 hour exfiltration test after repairs until

an acceptable leakage rate is attained. All repairs required shall be at the Contractor's expense.

3.14.6.2 Infiltration Test

Infiltration tests are acceptable only if the connecting conduit is continuously subjected to an external hydrostatic head (ground water level) at least 2 feet above the top of the conduit. Ground water level shall be determined by the procedures set forth in Section 8 of UNI-B-6.

All inlet and outlet pipes in the manhole shall be plugged with a watertight device. The volume of water that infiltrates into the manhole during a 4 hour period shall be measured in a manner determined by the City's Inspector. The test shall be conducted after the manhole has been subjected to the maximum ground water level for at least 4 hours to thoroughly saturate the manhole wall.

The allowable infiltration shall not exceed 0.1 gallon/foot of diameter/foot of head during a 4 hour test.

The Contractor shall repeat the 4 hour infiltration test after repairs until an acceptable leakage rate is attained. All repairs requires shall be at the Contractor's expense.

3.14.7 ACCEPTANCE

Portions of the work completed may be placed in operation after cleaning, testing and inspection requirements have been fulfilled. Such partial use of partial acceptance shall be subject to approval of City Inspector.

602-3.15 Restoration and Clean Up:

The Contractor shall restore or replace all removed or damaged paving, curbing, sidewalks, gutters, sod, shrubbery, fences, irrigation ditches, pipe, or other structures or surfaces to a condition equal to that before the work began and to the satisfaction of the Water Utilities Department. When pavement must be replaced and hot-mix asphalt paving is not available, the Contractor shall install cold-mix asphalt over the trench and replace it with hot-mix as soon as possible. The construction site shall be left clean and orderly.

A minimum base course of six inches shall be placed in trench areas prior to either permanent or temporary asphalt placement. The base course material shall conform to the following gradation:

<u>Sieve Designation</u>	<u>Percent by Weight</u>	<u>Passing Lab Sieves</u>
1-1/2"		0 - 5
7/8"		8 - 30
1/2"		30 - 55
#4		50 - 70
#40		70 - 90

LL shall not exceed 45

PI shall not exceed 15

LS shall not exceed 5

602-3.16 Construction Details

Standard Mahole.....	602-21
Drop Manhole.....	602-22
Drop Tie To Existing Manhole.....	602-23
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