TABLE OF CONTENTS

CHAPTER 3
WATER SYSTEM

CHAPTER 3
WATER SYSTEM

3.00.00 INTRODUCTION

All water distribution systems constructed within the City of Fort Lupton shall comply with the requirements of these STANDARDS AND SPECIFICATIONS and may include additional special criteria established by the City for overall hydraulics of the water utility system. Special criteria shall be outlined at pre-design meetings, as determined necessary by the City.

In the case of water mains larger than 16 inches, the owner or his representative shall submit construction specifications to the City for review and approval prior to the City's approval of the construction drawings.

3.01.00 INTERRUPTION OF SERVICE

The City's Public Works Division will operate all existing valves, hydrants, blow-offs and curb stops. **NO VALVE OR OTHER CONTROL DEVICE ON THE EXISTING PUBLIC SYSTEM WILL BE OPERATED FOR ANY PURPOSE BY ANYONE OTHER THAN THE CITY WITHOUT PRIOR WRITTEN AUTHORIZATION**. Twenty-four hours prior to the interruption of service, the contractor shall notify all users whose service will be interrupted in order for them to make provisions for necessary water storage. For water mains servicing commercial areas (i.e., restaurants) 48 hours prior notice shall be given, and work affecting the shut-down shall be coordinated with each business. No water line in service will be shutdown for more than a four-hour period at one time. Prior approval by the City is required for all shutdowns.

3.02.00 WATER BREAKS

If notification prior to shutdown is impossible, the contractor shall notify all users within one hour after the shutdown. Since prior notification was not possible, it will be the responsibility of the contractor to supply potable water to the users affected. The contractor shall also contact the City's Public Works Division and Fire Department in reference to this emergency shutdown within one hour.

3.03.00 METER SET INSTALLATION REINSPECTION FEE

Water tap fees provide for the initial inspection of the meter set only. Where additional inspections are made necessary by incomplete or faulty work, a fee in accordance with City Code will be charged for the second inspection and each subsequent inspection. This fee shall be charged to the holder of the permit and paid to the City before any additional inspections will be made.

TO SCHEDULE AN INSPECTION DURING REGULAR BUSINESS HOURS, CONTACT PUBLIC WORKS DEPARTMENT AT 303-857-6694. FOR AFTER HOURS EMERGENCIES CALL POLICE DISPATCH AT 720-652-4222.

3.10.00 DESIGN CRITERIA

3.11.00 SCOPE

It is the intent of this "design criteria" section to provide sufficient detailed information to enable the Engineer for the Owner/Developer to correctly and efficiently design the overall water system for a particular development. If there is a question or a concern regarding the design of any portion of the water system that is not adequately answered within this chapter, the owner/developer or his representative shall contact the City to get all issues resolved prior to design. Any deviation from these STANDARDS AND SPECIFICATIONS must be approved in writing by the City.

3.12.00 GENERAL

The water system shall be designed by or under the direct supervision of a professional engineer registered in the State of Colorado utilizing the most current technical standards along with good, sound engineering judgment throughout the design process. The engineer shall have experience in the design and construction of municipal water distribution systems. The development approval process includes the submittal of a Preliminary Development Plan, an Official Development Plan, utility study and construction drawings for review and approval by the City.

For design of the water system, the Fire Department shall be contacted early in the design process in order to determine the required fire flows for proposed facilities. Fire flow requirements will likely dictate the sizing and layout of the water distribution system.

3.12.01 Water System Utility Study Requirements

The Utility Study shall include the following information and shall be bound in an 8 ½ x 11 inch folder:

A) **Certification statement** - shall be included at the beginning of the report and shall read as follows: "This Utility Report for the design of the _____ development was prepared by me or under my direct supervision in accordance with the City of Fort Lupton's Standards and Specifications and acceptable professional practices of the industry. We acknowledge that the City of Fort Lupton's review of this Utility Study is only for general conformance with submittal requirements, current design criteria and standard engineering principals and practices. We are also aware of the provisions of the City Code of the City of Fort Lupton." The seal and signature of the professional engineer responsible for preparing the report shall follow this statement.

B) **Report text** for the water system design shall include the following at a minimum:

a) **Project location and Description** – a description of the boundary streets, project area and type of development proposed or anticipated use. Include a vicinity map.

b) **System layout** – a description of the existing and proposed water infrastructure in conformance with the City's latest master plan shall be provided and reference shall be made to a figure in the back of the report illustrating these improvements. The description shall include the sizes and types of existing and proposed pipes and the influence of the improvements on the project and surrounding area.

c) **Design flow requirements** – Complete design flow calculations and a discussion explaining the calculations and assumptions shall be provided. Items shall include types of facilities to be served, fire flow calculations based on building construction type and floor area, developed land area, number of units based on land

use, and population densities. Calculations for Average Day, Max Day and Peak Hour demands shall be presented. Max Day plus Fire Flow and Peak Hour demand scenarios shall be evaluated for worst case and shall include domestic demands, building sprinkler flows and domestic irrigation flows. Data shall be presented in table format, if possible, for ease of reading. The report shall acknowledge that the Public Works Department/Fire Department has provided the required fire flows and that they approve of the proposed fire hydrant locations.

d) **Hydraulic Analysis** – A detailed description of modeling assumptions and rationale shall be provided in the report text such that the analysis is clear and can be confirmed. Results of the analysis at a minimum shall include: minimum and maximum system pressures for the various scenarios modeled, corresponding node locations, distribution of fire flows among hydrants, and maximum pipe velocities. Data should be presented in table format. Reference shall be made to modeling data in the appendix and a figure of the pipe and node network provided.

e) **Conclusions** – a description of the results and how they follow the City criteria shall be provided. Any deviations from the City criteria shall be described and applicable variances requested.

C) f) **Appendices -** Printed data output from the modeling results shall be provided in the appendix and shall correspond with a figure of the pipe and node network. The appendix shall also include hydrant flow test results, hand calculations and any other pertinent data. A large size figure (24" x 36") illustrating the existing and proposed utility improvements shall be provided and shall conform to the City's latest master plan. The drawing shall include pressure zone boundaries, building finished floor elevations, elevation contours and locations of proposed and existing utility easements and right-of-way.

3.13.0 DESIGN DEMAND

The domestic demands for a particular development vary depending on the type of development, land use density, irrigation demand and building fire sprinkler flow requirements. However, the demand used to design a water system is largely a function of the required fire flow for a particular development.

There are two general categories of development for which domestic flow rates are determined: residential and commercial/industrial. Domestic demands for these developments are determined from Tables 3.13.A, 3.13.B and 3.13.C below and then peaking factors are applied to develop the Maximum Day Demand and Peak Hour Demand as follows:

Maximum Day Demand = 2.5 x Average Day Demand
Peak Hour Demand = 4.0 x Average Day Demand

Domestic demands for a development shall be combined with peak irrigation demand, building fire sprinkler demand and the project fire flow. The peak irrigation demand shall be determined by the irrigation designer and the fire sprinkler demand shall be determined by the fire sprinkler Engineer. The fire flow for a project is determined from the 2006 International Fire Code and requires the approval of the City Fire Marshal. Factors such as building area and construction type are required to determine the fire flow for a structure.

The design of the water distribution system shall be based on the higher of the two demand scenarios:

Maximum Day Demand + project fire flow + building fire sprinkler flow + peak irrigation flow, or

Peak Hour Demand + peak irrigation flow.

The City shall be consulted for design criteria with regard to non-standard developments, design of municipal infrastructure such as transmission mains, pump stations, etc. and for development with unusually high demands. The Public Works Director/City Engineer shall have final input in these instances.

Residential Average Day Demand shall be based on density, and zoning as determined by the Preliminary Development Plan and Official Development Plan for the project. A per capita demand of 200 gallons per person per day shall be applied toward the People per Unit specified in Table 3.13.A below. For residential planning purposes, Average Day Demand can be calculated on an acreage basis as specified in Table3.13.A.

Table 3.13.A – Residential Average Day Demand Data.

Zoning	Type of Development	Units per Acre*	People per Unit*	Gallons per Acre-Day**
R-1 to R-5	Single Family Detached	Up to 5	2.62	1650
R-8 to R-18 and District Center	Single Family Attached	Up to 18	2.62	4150

Commercial and industrial Average Day Demands will vary widely depending on the type of development. The following criteria in Table 3.13.B is based on historic information from the City's water records and can be used to estimate the water usage for the various developments listed. The City of Fort Lupton Water Resources Division should be consulted to determine tap fees.

Table 3.13.B – Commercial/Industrial Average Day Demand Data (Based on Building Area)

Type of Development	Unit	Design Demand (gallons/unit-day)
Auto Service and Repair	sf	0.12
Car Wash	bay	528
Childcare	sf	0.32
Church	sf	0.18
Grocery Store	sf	0.22
Gas Station with Car Wash	sf	8
Gas Station without Car Wash	sf	1.32
Hospital	sf	0.32
Hotel/Motel	room	130
Medical Office	sf	0.2
General Offices	sf	0.04
Restaurant	sf	1.1
Retail/Shopping Center	sf	0.16
School	sf	0.06
Warehouse/Industrial	sf	0.04

For commercial and industrial planning purposes, average day demands can be calculated on an acreage basis as specified in Table 3.13.C.

Table 3.13.C – Commercial/Industrial Average Day Demand Data (Based on Acreage)

Type of Development	Gallons per Acre-Day**
Retail Commercial	1400
Office	1400
Business Park	1400
District Center (non-residential)	1400
Industrial	220
School/Church	630

***** From the "2004 City of Fort Lupton Comprehensive Land Use Plan"

****** From the City of Fort Lupton "Water and Sewer Infrastructure Master Plan", URS, 2010.

3.14.00 HYDRAULIC DESIGN

A computer generated hydraulic analysis of the proposed infrastructure, or "model", shall be developed using standard industry software such as WaterCAD or City approved equal. In order for the model to properly correlate with the City's distribution system, a hydrant flow test needs to be performed on nearby hydrants and static and residual pressures obtained as a function of flow rate. This data shall be used in the model to develop a water source curve, represented by a reservoir and pump, and this will allow modeled pressures to vary over a range of imposed demands. The water source curve functions as a boundary condition in the model where proposed piping interfaces with the existing distribution system at this boundary.

The objective during hydrant flow testing is to obtain a flow rate similar to the design demand required for the proposed development. The hydrants to be tested shall be determined by the City and data obtained during this test shall be valid for up to one-year, unless otherwise approved in writing by the City. Distribution system factors may require that a fire flow be increased for a particular area of the system, as determined by Public Works/City engineering staff. A hydrant flow test shall be requested by the design engineer from the City Public Works/Engineering Division.

Special analysis may be required by the City for developments requiring large flow demands and shall be discussed with the Utilities Division. Future changes in zone pressures, in conformance with the City's latest master plan, shall be considered in the hydraulic analysis.

Upon approval by the City, exceptions to the computer generated hydraulic analysis may be made for the following:

- Developments requiring low domestic demands (less than 600 gpm) and with no fire flow requirement; or

- Developments proposing less than 200 feet of water main and no required fire hydrants.

For the above cases, hydraulic calculations should be provided as part of the Utility Report and shall demonstrate acceptable system pressures and velocities as a result of required flows.

3.15.00 OPERATING PRESSURES WITHIN THE DISTRIBUTION SYSTEM

Minimum recommended pressure within the distribution system shall be 50 pounds per square inch during the Peak Hour Demand and the maximum recommended pressure during the Average Day Demand shall be 100 pounds per square inch.

The maximum pressure fluctuation at any location in the distribution system between Peak Hour Demand and Average Day Demand shall not exceed 30 pounds per square inch.

The minimum pressure involving a fire flow scenario shall be 20 pounds per square inch as measured at the highest living space in the building(s).

3.16.00 PRESSURE REGULATING STATIONS

Pressure-reducing valve (PRV) installations are used to control pressure between distribution system pressure zones. When main extension plans are submitted for review, the need for a pressure-regulating valve installation shall be determined jointly by the developer's engineer and the City. Plans shall be submitted as part of the utility study indicating size, type, and location of the PRV installation. All calculations shall be submitted to the City for review.

For individual water services to buildings, water pressure regulators will be required if system pressures exceed 80 psi or at the discretion of the Building Division.

3.17.00 SIZING OF MAINS

3.17.01 Distribution Mains

All water mains shall be sized large enough to provide for domestic, irrigation, and fire protection flows to the area serviced. The maximum acceptable head loss for six, eight, ten and twelve inch mains is two feet per thousand feet of main for the Peak Hour Demand scenario. This acceptable head loss rate shall not apply for fire flow scenarios. The maximum pipe velocity for non-fire flow scenarios shall be 5 feet per second and for fire flow scenarios shall be 7 feet per second. Final size of distribution mains shall be approved in writing by the City. Over sizing of mains may be required by the City, and the recovery of the costs of such over sizing shall be in accordance with the City of Fort Lupton Municipal Code.

The minimum diameter for water mains in residential areas, including cul-de-sacs, shall be 6 inches. All schools, shopping centers, business parks, industrial parks, and high-density residential areas shall be looped with mains at least 8 inches in diameter. All waterlines shall be looped. No dead-end mains, except lines extending into cul-de-sacs serving not more than 6 single-family residential units, nor mains extending more than 150 feet from the lateral connection, will be permitted. All stubs and dead end mains shall have a blow-off installed. With the exception of fire hydrant laterals, only polyvinyl chloride (PVC) pipe is approved for water main installations 12 inches in diameter and smaller. Any other material proposed must be approved in writing by the City prior to construction. A Hazen-Williams “C” coefficient of 130 shall be used when modeling PVC and DIP pipe.

3.17.02 Transmission Mains

All transmission mains shall be sized in compliance with the City's "Water Distribution System Study," latest edition, or as otherwise approved in writing by the City. See section 3.22.00 for further details.

3.18.00 SYSTEM LAYOUT – CONSTRUCTION PLAN CRITERIA

3.18.01 General

All water mains shall be installed in dedicated rights-of-way or public easements. Water main installation in easements between single-family residential lots will only be allowed for the purpose of looping a water main at the end of a cul-de-sac. Waterlines should NOT be installed parallel to and directly below any concrete such as sidewalks, curbs, or gutters. Lines shall normally be located 5 feet north or west of street centerline, or 5 feet north or west of a curbed median, unless otherwise approved in writing by the City.

The minimum depth of cover for water mains from the final approved grade of the surface to the top of the water main shall be 5 feet. Where final grades have not been established, mains shall be installed to a depth great enough to insure 5 feet of cover below the approved future grade but in no event less than 5 feet of cover from the temporary grade. The maximum depth of cover for water mains shall be 8 feet below the final approved grade of the surface unless approved otherwise, in writing, by the City.

Plan and profile shall be required for all water main designs. Utility crossings shall be identified in the profile views for all known or planned utilities. The vertical alignment of water mains shall be designed such that unnecessary high points are avoided. If a high point in the main cannot be avoided, a controlled high point shall be located at a fire hydrant tee where trapped air in the system can be bled. For controlled high points in transmission mains (16 inch and larger), combination air valves shall be provided. High points at a water main lowering should be avoided by deflecting the main on both sides of the lowering such that positive pipe grades are maintained to controlled high points in the system. To maintain positive pipe grades to controlled high points, the maximum depth of cover to the main can increase to 8 feet, if approved in writing by the City. Refer to Sections 3.18.02 and 3.18.06 for the alignment of water lines with sewer lines. Refer to Section 3.18.07 for the design of combination air valves.

Water mains shall be laid a minimum of ten feet, horizontally and edge to edge, from any existing or proposed utility. Upon written approval by the City, a water main may be laid closer than ten feet to a parallel sewer main if it is laid in a separate trench and if the elevation of the invert of the water main is at least 18 inches above the crown of the sewer main and, in addition, PVC C-900 is used for the sewer main.

Water mains shall be designed such that they extend the entire frontage of the property to be served or as otherwise approved in writing by the City.

When the water main passes under a highway, railroad, or waterway, there shall be a minimum of five feet of cover and a steel casing shall be installed in accordance with the detail drawing in the Appendix of this chapter. The steel casing shall extend the entire width of the right-of-way or easement of the crossing structure or as directed by the City. In all cases, valves shall be located such that the water main at such crossings can be completely isolated without interruption of any services.

3.18.02 Waterline Crossing Over A Sanitary Sewer Line

When there is less than 18 inches of vertical clearance between the water main and the sanitary sewer, the sanitary sewer shall be encased in concrete a minimum of nine feet on each side of the centerline of the crossing or polyvinyl chloride pressure pipe in accordance with American Water Works Association C900, pressure class 305 psi may be used for the sanitary sewer.

3.18.03 Waterline Crossing Over A Storm Sewer Line

When there is less than 18 inches of vertical clearance between the water main and the storm sewer, each joint of the storm sewer within nine feet of the centerline of the crossing shall be encased in concrete.

Freeze potential of a water main shall be evaluated when crossing storm sewers or other exposures to the elements. If a water main crosses a storm sewer with 3 feet or less of vertical clearance, a 12" thick layer of extruded polystyrene insulating foam, also referred to as "XPS" shall be provided all around the water main for a minimum of 5 feet on each side of the storm sewer. The sheets of "XPS" shall be thick enough to allow shaping of the material so it fits snugly around all sides of the pipe leaving a minimum 12" thickness around all sides of thepipe. Bonding of individual sheets of "XPS" shall be in accordance with section 3.61.03 of these Standards and Specifications. Crossings of dead end water mains and storm sewer with less than 18 inches of vertical clearance shall be prohibited.

3.18.04 Sanitary Sewer Line Crossing Over A Waterline

In all cases, regardless of vertical clearance, the sanitary sewer shall be encased in concrete a minimum of nine feet on each side of the centerline of the crossing or polyvinyl chloride pressure pipe in accordance with American Water Works Association C900, pressure class 305 psi may be used.

3.18.05 Storm Sewer Line Crossing Over A Waterline

In all cases, regardless of vertical clearance, the joints of the storm sewer shall be encased in concrete a minimum of nine feet on each side of the centerline of the crossing.

Freeze potential of a water main shall be evaluated when crossing storm sewers or other exposures to the elements. If a water main crosses a storm sewer with 3 feet or less of vertical clearance, a 12" thick layer of extruded polystyrene insulating foam, also referred to as "XPS" shall be provided all around the water main for a minimum of 5 feet on each side of the storm sewer. The sheets of "XPS" shall be thick enough to allow shaping of the material so it fits snugly around all sides of the pipe leaving a minimum 12" thickness around all sides of thepipe. Bonding of individual sheets of "XPS" shall be in accordance with section 3.61.03 of these Standards and Specifications. Crossings of dead end water mains and storm sewer with less than 18 inches of vertical clearance shall be prohibited.

3.18.06 Limits on Vertical Separation

Under no circumstances shall the vertical clearance between any waterline and sanitary sewer or storm sewer be less than 18 inches without written approval from the City.

3.18.07 Combination Air Valves

Combination air valves are necessary to serve several functions: they exhaust large volumes of air from the system during start-up, they open during draining or if a negative pressure occurs and they release accumulated air from the system during operation. The vertical alignment of water mains shall be designed such that unnecessary high points are avoided as described in section 3.18.01 of these STANDARDS AND SPECIFICATIONS. If a high point in a distribution water main cannot be avoided, a controlled high point shall desirably be located at a

fire hydrant tee where trapped air in the system can be bled through the fire hydrant. If this is not possible due to legitimate design constraints, an air valve shall be located at the high point and within a manhole. For controlled high points in transmission mains (16 inch and larger), combination air valves shall be provided (refer to the detail drawing in the appendix of this Chapter).

Combination air valves for distribution mains and transmission mains shall be sized by the engineer in accordance with the manufacturer's recommendations and approved by the Public Works Director/City Engineer.

3.19.00 EASEMENTS

All water mains shall be in an easement which has a horizontal width of at least two times the depth to the pipe invert. The minimum easement shall be 20 feet in width for one utility, 30 feet in width for two utilities, and 40 feet in width for three utilities. Site-specific circumstances may dictate the need for wider easements. For normal depths, the main shall be located a minimum of 10 feet from and parallel to the edge of the easement. Meters and fire hydrants not installed within the right-of-way will require an easement dedication ten feet wide and extending five feet behind the meter or fire hydrant. If a fire hydrant lateral or water meter extends behind the curb more than ten feet, then the width of the easement shall be a minimum of 15 feet. All easements shall be for the exclusive use of the City of Fort Lupton. Neither landscaping (except grass and private irrigation systems) nor permanent structures (sheds, buildings, etc.) shall be placed in the easement.

The easement agreement, provided by the City, shall state that any temporary structures (including paving and fencing) placed in the easement shall be removed and replaced by the owner of the land when requested by the City so that maintenance can be performed. The owner of the land shall agree to hold the City of Fort Lupton harmless for any replacement of structures removed from the easement.

The following statement shall appear on all official development plans and all final plats**.**

UTILITY MAINTENANCE STATEMENT

All public water, storm sewer and sanitary sewer mains and appurtenances located in public ROW shall be maintained by the City of Fort Lupton Public Works Department. All public water, storm sewer, sanitary sewer mains and appurtenances under private drives are located in utility easements. City is responsible for maintenance of these water, storm and sanitary sewer facilities. City is not responsible for repair or replacement of private drive, curb and gutter or landscaping damaged during utility repair or maintenance.

3.20.00 FUTURE CONNECTIONS

A blow-off is required at the end of any water main which terminates and is anticipated to be extended in the future. Refer to the detail drawing in the Appendix of this chapter. When a future main extension is anticipated, the main shall include valves so that only one valve will have to be closed when the main is extended. The valve shall be restrained so when the one valve is closed and the line to be extended is exposed, the valve will not blow off. Restraint shall be made by the use of a mechanical joint anchoring tee (swivel tee), swivel cross, and by installing a minimum of two full lengths of pipe on the extension side of the valve (8 inch pipe and smaller). No service taps shall be allowed on a main which can be extended in the future between the single valve to be closed and the dead end.

3.21.00 SERVICES

Calculations for meter and service line sizes shall be prepared using the "Plumbing Data Sheet" available from the Building Division. The applicant shall prepare building plans and calculations and submit them to the Building Division for review and approval. The Building Division must approve all meter and service line sizes (before and after the meter) prior to beginning construction. The service lines, tap and meter shall be the same size, unless otherwise approved and/or required by the City. If the tap and meter are of different sizes, the fee shall be paid based on the larger size, unless a larger tap is approved and/or required by the City in which case the fee for the meter size shall be paid.

Each separated structure shall be served by a separate service line and meter. All non-residential developments with any irrigated areas are required to have separate irrigation taps and meters from the water main in accordance with the Fort Lupton City Code. Utility easements shall be required for service lines up to and including the meter pit.

No pressure booster facility of any kind shall be allowed on any service line between the public main and the meter. All service line pressure booster facilities shall be privately owned and maintained.

Water service lines shall be located a minimum of 10 feet away from all sewer services and a minimum of 5 feet away from all fire protection service lines (measured horizontally). All service lines shall be constructed perpendicular to the front property line of the property they are going to serve and not less than 5 feet from the side of a front property line. Service lines through private property to serve a separate property are prohibited.

Size changes, if allowed between the service line and the meter, shall be accomplished by providing a full sized meter vault and setter for the line size installed and using industry standard adapters to install a reduced size meter in the full size line.

Water taps cannot be issued prior to a building and/or tap entitlement approval. Exceptions must be approved by the City Manager; for example, conversion from well water to the City water system.

All service lines 3/4-inch through 2-inch shall be copper and shall be installed continuous without joints between the corporation stop at the water main and the meter or curb stop. Services shall be tapped at the main with a 45 degree angle from horizontal and shall have a minimum of 5 feet of cover and be laid as shown on the detail drawing in the Appendix of this chapter. The minor exception to this is allowed for the "slack" section in the service line near the tap which may have slightly less than 5 feet of cover.

Service connections requiring a flow greater than can be delivered through a 2-inch corporation and service line shall be 4-inch, 6-inch, or 8-inch connections and shall be polyvinyl chloride pipe in accordance with section 3.52.02 of these STANDARDS AND SPECIFICATIONS. Service connections (4-inch, 6-inch, or 8-inch) to new lines shall be made with mechanical joint anchoring tees (swivel tees) or reducing mechanical joint anchoring tees (swivel tees) if installed at the time of main line construction. Later connections, if installed, may also be made with tapping sleeves and tapping valves and at the developer's expense.

3.22.00 TRANSMISSION MAINS

All water mains larger than 12 inch in diameter shall be classified as "transmission mains."

All transmission mains shall have combination air valves installed at all high points on the line and on each side of butterfly valves in accordance with the detail drawing in the Appendix of this chapter.

All transmission mains shall have blow-off assemblies installed at all low points on the line and constructed in accordance with the detail drawing in the Appendix of this chapter.

With the exception of fire hydrant laterals, only polyvinyl chloride (PVC) pipe is approved for water main installations 12 inches in diameter and smaller. Any other pipe material must be approved in writing by the City. Lines 20 inches in diameter and larger may be ductile iron pipe or steel pipe, as approved in writing by the City. A Hazen Williams C coefficient of 130 shall be used when modeling PVC and DIP pipe and shall be 100 for steel pipe, unless otherwise approved in writing by the City.

The design of ductile iron and steel transmission mains and other critical direct bury appurtenances such as valves, shall require cathodic protection. Cathodic protection shall be designed by a qualified cathodic protection engineer, registered in the State of Colorado and shall conform to NACE Standard RP-01-69, latest revision. As a minimum, the cathodic protection system shall include magnesium anodes; test station thermal board and shunts; exothermic weld caps and coating; conductor, test stations, joint bond wires; wire splice kits; exothermic weld equipment and materials; wire and cable marker tags; and one-piece insulating sleeves and washers, all in conformance with section 3.62.00 of these STANDARDS AND SPECIFICATIONS. All of the data for these materials shall be submitted to the City for approval prior to installation. Test stations shall be shown on design drawings and as-built drawings. Cathodically protected pipe, except steel casing pipe, shall also require polyethylene wrap as described in section 3.61.02.

No service line taps or any taps less than six inches in diameter shall be made to transmission mains. Exceptions to this will be for combination air valves only.

Valves on transmission mains shall be placed no more than 1,200 feet apart. Where there are connections to transmission mains, all connecting mains shall include valves at the connection. There shall be a minimum of two valves at a tee connection and three valves at a cross connection.

3.23.0 UNLAWFUL CONNECTION

No installation of potable water supply piping or part thereof shall be made in such a manner that it will be possible for used, unclean, polluted, or contaminated water, mixtures, or substances to enter any portion of such piping from any tank, receptacle, equipment, or plumbing fixture by reason of back siphonage, suction, back pressure, or any other cause, either during normal use and operation or when any such tank receptacle, equipment, or plumbing fixture is flooded, or subject to pressure in excess of the main line operating pressure. No person shall make a connection or allow one to exist between pipes or conduits carrying domestic water supplied by the City and any pipes, conduits, or fixtures containing or carrying water, chemicals, liquids, gases, or any other substances from any other source. Refer to Section 3.24.08, Backflow Prevention Assemblies for further requirements.

3.24.00 APPURTENANCES

3.24.01 Valves

Residential distribution systems shall include valves to ensure that no more than 600 feet of main or 18 residential units and 1 fire hydrant will be out of service in the event of a single water main break. Valve placement shall be such that there are at least two valves at every tee and three valves at every cross.

Valves 16 inch or larger shall be butterfly valves. Main line valves shall be located at a tee, cross or elbow if possible. Under no circumstances shall a valve be located in concrete areas, such as sidewalks, crosspans, aprons, curbs, or gutters. Butterfly valve operators shall be located

on the north or east side of the water main. Any valve located in a greenbelt area shall have an 18-inch-wide by 6-inch thick concrete collar around the valve box.

3.24.02 Fire Hydrants

The maximum distance, as measured along the centerline of the street, between fire hydrants shall be 500 feet in residential areas and 300 feet in business and other high-value areas unless otherwise approved in writing by the City. One fire hydrant will be allowed on dead-end line provided that the line is an 8" line. The number and location of fire hydrants in a given area shall be approved in writing by the Fire Department. If hydrants are to be installed at locations other than street intersections, they shall be located on the extension of property side lot lines. In no case shall a hydrant be located closer than 5 feet to obstructions, driveways, etc. The fire hydrant shall be located within the right-of-way or pocket Utility Easement and on the same side of the street as the water main unless otherwise approved in writing by the City. Fences, landscaping, etc., shall in no way hinder the operation of the fire hydrant. In addition, clear distances to the fire hydrant shall be in accordance with Section 3.19.00 of these STANDARDS AND SPECIFICATIONS.

The fire hydrant lateral lines shall be set at 90 degrees to mains. The length of the fire hydrant lateral line shall be minimized and shall be no more than 70 feet long. No horizontal bends or offsets shall be used in fire hydrant lateral lines. Under no circumstances shall any tap be made on a fire hydrant lateral line.

3.24.03 Thrust Blocks and Joint Restraint Devices

All bends, tees, plugs, dead-ends, wet taps (in certain cases), hydrants, and blow-offs shall be designed and constructed with concrete thrust blocks. If the soil-bearing strength is unknown, the soil-bearing capacity used in design shall be 2,000 pounds/square foot. Refer to the detail drawings in the Appendix of this chapter.

Joint restraint devices shall be used on both sides of valves and fittings for pipe sizes 12 inches in diameter and smaller and in addition to thrust blocks. For transmission mains, 16 inches in diameter and larger, joint restraints shall be used for a specified distance as recommended using the latest edition of the pipe restraint calculator provided by EBAA Iron, or equivalent (www.rcp.ebaa.com). Thrust blocks will be required to be used in addition to joint restraint devices on transmission mains. Vertical bends in all pipe sizes shall be restrained using joint restraint devices and shall be restrained for a specified distance as recommended using the latest edition of the pipe restraint calculator provided by EBAA Iron, or equivalent (www.rcp.ebaa.com).

Harness rods, or "rodding", are not an acceptable means for restraining pipe and fittings unless it is specified inside vaults as shown on the detail drawings in the appendix of this Chapter. Under no circumstance shall steel harness rods be allowed to be in contact with soils.

3.24.04 Meters

Calculations for meter and service line sizes (before and after the meter) shall be prepared using the "Plumbing Data Sheet" available from the Planning Division at the City. The applicant shall prepare building plans and water demand calculations and submit them to the Building Division for review and approval. The Planning Division/Public Works Department must approve all meter and service line sizes prior to beginning construction. The service lines, tap and meter

shall be the same size, unless otherwise approved and/or required by the City. If the tap and meter are of different sizes, the fee shall be paid for the larger, unless a larger tap is approved and/or required by the City in which case the fee for the meter size shall be paid.

Water taps cannot be issued prior to a building and/or tap entitlement approval. Exceptions must be approved by the City Manager; for example, conversion from well water to the City water system.

Public water meter installations inside any buildings are prohibited unless otherwise approved, in writing, by the City. Meters shall be located within publicly-owned rights-of-way or easements. Meter pits shall not be located within concrete areas or areas exposed to vehicle traffic, unless otherwise approved in writing by the City. If the City approves of locating a meter pit in a concrete area or an area exposed to light vehicle traffic, then a heavy duty meter pit design shall be used in accordance with the design detail in the Appendix of this Chapter.

All water meters connected to the City of Fort Lupton's utility system shall be the property of the City. Under no circumstances shall anyone other than City personnel remove a water meter once the pit or vault has been inspected and approved. No connections shall be made in the meter pit, for irrigation or otherwise, by anyone other than authorized City personnel. Irrigation system connections shall be made downstream from the meter and a minimum of five feet from the meter pit or vault.

For any installation where special or unusual conditions might exist, detailed drawings, accompanied by a letter of explanation, shall be submitted to the City for review and approval.

For any water meter installation over 2 inches in size, detailed drawings of the proposed installation shall be submitted to the City for review and approval prior to construction.

There shall be no electrical wiring allowed in any water meter pit or vault unless authorized, in writing, by the City.

Inspections of all residential pits and commercial pits or vaults shall be conducted by the City. Locations and details for commercial pits or vaults shall be reviewed and approved in writing by the City.

3.24.05 Fire Protection Service Line

Valves on newly constructed fire lines shall be located on the tee at the main line. The owner shall maintain all private fire lines beginning at and including this valve. All fire sprinkler taps shall be installed with an approved backflow prevention device as defined by The Fort Lupton City Code 8-7-27 and a flow switch which will indicate when water has flowed through the line. A property requiring a domestic service line and a fire protection service line will have separate taps for each. Fire protection service lines shall be constructed of PVC from the fire line valve to the 90 degree bend for the building standpipe. The 90 degree bend and standpipe shall be ductile iron pipe in conformance with the International Fire Code as adopted by the Building Division. Fire line valves shall have a flange connection and shall bolt directly to a mechanical joint anchoring tee (swivel tee) at the main.

3.24.06 Valve Vaults

All valves larger than 12 inches shall be installed in a vault in accordance with the detail drawings in the Appendix of this chapter. All valve vaults shall be capable of withstanding

AASHTO H-20 highway loading. The vault shall also have lift hooks in the roof for valve removal inside the vault.

Vaults shall be made water proof after construction by use of sealants, epoxies or other approved methods. All vaults shall be designed with wall sleeves and link seal and be capable of handling thrusts caused by removing valves. All vent pipes for vaults shall be installed in conformance with the detail drawings in the Appendix of this chapter.

3.24.07 Manholes

Manholes shall be installed on all pressure regulating valves, permanent blow-off installations, and air release valves in accordance with the detail drawing in the Appendix of this chapter.

Revised with Ord No. 2016999 May 2016

3.24.08 Backflow Prevention Assemblies

To prevent backflow contamination of the City of Fort Lupton's potable water system, a reduced pressure zone (RPZ) backflow prevention device shall be installed inside the structure after the main shut off valve on all non-residential water service lines or where any condition might exist that would result in a higher pressure downstream of the water meter than exists in the main line and that could allow backflow or back siphonage of polluted or contaminated water or other substances from the water user's system. The assembly shall be installed per Colorado Department of Public Health and Environment guidelines and Colorado Plumbing Code to allow for proper operation and easy access for annual testing and maintenance.

A reduced pressure zone backflow prevention device shall be used for all non-residential irrigation services. This shall be required for both domestic potable and well water sources. The assembly shall be located a minimum of five feet downstream of the water meter and installed per Colorado Department of Public Health and Environment guidelines and Colorado Plumbing Code to allow for proper operation and easy access for annual testing and maintenance.

3.24.09 Backflow Prevention Cross Connection Control

(1) Purpose

The purpose of this program is to protect the public water system from contaminants or pollutants that could enter the distribution system by backflow from a customer's water supply system through the service connection.

(2) Authority

The authority to implement this program is contained in the following statute, legislation and regulations and acts:

a. Article 1-114 and Article 1-114.1 of Title 25 of the Colorado Revised Statutes (CRS)

b. Section 39 of 5 CCR 1002-11, Colorado Primary Drinking Water Regulations

c. Colorado Plumbing Code

(3) Applicability

This Standard applies to all commercial, industrial and multi-family residential service connections within the public water system and to any persons outside the City who are, by contract or agreement

with the public water system, users of the public water system. This Standard does not apply to single-family-residential service connections unless the Public Works Director becomes aware of a cross connection at the single family connection.

(4) Definitions

a. "ACTIVE DATE" means the first day that a backflow prevention assembly or backflow prevention method is used to control a cross-connection in each calendar year.

b. "AIR GAP" is a physical separation between the free flowing discharge end of a potable water supply pipeline and an open or non-pressure receiving vessel installed in accordance with standard AMSE A112.1.2.

c. "BACKFLOW" means the undesirable reversal of flow of water or mixtures of water and other liquids, gases or other substances into the public water systems distribution system from any source or sources other than its intended source.

d. "BACKFLOW CONTAMINATION EVENT" means backflow into a public water system from an uncontrolled cross connection such that the water quality no longer meets the Colorado Primary Drinking Water Regulations or presents an immediate health and/or safety risk to the public.

e. "BACKFLOW PREVENTION ASSEMBLY" means any mechanical assembly installed at a water service line or at a plumbing fixture to prevent a backflow contamination event, provided that the mechanical assembly is appropriate for the identified contaminant at the cross connection and is an in-line field-testable assembly.

f. "BACKFLOW PREVENTION METHOD" means any method and/or non-testable device installed at a water service line or at a plumbing fixture to prevent a backflow contamination event, provided that the method or non-testable device is appropriate for the identified contaminant at the cross connection.

g. "CERTIFIED CROSS-CONNECTION CONTROL TECHNICIAN" means a person who possesses a valid Backflow Prevention Assembly Tester certification from one of the following approved organizations: American Society of Sanitary Engineering (ASSE) or the American Backflow Prevention Association (ABPA). If a certification has expired, the certification is invalid.

h. "CONTAINMENT" means the installation of a backflow prevention assembly or a backflow prevention method at any connection to the public water system that supplies an auxiliary water system, location, facility, or area such that backflow from a cross connection into the public water system is prevented.

i. "CONTAINMENT BY ISOLATION" means the installation of backflow prevention assemblies or backflow prevention methods at all cross connections identified within a customer's water system such that backflow from a cross connection into the public water system is prevented.

j. "CONTROLLED" means having a properly installed, maintained, and tested or inspected backflow prevention assembly or backflow prevention method that prevents backflow through a cross connection.

k. "CROSS CONNECTION" means any connection that could allow any water, fluid, or gas such that the water quality could present an unacceptable health and/or safety risk to the public, to flow from any pipe, plumbing fixture, or a customer's water system into a public water system's distribution system or any other part of the public water system through backflow.

l. "MULTI-FAMILY" means a single residential connection to the public water system's distribution system from which two or more separate dwelling units are supplied water.

m. "SINGLE-FAMILY" means:

   i. A single dwelling which is occupied by a single family and is supplied by a separate service line; or

   ii. A single dwelling comprised of multiple living units where each living unit is supplied by a separate service line.

n. "UNCONTROLLED" means not having a properly installed and maintained and tested or inspected backflow prevention assembly or backflow prevention method, or the

backflow prevention assembly or backflow prevention method does not prevent backflow through a cross connection.

o. "WATER SUPPLY SYSTEM" means a water distribution system, piping, connection fittings, valves and appurtenances within a building, structure, or premises. Water supply systems are also referred to commonly as premise plumbing systems.

(5) Requirements

a. Commercial, industrial and multi-family service connections shall be subject to a survey for cross connections. If a cross connection has been identified an appropriate backflow prevention assembly and or method shall be installed at the customer's water service connection within 120 days of its discovery. The assembly shall be installed downstream of the water meter or as close to that location as deemed practical by the public water system. If the assembly or method cannot be installed within 120 days the Public Works Director must take action to control or remove the cross connection, suspended service to the cross connection or receive an alternative compliance schedule from the Colorado Department of Public Health and Environment.

b. In no case shall it be permissible to have connections or tees between the meter and the containment backflow prevention assembly.

i. In instances where a reduced pressure principle backflow preventer cannot be installed, the owner must install approved backflow prevention devices or methods at all cross-connections within the owner's plumbing system.

c. Backflow prevention assemblies and methods shall be installed in a location which provides access for maintenance, testing and repair.

d. Reduced pressure principle backflow preventers shall not be installed in manner subject to flooding.

e. Provisions shall be made to provide adequate drainage from the discharge of water from reduced pressure principle backflow prevention assemblies. Such discharge shall be conveyed in a mater which does not impact waters of the state.

f. All assemblies and methods shall be protected to prevent freezing. Those assemblies and methods used for seasonal services may be removed in lieu of being protected from freezing. The assemblies and methods must be reinstalled and then tested by a certified cross-connection control technician upon reinstallation.

g. Where a backflow prevention assembly or method is installed on a water supply system using storage water heating equipment such that thermal expansion causes an increase in pressure, a device for controlling pressure shall be installed.

h. All backflow prevention assemblies shall be tested at the time of installation and on an annual schedule thereafter. Such tests must be conducted by a Certified Cross-Connection Control Technician.

i. The Public Works Director shall require inspection, testing, maintenance and as needed repairs and replacement of all backflow prevention assemblies and methods, and of all required installations within the owner's plumbing system in the cases where containment assemblies and or methods cannot be installed.

j. All costs for design, installation, maintenance, testing and as needed repair and replacement are to be borne by the customer.

k. No grandfather clauses exist except for fire sprinkler systems where the installation of a backflow prevention assembly or method will compromise the integrity of the fire sprinkler system.

l. For new buildings, all building plans must be submitted to the Public Works Director and approved prior to the issuance of water service. Building plans must show:

i. Water service type, size and location

ii. Meter size and location

iii. Backflow prevention assembly size, type and location

iv. Fire sprinkler system(s) service line, size and type of backflow prevention assembly.

i. All fire sprinkling lines shall have a minimum protection of an approved double check valve assembly for containment of the system.

ii. All glycol (ethylene or propylene), or antifreeze systems shall have an approved reduced pressure principle backflow preventer for containment.

iii. Dry fire systems shall have an approved double check valve assembly installed upstream of the air pressure valve.

iv. In cases where the installation of a backflow prevention assembly or method will compromise the integrity of the fire sprinkler system the Public Works Director can chose to not require the backflow protection. The Public Works Director will measure chlorine residual at location representative of the service connection once a month and perform periodic bacteriological testing at the site. If the Public Works Director suspects water quality issues the Public Works Director will evaluate the practicability of requiring that the fire sprinkler system be flushed periodically.

(6) Inspection, Testing and Repair

a. Backflow prevention assemblies or methods shall be tested by a Certified Cross-Connection Control Technician upon installation and tested at least annually, thereafter. The tests shall be made at the expense of the customer.

i. Any backflow prevention assemblies or methods that are non-testable, shall be inspected at least once annually by a certified cross-connection control technician. The inspections shall be made at the expense of the customer.

b. As necessary, backflow prevention assemblies or methods shall be repaired and retested or replaced and tested at the expense of the customer whenever the assemblies or methods are found to be defective.

c. Testing gauges shall be tested and calibrated for accuracy at least once annually.

(7) Reporting and Recordkeeping

a. Copies of records of test reports, repairs and retests, or replacements shall be kept by the customer for a minimum of three (3) years.

b. Copies of records of test reports, repairs and retests shall be submitted to the Public Works Director by mail, facsimile or e-mail by the testing company or testing technician.

c. Information on test reports shall include, but may not be limited to,

i. Assembly or method type
ii. Assembly or method location
iii. Assembly make, model and serial number
iv. Assembly size
v. Test date; and
vi. Test results including all results that would justify a pass or fail outcome
vii. Certified cross-connection control technician certification agency
viii. Technician's certification number
ix. Technician's certification expiration date
x. Test kit manufacturer, model and serial number
xi. Test kit calibration date

b. The Public Works Director shall give notice in writing to any owner whose plumbing system has been found to present a risk to the public waters system's distribution system through an uncontrolled cross connection. The notice and order shall state that the owner must install a backflow prevention assembly or method at each service connection to the owner's premises to contain the water service. The notice and order will give a date by which the owner must comply.

i. In instances where a backflow prevention assembly or method cannot be installed, the owner must install approved backflow prevention assemblies or

methods at all cross-connections within the owner's water supply system. The notice and order will give a date by which the owner must comply.

(10) Conflict with other codes.

a. If a dispute or conflict arises between the Colorado Plumbing Code, and any plumbing, mechanical, building, electrical, fire or other code adopted by the State, then the most stringent provisions of each respective code shall prevail.

3.30.00 CONSTRUCTION SPECIFICATIONS

3.31.00 TRENCHING, BACKFILLING AND COMPACTION

Trenching, backfilling and compaction shall be done in accordance with Chapter 9 of these STANDARDS AND SPECIFICATIONS.

3.32.00 BEDDING

In the event unstable trench conditions are found at pipeline grade, a minimum of one and one-half inch uniformly graded, washed rock shall be used for trench stabilization. Depth of the stabilization shall be as approved in writing by the City.

Granular bedding material shall meet the requirements of Chapter 9 of these STANDARDS AND SPECIFICATIONS. Bedding shall be placed to six inches below the bottom of the pipe and shall be placed around the sides of the pipe and to a minimum of 12 inches above the top of the pipe and in accordance with the detail drawing in the Appendix of this chapter.

3.33.00 PIPELINE INSTALLATION

3.33.01 General

The City shall be notified at least 48 hours in advance of any pipe installation. No pipes shall be backfilled until they have been inspected by the City. Alignment and grade of the pipe and the location of fittings, valves, and hydrants shall be staked in accordance with the approved construction plans under the supervision of a professional surveyor registered in the State of Colorado.

Proper implements, tools, and facilities shall be provided and used by the contractor for the safe and convenient execution of the work. All pipe fittings, valves, and hydrants shall be carefully lowered into the trench by means of a derrick, ropes, or other suitable tools or equipment to prevent damage to water main materials and protective coatings and linings. Chains or cables shall not be used for handling pipe with protective coatings. Under no circumstances shall water main materials be dropped or dumped into the trench.

All pipe and fittings shall be carefully examined for cracks and other defects immediately before installation. The groove in the bells of the pipe shall be full and continuous or the pipe will be rejected. Defective pipe or fittings shall be removed from the job site within 24 hours of notification by the City. All foreign matter or dirt shall be removed from the interior and ends of pipe and accessories before they are lowered into position in the trench and prior to connection.

Every precaution shall be taken to prevent foreign material and trench water from entering the pipe and fittings. During construction, the contractor shall provide and maintain adequate equipment to properly remove and dispose of all water entering the trench and any other part of the work.

3.33.02 Pipe

Immediately before joining two lengths of pipe, the inside of the bell and the outside of the spigot end and the gasket shall be thoroughly cleaned. Caution shall be exercised to ensure that the correct type of gasket is used. A thin film of gasket lubricant shall be applied to the inside face of the gasket and the spigot end of the pipe. The spigot end of the pipe shall be placed in the bell with care to prevent the joint from contacting the ground. The joint shall be completed by pushing the pipe home with a slow steady pressure, without jerky or jolting movements. Pipe furnished without a depth mark shall be marked before assembly to ensure insertion to the full depth of the joint. The pipe shall then be properly set and brought to correct line and grade. After installation of the polyethylene protective wrap, if required, the pipe shall be secured in place by installation of bedding material and backfill, in accordance with Chapter 9 and the detailed drawings in the Appendix of this chapter.

Deflection from a straight line or grade, as required by horizontal or vertical alignments or offsets, shall not exceed the maximum allowable limits set by the manufacturer's specifications. If the alignment requires deflection in excess of the allowable deflection per joint, special bends, or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limits set forth, as approved, in writing, by the City.

All ductile iron pipe, fittings, and appurtenances shall be protected with minimum 8 mil polyethylene film wrap in accordance with section 3.61.02 of these STANDARDS AND SPECIFICATIONS. Miscellaneous steel or other ferrous pipe for temporary blow-offs, etc., shall be similarly protected. Methods for applying the wrap shall conform to the detail drawing in the Appendix of this chapter.

At times when installation is not in progress, the open ends of the pipe shall be closed with a watertight plug. Cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining, leaving a smooth end at right angles to the axis of the pipe. Pipe ends shall be smooth and beveled with a file or other tools according to the pipe manufacturer's recommendations.

Extra care should be used in handling PVC pipe during cold weather due to the reduced flexibility and impact resistance as temperatures approach and drop below freezing. PVC pipe to be stored outside and exposed to sunlight for more than 30 days shall be covered with an opaque material such as canvas. Clear plastic sheets shall not be used to cover the pipe. Air circulation shall be provided under the covering. Any over-exposed pipe, as determined by the City, will not be permitted for installation.

All PVC waterline installations shall include the installation of a single, 12-gauge, insulated copper tracing wire taped to the top of the pipe. The tracing wire shall be installed in a continuous run between fire hydrants and the ends of the tracer wire shall be brought to the surface in a cathodic protection box next to the fire hydrant in accordance with the detail drawing in the Appendix of this chapter. Wire splices shall be accomplished in accordance with the detail in the appendix of this chapter. Tracer wire shall be tested by the City, or by the contractor and observed by the City, for continuity prior to acceptance.

During the backfilling of all PVC waterline trenches, a continuous 2-inch-wide metallic-coated, detectable tape labeled "Waterline Buried Below" shall be placed in the trench backfill 2 feet above and directly over the pipe. Detectable tape shall be manufactured by Pro-Line, or City approved equal.

Following backfill and compaction of the water mains, cathodic protection test stations, shall be tested for effectiveness by the contractor and the results of the continuity test shall be submitted to the City. If cathodic protection of the pipe is determined not to meet industry standards, then corrections shall be made until it meets industry standards and is accepted by the City.

3.33.03 Fittings

Pipes shall be connected to valves and fittings by mechanical joints unless specified differently in the approved drawings. For approved slip-on joints, the joint shall be assembled with a ratchet jack or other approved method in a manner that does not cause any damage to the pipe. Both the spigot and bell must be thoroughly clean and free from tar or other coatings and rust.

For mechanical joint pipe, the last 8 inches of the outside of the spigot end of the pipe and the inside of the bell of all fittings and gate valves shall be thoroughly cleaned to remove oil, grit, tar (other than standard coating), and other foreign matter from the joint and then a thin film of gasket lubricant shall be applied. The cast iron gland shall then be slipped on the spigot end of the pipe with the lip extension of the gland toward the bell of the fitting. Gasket lubricant shall be applied to the rubber gasket and placed on the spigot end of the pipe with the thick edge towards the gland.

After the spigot end of the pipe is placed into the bell and fully inserted the gasket shall be pressed into place within the bell so it is even around the entire joint. After the gland is positioned behind the gasket, the contractor shall install all bolts and nuts and tighten them with a torque wrench in accordance with manufacturer's recommendations. Nuts spaced 180 degrees apart shall be tightened alternately to produce equal pressure on all parts of the gland.

Jointing shall be done in accordance with AWWA Specification C-111-07, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings, for all mechanical joint fittings.

3.34.00 VALVE AND VALVE BOX INSTALLATIONS

In addition to the jointing requirements mentioned in Section 3.33.03 of these STANDARDS AND SPECIFICATIONS, the additional requirements of this section shall apply. Valves and valve boxes shall be installed where shown on the approved drawings and as directed by the City. Valve boxes shall be firmly supported, centered, and plumbed over the operating nut of the valve with the box cover at or minus 1/4-inch within the surface of the finished pavement or at such other elevation as may be directed by the City. Extensions to within 4 feet of the finished grade shall be provided for valves installed with more than 5 feet of cover. All extensions shall be pinned to the valve operating nut. Earth fill shall be carefully tamped around each valve box to a minimum distance of 4 feet on all sides of the box, or to the undisturbed trench face if less than 4 feet. Valves shall have the interiors cleaned of all foreign matter before and after installation.

Gear cases shall be tightened and the valve shall be inspected in opened and closed positions to insure that all parts are in working condition prior to installation. The cases shall be supported by concrete blocks to prevent any shock or stress being transmitted to the valve.

3.35.00 THRUST BLOCKS

The contractor shall excavate as required to ensure that the thrust blocks are placed against undisturbed soil and shall form the sides of the thrust block to provide the size and shape as required in the detail drawing in the Appendix of these Standards and Specifications. When it is impossible, because of over excavation or other causes, to pour a thrust block against undisturbed earth, harness rods shall be used to anchor the fittings to the main in addition to the thrust block and as required by the City. After the concrete has been placed and has set, the contractor shall remove all forming materials prior to backfilling around the thrust block. Concrete for the thrust blocks shall comply with provisions set forth in Chapter 7 of these STANDARDS AND SPECIFICATIONS

The blocking shall be placed so that the pipe and fitting joints will be accessible for repair. A bond breaker shall be placed between the fittings and the thrust block. Backfill may be placed over the thrust blocks once the surface has set sufficiently to resist the weight of the backfill. However, no tamping or compacting shall be allowed above the thrust block for a minimum of 24 hours after placement. Concrete must set a minimum of 48 hours prior to the initial filling of the line.

3.36.00 CONNECTION TO EXISTING MAINS

At locations where connections to existing water mains are to be installed, the contractor shall locate the existing mains, both vertically and horizontally, and shall verify their exact size in advance of the time scheduled for making the connections. The contractor shall notify and schedule the connection with the City.

Prior to connecting to existing water mains, the contractor shall have all men, materials, and equipment ready to connect the fitting to the existing main to keep the shut-off time to a minimum. As soon as possible after making the connections, the contractor shall flush the connection to prevent any contamination of the existing facilities. The contractor shall take every precaution necessary to prevent dirt or debris from entering the main.

3.37.00 FIRE HYDRANT INSTALLATION

Before installation of a hydrant, the following operations shall be performed:

(A) The hydrant shall be thoroughly inspected for any defects or damage.

(B) The hydrant interior shall be thoroughly cleaned.

(C) The hydrant shall be opened and closed as many times as necessary to determine that all parts are in proper working order, valves are seating properly and the drain valve is operating freely.

(D) The hydrant shall be aligned so that the nozzles are rotated to face the accessible route by the Fire Department.

(E) The hydrant bury depth from the shoe to the finished grade shall be verified and the appropriate hydrant installed (see below). Extension kits will not be allowed on new hydrant installations without the prior written approval of the Public Works Director/City Engineer.

Following the installation of fire hydrants and before inspection by the City, the contractor shall ensure the following:

(A) The nozzle caps are removed, cleaned and greased with a food grade anti-seize compound such as those manufactured by Loctite, CRC, Assured Flow or USA Bluebook

(B) Reservoir oil is checked and filled as required.

(C) The operating nut is in new condition.

(D) The hydrant is re-painted in accordance with the requirements of Section 3.55.00.

Hydrants shall be set so that a minimum of 5 feet of cover is provided for the lateral line and the nozzles are a minimum of 18 inches above finished grade. Each hydrant shall be set on a concrete foundation at least 18 inches by 18-inches and 6 inches thick. Each hydrant shall be blocked against the end of the trench with a concrete thrust block. If the trench is unstable then the hydrant shall be mechanically restrained from the tee at the main to the hydrant in addition to the thrust block.

Hydrants shall have weep drain holes in the hydrant shoe and shall be surrounded with 1-1/2-inch washed rock. A sheet of 8-mil polyethylene shall be placed over the washed rock to prevent dirt from filling the rock. All hydrants shall stand plumb and shall be connected to the street main by a minimum 6-inch ductile iron lateral line. The lateral line, hydrant and fittings shall be wrapped in polyethylene. For new construction, the hydrant barrel from the flange to the shoe shall be ordered to meet the required field dimension so that the proper depth is achieved without the use of extensions. The fire hydrant bottom flange shall be adjusted to not more than 8 inches or less than 2 inches above the approved finished grade. For grade adjustments to existing hydrants, the maximum allowable height of extensions shall be 12 inches.

Depending upon hydrant location, the use of steel posts filled with concrete may be required for protection, as specified by the City. Hydrant gate valves shall have a restrained connection directly to the tee at the main (swivel tee). In areas where the hydrant bottom is installed below ground water, the drain shall be plugged and the hydrant marked with a metal tag to indicate the requirements to pump the hydrant after use. All other requirements shall be as shown on the detail drawing in the Appendix of this chapter.

3.38.00 TAPS

The size of tap and the tapping method for a given type and size of waterline shall be as follows. Transmission mains (16 inch pipes and larger) should not be tapped unless otherwise approved in writing by the City.

Host Pipe Size	Tap Size (DIP or PVC)			
	¾”	1”	1-1/2”	2”
6”	DT	DT/S	S	S
8”	DT	DT	S	S
10”	DT	DT	S	S
12”	DT	DT	S	S

S -- Tapping saddle required. All saddles shall have the AWWA taper on its threads.
DT -- Direct tap permitted.
S/DT -- Either a tapping saddle or a direct tap may be permitted depending on the situation.

All existing AC waterlines shall be tapped using a saddle.

All taps into the water main shall be at an angle of not more than 45 degrees from the horizontal, and corporation stops shall be installed.

Taps shall not be made on a water main until the main has passed the pressure tests and clear water tests and a "Release for Service" letter has been issued by the City. Care shall be taken to properly install water service lines so that a minimum of 12 inches of slack is in the service line at the main to protect against pull-out. Tapping mains may require digging out bedding material and cutting or removing part of the corrosion protective wrapping. After the taps are made, the wrap shall be repaired or replaced by the contractor to protect both the service line and the main.

Service taps shall have a minimum separation of 24 inches and be no closer than 24 inches to a main line joint.

All service taps shall be performed by the Contractor. All necessary materials for said taps, including corporations stops, copper line, meter pits, copper setters, curb stops, etc., shall be supplied by the Contractor. Said materials shall conform to these Standards and Specifications. The City will inspect each tap prior to backfilling.

Taps to PVC mains shall be accomplished with the mainline valves either side of the tap in the closed position.

Taps to PVC mains shall only be made when the air temperature is 32^{o}F or higher.

3.39.00 METER INSTALLATION

All meter installations shall be in accordance with the detail drawings in the Appendix of this chapter.

No connections shall be made in the meter pit other than those related to the meter and bypass. Sprinkler system or backflow preventer connections shall be made no closer than five (5) feet from the meter pit or vault on the downstream side of the meter. The City will own and maintain the service line and fittings up to, and including the meter.

Residential 3/4" x ¾" meters with transponders shall be provided and installed by the City upon the contractors request for a final meter inspection. All other meters and associated transponders shall be purchased by the contractor and then provided to the City for testing prior to installation. The contractor shall contact the City's Public Works Department prior to purchasing meters and transponders to verify the type and brands that are required. The contractor shall also contact the City's Public Works Department to make an appointment for delivery of said meter(s) to the Shop for testing. The location of installation and manufacturers information shall accompany the meter when delivered by the contractor to the City. The meter will be tested and a schedule set for picking up the meter within two working days by the contractor. In addition, the following specific criteria shall apply:

3.39.01 <u>3/4-Inch and 1-Inch Meter Installations</u>

The ¾" and 1" meter sets shall be installed in accordance with these STANDARDS AND SPECIFICATIONS and the detail drawing in the Appendix of this Chapter. The meter shall be located a minimum of 18 inches from the back of walk to the edge of the meter lid. Where no sidewalk exists, the meter shall be placed a maximum of 6 feet behind the back edge of the curb. In detached walk areas the meter shall be placed 6 feet behind the back edge of curb but no closer than 18 inches from the front edge of the walk to the edge of the meter lid. In all cases, the meter shall be installed within rights-of-way or public easements.

The dome or meter lid shall be level and 2 inches above the approved final grade. The copper setter shall be a minimum of 15 inches and a maximum of 17 inches below the meter pit lid. A variance of more than 2 inches vertically in installing the copper setter will not be accepted.

No meters shall be set in streets, sidewalks, driveway alignments, or concrete areas without specific design and prior approval of the City. Meter pits shall be constructed of modified hi-density polyethylene. The size shall be as specified in the detail drawing in the appendix of this Chapter. Grade adjustment shall be made at the top of the pit using concrete rings. The trench floor under the concrete rings shall be compacted earth. The concrete pit shall not bear on the service pipe. Lids shall be a 12" cast iron lid and bonnet and shall have a 2" diameter hole in the center to accommodate the transponder.

Final inspections of the meter pit will be made at the time the meter is actually set. The building permit applicant is responsible for any required adjustments to the copper setter or meter lid at that time.

3.39.02 1-1/2-Inch and 2-Inch Meter Installations

The 1 ½" and 2" meter sets shall be installed in accordance with these STANDARDS AND SPECIFICATIONS and the detail drawing in the appendix of this Chapter. Meter manhole lids shall be a maximum of 2 inches above the approved final grade.

The meter manhole shall be located a minimum of 3 feet behind sidewalk and in no case shall the manhole lid be located more than 25 feet from the back edge of curb. Where no sidewalk exists, the meter shall be placed a maximum of 6 feet behind the back of curb. In detached walk areas the meter shall be placed 6 feet behind the back edge of curb but no closer than 18 inches from the front edge of the walk to the edge of the meter lid. A curb stop is required on the service line behind the back of curb and outside of the manhole. In all cases, the meter manhole shall be installed within the right-of-way or public Utility Easements. No meter manholes shall be set in streets, concrete areas, driveway alignments, or other traffic area without specific design and prior approval of the City.

Meter manholes shall use a 24 inch aluminum ring and cover and the outside of the aluminum ring shall have 8 mils of tar applied. Once the tar is set then a 12" wide by 6" thick concrete collar shall be placed around the manhole ring. The manhole cover shall have a 2 inch diameter recessed hole in the center of the cover for the transponder and the cover shall have the lettering "Water Meter" cast into the lid. Meter manholes in traffic areas are only allowed at the discretion of the City. If allowed, the manhole shall use a 24 inch cast iron ring and cover and shall be designed to accommodate and protect the transponder. Approval by the City of this design will be on a project specific basis.

3.39.03 3-Inch and Larger Meter Installations

The 3" and larger meter sets shall be installed in accordance with these STANDARDS AND SPECIFICATIONS and the detail drawing in the Appendix of this Chapter. The entry hole through the roof of the vault shall be aligned perpendicular to the service line and adjacent to the water meter. Vaults shall be sealed at all joints and made watertight. Meter vault lids shall be a maximum of 2 inches above the approved final grade.

The meter vault shall be located a minimum of 5 feet behind sidewalk or back of curb and no more than 25 feet from the back of curb. Where no sidewalk exists, the meter shall be placed a

maximum of 6 feet behind the back of curb. In detached walk areas the meter shall be placed 6 feet behind the back edge of curb but no closer than 18 inches from the front edge of the walk to the edge of the meter lid. A curb stop is required on the service line behind the back of curb and outside of the vault. In all cases, the meter vault shall be installed within the right-of-way or public Utility Easements. No meter vaults shall be set in streets, concrete areas, driveway alignments, or other traffic area without prior approval of the City.

Meter vaults shall use a 24 inch aluminum cover and shall have the lettering "Water Meter" cast into the lid. A 24" x 36" aluminum cover adaptor and ring shall be used to enlarge the access opening and the adaptor shall have a 2 inch diameter hole for the transponder.

The outside of the aluminum ring shall have 8 mils of tar applied. Once the tar is set then a 12" wide by 6" thick concrete collar shall be placed around the manhole ring. Meter manholes in traffic areas are only allowed at the discretion of the City. If allowed, the manhole shall use a 24 inch cast iron ring and cover and shall be designed to accommodate and protect the transponder. Approval by the City of this design will be on a project specific basis.

PVC pipe shall be used on the service line outside the vault, except where the PVC pipe stubs through the vault walls. DIP shall be used inside the vault. For all 3 inch and 4 inch meter settings, 4 inch service pipe will be required on the City side of the meter. A reducer will be required before the meter and on the bypass for 3 inch settings. Insulators shall be provided between connections of dissimilar metals. Meter installations larger than 4 inch shall require shop drawing submittals for approval.

Final inspections of the meter manhole will be made at the time the meter is set.

3.40.00 TESTS

3.40.01 General

The contractor shall disinfect and test all mains and fire lines regardless of existing conditions. This may include repairing existing facilities that must be included in the test and are not capable of holding test pressures. All thrust blocks or other bracing facilities shall be in place at least 48 hours before the initial filling of the line. All tests will be administered by the City.

3.40.02 Filling and Venting Lines

All existing valves will be operated by the City. The line shall be slowly filled with water and all air expelled from the pipe. Care shall be taken so that all available hydrants (including hydrant gate valves), air valves, and other vents are open during the filling of the line. Where hydrants or other vents are not available in the line, the contractor shall make whatever taps are required for venting purposes. These taps shall be abandoned after pressure and disinfection tests have passed and the line has been completely flushed as required by the City. Following testing, the taps shall be removed back to the main and the main repaired by the use of a stainless steel repair clamp. The rate of filling the line shall not exceed the venting capacity of the vent.

3.40.03 Disinfection

The contractor will be required to disinfect all new water piping (mains, services, hydrant laterals, etc.), connections to the existing water system and water main breaks in accordance with AWWA C651-05, Disinfecting Water Mains. Disinfection of the water system shall be performed after all field placed concrete has fully cured, in accordance with Section 3.35.00 of these Standards, and following backfill of the water system. The City shall be notified at least 48 hours prior to disinfection or flushing is performed.

The tablet method (AWWA C651-05, Section 5.1.2) consists of placing calcium hypochlorite granules of tablets in the water main as it is being installed and then filling the main with potable water when installation is completed. During construction, 5 g calcium hypochlorite tablets shall be placed in each section of pipe. Tablets shall be placed in each hydrant, hydrant branch, and similar appurtenances. The minimum number of 5 g tablets required for each pipe section shall be $0.0012\ d^2L$ rounded to the next higher integer, where d is the inside pipe diameter in inches and L is the length of the pipe section in feet. Regardless of the number of tablets calculated by this formula for use, the contractor shall achieve a minimum dosage of chlorine of 50 ppm (50 mg/liter).

The tablets shall be attached by a food-grade adhesive, such as Permatex Form-A-Gasket No. 2 and Permatex Clear RTV Silicone Adhesive Sealant manufactured by Loctite Corp. There shall be no adhesive on the tablet except on the broad side attached to the surface of the pipe. Attach all the tablets inside and at the top of the main, with approximately equal numbers of tablets at each end of a given pipe length. Tablets shall be attached before the pipe section is placed in the trench and their position shall be marked on the pipe so that the pipe can be installed with the tablets in the proper position.

When installation has been completed, the main shall be filled with water at a rate such that water within the main will flow at a velocity no greater than 1 ft/s. Precautions shall be taken to ensure that air pockets are eliminated. This water shall remain in the pipe for at least 24 hours. Heavily chlorinated water should not remain in the pipe for prolonged periods to prevent damage to the pipe lining and fittings.

If a connection or repair is made to an existing water main with an equivalent length equal to or less than 18 feet of pipe, the new pipe, fittings and valves required for the connection shall be spray-disinfected or swabbed with a minimum 1 percent solution of chlorine just prior to being installed in accordance with AWWA C651-05, Section 10. If possible, flushing from both directions toward the work area shall be performed immediately following repairs.

3.40.04 Flushing the Main

The entire line shall be flushed after the specified disinfection time as required in Section 3.40.03. Such flushing shall continue until the water is clear and meets the chlorine content of the existing line. The entire line, including hydrant leads, branch lines, and dead-end mains shall be flushed. The discharge of flushed water shall be accomplished such that no erosion will occur and with no harm to fish, animals, or plants in accordance with Federal and State regulatory agencies. The Water Quality Control Division of The Colorado Department of Public Health and Environment (CDPHE) requires all water line contractors to possess a current Discharge Permit for discharges of chlorinated and process waters associated with the installation of new mains or conduits. Contact CDPHE Water Quality Control Division at 303-692-3539 for information on obtaining the required permit. Procedures for discharge will be subject to the review of the City.

3.40.05 Pressure Test

After the pipe and appurtenances have been laid, the line has been backfilled, disinfection and flushing of the system has occurred and all field-place concrete has cured in accordance with Section 3.35.00 of these STANDARDS AND SPECIFICATIONS each valved section, unless otherwise directed by the CITY, shall be subjected to a hydrostatic pressure of not less than 150 psi. However, in all cases the test pressure shall be 50 percent over existing main pressure in the test area as measured at the lowest elevation of the water main. The test duration shall be a minimum of one hour. If the test pressure drops more than 5 p.s.i. during the test, measured water shall be added to the test section to bring the section up to the specified test pressure. Water added to maintain the pressure shall be per AWWA C600-05 and AWWA C605-05. Allowable leakage shall be calculated according to the following formula:

Ductile Iron and PVC Pipe:

$$L = \frac{N \times D \times SQRT(P)}{74{,}000}$$

L = Allowable Leakage in gallons per hour
N = Total length of pipe being tested in feet
D = Nominal diameter of pipe in inches
P = The average test pressure in psi

When testing against existing closed valves, an additional leakage per closed valve of 0.0078 gal/hr/in. of nominal valve size may be allowed at the discretion of the City.

Each test section of pipe shall be slowly filled with water and the specified test pressure (measured at the lowest point of elevation) shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, gauges, and all necessary apparatus and labor shall be furnished by the contractor. Gauges and measuring devices shall be approved by the City. Before applying the specified test pressure all air shall be expelled from the pipe. Any cracked or defective pipes, fittings, valves, or hydrants discovered in the pressure test shall be removed and replaced by the contractor with sound material including any existing pipe or appurtenances that are leaking and were included in the test section. After all visible leaks have been repaired; the pressure test shall be conducted again. Should testing show a leakage rate in excess of the rates calculated from the formula above, the pipeline shall not be accepted. The pipeline shall be repaired, rechlorinated to meet the criteria in Section 3.40.03 of these STANDARDS AND SPECIFICATIONS and retested as described in this section until it meets the test requirements and is accepted by the City.

3.40.06 Bacteriological and Turbidity Test

Water from all new water mains and appurtenances must successfully pass a bacteriological and turbidity test before the main is placed in service. After final flushing, an acceptable sample shall be collected from the new mains and appurtenances. A sample shall be collected for every 1200 ft of new pipe.

All sampling shall be performed by the City. A minimum 24 hours is required to receive bacteriological test results and may take as long as 72 hours. No bacteriological tests will be taken on Fridays.

If unsatisfactory results are obtained from bacteriological tests, the water system shall be rechlorinated by the continuous-feed or slug method of chlorination in accordance with AWWA

C651-05, Section 8, until satisfactory results are obtained. Rechlorination shall be done by the contractor, at his expense and under the City's supervision.

3.40.07 Cathodic Protection System Testing

Following construction of water mains and other appurtenances requiring cathodic protection, the following tests shall be performed:

1. Test the pipe-to-soil voltage potential by comparing to a copper sulfate half-cell. One lead of the volt meter is connected to the pipe lead and the other is connected to the copper sulfate half cell buried in moist in-situ soil near the pipe installation. The potential shall read 0.85 volt or higher. A value of 0.80 volts or less means the pipe is corroding.

2. Check the continuity of the pipe. Prior to completely backfilling the pipe an ohmmeter shall be connected between each end of the installed pipe to measure an ohm reading. Next, test between the test box lead wire and the pipe. A reading of 3 ohms or less shall be achieved for both tests.

3. Test the voltage output of the anode. As in test one above, connect the voltmeter to the anode lead wire and the other lead to the copper sulfate half cell. The voltage reading shall be between 1.4 and 1.6 volts.

4. Measure the current flow from the anode to the pipe. The volt meter is connected to the anode test lead and the other voltmeter lead is connected to the pipe test lead in the test box. The reading shall be between 0.005 amp and 0.3 amp. If the current is more than 1.3 times the design needs, a resistance shall be added to the circuit to extend the life of the anodes.

3.41.00 WORKING WITH ASBESTOS CEMENT PIPE

Approximately one-third of the City's distribution system is asbestos-cement (AC) pipe, commonly known as "Transite". When working with AC pipe by tapping, removing portions of the pipe, attaching fittings or disposing of the pipe, certain precautions need to be taken. It will be the responsibility of the contractors working within the City to follow State and Federal regulations (such as Colorado Department of Public Health and Environment, Regulation 8 Part B) as they apply to asbestos materials.

3.42.00 ABANDONMENT PROCEDURES

Abandonment of City water facilities shall follow these procedures. The City shall approve of facilities to be abandoned and the method and materials used for the abandonment.

Water Services:

- Expose the tap at the main line connection.
- Disconnect the service line from the corporation stop and pull the service line away from the main.
- Remove the corporation stop and install an approved repair clamp on the main.
- Rewrap Cast Iron or Ductile Iron Pipe with polyethylene and tape.
- After inspection, backfill and compact the excavation.

- Remove the meter and yoke from the meter pit and return the meter to the City.
- Remove the meter pit cover.
- Backfill the meter pit and compact the excavation to finished grade

Water Lines:

- Shut down the main and remove a section of pipe.
- Any main and fittings that will remain in service shall be disinfected in accordance with Section 3.40.03.
- Plug the pipe or fitting and rewrap Cast Iron or Ductile Iron Pipe with polyethylene and tape.
- Install required thrust block.
- Pressure grout the abandoned water line.

Water Valve Boxes:

- Notify City prior to abandoning the water valve and whether the valve will be abandoned in an open or closed position.
- Remove the top section of the valve box and lid.
- Fill the valve box with squeegee and patch the top 8" of the hole with the same type of material as the area surrounding the valve box.

3.50.00 MATERIALS

3.51.00 GENERAL

With the exception of fire hydrant laterals, only polyvinyl chloride (PVC) pipe is approved for water distribution main installations. Any other material proposed must be approved by the City in writing, prior to construction. All materials furnished shall be new and undamaged. Transmission mains, 16 inches in diameter and larger, may be ductile iron pipe or steel pipe at the discretion of the City.

Acceptance of materials or the waiving of inspection thereof shall in no way relieve the Developer of the responsibility for furnishing materials meeting the requirements of these STANDARDS AND SPECIFICATIONS. The City reserves the right to direct or deny the use of certain types of materials in specific circumstances. All materials delivered to the job site shall be adequately housed and protected to ensure the preservation of their quality for the work. The presence of any defects in any materials may constitute sufficient cause for rejection of the pipe or appurtenances. Rejected materials shall be removed from the work site unless otherwise permitted by the City.

All references cited in these STANDARDS AND SPECIFICATIONS as the Denver Water Board Specifications shall mean the latest edition of the Engineering Standards of the Board of Water Commissioners of Denver, Colorado.

3.52.00 PIPE

3.52.01 Ductile Iron Pipe (DIP)

All ductile iron pipe shall be manufactured in accordance with AWWA Standard C-151-02, Ductile Iron Pipe Centrifugally Cast for Water. Pipe furnished under this specification shall conform to pressure class 350.

Ductile iron pipe shall be approved for fire hydrant laterals, pipe stubs through walls (as required) and other applications as approved by the City in writing. Pipe materials for transmission mains, 16" in diameter and larger, shall be as approved by the City in writing.

The joint type shall be "push-on, single-gasket" type conforming with applicable requirements of AWWA Standard C-111-07, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings. Joint types other than "push-on, single-gasket" are acceptable only if specifically approved by the City in writing.

Pipe shall have normal laying length of either 18 feet or 20 feet. Random lengths are not acceptable.

Iron used in the manufacture of pipe shall have 60/42/10 physicals in accordance with AWWA C-151-02.

Pipe shall have standard thickness cement mortar linings in accordance with AWWA Standard C-104-08, Cement Mortar Lining for Ductile Iron Pipe and Fittings. Pipe shall have a standard asphaltic coating on the exterior

The weight, pressure class or nominal thickness, and casting period shall be shown on eachpipe. The manufacturer's mark, the year in which the pipe was produced, and the letters "DI" or

"Ductile" shall be cast or stamped on the pipe.

3.52.02 Polyvinyl Chloride Pipe (PVC)

All PVC pipe shall meet the requirements of AWWA Specification C-900-07, Polyvinyl Chloride Pressure Pipe and Fabricated Fittings (4" - 12"), and shall be Pressure Class 305 psi (DR 14), or AWWA C-905-08, Polyvinyl Chloride Pressure Pipe and Fabricated Fittings (14" - 48"), and shall be Pressure Class 235 psi (DR 18).

All pipe shall be suitable for use as a pressure conduit. Provisions must be made for expansion and contraction at each joint with a rubber ring. The bell shall consist of an integral wall section with a solid cross-section rubber ring which meets the requirements of AWWA Specification C-900-07.

Standard laying lengths shall be twenty feet (20') for all sizes. Random lengths shall not be acceptable.

Each length of pipe shall bear the date manufactured, type, grade, length, manufacturer's name, and NSF seal of approval.

Pipe joints shall be made using an integral bell with an elastomeric gasket push-on type joint or using machined couplings of a sleeve type with rubber ring gaskets and machined pipe ends to form a push-on type joint.

Solvent cement joints are strictly prohibited.

The manufacturer shall furnish a certified statement that all of the specified tests and inspections 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 City upon request.

The following test station box has been approved by the City for use with tracer wire installations:

Valvco, Terminal Box #NM (5" ID) without locking lid
Others as approved in writing.

3.52.03 <u>Steel Pipe</u>

Upon approval by the City, the use of steel pipe may be allowed for transmission mains 16 inches in diameter or larger. The pipe shall meet Standard AWWA C-200-05, Steel Water Pipe 6 inch and Larger, and installed accordingly. Detailed specifications shall be as approved by the City on a case-by-case basis.

Steel mains larger than 12" shall require cathodic protection and shall be designed by a qualified cathodic protection engineer, registered in the State of Colorado. Cathodically protected pipe shall also require polyethylene wrap as described in section 3.61.02.

3.53.00 FITTINGS

All mechanical joint fittings shall be manufactured in accordance with AWWA C110-08, Ductile Iron and Gray Iron Fittings, or AWWA C153-06, Ductile Iron Compact Fittings. Fittings shall be furnished with rubber gasket joints in accordance with AWWA C111-07, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.

All fittings shall be 350 PSI pressure rating and shall conform to the dimensions and weights shown in the tables of the above referenced AWWA Standards. All fittings shall be made from gray iron or ductile iron. The manufacturer shall prepare a certified 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 City upon request.

All ductile iron flanged fittings shall be manufactured in accordance with AWWA C110-08 for integrally cast flange fittings or AWWA C115, Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges, for threaded flange fittings. Typical ductile iron flanged fittings shall be rated for 250 psi working pressure. A working pressure of 350 psi may be achieved with the use of special gaskets.

The following are additional requirements or exceptions to the standards mentioned above:

All fittings 4" through 16" shall be furnished with a fusion bonded epoxy inside and out, with a standard thickness as defined in AWWA C116-03, Protective Fusion Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings. The requirement for fusion bonded epoxy on fittings may be waived by the City if specific fittings are not available.

All fittings shall be furnished complete with tee-head mechanical joint bolts and hexagon nuts and shall be fabricated from a high strength, low alloy steel known in the industry as "Cor-Ten" or approved equal.

Mechanical joint anchoring fittings (swivel) as approved by the City, in writing, may also be used.

3.54.00 VALVES

3.54.01 General

All valves shall open left (counterclockwise). Valves shall have a 2-inch-square operating nut. Extension stems shall be pinned to the operating nut for a secure connection. Set screw type connections will not be allowed.

All buried valves shall be installed with a valve box meeting the material specifications of Section 3.54.04 of these STANDARDS AND SPECIFICATIONS.

3.54.02 Gate Valves

Gate valves shall be required for 4 inch through 12 inch valve sizes, unless approved otherwise by the City in writing. Gate valves shall be iron body, resilient-seated gate valves with non-rising bronze stems with design, construction, and pressure ratings conforming to AWWA Specifications C-509-01, Resilient Seated Gate Valves, or C515-01, Reduced Wall Resilient Seated Gate Valves, and with modifications specified herein. Stem seals shall be triple "O" ring seals designed so that the seals above the stem collar can be replaced with the valve under pressure and in full open position.

Gate valves approved by the City shall be one of the following types:

American Flow Control, Series 2500 (C515 only)
Mueller, Series 2360 (C509 only)
American AVK, Series 45
CLOW Valves, Models 2639 and 2640

With the exception of tapping valves and valves in vaults, gate valves shall have mechanical joint ends.

Gate valves requiring flanged ends shall have dimensions and drilled holes that conform to ANSI B16.1, Class 125. Flange faces shall be machined to a flat surface with a serrated finish in accordance with AWWA C207-07, Steel Pipe Flanges (4 in. through 144 in). Tapping valves and valves in water vaults for 3” and larger meters shall have a flange connection on one side of the valve and a mechanical joint on the other side (refer to section 3.60.04 for approved tapping valves).

All ferrous internal and external surfaces of the valves shall be epoxy coated in conformance with AWWA C116-03, Protective Fusion Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings, and C550-05, Protective Interior Coatings for Valves and Hydrants. The coating shall be a two-part thermosetting epoxy suitable for field over coating and for touch-up with the same coating material without special surface preparation. The supplier shall furnish detailed performance tests of adhesion, hardness and abrasion resistance of the furnished coatings when requested by the City. The coating shall have a successful record of performance in valves, pipe or other fittings for a minimum of ten years.

The resilient seat gate valve stem shall have external break-off capabilities for over-torquing and positive stop to prevent over compression.

All external bolts, nuts and washers used in conjunction with valves shall be stainless steel and tee-bolts shall be "Cor-Ten". Valves shall be delivered complete with bolts, glands and rubber gaskets in conformance with AWWA C111-07, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.

3.54.03 Butterfly Valves

Butterfly valves shall be required for 16 inch and larger valves, unless approved otherwise by the City in writing. All butterfly valves shall be installed in a vault in accordance with the detail drawings in the Appendix of this chapter. Butterfly valves shall have a combination air and vacuum valve installed on both sides of the valve.

Butterfly valves approved by the City shall be one of the following types:

Mueller, Lineseal III and XPII (sizes up to 48”)
Pratt, Triton XR-70 (sizes 24” to 72”),
K-Flo, 500 Series (sizes up to 20”)

Butterfly valves shall be geared and designed for underground service and shall conform to AWWA Specification C-504-06, Rubber Seated Butterfly Valves, Class 150-B. Valves shall be tight closing rubber seat type with the rubber seats bonded to the valve body. No metal to metal sealing surfaces will be permitted. Valves shall be bubble tight to 150 PSI minimum rated pressure with flow in either direction. Valve discs shall rotate 90 degrees from the full open position to the shut-tight position. Valve bearings shall be sleeve-type corrosion-resistant, and self-lubricating with the load not to exceed 2,500 PSI.

All butterfly valves shall be furnished with flanged ends. Dimensions and drilling shall conform to ANSI B16.1, Class 125. Flanges shall be machined to a flat surface with a serrated finish in accordance with AWWA C207-07, Steel Pipe Flanges (4 in through 144 in). The flanges shall have full-sized bolt holes through the flanges, except that drilled and tapped holes will be acceptable only in the areas where the shaft passes through the body. Flanges with all holes tapped will not be allowed.

All ferrous internal and external surfaces of the valves shall be epoxy coated in conformance with AWWA C116-03, Protective Fusion Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings, and C550-05, Protective Interior Coatings for Valves and Hydrants.

All external bolts, nuts and washers used in conjunction with valves shall be stainless steel and tee-bolts shall be "Cor-Ten".

3.54.04 Valve Boxes

Valve box risers for standard bury depths shall be two-piece with a 5-1/4-inch diameter screw-type shaft that is adjustable from 45 inches to 60 inches in height. Extensions shall be required for pipes with greater bury depth and the number of extensions shall be minimized. Valve boxes shall be made of gray cast-iron with a large oval base and conform with ASTM A48 Class 30A. Valve boxes shall be considered integral units and shall have at least 6 inches adjustment above and below the specified depth of cover over the pipe. Valve box lids shall be marked with the word "WATER," and shall have a lip or flange extending into the valve box shaft. No slip-type boxes will be allowed.

Valve boxes for buried gate valves shall be one of the following types as approved by the City:

Tyler, series 6860 (with No. 160 base)
Olympic Foundry Inc., Model No. 450VB
Castings Inc., Series 6850
East Jordan Iron Works, Series 8560

3.55.00 FIRE HYDRANTS

Hydrants will be Waterous, Pacer Model WB-67-250 with the following options:

-- Bronze to bronze seating.
-- Oil cup reservoir.
-- Bronze "safety sleeve" stem coupling.
-- Bronze operating nut.
-- Epoxy-coated upper and lower washer assembly.
-- Fire hydrants shall open left (counterclockwise).

Hydrants shall have a 5-1/4-inch main opening with a 6-inch mechanical joint end. Each hydrant shall be equipped with one 4-1/2-inch pumper nozzle and two 2-1/2-inch hose nozzles with national standard threads. A traffic break-away feature shall be incorporated into the barrel of the hydrant at the ground line.

Hydrants shall be thoroughly cleaned at the factory and then painted with a prime coat of synthetic red primer, Type IV-TTP-86f, followed by one shop coat of fire engine red industrial enamel (Rust-oleum 7407 masstone tint base #1210, or approved equal). Fire hydrant paint shall not be lead based. Care shall be taken when handling hydrants to protect the paint. The installation contractor shall repaint all hydrants after installation with Rustoleum brand High Performance Protective Enamel (7564 Safety Red), as determined by the City.

The operating nut shall be National Standard pentagon measuring 1-1/2 inches from point to opposite flat. Nozzle covers shall have the same size and shape nut as the operating nut and shall be attached by chain to the hydrant body.

Any product that must be modified to meet these STANDARDS AND SPECIFICATIONS shall be accompanied by a certification signed by a company officer that states that these changes have been incorporated into the product furnished and, in addition, the hydrant shall be tagged by the manufacturer to assure that all the above options were included.

3.56.00 BLOW-OFFS

For host pipes less than 16” in diameter, blow-offs shall consist of a 2” tap, a 2” blow-off pipe and a blow-off assembly as manufactured by Kupferle Foundry Company (model TF500) or City approved equal. Refer to the detail drawing in the appendix of this chapter. The main tap shall consist of a corporation stop and the blow-off pipe shall have a curb stop installed between the tap and blow-off assembly and shall have a 2-inch square operating nut with a valve box. The freeze-proof blow-off assembly shall empty through a drain hole into drain rock below the valve box.

The standard required blow-off for 16-inch and larger mains shall be a 6-inch or larger pipe with a gate valve meeting the material requirements of Section 3.54.02 of these STANDARDS AND SPECIFICATION and a manhole meeting the material requirements of Section 3.57.00 of these

STANDARDS AND SPECIFICATIONS. This blow-off shall also conform to the detail drawing in the Appendix of these Standards and Specifications.

3.57.00 MANHOLES AND VAULTS

3.57.01 General

Manholes, Vaults and associated components (i.e. manhole sections, lids, walls and base slabs) shall be designed in accordance with ASTM C 857 and ASTM C 858 to handle applicable loads, including earth, thrust and live loads. Concrete shall have a minimum 28 day mix design of 5,000 psi. All concrete structures shall be designed for HS-20 loading in accordance with AASHTO Standards. Concrete structures shall be manufactured by facilities certified by the National Precast Concrete Association (NPCA). Concentric reducing sections for manholes shall not be used.

Vaults shall be cast with a separate roof slab for removal and shall be 8 inches minimum thickness. Vault walls shall be cast in one continuous placement and corners shall have added reinforcement as shown in the standard detail in the appendix of these Standards and Specifications. Minimum wall thickness shall be 6 inches and reinforcement shall be at least one inch from the face of the vault. Shop drawings for vault designs shall be submitted to the City and shall be signed and sealed by a Registered Professional Engineer in the State of Colorado.

Steps shall be ½" minimum diameter steel reinforcing bar with a polypropylene plasticcovering. Steps shall be placed 12 inches on center and 18 inches maximum from the top of the ring to the first step. Steps shall align with one another in a straight vertical line. Steps shall be PS2-PF manufactured by M.A. Industries, Inc., or City approved equal.

3.57.02 Rings and Covers

All gray iron manhole rings and covers shall conform to the requirements of AASHTO M 105 Class 35B or ASTM A48 Class 35B. Ductile Iron castings shall conform to the requirements of ASTM A536 Grade 80-55-06. Aluminum castings shall conform to the requirements of ASTM B 26 Alloy 356 or 319. All castings shall conform to Federal Specification RR-F-621E, for shape and dimension required and shall have a minimum traffic load rating of AASHTO H20-44.

Each casting shall have markings by the foundry showing: name of foundry, country of manufacture, AASHTO or ASTM designation number, Class number and letter and cast date. Lids shall have lettering, and City logo if required, as shown in the detail drawings in the appendix of this chapter.

Castings shall be free from plugging, sand, blowholes, shrinkage, cracks, and other cold shuts and be well cleaned by shot blasting. Runners, risers, fins, and other cast-on pieces shall be removed from the castings and ground smooth. Bearing surfaces between manhole rings and covers shall be cast or machined with such precision that a uniform bearing surface shall be provided throughout the perimeter area of contact.

Covers shall be 23-7/8" in diameter and frame or ring height shall be 8" tall in accordance with the standard detail in the appendix of these Standards, or as otherwise approved in writing. Concrete extension collars shall be used to adjust the manhole ring and cover to approved street or ground surface.

Gray iron ring and covers shall be the following type or City approved equal:

East Jordan Iron Works, No. 00240568 (cover); No. 00242011 (ring)

Water meter vaults for 3" and larger services and butterfly valve vaults shall have a 24" x 36" cover adaptor ring to enlarge the access opening as shown on the detail drawings in the appendix of this chapter. Adaptor rings shall have a 2-inch diameter machined hole and there shall be a 3-1/2-inch diameter recessed area above the hole so that the transponder can be installed flush with the surface pattern of the lid.

Gray iron 24" x 36" adaptor rings shall be the following type or City approved equal:

East Jordan Iron Works, No. 2455E (adaptor); No. 2455Z (ring)
D & L Foundry, No. A-1425 (adaptor and ring)

Water meter manholes for 1-1/2" and 2" services shall have aluminum rings and covers. The center of the covers shall have a 2-inch diameter machined hole and there shall be a 3-1/2-inch diameter recessed area above the hole so that the transponder can be installed flush with the surface pattern of the lid. Aluminum rings and covers shall not be allowed in traffic areas however.

Aluminum rings and covers shall be the following type or City approved equal:

Castings Inc., Model MH-100-24 AL

All manholes and vaults installed in "field conditions" or in areas prone to tampering shall have locking covers and shall have gaskets for a water tight seal to prevent inflow. Locking lids shall be ductile iron. Bolt down type locking covers will not be accepted.

Locking type rings and covers shall be the following type or City approved equal:

Certainteed Pamrex Cover .

3.57.03 Base Slabs and Base Beams

When required, manhole base beams shall be precast, reinforced concrete. The beams shall be 12 inches wide by 9 inches deep by 8 feet long. The reinforcement shall consist of three No. 5 bars longitudinally and No. 4 bars at 12-inch centers transversely.

Base slabs may be poured in place or precast. The slab shall be designed to uniformly support AASHTO H-20 traffic loading and any earth loading. The minimum slab thickness shall be 6 inches. The minimum reinforcement in the base slab shall conform to the detail drawings in the Appendix of this chapter.

3.57.04 Joint Material

Joint material used to join all sections shall be a flexible butyl resin joint sealing compound meeting Federal specifications SS-S-210-A and AASHTO M-198-B. Joint material shall be Conseal CS-102 manufactured by Concrete Sealants, Inc., or City approved equal.

3.57.05 Mortar

Mortar used in repair of precast sections and for grouting joints shall be composed of one part Portland cement and not more than three nor less than two parts of fine aggregate. Hydrated lime or masonry cement shall not be used. Portland cement shall meet the requirements of ASTM C-250, Type II. Fine aggregate shall consist of well-graded natural sand having clean, hard, durable, uncoated grains, free from organic matter, soft or flaky fragments or other deleterious substances. The fine aggregate shall be thoroughly washed and shall be uniformly graded from coarse to fine with a minimum of 95 percent passing a No. 4 sieve and a maximum of 7 percent passing a No. 100 sieve.

3.58.00 VAULT ELECTRICAL AND MECHANICAL

SECTION NOT USED

3.59.00 VENT PIPES

For typical above ground vent pipe installations, vent pipes shall be 3-feet tall and 8-inch diameter seamless aluminum pipe in accordance with the details in the appendix of these Standards and Specifications. Vent pipes that are located in a "field" condition or areas that may require a more visible installation shall be 8 ft tall and 6-inch diameter galvanized schedule 40 steel pipe which conforms to ASTM Standard Designation A-53. The vent screen shall be a 3/4-inch, No. 9-11 flattened, expanded galvanized metal screen.

Below-ground, vent pipes shall be 6-inch diameter, SDR 35 or Schedule 40 PVC with glued joints in accordance with the details in the appendix of these Standards and Specifications. For galvanized steel vent pipe installations, a PVC glued joint by standard pipe thread female adapter shall be used to connect the steel pipe to the PVC pipe at ground level.

3.60.00 SERVICE CONNECTIONS

3.60.01 Pipe

Acceptable material for ¾" through 2" service lines is seamless copper tube and for 4" and larger service lines polyvinyl chloride (PVC) pipe shall be used. All service pipes shall conform to one of the following specifications.

(A) Seamless copper tube designated as "Type K" (soft) in the industry shall be used for ¾", 1", 1-1/2" and 2" service lines. Service pipe and fittings 1-1/4" in diameter are prohibited.

(B) Polyvinyl chloride pipe conforming to Section 3.52.02 of these STANDARDS AND SPECIFICATIONS shall be used for 4-inch and larger service lines. Three-inch service pipe is not readily available and service pipe specified as 3-inch shall be upsized to 4-inch from the main connection to the meter pit.

3.60.02 Saddles

For ¾" to 2" taps requiring saddles, the saddles shall be AWWA taper thread (CC thread) and shall be manufactured in accordance with AWWA C-800-05, Underground Service Line Valves and Fittings. Cast saddle top and nuts shall be constructed of 85-5-5-5 ASTM B62 brass and straps shall be silicon bronze.

The following saddles have been approved for use with ductile iron, cast iron, AC or PVC host pipes, 6" through 12":

	¾"	1	1½"	2"
Mueller	---------- BR2B Series ----------			
McDonald	---------- 3825 Series ----------			

3.60.03 Curb Stop Valves and Curb Stop Boxes

All curb stops shall be manufactured in accordance with AWWA C800-05, Underground Service Line Valves and Fittings, and shall be constructed of brass in accordance with ASTM-B62 (common trade name 85-5-5-5). Curb stop valves shall be ball type with a maximum working pressure of 300 psi and shall have compression fittings.

Curb stop valves for use with copper service pipe shall be the following type or City approved equal:

	¾"	1	1½"	2"
Mueller	n/a	n/a	B-25209	B-25209
McDonald	n/a	n/a	6100Q	6100Q

Curb stop boxes shall be cast iron and shall have an inside diameter of 4-1/4" with a large bottom section and pipe cut outs for the service line. Curb stop boxes shall be the following type or City approved equal:

Tyler Series 145R
Castings Inc. CI 145R

3.60.04 Tapping Sleeve and Valve

Tapping sleeves shall be required on existing host pipe for all taps larger than 2 inch, unless a tee is provided**.**

Cast or Ductile Iron Host Pipe

Full body Mechanical Joint (MJ) cast or ductile iron tapping sleeves are required.

Tapping sleeves for Cast Iron or Ductile Iron shall be the following type or City approved equal:

Mueller H-615
Waterous Series 1004 or 2800
US Pipe T-9
Tyler/Union Compact (up to 12")

PVC or AC Host Pipe

Fabricated stainless steel triangular sidebar style with stainless steel flange tapping sleeves are required. No coated carbon steel saddles will be allowed. A flange insulator kit between the valve and sleeve is required. Stainless steel bolts will be required on the tapping sleeve side of the valve. Tapping sleeve shall be rated for 250 PSI minimum operating pressure (sizes 4"-12") and 200 PSI minimum operating pressure for larger sizes.

Tapping sleeves for PVC or AC host pipes shall be the following type or City approved equal:

JCM 432 or 452
Mueller H-304
Ford FTSS
Romac SST III or STS 420
Smith Blair 665

Steel Host Pipe
Weld on Saddles shall be required. These taps are application specific and require approval by the City Engineer.

Tapping valves shall be resilient seat, cast iron or ductile iron body, fully bronze mounted with non-rising stem and shall be in conformance with section 3.54.02 of these Standards and Specifications. Tapping valves shall have a flange connection on one side meeting the requirements of ANSI B16.1 Class 125 and a mechanical joint on the other side meeting AWWA C111-07, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings. Valves shall be delivered complete with bolts and gaskets.

Tapping sleeves for Steel host pipes shall be the following type or City approved equal:

Mueller, Series 2360 (sizes 4" – 12")
American AVK, Series 45 (sizes 4" – 12")

3.60.05 Corporation Stops

All corporation stops and threaded brass fittings shall be manufactured in accordance with AWWA C800-05, Underground Service Line Valves and Fittings, and shall be constructed of brass in accordance with ASTM-B62 (common trade name 85-5-5-5). All corporation stops shall be tested at the factory and shall meet the following minimum physical requirements:

Tensile strength	30,000 PSI minimum
Yield Strength	14,000 PSI minimum
Elongation in 2 inches	20 percent minimum

Corporation stops shall be ball valve type designed for a maximum working pressure of 300 psi. The inlet side shall have AWWA taper thread (CC thread) and the outlet side shall have a compression fitting.

Corporation stops shall be the following type or City approved equal:

	¾″	1	1½″	2″
Mueller	---------- B-25008 ----------			
McDonald	---------- 4701BQ ----------			

3.60.06 Stop and Waste

Stop and waste valves will not be allowed.

3.60.07 Compression Couplings

Only compression fittings will be allowed on copper service pipe. All compression couplings shall be manufactured in accordance with AWWA C800-05, Underground Service Line Valves and Fittings, and shall be constructed of brass in accordance with ASTM-B62 (common trade name 85-5-5-5).

Compression couplings shall be the following type or City approved equal:

Ford: C44-G Series (Grip Joint Connection)
McDonald: 4758-Q
Mueller: H-15403

Upsizing of service lines after the meter shall be in accordance with the detail drawing of this chapter. Compression couplings for upsizing shall be the following type or City approved equal:

	¾" to 1"	1" to 1-1/2"	1½" to 2"	2" to 3"
Mueller	H-15403	H-15403	n/a	n/a
McDonald	4758Q	4758Q	n/a	n/a

3.61.00 ENCASEMENT

3.61.01 Concrete

All concrete shall be a minimum of Class A and shall conform to City standards for Portland cement concrete as specified in Chapter 7 of these STANDARDS AND SPECIFICATIONS. All concrete encasements shall be a minimum of 6 inches thick from outside of pipe to outside of encasement. Reinforcement for pipe encasements shall include #4 "hoop" reinforcement steel on 12" centers transverse and longitudinal #4 reinforcement placement shall conform with detail W27 of these STANDARDS AND SPECIFICATIONS. Material properties for reinforcing steel shall conform with Section 3.67.00 of these STANDARDS AND SPECIFICATIONS.

3.61.02 Polyethylene Encasement

Polyethylene encasement material shall be a minimum of 8 mils thick and shall be a high density, cross-laminated polyethylene film. All polyethylene encasement material shall be manufactured in accordance with ANSI/AWWA Standard C-105/A21.5-05, Polyethylene Encasement for Ductile Iron Pressure Pipe and Fittings. The raw materials used to manufacture polyethylene film shall be Type I, Class A, Grade E-1 in accordance with ASTM Standard Designations D-1250.

3.61.03 Extruded Polystyrene Insulating Foam

"Extruded Polystyrene Insulating Foam" or "Rigid, Cellular Polystyrene Thermal Insulation" also referred to as "XPS" shall be manufactured in accordance with ASTM C 578-08b. Bonding

sheets of "XPS" together shall be accomplished by using "3M 78 Polystyrene Foam Insulation Spray Adhesive" or City approved equal.

3.62.00 CATHODIC PROTECTION

3.62.01 General

Unless otherwise specified, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice. All materials and equipment shall conform to the respective specifications and other requirements specified herein.

3.62.02 Sacrificial Anodes

Dimensions of the magnesium anodes shall conform to the dimensions for standard sizes of anodes and of the weights specified. All magnesium anodes shall be cast around a galvanized steel core (flat strap or spring) and be made of high potential magnesium alloy conforming to the following compositions by weight:

Aluminum	0.01% Max.
Manganese	0.50% Min. to 1.30% Max.
Zinc	0.005% Max.
Copper	0.02% Max.
Nickel	0.001% Max.
Iron	0.03% Max.
Other Impurities	0.05% Each Max.
Other Impurities	0.30% Total Max.
Magnesium	Balance

Contractor shall furnish spectrographic analyses or a letter of compliance on samples from each heat or batch of anodes used on the project.

Sacrificial anodes shall be provided with specific backfill in a permeable cloth sack. Anodes shall be centered in the backfill material and shall be buried to a depth as specified by the design engineer. The weight and nominal dimensions of the packaged anode shall be as follows:

48 lb. bare anode (5.50" X 5" X 31") = approx. 100 lb. packaged (8" Dia. X 38"L)

The anode backfill material shall consist of 75 percent gypsum, 20 percent bentonite, and 5 percent sodium sulfate, and shall be of the quick wetting type.

All anodes shall be shipped and stored in waterproof bags or wrapping and shall be AMAX "MaxMag", Dow "Galvomag" or City approved equal.

Sacrificial anode lead wires shall consist of #12 AWG Type RHW or USE, black insulated stranded copper wire. Lead wires shall be a minimum of 25 feet in length. The lead wires shall be connected to the galvanized steel core of the anode by silver soldering and this connection shall be sealed with a waterproof epoxy or electrical potting compound.

3.62.03 Wire Conductors

Test station wires shall be #12 AWG and #8 AWG single conductor, stranded copper Type RHW. Wire color coding shall be as shown on the design drawings.

Joint bond wires shall be #4 AWG single conductors, stranded copper with Type HMWPE insulation.

3.62.04 Wire Splice Connections

All splices of buried test station or anode wires shall be made using a mechanical connector and soldered then sealed with an epoxy type material. Splice kits shall be Royston "MINI SPLICE-RIGHT" with a "Crimpit" type or City approved equal**.**

3.62.05 Exothermic Welds

All electrical cable connections to the buried piping shall be made by an exothermic weld. Exothermic type weld materials including the proper size and type of weld cartridges and welder molds for use on steel or ductile iron pipe shall be by Erico Products Inc. "CADWELD" or Burndy "THERMOWELD" or City approved equal.

Copper sleeves specifically designed for the purpose shall be crimped on all bare wire ends of all stranded cables prior to exothermic welding to improve mechanical strength and thermal capacity.

3.62.06 Exothermic Weld Coating

For ductile iron pipe, exothermic weld coatings shall be a cold applied compound such as Koppers "Bitumastic 50", Royston "Roskote A51", or City approved equal.

For steel pipe, exothermic weld coatings shall be a mastic filled plastic weld cap such as Royston "Handicap" or City approved equal.

3.62.07 Test Stations

Flush mount cathodic protection test stations shall be those made specifically for the purpose and shall consist of test station enclosure, cast iron lid, terminal block with studs, and shunt.

Test station enclosures in shall be composed of concrete and shall be Brooks Products Inc. Model" No. 1-RT" or Christy Mfg. Model "G3" or "G5" with the lid inscribed with the words "CP TEST". Test station enclosures within vehicle traffic areas shall be cast iron in accordance with Section 3.54.04 of these Standards and Specifications.

A separate terminal board manufactured from a minimum 3/16 inch thick plastic or glass reinforced laminate with minimum dimensions of 3 inches by 4 inches shall be provided to terminate the test station and anode wires. Terminal boards shall be CP Test Services Model NM-5 terminal board or City approved equal.

Terminal board hardware shall be nickel plated brass and consist of a minimum of five 1/4 inch studs with double nuts, flat washers, and lock washers. The layout of the hardware shall be as shown on the City approved design drawings.

Each test station shall also be furnished with a Colt Mfg. Co. calibrated 0.01 ohm - 8 ampere color code yellow) test station shunt or City approved equal. Exception: the shunt is not required at test stations designated as insulating fitting or test stations with no anodes type test stations.

3.62.08 Insulating Flange Kits

Dielectric flange kit materials shall consist of full faced gaskets, bolt sleeves, non-metallic washers, and steel backing washers.

Gaskets shall be "Type E") (full face) phenolic with a Buna-N o-ring type sealing element**.** Insulating bolt sleeves shall be the single one-piece sleeve and washer type made of Minion or acetyl resin plastic, shall fit within the bolt facing of the flange, and shall allow the standard size bolt or stud for the flange to be inserted. This subparagraph shall also apply to harness rods or tie bolts where insulating sleeves and washers are specified.

The steel backing washers shall be 1/8" thick; cadmium plated, hot rolled steel and shall fit within the bolt facing on the flange.

3.63.00 METERS

3.63.01 General

All water meters shall be Badger and use Orion transponders, unless approved otherwise. Approval of the meter by size, type and brand shall be obtained from the City prior to purchasing the meter. All meters, other than residential 5/8" x ¾", shall be purchased by the contractor and delivered to the City Meter Shop to be pre-tested prior to installing the meter in the meter setting in accordance with Section 3.39.00 of these STANDARDS AND SPECIFICATIONS.

3.63.02 Magnetic Drive Displacement-Type Water Meters

All magnetic drive displacement-type meters shall conform to AWWA C700-02, Cold Water Meters Displacement Type Bronze Main Case, and AWWA C710-02, Cold Water Meters Displacement Type Plastic Main Case.

3.63.03 Compound and Turbine Meters

Compound meters shall conform to AWWA 702-01, Cold Water Meters Compound Type, and AWWA 701-07, Cold Water Meters Turbine Type, and C703-96 (reaffirmed 2004) Cold Water Meters Fire Service Type. Strainers shall be provided upstream of all compound meters. Turbine meters shall be supplied with integral strainers.

3.63.04 Mastered Meters

Every "Master Metered" system to which fire hydrants or fire protection lines will be connected shall have a UL/FM approved "Fire Service Protection Water Meter" in accordance with AWWA C703-96(R04), Cold Water Meters – Fire Service Type. The City Utility Department shall be contacted prior to design for meter requirements.

3.63.05 Meter Bypass Line

Bypass lines shall be required on all 1-1/2” and larger domestic water meter installations and shall contain an independent control valve. The bypass shall not contain tees, plugs, or other outlets through which water could be withdrawn. Bypass valves shall have locking devices.

3.63.06 Meter Check Valves

For 1-1/2” and 2” meter installations, single check valves shall be installed inline with the service pipe and downstream of the meter setter in accordance with the standard details of this Chapter. Single check valves shall be manufactured in accordance with AWWA C800-05, Underground Service Line Valves and Fittings, and castings shall be constructed of brass in accordance with ASTM-B62 (common trade name 85-5-5-5).

Single check valves for 1-1/2” and 2” meter installations shall be the following type or City approved equal:

Ford HS11-666 (1-1/2”); HS11-777 (2”)

For 3” and larger meter installations, swing check valves shall be installed downstream and adjacent to the meter as well as on the bypass. Swing-check valves shall be manufactured in accordance with AWWA Standard C-508-01, Swing-Check Valves for Waterworks Service (2 in through 24 in) and shall have interior epoxy coating in accordance with AWWA Standard C-550-05, Protective Interior Coatings for Valves and Hydrants. Swing check valves shall have an outside lever and weight and shall have metal seats. Swing check valves shall be iron body bronze mounted with flanged ends in accordance with ANSI B16.1.

Swing check valves for 3” and larger meter installations shall be the following type or City approved equal:

American Flow Control, Series 50-SC and 600
AVK, 41 Series
Mueller, A-2600-6-01
Kennedy, Style 106

3.63.07 Meter Valves

Meter valves for ¾” through 2” services shall be manufactured in conjunction with the setter. Valve shall be an angle lock wing type ball valve and shall be on the inlet side of the setter for ¾” and 1” setters and on the inlet and outlet sides for 1-1/2” and 2” setters.

For valves 4” and larger, gate valves shall be used and shall conform to Section 3.54.02 of these STANDARDS AND SPECIFICATIONS.

3.63.08 Meter Yokes (Setters)

All meter setters shall be manufactured in accordance with AWWA C800-05, underground Service Line Valves and Fittings, and all castings shall be constructed of brass in accordance with ASTM-B62 (common trade name 85-5-5-5). Meter setters shall be designed in accordance with the detail drawings in the appendix of this chapter.

The following meter setters: shall be the following type or City approved equal:

	¾”*	1**	1½”***	2”***
Mueller	B-2474	B-2474	B-2423	B-2423
A.Y. McDonald	31-309WXTT33	31-410WXTT44	20-B618WWFF665	20-B718WWFF775

* 9” setter height
** 10” setter height. Requires bypass piping.
*** 18” setter height. Requires bypass piping.

For installation of a smaller meter on an existing setter, size changes shall be accomplished by providing a full sized meter vault and setter for the line size installed and using industry standard adapters to install a reduced size meter in the full size line. Adapters: shall be the following type or City approved equal:

1 ½” meter on 2” line	- 1 pair Ford A67 adapters
1” meter on 2” line	- 1 pair Ford A47 adapters
1” meter on 1 ½” line	- 1 pair Ford A46 adapters
5/8” X ¾” meter on 1” line	- 1 pair Ford A24 adapters
Other sizes	- Contact Utilities/Meter Shop

3.63.09 <u>Valve and Meter Supports</u>

Meter supports shall be fabricated of concrete and valve supports shall be fabricated of steel in conformance with detail W13 of these STANDARDS AND SPECIFICATIONS.

3.63.10 <u>Meter Pits (3/4” and 1” service lines)</u>

Meter pits for ¾” and 1” service lines shall be constructed of modified high density polyethylene with a minimum nominal wall thickness of 0.50”, shall have protective UV degradation with a low temperature brittleness which exceeds -76^{o}F, a thermal transfer rate of .40, smooth walled (inside and out) and shall have a vertical crush rating which exceeds 20,000 pounds. No meter pits shall be set in streets, concrete areas, driveway alignments, or other areas of vehicle traffic.

Meter pits shall be the following type or City approved equal:

Mid-States Plastics Inc. B-Series (20” dia. for ¾” services and 24” dia. for 1” services)

A concrete meter pit is available as an alternate to the plastic meter pit upon approval in writing by the City. Note that this meter pit is not intended for installation in areas of vehicle traffic. Concrete meter pits: shall be the following type or City approved equal:

Copeland Enterprises, Inc., 24” Water Meter Pit.

Meter pit covers shall be airtight and shall have a 13” diameter cast iron cap-type top lid and bonnet with a locking screw forged pentagon bolt. Lids shall have a 2” diameter hole centered in the lid for the transponder. A deep dish plastic inner lid shall be provided below the top lid. Meter risers shall not be allowed on new meter pit installations.

13” diameter meter pit covers shall be the following type or City approved equal:

Castings Inc. Model M70

3.64.00 PRESSURE-REDUCING VALVE

All pressure-reducing valves shall be Cla-Val model 90-01, or approved equal. The valve shall be designed to reduce a high upstream pressure to a constant downstream pressure by way of a pilot control system. The pilot system shall control the main valve which shall be single-seated, hydraulically-operated, diaphragm, globe-valve type. The typical valve seats shall be bronze (Note that the manufacturer recommends stainless steel seats when subjected to sustained high velocities through the valve). An indicator rod or flow tube shall be furnished as an integral part of the valve to show the position of the valve.

3.65.00 COMBINATION AIR VALVES

Air release valves shall be in conformance with AWWA C512-07, Air Release, Air/Vacuum and Combination Air Valves.

Single body combination air valves shall be the following type or City approved equal:
Note that inflow preventers shall be required on all vault installations:

Val-Matic Series 200
APCO Series 140C
ARI D-040

Combination air valves 2" and smaller shall have threaded NPT type inlets and outlets. For 3" and larger combination air valves, inlets shall be flanged.

Inflow preventers shall be the following type or City approved equal for combination air valves installed in vaults that could potentially flood with groundwater:

Val-Matic, Flood Safe

Inflow preventers shall be the following type or City approved equal for combination air valve installations that are not prone to groundwater flooding:

Wager Company, Model 2100

3.66.00 RESTRAINING SYSTEMS

3.66.01 Harness Rods

Harness rods and nuts shall be SAE type 304 stainless steel

3.66.02 Joint Restraint Devices

Joint restraint devices shall be manufactured of ductile iron conforming to ASTM A 536. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to AWWA C111/A21.11-07, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings, and ANSI/AWWA C153/A21.53-06, Ductile Iron Compact Fittings. Twist-off nuts, sized the same as the tee-head bolts, shall be used to insure

that the proper torque is applied to the bolts. In no case shall the twist-off bolts be torqued beyond the manufacturers' recommendations.

Mechanical joint restraint device shall have a working pressure of at least 350 psi for pipe sizes 4-16 inch and 250 psi for pipe sizes 18-48 inches, with a minimum safety factor of 2:1. Mechanical joint restraint devices shall be the following type or City approved equal:

EBAA Iron, Mega-lug, Series 1100 (DIP), Series 2000 (PVC)
Star, Series 3000, 3000S and 3000OS (DIP), Series 4000 (PVC)
Uniflange, Series 1400

Push on joint bell restraint harnesses shall have working pressures for PVC pipe of at least 200 psi for sizes 12 inches and smaller, 235 psi for pipe sizes 14 to 16 inches and working pressures for ductile iron pipe of at least 350 psi for pipe sizes up to 16 inches. Bell restraint harnesses shall be the following type or City approved equal: (bell restraint harnesses are not recommended for pipe sizes above 16 inches):

EBAA Iron, Mega-lug, Series 1700 (DIP), Series 1500, 1600 and 2800 (PVC)
Star Pipe Products, Series 3100P (for DIP only)
Smith-Blair, Series 165 (for PVC only)

3.67.00 CONCRETE REINFORCEMENT

All deformed reinforcing bars shall conform to ASTM Standards A-615, Grade 40 or 60, or ASTM Standard A-671, Grade 40 or 60. All welded wire steel fabric shall conform to ASTM Standard A-185.

3.68.00 BACKFLOW PREVENTION DEVICE

Backflow prevention devices shall conform to the requirements of AWWA C510-07, Double Check Valve Backflow Prevention Assembly, and C511-07, Reduced Pressure Principle Backflow Prevention Assembly. Backflow devices shall also meet the application requirements in section 3.24.08 of these Standards and Specifications and the City of Fort Lupton Municipal Code.

3.69.00 REPAIR CLAMPS

Repair clamps shall be entirely 18-8 Type 304 stainless steel including bands, lugs, nuts, and bolts. Gaskets shall be gridded virgin GPR compounded for water service and meeting the requirements of ASTM D 2000-90M 4AA607. Repair clamps shall be single or double panel as required to fit the pipe and shall have a minimum working pressure rating of 150 psi. Repair clamp length shall be greater than or equal to the host pipe diameter.

Repair clamps approved by the City shall be one of the following types:

PowerSeal, Model 3121AS or 3122AS
Ford, Style FS1 or FS2
Smith-Blair, Models 261 and 262
Romac, Style SS1 or SS2