SECTION 15010

MECHANICAL PIPING, GENERAL

PART 1 – GENERAL

1.01 SUMMARY

A. SCOPE:

This section specifies systems of process piping and general requirements for piping systems. Work included in 15010 applies to Division 15 work to provide materials, labor, tools, permits and incidentals to provide and make ready for Owner's use unburied piping system including, but not necessarily limited to: heating, ventilation, air conditioning, process, and plumbing systems for proposed project. Detailed specifications for the components listed on the Piping System Specification Sheets are found in Division 2 and other sections of Division 15. This section shall be used in conjunction with those sections. Requirements of Section are a minimum for Division 15 Sections, unless otherwise stated in each Section, in which case that Section's requirements take precedence.

B. DEFINITIONS:

Pressure terms used in this Section and elsewhere in Division 15 are defined as follows:

1. Maximum: The greatest continuous pressure at which the piping system operates.
2. Test: The hydrostatic pressure used to determine system acceptance.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI A13.1	Scheme for the Identification of Piping Systems
ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.3	Malleable-Iron Threaded Fittings
ANSI B16.11	Forged Fittings, Socket-Welding and Threaded
ANSI B16.22	Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
ANSI B16.26	Cast Copper Alloy Fittings for Flared Copper Tubes
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A105/A105M	Carbon Steel Forgings for Piping Applications
ASTM A106	Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A197	Cupola Malleable Iron
ASTM B88	Seamless Copper Water Tube
ASTM D1248	Polyethylene Plastics Molding and Extrusion Materials
ASTM D1784	Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2665	Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM F441/F441M	Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
AWWA C651	Disinfecting Water Mains
UPC-1994	Uniform Plumbing Code, 1994 edition, amended by the State of California, 1995

The following related specification sections are referenced herein:

A. Section 01300 – Submittals

B. Section 02120 – Pressure Pipeline Testing

C. Section 02130 – Non Pressure Pipeline Testing

D. Section 15096 – Pipe Hangers and Supports

E. Data on piping materials shall be provided in accordance with Section 01300 where specified.

B. equipment and piping coordination and installation drawings:

1. The Drawings show only the general arrangements of the project equipment, piping and appurtenances. Contractor shall prepare and submit coordination and installation drawings, prior to construction, that show the specific locations and dimensions of equipment, tanks, control panels, piping, trench and rack mounted piping, valves, appurtenances, platform gratings, HVAC equipment, ductwork, grilles, diffusers, fire sprinklers, lights, electrical services and related items, based upon dimensions for the actual equipment to be furnished from the accepted shop drawings. Composite Drawings show

services on a single sheet. Key Drawings to structural column identification system, and progressively number. Prior to completion of Drawings, coordinate proposed installation with architectural and structural requirements, and other trades (including plumbing, fire protection, electrical, ceiling suspension, and tile systems), and provide reasonable maintenance access requirements.

2. The coordination and installation drawings are required for the following systems:

   a. Equipment and associated piping in Division 11 and Division 15.

   b. All unburied piping systems.

3. DRAWING REQUIREMENTS:

   a. Drawings shall be prepared with AutoCAD 2004 software on a PC compatible hardware platform. The drawing files shall be submitted with each piping system print on CDs.

   b. The drawings shall be printed at a minimum scale of 3/8" = 1', on a minimum sheet size of 11" x 17". Piping shall be shown in plan and section views, or alternatively, as isometric piping spool drawings. Drawings shall indicate location, size and elevation above finished floor of HVAC/plumbing equipment, ductwork, and piping. Drawings shall also indicate proposed ceiling grid and lighting layout as shown on electrical drawings and reflected in ceiling drawings.

   c. Piping of nominal size less than 8" may be single line with scaled lay lengths and fittings. Piping of size 8" and greater shall be double line with scaled flanges, lay lengths, and fittings. Each pipe run shall be dimensioned. Indicate piping that must be graded to have right-of-way over more flexible items.

   d. All pipe supports, thrust restraints, and seismic bracing shall be shown. Fittings, hangers, access panels, valves, and all devices shown on the P&ID drawings shall be shown.

   e. Drawings are to incorporate Addenda items and change orders.

4. Distribute drawings to all trades involved. During preparation of the drawings, Contractor shall provide interface and coordination between all equipment suppliers and subcontractors, and, including as a minimum, the structural, architectural, mechanical, electrical, and instrumentation and control elements of the work, including the process and instrumentation diagrams.

5. Review and revise as necessary section cuts in Contract Drawings after verification of field conditions. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Engineer of discrepancies between that indicated on Drawings and that exist in field prior to installation related thereto. Contractor shall bear costs resulting from failure to properly coordinate installation or failure to advise Engineer of conflict.

6. Submittal and review of the coordination and installation drawings shall be completed at least 30 days prior to commencement of piping fabrication for each system. For piping systems that are field fabricated, such as polyvinyl chloride piping systems, submittal and review shall be completed at least 30 days prior to construction of each system.

7. Final coordination drawings with appropriate information added shall be submitted as Record Drawings at completion of project.

1.04 QUALITY ASSURANCE

A. CONTRACT DOCUMENTS

Where Contract Documents are at variance with applicable codes governing work, code and local jurisdiction requirements take precedence, and Contractor shall include cost necessary for code compliance or local jurisdiction compliance in bid price. Costs shall include machinery and equipment necessary to comply with Occupational Safety and Health Act of 1970, as currently revised, as interpreted for equipment manufacturer requirements.

Drawings are intended to be diagrammatic and are based on one manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., ducts and piping) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than basis of design, including but not limited to architectural, structural, electrical, HVAC, and plumbing.

B. MINIMUM RULES, REGULATIONS AND LAWS

As a minimum requirement, work in accordance with the following rules and regulations and applicable laws:

1. NFPA
2. OSHA
3. Codes as published by ICBO:
   a. CBC
   b. UFC
   c. UMC
   d. UPC

e. Related supplements and standards

4. California State Energy Code

5. State of California and local jurisdictional requirements

C. REGULATORY REQUIREMENTS

1. UL and CSA Compliance: Provide UL and CSA listed equipment. Equipment supplier is responsible for obtaining state, county, and city acceptance on equipment not UL approved or not listed for installation.

2. ASME Compliance: Provide units listed by the ASME for unified pressure vessels, water heaters and boilers exceed 200,000 BTUH, when hot water storage tanks which 120 gallons, and hot water expansion tanks are connected to ASME-rated equipment or required by code or local jurisdiction.

3. Provide safety controls required by National Boiler Code (CSD-1) for boilers and water heaters exceeding 400,000 BTUH.

D. PERMITS AND INSPECTIONS

1. Unless otherwise distinctly hereinafter specified, apply and pay for necessary permits, plans check, and inspections required by public authority having jurisdiction (AHJ).

2. Refer to General and Supplementary Conditions for payment of water and sewer service connection fees.

3. Obtain certificates of inspection from AHJs and deliver to Owner before final acceptance.

4. Each trade shall consult local building department and utility companies prior to commencement of work to ascertain existence and location of existing underground utilities. Protect existing service against damage and interruption of use, and reroute as may be necessary to accomplish new work. Include costs for materials and installation for rerouting as specified for new work in bid price.

E. FITTINGS AND COUPLING COMPATIBILITY

To assure uniformity and compatibility of piping components, fittings and couplings for grooved end piping systems and plastic piping systems shall be furnished by the same manufacturers.

1.05 SEQUENCING AND SCHEDULING

A. For proper execution of work cooperate with other trades as needed.

B. To avoid installation conflicts, thoroughly examine complete set of Contract Documents. Resolve conflicts with Engineer prior to fabrication and installation.

C. Prior to installation of equipment requiring electrical connections, examine manufacturer's shop drawings, wiring diagrams, product data, and installation instructions. Verify that electrical characteristics indicated in Contract Documents are consistent with electrical characteristics of actual equipment being installed. When inconsistencies occur request clarification from Engineer.

1.06 EXISTING SOILS CONDITIONS

A. Understand existing soils conditions before submitting bid on work. No additional allowance will be granted due to lack of information for existing conditions of subsurface soils.

B. Submittal of a bid will be considered acknowledgment of review/understanding of project geotechnical soils report.

PART 2 – PRODUCTS

2.01 HAZARDOUS MATERIALS

Do not use products containing asbestos, lead, arsenic, or any other material defined by EPA as hazardous to human or animal life.

2.02 PIPING MATERIALS

Unless otherwise specified, piping materials, including pipe, gaskets, fittings, connection and joint assemblies, linings and coatings, shall be selected from those listed on the piping system specification sheets. Piping materials shall conform to detailed specifications for each type of pipe and piping appurtenance specified in Division 2 and the other sections of Division 15. If, in addition to the pipe service symbol, the Drawings contain specific callouts for pipe materials, the information on the Drawings shall govern on an exception basis.

2.03 PIPING IDENTIFICATION

A. PLASTIC CODING MARKERS:

1. Plastic markers for coding pipe shall conform to ANSI A13.1 and shall be as manufactured by W. H. Brady Company, Seton Name Plate Corporation, Marking Services Inc., or equal. Markers shall be the mechanically attached type that are easily removable; they shall not be the adhesive applied type. Markers shall consist of pressure sensitive legends applied to plastic backing which is strapped or otherwise mechanically attached to the pipe. Legend

and backing shall be resistant to petroleum based oils and grease and shall meet criteria for humidity, solar radiation, rain, salt, fog and leakage fungus, as specified by MIL-STD-810C. Markers shall withstand a continuous operating temperature range of -40 F to 180 F. Plastic coding markers shall not be the individual letter type but shall be manufactured and applied in one continuous length of plastic.

2. Markers bearing the legends on the following background colors:

W, HW, CW - Blue

D, V - Brown

FA - Yellow

Lettering height shall be as follow:

Outside pipe diameter,[(a)] inches	Letter height, inches
Less than 1 1/2	1/2
1 1/2 through 3	1 1/8
Greater than 3	2 1/4

[(a)] Outside pipe diameter shall include insulation and jacketing.

3. In addition, pipe markers shall include uni- and bi-directional arrows in the same sizes as the legend. Legends and arrows shall be white on blue or red backgrounds and black on other specified backgrounds.

B. PLASTIC TRACER TAPE:

1. Tracer tape shall be 6" wide, colored the same as the background colors as specified in Table A, in Paragraph 3.08, below and made of inert plastic material suitable for direct burial. Tape shall be capable of stretching to twice its original length and shall be as manufactured by Allen Systems, W. H. Brady Co., Seton Name Plate Corporation, Marking Services Inc., or equal.

2. Two messages shall be printed on the tape. The first message shall read ***"CAUTION CAUTION CAUTION PIPE BURIED BELOW"*** with bold letters approximately 2" high. The second message shall read ***"CALL CITY OF VACAVILLE"*** with letters approximately 3/4" high. Both messages shall be printed at maximum intervals of 2'.

PART 3 -- EXECUTION

3.01 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle materials and equipment in a manner to prevent damage and deterioration. Store in original container that identifies manufacturer's name, brand and model number. Do not store indoor equipment outdoors unless provided with a waterproof protective cover.

B. Replacement: In event of damage, immediately make repairs and replacements necessary.

3.02 INSTALLATION

Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level, firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.

A. LOCATION:

Piping shall be provided as specified except for adjustments to avoid architectural and structural features and shall be coordinated with electrical construction.

B. PIPING SIZES:

Where the size of piping is not specified, the Contractor shall provide piping of the sizes required by UPC. Unless specified otherwise, small piping (less than 1" in diameter) required for services not described by UPC shall be 1/2".

C. PIPE SUPPORT, ANCHORAGE, AND SEISMIC BRACING:

Piping shall be supported by anchor brackets, guides, saddles or hangers. Acceptable types of supports, guides, saddles, hangers and structure attachments for general pipe support, expansion/ contraction and for seismic bracing, as well as anchorage details, are shown on the Drawings or specified. Minimum spacing shall be as specified for supports and for seismic bracing. Where a specific type of support or anchorage is indicated on the drawings, then only that type shall be used there. Piping shall be vertically supported by anchor brackets, guides, saddles or hangers and shall be seismically braced where indicated to resist lateral load. Supports shall be provided on each run at each change of direction. Pipe supports shall be Type 304 or 316 stainless steel as indicated on the Mechanical detail drawings and in Sections 15096. Unless otherwise specified, existing pipes and supports shall not be used to support new piping.

Provide seismic control per Section 11050, Equipment Mounting.

D. ANCHORAGE FOR BURIED PIPING:

All plugs, caps, tees and bends in buried pressure piping systems shall be anchored by means of reaction backing or restrained joints as specified. If restrained joints are not specified, reaction backing consisting of concrete thrust blocks shall be provided in accordance with the installation instructions of the pipe material manufacturer.

E. BEDDING AND BACKFILL:

Bedding and backfill for buried piping shall be as specified in Section 02300.

F. NOISE AND VIBRATION

1. Install vibration isolators, flexible connectors, expansion joints, and measures required to prevent noise and vibration from being transmitted to occupied areas. Select equipment to operate within noise coefficient (NC) design level for particular type of installation in relation to its location.

2. After installation, make proper adjustments to reduce noise and vibration to acceptable levels as defined by Engineer.

G. REPAIRS

Repair damages to building around pipes, ducts, and fixtures that occur during installation.

H. CUTTING AND PATCHING

Refer to section specific to pipe material.

3.03 PIPING IDENTIFICATION

A. PIPE CODING:

After application of the specified coating and insulation systems, exposed piping, interior and exterior, and piping in ceiling spaces, pipe trenches, pipe chases and valve boxes shall be identified with plastic markers. Legend markers and directional arrows shall be located at each side of walls, floors and ceilings, at one side of each piece of equipment, at piping intersections, and at approximately 50' centers.

B. PLASTIC TRACER TAPE:

A single line of tape shall be provided 2.5' above the centerline of each buried pipe. For pipelines buried 8' or greater below finished grade, Contractor shall provide a second line of tape 12" below finished grade, above and parallel to each buried pipe. Tape shall be spread flat with message side up before backfilling.

C. MAGNETIC TRACER TAPE:

Polyethylene magnetic tracer tape shall be buried 12-18" below ground and shall be above and parallel to buried nonferrous, plastic and reinforced thermosetting resin pipelines. For pipelines buried 8' or greater below final grade, the Contractor shall provide a second line of tape 2.5' above and parallel to the buried pipe.

3.04 VALVE IDENTIFICATION

All valves 4" in diameter and larger shall be provided with a stainless steel identification tag bearing the specified valve number stamped in 1/4" high letters. The valve designation system shall be as indicated on the Drawings. The tags shall be installed on valve flanges in a position visible from floor level. Flangeless valves 8" in diameter and

larger shall have tags attached to the valve body by self-tapping corrosion resistant metal screws. Flangeless valves 6" in diameter and smaller shall have tags attached to the valve stem by stainless steel wire. Wire shall be 0.063" minimum.

3.05 TESTING

A. GENERAL

1. Upon completion of piping, but prior to application of insulation on exposed piping, the Contractor shall test the piping systems. Pressures, media and test durations shall be as specified below. Equipment which may be damaged by the specified test conditions shall be isolated. Testing shall be performed using calibrated test gages and calibrated volumetric measuring equipment to determine leakage rates. Each test gage shall be selected so that the specified test pressure falls within the upper half of the gage's range. Unless otherwise specified, the Contractor shall notify the Engineer 24 hours prior to each test.
2. Unless otherwise specified, testing, as specified herein, shall include existing piping systems which connect with new pipe systems. Existing pipe shall be tested to the nearest existing valve. Any piping which fails the test shall be repaired. Repair of existing piping will be considered and paid for as extra work.

B. LIQUID SYSTEMS

Leakage shall be zero at the specified test pressure throughout the specified duration for the following systems: exposed piping, buried insulated piping, and buried or exposed piping carrying liquid chemicals. Unless otherwise specified, leakage from other buried liquid piping systems shall be as specified in Section 02120 and 02130.

C. DRAINS

Building and structure drain systems, other than pumped drain systems, shall be tested in accordance with UPC.

3.06 CLEANING AND FLUSHING

A. GENERAL

Piping systems shall be cleaned following completion of testing and prior to connection to operating, control, regulating, or instrumentation equipment. The Contractor may, at his/her option, clean and test sections of buried or exposed piping systems. Use of this procedure, however, will not waive the requirement for a full pressure test of the completed system. Unless specified otherwise, piping 24" in diameter and smaller shall first be cleaned by pulling a tightly fitting cleaning ball or swab through the system. Piping larger than 24" in diameter may be cleaned manually or with a cleaning ball or swab.

B. LIQUID SYSTEMS

After completion of cleaning, liquid systems, unless otherwise specified, shall be flushed with clean water. With temporary screens in place, the liquid shall be circulated through the piping system using connected equipment for a minimum period of 15 minutes and until no debris is collected on the screens.

C. APPURTENANCES AND PIPING EXTERIOR

Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated by this work. Prepare piping for coatings per Section 09960.

3.07 REVIEW BY ENGINEER, ACCEPTANCE AND LETTER OF CONFORMANCE

A. REVIEW BY ENGINEER

Notify Engineer, in writing, at following stages of construction so that Engineer may, at their option, visit site for review and construction observation:

1. Plumbing:
   a. Underground piping installation prior to backfilling
   b. When ceiling installation is started.
   c. When main systems, or portions of, are being tested and ready for inspection by the agency having jurisdiction.
2. HVAC:
   a. When ductwork installation starts.
   b. When installation starts for each different major type of equipment.
   c. When ceiling installation is started.
   d. When lines or ducts are to be permanently concealed by construction or insulation systems.
   d. When balancing and testing is started.

B. ACCEPTANCE

System cannot be considered for acceptance until work is completed and it is demonstrated to Engineer that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:

1. Testing.
2. Cleaning.
3. System balancing and balancing logs.
4. Instruction and operating manuals.
5. Training of operating personnel.

6. Record Drawings.
7. Guaranty certificates.
8. Start-up and test document.
9. Letter of conformance.

C. LETTER OF CONFORMANCE

1. Provide letter and copies of extended warranties with a statement in letter that mechanical items were installed in accordance with manufacturer's recommendations. Include letter of conformance and warranties in operating and maintenance manuals.
2. Warranties shall begin at date of substantial completion.

3.08 PIPING SPECIFICATION SHEETS

Piping and valves for groupings of similar plant processes or types of service lines are specified on individual piping specification sheets. Piping services are grouped according to the chemical and physical properties of the fluid conveyed and/or by the temperature or pressure requirements. Each grouping of services is identified by a piping system number. Piping services specified in the and indicated on the Drawings are alphabetically arranged by designated service symbols as shown in Table A. Table A also indicates the system number, fluid category, and pipe marker background color of each service.

Table A. Piping Services

Symbol	Service	Pipe Material	Pipe Marker Background
D	Drain	Schedule 80 PVC	Brown
W	Potable Water	Buried: HDPE Tubing Above Ground: Copper	Blue
V	Vent	Schedule 80 PVC	Brown
FA	Foul Air	Schedule 80 PVC	Yellow
FM	Force Main	DR17 HDPE: encased in existing Sanitary Sewer PVC: connecting Package Lift Station to the Force Main tie-in.	Black-
SS	Sanitary Sewer	C900 PVC	Black-

****END OF SECTION****

SECTION 15062

DUCTILE IRON PIPE

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE

This section specifies ductile iron pipe, ductile fittings, and gaskets.

B. TYPES OF SERVICE

Piping specified in this section shall be used for the service applications described in Section 15010.

C. DEFINITION

Where cast iron pipe is specified, the term and symbol shall mean ductile iron pipe.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by the organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, reference to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
ANSI A21.14	Ductile-Iron Fittings 3-Inch through 24-Inch, for Gas
ANSI A21.52	Ductile-Iron Pipe, Centrifugally Cast, for Gas
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
ANSI B16.5	Pipe Flanges and Flanged Fittings
ASTM A716	Ductile Iron Culvert Pipe
ASTM C150	Portland Cement

Reference	Title
AWWA C104 (ANSI A21.4)	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110	Ductile-Iron and Gray-Iron
AWWA C116	Protective Fusion-Bonded Epoxy Coatings
ANSI A21.10	Fittings, 3 In. Through 48 In. (75 mm Through 1200 mm), for Water and Other Liquids
AWWA C111 (ANSI A21.11)	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115 (ANSI A21.15)	Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C150 (ANSI A21.50)	Thickness Design of Ductile-Iron Pipe
AWWA C151 (ANSI A21.51)	Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C153 (ANSI A21.53)	Ductile-Iron Compact Fittings, 3 In. Through 24 In. (76 mm Through 610 mm) and 54 In. Through 64 In. (1,400 mm Through 1,600 mm), for Water Service
AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	Grooved and Shouldered Joints

1.03 SUBMITTALS

The following data shall be provided in accordance with Section 01300, Submittals.

A. Shop drawings, product data sheets, and information for linings and coatings.

B. Alignment drawings.

C. Certifications specified in the following documents:

ANSI A21.14, Paragraph 14-4.2
ANSI A21.52, Paragraph 52-4.2
ASTM A716, Paragraph 4.2
AWWA C110, Paragraph 10-5.3
AWWA C111, Paragraph 11-7.1
AWWA C115, Paragraph 15-4.2
AWWA C151, Paragraph 51-5.2
AWWA C153, Paragraph 53-6.3
AWWA C606, Paragraph 4.1.1.1

PART 2 – PRODUCTS

2.01 GENERAL

Pipe design, materials and manufacture shall comply with the following documents:

Item	Document
Thickness design	AWWA C150
Manufacturing requirements	
Water or other liquid	AWWA C151
Gas	ANSI A21.52
Gravity service pipe	ASTM A716
Joints	
Rubber gasket	AWWA C111
Threaded flange	AWWA C115
Fittings	
Water or other liquid	AWWA C110/AWWA C153
Gas	ANSI A21.14
Cement mortar lining	AWWA C104

2.02 PIPE

Unless otherwise specified, ductile iron pipe shall be minimum pressure Class 150 and have nominal laying lengths of 18' or 20'. For grooved-end or flanged pipe, wall thickness shall be minimum Thickness Class 53 except where the specified pressure requires heavier pipe.

2.03 GASKETS

Unless otherwise specified, gasket stock shall be a synthetic rubber compound in which the elastomer is nitrile or neoprene. The compound shall contain not less than 50% by volume nitrile or neoprene and shall be free from factice, reclaimed rubber and other deleterious substances. Gaskets shall, in addition, comply with AWWA C111 for push-on and mechanical joints and with AWWA C606 for grooved end joints.

2.04 FITTINGS

Unless otherwise specified, fittings shall conform to AWWA C110. Ends shall be flanged, restrained mechanical joint, restrained push-on, or grooved to suit the conditions specified. The AWWA C153 compact ductile iron fittings in sizes 3-12" are an acceptable substitute for standard fittings unless otherwise specified. Long-radius elbows shall be provided where specified. To assure uniformity and compatibility of piping components, fittings and couplings for grooved end piping systems shall be furnished by the same manufacturers.

2.05 JOINTS

A. UNRESTRAINED JOINTS (NOT USED)

B. RESTRAINED JOINTS

1. GENERAL: Unless otherwise specified, restrained joints are required for all exposed and buried piping. Unless otherwise specified, restrained joints shall be flanged or grooved end for exposed service and push-on or grooved end for buried service.

2. PUSH-ON JOINTS: Restrained push-on joints shall be as specified in Paragraph 15060-2.05 A.1., modified for restraint. Joints shall be the Flex-Ring or Lok-Ring Joint as manufactured by American Cast Iron Pipe Company, TR Flex Joint as manufactured by US Pipe, or equal. Restrained joints shall be capable of being deflected after full assembly. Joint assembly shall be in strict conformance with AWWA C600 and manufacturer's recommendations. No field cuts of restrained pipe are permitted without prior approval of the Engineer.

3. FLANGE ASSEMBLIES:

   a. Unless otherwise specified, flanges shall be ductile iron and shall be threaded-on flanges conforming to ANSI/AWWA A21.15/C115 or cast-on flanges conforming to ANSI/AWWA A21.10/C110. Flanges shall be adequate for 250 psi working pressure. Bolt circle and bolt holes shall match those of ANSI B16.1, Class 125 flanges and ANSI B16.5, Class 150 flanges. Where specified, flanges shall be threaded-on or cast-on flanges conforming to ANSI B16.1, Class 250.

   b. Unless otherwise specified, bolts and nuts for flange assemblies shall conform with Paragraph 15120-2.01 C. Gaskets shall be as specified in Paragraph 15120-2.01 B.

4. GROOVED END JOINTS

   Grooved end couplings shall conform to AWWA C606 and shall be Gustin-Bacon 500 Series, Victaulic Style 31, or equal with flush seal type gasket designed for ductile iron pipe. Unless otherwise specified, grooved end couplings shall be rigid joint for exposed service and flexible joint for buried service. Unless otherwise specified, bolts and nuts shall comply with Paragraph 15062-2.05 C.

5. MECHANICAL JOINTS

   a. Where specified, restrained mechanical joints shall be the positive restraint type. Mechanical joints with retainer glands are not acceptable.

   b. Locked mechanical hydrant tees, bends and adapters are an acceptable substitute for anchoring fire hydrants and valves to the pipe main.

C. BOLTS AND NUTS

Corrosion-resistant bolts and nuts for use with ductile iron joints shall be high-strength, low-alloy steel as specified in ANSI/AWWA C111/A21.11.

2.06 PIPE COATING

A. Unless otherwise specified, pipe and fittings shall be coated with asphaltic material as specified in AWWA C151.

1. Piping in the wet well shall be coated with epoxy in accordance with 09960.
2. Exposed ductile iron pipe in the valve vault and the meter vault shall be coated with a minimum of 5 mils of polyamidoamine epoxy primer, ready to receive field coating as specified in these Specifications.

2.07 PIPE LINING

A. CERAMIC EPOXY LINING

1. Pipe and fittings shall be ceramic epoxy lined with Protecto 401 ceramic epoxy to a thickness of 40 mils, minimum.
2. Surface preparation of ductile iron pipe, application of lining, inspection and certification of lining, and handling of finished product shall be in accordance with manufacturer's standard specifications.

2.08 POLYETHYLENE WRAP

A. One sheet, continuous 8-mil per ANSI/AWWA C105/A21.5-99, linear low density polyethylene (LLDPE) and shall be marked at two foot intervals with manufacturer's name, year of manufacture, AWWA C105, film thickness and material, pipe size, and repair warning. Secured in place with 10-mil polyethylene tape.

PART 3 – EXECUTION

3.01 INSTALLATION

A. GENERAL

1. Piping runs specified on the drawings shall be followed as closely as possible. Proposed deviations shall be submitted in accordance with Section 01300 of the technical specifications.
2. Pipe shall be installed in accordance with AWWA C600.
3. Connections to existing structures and manholes shall be made so that the finished work will conform as nearly as practicable to the requirements specified for the new manholes, including necessary concrete work,

cutting and shaping. Concrete mortar shaping within any structure and manhole shall be as specified.

4. Polyethylene Wrap: Installation per Method A requirements of ANSI/AWWA C105/A21.5. Excess slack width in the polyethylene tube shall be taken up to make a snug, but not a tight fit, around the pipe barrel and secured with adhesive tape in a fold on the top of each pipe length at the quarter points. Any rips, punctures or other damage to the polyethylene sleeve shall be repaired with adhesive tape or a short length of polyethylene tube cut open, wrapped around the pipe and secured in place.

5. All buried metal parts such as valves and bolt-ups not cement mortar coated shall be coated with two coats of bitumastic, and encased with one sheet of 8-mil minimum thickness polyethylene to form a continuous and all-encompassing layer of polyethylene between the protected metal and surrounding earth. All polyethylene shall be secured in place with 10-mil polyethylene tape. Bitumastic shall consist of two coats of Carboline Bitumastic Super Service Black, or equal, 10 mils each coat. Apply only to clean, dry surfaces. Remove rust, paint and other foreign matter by wire brushing or scraping.

B. INSULATING SECTIONS (NOT USED)

C. ANCHORAGE

Anchorage shall be provided as specified. Calculations and drawings for proposed alternative anchorage shall be submitted in accordance with Section 01300.

3.02 ACCEPTANCE TESTING

Hydrostatic pressure tests shall be conducted in accordance with Section 4 of AWWA C600 except that test pressures and allowable leakage shall be as listed in Section 02120. The Contractor shall conduct the tests in the presence of the Engineer.

****END OF SECTION****

SECTION 15064

POLY-VINYL CHLORIDE PIPE (PVC)

PART 1 – GENERAL

1.01 SUMMARY

A. SCOPE

1. This section specifies polyvinylchloride pipe and fittings.

B. PIPE DESIGNATIONS:

Designation	Definition
PVC	Poly-vinyl chloride

1.02 REFERENCES

A. This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by the organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, reference to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
AASHTO M278	Class PS 50 Polyvinyl Chloride (PVC) Piping Systems Subsurface Drainage of Transportation Facilities
ASTM D1784	Rigid Polyvinylchloride (PVC) Compounds and Chlorinated Polyvinylchloride (CPVC) Compounds
ASTM D1785	Polyvinylchloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	Polyvinylchloride (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2321	Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe
ASTM D2467	Socket-Type Polyvinylchloride (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2564	Solvent Cements for Polyvinylchloride (PVC) Plastic Piping Systems
ASTM D2665	Polyvinylchloride (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D3034	Type PSM Polyvinylchloride (PVC) Sewer Pipe and Fittings

Reference	Title
ASTM F402	Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe

1.03 SUBMITTALS

A. Manufacturer's data certificates of compliance with the specified standards.

B. Provide information on materials, pipe dimensions, fittings, gaskets and solvent cement.

1.04 QUALITY ASSURANCE

To assure uniformity and compatibility of piping components, fittings and couplings for plastic piping systems shall be furnished by the same manufacturer.

PART 2 – PRODUCTS

2.01 PVC PIPE

A. NON-PRESSURE PIPE

Flexible pipe, fittings, and joint materials specified herein consist of SDR-26 polyvinyl chloride pipe, hereinafter referred to as SDR-26 PVC unless noted otherwise. All materials incidental to flexible pipe installations such as gaskets, joint lubricants, cements, etc., shall be supplied by the pipe manufacturer. All flexible pipe required in odd lengths shall be cut using a proper cutting tool and guide that insures true-line cut on planes perpendicular to the pipe axis. No bevel cuts for pipeline alignment adjustments will be permitted.

Unless otherwise specified, SDR-26 PVC pipe shall be in accordance with the requirements for SDR-26 sewer pipe as stated in ASTM D3034 for pipe diameters 4 through 15 inches and ASTM F789. Pipe joints and fittings shall be factory assembled, integral wall bell and spigot configuration, compatible with the pipe and shall meet the requirements of ASTM D3212.

PVC pipe shall have a solid cross section rubber ring gasket. The gasket shall be securely attached to the pipe to prevent displacement of the gasket when installed in the field. All rubber-ring gaskets shall be in accordance with ASTM F477. Lubricant used for field assembly of gasketed PVC pipe shall have no detrimental effect on the gasket, joint, fitting, or pipe and shall be as recommended by the manufacturer. Provide rubber waterstops at the entry of all PVC pipe into manhole bases.

All PVC pipe shall be joined by compression joints unless otherwise indicated in the Contract Documents and shall conform to the following requirements:

1. Polyvinyl-chloride pipe (PVC) laterals shall conform to the requirements of ASTM D 3034, Class SDR 26. Material for PVC pipe shall conform to the requirements of ASTM D 1784, cell Class 12454-B or 12454-C, as defined therein.
2. Where Polyvinyl-chloride pipe (PVC) is indicated on the Drawings, furnish and install PVC pipe conforming to AWWA C900 Pressure Class PVC Pipe, referred to herein as C900 PVC Pipe. C900 PVC Pipe shall conform to ASTM D2241, with a minimum pressure class of 150 and maximum standard dimension ratio (SDR) of 21.

2.03 BEDDING MATERIAL

As indicated on the Drawings.

2.04 FLEXIBLE COUPLINGS

Flexible couplings shall be rubber, full-circle, clamp-on type provided with stainless steel shear ring and two stainless-steel band, screw clamps to secure the coupling tightly to entering and exiting pipes. All screw-clamp hardware shall be Type 316 stainless steel. Rubber material shall be suitable for sewage service. Use Mission Rubber ARC couplings only; no equal.

PART 3 – EXECUTION

3.01 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Handling

1. Use wide fabric choker slings.
2. Do not drop pipe or fittings even on cushions.
3. Do not use hooks.
4. Polyvinyl chloride pipe has reduced flexibility and impact resistance as temperatures approach and drop below freezing. Extra care should be used in handling and installing PVC pipe during cold weather.

B. Storage

1. Store and use lubricants in a manner that will avoid contamination.
2. Store loose rubber gaskets in a cool, dark location away from grease, oil, and ozone producing electric motors.
3. Store pipe on a surface that provides even support for the pipe barrel. Do not store pipe supported by the bell.
4.

3.02 PIPE CUTTING

Pipe shall be cut smooth, straight, and at right angles to the pipe axis with saws or pipe cutters designed specifically for the material. Burrs and dust shall be removed from the jointing surfaces. Cut ends shall be beveled in accordance with manufacturer's recommendations.

3.03 INSTALLATION

A. Unless otherwise specified, PVC pipe 4" in diameter and greater shall be joined by means of gasketed push-on joints.

B. Connections to different types of pipe shall be by means of an elastomeric rubber coupling with stainless steel bands and tightening bolts, appropriate to the sizes of the pipes to be joined. Where such couplings are used, bolts shall be uniformly torqued in accordance with pipe manufacturer's recommendation. Foreign material shall be removed from the pipe interior prior to assembly.

C. Join pipe and fittings to the tolerances recommended by the manufacturer. Do not disturb previously completed joints during the joining operation.

D. Install buried pipe in accordance with the Contract Drawings and the manufacturer's recommendations.

E. Pipe shall be inspected both prior to and after installation in the ditch, and all defective lengths shall be rejected and immediately removed form the working area.

3.04 INSPECTION AND TESTING

The Contractor shall conduct the tests in the presence of the Engineer. PVC pipe, which has any of the following defects, will not be accepted:

A. Pipe which is sufficiently out-of-round to prohibit proper joining or that is visibly out-of-round.

B. Improperly formed ends.

C. Fractured, cracked, chipped, dented, abrasions, or otherwise damaged pipe.

D. Pipe that has been damaged during shipment or handling. Acceptance of the pipe at point of delivery will not relieve the Contractor of full responsibility for any defects in material of the completed pipeline.

3.05 PERFORMANCE REQUIREMENTS

A. Gravity flow sanitary sewers and drainage pipelines are required to have a straight alignment and uniform grade between manholes. Foul air pipe shall have straight alignment and uniform grade between fittings.

B. Test pipe with low pressure air. Fill to 5 psi, allow 3 minutes to stabilize pressure and temperature. If the pressure drops below 3.5 psi in the first 3 minutes, add air until the pressure reaches 3.5 psi then commence the test. After the 3-minute stabilization period, the Contractor shall test the pipe for 2 minutes. If the pressure drops 1 psi or less in the 2-minute test period, the pipe will be considered to have passed.

C. Sections of pipelines and manholes that fail any test shall be repaired or replaced, as acceptable to Engineer, and retested until the test is passed.

****END OF SECTION****

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SECTION 15070

HIGH DENSITY POLYETHYLENE (HDPE) PIPE

PART 1 – GENERAL

1.01 SUMMARY

A. This Section specifies high density polyethylene (HDPE) pipe and fittings.

B. Characteristics

The piping system shall conform with the following Dimension Ratio (DR), minimum 17, pressure-rating 100 psi minimum.

1.02 QUALITY ASSURANCE

A. Referenced Standards: This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In case of conflict between the requirements of this Section and the listed documents, the requirements of this Section shall prevail.

Reference	Title
ASTM D1248	Polyethylene Plastics Molding Extrusion Compounds
ASTM D2321	Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2657	Heat Fusion Joining of Polyolefin Pipe and Fittings
ASTM D2837	Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
ASTM D3350	Polyethylene Plastic Pipe and Fittings Material
ASTM F714	Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F2620	Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
AWWA C906	Polyethylene (PE) Pressure Pipe and Fittings, 4-inch through 63-inch for Water Distribution and Transmission
PPI TR3	Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials
PPI TR4	Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings Compounds

B. Inspection and Testing: All HDPE materials, pipe and fittings shall be inspected and tested in accordance with the requirements of AWWA C906.

1.03 SUBMITTALS

A. Procedures: Section 01300.

B. Furnish shop drawings in conformance with the requirements of this Section, and the following:

1. Fully detailed shop drawings showing each type and size of pipe section and fitting to be furnished. All materials of construction shall be identified.
2. Detail drawings, which show the type and location of all fittings and joints.

E. A report containing a copy of all manufacturer's test results for all tests conducted in accordance with Paragraph 1.02 B.

F. System used to measure the interior deflection of the pipes.

G. Butt-fusion welder's qualifications.

H. Manufacturer's certification that the pipe meets all the specifications.

I. Pipe manufacturer's installation instructions.

J. Any deviations from the specifications and the reasons therefor.

1.04 QUALITY ASSURANCE PROGRAM

A. Resin Evaluation:

All incoming resin shall be sampled and checked against test results supplied by the manufacturer. Samples shall be taken from the top and bottom of each compartment from every hopper car received.

All resin samples will undergo the following specification verifications:

1. Melt index ASTM D-2138.
2. Stress exponent.
3. Moisture content.
4. Thermal stability ASTM D-3350.
5. Density ASTM D-1505.

The results of these tests shall become part of the manufacturer's permanent quality control records.

B. Finished Goods Evaluation:

Each length of pipe produced shall be checked by production staff for the items listed below. The results of all measurements shall be recorded on production sheets which become part of the manufacturer's permanent records.

1. Pipe in process is checked visually, inside and out for cosmetic defects (grooves, pits, hollows, etc.) which are cause for rejection.
2. Pipe outside diameter is measured using a suitable periphery tape to ensure conformance with ASTM F714.
3. Pipe wall thickness is measured at 12 equally spaced locations around the circumference at both ends of the pipe to ensure conformance with ASTM F714.
4. Pipe length is measured.
5. Pipe marking is examined and checked for accuracy.
6. Pipe ends are checked to ensure they are cut square and clean.
7. Subject inside surface to a "reverse bend test" to ensure the pipe is free of oxidation (brittleness).

1.05 DELIVERY, STORAGE, AND HANDLING

Delivery, storage, and handling shall conform to the requirements of Section 15010.

PART 2 - PRODUCTS

2.01 GENERAL

A. HDPE materials, pipe and fittings shall be manufactured, inspected, sampled and tested in accordance with the requirements of AWWA C906 and this Section. In case of conflict between the requirements of this Section and AWWA C906, the requirements of this Section shall prevail.

2.02 MATERIALS

A. HDPE piping components shall be manufactured from materials that meet or exceed the requirements of the Plastic Piping Institute designation PE3408 and that conform to the requirements of ASTM D3350 for a cell classification of PE 345464C. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the same raw material pipe.

B. The pipe shall be homogeneous throughout and free of visible cracks, bubbles, holes, foreign inclusions or other injurious defects. It shall be uniform in color, opacity, density, and other physical properties and produced to the dimensions and tolerances specified in ASTM F714. The inside and outside surfaces shall be semi-matte or glossy in appearance. Any pipe not meeting these criteria shall be rejected.

C. The polyethylene pipe manufacturer shall provide certification that stress regression testing has been performed on the specific product. The said certification shall include a stress life curve per ASTM D2837. The stress regression testing shall have been done in accordance with ASTM D2837, and the manufacturer shall provide a product supplying a minimum Hydrostatic Design basis (HDR) of 1,600 psi, as determined in accordance with ASTM D2837. The manufacturer's certification shall state that the pipe was manufactured from one specific resin in compliance with these specifications. The certification shall state the specific resin used, its source, and list its compliance to these specifications.

D. The material shall be listed by PPI (the Plastics Pipe Institute, a division of the Society of the Plastics Industry) in PPI TR-4 with a 73° F hydrostatic design stress rating of 400 psi. The PPI listing shall be in the name of the pipe manufacturer, and shall be based on ASTM D1827 and PPI TR-3 testing and validation of samples of the pipe manufacturer's production pipe.

2.03 PIPE

A. HDPE pipe to be installed indicated on the Drawings. HDPE pipe shall have nominal inside diameters and minimum DR 17. Nominal inside diameters indicate the minimum required hydraulic requirement for the pipe. The field installed diameter shall be determined by the Contractor.

B. The dimensions and tolerances shall be as specified in AWWA C906. Pressure class shall be as indicated below:

1. Pressure class in accordance with AWWA C906: minimum of 160 psi.
2. Maximum deflection in installed condition of the average inside diameter of the pipe: 5 percent of vertical diameter.

2.04 FITTINGS

A. Fittings shall conform to the applicable requirements of AWWA C906 for the joining methods specified in Paragraph 3.02 B.

2.05 PIPE MARKINGS:

A. The following shall be continuously indent printed on the pipe, or spaced at intervals not exceeding five feet:

1. Name and/or trademark of the pipe manufacturer.
2. Nominal pipe size.
3. Dimension ratio.
4. The letters PE followed by the polyethylene grade in accordance with ASTM D1248, followed by the hydrostatic design basis in 100's of psi, e.g., PE 3408.

5. Manufacturing standard reference, e.g., ASTM F714-97.

6. A production code from which the date and place of manufacture can be determined.

2.06 JOINTS

A. Thermal butt fusion type. Internal weld beads shall be removed.

2.07 MITERED FITTINGS

Mitered fittings shall be provided by the factory using butt fusion from pipe the same size and DR rating as the main pipeline.

PART 3 - EXECUTION

3.01 PIPE HANDLING AND STORAGE

A. Use care in handling and storage of the pipe. Store pipe on clean, level ground to prevent scratching or gouging of the pipe. If the pipe is stacked for storage, stack the pipe in accordance with the pipe manufacturer's recommendations. Handle the pipe in such a manner that it is not damaged by dragging over sharp objects or cut by chokers or lifting equipment. Cover the storage area to prevent sun exposure which may cause pipe ovality.

B. Sections of pipe with cuts, gouges, or scratches on the outside diameter (OD) surface shall not be allowed for pipe trench installation. The inside diameter (ID) surface shall be free of cuts, gouges, and/or scratches. Pipe ends shall not be cracked, scratched, or gouged.

C. Sections of pipe with cuts, gouges, or scratches that exceed allowable limits shall be removed completely and the ends of the pipeline rejoined.

Acceptable limits for cuts, gouges, or scratches are as follows:

Outer surface: maximum allowable depth of cut, scratch, or gouge shall be 5 percent of wall thickness.

Inner surface: shall be free of cuts, gouges, and/or scratches.

Pipe, fittings and accessories shall be carefully inspected before and after installation and those found defective shall be rejected. Before being placed in position, pipe, fittings, and accessories shall be cleaned, and shall be maintained in a clean condition. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings or any other material be dropped or dumped into trenches.

3.02 INSTALLATION

A. Install HDPE pipe in accordance with manufactures recommendations, the requirements of Section 15100, and the requirements of this Section.

B. Contractor shall confirm that existing pipe is free of debris and will allow installation of HDPE prior to installation. Any obstructions shall be removed by Contractor prior to installation of HDPE within existing pipe.

C. Unless otherwise specified, install the piping system in accordance with ASTM D2321, AWWA C906 and the manufacturer's recommendations.

D. Joining:

1. Join pipe and fittings into continuous lengths on the job site above ground. Unless otherwise specified, join pipes by the butt-fusion method performed in accordance with the pipe manufacturer's recommendations and ASTM D2657. Socket fusion, extrusion welding and hot gas welding shall not be used. Be solely responsible for producing sound welds which will withstand stress occurring during HDD installation and sliplining and that contain no excess joint material.
2. Consult the pipe supplier to obtain machinery and expertise for the joining by butt-fusion of HDPE pipe and fittings. No pipe or fittings shall be joined by fusion by any of the Contractor's personnel unless they have a minimum of two years experience in the techniques involved and have performed the work on at least two previous, similar projects. Butt fusion joining shall yield a joint strength equal to or greater than the tensile strength of the pipe.
3. Remove interior and exterior weld bead prior to pressure testing the pipe.

E. Excavation and Access Pits

1. Access pit length shall be such that the minimum bending radius for the HDPE pipe, per the pipe supplier is maintained. Sheeting, shoring and bracing requirements shall be in accordance with these specifications and applicable jurisdictional standards.
2. Access pit excavations shall be performed at all points where the HDPE pipe will be inserted into the existing pipeline as shown on Plans. Access pit excavations shall coincide with host pipe lateral connection points or other appurtenance installations.

F. Pulling Equipment

1. The pulling mechanism shall be properly connected to the end of the HDPE pipe via a pulling head or arrangement approved by the pipe supplier.

2. The maximum pulling tension on the HDPE pipe shall not exceed the pipe supplier's safe pulling force as submitted for this project.

G. Annular Space Grouting

1. The annular space between the outside of the HDPE pipe and the inside of the existing host pipe shall be filled with a flowable grout in accordance with the contract documents.
2. Samples of grout shall be obtained in accordance with ASTM C495. One set of four standard cylinders shall be cast for each batch. Special handling and sampling procedures shall be followed if indicated by the grout manufacturer. The samples must meet the design compressive strength of the grout as outlined in this specification and per the grout manufacturer. Samples shall be tested in accordance with ASTM C495.
3. Grouting of the annular space shall be done in such a manner as to prevent damage, floating, or collapse of the HDPE pipe. Grouting operations shall be properly vented. If the distance between grout points exceeds the Contractor's pumping capability additional grouting points shall be excavated.
4. The HDPE pipe shall be filled with water prior to the grouting procedure. This shall aid in keeping the fusible polyvinylchloride pipe from floating or collapsing during grouting operation and also aid in dissipating the heat of hydration and its effects on the HPDE pipe as the grout cures. This can be done in coordination with the testing performed on the HDPE pipe.

H. Preparation Prior to Making Connections into Existing Piping Systems

1. Approximate locations for existing piping systems are shown in the construction documents. Prior to making connections into existing piping systems, the Contractor shall:

   i) Field verify location, size, piping material and piping system of the existing pipe.

   ii) Obtain all required fittings, which may include saddles, sleeve type couplings, flanges, tees, or others as shown in the construction documents.

   iii)Have installed all temporary pumps and/or pipes in accordance with established connection plans.

2. Unless otherwise approved, new piping systems shall be completely assembled and successfully tested prior to making connections into existing pipe systems.

I. Pipe System Connections

1. Pipe connections shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines and as indicated in the construction documents. Pipe connections to structures shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines.

3.03 TESTING

A. Deflection Testing:

1. General: Perform deflection testing on the entire length of installed HDPE pipe and pipe liner after completion of hydrostatic pressure tests. Deflection of pipe shall not exceed the maximum deflection specified in Paragraph 2.03 B.
2. Deflection Device: Determine whether the allowable deflection has been exceeded by use of a deflection measuring device.
   a. Deflection Measuring Device: This device shall be sensitive to 1.0 percent of the diameter of the pipe being tested and accurate to 1.0 percent of the indicated dimension.
   b. Deflection Measuring Device Procedure: Measure deflections through each run of installed pipe. If deflection readings in excess of the maximum allowable specified in Paragraph 2.03 B are obtained, retest pipe by a run from the opposite direction.
   c. At deflections in the pipeline that exceed the maximum allowable deflection, provide the Engineer with the following information:
      (1) Location of deflection along pipe length.
      (2) Length of pipeline affected by deflection.
      (3) Accurate measurement to $\pm$1.0 percent of deflection.

B. Hydrostatic Testing and Leakage Testing or Pressure Piping

1. Hydrostatic and leakage testing for piping systems that contain mechanical jointing as well as butt fused HDPE jointing shall comply with AWWA C605.
2. Unless agreed to or otherwise designated by the owner or engineer, for a simultaneous hydrostatic and leakage test following installation, a pressure equal to 150% of working pressure at point of test, but not less than 125% of normal working pressure at highest elevation shall be applied. The duration of the pressure test shall be for two (2) hours.
3. If hydrostatic testing and leakage testing are performed at separate times, follow procedures as outlined in AWWA C605.
4. In preparation for pressure testing the following parameters must be followed:

a. All air must be vented from the pipeline prior to pressurization. This may be accomplished with the use of the air relief valves or corporation stop valves, vent piping in the testing hardware or end caps, or any other method which adequately allows air to escape the pipeline at all high points. Venting may also be accomplished by 'flushing' the pipeline in accordance with the parameters and procedures as described in AWWA C605.

b. The pipeline must be fully restrained prior to pressurization. This includes complete installation of all mechanical restraints per the restraint manufacturer's guidelines, whether permanent or temporary to the final installation. This also includes the installation and curing of any and all required thrust blocking. All appurtenances included in the pressure test, including valves, blow-offs, and air-relief valves shall be checked for proper installation and restraint prior to the beginning of the test.

c. Temporary pipeline alignments that are being tested, such as those that are partially installed in their permanent location shall be configured to minimize the amount of potentially trapped air in the pipeline.

C. If the pipe does not pass the hydrostatic test and/or the deflection test, repair and/or replace the defective pipe.

****END OF SECTION****

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SECTION 15096

PIPE HANGERS AND SUPPORTS

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE

This section specifies hangers and supports for all piping systems specified in Section 15010. This section does not include pipe supports for pipe anchors, guides or seismic restraints.

B. OPERATING CONDITIONS

The hangers and supports specified in this section are provided to resist pipe loads occurring primarily in the downward (gravity) direction. For the purpose of pipe hanger and support selection, this section establishes pipe support classifications based on the operating temperatures of the piping contents. Pipe support classifications are as follows:

1. Hot Systems: A. 120°F to 450°F
2. Ambient Systems: B. 60°F to 119°F
3. Cold Systems: C-1. 33°F to 59° F, C-2. -20°F to 32° F

C. HANGER AND SUPPORT SELECTION

1. The Contractor shall select pipe hangers and supports as specified in the project manual. Selections shall be based upon the pipe support classifications specified in this section, and any special requirements which may be specified in the project manual.
2. The Contractor shall review the piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the type of support to be used at each hanger point.
3. Hangers and supports shall withstand all static and specified dynamic conditions of loading to which the piping and associated equipment may be subjected. As a minimum, consideration shall be given to the following conditions:
   a. Weights of pipe, valves, fittings, insulating materials, suspended hanger components, and normal fluid contents.
   b. Weight of hydrostatic test fluid or cleaning fluid if normal operating fluid contents are lighter.

c. Reaction forces due to the operation of safety or relief valves.

d. Wind, snow, or ice loadings on outdoor piping.

4. Hangers and supports shall be sized to fit the outside diameter of pipe, tubing, or, where specified, the outside diameter of insulation.

5. Where negligible movement occurs at hanger locations, rod hangers shall be used for suspended lines, wherever practical. For piping supported from below, bases, brackets or structural cross members shall be used.

6. Hangers for the suspension of size 2½ inches and larger pipe and tubing shall be capable of vertical hanger component adjustment under load.

7. The supporting systems shall provide for and control the free or intended movement of the piping including its movement in relation to that of connected equipment.

8. Where there is horizontal movement at a suspended type hanger location, hanger components shall be selected to allow for swing. The vertical angle of the hanger rod shall not, at any time, exceed 4°.

9. There shall be no contact between a pipe and hanger or support component of dissimilar metals. Prevent contact between dissimilar metals when supporting copper tubing by use of copper-plated, rubber, plastic or vinyl coated, or stainless steel hanger and support components.

10. Unless otherwise specified, existing pipes and supports shall not be used to support new piping.

11. Unless otherwise specified, pipe support components shall not be attached to pressure vessels.

12. Stock hanger and support components shall be used wherever practical.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between this section and the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by the organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, reference to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
AISC Manual of Steel Construction	American Institute of Steel Construction, Manual of Steel Construction, Allowable Stress Design - 9th Edition
FEDSPEC WW-H-171e	Hangers and Supports, Pipe
MFMA-2	Metal Framing Manufacturer's Association, Metal Framing Standards Publication
MSS SP-58	Pipe Hangers and Supports—Materials, Design and Manufacture
MSS SP-69	Pipe Hangers and Supports—Selection and Application

1.03 SUBMITTALS

Submittals shall be made in accordance with Section 01300, Submittals. Hanger and support locations, load calculations, and manufacturer drawings shall be provided as part of the submittals for equipment and piping coordination and installation drawings required in Section 15010 PIPING SYSTEMS.

PART 2 – PRODUCTS

2.01 ACCEPTABLE PRODUCTS

Standard pipe supports and components shall be manufactured by B-Line, Carpenter & Patterson, Kin-Line, Grinnell, Michigan, Pipe Shields Incorporated, Superstrut, Unistrut, or equal. Pipe support components shall conform to the requirements of MSS SP-69 and FEDSPEC WW-H-171e. Pipe support materials shall conform to the requirements of MSS SP-58. Metal framing system components shall MFMA-2.

2.02 MATERIALS

A. GENERAL

1. For moist and corrosive service conditions and where specified or indicated, pipe hangers and supports, structural attachments, fittings and accessories, nuts, bolts, washers, and other fasteners shall be Type 316 stainless steel.
2. Moist and corrosive service is defined as the following:
   a. Inside enclosed water and wastewater hydraulic structures
   b. Submerged, intermittently submerged in water or wastewater
   c. Less than 2 feet above liquid in open water and wastewater hydraulic structures
   d. Within chemical storage and feeding containment areas and concrete pipe trenches
   e. As indicated in the Drawings and Specifications.

3. All materials for other service conditions shall be hot-dip galvanized after fabrication.

B. PIPE HANGERS AND SUPPORTS

1. TYPE 1—PIPE STANCHION SADDLE: Saddles and yokes shall be carbon steel and comply with MSS Type 37 and FEDSPEC Type 38.
   a. Steel pipe (insulated) shall be Carpenter & Patterson Fig. 125, B-Line B3090, or equal, with insulation shield.
   b. Steel pipe (uninsulated) shall be Carpenter & Patterson Fig. 125, B-Line B3090, or equal.
   c. Cast and ductile iron pipe shall be Carpenter & Patterson Fig. 125, B-Line B3090 NS, or equal.
   d. Copper pipe (uninsulated) shall be Carpenter & Patterson Fig. 125, B-Line B3090, or equal, with insulation shield or lined with dielectric material.
   e. Copper pipe (insulated) shall be Carpenter & Patterson Fig. 125, B-Line B3090, or equal, with insulation shield.
   f. Plastic pipe shall be Carpenter & Patterson Fig. 125, B-Line B3090, or equal.

2. TYPE 2—FLANGE PIPE SUPPORT
   a. Flange type pipe support shall be B-Line B3094, or equal.

3. TYPE 6—FRAMING CHANNEL PIPE CLAMP: Pipe clamps shall be steel with galvanized finish and material thickness as listed below.
   a. Steel pipe (uninsulated): Pipe size 3/8 inch and 1/2 inch shall be 16-gage; 3/4 inch through 1 1/4 inches shall be 14 gage; 1 1/2 inches through 3 inches shall be 12-gage; 3 1/2 inches through 5 inches shall be 11- gage; 6 and 8 inches shall be 10-gage; Michigan Model 431, Powerstrut PS 1100, Unistrut P 1109 series, or equal.
   b. Steel pipe (insulated) : Pipe clamp shall be as described in Paragraph 15096-2.02 B.3.a with insulation shield.
   c. Copper (uninsulated) and plastic pipe: Pipe size 3/8 inch through 1 inch shall be 16-gage; 1¼ inches and 1½ inches shall be 14-gage; 2 inches through 3 inches shall be 12-gage; 4 inches shall be 11-gage; clamp shall be copper-plated, plastic coated or lined with dielectric material; Michigan model 432, Powerstrut PS 1200, Unistrut P 2024C and P 2024PC series, or equal.
   d. Copper pipe (insulated): Pipe clamp shall be as described in Paragraph 15096-2.02 B.3.a with insulation shield.

4. TYPE 7—U-BOLT: U-bolts shall be carbon steel with configuration equivalent to MSS and FEDSPEC Type 24.

a. Steel pipe (uninsulated) shall be Grinnell Fig. 137, B-Line B3188, or equal.

b. Steel pipe (insulated) shall be Grinnell Fig. 137, B-Line B3188, or equal, with insulation shield.

c. Cast and ductile iron pipe shall be Grinnell Fig. 137, B-Line B3188, or equal.

d. Copper pipe (uninsulated) shall be Carpenter & Patterson Fig. 222 CT, B-Line B3501 CT, Grinnell Fig. 137C, or equal.

e. Copper pipe (insulated) shall be Grinnell Fig. 137, B-Line B3188, or equal, with insulation shield.

f. Plastic pipe shall be Grinnell Fig. 137C, Michigan model 151, B-Line B3188 C, or equal.

5. TYPE 10—(Not Used)

6. TYPE 11—OFFSET PIPE CLAMP: Pipe clamp shall be carbon steel with configuration and components as specified and shall be of standard design manufactured by a pipe hanger component manufacturer.

a. Steel pipe (insulated) shall be B-Line B3148, Grinnell Fig. 103, or equal, with insulation shield.

b. Steel pipe (uninsulated) shall be B-Line B3148, Grinnell Fig. 103, or equal.

c. Cast and ductile iron pipe shall be B-Line B3148 NS, Grinnell Fig. 103, or equal.

d. Copper pipe (insulated) shall be B-Line B3148, Grinnell Fig. 103, or equal, with insulation shield.

e. Copper pipe (uninsulated) shall be B-Line B3148, Grinnell Fig. 103, or equal, lined with dielectric material.

f. Plastic pipe shall be B-Line B3148, Grinnell Fig. 103, or equal.

g. Vertical pipe support applications shall be as specified above except that insulation shields shall not be used for insulated pipe.

7. TYPE 12— Not Used

8. TYPE 13—FRAMING CHANNEL PIPE STRAP: Pipe strap shall be carbon steel, with configuration equivalent to MSS Type 26.

a. Steel pipe (uninsulated) shall be Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal.

b. Steel pipe (insulated) shall be Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal, with insulation shield.

c. Copper pipe (uninsulated) shall be Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal, with insulation shield or lined with dielectric material.

d. Copper pipe (insulated) shall be Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal, with insulation shield.

e. Plastic pipe shall be Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal.

C. RACK SUPPORTS

1. GENERAL: Unless otherwise specified, pipe rack components shall have a minimum steel thickness of 12 gage, with a maximum deflection 1/240 of the span.

2. TYPE 21—PIPE RACK SUPPORT: Post and cross members shall be framing channel as specified in Paragraph 15096-2.02 E.5. Pipe rack fittings shall be carbon steel, of standard design manufactured by framing channel manufacturer. 90° fittings shall be gusseted Unistrut P2484, B-Line B844, or equal. Post base fittings shall be as specified in Paragraph 15096-2.02 D.5.

D. STRUCTURAL ATTACHMENTS

1. TYPE A—MALLEABLE IRON CONCRETE INSERT: Concrete inserts shall be malleable iron and comply with MSS and FEDSPEC Type 18. Grinnell Fig. 282, Carpenter & Patterson Fig. 108, or equal.

2. TYPE B—SIDE BEAM BRACKET: Bracket shall be malleable iron and comply with MSS Type 34 and FEDSPEC Type 35. Grinnell Fig. 202, B-Line B3062, or equal.

3. TYPE C—MALLEABLE BEAM CLAMP WITH EXTENSION PIECE: Clamp and extension piece shall be malleable iron, tie rod shall be steel. Beam clamp shall comply with MSS and FEDSPEC Type 30. Grinnell Fig. 218 with Fig. 157 extension piece, B-Line B3054, or equal.

4. TYPE D—STEEL BEAM CLAMP WITH EYE NUT: Beam clamp and eye nut shall be forged steel. Configuration and components shall comply with MSS and FEDSPEC Type 28. Grinnell Fig. 292, Carpenter & Patterson Fig. 297, or equal.

5. TYPE E—FRAMING CHANNEL POST BASE: Post bases shall be carbon steel, of standard design manufactured by framing channel manufacturer. Single channel: Unistrut P2072A, B-Line B280, or equal. Double channel: Unistrut P2073A, B-Line B281, or equal.

6. TYPE F—WELDED BEAM ATTACHMENT: Beam attachment shall be carbon steel and comply with MSS and FEDSPEC Type 22. B-Line B3083, Grinnell Fig. 66, or equal.

7. TYPE G—WELDED STEEL BRACKET: Bracket shall be carbon steel and comply with MSS Type 32 and FEDSPEC Type 33 for medium welded bracket. Heavy welded bracket shall comply with MSS Type 33 and FEDSPEC Type 34.

8. TYPE H—CAST IRON BRACKET: Bracket shall be cast iron, Carpenter & Patterson Fig. 340, or equal.

9. TYPE J—ADJUSTABLE BEAM ATTACHMENT: Beam attachment shall be carbon steel, Carpenter & Patterson Fig. 151, B-Line B3082, or equal.

10. TYPE K—DOUBLE CHANNEL BRACKET: Wall channel shall be single channel framing channel as specified in Paragraph 15096-2.02 E.5. Cantilever bracket shall be a carbon steel double framing channel assembly, Unistrut P2542 through P2546, B-Line B297-12 through B297-36, or equal.

11. TYPE L—SINGLE CHANNEL BRACKET: Wall channel shall be single channel framing channel as specified in Paragraph 15096-2.02 E.5. Cantilever bracket shall be a carbon steel single framing channel assembly, Unistrut P2231 through P2234, B-Line B198-6, B198-12, B196-18 and B196-24, or equal.

12. TYPE M—WALL MOUNTED CHANNEL: Wall channel shall be single channel framing channel as specified in Paragraph 15096-2.02 E.5.

13. TYPE N—PIPE STANCHION FLOOR ATTACHMENT: Base plate shall be carbon steel with 1/2 inch minimum thickness. Anchor bolt holes shall be 1/16 inch larger than the anchor bolt diameter. The space between the base plate and the floor shall be filled with nonshrink grout.

E. ACCESSORIES

1. HANGER RODS: Rods shall be carbon steel, threaded on both ends or continuous threaded and sized as specified.

2. WELDLESS EYE NUT: Eye nut shall be forged steel and shall comply with MSS and FEDSPEC Type 17. Eye nut shall be Grinnell Fig. 290, B-Line B3200, or equal.

3. WELDED EYE ROD: Eye rod shall be carbon steel with eye welded closed. Inside diameter of eye shall accommodate a bolt diameter 1/8 inch larger than the rod diameter. Eye rod shall be Grinnell Fig. 278, B-Line B3211, or equal.

4. TURNBUCKLE: Turnbuckle shall be forged steel and shall comply with MSS and FEDSPEC Type 13. Turnbuckle shall be Grinnell Fig. 230, B-Line B3202, or equal.

5. FRAMING CHANNEL: Framing channel shall be 1⅝ inches square, roll formed, 12-gage carbon steel. Channel shall have a continuous slot along one side with in-turned clamping ridges. Single channel: Unistrut P1000, B-Line B22, or equal. Double channel: Unistrut P1001, B-Line B22A, or equal. Triple channel: Unistrut P1004A, B-Line B22X, or equal.

2.03 Not Used

PART 3 – EXECUTION

3.01 HANGER AND SUPPORT LOCATIONS

A. The Contractor shall locate hangers and supports as near as possible to concentrated loads such as valves, flanges, *etc.* Locate hangers, supports and accessories within the maximum span lengths specified in the contract documents to support continuous pipeline runs unaffected by concentrated loads. Hanger and support locations and components shall be indicated on the piping layout drawings required by Paragraph 15010-1.03.

B. At least one hanger or support shall be located within 2 feet from a pipe change in direction.

C. The Contractor shall locate hangers and supports to ensure that connections to equipment, tanks, *etc.*, are substantially free from loads transmitted by the piping.

D. Where piping is connected to equipment, a valve, piping assembly, *etc.*, that will require removal for maintenance, the piping shall be supported in such a manner that temporary supports shall not be necessary for this procedure.

E. Pipe shall not have pockets formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves and fittings.

3.02 INSTALLATION

A. Welded and bolted attachments to the building structural steel shall be in accordance with the requirements of the AISC Manual of Steel Construction. Unless otherwise specified, there shall be no drilling or burning of holes in the building structural steel.

B. Hanger components shall not be used for purposes other than for which they were designed. They shall not be used for rigging and erection purposes.

C. The Contractor shall install items to be embedded before concrete is poured. Fasten embedded items securely to prevent movement when concrete is poured.

D. Embedded anchor bolts shall be used instead of concrete inserts for support installations in areas below water surface or normally subject to submerging.

E. The Contractor shall install thermal pipe hanger shields on insulated piping at required locations during hanger and support installation. Butt joint connections to pipe insulation shall be made at the time of insulation installation in accordance with the manufacturer's recommendations.

F. Hanger and support components in contact with plastic pipe shall be free of burrs and sharp edges.

G. Rollers shall roll freely without binding.

H. Finished floor beneath Type N structural attachments and framing channel post bases shall be roughed prior to grouting. Grout between base plate and floor shall be free of voids and foreign material.

I. Base plates shall be cut and drilled to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.

J. Plastic or rubber end caps shall be provided at the exposed ends of all framing channels that are located up to 7 feet above the floor.

3.03 ADJUSTMENTS

The Contractor shall adjust hangers and supports to obtain required pipe slope and elevation. Shims made of material that is compatible with the piping material may be used. Stanchions shall be adjusted prior to grouting their base plates.

****END OF SECTION****

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SECTION 15100

PIPING SYSTEMS

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE

This section specifies systems of process piping and general requirements for piping systems. Detailed specifications for the components listed on the Piping System Specification Sheets are found in other sections of Division 15. This section shall be used in conjunction with those sections.

B. DEFINITIONS

Pressure terms used in this Section and elsewhere in Division 15 are defined as follows:

1. Maximum: The greatest continuous pressure at which the piping system operates.
2. Test: The hydrostatic pressure used to determine system acceptance.

1.02 QUALITY ASSURANCE

A. REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AASHTO M36/M36M	Metallic (Zinc or Aluminum) Coated Corrugated Steel Culverts and Underdrains
ANSI A13.1	Scheme for the Identification of Piping Systems
ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
ANSI B16.3	Malleable-Iron Threaded Fittings
ANSI B16.5	Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
ANSI B16.9	Factory-Made Wrought Steel Buttwelding Fittings
ANSI B16.11	Forged Fittings, Socket-Welding and Threaded
ANSI B16.12	Cast Iron Threaded Drainage Fittings
ANSI B16.22	Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
ANSI B16.26	Cast Copper Alloy Fittings for Flared Copper Tubes
ANSI B31.3	Process Piping
ASTM A47	Ferritic Malleable Iron Castings
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A74	Cast Iron Soil Pipe and Fittings
ASTM A105/A105M	Carbon Steel Forgings for Piping Applications
ASTM A106	Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A197	Cupola Malleable Iron
ASTM A234/A234M	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A312/A312M	Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A403/A403M	Wrought Austenitic Stainless Steel Piping Fittings
ASTM A536	Ductile Iron Castings
ASTM A570/A570M	Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM B88	Seamless Copper Water Tube
ASTM D1784	Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	Ductile-Iron and Gray-Iron Fittings, 3-Inch Through 48-Inch (75 mm Through 1200 mm), for Water and Other Liquids
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151	Ductile-Iron Pipe Centrifugally Cast for Water
AWWA C200	Steel Water Pipe—6" (150 mm) and Larger
AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe—4 In. (100 mm) and Larger—Shop Applied
AWWA C206	Field Welding of Steel Water Pipe

Reference	Title
AWWA C207	Steel Pipe Flanges for Waterworks Services---Sizes 4" through 144" (100 mm through 3600 mm)
AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C209	Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
AWWA C210	Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
AWWA C214	Tape Coating Systems for the Exterior of Steel Water Pipelines
AWWA M11	Steel Pipe—A Guide for Design and Installation

B. FITTINGS AND COUPLING COMPATIBILITY

To assure uniformity and compatibility of piping components, fittings and couplings for grooved end piping systems and plastic piping systems shall be furnished by the same manufacturers.

1.03 SUBMITTALS

A. Product data on piping materials shall be provided in accordance with Section 2-1.05 of the General Conditions where specified.

B. EQUIPMENT AND PIPING COORDINATION AND INSTALLATION DRAWINGS:

1. The drawings show only the general arrangements of the project equipment, piping and appurtenances. Contractor shall prepare and submit coordination and installation drawings that show the specific locations and dimensions of equipment, tanks, control panels, piping, valves, appurtenances, gratings, and related items, based upon dimensions for the actual equipment to be furnished from the accepted shop drawings.
2. The coordination and installation drawings are required for the following systems:

   a. Equipment and associated piping in Division 11 and Division 15
   b. All unburied piping systems

3. DRAWING REQUIREMENTS:

   a. Drawings shall be prepared with AutoCAD software, compatible with AutoCAD Version 2005, on a PC compatible hardware platform using Microsoft Windows XP operating system. The drawing files shall be submitted with each piping system print. The drawing files shall be submitted on rewritable CDROM disks.

b. The drawings shall be printed at a minimum scale of 3/8" = 1', on a minimum sheet size of 11" x 17". Piping shall be shown in plan and section views, or alternatively, as isometric piping spool drawings.

c. Piping of nominal size less than 8" may be single line with scaled lay lengths and fittings. Piping of size 8" and greater shall be double line with scaled flanges, lay lengths, and fittings. Each pipe run shall be dimensioned.

d. All pipe supports, thrust restraints, and seismic bracing shall be shown. All devices shown on the P&ID drawings shall be shown.

e. During preparation of the drawings, Contractor shall provide interface and coordination between all equipment suppliers and subcontractors, and, including as a minimum, the structural, architectural, mechanical, electrical, and instrumentation and control elements of the work, including the process and instrumentation diagrams.

f. Submittal and review of the coordination and installation drawings shall be completed at least 30 days prior to commencement of piping fabrication for each system. For piping systems that are field fabricated, such as polyvinyl chloride piping systems, submittal and review shall be completed at least 30 days prior to construction of each system.

C. Drawings shall be original layouts by the Contractor; photocopies of contract drawings are not acceptable. Layout drawings shall show pipe support locations as required by Section 15140 and seismic restraint locations as required by Section 15150.

D. Load and sizing calculations for supports and seismic restraints shall be submitted as specified in Sections 15140 and 15150.

PART 2 – PRODUCTS

2.01 PIPING MATERIALS

Unless otherwise specified, piping materials, including pipe, gaskets, fittings, connection and joint assemblies, linings and coatings, shall be selected from those listed on the piping system specification sheets. Piping materials shall conform to detailed specifications for each type of pipe and piping appurtenance specified in other sections of Division 15.

2.02 PIPING IDENTIFICATION

A. PLASTIC CODING MARKERS

Plastic markers for coding pipe shall conform to ANSI A13.1 and shall be as manufactured by W. H. Brady Company, Seton Name Plate Corporation, Marking

Services Inc., or equal. Markers shall be the mechanically attached type that are easily removable; they shall not be the adhesive applied type. Markers shall consist of pressure sensitive legends applied to plastic backing which is strapped or otherwise mechanically attached to the pipe. Legend and backing shall be resistant to petroleum based oils and grease and shall meet criteria for humidity, solar radiation, rain, salt, fog and leakage fungus, as specified by MIL-STD-810C. Markers shall withstand a continuous operating temperature range of -40°F to 180°F. Plastic coding markers shall not be the individual letter type but shall be manufactured and applied in one continuous length of plastic.

Markers bearing the legends on the background colors specified in the PIPESPEC shall be provided in the following letter heights:

Outside pipe diameter,[a] inches	Letter height, inches
Less than 1½	½
1½ through 3	1⅛
Greater than 3	2¼

[a] Outside pipe diameter shall include insulation and jacketing.

In addition, pipe markers shall include uni- and bi-directional arrows in the same sizes as the legend. Legends and arrows shall be white on blue or red backgrounds and black on other specified backgrounds.

B. PLASTIC TRACER TAPE

1. Tracer tape shall be 6" wide, colored the same as the background colors as specified in Table A, paragraph 15010-3.06, and made of inert plastic material suitable for direct burial. Tape shall be capable of stretching to twice its original length and shall be as manufactured by Allen Systems, W. H. Brady Co., Seton Name Plate Corporation, Marking Services Inc., or equal.
2. The message shall read *"CAUTION PIPE BURIED BELOW"* with bold letters approximately 2" high.

2.03 VALVES

Valves of the same size and service shall be provided by a single valve manufacturer. Packing shall be non-asbestos material. Actual length of valves shall be within 1/16 inch (plus or minus) of the manufacturer's specified length. Flanges shall meet the requirement of ANSI B16.5. Push-on and mechanical joints shall meet the requirements of AWWA C111.

PART 3 – EXECUTION

3.01 INSTALLATION

A. LOCATION

Piping shall be provided as specified except for adjustments to avoid architectural and structural features and shall be coordinated with electrical construction.

B. PIPING SIZES

Where the size of piping is not specified, the Contractor shall provide piping of the sizes required by UPC. Unless specified otherwise, small piping (less than 1" in diameter) required for services not described by UPC shall be ½".

C. PIPE SUPPORT, ANCHORAGE, AND SEISMIC BRACING

Piping shall be supported by anchor brackets, guides, saddles or hangers. Acceptable types of supports, guides, saddles, hangers and structure attachments for general pipe support, expansion/ contraction and for seismic bracing, as well as anchorage details, are shown on the drawings or specified. Minimum spacing shall be as specified or indicated for supports and for seismic bracing. Where a specific type of support or anchorage is indicated on the drawings, then only that type shall be used there. Piping shall be vertically supported by anchor brackets, guides, saddles or hangers and shall be seismically braced where indicated to resist lateral load. Supports shall be provided on each run at each change of direction. Pipe supports shall be hot-dip or mechanically galvanized. Unless otherwise specified, existing pipes and supports shall not be used to support new piping.

D. ANCHORAGE FOR BURIED PIPING

All plugs, caps, tees and bends in buried pressure piping systems shall be anchored by means of reaction backing or restrained joints as specified.

E. BEDDING AND BACKFILL

Bedding and backfill for buried piping shall be as specified in Section 02300.

3.02 PIPING IDENTIFICATION

A. PIPE CODING

After application of the specified coating and insulation systems, exposed piping, interior and exterior, and piping in ceiling spaces, pipe trenches, pipe chases and valve boxes shall be identified with plastic markers as specified in Paragraph 15010-2.02. Legend markers and directional arrows shall be located at each side of walls, floors and ceilings, at one side of each piece of equipment, at piping intersections, and at approximately 50-foot centers.

B. PLASTIC TRACER TAPE

A single line of tape as specified in Paragraph 15010-2.02 shall be provided 2 feet above the centerline of each buried pipe. For pipelines buried 8 feet or greater below finished grade, Contractor shall provide a second line of tape 12 inches below finished grade, above and parallel to each buried pipe. Tape shall be spread flat with message side up before backfilling.

3.03 VALVE IDENTIFICATION (not used)

3.04 TESTING

A. GENERAL

1. Upon completion of piping, but prior to application of insulation on exposed piping, the Contractor shall test the piping systems. Pressures, media and test durations shall be as specified in the PIPESPEC. Equipment which may be damaged by the specified test conditions shall be isolated. Testing shall be performed using calibrated test gages and calibrated volumetric measuring equipment to determine leakage rates. Each test gage shall be selected so that the specified test pressure falls within the upper half of the gage's range. Unless otherwise specified, the Contractor shall notify the Construction Manager 24 hours prior to each test.
2. Unless otherwise specified, testing, as specified herein, shall include existing piping systems which connect with new pipe systems. Existing pipe shall be tested to the nearest existing valve. Any piping which fails the test shall be repaired. Repair of existing piping will be considered and paid for as extra work.

B. LIQUID SYSTEMS

Leakage shall be zero at the specified test pressure throughout the specified duration for the following systems: exposed piping, buried insulated piping, and buried or exposed piping carrying liquid chemicals. Unless otherwise specified, leakage from other buried liquid piping systems shall be as specified in Sections 02120 and 02130.

C. DRAINS

Drain systems, other than pumped drain systems, shall be tested in accordance with UPC and these specifications.

3.05 CLEANING AND FLUSHING

A. GENERAL

Piping systems shall be cleaned following completion of testing and prior to connection to operating, control, regulating or instrumentation equipment. The

Contractor may, at his option, clean and test sections of buried or exposed piping systems. Use of this procedure, however, will not waive the requirement for a full pressure test of the completed system. Unless specified otherwise, piping 24" in diameter and smaller shall first be cleaned by pulling a tightly fitting cleaning ball or swab through the system. Piping larger than 24" in diameter may be cleaned manually or with a cleaning ball or swab.

B. LIQUID SYSTEMS

After completion of cleaning, liquid systems, unless otherwise specified, shall be flushed with clean water.

3.06 PIPING SPECIFICATION SHEETS (PIPESPEC)

Piping and valves for groupings of similar plant processes or types of service lines are specified on individual piping specification sheets (PIPESPECS). Piping services are grouped according to the chemical and physical properties of the fluid conveyed and/or by the temperature or pressure requirements. Each grouping of services (PIPESPEC) is identified by a piping system number. Piping services specified in the PIPESPECS and on the drawings are alphabetically arranged by designated service symbols as shown in Table A. Table A also indicates the system number, fluid category, and pipe color of each service.

Table A. Piping Services

Symbol	Service	System	Fluid Category	Pipe Marker Background
D	Drain	1	Drain/Vent	Green
FM	Force Main	2	Wastewater	Green
SS	Sanitary Sewer	5	Wastewater	Green
V	Vent	1	Drain/Vent	Green

3.06 PIPING SPECIFICATION SHEET—PIPESPEC

Piping Symbol/Service:	D—Drain	**System—1**
	V – Vent	

Test Requirements:

Medium:	Water; ref. spec paragraph 15010-3.04 C
Pressure:	5 psig
Duration:	120 minutes

Buried Pipe:
(See drawings for pipe size.)

PVC: ASTM D1784, Class 12454-B, ASTM D1785,Sch. 80. Ref spec Section 15070
Conn; Solvent weld
Ftgs; PVC Sch. 80, solvent weld.

Exposed Pipe:
(See drawings for pipe size.)

Polyvinyl Chloride (PVC) pipe, Schedule 80, Class 12454-B, rigid, unplasticized pipe made from polyvinyl chloride in accordance with ASTM D1784 and D1785. Pipe joints shall be solvent weld, pipe fittings of the same material as the pipe, conforming to ASTM D2466.

Remarks:

1. Piping shall be provided with a minimum downward slope of ¼" per foot in the direction of flow, or as indicated on the Drawings.

3.06 PIPING SPECIFICATION SHEET—PIPESPEC

Piping Symbol/Service:	FM—Force Main	**System—2**
Test Requirements:		
Medium:	Water; ref. spec paragraph 15010-3.04 C	
Pressure:	150 psig	
Duration:	120 minutes	
Gasket Requirements:		
Flange:	Compressed gasketing consisting of fibers (Kevlar) and neoprene binder (Garlock 3300 or equal)	
Push-on/Mech Cpl:	Nitrile or Neoprene	
Buried Pipe: (See drawings for pipe size.)	HDPE; AWWA 906, D R17, ref. Section 15070. Conn; buttfused. Ftgs; AWWA C906, except where noted on the drawings. Remove inside weld bead.	
Exposed Pipe: (See drawings for pipe size.)	(Ductile iron; AWWA C151, Class 150, ref. Section 15062, except flanged pipe shall be thickness Class 53, , Coating and lining per 15062. Conn; Flanged ends per AWWA C115 and AWWA C110, faced and drilled to 125 lb standards. Ftgs; AWWA C153, except where noted on the drawings.	

3.06 PIPING SPECIFICATION SHEET—PIPESPEC

Piping Symbol/Service:	SS — Sanitary Sewer	**System—S**
Test Requirements:	Ref. spec Section 02130	
Gasket Requirements:		
Push-on:	Nitrile/Neoprene (PVC) Urethane Compression (VCP)	
Buried Pipe: (See drawings for pipe size.)		
	PVC SDR 35, Section 15064 or PVC, C900.	

Remarks:

1. Piping shall be provided with a minimum downward slope of ¼" per foot in the direction of flow, or as indicated on the Drawings.

****END OF SECTION****

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SECTION 15130

PIPING APPURTENANCES

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE

This section specifies flow and level gages, pressure gages, strainers, vents and drains.

B. EXCLUSIONS

Temperature, pressure and flow measuring devices used for instrumentation are specified in Division 16.

1.02 SUBMITTALS

Manufacturer's product data shall be provided in accordance with Section 01300.

PART 2 – PRODUCTS

2.01 PRESSURE DEVICES

A. GAGE VALVES

Unless otherwise specified, gage valves shall be ½" ball valves in accordance with Section 15180. The exposed threads of each gage valve shall be protected by a brass plug.

B. PRESSURE GAGES

1. Pressure gages shall be provided at the discharge of all pumps, and where indicated on the Drawings.
2. Unless otherwise specified, pressure gage scales shall be selected so that the normal operating pressure falls between 50 and 80% of full scale, shall be 3½", 270° movement, 1.0% accuracy, full scale, and suitable for bottom stem mounting. Gages shall have a Type 316 stainless steel bourdon tube. All gages shall have a 300 series stainless steel case, shatterproof glass, and a ¼ " NPT bottom connection.
3. Pressure gages for air, gas, and low pressure services (0–10') shall be premium grade, heavy-duty bourdon-tube units (bellow type for vacuum) with Delrin bushings and pinion, and stainless steel sector.

4. Gages on liquid service shall be as noted above, except they shall be provided with an internal pulsation dampening system consisting of either a glycerin fill or a silicone fluid fill. Snubbers or orifices shall not be utilized. Gages shall be Ashcroft Duragauge Fig. 1009, or equal.

5. Gages on liquid service shall be provided with diaphragm type seals with flushing connections. Seals shall have ASTM A276 Type 316 stainless steel bodies and Type 316L diaphragm unless otherwise specified. Seals shall be Mansfield and Green Type SG, Ashcroft Type 101, or equal. Seals and associated instruments shall be factory filled.

PART 3 – EXECUTION

3.01 (DELETED)

3.02 GAGE TAPS

Gage taps shall be provided as indicated on the Drawings. Gage taps shall consist of a ½" gage valve attached by a threaded nipple to the pipeline.

****END OF SECTION****

SECTION 15184

MANUAL VALVE AND GATE OPERATORS AND OPERATOR APPURTENANCES

PART 1 – GENERAL

1.01 DESCRIPTION

This section specifies manual operators for valves and gates, and operator appurtenances. Contractor shall provide all tools, supplies, materials, equipment, and labor necessary for furnishing, installing, adjusting, and testing of valve actuators. Provide manual operators as indicated on the Plans..

1.02 REFERENCES

This section contains references to the following document. It is a part of this section as specified and modified. In case of conflict between this section and the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by the organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, reference to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
AWWA C500	Metal-Seated Gate Valves for Water Supply Service
AWWA C504	Rubber-Seated Butterfly Valves

1.03 SUBMITTALS

Submittals shall be provided in accordance with Section 01300 of the Technical Specifications and shall include the information as noted below.

A. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the

specifications are indicated and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

B. Manufacturer's catalog information and other data confirming conformance to design and material requirements.

C. Shop drawings for actuators shall be submitted as part of the submittals for the associated valves in accordance with Section 15200, Valves and Appurtenances.

D. Contractor shall submit design calculations showing the required valve operation torques and the design torque provided by each actuator.

PART 2 – PRODUCTS

2.01 GENERAL

A. Supplier shall supply and mount all actuators, including any type of manual or powered actuators, on the valves at the factory. Each valve and actuator shall be shipped as a unit.

B. Each actuator shall have sufficient torque capacity and features to seat, unseat, and rigidly hold in any intermediate position the valve it controls under the operating conditions for the valve.

C. Each actuator shall be provided with an externally mounted mechanical valve position indicator.

D. Each valve body or operator shall have cast thereon the word "OPEN", an arrow indicating the direction to open, and flow direction arrows.

2.02 OPERATORS

A. GENERAL:

Unless otherwise indicated, nonburied valves shall have an operating wheel, handle, or lever mounted on the actuator. Buried valves shall have AWWA 2-inch operating nuts and non-rising stems. Unless specified otherwise, the direction of rotation of the operator shall be counterclockwise for opening.

B. WRENCH NUTS, BOXES, AND GUIDES:

Wrench nuts shall comply with Section 3.15 of AWWA C500. A minimum of two operating keys, but no fewer than 1 key per every 10 valves, shall be provided for operation of the wrench nut operated valves.

C. GEAR ACTUATORS

1. Unless otherwise noted, gear actuators shall be provided for the following.
   a. Where specified or shown
   b. Where a lever or wheel operator effort would otherwise be greater than 60 foot -pounds of torque or 60 pounds of force at the rim of the wheel or lever
2. Gear actuators shall be of the worm or helical gear type with the output shaft perpendicular to the valve shaft and a removable hand wheel mounted on the output shaft. Except as required herein, the gear actuators shall conform to AWWA C504 and shall be certified.
3. Actuators shall be capable of being removed from the valve without dismantling the valve or removing the valve from the line.
4. Gearing shall be machine-cut steel designed for smooth operation. Bearings shall be permanently lubricated, with bronze bearing bushings provided to take all thrusts and seals and to contain lubricants. Housings shall be sealed to exclude moisture and dirt, allow the reduction mechanisms to operate in lubricant, and be of the same material as the valve body.
5. Manual input effort to the handwheel shall be a maximum of 40 foot pounds for operating the valve from full open to full close, under any operating conditions. Gear operators shall indicate valve position and have adjustable stops. Maximum handwheel size shall be 24 inches in diameter. Minimum handwheel size shall be 12 inches.

D. CHAIN WHEELS (NOT USED)

2.03 OPERATOR APPURTENANCES

A. VALVE BOXES:

Valve boxes shall be cast iron and shall have suitable base castings to fit properly over the bonnets of their respective valves and heavy top sections with stay-put covers. Covers shall be hot-dip galvanized.

B. FLOOR BOXES:

Floor boxes shall be hot-dip galvanized. Where the operating nut is in the concrete slab, the floor box shall be Monel or UHMW PE bushed. Bronze bushings will not be allowed. Where the operating nut is below slab, the opening in the bottom of the box shall be sufficient for passage of the operating key. Floor boxes for operating nuts recessed in concrete shall be standard cast iron boxes cast into the concrete, with fastening top by Clow, or equal.

C. ADJUSTABLE SHAFT VALVE BOXES:

Adjustable shaft valve boxes shall be concrete or cast iron Brooks No. 3RT, Christie G5, Empire 7-1/2 valve extension box, or equal. Box covers on water lines shall be impressed with the letter "W". Sewer line covers shall be impressed with the letter "S".

D. STEM GUIDES

Stem guides shall be of the adjustable wall bracket type, UHMW PE bushed, with maximum spacing of 10 feet as manufactured by Clow, Rodney Hunt, or equal. The minimum number of guides are indicated on the Drawings Extended operating stems shall have universal joints and pin couplings if longer than 10 feet and a rating of at least five times the maximum operating torque.

PART 3 – EXECUTION

3.01 GENERAL

Installation shall be as specified herein. Valve operators shall be located so that they are readily accessible for operation and maintenance. Valve operators shall be mounted for unobstructed access, but mounting shall not obstruct walkways. Valve operators shall not be mounted where shock or vibration will impair their operation. Support systems shall not be attached to handrails, process piping, or mechanical equipment.

3.02 OPERATORS

A. GENERAL:

Valves and gates shall be provided with manual operators, unless specified otherwise. Where possible, manual operators shall be located between 48" and 60" above the floor or a permanent work platform.

B. WRENCH NUTS:

Wrench nuts shall be provided on buried valves, on valves which are to be operated through floor boxes, and where specified. Extended wrench nuts shall be provided if necessary so that the nut will be within 6" of the valve box cover.

C. CHAIN WHEELS (NOT USED)

3.03 OPERATOR APPURTENANCES

A. VALVE BOXES:

Valve boxes extending to finished surfaces shall be provided for buried valves.

B. FLOOR BOXES:

Floor boxes shall be provided for wrench operation of valves located below concrete slabs. Each floor box and cover shall be of the depth required for installation in the slab.

****END OF SECTION****

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SECTION 15190

ECCENTRIC PLUG VALVES

PART 1 – GENERAL

1.01 DESCRIPTION

This section specifies eccentric plug valves.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between this section and the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by the organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, reference to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A276	Stainless Steel Bars and Shapes
ASTM A436	Austenitic Gray Iron Castings
ASTM A536	Ductile Iron Castings
AWWA C504	Rubber-Seated Butterfly Valves

1.03 SUBMITTALS

The following product data shall be provided in accordance with Section 01300:

A. Manufacturer's product data.

B. Applicable operating and maintenance information specified in Section 01730.

PART 2 – PRODUCTS

2.01 ACCEPTABLE PRODUCTS

Eccentric plug valves shall be as manufactured by Clow, DeZurik, or equal, modified to meet the requirements specified in these Specifications valves.

2.02 MATERIALS

Materials of construction shall be as follows:

Component	Material
Body	Cast iron, ASTM A126, Class B
Plug	Cast iron, ASTM A126, Class B, or cast iron ASTM A436 (Ni-resist), or ductile iron, ASTM A536
Plug facing	Neoprene or Buna-N
Body seats	
Less than 3 inches	Cast iron, ASTM A126, Class B
3 inches and larger	Stainless steel, ASTM A276, Type 304 or nickel
Packing	Buna V-flex or TFE

2.03 MANUFACTURE

A. GENERAL:

1. Valves shall be straight-flow non-lubricated resilient plug type suitable for drip-tight, bi-directional shutoff at the specified valve design pressure. Port areas for the valve shall be at least 100% of the adjacent full pipe area. Valve body seats consisting of nickel for valves 3 inches and larger shall be constructed of a welded-in overlay of not less than 90% pure nickel. Upper and lower journal bearings shall be replaceable, sleeve-type, corrosion resistant, and permanently lubricated. Packing shall be self-adjusting chevron type replaceable without disassembling the valve.
2. Unless otherwise specified, valves shall, as a minimum, conform to the following pressure ratings:

Size, inches	Design pressure, psig
12 and smaller	175
14 through 36	150
42 through 54	125

B. END CONNECTIONS:

Valves 3 inches and smaller shall have threaded ends. Valve flange drilling for valves larger than 3 inches shall be per ANSI B16.1, Class 125. Grooved-end valves may be provided with grooved-end piping systems.

2.04 MANUAL OPERATORS:

Unless otherwise specified, exposed service valves 4 inches and smaller shall be provided with a lever type manual operator. Exposed service valves larger than 4 inches shall be provided with totally enclosed worm gear operators. Where specified, manual operators shall have an adjustable stop. All operator components shall be sized for the valve design pressure in accordance with AWWA C504, Section 3.8. Buried service valves shall be provided with wrench nuts. Manual operators shall have operating torques less than 80 ft-lbs. Unless specified otherwise, each manual operator shall be provided with a hand crank. Unless specified otherwise, the direction of rotation of the operator shall be counterclockwise for opening.

2.05 NOT USED

PART 3 – EXECUTION

3.01 INSTALLATION

Unless otherwise specified, valves shall be provided with the seat downstream away from flow. Valves at tank connections shall be installed with seat away from tank. Valves on pump discharge lines shall be installed with seat adjacent to the pump. Each valve shall be installed with the plug in the horizontal position.

****END OF SECTION****

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SECTION 15200

VALVES AND APPURTENANCES

PART 1 – GENERAL

1.01 SUMMARY

A. Contractor shall provide all tools, supplies, materials, equipment, and labor necessary for furnishing, installing, adjusting, and testing of all valve units.

B. The provisions of this Section shall apply to all valve and gate units specified in the Contract Documents. Valve units consist of the valves, actuators, sensors, limit switches, controls, and other devices specified in the valve, electrical, and instrumentation Sections and Drawings to provide a complete and operable valve unit.

C. For valves that require an electric motor, or other type of powered actuator Contractor shall assign the valve Supplier as the system integrator for the complete valve unit. The Supplier shall assume responsibility for furnishing, adjusting, testing, and satisfactory performance of each valve, actuator, sensors, limit switches, controls, and other devices as specified and shown. In addition, the valve Supplier shall be responsible for any field adjustments and settings required for satisfactory performance of each valve.

D. Contractor shall submit design calculations, test and performance data, and other information as required to substantiate that valve units proposed in the submittals will meet the performance requirements as specified and shown.

1.02 REFERENCED STANDARDS

A. The following documents are referenced in this Section.

Reference	Title
ASTM B 62	Composition Bronze or Ounce Metal Castings

1.03 SUBMITTALS

A. Shop drawings of all valves and actuators, including associated wiring diagrams, electrical data, control system information, and protective coatings shall be submitted in accordance with the requirements in 01300 of the Technical Specifications.

B. A schedule of valves to be furnished with labels shall be submitted, indicating the label location, attachment method, and proposed text for each valve.

1.04 QUALITY ASSURANCE

A. Unless specified otherwise, each valve body shall be tested with a water test pressure equal to twice its working pressure rating.

B. Prior to shipment to the Site, Contractor shall submit a certified, notarized copy of the pressure test reports for all valves over 12 inches in nominal size. These test reports shall be in compliance with the requirements of the applicable reference standards as specified.

PART 2 – PRODUCTS

2.01 GENERAL

A. Contractor shall furnish all valves, gates, actuators, stem extensions, and other accessories as shown or specified. Unless otherwise indicated, provide valves of same size as upstream pipe size. All valves and gates shall be new and of current design. All valves of the same type shall be identical and supplied by a single manufacturer.

B. All valves of size 6 inches and larger shall have actuators with position indicators.

C. Valves and actuators shall have the name of the manufacturer, nominal size, flow direction arrow, design working pressure, and the reference standard cast in raised letters or indelibly marked on an appropriate part of the body.

D. Valves and actuators located outdoors, within a building below the adjacent finished grade, in vaults, or where otherwise indicated, shall be specially designed for submerged service where water may submerge the valve and actuator due to a malfunction or damage to the facilities. All other units shall be weather tight and suitable for outdoor service.

E. Buried valves shall be provided with valve boxes and covers that contain position indicators, and valve extensions.

F. Clearances and access shall be provided as specified below. Prior to preparation of Shop Drawings Contractor shall evaluate the location of each valve to identify and prevent potential interferences and clearances not in compliance with those specified below.

1. Valves shall be installed to provide access space and clearances for operation, removal, and maintenance, and to avoid conflicts between valve actuators and walls, structural members, handrails and other potential interferences. Clearances shall be as recommended by the valve and operator manufacturer, or as required by applicable electrical, fire, and mechanical codes and regulations, whichever is greater.

G. (NOT USED)

H. Flanges, gaskets, and bolts for valves shall be in accordance with Section 15010, Mechanical Piping, General.

I. Unless otherwise specified, all interior bronze parts of valves shall conform to the requirements of ASTM B 62.

J. A label shall be provided on all valves designated with a valve number in the Contract Documents. The label shall be of 1/16-inch thick plastic or stainless steel with a minimum size of 2 inches by 4 inches. Each label shall be permanently attached to the valve using stainless steel screws, stainless steel wire and connectors, or another method subject to approval.

K. SERVICE

1. Domestic Hot and Cold Water Shutoff and Isolation Valves:
   a. Pipe Sizes 2-1/2 Inches and Smaller: Ball valve.
   b. Pipe Sizes 3 Inches and Larger: Gate valve or butterfly valve.
2. Drain Service; All Pipe Sizes: Drain valves.
3. Bypass Around Pressure-Reducing Valves: Globe valves.
4. Check Valves: Swing check.

L. MANUFACTURERS

See individual Sections as appropriate:

Section 15180	Ball Valves
Section 15190	Eccentric PlugValve
Section 15250	Air Release and Vacuum Valves
Section 15220	Check Valves
Section 15240	Specialty Valves

2.02 PROTECTIVE COATINGS

A. Ferrous surfaces in water passages of all valves of size 6 inches and larger shall be abrasive blasted and at the factory. Factory coating shall be Fusion Bonded Epoxy or Amine Cured Epoxy. Surface preparation shall be a White Metal Blast Cleaning per SSPC-SP5.

B. Coatings shall be applied prior to assembly of component parts. Before abrasive blasting, all surfaces shall be ground to remove casting imperfections, rough areas, and other areas that will be detrimental to the coating system during service. Corners and edges of casting surfaces shall be ground to a minimum radius of 1/8-inch.

C. Exterior surfaces of all unburied and submerged valves and actuators shall be factory coated as specified for the associated piping in Section 09900, Protective Coatings.

D. Flange faces shall not be protective coated.

E. The exterior surfaces of valves that are buried shall be field protective coated as specified for the exterior surfaces of the associated buried piping.

2.03 VALVE ACTUATORS (NOT USED)

PART 3 – EXECUTION

3.01 VALVE INSTALLATION

A. Valves shall be installed in accordance with the manufacturer's written instructions and as shown and specified. Clearances and access shall be as specified above. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so that separate support can be provided when necessary.

B. Insulation: Where insulation is indicated, install extended stem valves, arranged in proper manner to receive insulation.

D. Gates shall be fitted, supported and braced to prevent warping, binding, and bending under operating conditions. Embedded parts cast into concrete shall be accurately positioned and supported during placement of concrete.

E. Assembly of Valves and Piping

1. Install valves with piping in accordance with Section 15010, Mechanical Piping, General and with the requirements in this Section.
2. Valves shall be installed with piping prior to the assembled piping or attached supports being cast into concrete or attached to supports.
3. Construction sequences and operations shall be such that the adjacent piping provides support for the valves, and that the valves do not support the piping. Where permanent supports are shown to be located at valves, the supports shall be installed after the piping and valves have been installed as a completed assembly on temporary supports.
4. Piping and valve assemblies shall be installed so that the piping does not exert forces on the valves from settlement or assembly operations.

5. Joining of valves to piping shall not be performed where the flanges are out of alignment or do not have the proper fit. Where piping alignment deviations exist the piping shall be adjusted before the valve is joined to the piping.

6. Unless shown otherwise, butterfly, plug, and ball valves shall be installed with the shafts in the horizontal position. Gates, gate valves, and other types of valves shall be installed with the stems in the vertical position. For manually operated valves 3 inches in nominal size and smaller, valve operators and indicators shall be oriented to display toward the normal operating direction.

7. Outside screw and yoke stems, except provide inside screw, nonrising stem where space prevents full opening of OS&Y valves. Renewable seats shall be used, except where otherwise indicated.

F. Installation of Check Valves

1. Swing Check Valves: Install in horizontal position with hinge pin horizontally perpendicular to centerline of pipe. Install for proper direction of flow.

G. Floor boxes, valve boxes, extension stems, and floor stands shall be installed vertically centered over the operating nut, with couplings as required. The elevation of the box top shall be adjusted to conform with the elevation of the finished floor, grade, or pavement at the completion of the Work. Boxes and stem guides shall be adequately supported during concrete placement to maintain vertical alignment and proper orientation.

H. Storage and Preparation for Installation

1. Valves shall be packaged and stored to prevent exposure to sunlight, chemical exposure, and atmospheric pollution.

2. Prior to installation each valve shall be inspected for damage. Any damage to seats, machined surfaces, or protective coatings shall be repaired before installation. Each valve shall be cleaned to remove any dirt and debris from the interior surfaces and seat areas. Valves shall be in the closed position for installation.

1. Some valves must be installed with seats or seat adjustment rings on the downstream side of the valve. Determine these requirements prior to installation and install the valve in the correct orientation.

3.02 VALVE ADJUSTING AND CLEANING

A. Inspect valves for leaks. Adjust or replace packing to stop leaks. Replace valve if leak persists.

B. Valve Identification. Tag valves per Section 15010.

****END OF SECTION****

SECTION 15220

CHECK VALVES

PART 1 – GENERAL

1.01 DESCRIPTION

This section specifies outside lever and weight swing check valves.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between this section and the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by the organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, reference to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A276	Stainless Steel Bars and Shapes
AWWA C508	Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS

1.03 SUBMITTALS

A. Manufacturer's catalog information including dimensions, cross-sectional views, details of construction and materials list shall be provided in accordance with Section 01300 of the Technical Specifications.

B. Applicable operating and maintenance information specified in Section 01730.

PART 2 – PRODUCTS

2.01 ACCEPTABLE PRODUCTS

Check valves shall be Golden Anderson Fig. 340, or equal, modified to meet the requirements specified in this section.

2.02 MATERIALS

Materials of construction shall be as follows:

Component	Material
Body, Cover	Cast iron, ASTM A126, Class B
Disc	Cast iron, ASTM A126, Class B
Seat Rings	Bronze, AWWA C508
Hinge Shafts and Hinge Pins	Stainless steel, ASTM 276, Type 304
Shaft Bushings	Bronze, AWWA C508

2.03 MANUFACTURE

A. Disc, disc arm, shaft, keyways, lever and weight shall be capable of closing within 0.05 seconds of pump stoppage and fluid moving at velocity of 8 ft/sec. Weight location shall be adjustable. The valve design shall permit mounting levers on either side of the valve body.

B. Valves shall be provided with a clear opening equal to or greater than the connecting piping, with no raised seating surface. Seats shall be threaded onto the body or fitted with an O-ring seal and locked in place with stainless steel screws or pins and shall be replaceable. Shafts shall be provided with stuffing box and packing or O-ring seals at each end which are externally replaceable.

C. Unless otherwise specified, valves shall, as a minimum, conform to the following pressure ratings:

Size, inches	Working Pressure, psig	Hydrostatic Pressure, psig
2 through 12	175	350

PART 3 – EXECUTION

3.01 INSTALLATION

Swing check valves shall be installed in accordance with the manufacturer's recommendations.

****END OF SECTION****

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SECTION 15505

MECHANICAL IDENTIFICATION

PART 1 – GENERAL

1.01 SUMMARY

A. Work Included: Materials and installation of mechanical systems identification.

1.02 REFERENCED STANDARDS

A. References

Reference	Title
ANSI A13.1	Scheme for Identification of Piping Systems

1.03 SUBMITTALS

A. Equipment Identification Tag materials

B. Equipment Identification Tag chart

C. Pipe markers, duct markers

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.

B. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices, unless otherwise indicated.

PART 2 – PRODUCTS

2.01 MECHANICAL IDENTIFICATION MATERIALS

A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 15 sections. Where more than a single type is specified for application, provide single selection for each product category.

B. Manufacturers: Allen Systems, Inc., W. H. Brady Co., Signmark Division, Industrial Safety Supply Co., Inc., Seton Name Plate Corporation, or approved.

2.02 PLASTIC PIPE MARKERS

A. Provide one of the following:

1. Snap-on Type: Manufacturer's standard preprinted, semi-rigid snap-on, color-coded pipe markers.
2. Pressure-Sensitive Type: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure sensitive, vinyl pipe markers.

B. Small Pipes: For external diameters less than 6 inches (including insulation, if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pretensioned semi-rigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Laminated or bonded application of pipe marker to pipe (or insulation).
4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4 inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inches.

C. Large Pipes: For external diameters of 6 inches and larger (including insulation, if any), provide either full-band or strip-type pipe markers, but not narrower than three times letter height (and of required length), fastened by one of the following methods:

1. Laminated or bonded application of pipe marker to pipe (or insulation).
2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2 inches wide; full circle at both ends of pipe marker, tape lapped 3 inches.
3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

D. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.

1. Pipe Marker Schedule -- Exposed pipe shall be labeled indicating pipe contents as shown.
    a. Potable Water (W)
    b. Non-Potable Water (NPW)
    c. Vent (V,VTR)
    d. Drain (D)

E. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

2.03 PLASTIC DUCT MARKERS

A. General: Manufacturer's standard laminated plastic, color-coded duct markers. Supply separate color codes for supply, exhaust, outside, and return air.

B. Include the Following Nomenclature:

1. Direction of air flow.
2. Duct service (supply, return, exhaust, outdoor air)

2.04 VALVE TAGS

A. Brass Valve Tags: Polished brass valve tags with stamp-engraved piping system abbreviation in 1/4-inch high letters and sequenced valve numbers 1/2 inch high, and with hole for fastener. 1-1/2-inch diameter tags, except as otherwise indicated.

B. Valve Tag Fasteners: Solid brass chain (wire link or beaded type), or solid brass S-hooks.

C. Access Panel Markers: Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include center hole to allow attachment.

2.05 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Engraving stock melamine plastic laminate, Federal Specification L-P-387, in the size and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color), punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16 inch for units up to 20 sq. in. or 8 inches in length; 1/8 inch for larger units.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.06 PLASTIC EQUIPMENT MARKERS

A. General: Manufacturer's standard laminated plastic, color-coded equipment markers. Conform to the following color code:

1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.

B. Nomenclature: Match terminology used on drawing schedules as closely as possible.

C. Size: Provide approximate 2-1/2- by 4-inch markers for control devices, dampers, and valves; and 4-1/2- by 6-inch markers for equipment.

2.07 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in mechanical identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.

B. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples: Chiller No. 3, Air Handling Unit No. 42, Standpipe F12, and the like).

PART 3 – EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.02 MECHANICAL EQUIPMENT IDENTIFICATION

A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices: Pumps, compressors, chillers, cooling towers and similar motor driven units, electric duct heaters, terminal units, coils, fans, water heaters, blowers, unitary HVAC equipment, tanks and pressure vessels, filters, water treatment systems and similar equipment.

B. Valve identification tags and charts shall conform to Agency tag numbering system. No tag will be allowed to be installed until after the Agency has reviewed and approved the tag numbering.

1. Tags which have been installed without Agency approval of tag numbering shall be removed and replaced with new appropriately numbered tag at Contractor's expense.

3.03 ADJUSTING AND CLEANING

A. Adjusting: Relocate any mechanical identification device which has become visually blocked.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

****END OF SECTION****

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