

GENERAL MECHANICAL PROVISIONS

1. GENERAL

1.1 Intent

- .1 Contract Documents and drawings of this Division are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.
- .2 Follow Manufacturers' recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .3 Install equipment generally in locations and routes shown. Run piping and ductwork close to building structure, parallel to building lines to maximize head room and with minimum interference with other services. Remove and replace improperly installed equipment to satisfaction of the Contract Administrator at the Contractor's cost.
- .4 Install equipment to provide access and ease of maintenance.
- .5 Connect to equipment specified in other Sections and to equipment supplied and installed by other contractors or by the City. Uncrate equipment, move in place and install complete.

1.2 Coordination of Work

- .1 Cooperate and coordinate with other trades on the Site.
- .2 Where dimensional details are required, work with the applicable architectural and structural Drawings.
- .3 Any areas indicated as space for future materials or equipment shall be left clear.

1.3 Metric Conversion

- .1 All units in this Division are expressed in SI units.
- .2 Submit all Shop Drawings and maintenance manuals in SI units.
- .3 On all submittals (Shop Drawings etc.) use the same SI units as stated in the Specification.
- .4 Equivalent Nominal Diameters of Pipes - Metric and Imperial:
 - .1 Where pipes are specified with metric dimensions and Imperial sized pipes are available, supply and install equivalent nominal Imperial sized pipe as indicated in the table, and supply and install at no extra cost adapters to ensure compatible connections to all metric sized fittings, equipment and piping.
 - .2 When CSA approved pipes for equipment where nominal SI Metric pipes are provided, the Contractor shall supply and install at no extra cost adapters to ensure compatible

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connections between the SI Metric pipes and all new and existing pipes, fittings, and equipment.

mm (in) (NPS)	mm (in) (NPS)	mm (in) (NPS)
3 (1/8)	65 (2-1/2)	375 (15)
6 (1/4)	75 (3)	450 (18)
10 (3/8)	100 (4)	500 (20)
15 (1/2)	125 (5)	600 (24)
20 (3/4)	150 (6)	750 (30)
25 (1)	200 (8)	900 (36)
30 (1-1/4)	250 (10)	1200 (48)
40 (1-1/2)	300 (12)	
50 (2)		

.5 Metric Duct Sizes:

- .1 The metric duct sizes are expressed as 25 mm = 1 in.

1.4 Shop Drawings

- .1 Provide printed copies of Shop Drawing, in accordance with Section 01300 – Submittals, for all scheduled equipment and as specified in specific equipment sections of this Specification.
- .2 Identify materials and equipment by manufacturer, trade name and model number. Include copies of applicable brochure or catalogue material. Do not assume applicable catalogues are available in the Contract Administrator's office. O&M Manuals are not suitable submittal material.
- .3 Clearly mark submittal material using arrows, underlining or circling to show differences from specified, e.g. ratings, capacities and options being proposed. Cross out non-applicable material. Specifically note on the submittal specified features such as special tank linings, pumps seals materials or painting.
- .4 Include weights, dimensional, and technical data sufficient to check if equipment meets requirements. Include wiring, piping, and service connection data and motor sizes. Provide additional information as specified in specific equipment sections of this specification.
- .5 Installed materials and equipment shall meet specified requirements regardless of whether or not Shop Drawings are reviewed by the Contract Administrator.
- .6 Do not order equipment or material until the Contract Administrator has reviewed and returned Shop Drawings.
- .7 Submit shop drawings for pipe and equipment labels.
- .8 Retain one (1) copy of Shop Drawings on Site for review.

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1.5 Cutting, Patching and Coring

- .1 Provide holes and sleeves, cutting and fitting required for mechanical Work. Relocate improperly located holes and sleeves.
- .2 Drill for expansion bolts, hanger rods, brackets, and supports.
- .3 Provide openings and holes required in precast members for mechanical work. Cast holes 100 mm (4 in) or larger in diameter. Field-cut smaller than 100 mm (4 in).
- .4 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the respective Section.

1.6 Equipment Protection and Clean-Up

- .1 Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.
- .2 Protect equipment with polyethylene covers and crates.
- .3 Operate, drain and flush out unsealed bearings and refill with new change of oil, before final acceptance.
- .4 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances.
- .5 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.
- .6 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

1.7 Installation of Equipment

- .1 Unions and flanges shall be provided in piping or ductwork to permit easy removal of equipment.
- .2 Maintain permanent access to equipment for maintenance.

1.8 Connections to Existing Services

- .1 Maintain liaison with the Contract Administrator and provide a schedule to interrupt, re-route or connect to water, sewer, heating, or gas systems, with minimum interruption of services.
- .2 Major services shall not be interrupted before all preparatory work is completed and all required materials are on Site. Provide a minimum of forty eight (48) hours notice for all service shutdown.
- .3 Interruptions and shutdowns of existing services shall be by the building maintenance staff.

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1.9 Equipment and Materials

- .1 Refer to Section 01600 – Material and Equipment.
- .2 Each major component of equipment shall bear manufacturer's name, address, catalogue and serial number in a conspicuous place.
- .3 Where two or more products of the same type are required, products shall be of the same manufacturer.

1.10 Equipment Protection and Clean-Up

- .1 Refer to Section 01600 – Materials and Equipment.
- .2 Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.
- .3 Protect equipment with polyethylene covers and crates.
- .4 Operate, drain and flush out unsealed bearings and refill with new change of oil, before final acceptance.
- .5 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances.
- .6 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.
- .7 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

1.11 Electrical Motors

- .1 Supply mechanical equipment complete with electrical motors.
- .2 Provide motors designed, manufactured, and tested in accordance with the latest edition of the following codes and standards: NEMA, EEMAC, CSA, CEC Part 1, IEEE and ANSI. All motors to be CSA labelled. All motors to be approved for use in the designated area classification by the Provincial Electrical Protection Branch. All motors intended for use with a variable speed drive (variable frequency drive) shall be inverter only rated.
- .3 Unless specified otherwise, provide motors designed for full voltage starting, EEMAC Design B. Motors driving high torque or high inertia loads may be EEMAC Design C or D.
- .4 Provide motors rated for continuous duty with 1.15 service factor unless specified otherwise in the driven equipment specifications. Provide all motors with thermal overload protection.
- .5 Motors less than 0.37 kW shall be 120 V, 60 Hz, 1 phase. Motors ½ hp and larger shall be 3 phase at the indicated voltage.
- .6 All motors shall be 1800 rpm unless indicated otherwise.

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- .7 Provide motors with grease or oil lubricated anti-friction type ball or roller bearings.
- .8 Provide motors designed with Class B insulation; Class F insulation for totally enclosed motors.
- .9 Refer to electrical specifications, Division 16, for voltage, frequency, and phase data. This shall take precedence over any reference in Division 15.
- .10 Where motor power is stated in watts or kilowatts, nominal motor horsepower multiplied by 746 or 0.746 respectively, has been used as the conversion factor.
- .11 Minimum certified motor efficiency shall be as outlined in Manitoba Hydro's latest high efficiency motor incentives program, or the following table, whichever indicates the higher minimum efficiency.

MINIMUM EFFICIENCY (%) *

kW	3600 RPM	1800 RPM	1200 RPM	900 RPM
0.75	75.5	82.5	80.0	74.0
1.1	82.5	84.0	85.5	77.0
1.5	84.0	84.0	86.5	82.5
2.3	85.5	87.5	87.5	84.0
3.7	87.5	87.5	87.5	85.5
5.6	88.5	89.5	89.5	85.5
7.5	89.5	89.5	89.5	88.5
11.3	90.2	91.0	90.2	88.5
15	90.2	91.0	90.2	89.5
18.9	90.5	91.7	91.3	89.6
22.5	90.8	91.9	91.4	90.7
30	91.4	92.5	92.3	90.6
50	91.9	92.7	92.3	91.3
60	92.4	93.2	92.9	91.6
75	92.5	93.5	93.1	92.8
100	93.0	93.7	93.5	92.7

(*) As defined in CSA C390 or IEEE 112B Nominal Standards

1.12 Access Doors

- .1 Provide access doors for maintenance or adjustment purposes for all mechanical system components including:
 - .1 Volume and splitter dampers
 - .2 Controls, coils, and terminal units
 - .3 Filters
 - .4 Strainers

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- .2 Steel frame access panel with stainless steel piano-type hinge, channel reinforced steel door panel, three "Symmons" fasteners per door. Door panel recessed to receive ceiling or wall material to give finished appearance showing only hinge and fasteners. Provide acoustic gasket between door panel perimeter and steel frame. Rated access doors shall be UL-listed.
- .3 Mark removable ceiling tiles used for access with colour coded dots.
- .4 Sizes to be 200 x 200 mm (8 x 8 in) for cleanout, 300 x 300 mm (12 x 12 in) for hand 600 x 600 mm (24 x 24 in) for body access minimum.
- .5 Provide UL-listed fire rated access doors installed in rated wall and ceilings.

1.13 Miscellaneous Metals

- .1 Supply and install all necessary miscellaneous metals to hang or support materials, equipment and provide access for Work under this Contract.
- .2 All miscellaneous metals shall be prime painted for interior applications and galvanized for exterior applications.
- .3 Miscellaneous metals shall include but not limited to:
 - .1 Hangers for equipment, piping and ductwork.
 - .2 Support for equipment.
 - .3 Access platforms and catwalks.

1.14 Pipe Sleeves

- .1 Minimum thickness: 4.7 mm.
- .2 Seep Ring:
 - .1 Center steel flange for water stoppage on sleeves in exterior or water-bearing walls, 4.7 mm minimum thickness.
 - .2 Outside Diameter: Unless otherwise shown, 75 mm greater than pipe sleeve outside diameter.
 - .3 Continuously fillet weld on each side all around.
 - .4 Factory Finish:
- .3 Above Grade in Nonsubmerged Areas: Hot-dip galvanized after fabrication.
 - .1 Hot-dip applied, meeting requirements of ASTM A153/A153M.

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- .2 Electroplated zinc or cadmium plating is unacceptable.
- .3 As specified in Section 15200-000 – Process Piping.
- .4 Below Grade or in Submerged or Damp Environments: Shop-lined and coated.
 - .1 Lining and coating in accordance with Section 09870 – Coating Systems for Steel Tanks and Pipes.

1.15 Temporary or Trial Usage

- .1 Temporary or trial usage by the City or Contract Administrator of mechanical equipment supplied under Contract shall not represent acceptance.
- .2 Repair or replace permanent equipment used temporarily.
- .3 Repair or otherwise rectify damage caused by defective materials or workmanship during temporary or trial usage.

2. PRODUCTS

2.1 Identification Labels

- .1 Pipe Labels:
 - .1 Labels:
 - .1 Snap-on, reversible type with lettering and directional arrows, sized for outside diameter of pipe and insulation.
 - .2 Provided with ties or straps for pipes of 150 mm and over diameter.
 - .3 Designed to firmly grip pipe so labels remain fixed in vertical pipe runs.
 - .2 Material: Heavy-duty vinyl or polyester, suitable for exterior use, long lasting, and resistance to moisture, grease, and oils.
 - .3 Letters and Arrows: Black on OSHA safety yellow background.
 - .4 Colour Field and Letter Height: Meet ASME A13.1.
 - .5 Message: Piping system name as indicated in Section – 15200-00S Piping Schedule.
 - .6 Acceptable Manufacturers:
 - .1 Brady Signmark; B-915 BradySnap-On and Strap-On Pipe Markers.
 - .2 Seton Identification Products; Ultra-mark Pipe Markers.

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.2 Equipment Labels:

- .1 Applies to equipment with assigned tag numbers, where specified.
- .2 Letters: Black engraved, 19 mm high minimum.
- .3 Background: White.
- .4 Materials:
 - .1 Rigid laminate.
 - .2 Multi-layered acrylic.
- .5 Furnish 25 mm margin with holes at each end of label, for mounting. On fibreglass labels, furnish grommets at each hole.
- .6 Size:
 - .1 50 mm minimum and 75 mm maximum high, by 350 mm minimum and 450 mm maximum long.
 - .2 Furnish same size base dimensions for all labels.
- .7 Message: Equipment names and tag numbers as used in sections where equipment is specified.
- .8 Manufacturers:
 - .1 Brady Signmark.
 - .2 Seton Identification Products.

3. EXECUTION

3.1 General

- .1 Do not install water piping immediately over or within a 1 m horizontal clearance of any electrical panel, motor starter, or HCP. Where piping must be located within these zones, install piping inside a PVC conduit or shield the electrical device to protect it from direct water access.

3.2 Identification

- .1 Pipe Labels:
 - .1 Provide and install pipe labels and flow direction arrows. Locate at connections to equipment, valves, or branching fittings at wall boundaries.

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- .2 At intervals along piping not greater than 6 m on center with at least one label applied to each exposed horizontal and vertical run of pipe.
- .3 At exposed piping not normally in view, such as above suspended ceilings and in closets and cabinets.
- .4 Supplementary Labels: Provide to City those listed in Piping Schedule that do not receive arrows.
- .5 Application: To pipe only after painting in vicinity is complete or as approved by Contract Administrator.
- .6 Installation: In accordance with manufacturer's instructions.
- .2 Equipment Labels:
 - .1 Locate and install on equipment or concrete equipment base.
 - .2 Anchor to equipment or base for easy removal and replacement with ordinary hand tools.
- .3 Valves:
 - .1 Provide 20 mm ($\frac{3}{4}$ in) diameter brass, with metal photo black numbers, or white lamacoid with black engraved numbers, secured to valve stem with key chain.
 - .2 Provide neat, typewritten directories, giving valve number, services and location. Frame one copy under glass for wall mounting as directed, second copy to be forwarded to Contract Administrator. Include copies in O&M Manuals.
- .4 Controls:
 - .1 Tag automatic controls, instruments and relays and match/key to control Shop Drawing identification numbers. Tag all equipment and control panels.
 - .2 Identify electric starting switches, thermostats controlling motors, remote push button stations, and controls equipment supplied under this division with lamacoid plates having 6 mm ($\frac{1}{4}$ in) minimum letter size. Identification to state equipment controlled.

3.3 Colour Coding Schedule

- .1 Coordinate colour coding of piping and equipment with Work of Division 9.

END OF SECTION

PIPING SUPPORT SYSTEMS

1. GENERAL

1.1 References

- .1 The following is a list of standards which may be referenced in this Section:
 - .1 ASTM:
 - .1 A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
 - .2 BOCA: Basic Building Code.
 - .3 ICBO: Uniform Building Code.
 - .4 NBC
 - .5 Manufacturers' Standardization Society (MSS):
 - .1 SP 58, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 SP 69, Pipe Hangers and Supports - Selection and Application.
 - .3 SP 89, Pipe Hangers and Supports - Fabrication and Installation Practices.

1.2 Submittals

- .1 Shop Drawings:
 - .1 Drawings of piping support system, locating each support, brace, hanger, guide, component, and anchor. Identify support, hanger, guide, and anchor type by catalog number and Shop Drawing detail number.
 - .2 Revisions to support systems resulting from changes in related piping system layout or addition of flexible joints.
- .2 Information Submittals: Maintenance information on piping support system.

1.3 Qualifications

- .1 Piping support systems shall be designed and Shop Drawings prepared and sealed by a Professional Engineer registered in the Province of Manitoba.

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1.4 Design Requirements

.1 General:

- .1 Design, size, and locate piping support systems throughout facility, whether shown or not.
- .2 Piping smaller than 750 mm: Supports are shown only where specific types and locations are required; additional pipe supports may be required.
- .3 Piping 750 mm and larger: Support systems have been designed for piping shown.
- .4 Meet requirements of MSS SP 58, MSS SP 69, and MSS SP 89, or as modified by this Section.

.2 Pipe Support Systems:

- .1 Support Load: Dead loads imposed by weight of pipes filled with intended service commodity except air and gas pipes, plus insulation.
- .2 Maximum Support Spacing and Minimum Rod Size:

.1 Mild Steel or Ductile Iron Piping:

Pipe Size	Maximum Support/ Hanger Spacing	Minimum Rod Size Single Rod Hangers
25 mm & smaller	1.8 m	6.25 mm
32.5 mm through 62.5 mm	2.4 m	6.25 mm
75 mm & 100 mm	3.0 m	9.5 mm
150 mm	3.6 m	9.5 mm
200 mm	3.6 m	12.5 mm
250 mm & 300mm	4.3 m	15.9 mm
350 mm	4.8 m	19.1 mm
400 mm & 450 mm	4.8 m	22.2 mm
500 mm	5.4 m	25.4 mm
600 mm	5.4 m	31.7 mm
762 mm & larger	As shown on Drawings	As shown on Drawings

.2 Copper Piping:

- .1 Maximum Support Spacing: 0.61 m less per size than listed for steel pipe, with 25.4 mm and smaller pipe supported every 1.5 m.
- .2 Minimum Hanger Rod Sizing: Same as listed for steel pipe.

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.3 Plastic and Fibreglass Piping:

- .1 Maximum support spacing: As recommended by Manufacturer for flow temperature in pipe.
- .2 Minimum Hanger Rod Sizing: Same as listed for steel pipe.

.4 Stainless Steel Piping:

SST Pipe Size	Maximum Support/ Hanger Spacing	Minimum Rod Size Single Rod Hangers
25 mm through 100 mm	2.4 m	6.25 mm
150 mm	2.4 m	9.5 mm
200 mm & 250 mm	3.0 m	12.5 mm
300 mm	3.0 m	12.5 mm
350 mm & 400 mm	3.6 m	15.9 mm
450 mm & 500 mm	4.3 m	19.1 mm
600 mm	4.3 m	22.2 mm

.3 Framing Support System:

- .1 Beams: Size such that beam stress does not exceed 172 MPa and maximum deflection does not exceed 1/240 of span.
- .2 Column Members: Size in accordance with Manufacturer's recommended method.
- .3 Support Loads: Calculate using weight of pipes filled with intended service commodity.
- .4 Maximum Spans:
 - .1 Steel and Ductile Iron Pipe, 75 mm diameter and larger: 3 m centres, unless otherwise shown.
 - .2 Other Pipelines and Special Situations: May require supplementary hangers and supports.
- .4 Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear and pullout loads imposed by loading and spacing on each particular support.
- .5 Vertical Sway Bracing: 3 m maximum centres, or as shown.
- .6 Existing Support Systems: Use existing supports systems to support new piping only if Contractor can show that they are adequate for additional load, or if they are strengthened to support additional load.

PIPING SUPPORT SYSTEMS

2. PRODUCTS

2.1 General

- .1 When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated by catalogs.
- .2 Special support and hanger details are shown for cases where standard catalog supports are inapplicable.
- .3 Materials: In accordance with Tables 1 and 2, in this Section.

2.2 Hangers

- .1 Clevis Type: MSS SP 58 and SP 69, Type 1 or 6.
 - .1 Anvil; Figure 104 or 260.
 - .2 B-Line; Figure B3198 or B3100.
- .2 Hinged Split-Ring Pipe Clamp: MSS SP 58 and SP 69, Type 6 or 12.
 - .1 Anvil; Figure 104.
 - .2 B-Line; Figure B3198H.
- .3 Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.
- .4 Attachments:
 - .1 I-Beam Clamp: Concentric loading type, MSS SP 58 and SP 69, Type 21, 28, 29, or 30, which engage both sides of flange.
 - .2 Concrete Insert: MSS SP 58 and SP 69, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.

2.3 Saddle Supports

- .1 Pedestal Type: Schedule 40 pipe stanchion, saddle, and anchoring flange.
 - .1 Nonadjustable Saddle: MSS SP 58 and SP 69, Type 37 with U-bolt.
 - .1 Anvil; Figure 259.
 - .2 B-Line; Figure B3090.
 - .2 Adjustable Saddle: MSS SP 58 and SP 69, Type 38 without clamp.
 - .1 Anvil; Figure 264.
 - .2 B-Line; Figure B3093.

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2.4 Wall Brackets

- .1 Welded Steel Bracket: MSS SP 58 and SP 69, Type 33 (heavy-duty).
 - .1 Anvil; Figure 199.
 - .2 B-Line; Figure B3067.
- .2 One-Hole Clamp: Anvil; Figure TBA
- .3 Channel Type:
 - .1 Unistrut.
 - .2 Anvil; Power-Strut.
 - .3 B-Line; Strut System.
 - .4 Aickinstrut (FRP).

2.5 Pipe Clamps

- .1 Riser Clamp: MSS SP 58 and SP 69, Type 8:
 - .1 Anvil; Figure 261.
 - .2 B-Line; Figure B3373.

2.6 Channel Type Support Systems

- .1 Channel Size: 2.7 mm (12 gauge), 41.3 mm wide minimum steel, 27.6 mm wide minimum FRP.
- .2 Members and Connections: Design for all loads with safety factor of 5.
- .3 Manufacturers:
 - .1 B-Line; Strut System.
 - .2 Unistrut.
 - .3 Anvil; Power-Strut.
 - .4 Aickinstrut (FRP System).

2.7 Accessories

- .1 Insulation Shields:
 - .1 Type: Galvanized steel or stainless steel, MSS SP 58 and SP 69, Type 40.

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- .2 Acceptable Manufacturers:
 - .1 Anvil; Figure 167.
 - .2 B-Line; Figure B3151.
 - .2 Welding Insulation Saddles:
 - .1 Type: MSS SP 58 and SP 69, Type 39.
 - .2 Acceptable Manufacturers:
 - .1 Anvil; Figure Series 160.
 - .2 B-Line; Figure Series B3160.
 - .3 Vibration Isolation Pads:
 - .1 Type: Neoprene Waffle.
 - .2 Acceptable Manufacturers:
 - .1 Mason Industries; Type W.
 - .2 Korfund; Korpad 40.
- 2.8 Intermediate Pipe Guidelines**
- .1 Piping 150 mm and Smaller:
 - .1 Type: Pipe clamp with oversized pipe sleeve to provide minimum 3.2 mm clearance.
 - .2 Acceptable Manufacturers:
 - .1 B-Line; B3148 or B3180.
 - .2 Anvil; Figure 103.
 - .2 Piping 200 mm and Larger:
 - .1 Type: Specially formed U-bolts with double nuts to provide 6.4 mm minimum clearance around pipe.
 - .2 U-Bolt Stock Size:
 - .1 200 mm Pipe: 15.9 mm.
 - .2 250 mm Pipe: 19.1 mm.

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- .3 300 mm through 400 mm Pipe: 22.2 mm.
- .4 450 mm through 762 mm Pipe: 25.4 mm.

2.9 Pipe Alignment Guides

- .1 Type:
 - .1 Piping 200 mm and smaller: Spider or sleeve type.
 - .2 Piping 250 mm and larger: Roller type.
- .2 Manufacturers:
 - .1 Flexonics.
 - .2 Anvil.
 - .3 B-Line.

2.10 Pipe Anchors

- .1 Type: Anchor chair with U-bolt strap.
- .2 Acceptable Manufacturers:
 - .1 Anvil; Figure TBA
 - .2 B-Line; Figure B3147A or B3147B.

3. EXECUTION

3.1 Installation

- .1 General:
 - .1 Install support systems in accordance with MSS SP 69 and MSS SP 89, unless shown otherwise.
 - .2 Support piping connections to equipment by pipe support and not by equipment.
 - .3 Support large or heavy valves, fittings, and appurtenances independently of connected piping.
 - .4 Support no pipe from pipe above it.

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- .5 Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.
 - .6 Do not install pipe supports and hangers in equipment access areas or bridge crane runs.
 - .7 Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing and to reduce movement after start-up.
 - .8 Install lateral supports for seismic loads at all changes in direction.
 - .9 Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.
 - .10 Repair mounting surfaces to original condition after attachments are made.
- .2 Standard Pipe Supports:
- .1 Horizontal Suspended Piping:
 - .1 Single Pipes: Adjustable swivel-ring, split-ring, or clevis hangers.
 - .2 Grouped Pipes: Trapeze hanger systems.
 - .3 Furnish galvanized steel protection shield and oversized hangers for insulated pipe.
 - .4 Furnish precut sections of rigid insulation with vapour barrier at hangers for insulated pipe.
 - .2 Horizontal Piping Supported From Walls:
 - .1 Single Pipes: Wall brackets or wall clips attached to wall with anchors. Clips attached to wall mounted framing also acceptable.
 - .2 Stacked Piping:
 - .1 Wall mounted framing system and clips acceptable for piping smaller than 75 mm minimal diameter.
 - .2 Piping clamps that resist axial movement of pipe through support not acceptable.
 - .3 Wall mounted piping clips not acceptable for insulated piping.
 - .3 Horizontal Piping Supported From Floors:
 - .1 Stanchion Type:
 - .1 Pedestal type; adjustable with stanchion, saddle, and anchoring flange.

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- .2 Use yoked saddles for piping whose centreline elevation is 450 mm or greater above floor and for exterior installations.
- .3 Provide neoprene waffle isolation pad under anchoring flanges, adjacent to equipment or where otherwise required to provide vibration isolation.
- .2 Floor Mounted Channel Supports:
 - .1 Use for piping smaller than 75 mm nominal diameter running along floors and in trenches at piping elevations lower than can be accommodated using pedestal pipe supports.
 - .2 Attach channel framing to floors with anchor bolts.
 - .3 Attach pipe to channel with clips or pipe clamps.
- .3 Concrete Cradles: Use for piping larger than 75 mm along floor and in trenches at piping elevations lower than can be accommodated using stanchion type.
- .4 Vertical Pipe: Support with wall brackets and base elbow or riser clamps on floor penetrations.
- .5 Standard Attachments:
 - .1 To Concrete Ceilings: Concrete inserts.
 - .2 To Steel Beams: I-beam clamp or welded attachments.
 - .3 To Wooden Beams: Lag screws and angle clips to members not less than 62 mm thick.
 - .4 To Concrete Walls: Concrete inserts or brackets or clip angles with anchor bolts.
- .6 Existing Walls and Ceilings: Install as specified for new construction, unless shown otherwise.
- .3 Intermediate and Pipe Alignment Guides:
 - .1 Provide pipe alignment guides (or pipe supports that provide same function) at expansion joints and loops.
 - .2 Guide piping on each side of expansion joint or loop at 4- and 14-pipe diameters from each joint or loop.
 - .3 Install intermediate guides on metal framing support systems not carrying pipe anchor or alignment guide.

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.4 Accessories:

- .1 Insulation Shield: Install on insulated nonsteel piping. Oversize rollers and supports.
- .2 Welding Insulation Saddle: Install on insulated steel pipe. Oversize rollers and supports.
- .3 Vibration Isolation Pad: Install under base flange of pedestal type pipe supports adjacent to equipment, and where required to isolate vibration.
- .4 Dielectric Barrier:
 - .1 Install between carbon steel members and copper or stainless steel pipe.
 - .2 Install between stainless steel supports and nonstainless steel ferrous metal piping.
- .5 Electrical Isolation: Install 6.4 mm by 75 mm neoprene rubber wrap between submerged metal pipe and oversized clamps.

3.2 Field Finishing

- .1 Paint supports in accordance with Section 09901 – Painting and Finishing – Process Mechanical.

3.3 Hanger Materials

- .1 Select hanger material in accordance with the following tables:

Table 1 Nonchemical Areas	
Exposure Conditions	Hanger Material
Process areas: high humidity	Stainless steel or FRP
Process areas: wetted or submerged	Stainless steel or FRP

Notes:

- 1. Precoated steel to be fusion bonded epoxy or vinyl copolymer (Plastisol).
- 2. Stainless steel to be Type 304.
- 3. Galvanized steel to be per ASTM A653, Class G90, or hot-dip galvanized after fabrication to ASTM A123.

END OF SECTION

PROCESS PIPING

1. GENERAL

1.1 Scope

- .1 This Section covers the supply, installation, testing, cleaning, and placing into operation of all process piping systems including fittings.

1.2 References

- .1 The following is a list of standards which may be referenced in this Section and any supplemental Data Sheets:
 - .1 ANSI:
 - .1 B1.20.1, Pipe Threads, General Purpose (Inch)
 - .2 B16.1, Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
 - .3 B16.3, Malleable Iron Threaded Fittings
 - .4 B16.5, Pipe Flanges and Flanged Fittings
 - .5 B16.9, Factory-Made Wrought Steel Butt-welding Fittings
 - .6 B16.11, Forged Fittings, Socket-Welding and Threaded
 - .7 B16.15, Cast Bronze Threaded Fittings, Classes 125 and 250
 - .8 B16.21, Nonmetallic Flat Gaskets for Pipe Flanges
 - .9 B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
 - .10 B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings Class 150, 300, 400, 600, 900, 1500, and 2500
 - .11 B16.25, Butt Welding Ends
 - .12 B16.42, Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300
 - .2 ASME:
 - .1 Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels
 - .2 Boiler and Pressure Vessel Code, Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators

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- .3 B31.1, Power Piping
- .4 B31.3, Process Piping
- .5 B31.9, Building Services Piping
- .6 B36.10M, Welded and Seamless Wrought Steel Pipe
- .3 ASNT: SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing.
- .4 ASTM:
 - .1 A47, Standard Specification for Ferritic Malleable Iron Castings.
 - .2 A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - .3 A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications.
 - .4 A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 - .5 A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .6 A135, Standard Specification for Electric-Resistance-Welded Steel Pipe.
 - .7 A139, Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over).
 - .8 A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - .9 A181/A181M, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
 - .10 A182/A182M, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - .11 A183, Standard Specification for Carbon Steel Track Bolts and Nuts.
 - .12 A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
 - .13 A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service or Both.

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- .14 A197/A197M, Standard Specification for Cupola Malleable Iron.
- .15 A216/A216M, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
- .16 A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- .17 A276, Standard Specification for Stainless Steel Bars and Shapes.
- .18 A283/A283M, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
- .19 A285/A285M, Standard Specification for Pressure Vessel Plates, Carbon Steel, Low and Intermediate Tensile Strength.
- .20 A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- .21 A312/A312M, Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes.
- .22 A320/A320M, Standard Specification for Alloy/Steel Bolting Materials for Low-Temperature Service
- .23 A536, Standard Specification for Ductile Iron Castings.
- .24 A563, Standard Specification for Carbon and Alloy Steel Nuts.
- .25 A587, Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry.
- .26 A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
- .27 B32, Standard Specification for Solder Metal.
- .28 B75, Standard Specification for Seamless Copper Tube.
- .29 B88, Standard Specification for Seamless Copper Water Tube.
- .30 D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers – Tension.
- .31 D413, Standard Test Methods for Rubber Property - Adhesion to Flexible Substrate.

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- .32 D1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
- .33 D1330, Standard Specification for Rubber Sheet Gaskets.
- .34 D1784, Standard Specification for Rigid PVC Compounds and CPVC Compounds.
- .35 D1785, Standard Specification for PVC Plastic Pipe, Schedules 40, 80, and 120.
- .36 D2464, Standard Specification for Threaded PVC Plastic Pipe Fittings, Schedule 80.
- .37 D2466, Standard Specification for PVC Plastic Pipe Fittings, Schedule 40.
- .38 D2467, Standard Specification for PVC Plastic Pipe Fittings, Schedule 80.
- .39 D2564, Standard Specification for Solvent Cements for PVC Plastic Piping Systems.
- .40 D3222, Standard Specification for Unmodified PVDF Molding Extrusion and Coating Materials.
- .5 AWWA:
 - .1 C200, Steel Water Pipe - 6 Inches and Larger.
 - .2 C207, Steel Pipe Flanges for Waterworks Service, Sizes 4 Inches through 144 Inches.
 - .3 C208, Dimensions for Fabricated Steel Water Pipe Fittings.
 - .4 C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
 - .5 C213, Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
 - .6 C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.
 - .7 C217, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Buried/Submerged Steel Water Pipelines.
 - .8 C606, Grooved and Shouldered Type Joints.
 - .9 M11, Steel Pipe - A Guide for Design and Installation.

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- .6 AWS:
 - .1 A5.8, Specification for Filler Metals for Brazing and Braze Welding
 - .2 QC 1, Standard for AWS Certification of Welding Inspectors
- .7 MSS: SP43, Wrought Stainless Steel Butt-Welding Fittings Including Reference to Other Corrosion Resistant Materials
- .8 NFPA: 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances
- .9 NSF:
 - .1 60, Drinking Water Treatment Chemicals - Health Effects.
 - .2 61, Drinking Water System Components - Health Effects.

1.3 Design Requirements

- .1 Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:
 - .1 Boiler and Steam Piping: ASME B31.1
 - .2 Process Piping: ASME B31.3
 - .3 Building Service Piping: ASME B31.9, as applicable
 - .4 Provincial Regulations

1.4 Submittals

- .1 General:
 - .1 Provide process piping submittals separated in process areas as per drawing key plan:
 - .1 D: Deacon Booster Pumping Station
 - .2 Identify process area in the title of all submittal transmittals.
- .2 Shop Drawings:
 - .1 Shop Fabricated Piping:
 - .1 For epoxy coated steel piping, all sizes, and stainless steel piping, sizes 50 mm and larger, provide detailed pipe fabrication or spool drawings showing fittings and

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- bends, dimensions, field weld locations, coatings, hydrotest information and other pertinent information.
- .2 For shop fabricated piping that connects to existing flanges and nozzles, measure and show on the Shop Drawings the as-built information for the existing flange centrelines, flange faces and any angular misalignment. Adjust design of new piping accordingly so that new piping accurately mates with existing piping.
 - .3 For embedded piping 100 mm and larger, provide layout drawings showing location of each pipe section and each special length; number or otherwise designate laying sequence on each piece.
- .2 Hydraulic Thrust Restraint for Restrained Joints: details including materials, sizes, assembly ratings, and pipe attachment methods.
 - .3 Dissimilar Buried Pipe Joints: joint types and assembly drawings.
- .3 Quality Control Submittals:
 - .1 Certificate of Satisfactory Installation, Form 102, as per Section 01650 - Equipment Installation.
 - .2 Laboratory Testing Equipment: certified calibrations, Manufacturer's product data, and test procedures
 - .3 Certified welding inspection and test results
 - .4 Qualifications:
 - .1 Weld Inspection and Testing Agency: Certification and qualifications
 - .2 Welding Inspector: certification and qualifications
 - .3 Welders:
 - .1 List of qualified welders and welding operators
 - .2 Current test records for qualified welder(s) and weld type(s) for factory and field welding
 - .5 Weld Procedures: records in accordance with ASME Boiler and Pressure Vessel Code, Section IX for weld type(s) and base metal(s)
 - .6 Nondestructive inspection and testing procedures
 - .7 Manufacturer's Certification of Compliance:
 - .1 Pipe and fittings

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- .2 Welding electrodes and filler materials
- .3 Factory applied resins and coatings
- .8 Certified weld inspection and test reports
- .9 Test logs
- .10 Procedures pickling and passivation of stainless steel piping
- .11 Pipe coating applicator certification
- .12 Bacteriological testing report

1.5 Qualifications

- .1 Independent Inspection and Testing Agency:
 - .1 Ten (10) years' experience in field of welding and welded pipe and fittings' testing required for this Work.
 - .2 Calibrated instruments and equipment, and documented standard procedures for performing specified testing.
 - .3 Certified in accordance with ASNT SNT-TC-1A for testing procedures required for this Work.
 - .4 Testing Personnel: qualified for non-destructive test methods to be performed.
 - .5 Inspection Services: qualified welding inspector.
- .2 Welding Inspector: AWS certified, AWS QC 1 qualified, with prior inspection experience of welds specified.
- .3 Welder and Welding Operator Qualifications:
 - .1 Qualified by accepted inspection and testing agency before starting Work in accordance with Section IX, Article III of the ASME Boiler and Pressure Vessel Code.
 - .2 Qualified to perform groove welds in Positions 2G and 5G for each welding process and pipe material specified.
 - .3 Qualification tests may be waived by the Contract Administrator based on evidence of prior qualification.

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1.6 Quality Control

- .1 Quality Control: Contractor shall provide services of independent inspection and testing agency for welding operations as approved by Contract Administrator.
- .2 Welding materials, fabrication standards and labour qualifications shall conform to ANSI/ASME B31.1, ANSI/ASME B31.3, ANSI B16.25, ASME Boiler and Pressure Vessel Code, Section 9, CSA W59 and the Provincial Board of Labour Regulations.
- .3 Use welders fully qualified and licensed by provincial authorities in accordance with CSA W59.

1.7 Delivery, Storage, and Handling

- .1 General:
 - .1 Flanges: securely attach metal, hardboard, or wood protectors over entire gasket surface.
 - .2 Threaded or Socket Welding Ends: fit with metal, wood, or plastic plugs or caps.
 - .3 Linings and Coatings: prevent excessive drying.
 - .4 Cold Weather Storage: locate products to prevent coating from freezing to ground.
 - .5 Handling: use heavy canvas or nylon slings to lift pipe and fittings.

2. PRODUCTS

2.1 Piping

- .1 As specified on Piping Data Sheets and Piping Schedule located at the end of this Section as a Supplement.
- .2 Diameters Shown:
 - .1 Standardized Products: nominal size.
 - .2 Fabricated Steel Piping: outside diameter, ASME B36.10M.

2.2 Joints

- .1 Grooved End System:
 - .1 Rigid, except where joints are used to correct misalignment, to provide flexibility, or where shown, furnish flexible type.

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- .2 Flanges: when required, furnish with grooved type flange adapters of same Manufacturer as grooved end couplings.
- .2 Flanged Joints:
 - .1 Flat-faced carbon steel or alloy flanges when mating with flat-faced cast or ductile iron flanges.
 - .2 Higher pressure rated flanges as required to mate with equipment when equipment flange is of higher pressure rating than required for piping.
- .3 Threaded Joints: NPT taper pipe threads in accordance with ANSI B1.20.1.
- .4 Mechanical Pipe Couplings: Provide Depend-O-Lok and or Victaulic pipe couplings where shown on drawings.
- .5 Thrust Tie-Rod Assemblies: NFPA 24; tie-rod attachments relying on clamp friction with pipe barrel to restrain thrust are unacceptable.
- .6 Mechanical Joint Anchor Gland Follower:
 - .1 Ductile iron anchor type, wedge action, with break off tightening bolts.
 - .2 Manufacturer and Product: EBAA Iron Inc.; Megalug.
- .7 Flexible Mechanical Compression Joint Coupling:
 - .1 Stainless steel, ASTM A276, Type 305 bands.
 - .2 Manufacturers:
 - .1 Pipeline Products Corp.
 - .2 Fernco Joint Sealer Co.

2.3 Welding

- .1 Welding materials shall be in accordance with CSA W48.

2.4 Gasket Lubricant

- .1 Lubricant shall be supplied by pipe manufacturer and no substitute or “or-equal” will be allowed.

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2.5 Fabrication

- .1 Mark each pipe length on outside:
 - .1 Size or diameter and class
 - .2 Manufacturer's identification and pipe serial number
 - .3 Location number on laying drawing
 - .4 Date of manufacture
- .2 Code markings according to approved Shop Drawings.
- .3 Flanged pipe shall be fabricated in the shop, not in the field, and delivered to the Site with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by the Manufacturer.

2.6 Finishes

- .1 Factory prepare, prime, and finish coat in accordance with Pipe Data Sheet(s), Section 09870 – Coating Systems for Steel Tanks and Pipes, and Section 15010 – General Mechanical Provisions.
- .2 Galvanizing:
 - .1 Hot-dip applied, meeting requirements of ASTM A153.
 - .2 Electroplated zinc or cadmium plating is unacceptable.

3. EXECUTION

3.1 Piping Material Selection

- .1 Select piping material for the various services based on Section 15200-00S – Piping Schedule.

3.2 Examination

- .1 Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.
- .2 When connecting to existing flanges and nozzles, accurately measure pipe/flange locations and any angular misalignment and make appropriate adjustments so that new piping will mate up properly.

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- .3 Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.
- .4 Welding Electrodes: verify proper grade and type, free of moisture and dampness, and coating is undamaged.

3.3 Preparation

- .1 Notify Contract Administrator at least two (2) weeks prior to field fabrication of pipe or fittings.
- .2 Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.
- .3 Damaged Coatings and Linings: repair using original coating and lining materials in accordance with Manufacturer's instructions.

3.4 Welding

- .1 Perform in accordance with Section IX, ASME Boiler and Pressure Vessel Code and ASME B31.1, B31.3 and B31.9 for Pressure Piping, as may be specified on Piping Data Sheets, and if recommended by piping or fitting Manufacturer
- .2 Weld Identification: mark each weld with symbol identifying welder
- .3 Pipe End Preparation:
 - .1 Machine Shaping: preferred
 - .2 Oxygen or Arc Cutting: smooth to touch, true, and slag removal by chipping or grinding
 - .3 Beveled Ends for Butt Welding: ANSI B16.25
- .4 Surfaces:
 - .1 Clean and free of paint, oil, rust, scale, slag, or other material detrimental to welding.
 - .2 Clean stainless steel joints with stainless steel wire brushes or stainless steel wool prior to welding.
 - .3 Thoroughly clean each layer of deposited weld metal, including final pass, prior to deposition of each additional layer of weld metal with a power-driven wire brush.
- .5 Alignment and Spacing:
 - .1 Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness.

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- .2 Root Opening of Joint: as stated in qualified welding procedure.
- .3 Minimum Spacing of Circumferential Butt Welds: minimum four times pipe wall thickness or 25 mm, whichever is greater.
- .6 Climatic Conditions:
 - .1 Do not perform welding if there is impingement of any rain, snow, sleet, or high wind on the weld area, or if the ambient temperature is below 0°C.
 - .2 Stainless Steel and Alloy Piping: If the ambient is less than 0°C, local preheating to a temperature warm to the hand is required.
- .7 Tack Welds: performed by qualified welder using same procedure as for completed weld, made with electrode similar or equivalent to electrode to be used for first weld pass, and not defective. Remove those not meeting requirements prior to commencing welding procedures.
- .8 Surface Defects: chip or grind out those affecting soundness of weld.
- .9 Weld Passes: as required in welding procedure.
- .10 Weld Quality: free of cracks, incomplete penetration, weld undercutting, excessive weld reinforcement, porosity slag inclusions, and other defects in excess of limits shown in applicable piping code.

3.5 Installation-General

- .1 Join pipe and fittings in accordance with Manufacturer's instructions, unless otherwise shown or specified.
- .2 Remove foreign objects prior to assembly and installation.
- .3 Flanged Joints:
 - .1 Install perpendicular to pipe centreline.
 - .2 Bolt Holes: straddle vertical centrelines, aligned with connecting equipment flanges or as shown.
 - .3 Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.
 - .4 Plastic Flanges: install annular ring filler gasket at joints of raised-face flange.
 - .5 Raised-Face Flanges: use flat-face flange when joining with flat-faced ductile or cast iron flange.

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- .6 Verify compatibility of mating flange to adapter flange gasket prior to selecting grooved adapter flanging.
- .7 Threaded flanged joints must be shop fabricated and delivered to Site with flanges in-place and properly faced.
- .8 Manufacturer:
 - .1 Same as pipe Manufacturer.
 - .2 Victaulic flange adapter.
- .4 Threaded and Coupled Joints:
 - .1 Conform to ANSI B1.20.1.
 - .2 Produce sufficient thread length to ensure full engagement when screwed home in fittings.
 - .3 Countersink pipe ends, ream and clean chips and burrs after threading.
 - .4 Make connections with not more than three threads exposed.
 - .5 Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets.
- .5 Grooved-End Joints:
 - .1 Type: rigid, except where joints are used to correct misalignment, to provide flexibility, and where shown otherwise, in which case provide flexible type.
- .6 Soldered Joints:
 - .1 Use only solder specified for particular service.
 - .2 Cut pipe ends square and remove fins and burrs.
 - .3 After thoroughly cleaning pipe and fitting of oil and grease using solvent and emery cloth, apply noncorrosive flux to the male end only.
 - .4 Wipe excess solder from exterior of joint before hardened.
 - .5 Before soldering, remove stems and washers from solder joint valves.
- .7 PVC and CPVC Piping:
 - .1 Provide Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.

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- .2 Use strap wrench for tightening threaded plastic joints. Do not over tighten fittings.
- .3 Do not thread Schedule 40 pipe.
- .8 All bolt threads shall be coated with an anti-seize compound prior to being made up with nuts unless otherwise specified in the detail piping system specifications. All bolts for submerged flanges shall be coated with an anti-seize compound that has NSF-61 certification.

3.6 Pipe Coatings

- .1 Provide epoxy coating and lining on piping when indicated on the piping data sheet(s) or in Section 15200-00S – Piping Schedule.
- .2 Shop apply coating and lining to the greatest extent possible. Touch up coating and linings in the field as required. Minimize the number of field welds and use only where shown on approved Shop Drawings. Apply coating and lining to field welds and meet the same surface preparation, coating and testing requirements as shop welds.
- .3 Before applying coatings and linings to metal piping, grind and round off all sharp edges, maximum radius of edges: 6 mm.
- .4 All interior epoxy coatings shall conform to NSF Standard 61 – Drinking Water System Components, suitable for use in potable water applications. Coating materials and application shall be in accordance with Section 09870 – Coating Systems for Steel Tanks and Pipes.
- .5 Colour of top coat: As selected by Contract Administrator from a set of standard colours which shall include white.

3.7 Tape Wrap

- .1 For welded joints on Yellow jacketed pipe and at other indicated locations apply tape to buried pipe and fittings. Use Polyken, Tec-Tape or Denso tape, consisting of primer and tape applied to minimum thickness of 0.90 mm in accordance with AWWA C209.
- .2 For flanged or coupled joints and for fittings use petrolatum primer, mastic and tape; Polyken, Tec-Wrap or Denso, in accordance with AWWA C217.
- .3 Shrink Sleeve: As an alternative to tape wrap, shrink sleeves are acceptable if material and method of installation is reviewed and accepted by the Contract Administrator prior to use.

3.8 Installation-Exposed Piping

- .1 Piping Runs:
 - .1 Parallel to building or column lines and perpendicular to floor, unless shown otherwise.

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- .2 Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement.
- .2 Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.
- .3 Install piping so that no load or movement in excess of that stipulated by equipment Manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.
- .4 Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other Work.
- .5 Piping clearance, unless otherwise shown:
 - .1 Over Walkway and Stairs: minimum of 2200 mm, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
 - .2 Between Equipment or Equipment Piping and Adjacent Piping: Minimum 1000 mm, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
 - .3 From Adjacent Work: minimum 100 mm from nearest extremity of completed piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
 - .4 Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.
 - .5 Headroom in front of openings, doors, and windows shall not be less than the top of the opening.
 - .6 Do not install piping containing liquids or liquid vapours in transformer vaults or electrical equipment rooms.
 - .7 Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical Work.

3.9 Thrust Restraint

- .1 Location:
 - .1 Buried Piping: where shown and where required to restrain force developed at pipeline tees, plugs, caps, bends, and other locations where unbalanced forces exist due to hydrostatic testing and normal operating pressure.
 - .2 Exposed Piping: at all joints in piping.

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- .2 Thrust Ties:
 - .1 Steel Pipe: attach with fabricated lugs.
 - .2 Ductile Iron Pipe: attach with socket clamps against a grooved joint coupling or flange.
 - .3 Flanged Coupling Adapters: for exposed installations, install Manufacturer's anchor studs through the coupling sleeve.
- .3 Mechanical Joint Valve Restraint in Proprietary Restrained Joint Piping: install pipe joint Manufacturer's adapter gland follower and pipe end retainer, or thrust tie-rods and socket clamps.

3.10 Pipe Sleeves

- .1 Refer to Section 15010 – General Mechanical Provisions.

3.11 Wall Pipes for Slab, Floor, Wall, and Roof Penetrations

- .1 Steel or Stainless Steel Wall Pipe:
 - .1 Same material and thickness as connecting pipe, except 6 mm minimum thickness.
 - .2 Lining: same as connecting pipe, factory-applied.
 - .3 Thrust Collar:
 - .1 Outside Diameter: unless otherwise shown, 75 mm greater than outside diameter of wall pipe.
 - .2 Continuously fillet welded on each side all around.
- .2 Ductile Iron Wall Pipe:
 - .1 Diameter and Ends: same as connecting ductile iron pipe.
 - .2 Thickness: equal to or greater than remainder of pipe in line.
 - .3 Fittings: in accordance with applicable Pipe Data Sheet.
 - .4 Thrust Collars:
 - .1 Rated for thrust load developed at 250 psi.
 - .2 Safety Factor: 2, minimum.
 - .3 Material and Construction: ductile iron or cast iron, cast integral with wall pipe wherever possible, or thrust rated, welded attachment to wall pipe.

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- .5 Manufacturers:
 - .1 American Cast Iron Pipe Co.
 - .2 U.S. Pipe and Foundry Co.

3.12 Branch Connections

- .1 Do not install branch connections smaller than 13 mm nominal pipe size, including instrument connections, unless shown otherwise.
- .2 When line of lower pressure connects to a line of higher pressure, requirements of Piping Data Sheet for higher pressure rating prevails up to and including the first block valve in the line carrying the lower pressure, unless otherwise shown.
- .3 Threaded Pipe Tap Connections:
 - .1 Ductile Iron Piping: connect only with service saddle or at a tapping boss of a fitting, valve body, or equipment casting.
 - .2 Welded Steel or Alloy Piping: connect only with welded threadolet or half-coupling as specified on Piping Data Sheet.
 - .3 Limitations: threaded taps in pipe barrel are unacceptable.

3.13 Vents and Drains

- .1 Vents and drains at high and low points in piping required for completed system may or may not be shown. Install vents on high points and drains on low points of pipelines at all low and high point locations; except for epoxy coated pipe, install vents and drains only where shown.

3.14 Interim Cleaning

- .1 Prevent accumulation of weld rod, weld spatter, pipe cuttings and filings, gravel, cleaning rags, and other foreign material within piping during fabrication and assembly.
- .2 Examine piping to assure removal of foreign objects prior to assembly.
- .3 Shop cleaning may employ conventional commercial cleaning method if it does not corrode, deform, swell, or otherwise alter physical properties of material being cleaned.

3.15 Testing

- .1 General:
 - .1 Conduct hydraulic pressure and leakage tests on newly installed piping.
 - .2 Supply and install necessary equipment and material and make taps in pipe, as required. Provide blind flanges as required.

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- .3 Contract Administrator will monitor the tests. Provide advance notice of start of testing.
- .4 Test Pressures: As specified.
- .5 Test Records: make records of each piping system installation during the test to document the following:
 - .1 Date of test
 - .2 Description and identification of piping tested
 - .3 Test fluid
 - .4 Test pressure
 - .5 Remarks, including:
 - .1 Leaks (type, location)
 - .2 Repairs made on leaks
 - .6 Certification by Contractor and signed acknowledgment by Contract Administrator that tests have been satisfactorily completed.
- .2 Testing New Pipe Connected to Existing Pipe: isolate new pipe with grooved end pipe caps, spectacle blinds, or blind flanges.
- .3 Concrete Encased Piping: Test piping prior to placement of concrete.
- .4 Preparation and Execution:
 - .1 Buried Pressure Piping:
 - .1 Conduct final hydrostatic acceptance tests after trench has been completely backfilled.
 - .2 An initial service leak test may be conducted with a partially backfilled trench and the joints left open for inspection, if field conditions permit, as determined by the Contract Administrator.
 - .3 Expose joints for the acceptance test on buried pressure piping to be pneumatically tested or subjected to an initial service leak test.
 - .2 Exposed Piping: Conduct tests after piping has been completely installed including supports, hangers, and anchors, but prior to insulation.

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.5 Hydrostatic Leak Tests:

.1 Equipment: Supply and install the following:

Amount	Description
2	Graduated containers
2	Pressure gauges
1	Hydraulic force pump
	Suitable hose and suction pipe as required

.2 Procedure:

- .1 Use water as the hydrostatic test fluid.
- .2 Provide clean test water of such quality as to minimize corrosion of the materials in the piping system.
- .3 Open vents at high points of the piping system to purge air pockets while the piping system is filling.
- .4 Venting during the filling of the system may also be provided by loosening flanges with a minimum of four bolts or by the use of equipment vents.
- .5 Test piping systems at the test pressure specified in Section 15200-00S – Piping Schedule.
- .6 Maintain hydrostatic test pressure continuously for thirty (30) minutes minimum and for such additional time as necessary to conduct examinations for leakage.
- .7 Examine joints and connections for leakage.
- .8 The piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of weeping or leaking.
- .9 Correct visible leakage and retest to satisfaction of the Contract Administrator.

.3 Gravity Sewers and Drains:

- .1 Test by water or air exfiltration tests as prescribed by local or state plumbing codes and visually examine for leaks.
- .2 Repair leaks and retest system until no further leakage is evident.

.6 Pneumatic Leak Tests:

- .1 Perform on compressed air, instrument air, natural gas, and vacuum piping.

PROCESS PIPING

- .2 Equipment: Supply and install the following:

Amount	Description
1	Pneumatic compressor separator-dryer system capable of providing oil-free dry air and equipped with one or more full capacity safety relief valves set at a pressure of not more than 105% of the required primary test pressure
1	Calibrated test gauge

- .3 Procedure:

- .1 Perform pneumatic testing using accurately calibrated instruments and oil-free, dry air.
- .2 Perform tests only on exposed piping, after piping has been completely installed, including supports, hangers and anchors, and inspected for proper installation.
- .3 Test piping system at the test pressure specified in the Piping Schedule.
- .4 Take necessary precautions to protect personnel from hazards associated with air testing.
- .5 Secure piping to be tested to prevent damage to adjacent piping and equipment in event of a joint failure.
- .6 Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by test.
- .7 Apply maximum 172 kPa preliminary pneumatic test to piping system prior to final leak testing, to locate major leaks.
- .8 Examine joints and connections for leakage with soap bubbles.
- .9 Correct visible leaks and retest to satisfaction of the Contract Administrator.
- .10 Gradually increase pressure in the system to not more than one-half of test pressure.
- .11 Thereafter increase pressure in steps of approximately one tenth ($\frac{1}{10}$) of maximum test pressure until required test pressure is reached.
- .12 Maintain pneumatic test pressure continuously for minimum ten (10) minutes and for such additional time as necessary to conduct a soap bubble examination for leakage.

PROCESS PIPING

- .13 The piping system, exclusive of possible localized instances at pump or valve packing, shall show no evidence of leakage.
- .14 Correct visible leakage retest to satisfaction of the Contract Administrator.
- .15 Following pneumatic testing, thoroughly purge, with nitrogen, lines that are to carry flammable gases to assure no explosive mixtures will be present in the system during the filling process.

3.16 Cleaning and Disinfection

- .1 Following assembly and testing, and prior to final acceptance, flush piping with water, (except as stated below), and remove accumulated construction debris and other foreign matter.
- .2 Insert cone strainers in the connections to attached equipment and leave until cleaning has been accomplished.
- .3 Minimum Flushing Velocity: 0.8 m per second.
- .4 Remove accumulated debris through drains 50 mm and larger or by removing spools and valves from piping.
- .5 Immediately following drainage of flushed lines, dry piping with compressed air.
- .6 DBPS process air and compressed air piping shall be blown clean of loose debris with compressed air.
- .7 Disinfect piping intended to carry potable water before placing in service in accordance with Section 11650 – Disinfection of Piping and Equipment:

3.17 Field Finishing

- .1 Notify Contract Administrator at least three (3) days prior to start of any surface preparation or coating application work.
- .2 As specified in Section 09870 – Coating Systems for Steel Tanks and Pipes.
- .3 Paint the exterior of ferrous metal piping, copper piping, iron piping and PVC piping in accordance with Section 09870 – Coating Systems for Steel Tanks and Pipes.
- .4 Repair any damage to coating and lining on embedded pipes and sleeves.

3.18 Pipe Identification

- .1 Refer to Section 15010 – General Mechanical Provisions.

PROCESS PIPING

3.19 Field Quality Control

- .1 Pressure test piping for leakage. Refer to Section 15200-00S – Piping Schedule for test pressures and test media.
- .2 Minimum Duties of Welding Inspector:
 - .1 Job material verification and storage.
 - .2 Qualification of welders.
 - .3 Certify conformance with approved welding procedures.
 - .4 Maintenance of records and preparation of reports in a timely manner.
 - .5 Notification to Contract Administrator of unsatisfactory weld performance within twenty four (24) hours of weld test failure.
- .3 Required Weld Examinations:
 - .1 Perform examinations in accordance with Piping Code: ASME B31.3. 10% of the circumferential butt welds shall be random radiographed. For concrete encased steel pipes and pipes under foundations, provide radiographic examination of 50% of welds as selected by the Contract Administrator.
 - .2 Perform examinations for every pipe thickness and for each welding procedure, progressively, for all piping covered by this section.
 - .3 Examine at least one (1) of each type and position of weld made by each welder or welding operator.
 - .4 For each weld found to be defective under the acceptance standards or limitations on imperfections contained in the applicable Piping Code, examine two additional welds made by the same welder that produced the defective weld. Such additional examinations are in addition to the minimum required above. Examine, progressively, two (2) additional welds for each tracer examination found to be unsatisfactory.

3.20 Supplements

- .1 15200-00S – Piping Schedule.
- .2 Data Sheets.

<u>Number</u>	<u>Title</u>
15200-03	Carbon Steel Pipe and Fittings-General Service
15200-04	Carbon Steel Pipe and Fittings-Large Diameter

PROCESS PIPING

Number	Title
15200-10	Polyvinyl Chloride (PVC) Pipe and Fittings
15200-13	Copper and Copper Alloy Pipe, Tubing, and Fittings

END OF SECTION

PIPING SERVICE LEGEND

SERVICE

CWS	Cooling Water Supply
DD	Deacon Effluent (Post UV)
DS	Deacon Suction
DU	Deacon UV (Pre UV)
ELC	Electrical Conduit
PW	Potable Water
SAM	Sample

MATERIAL

COP	Copper
CS	Carbon Steel
PVC	Polyvinyl Chloride
SST	Stainless Steel

PRESSURE TEST

H	Hydrostatic
I	In Service
P	Pneumatic
NA	Not Applicable

END OF SECTION

Service	Commodity Abbreviation	Nominal Size(s) (mm)	Exposure ²	Piping Material ²	Specification Section	Test Type and Pressure (kPa) ¹	Remarks
DEACON BOOSTER PUMPING STATION							
Potable Water	PW	200	EXP	Epoxy Coated / Lined Steel	15200-03	H, 1345	
Potable Water	DD, DS, DU	600, 750, 900	EXP	Epoxy Coated / Lined Steel	15200-04	H, 1345	
Cooling Water Supply	CWS	25, 50	EXP	COP	15200-13	H, 1000	
Drain	DRN	25, 50, 100	EXP	PVC	15200-10	N/A	
Pump Control Valve Water Pipe	-	15, 20, 25, 40, 50	EXP	COP	15200-13	N/A	Copper tubing to be Supplied and Installed as recommended by the Pump Control Valve Manufacturer

Notes

- 1) H-Hydraulic; P-Pneumatic
- 2) For pipe material and service exposure abbreviations, refer to Section 15200-00L.

DATA SHEET – CARBON STEEL PIPE AND FITTINGS-GENERAL SERVICE

Item	Size	Description
Pipe	550 mm and smaller Screwed: 40 mm and smaller Welded and Grooved: 50 mm thru 250 mm 300 mm thru 400 mm 450 mm thru 550 mm	Black carbon steel, ASTM A106, Grade B seamless or ASTM A53, Grade B, seamless or ERW. Threaded, butt-welded, grooved end, and flanged joints: Schedule 80. Schedule 40. Schedule 30. Standard weight (9.5 mm min. wall thickness).
Linings (Note 2)	All	Shop-Applied Liquid Epoxy Lining: Apply in strict accordance with manufacturer's instructions and requirements of AWWA C210 and Section 09870 – Coating Systems for Steel Tanks and Pipes, including surface cleaning and preparation. For pipe interior, follow System 1, as specified in Section 09870 – Coating Systems for Steel Tanks and Pipes.
Coatings	All All All All	For exposed piping, follow System 5, as specified in Section 09870 – Coating Systems for Steel Tanks and Pipes. For immersed piping, follow System 1, as specified in Section 09870. For buried piping, apply coating in accordance with AWWA C214 consisting of at least four layers: <ol style="list-style-type: none"> 1. Primer layer. 2. Inner Layer Tape: Corrosion-protective tape, 0.5 mm (20 mils), with black exterior. 3. Outer Layer Tape: Mechanical protective tape, 0.76 mm (30 mils), with gray exterior. 4. Outer Layer Tape: Mechanical protective tape, 0.76 mm (30 mils), with white exterior. Total tape thickness minimum 2.0 mm (80 mils). Hold back minimum of 60 mm from end of pipe for welded joints. For concrete encased piping, tape wrap as specified above for buried piping; or alternatively, follow System 5, as specified in Section 09870 – Coating Systems for Steel Tanks and Pipes.
Joints	40 mm and smaller 50 mm and larger	Threaded or flanged at valves and equipment or grooved end meeting the requirements of AWWA C606. See Note 1. Butt-welded or flanged at valves and equipment, or grooved end meeting the requirements of AWWA C606.

DATA SHEET – CARBON STEEL PIPE AND FITTINGS-GENERAL SERVICE

Item	Size	Description
Fittings	40 mm and smaller 50 mm and larger	<p>Threaded: 680- or 2070 kPag malleable iron, ASTM A197 or ASTM A47, dimensions in accordance with ANSI B16.3.</p> <p>Grooved End: Malleable iron ASTM A47 or ductile iron ASTM A536, grooved ends to accept couplings without field preparation, EPDM elastomers for potable water service, rigid style coupling or as otherwise noted. Victaulic; Grinnell.</p> <p>Butt Welded: Wrought carbon steel butt- welding, ASTM A234/A234M, Grade WPB meeting the requirements of ANSI B16.9; fitting wall thickness to match adjoining pipe; long radius elbows unless shown otherwise.</p> <p>Grooved End: Malleable iron ASTM A47 or ductile iron ASTM A536, grooved ends to accept couplings without field preparation, EPDM elastomers for potable water service, rigid style coupling or as otherwise noted. Victaulic Style 44; Grinnell.</p> <p>Victaulic Depend-O-Lok, AWWA C221, EPDM elastomer, epoxy coated steel or 316 stainless steel wetted parts, restrained or non-restrained coupling as indicated on Drawings.</p>
Pipe Couplings	75 mm and larger	<p>Victaulic Depend-O-Lok, AWWA C221, EPDM elastomer, epoxy coated steel or 316 stainless steel wetted parts, restrained (FxF) or non-restrained coupling (FxE or ExE) as indicated on Drawings.</p> <p>Bolted type sleeve type couplings, restrained or non-restrained as shown; restrained couplings with harness per AWWA M11 and as indicated on the drawings. See Section 15205 – Piping Specialties.</p>
Branch Connections	40 mm and smaller 50 mm and larger	<p>Threaded, straight, or reducing tees in conformance with Fittings specified above. See Note 1.</p> <p>Butt-welding or grooved end tee in conformance with Fittings specified above.</p>
Flanges	40 mm and smaller 50 mm to 100 150 to 550	<p>Forged carbon steel, ASTM A105/A105M, Grade II, ANSI B16.5 Class 150, socket-weld or threaded, 1.5 mm raised face.</p> <p>Forged carbon steel, ASTM A105/A105M, ANSI B16.5, welding neck type, bore to match pipe internal diameter, 1.5 mm raised face.</p> <p>Supply and install flat-faced flanges when mating with flat-faced valves and fittings.</p> <p>Grooved End Adapter Flange: Malleable iron ASTM A47 or ductile iron ASTM A536. Victaulic; Grinnell.</p> <p>AWWA C207, Class D, slip-on.</p> <p>Supply and install flat-faced flanges when mating with flat-faced valves and fittings.</p>
Blind Flanges	100 mm and smaller 200 to 550	<p>Forged carbon steel, ASTM A105/A105M, Grade II, ANSI B16.5 Class 150, 1.5 mm raised face.</p> <p>Steel, AWWA C207, thickness to suit Class D unless otherwise noted.</p>

DATA SHEET – CARBON STEEL PIPE AND FITTINGS-GENERAL SERVICE

Item	Size	Description
Unions	40 mm and smaller	Threaded malleable iron, ASTM A197 or A47, 1035- or 2070 kPag WOG, meeting the requirements of ANSI B16.3.
Couplings	50 mm and larger	Grooved End: Rigid joint malleable iron, ASTM A47 or ductile iron, ASTM A536. Victaulic; Grinnell. Screwed End: Malleable iron, ASTM A197 or A47. See Note 1.
Bolting	Exposed piping	Flanges: Carbon steel ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts. Use 3 mm undersize bolting material for insulating flanges. Grooved End Couplings: Carbon steel, ASTM A183 bolts and nuts, 760 MPa minimum tensile strength.
	Submerged and underground	General Conditions: Type 316, ASTM A193/A193M, Grade B8M hex head bolts and ASTM A194/A194M Grade 8M hex head nuts.
Gaskets	50 mm thru 250 mm	Black neoprene, 2 mm thick, ring type for RF flanges, full face for flat face flanges.
	300 mm and larger	Black neoprene, 3.2 mm thick, ring type for RF flanges, full face for flat face flanges. Grooved Couplings: EPDM per ASTM D2000 for water and air to 110°C.
Thread Lubricant	40 mm and smaller	General Service: Teflon tape.

- Notes:
1. Do not use threaded connections on epoxy coated pipe. For small tapings such as vents, drains and gauge connections, supply and install a 50 mm flanged nozzle with a coated blind flange tapped to the size of the required connection.
 2. Pipe epoxy lining is required only where indicated on the Section 15200-00S – Piping Schedule.

END OF SECTION

DATA SHEET – CARBON STEEL PIPE AND FITTINGS – LARGE DIAMETER

Item	Size	Description
Pipe	All Welded and grooved: 600 mm 750 mm 900 mm	Manufactured in accordance with AWWA C200, except as herein modified. Fabricated from carbon steel sheet ASTM A1011 (Grades 30, 33, 36 or 40), A907 (Grade 36), or from plate ASTM A36, A283 (Grades C or D), or coil ASTM A139 (Grades B or C). Maximum carbon content of 0.25%. Minimum elongation of 22 percent in a 50.4 mm gauge length. Longitudinal and girth seams, whether straight or spiral, shall be butt welded using an approved electric-fusion-weld process. 610 mm outside dia., 9.5 mm min. wall thickness 762 mm outside dia., 9.5 mm min. wall thickness 914 mm outside dia., 9.5 mm min. wall thickness
Linings	All	Shop-Applied Liquid Epoxy Lining: Apply in strict accordance with manufacturer's instructions and requirements of AWWA C210 and Section 09870, including surface cleaning and preparation. For pipe interior, follow System 1, as specified in Section 09870.
Coatings	All All All All	For exposed piping, follow System 5, as specified in Section 09870. For immersed piping, follow System 1, as specified in Section 09870. For buried piping, apply coating in accordance with AWWA C214 consisting of at least four layers: <ol style="list-style-type: none"> 1. Primer layer. 2. Inner Layer Tape: Corrosion-protective tape, 0.5 mm (20 mils), with black exterior. 3. Outer Layer Tape: Mechanical protective tape, 0.76 mm (30 mils), with gray exterior. 4. Outer Layer Tape: Mechanical protective tape, 0.76 mm (30 mils), with white exterior. Total tape thickness minimum 2.0 mm (80 mils). Hold back minimum of 60 mm from end of pipe for welded joints.

DATA SHEET – CARBON STEEL PIPE AND FITTINGS – LARGE DIAMETER

Item	Size	Description
Coatings (Continued)	All	For concrete encased piping, tape wrap as specified above for buried piping; or alternatively, follow System 5, as specified in Section 09870.
Joints	All	<p>Exposed: Flanged, butt-welded or restrained flexible coupling. Where shown, provide grooved end meeting the requirements of AWWA C606.</p> <p>Buried or Concrete Encased: Field-welded butt strap with internal welding, double butt-welded or lap welded; AWWA C200, suitable for at least 700 kPa service and, regardless of type, shall be designed to be self-centering. Both bell and spigot ends shall be sized to provide a difference in circumferential measurement between the outside circumference of the spigot and the inside circumference of the bell of not less than 2.3 mm and not more than 12.4 mm.</p>
Fittings	600 mm to 900 mm	<p>Fabricated: Carbon steel fabricated from pipe in accordance with AWWA C208; suitable for butt welding, elbows to have a 22.5-degree maximum mitre section angle, minimum of three sections; wyes, tees, crosses, and outlets to be reinforced in accordance with AWWA M11.</p> <p>Formed Fittings: Wrought carbon steel butt-welding type, ASTM A234/A234M, Grade WPB meeting the requirements of ANSI B16.9; fitting wall thickness to match adjoining pipe; long radius elbows unless shown otherwise.</p> <p>Grooved End: Malleable iron ASTM A47 or ductile iron ASTM A536, grooved ends to accept couplings without field preparation, EPDM elastomers for potable water service, rigid style coupling or as otherwise noted. Victaulic Style 44; Grinnell. Supply and install Type “D” Vic-ring. Coupling and “D” Vic-Ring shall be supplied by the manufacturer as a package.</p>
Pipe Couplings	600 mm to 900 mm	<p>Victaulic Depend-O-Lok, AWWA C221, EPDM elastomer, epoxy coated steel or 316 stainless steel wetted parts, restrained (FxF) or non-restrained coupling (FxE or ExE) as indicated on Drawings.</p> <p>Bolted type sleeve type couplings, restrained or non-restrained as shown; restrained couplings with harness per AWWA M11 and as indicated on the drawings. See Section 15205 – Piping Specialties.</p>
Flanges	600 mm to 900 mm	Steel, AWWA C207, Class D, ANSI B16.5, slip-on, flat faced.
Blind Flanges	All	Steel, AWWA C207, thickness to suit Class D unless otherwise noted.

DATA SHEET – CARBON STEEL PIPE AND FITTINGS – LARGE DIAMETER

Item	Size	Description
Bolting	Exposed piping	Flanges: Carbon steel ASTM A307, Grade B threaded studs, and ASTM A563, Grade A hex head nuts. Use 3 mm undersize bolting material for insulating flanges. Grooved End Couplings: Carbon steel, ASTM A183 bolts and nuts, 760 MPa minimum tensile strength.
	Submerged and underground piping	General Conditions: Type 316, ASTM A193/A193M, Grade B8M hex head bolts and ASTM A194/A194M Grade 8M hex head nuts.
Gaskets	All flanges	Water Service: 3.2 mm thick, black neoprene, full face type. Grooved Couplings: EPDM per ASTM D2000 for water and air to 110°C.

- Notes:
1. For piping 550 mm and smaller follow Section 15200-03 – Data Sheet – Carbon Steel and Pipe and Fittings-General Service.
 2. Do not use threaded connections on epoxy coated pipe. For small tappings such as vents, drains and gauge connections, supply and install a 50 mm flanged nozzle with a coated blind flange tapped to the size of the required connection.
 3. Design and install pipe in accordance with AWWA M11, Steel Pipe - A Guide for Design and Installation.

END OF SECTION

DATA SHEET – STAINLESS STEEL PIPE AND FITTINGS-GENERAL SERVICE

Item	Size	Description
Pipe	50 mm & smaller	Schedule 40S: ASTM A312/A312M, Type 304 / 316
Joints	50 mm & smaller 60 mm & larger	Threaded or flanged at equipment as required or shown. Butt-welded or flanged at valves and equipment.
Fittings	50 mm & smaller 60 mm & larger	Threaded Forged: 1,000 CWP, ASTM A182/A182M, Grade F304L. Butt-Welded: ASTM A774/A774M Grade 304L conforming to MSS SP 43, “as-welded” grade, pickled and passivated; fitting wall thickness to match adjoining pipe; long radius elbows unless shown otherwise.
Branch Connections	50 mm & smaller 60 mm & larger	Tee or reducing tee in conformance with Fittings above. Butt-welding tee or reducing tee in accordance with Fittings above.
Flanges	25 mm & 40 mm 50 mm and larger	Forged Stainless Steel: ASTM A182/A182M, Grade F304L, ANSI B16.5 Class 150, socketweld, raised face. Cast Carbon Steel: ASTM A216/A216M Grade WCA, drilled, ANSI B16.5 Class 150 Van Stone Type with stainless steel stub ends, ASTM A240 Type 304L “as-welded grade”, conforming to MSS-SP43, wall thickness same as pipe.
Unions	50 mm & smaller	Threaded Forged: ASTM A182/A182M, Grade F304, 13800 or 20700 kPag WOG, integral ground seats, AAR design meeting the requirements of ANSI B16.11, bore to match pipe.
Bolting	All	Forged Flanges: Type 304 stainless steel, ASTM A320/A320M Grade B8M hex head bolts and ASTM A194/A194M Grade 8M hex head nuts. Van Stone Flanges: Carbon steel ASTM A307 Grade B hex head bolts and ASTM A563 Grade A hex head nuts. Supply and install same on mating cast iron flange on valve or equipment with flat ring gasket.
Gaskets	All Flanges	Flanged, Water and Sewage Service: 5 mm thick, unless otherwise specified, red rubber (SBR), hardness 80 (Shore A), rated to 93 °C, conforming to ANSI B16.21, AWWA C207, and ASTM D1330, Grades 1 and 2. Blind flanges shall be gasketed covering entire inside face with gasket cemented to blind flange.
Thread Lubricant	50 mm & smaller	Teflon tape.

END OF SECTION

DATA SHEET – POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

Item	Size	Description
Pipe	All	Schedule 80 PVC: Type I, Grade I or Class 12454-B conforming to ASTM D1784 and ASTM D1785. Threaded Nipples: Schedule 80 PVC.
Fittings	All	Schedule to Match Pipe Above: ASTM D2466 and ASTM D2467 for socket weld type and Schedule 80 ASTM D2464 for threaded type.
Joints	All	Solvent socket weld except where connection to threaded valves and equipment may require future disassembly.
Flanges	All	One piece, molded hub type PVC flat face flange in accordance with Fittings above, Class 150 ANSI B16.1 drilling
Bolting	All	Flat Face Mating Flange and In Corrosive Areas: ASTM A193/A193M, Type 316 stainless steel Grade B8M hex head bolts and ASTM A194/A194M Grade 8M hex head nuts. With Raised Face Mating Flange: Carbon steel ASTM A307 Grade B square head bolts and ASTM A563 Grade A heavy hex head nuts.
Gaskets	All	Flat Face Mating Flange: Full faced 3 mm thick ethylene propylene (EPR) rubber. Raised Face Mating Flange: Flat ring 3 mm ethylene propylene (EPR) rubber, with filler gasket between OD of raised face and flange OD to protect the flange from bolting moment.
Solvent Cement	All	As recommended by the pipe and fitting manufacturer conforming to ASTM D2564, except solvent weld cement for PVC pipe joints in sodium hypochlorite service shall be free of silica filler and shall be certified by the manufacturer to be suitable for that service. Certification shall be submitted.
Thread Lubricant	All	Teflon Tape.

END OF SECTION

DATA SHEET – COPPER AND COPPER ALLOY PIPE, TUBING AND FITTINGS

Item	Size	Description
General		Materials in contact with potable water shall conform to NSF 61 acceptance.
Tubing	75 mm and smaller	Seamless, conforming to ASTM B88 as follows: Water (exposed)Type L, hard drawn
Fittings	75 mm and smaller	Other Services: Commercially pure wrought copper, socket joint, conforming to ASTM B75, dimensions conforming to ASME B16.22.
Flanges	All	Copper, socket joint, conforming to ASTM B75, faced and drilled 150-pound ASME B16.24 standard.
Bolting	All	Other Services: ASTM A307, carbon steel, Grade A hex head bolts, and ASTM A563 Grade A hex head nuts.
Gaskets	All	1.5 mm thick non-asbestos compression type, full-face, Cranite, Johns Manville.
Solder	75 mm and smaller	Other Services: Wire solder (95% tin), conforming to ASTM B32 Alloy Grade Sn95. Do not use cored solder. Solder joints in accordance with ANSI B16.22.

END OF SECTION

PROCESS VALVES AND OPERATORS

1. GENERAL

1.1 Work by Contractor

- .1 This Section covers the Work necessary by the Contractor to Supply and Install the process valves and operators as described in this Contract.
- .2 Additional to the electric actuators to be Supplied and Installed within the DBPS as shown on the Drawings, the Contractor shall also supply one (1) matching spare electric actuator.

1.2 References

- .1 The following is a list of standards which may be referenced in this Section:
 - .1 API:
 - .1 API 600, Steel Valves-Flanged and Buttwelding Ends
 - .2 API 602, Compact Steel Gate Valves-Flanged, Threaded, Welded and Extended-Body Ends
 - .3 API 608, Metal Ball Valves-Flanged and Butt-Welding Ends
 - .4 API 609, Butterfly Valves, Lug Type and Wafer Type.
 - .5 API 589, Valve Inspection and Testing.
 - .2 ANSI:
 - .1 B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
 - .2 C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - .3 ASSE: 1011, Performance Requirements for Hose Connection Vacuum Breakers.
 - .4 ASTM:
 - .1 A276, Standard Specification for Stainless Steel Bars and Shapes.
 - .2 A351, Standard Specification for Castings, Austenitic, Austenitic-Ferric (Duplex), for Pressure-Containing Parts.
 - .3 A564, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
 - .4 B61, Standard Specification for Steam or Valve Bronze Castings.
 - .5 B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .6 B98, Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.

PROCESS VALVES AND OPERATORS

- .7 B127, Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
- .8 B139, Standard Specification for Phosphor Bronze Rod, Bar, and Shapes.
- .9 B164, Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
- .10 B194, Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar.
- .11 B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
- .12 D429, Test Methods for Rubber Property—Adhesion to Rigid Substrates.
- .13 D1784, Standard Specification for Rigid PVC Compounds and CPVC Compounds.
- .5 AWWA:
 - .1 C500, Metal-Seated Gate Valves for Water Supply Service.
 - .2 C504, Rubber-Seated Butterfly Valves.
 - .3 C508, Swing-Check Valves for Waterworks Service, 2 in. to 24 in. NPS.
 - .4 C509, Resilient-Seated Gate Valves for Water Supply Service.
 - .5 C510, Double Check Valve, Backflow-Preventer Assembly.
 - .6 C511, Reduced-Pressure Principle Backflow Prevention Assembly.
 - .7 C540, Power-Actuating Devices for Valves and Sluice Gates.
 - .8 C550, Protective Epoxy Interior Coatings for Valves and Hydrants.
 - .9 C606, Grooved and Shouldered Joints.
 - .10 C800, Underground Service Line Valves and Fittings.
- .6 MSS:
 - .1 SP-81, Stainless Steel, Bonnetless, Flanged Knife Gate Valves.
 - .2 SP-88, Diaphragm Type Valves.

1.3 Submittals

- .1 General:
 - .1 Provide valve submittals separated in process areas as per drawing key plan:
 - .1 D: Deacon Booster Pumping Station

PROCESS VALVES AND OPERATORS

- .2 Identify process area in the title of all submittal transmittals.
- .2 Shop Drawings:
 - .1 Product data sheets for make and model.
 - .2 Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
 - .3 Furnish Shop Drawings for complete actuator assemblies and accessories prior to delivery.
 - .4 Provide calculations for sizing, noise, cavitation and actuator torque for open-close/throttle and modulating valves. Provide valve coefficient (Cv) versus percent open curves for each size of valve in each process area.
 - .5 Power and control wiring diagrams, including terminals and numbers.
 - .6 Complete motor nameplate data.
 - .7 Submit a completed ISA S20.50 Instrument Specification Sheet for each device.
- .3 Information Submittals:
 - .1 Certificate of compliance for:
 - .1 Electric operators; full compliance with AWWA C540.
 - .2 Butterfly valves; full compliance with AWWA C504.
 - .3 API ANSI classes 300 and 600 valves; full compliance with API standards.
 - .2 Factory calibration and testing reports: Handwritten reports will not be accepted.
 - .3 O&M Manual.
 - .1 API ANSI classes 300 and 600 valves; full compliance with API standards.
 - .4 Certification of NSF 61B compliance.

2. PRODUCTS

2.1 General

- .1 Provide new material only.

PROCESS VALVES AND OPERATORS

- .2 All valves to include operator, actuator, handwheel, chain wheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and accessories for a complete operation.
- .3 Valve to be suitable for intended service. Renewable parts not to be of a lower quality than specified.
- .4 Valve same size as adjoining pipe.
- .5 Valve ends to suit adjacent piping.
- .6 Size operator to operate valve for the full range of pressures and velocities.
- .7 Valve to open by turning counterclockwise.
- .8 Factory mount operator, actuator, and accessories.
- .9 Provide lubricants of the type recommended by the equipment Manufacturer in sufficient quantity to fill all lubricant reservoirs and to replace all consumption during demonstration and run testing prior to Substantial Performance. Lubrication systems and lubrications shall be certified to ANSI/NSF Standard 61, to be compatible with potable water use.

2.2 Schedules

- .1 Requirements relative to this Section are shown on the valve schedules located at the end of this Section.

2.3 Materials

- .1 Brass and bronze valve components and accessories that have surfaces in contact with water to be alloys containing less than 16% zinc and 2% aluminum.
 - .1 Approved alloys are of the following ASTM designations: B61, B62, B98 (Alloy UNS No. C65100, C65500, or C66100), B139 (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.
 - .2 Stainless steel Alloy 18-8 may be substituted for bronze.

2.4 Factory Finishing

- .1 Epoxy Lining and Coating:
 - .1 Use where specified for individual valves described herein.
 - .2 In accordance with AWWA C550 unless otherwise specified.
 - .3 Either two-part liquid material or heat-activated (fusion) material except only heat-activated material if specified as “fusion” or “fusion bonded” epoxy.

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.4 Minimum 0.18 mm dry film thickness except where limited by valve operating tolerances.

.2 Exposed Valves:

.1 In accordance with Division 9 for Painting and Protective Coatings.

.2 Safety isolation valves and lockout valves with handles, handwheels, or chain wheels "safety yellow."

2.5 Valves

.1 Ball Valves:

.1 Type V300 Ball Valve 50 mm and Smaller for General Water Service:

.1 Two-piece end entry type, bronze body and end piece, hard chrome-plated bronze or brass ball, RTFE seats and packing, blowout-proof stem, zinc-coated steel hand lever operator with vinyl grip, rated 4140 kPa WOG, 1035 kPa SWP.

.2 Acceptable Manufacturers:

.1 Threaded:

.1 Milwaukee; BA100.

.2 Nibco; T-585-70.

.3 Conbraco Apollo; 70-100.

.2 Soldered:

.1 Milwaukee; BA150.

.2 Nibco; S-585-70.

.3 Conbraco Apollo; 70-200.

.2 Type V462 Gauge Cock 3 mm-6 mm:

.1 6 mm bronze body, hexagon end pattern, tee head, male ends, rated 862 kPa SWP.

.2 Manufacturer and Product: United Brass Works; Figure 973.

.2 Butterfly Valves:

.1 General:

.1 Valves specified as AWWA C504 to be in full compliance with AWWA C504 and following requirements:

.1 Suitable for throttling operations and infrequent operation after periods of inactivity.

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- .2 Elastomer seats bonded or vulcanized to body shall have adhesive integrity of bond between seat and body assured by testing, with minimum 75-pound pull in accordance with ASTM D429, Method B.
 - .3 Bubble-tight with rated pressure applied from either side.
 - .4 No travel stops for disc on interior of body.
 - .5 Self-adjusting V-type or O-ring shaft seals.
 - .6 Isolate metal-to-metal thrust bearing surfaces from flowstream.
 - .7 Stainless steel disc or disc with stainless steel disc edge.
- .2 Type V500 Butterfly Valve 75 mm to 1800 mm:
- .1 Flanged end, short body type.
 - .2 AWWA C504, Class 250B.
 - .3 Cast iron body, cast or ductile iron disc with Type 304 stainless steel shaft, EPDM rubber seat bonded or molded in body only, and stainless steel seating surface.
 - .4 Painting and Coating
 - .1 Interior surfaces shall be coated with a protective system in accordance to AWWA Standard C550 – Protective Interior Coatings of Valves and Hydrants, which can be used in a potable water system.
 - .2 Interior coatings shall comply with ANSI/NSF 61 “Drinking Water System Components – Health Effects”.
 - .3 Coating shall be two (2) or more layers (0.13 mm, 5 mils, minimum each coat) Polyamide Epoxy, Amerlock 400, Tnemec Series 140F Pota-Pox Plus or approved equal. Application as per Manufacturer’s recommendations.
 - .4 Coatings shall be holiday free as defined in Section 5.2.3 of AWWA Standard C550.
 - .5 Exterior surfaces shall be painted consistent with interior surfaces.
 - .6 Surfaces shall be prepared to NACE SSPC-SP10- Near-White Metal Blast Cleaning
 - .7 All machined surfaces shall be protected with an approved coating, prior to assembly to prevent rusting. Machined surfaces for valve seats shall have particular attention paid to, as this area if untreated, has proven to support "barnacle growth" which can prevent watertight closure of the valve.
 - .5 Acceptable Manufacturers:
 - .1 Pratt

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- .2 DeZurik
- .3 Val-Matic
- .3 Type V602 Check Valve, 50 mm and Smaller:
 - .1 All bronze, threaded cap, threaded ends, swing type replaceable Teflon disc and bronze disc holder, rated 1035 kPa SWP, 2070 kPa WOG.
 - .2 Acceptable Manufacturers:
 - .1 Walworth; Figure 3412.
 - .2 Milwaukee; Figure 510.
- .4 Type V940 Solenoid Valve 6 mm to 50 mm:
 - .1 Two-way internal pilot operated diaphragm type, brass body, resilient seat suitable for air or water, solenoid coil molded epoxy, NEMA insulation Class F, 120 VAC, 60 Hz, unless otherwise indicated. Solenoid enclosure NEMA 250, Type 4 unless otherwise indicated. Normal position CLOSED when de-energized as indicated.
 - .2 Minimum operating pressure differential no greater than 35 kPa (gauge), maximum operating pressure differential not less than 863 kPa (gauge).
 - .3 Acceptable Manufacturers:
 - .1 ASCO.
 - .2 Skinner.

2.6 Operators

- .1 General
 - .1 Where indicated in Section 15202-01 – Automated Valve Schedule, provide valve gear boxes suitable for submersible operation, with NSF approved food grade lubricant. Provide epoxy coating in accordance with Section 09870 – Coating Systems for Steel Tanks and Pipes, or similar coating systems approved by Contract Administrator.
- .2 Manual Operator:
 - .1 General:
 - .1 Operator force not to exceed 175 N (40 lb) under any operating condition, including initial breakaway. Gear reduction operator when force exceeds 175 N.
 - .2 Operator self-locking type or equipped with self-locking device.
 - .3 Position indicator on quarter-turn valves.

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- .4 Worm and gear operators one-piece design worm-gears of gear bronze material. Worm hardened alloy steel with thread ground and polished. Traveling nut type operators threader steel reach rods with internally threaded bronze or ductile iron nut.
- .2 Exposed Operator:
 - .1 Galvanized and painted handwheels.
 - .2 Lever operators allowed on quarter-turn valves 200 mm and smaller.
 - .3 Cranks on gear type operators.
 - .4 Chain wheel operator with tiebacks, extension stem, floor stands, and other accessories to permit operation from normal operation level.
 - .5 Valve handles to take a padlock, and wheels a chain and padlock.
- .3 Electric Valve Operators:
 - .1 General:
 - .1 Supply and Install actuator suitable for full 90° rotation of quarter-turn valves or for use on multi-turn valves, as required.
 - .2 Comply with AWWA C540.
 - .3 Size for 1 1/2 times required valve operating torque. The torque required to stall the motor shall not exceed torque rating of the valve.
 - .4 Supply and Install controls integral with the actuator and fully equipped as specified in AWWA C540.
 - .5 Include the following features:
 - .1 Stem protection for rising stem valves.
 - .2 Handwheel for manual override control of the valve.
 - .3 Valve position indication.
 - .4 Visual indicator for position of positioner.
 - .5 Built-in motor overload protection.
 - .6 Two SPDT type limit switches, field adjustable cam-operated, with contacts rated for 5 A, 120 VAC, housed in actuator control enclosure, factory installed.
 - .7 Two SPDT torque limit switches, 10 A, 125 VAC. The torque limit switches are to be factory preset and field adjustable, housed in actuator control enclosure, factory installed.

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- .8 Adjustable mechanical limit stops to prevent over-turning of the valve.
- .6 Supply and Install all required actuator mounting hardware and accessories.
- .7 Supply and Install control devices and actuator as a matched set from the same Manufacturer wherever possible.
- .8 Each actuator shall be capable of operating in any horizontal or vertical orientation.
- .9 Unless noted otherwise, the actuator shall fail to the last position when the control function or power fails.
- .10 Motors shall be rated at 20% intermittent duty cycle.
- .11 The actuator speed shall be field adjustable.
- .12 Supply and Install a terminal board for field wiring.
- .2 Electric Operators, Open-Close Service:
 - .1 Size motors for one complete OPEN-CLOSE-OPEN cycle no less than once every 10 minutes.
 - .2 Operators shall be suitable for positioning of valve at intermediate positions.
 - .3 Integral OPEN-STOP-CLOSE pushbutton controls.
 - .4 Reversing motor starter.
 - .5 Integral COMP-OFF-HAND Selector Switch
 - .6 Minimum monitoring and control signal requirements:
 - .1 Open Command Input (from a remote dry contact).
 - .2 Close Command Input (from a remote dry contact).
 - .3 Open Status (dry contact for remote indication).
 - .4 Closed Status (dry contact for remote indication).
 - .5 Computer (Remote) Mode (dry contact for remote indication).
 - .6 Remote dry contacts will be rated 2 A at 120 VAC minimum.
 - .7 OPEN and CLOSED indicating lights.
 - .7 Actuator Power Supply:
 - .1 575 V three-phase or 120 V single-phase as indicated in Section 15202-01 – Automated Valve Schedule.

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- .2 Provide control power transformer, 120 V secondary, if required.
- .8 Enclosure:
 - .1 Provide actuators with NEMA 4 enclosures, suitable for use in an industrial environment.
 - .2 Provide 120 V space heaters.
- .9 Control Features: Electric actuators with features noted in Section 15202-01 – Automated Valve Schedule.
- .3 Additional to the requirements specified above, the actuators to be Supplied and Installed on valves FV-Y011A and FV-Y021A shall meet the following design requirements:
 - .1 Design Parameters:
 - .1 Throttling /Modulating, Class 4 1200 starts / hour
 - .2 Opening: Quarter Turn, Counter Clockwise to open
 - .3 Service Temperature: -40°C to +70°C (-22°F to +158°F)
 - .4 Opening/ Closing Time: 30 to 180 seconds
 - .5 Mounting: Remote, floor stand mounted and coupler shaft
 - .2 It shall be possible to carry out the setting of the torque, turns, and configuration of the indication contacts without the necessity to remove any electrical compartment covers.
 - .3 Actuator Sizing:
 - .1 The electric actuators for the butterfly valves shall be sized to provide the torque required to close or open the valve for full bi-directional flow at a differential pressure equal to the AWWA numerical class designation of the valve. The maximum thrust output of the actuator shall not exceed the valve shaft torque capability as indicated in the latest revision of AWWA Standard C504.
 - .4 Mounting:
 - .1 Electric actuator shall be designed and constructed for remote mounting on a floor stand, coupled to the gear actuator with a connection shaft. Floor stands shall be designed and constructed such that the centre of the handwheel is 900 millimetres off of the operating floor. The length of the extension shafts shall be confirmed by field measurement prior to manufacture.
 - .5 Coupling shaft shall be designed to accommodate actuator torque for the various length of shaft required.

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.6 Motor:

- .1 Motors shall be CSA Approved, of the totally-enclosed, reversing, squirrel cage induction type with Class 'B' insulated windings and suitable for operation at 10% above and below normal 575 V, 3 phase, 60 cycle power supply. Motor duty rating shall be sufficient for one complete operating cycle (open-close-open) without exceeding its temperature rating. Motor bearings shall be amply proportioned, of the anti-friction type and permanently lubricated.
- .2 The motor shall be of a design that allows for electrical and mechanical disconnection without disturbing the gear case or valve position. Electrical and mechanical disconnection of the motor should be possible without draining the lubricant from the actuator gear case. Plugs and sockets are not acceptable as a means of electrical connection for the motor.
- .3 The actuator shall include circuitry to ensure the motor runs with the correct rotation for the required direction of operation with either phase sequence of the 3-phase power supply.
- .4 Motor Protection:
 - .1 Protection shall be provided for the motor as follows:
 - .1 The motor shall be de-energized in the event of a stall when attempting to unseat a jammed valve.
 - .2 Motor temperature shall be sensed by a thermostat to protect against overheating.
 - .3 Single phasing protection.
 - .4 Instantaneous reversal protection whereby an automatic time delay circuit limits the current surges when the actuator is signalled to instantaneously reverse direction.
 - .2 Integral Starter and Transformer:
 - .1 The reversing starter, control transformer and local controls shall be integral with the valve actuator, suitably housed to prevent breathing and condensation built-up. For ON/Off service, the starter shall be an electromechanical type suitable for 60 starts per hour, and of rating appropriate to motor size. For modulating duty, the starter shall be a solid state type suitable for up to a maximum of 1,200 starts per hour with a duty in accordance with IEC34-1 to S4 50%. The controls supply transformer shall be fed from two of the incoming three phases. It shall have the necessary tapings and be adequately rated to provide power for the following functions:

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- .2 120 VAC energization of the contactor coils
- .3 24 VDC output where required for remote controls
- .4 Supply for all the internal electrical circuits
- .3 The primary and secondary windings shall be protected by easily replaceable fuses.
- .4 The reversing motor controller shall consist of separate contactors for controlling valve movement in either the opening or closing direction. Each contactor shall be magnetic, full voltage across-the-line type, sized to suit the motor power rating, and shall provide low voltage and thermal overload protection by means of three bi-metallic or melting alloy elements which shall be correctly related to the motor nameplate full load current and temperature rise of the motor. The contactors shall be of robust construction with double break contacts, requiring a minimum of maintenance and being easily replaceable; mechanical and electrical interlocks shall be provided.
- .5 Gearing:
 - .1 The actuator gearing shall be totally encased in an oil or filled sealed gear case complete with fill and drain taps, suitable for operation at any angle. All gearing shall be of hardened steel alloy and alloy bronze construction with machine cut teeth. Thrust bearings of the ball or roller type shall be provided at the base of the operator. The gear case shall be designed to be opened for inspection or repair without releasing the stem thrust or taking the valve out of service.
 - .2 Standard SAE80EP gear oil shall be used to lubricate the gear case. Special or exotic lubricants shall not be used as they may be difficult to source in remote locations.
- .6 Manual Operation:
 - .1 Motorized actuators shall be provided with a handwheel, which shall not rotate during motor operation. The handwheel shall be made of cast iron or aluminum with the word "OPEN" and a directional arrow cast in relief on the rim. Spinners shall be provided on the handwheels. The handwheel operation shall be accomplished by a padlockable declutch lever. The handwheel shall disengage automatically from the operating mechanism once the motor is capable of operation. The handwheel shall be located sufficiently away from the valve flanges, housings, etc. that personnel will not hit their knuckles on any of these obstructions when using the handwheel.

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- .2 The handwheel shall be positioned on the operating floor as indicated above.
 - .3 The handwheel shall be sized to allow one man operation with a maximum rim pull of 356 Newtons (80 ft. lbs.) at maximum torque conditions.
 - .4 Clockwise operation of the handwheel shall give closing movement of the valve unless otherwise stated in this specification.
- .7 Drive Bushing:
- .1 The actuator shall be furnished with a drive bushing easily detachable for machining to suit the valve stem or gearbox input shaft. The drive bushing shall be positioned in the base of the actuator to facilitate the valve stem extensions.
 - .2 Thrust bearings, when housed in a separate thrust base, should be of the sealed-for-life type.
- .8 Position Limit and Torque Limit Switches:
- .1 Limit switches shall be provided and set to stop the motion of the valve when it reaches the fully open and fully closed position. In addition, torque limiting switches shall be provided for open and close position as well to prevent damage to the operating mechanism in the case of torque overload. The torque switch shall be fitted with a mechanical interlock to prevent torque trip on valve opening. Provision shall be made for four extra limit switches, adjustable to any valve position.
 - .2 Switch design shall permit visual verification of switch position without disassembly.
 - .3 Switch contact rating on inductive circuits shall be 600VAC per NEMA standard ICS 2-125 heavy duty.
 - .4 Torque protection reset shall not allow repeated starting in the same direction when control signal is maintained.
 - .5 The manufacturer's representative shall field check the calibrations and settings of the limit and torque switches after installation, in the presence of the Contract Administrator.
- .9 Torque and turns limitation to be adjustable as follows:
- .1 Position setting range: 0.5 to 100,000 turns, with resolution to 15° of actuator output.
 - .2 Torque setting: 40 to 100% rated torque.

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- .3 Torque sensing must be affected purely electrically or electronically. Extrapolating torque from mechanically measured motor speed is not acceptable due to response time.
 - .4 "Latching" to be provided for the torque sensing system to inhibit torque off during unseating or during starting in mid-travel against high inertia loads.
- .10 Position Indication:
- .1 The actuator shall incorporate an illuminated, mechanical dial indicator and digital readout to show continuous movement from fully open to fully closed in 1% increments. The digital display shall be maintained even when the power to the actuator is isolated.
 - .2 The local display should be large enough to be viewed from a distance of 1.83 m when the actuator is powered up.
 - .3 Provision shall be made in the design for a contactless transmitter to give a 4 to 20 mA analog signal corresponding to valve travel for remote indication.
- .11 Push Buttons and Selector Switches:
- .1 Each actuator shall be complete with a local Open-Stop-Close push-button station with external Red-Open, Green-Closed indicating lights and a Local-Off-Remote selector switch padlockable in any one of the following three positions:
 - .2 Local Control Only
 - .3 Off (No Electrical Operation)
 - .4 Remote Control plus Local Stop Only
 - .5 It shall be possible to select maintained or non-maintained local control.
 - .6 The local controls shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.
- .12 Controls:
- .1 The internal control and monitoring circuits shall operate at nominal 24 VDC with interposing relays to energize the 120 VAC contactor coil circuits (where employed). All necessary transformers shall be provided.
 - .2 The necessary wiring and terminals shall be provided in the actuator for the following control functions:

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- .1 Additional geared limit switch closed when valve fully open.
 - .2 Additional geared limit switch closed when valve fully closed.
 - .3 Removable links for substitution by external interlocks to inhibit valve opening and/or closing.
 - .4 Provision of 4 to 20 mA R to I position transmitter suitable for any one or more of the following methods of control:
 - .1 Open, Close and Stop.
 - .2 Open and Close.
 - .3 Overriding Emergency Shut-down to Close (or Open) valve.
 - .4 Two-wire control, Energize to Close (or Open), De-energize to Open (or Close).
 - .5 Selection of maintained or push-to-run control for modes a) and b) above shall be provided by links.
 - .6 The internal circuits associated with the control and monitoring functions are to be designed to withstand simulated lightning impulses of up to 1 kV.
- .13 Monitoring Facilities:
- .1 Facilities shall be provided for monitoring actuator operation and availability as follows:
 - .1 Motor (availability) relay, having one normally open contact, the relay being energized from the control transformer only when the Local/Off/Remote selector switch is in the Remote position to indicate that the actuator is available for remote (control room) operation.
 - .2 Where required, it shall be possible to provide indication of thermostat trip and "Remote" selected as discreet signals.
 - .3 Provision shall be made for the addition of diagnostic module which will store and enable download of historical actuator data to permit analysis of changes in actuator or valve performance.
 - .4 Diagnostic status screens must be provided to show multiple functions simultaneously so troubleshooting can be affected rapidly and efficiently. All diagnostic information should be contained on no more than seven or eight (7 or 8) screens so multiple functions can be checked simultaneously.

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.14 Wiring and Terminals:

- .1 Internal wiring shall be of CSA approved insulated stranded cable of appropriate size for the control and 3-phase power. Each wire shall be clearly identified at each end. Permanent heat shrunk labelling shall be used.
- .2 The terminals shall be embedded in terminal block of high tracking-resistance compound.
- .3 The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight 'O' ring seal.
- .4 The terminal compartment of the actuator shall be provided with a minimum of two (2) threaded cable entries.
- .5 All wiring supplied as part of the actuator is to be contained within the main enclosure for physical and environmental protection. External conduit connections between components is not acceptable.
- .6 Control logic circuit boards and relay boards must be mounted on plastic mounts to comply with double insulated standards. No more than a single primary size fuse shall be provided to minimize the need to remove single covers for replacement.
- .7 A durable terminal identification card showing plan of terminals shall be attached to the inside of the terminal box cover indicating:
 - .1 Serial number
 - .2 External voltage values
 - .3 Wiring diagram number
 - .4 Terminal Layout
- .8 The identification card must be suitable to inscribe cable core identification alongside terminal numbers.

.15 Enclosure:

- .1 Actuators shall be O-ring sealed, watertight to NEMA 6/IP68 as well as have an inner watertight and dustproof O-ring seal between the terminal compartment and the internal electrical elements of the actuator, fully protecting the switch mechanism, motor and all other internal electrical elements of the actuator from ingress of moisture and dust when the terminal cover is removed on site for cabling.
- .2 Actuators shall be provided with an internal motor and compartment heater.

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.3 All external fasteners shall be of stainless steel.

.16 Protective Coatings:

.1 All external ferrous components including floor stands, adaptors and mounting plates, shall be painted and tested in accordance to Section 11901 – Factory Applied Protective Coatings.

.2 Any touch-up paintwork required during installation shall be undertaken by the Installation Contractor. The touch-up paint shall be of the same colour and specifications used in the above clauses and shall be supplied by the Contractor. The Contractor shall provide a minimum of one (1) litre of paint product for this purpose.

.4 Acceptable Manufacturers:

.1 Rotork

.2 Limitorque

2.7 Accessories

.1 Tagging: 38 mm diameter heavy brass or stainless steel tag attached with No. 16 solid brass or stainless steel jack chain for each valve, bearing the valve tag number shown on the Valve Schedule and/or Drawings.

.2 Chain Wheel and Guide:

.1 Handwheel direct-mount type.

.2 Complete with chain.

.3 Galvanized or cadmium-plated.

.4 Acceptable Manufacturers:

.1 Clow Corp.; Figure F-5680.

.2 Walworth Co.; Figure 804.

.3 DeZurik Corp.; Series W or LWG.

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3. EXECUTION

3.1 Installation by Contractor

- .1 Flange Ends:
 - .1 Flanged valve boltholes shall straddle vertical centerline of pipe.
 - .2 Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.
- .2 Screwed Ends:
 - .1 Clean threads by wire brushing or swabbing.
 - .2 Apply joint compound.
 - .3 PVC and CPVC Valves: Install using solvents approved for valve service conditions.
 - .4 Valve Orientation:
 - .1 Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 1476 mm or less above finished floor, unless otherwise shown.
 - .2 Install operating stem horizontal in horizontal runs of pipe having centerline elevations between 1476 mm and 2057 mm above finish floor, unless otherwise shown.
 - .3 Orient butterfly valve shaft so that unbalanced flows or eddies are equally divided to each half of the disc, i.e., shaft is in the plane of rotation of the eddy.
 - .4 If no plug valve seat position is shown, locate as follows:
 - .1 Horizontal Flow: The flow shall produce an “unseating” pressure, and the plug shall open into the top half of valve.
 - .2 Vertical Flow: Install seat in the highest portion of the valve.
 - .5 Supply and Install a line size ball valve and union upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.
 - .6 Locate valve to provide accessibility for control and maintenance.
 - .7 Extension Stem for Operator: Where the depth of the valve is such that its centreline is more than 1000 mm below grade, Supply and Install an operating extension stem with 50 mm operating nut to bring the operating nut to a point 150 mm below the surface of the ground and/or box cover.

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- .8 Torque Tube: Where operator for quarter-turn valve is located on floor stand, Supply and Install extension stem torque tube of a type properly sized for maximum torque capacity of the valve.
- .9 Floor Box and Stem: Steel extension stem length shall locate operating nut in floor box.
- .10 Chain Wheel and Guide: Install chain wheel and guide assemblies or chain lever assemblies on all manually operated valves with stem centrelines more than 2000 mm above the operating floor or grade. Chains shall extend to within 1200 mm of the operating floor or grade. Chain wheel and guide assemblies shall also be provided for valves as specified in Section 15202-02 – Manual Valve Schedule. Where chains hang in normally travelled areas, use “L” type tie-back anchors.

3.2 Field Quality Control by Contractor

- .1 Demonstration Tests: Conduct position and travel tests on each valve locally and remotely if automated. Provide checklist of functional testing for all valves in 15202-01 – Automated Valve Schedule and 15202-02 – Manual Valve Schedule.
- .2 Performance Test: In accordance with operating conditions indicated in supplemental valve schedules sheets.
- .3 Valve may be either tested while testing pipelines, or as a separate step.
- .4 Test that valves open and close smoothly under operating pressure conditions. Test that two-way valves open and close smoothly under operating pressure conditions from both directions.
- .5 Inspect air and vacuum valves as pipe is being filled to verify venting and seating is fully functional.
- .6 Count and record number of turns to open and close valve; account for any discrepancies with Manufacturer’s data.
- .7 Set, verify, and record set pressures for all relief and regulating valves.
- .8 Automatic valves to be tested in conjunction with control system testing. Set all opening and closing speeds, limit switches, as required or recommended by the Contract Administrator.
- .9 Test hydrostatic relief valve seating; record leakage. Adjust and retest to maximum leakage of 1.24 l/min/m of seat periphery.

3.3 Manufacturer's Representative Field Services

- .1 The valve(s) as listed below require Manufacturer’s field services:
 - .1 Valves in the Automated Valve Schedule

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- .2 Verify satisfactory delivery of the equipment by completing Form 100, illustrated in Section 01650 – Equipment Installation.
- .3 Instruct Contractor in the methods and precautions to be followed in the installation of the equipment. Certify the Contractor's understanding by completing Form 101, illustrated in Section 01650 – Equipment Installation.
- .4 Arrange for a technically qualified Manufacturer's Representative to attend the installation work, certify correct installation, train operating and maintenance staff and undertake the testing of the system for sufficient periods, to ensure the equipment is installed, operated, and maintained in accordance with the Manufacturer's recommended procedures.
- .5 The minimum periods of Site attendance as total number of business days for all equipment are identified in the following table along with the form to be completed on each of these trips.
- .6 The total number of trips will depend on the Contractor's schedule. The cost of additional trips, to be determined by the Contract Administrator, will be borne by the Contractor. Arrange for a technically qualified Manufacturer's Representative to attend the installation work, certify correct installation, train operating and maintenance staff and undertake the testing of the system for sufficient periods, to ensure the equipment is installed, operated, and maintained in accordance with the Manufacturer's recommended procedures.

Item	Description	Total number of business days	Form
1	Equipment Delivery	1	100
2	Installation Assistance	1	101
3	Witnessing of Equipment Installation	3	102
4	Assistance in Equipment Performance Testing	3	103
5	Operator and Maintenance Training	2	T1

3.4 Installation Witnessing

- .1 The Contractor shall ensure that equipment is installed plumb, square and true within tolerances specified by the Manufacturer's Representative and as indicated in the Contract Documents.
- .2 The Manufacturer's Representative shall ensure the equipment is installed as required to provide satisfactory service.
- .3 The Manufacturer's Representative and the Contractor are to cooperate to fulfill the requirements for a successful installation as documented by Form 102, illustrated in Section 01650 – Equipment Installation.

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3.5 Equipment Performance Testing

- .1 The Manufacturer's Representative shall ensure that each valve and actuator (electric or manual), including all component parts, operates as intended.
- .2 The Manufacturer's Representative shall demonstrate satisfaction of requirements specified herein.
- .3 The Manufacturer's Representative and the Contractor are to cooperate to fulfill the requirements for successful testing of the equipment as documented by Form 103, illustrated in Section 01650 – Equipment Installation.

3.6 Training

- .1 The Manufacturer's Representative shall provide the services of factory trained instructors for the purpose of training the City's personnel in the proper O&M of the equipment as documented by Form T1. Conform to the requirements of Section 01650 – Equipment Installation.

3.7 Supplements

- .1 The supplements listed below, following “End of Section,” are part of this Specification.
 - .1 15202-01 - Automated Valve Schedule.
 - .2 15202-02 - Manual Valve Schedule.

END OF SECTION

PIPING SPECIALTIES

1. GENERAL

1.1 References

- .1 The following is a list of standards which may be referenced in this Section:
 - .1 ASME:
 - .1 B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
 - .2 B16.5, Pipe Flanges and Flanged Fittings: NPS 12 mm through NPS 600 mm.
 - .2 AWWA:
 - .1 C153/A21.53, Ductile-Iron Compact Fittings, 76 mm through 1,600 mm, for Water Service.
 - .2 C210, Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
 - .3 C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
 - .4 C219, Bolted, Sleeve-Type Couplings for Plain-End Pipe.
 - .5 Manual M11, Steel Water Pipe—A Guide for Design and Installation.
 - .3 ASTM:
 - .1 A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - .2 A276, Standard Specification for Stainless Steel Bars and Shapes.
 - .4 NSF: NSF 61, Drinking Water System Components—Health Effects.

1.2 Submittals

- .1 Action Submittals: Manufacturer's data on materials, construction, end connections, ratings, overall lengths, and live lengths (as applicable).
- .2 Informational Submittals:
 - .1 Coupling Harness:
 - .1 Details, ratings, calculations and test reports for thrust restraints relying on welded bars or rings.

PIPING SPECIALTIES

- .2 Weld procedure qualifications.
- .3 Load proof-testing report of prototype restraint for any size coupling.

2. PRODUCTS

2.1 General

- .1 Supply and Install required piping specialty items, as shown on the Drawings or as specified and as required by applicable codes and standard industry practice.
- .2 Rubber ring joints, mechanical joints, flexible couplings, and proprietary restrained ductile iron pipe joints are considered flexible joints; welded, screwed, and flanged pipe joints are not considered flexible.

2.2 Couplings

- .1 General:
 - .1 Coupling linings for use in potable water systems shall be in conformance with NSF 61.
 - .2 Couplings shall be rated for working pressure not less than indicated in Section 15200-00S – Piping Schedule, for the service and not less than 1,035 kPa.
 - .3 Couplings shall be lined and coated with fusion-bonded epoxy in accordance with AWWA C213.
 - .4 Restrained Couplings: Unless thrust restraint is provided by other means, couplings shall be harnessed in accordance with requirements of AWWA Manual M11, and restrained with retainer bar or ring welded to pipe end, or as shown on Drawings.
 - .5 Sleeve type couplings shall conform to AWWA C219 and shall be hydraulically expanded beyond minimum yield for accurate sizing and proofing of tensile strength.
- .2 Restrained Dismantling Joints:
 - .1 Pressure Rating:
 - .1 Minimum working pressure rating shall not be less than rating of the connecting flange.
 - .2 Proof testing shall conform to requirements of AWWA C219 for bolted couplings.
 - .2 Acceptable Manufacturers:
 - .1 Smith-Blair;

PIPING SPECIALTIES

.2 Viking Johnson.

.3 Victaulic

2.3 Expansion Joints

.1 Expansion Joints (Flexible Couplings) shall be Supplied and Installed on each Branch 1 pump discharge.

.2 Elastomer Bellows:

.1 Type: Reinforced molded wide arch.

.2 End Connections: Flanged, drilled 125-pound ASME B16.1 standard, with galvanized steel retaining rings.

.3 Washers: Over retaining rings to help provide leak-proof joint under test pressure.

.4 Thrust Protection: Control rods (4 minimum per joint) to protect the bellows from overextension.

.5 Bellows Arch Lining: Buna-N, nitrile, or butyl.

.6 Rated Temperature: 250°C.

.7 Shop primed and painted.

.8 All coatings and linings shall be NSF 61 approved for potable water service.

.9 Acceptable Manufacturers:

.1 EVR Products – Model # SJ-221

3. EXECUTION

3.1 General

.1 Provide accessibility to piping specialties for control and maintenance.

3.2 Piping Flexibility Provisions

.1 General:

.1 Thrust restraint shall be provided as specified in Section 15200-000 – Process Piping.

.2 Install flexible couplings to facilitate piping installation, in accordance with approved shop drawings.

PIPING SPECIALTIES

- .2 Flexible Joints at Concrete Backfill or Encasement: Install within 450 mm or one-half pipe diameter, whichever is less, from the termination of any concrete backfill or concrete encasement.
- .3 Flexible Joints at Concrete Structures:
 - .1 Install 450 mm or less from face of structures; joint may be flush with face.
 - .2 Install a second flexible joint, whether or not shown:
 - .1 Pipe Diameter 450 mm and Smaller: Within 450 mm of first joint.
 - .2 Pipe Diameter Larger than 450 mm: Within one pipe diameter of first joint.
 - .4 Piping Installation: Allow for thermal expansion due to differences between installation and operating temperatures.
 - .5 Expansion Joints:
 - .1 Grooved Joint and Flanged Piping Systems: Elastomer bellows expansion joint.
 - .2 Nonmetallic Pipe: Teflon bellows expansion joint.
 - .3 Screwed and Soldered Piping Systems: Copper or galvanized and black steel pipe expansion compensator, as applicable.
 - .4 Air and Water Service above 49°C: Metal bellows expansion joint.
 - .5 Pipe Run Offset: Flexible metal hose.

3.3 Service Saddles

- .1 Ferrous Metal Piping (except stainless steel): Double-strap iron.
- .2 Plastic Piping: Nylon-coated iron.

3.4 Couplings

- .1 General:
 - .1 Install in accordance with Manufacturer's written instructions.
 - .2 Before coupling, clean pipe holdback area of oil, scale, rust, and dirt.
 - .3 Application:
 - .1 Metallic Piping Systems: Flexible couplings, transition couplings, and flanged coupling adapters.

PIPING SPECIALTIES

- .2 Concrete Encased Couplings: Flexible coupling.

3.5 Flexible Pipe Connections to Equipment

- .1 Install to prevent piping from being supported by equipment, for vibration isolation, and where shown.
- .2 Limit Bolts and Control Rods: Tighten snug prior to applying pressure to system.

END OF SECTION

PROCESS CENTRIFUGAL PUMPS

1. GENERAL

1.1 Section Includes

- .1 This Section specifies the supply, factory testing, delivery, installation, testing and performance verification of process centrifugal pumping equipment.

1.2 References

- .1 The following is a list of standards that may be referenced in this Section:
 - .1 ASTM:
 - .1 A48, Standard Specification for Gray Iron Castings.
 - .2 A576, Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
 - .2 Hydraulic Institute Standards
 - .3 NEC
 - .4 NEMA
 - .5 NFPA: 70, National EC
 - .6 UL
 - .7 ULC
 - .8 AWWA:
 - .1 C510, Double Check Valve Backflow Prevention Assembly.
 - .2 C511, Reduced-Pressure Principle Backflow Prevention Assembly.
 - .9 CSA:
 - .1 C22.1 Canadian Electrical Code, Safety Standard for Electrical Safety Installations
 - .10 NEMA: MG 1, Motors and Generators.
 - .11 National Sanitation Foundation.

PROCESS CENTRIFUGAL PUMPS

1.3 Definitions

- .1 Terminology pertaining to pumping unit performance and construction shall conform to Section 11300 – Process Pumps General Requirements, and ratings and nomenclature of the Hydraulic Institute Standards.

1.4 Submittals

- .1 Shop Drawings, Refer to Section 01300 - Submittals:
 - .1 Make, model, weight, and horsepower of each equipment assembly.
 - .2 Complete catalog information, descriptive literature, specifications, dimensions, and identification of materials of construction.
 - .3 Performance data curves showing head, capacity, horsepower demand, and pump efficiency over entire operating range of pump, from shutoff to maximum capacity. Indicate separately design points, head, capacity, horsepower demand, overall efficiency, and minimum submergence required at guarantee point.
 - .4 Detailed mechanical, and electrical drawings showing the equipment dimensions, size, and locations of connections and weights of associated equipment.
 - .5 Power and control wiring diagrams, including terminals and numbers.
 - .6 Control Panel external face layout and inter layout drawings and electrical wiring diagrams.
 - .7 Complete motor nameplate data, as required by NEMA, from motor Manufacturer.
 - .8 Factory finish system.
 - .9 Bearing life calculations.
- .2 Quality Control Submittals:
 - .1 Factory and field performance test reports and logs.
 - .2 Manufacturer's certification of compliance that factory finish system meets requirements specified herein.
 - .3 Special shipping, storage and protection, and handling instructions.
 - .4 Suggested spare parts list to maintain equipment in service for period of 1 year and 5 years. Include list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
 - .5 List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

PROCESS CENTRIFUGAL PUMPS

- .6 Certificate of Satisfactory Installation, Form 102, as indicated in Section 01650 – Equipment Installation.
- .7 Provide an operation and maintenance manual and maintenance summary in conformance with the requirements of Division 1, General Requirements, and Section 01730 – Operation and Maintenance Manuals.
- .8 Size, length and spacing of anchor bolts or attachment to the foundations or supports.
- .9 External utility requirements: air, water, power, etc. for each component.

2. PRODUCTS

2.1 Water Booster Pump Systems – General (Tag Numbers: P-D920A, P-D921A)

- .1 General:
 - .1 Provide a packaged booster pump system as indicated in the schedule below and as shown on the Drawings.
 - .2 Packages shall include two (2) pumps, piping, valves, relief valves, pressure reducing valves and appurtenances, factory assembled, skid mounted, and tested.
 - .3 Pumps shall be single stage, motor mounted end suction centrifugal pumps.
 - .4 Pumps shall be fitted with Manufacturer's standard self lubricating mechanical seal suitable for potable water service.
- .2 Pump Materials
 - .1 Impeller: Grey cast iron, ASTM A48 Class 35B, with hardened edges
 - .2 Casing: Grey cast iron, ASTM A48 Class 35B
 - .3 Shaft: AISI type 431 stainless steel, ASTM A276
- .3 Piping:
 - .1 Stainless steel piping and fittings in accordance with Section 15200-08 – Stainless Steel Pipe and Fittings – General Service.
 - .2 Fabrication and installation in accordance with Section 15200-000 – Process Piping.
- .4 Valves:
 - .1 Isolation Valves: Full port ball or butterfly type in accordance with Section 15202 – Process Valves and Operators.

PROCESS CENTRIFUGAL PUMPS

- .2 Check Valves: Non-slam type in accordance with Section 15202 – Process Valves and Operators.

- .5 Pressure Gauges:
 - .1 Provide one gauge on the discharge of each pump and a common gauge on the suction piping.
 - .2 Provide in accordance with Division 17.

- .6 Acceptable Manufacturers:
 - .1 S.A. Armstrong.
 - .2 Bell & Gossett.
 - .3 Paco Pumps.

- .7 Booster Pump Schedule:

Tag Numbers	P-D920A, P-D921A
Name	Cooling Water Booster Pump Package
Flow Rate, each pump	2.0 L/s
Pump Head	45 m
Pumped Fluid	Potable Water
Suction Pressure	48 kPa(g)
Pump Discharge Pressure	550 kPa(g)
Pump Casing Design Pressure	1035 kPa
Motor	3.7 kW
Motor Speed (rpm)	3560 rpm
Power	575V / 3 ph / 60 Hz
Pump Speed Control	Constant speed.
Suction connection	38 mm, 150-lb RF flange
Discharge connection	25 mm, 150-lb RF flange
Manufacturer/Model	Armstrong Series 4280

PROCESS CENTRIFUGAL PUMPS

3. EXECUTION

3.1 Manufacturer's Representative

- .1 For pump systems, provide the services of a qualified technical representative for installation, testing and Performance Verification.

3.2 Installation

- .1 Install, arrange, and connect equipment as shown on Drawings and in accordance with Manufacturer's recommendations.
- .2 Have the Manufacturer's Representative instruct Contractor in the methods and precautions to be followed in the installation of the equipment
- .3 Have the Manufacturer's Representative supervise and cooperate with the Contractor as necessary.

3.3 Factory Tests

- .1 Check impeller(s), motor rating(s), and electrical connection(s) for compliance to the specifications and shop drawings.
- .2 Vacuum test all pumps to establish sealing integrity, and momentarily energize to determine correct rotation and current draw (prior to immersion).

3.4 Extra Materials

- .1 Provide any special tools required for the maintenance of the equipment supplied. Special tools are tools which are not normally available in mechanic's or millwright's tool kit and which are peculiar to the equipment supplied.

3.5 Field Quality Control

- .1 Pump systems.
 - .1 Provide Certificate of Equipment Satisfactory Installation, Form 102, in accordance with Section 01650 – Equipment Installation.
 - .2 Provide Certificate of Equipment Satisfactory Performance, Form 103, in accordance with Section 01650 – Equipment Installation.

3.6 Training

- .1 Provide training for water pumping system. Training of City's personnel shall be carried out as per Section 01664 – Training.

END OF SECTION