Metropolitan St. Louis
Sewer District

2350 Market Street
St. Louis, MO 63103-2555
314-768-6200
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January 8, 2025

Word file Via email to State SRF Program
Missouri AIS Coordinator

RE: Request for Waiver of AIS Provisions for 10-inch and 12-inch Trunnion Ball Valves
Metropolitan St. Louis Sewer District
Bissell Point & Lemay Wastewater Treatment Facilities (WWTF)
Fluidized Bed Incinerators
Design-Build Project No. 12565-015.8

To Whom it may Concern,

GENERAL

The Metropolitan St. Louis Sewer District (MSD) has executed a Design-Build contract to Kokosing/Plocher LLC for solids management upgrades at both their Bissell Point and Lemay Waste Water Treatment Facilities, formally known as Project No. 12565-015.8. These upgrades will include the design and construction of new fluidized bed incineration processes and facilities to replace the existing multiple hearth incinerators. The fluidized bed incineration system will include fluidized bed incinerator reactors, a sand system, fluidizing air blowers and purge air blowers, primary heat exchangers, conditioning heat exchangers, wet scrubber systems, granular activated carbon (GAC) systems, WESP, induced draft (ID) fans, along with other ancillary systems. Prior to incineration, new sludge dewatering and transport systems will be constructed. These systems will include sludge receiving wells, raw sludge pumping, centrifuges with associated polymer feed system, sludge cake receiving bins, sludge cake conveyance (conveyors and pumps), a sludge cake receiving station, and sludge cake truck loading station, and other associated items. Work at both facilities will be taking place concurrently to support a project in service date of February 22, 2028.

As a recipient of funding from various state and federal sources to support this project, the project is to comply with the Consolidated Appropriations Act 2014 and the American Iron & Steel requirements therein.

The Metropolitan St. Louis Sewer District is requesting a project-specific waiver of the AIS requirements to be issued for the high-pressure trunnion mounted ball valves for the Bissell Point & Lemay WWTF Fluidized Bed Incinerators Design-Build Project No. 12565-015.8 due to the limited number of technically acceptable suppliers with the appropriate experience and installations in the United States for 10-inch and 12-inch diameter trunnion ball valves for use in a similar dewatered sludge cake application. These specialized ball valves are an integral part of the sludge cake feed system to the incinerators that must perform as intended and be maintained in working condition to

allow the facility to successfully operate. Due to extreme pressures and harsh operating conditions, all parts of the sludge cake feed system, including these trunnion ball valves, must have a proven record of reliable operation and minimal maintenance to maintain satisfactory operation. MSD is concerned that using an unproven valve in this complex and large sludge process is a high risk and could possibly lead to significant operational and maintenance issues, thereby requiring improvement or replacement of these valves in the future. Please refer to the letter (Attachment A) from Arcadis, the process engineer, for more information on valve manufacturer required experience.

INFORMATION TO SUPPORT THE VARIANCE REQUEST

In accordance with the United States Environmental Protection Agency (USEPA) memorandum, *Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014,* the following information is provided in requesting a waiver.

The Kokosing/Plocher (KP) Team

Design-Builder and General Contractor
Kokosing/Plocher (KP), 303 E. Hoffmeister, St. Louis, MO 63125
Deputy Project Manager: Nick Kampwerth, PE, nakampwerth@plocherco.com
Cell 618.781.4082

Engineers
Lead: Crawford, Murphy & Tilly, 1 Memorial Dr, Suite 500, St Louis, MO 63102
Design Manager: Raed Armouti, PE, rarmouti@cmtengr.com, work 314.571.9058
Process: Arcadis, 4665 Cornell Road, Suite 200, Cincinnati, OH 45241
Solids Lead Engineer: Brad Olson, PE, Bradley.Olson@arcadis.com, work 513.985.8019

Locations of Project

Bissell Point Wastewater Treatment Facility
10 E. Grand Ave.
St. Louis, Missouri 63147

Lemay Wastewater Treatment Facility
9214 S. Broadway Street
St. Louis, Missouri 63125

Total Project Scope Value (Both Locations): $898,500,000.00

Scope of Cake Valve Supply

Bissell Point -
10-inch Class 600, full port, trunnion ball valve, cast or forged steel body
Quantity: 24
Unit of Measure: Lump Sum cost per each valve
Estimated Cost: [redacted]

12-inch Class 600, full port, trunnion ball valve, cast or forged steel body
Quantity: 10
Unit of Measure: Lump Sum cost per each valve
Estimated Cost: [redacted]

Lemay -
10-inch Class 600, full port, trunnion ball valve, cast or forged steel body
Quantity: 24
Unit of Measure: Lump Sum cost per each valve
Estimated Cost: [redacted]

12-inch Class 600, full port, trunnion ball valve, cast or forged steel body
Quantity: 10
Unit of Measure: Lump Sum cost per each valve
Estimated Cost: [redacted]

Total Estimated Cost: [redacted]

Estimated Trunnion Ball Valve Schedule (Both Locations)

Below is the critical path timeline for supply and installation of these valves:
March 2025: AIS Waiver Granted
April 2025: Supplier Bid Event Closed & Valve Supplier Selected
May 2025: Engineering Submittal and Shop Drawings Completed/Submitted for Approval
June 2025: Submittal Approved & Valves Released for Production (anticipated 56-60 week fabrication time)
July 2026: Valve Delivery to Sites – Installation to Begin
November 2026: Cake Pipe and Valves Installation Completed & Ready for Commissioning
December 2026 – January 2028: Start-up & Commissioning, Trial Operation Period

A project schedule highlighting cake piping and valves is included (Attachment B).

Valve Specifications and Background

Project Specification **Section 40 05 53** – Process Valves, Four-Inch Diameter and Larger (Attachment C) specifies the requirements of all process valves four-inches and larger, including the trunnion ball valves as follows.

Section **1.03 A. Manufacturer Qualifications** are as follows:

1. Manufacturer shall have minimum of five years of experience producing substantially similar valves using the same materials and equipment to that required and be able to provide evidence of at least five installations in satisfactory operation with the same service, size, and pressure class for at least five years.
2. A manufacturer's qualifications must be applicable to process valves produced directly by the manufacturer or by a company acquired by the manufacturer. Manufacturer shall not claim experience for valves not directly produced by company of record.
3. For valves installed in sludge cake service (dewatered sludge), manufacturer experience must be applicable to municipal wastewater sludge cake with a minimum of 20 percent total solids content.

Background for the development of Section 1.03 A. Manufacturer Qualifications: Trunnion mounted ball valves for high pressure dewatered municipal sludge cake service is an application where very few valve manufacturers can provide experience or example installations. We specifically specified two manufacturers ([redacted]) because of their significant experience in the municipal sludge cake industry.

It is industry standard to require equipment system component manufacturers (such as valve manufacturers) for wastewater projects to provide an experience portfolio which demonstrates a successful history of installations in similar applications. This helps to ensure that the end user receives a safe, high-quality, and tested product that will not fail under strenuous operating conditions; in this case, highly abrasive solids and high pressures up to 1440 psi. While many manufacturers likely can provide quality products for the industries and applications it typically serves, K/P cannot recommend a first-in-kind installation of an untested valve in this application. Many times, the equipment or valves fail as manufacturers underestimate the complexity of municipal sludge on items such as viscosity, rheology, grit, abrasiveness, organics, etc. Given the extremely high pressure service to which these valves would be subjected, any failure would be a significant safety concern.

Section **2.05 B. General**:

1. The ball valves in the dewatered sludge cake service shall be full port ball valve trunnion-mounted designed for high pressure service. The valves shall be ANSI Class 600 with a maximum working pressure of 1,440 psi and 400 degrees Fahrenheit. The

valves shall be API monogrammed and shall be built and audited to API 6D and ANSI standards. The valve shall consist of a full port ball that rotates on a fixed axis with an upper stem and lower trunnion. The valve shall be a bi-directional flow valve with independent sealing capability on each side of the ball. The valve shall also be a non-lubricated valve, designed for dirty service (high solids applications).

SUPPORTING DOCUMENTATION NECESSARY TO DEMONSTRATE THE AVAILABLILTY, QUANTITY, AND/OR QUALITY OF THE MATERIALS FOR WHICH THE WAIVER IS REQUESTED

Kokosing/Plocher and their design team evaluated six suppliers for the trunnion ball valves as summarized in the table provided on the following page. Only two manufacturers meet the technical specifications and have adequate municipal sludge cake experience:

- [redacted]

Manufacturer	Meet Technical Specifications	AIS Compliant	Municipal Sludge Cake Service Experience	Remarks
[redacted]	No (per KF)	No	Yes	Included in the RFP specifications. Installed at Cincinnati, Cleveland, Columbus, Washington, DC, and Toronto (CN). KF Sales Manager does not recommend application despite past successful installations. No longer meets AIS.
[redacted]	Yes	No	No; declined to provide list of experience	Citizens Energy Group Indianapolis, IN Belmont WWTP Arcadis Project
[redacted]	Yes	Yes	No	No municipal sludge cake installations Has agreed to provide a performance bond in lieu of experience, but bond does not cover the full range of risk identified as concerns.
[redacted]	Yes	Yes	No	Identified by KP No recent installation on municipal sludge cake Bond will not be provided for performance and replacement in lieu of experience
[redacted]	Yes	No	Yes	• MSD Bissell Plant • MCES Metro, B&V Project • Buffalo, NY Sewer Authority Arcadis Project • Various Cake Feed Projects through Schwing America
[redacted]	Yes	No	Yes	• Oneida County, NY • Hopewell, VA WWTP • Little Blue Valley Sewer Dist, MO • Rock Creek, MO • G.E. Booth WWTP, Toronto

Additional information provided by KP to review cake valve manufacturers is further described below in the same order as the table above.

[redacted]

The KP Team intended to purchase the RFP named manufacturer, [redacted] for this service. After the project award (May 2023), [redacted] advised KP that [redacted] Valves were not suitable for this application because [redacted] no longer offered the special materials/design required for sludge cake/dewatering applications. [redacted] declined to supply or support the project. [redacted] Industries verbally advised KP that [redacted] valve manufacturing no longer meets AIS requirements as required of the SRF funding of the project. See Attachment D for applicable email from [redacted] Valve.

KP concluded that [redacted] was not acceptable for the project.

[redacted]

Per Attachment E, KP was advised by [redacted] that "...after extensive research, we have concluded the 5-year proof requirement of our valves being installed in "Wastewater Dewatered Sludge Applications" is not possible. The majority of our valves have been placed by our distributors and we do not have the capability to investigate the end user and the exact location/process. Based on the given processes for this application, we can assure you that our valves meet or exceeds all standards."

KP concluded that [redacted] was not acceptable for the project.

[redacted]

MSD, Black & Veatch (MSD Reps.), and KP met with [redacted] in St. Louis. [redacted] advised that [redacted] trunnion ball valves meet the project specifications, however, [redacted] did not have any installations of these valves on sludge cake. During that meeting, we discussed the markets and applications where their trunnion mounted style, full port ball valves have been installed by [redacted], and the references provided by [redacted] for those past installations was for valve service primarily in the petroleum and mining industry.

As an alternative to meeting the technical requirements for past experience with municipal sludge cake service, the distributor for [redacted] indicated that a Performance Bond could be provided for the [redacted] valves. The bond proposed by the [redacted] valve distributor would only cover the material replacement cost of a damaged

valve and would not include the full labor and material costs to replace malfunctioning or defective valves. Nor would the bond cover the full labor and material costs to replace the aggregate of the valves if excessive maintenance or repair is necessary.

Due to the limited capacity of the proposed bond, KP concluded that [redacted] is not an acceptable valve manufacturer for the project. Additionally, MSD does not consider that the proposed bond adequately reduced the risk associated with using an unproven valve in this service.

Attachments for the [redacted] offering include the proposed valve details and also a letter from the distributor to confirm bond commitment.

[redacted]

KP worked extensively with [redacted] to determine if an acceptable valve could meet the specifications. [redacted] provided a record of installing eight, 6-inch, trunnion ball valves from 1991 at a [redacted] municipal wastewater treatment plant. [redacted] had not provided a similar installation for sludge in over 30 years.

KP presented [redacted] to MSD as a possible substitute (see Attachment G), however, after discussing this service further with MSD, KP agreed with MSD that [redacted] was not acceptable for the project due to lack of sludge cake experience. The [redacted] distributor also declined to provide a bond to guarantee the performance of the [redacted] offering.

Without the required experience or adequate performance bond, KP concluded that [redacted] was not acceptable for the project.

[redacted]

[redacted] and, as a result, has significant trunnion ball valve experience for sludge cake service. Some examples of installations that demonstrate [redacted] experience are discussed below.

[redacted] trunnion valves are installed at MSD's Bissell Point WWTF sludge cake receiving system. These valves have performed well over the years with no maintenance issues.

[redacted] sold (40) units of 8" and 10" Class 600 Trunnion Mounted Ball Valves for Sludge Cake Service to Metropolitan Council Environmental Services (MCES). These valves were installed in 2021. A project waiver was granted by USEPA for the project trunnion ball valves as further discussed below.

[redacted] provided trunnion valves for the Buffalo, NY Sewer Authority.

[redacted] provided trunnion valves for sludge cake feed systems through Schwing America for various municipal treatment facilities.

KP concluded that [redacted] can meet the technical requirements and has the required qualifications and experience to meet the specification.

Excerpts of [redacted] trunnion ball valve brochure are included herein (Attachment H).

[redacted]

Requested confirmation that [redacted] Trunnon Mounted Ball Valves can meet both the technical requirements and qualification/experience requirements of the specification has been provided by [redacted]

KP concluded that [redacted] valves can meet the technical requirements and has the required qualifications and experience to meet the specification.

Attachment I includes a letter listing similar installations, proposed valve details, and brochure excerpts.

OTHER CONSIDERATIONS

The EPA has granted American Iron and Steel project waivers for high pressure ball valves on two previous occasions:

1. Jan 12, 2021(Attachment J) - Project Waiver of American Iron and Steel Requirements to the Metropolitan Council of Environmental Services in St. Paul, Minnesota for 8-inch and 10-inch trunnion mounted, full-port ball valves for the City of St. Paul's Solids Renewal & Improvements project.
2. Feb 5, 2019 (Attachment K) - Project Waiver of American Iron and Steel Requirements to the Sioux City, Iowa for 8-inch and 10-inch trunnion mounted, high pressure full-port

ball valves for the Sioux City Wastewater Treatment Plant Dewatering and Odor Control project.

We request a Project Waiver of American Iron and Steel be granted to MSD St. Louis, MO for the 10-inch and 12-inch trunnion mounted, high pressure full-port ball valves to be installed for the Bissell Point & Lemay Wastewater Treatment Facilities (WWTF) Fluidized Bed Incinerators. Due to long lead times for this valve supply, we would appreciate that the requested waiver be granted by January 31, 2025, to allow the project to stay on schedule.

All other materials on the project are planned to be in full compliance with AIS requirements.

Please let us know if you have any questions or require additional information.

Respectfully,

Jerry L. Jung, PE
Project Manager
Metropolitan St. Louis Sewer District
2350 Market Street
St. Louis, MO 63103
Tel: 314.768.6226
Email: jjung@stlmsd.com

EPA has redacted information from this waiver request and excluded several attachments from publication for public comment because they may contain business proprietary information. The EPA waivers referenced in the request are also removed, but may be found on the EPA AIS website. If you have any questions about materials not included in this publication, please contact SRF_AIS@epa.gov.

Attachments:
Attachment A: Arcadis Letter
Attachment B: Project Schedule – Cake Piping and Valve (Excerpt)
Attachment C: Spec. Section 40 05 53 – Process Valves, Four-Inch Diameter
Attachment D: [redacted]
Attachment E: [redacted]
Attachment F: [redacted]
Attachment G: [redacted]
Attachment H: [redacted]
Attachment I: [redacted]
Attachment J: AIS Waiver by USEPA for MCES Trunnion Ball Valves
Attachment K: AIS Waiver by USEPA for Sioux City Trunnion Ball Valves

ATTACHMENT A

Arcadis Letter

ARCADIS

Date: August 14, 2024

Kokosing/Plocher
Attn: Mr. Nick Kampwerth

[redacted]
www.arcadis.com

Subject: Design Engineer Support of Metropolitan St. Louis Sewer District
Waiver Request of AIS Provisions for 10-inch and 12-inch Trunnion Ball Valves

Dear Mr. Kampwerth,

Arcadis has been assisting Kokosing/Plocher and the Metropolitan St. Louis Sewer District in the search for a high-pressure trunnion mounted ball valve manufacturer that meets the technical specifications, AIS sourcing, and previous experience requirements for the Bissell Point & Lemay WWTF Fluidized Bed Incinerators Design-Build Project. We have been unable to identify any manufacturer that meets all necessary requirements and therefore stand in support of an AIS waiver request for these valves.

The high pressure sludge cake piping system, of which these specialized trunnion mounted valves are a part of, is an extremely demanding service that is critical to the success of the overall project. The service conditions require pumping of a highly abrasive sludge at high pressures approaching 1,500 psig. As design engineer responsible for the design of this system, Arcadis offers the following discussion regarding the development of our project specifications

Valve Specifications and Background

Project Specification Section 40 05 53 – Process Valves, Four-Inch Diameter and Larger (Attachment B) specifies the requirements of all process valves four-inches and larger, including the trunnion ball valves as follows.

Section 1.03 A. Manufacturer Qualifications are as follows:

1. *Manufacturer shall have minimum of five years of experience producing substantially similar valves using the same materials and equipment to that required and be able to provide evidence of at least five installations in satisfactory operation with the same service, size, and pressure class for at least five years.*
2. *A manufacturer's qualifications must be applicable to process valves produced directly by the manufacturer or by a company acquired by the manufacturer. Manufacturer shall not claim experience for valves not directly produced by company of record.*
3. *For valves installed in sludge cake service (dewatered sludge), manufacturer experience must be applicable to municipal wastewater sludge cake with a minimum of 20 percent total solids content.*

Section 2.05 B. General:

1. *The ball valves in the dewatered sludge cake service shall be full port ball valve trunnion-mounted designed for high pressure service. The valves shall be ANSI Class 600 with a maximum working pressure of 1,440 psi and 400 degrees Fahrenheit. The valves shall be API monogrammed and shall be built and audited to API 6D*

and ANSI standards. The valve shall consist of a full port ball that rotates on a fixed axis with an upper stem and lower trunnion. The valve shall be a bi-directional flow valve with independent sealing capability on each side of the ball. The valve shall also be a non-lubricated valve, designed for dirty service (high solids applications).

Trunnion mounted ball valves for high pressure dewatered municipal sludge cake service is an application where very few valve manufacturers can provide experience or example installations. We specifically specified two manufacturers ([redacted]) because of their ability to meet the technical specifications as well as the experience requirements.

Regarding the experience clause, it is industry standard to require system component manufacturers (such as valve manufacturers) for wastewater projects to provide an experience portfolio which demonstrates a successful history of installations in similar applications. This helps to ensure that the end user receives a safe, high-quality, and tested product that will not fail under strenuous operating conditions. Given the extremely high pressure service to which these valves would be subjected, any failure would be a significant safety concern. While other manufacturers likely can provide quality products for the industries and applications they typically serve, Arcadis must follow a Standard of Care that does not allow us to recommend or accept a first-in-kind installation of an untested valve in this challenging application.

Please let us know if you have any questions or require additional information in support of this waiver request.

Sincerely,
Arcadis U.S., Inc.

[redacted]

[redacted]

[redacted]

ATTACHMENT C

Spec. Section 40 05 53

Process Valves

Four-Inch Diameter Cake Piping

and

Valve (Excerpt)

DIVISION 40 – PROCESS INTERCONNECTIONS
Section 40 05 53 – Process Valves, Four-Inch Diameter and Larger

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install process valves, four-inch diameter and larger, and appurtenances, complete and operational.
2. Valves for digester gas and air have been specifically identified. All other valves are for liquid service.

B. Coordination

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before process valves Work.

C. Related Sections

1. Section 05 05 33 - Anchor Systems
2. Section 09 91 00 - Painting
3. Section 33 05 05 - Buried Piping Installation
4. Section 40 05 05 - Exposed Piping Installation

1.02 REFERENCES

A. Standards referenced in this Section are listed below:

1. American Bearing Manufacturers Association (ABMA).
2. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
3. ANSI B16.34, Valves-Flanged, Threaded and Welding end. (ASME B16.34).
4. ANSI/NSF 61 Drinking Water Components – Health Effects.
5. API STD 594, Check Valves, Flanged Lug, Wafer and Butt-Welding.
6. API STD 598, Valve Inspection and Testing.
7. API STD 609, Butterfly Valves: Double Flanged, Lug-Type and Wafer-Type.
8. ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
9. ASTM A193/A193M, Specification for Alloy-Steel and Stainless-Steel Bolting Materials for High-Temperature Service.
10. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service, or Both.

11. ASTM A240/A240M, Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
12. ASTM A276, Specification for Stainless Steel Bars and Shapes.
13. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
14. ASTM A351/A351M, Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts.
15. ASTM A380, Practice for Cleaning, Descaling and Passivation of Stainless-Steel Parts, Equipment and Systems.
16. ASTM A536, Specification for Ductile Iron Castings.
17. ASTM A564/A564M, Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
18. ASTM A743/A743 M, Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
19. ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
20. ASTM B98/B98M, Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
21. ASTM B138/B138M, Specification for Manganese Bronze Rod, Bar and Shapes.
22. ASTM B265, Specification for Titanium and Titanium Alloy Strip, Sheet and Plate.
23. ASTM B584, Specification for Copper Alloy Sand Castings for General Applications.
24. ASTM D429, Test Methods for Rubber Property - Adhesion to Rigid Substrates.
25. AWWA C501, Cast-Iron Sluice Gates.
26. AWWA C502, Dry-Barrel Fire Hydrants.
27. AWWA C504, Rubber-Seated Butterfly Valves.
28. AWWA C507, Ball Valves, 6-inch through 48-inch.
29. AWWA C508, Swing-Check Valves for Waterworks Service, 2-inch through 24-inch NPS.
30. AWWA C509, Resilient-Seated Gate Valves for Water Supply Service.
31. AWWA C540, Power-Actuating Devices for Valve and Slide Gates.
32. AWWA C550, Protective Interior Coatings for Valves and Hydrants.
33. AWWA Manual M49, Butterfly Valves: Torque, Head Loss, and Cavitation Analysis.
34. FS TT-C-494, Coating Compound, Bituminous, Solvent Type, Acid-Resistant.
35. NEMA MG 1, Motors and Generators.

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications

1. Manufacturer shall have minimum of five years of experience producing substantially similar valves using the same materials and equipment to that required and be able to provide evidence of at least five installations in satisfactory operation with the same service, size, and pressure class for at least five years.
2. A manufacturer's qualifications must be applicable to process valves produced directly by the manufacturer or by a company acquired by the manufacturer. Manufacturer shall not claim experience for valves not directly produced by company of record.
3. For valves in sludge cake service (dewatered sludge), manufacturer experience must be applicable to municipal wastewater sludge cake with a minimum of 20 percent total solids content.
4. If qualifications cannot be met, supplier can alternatively provide a bond or deposit in the amount of not less than 100% of the contract price, which will be held for not less than the specified experience period.

B. Component Supply and Compatibility

1. Obtain each type of equipment and appurtenances included in this Section, regardless of the component manufacturer, from a single manufacturer of the type of process valve. For each type of valve, do not furnish valves of more than one manufacturer.
2. Supplier of each type of equipment specified shall review and approve or prepare all Shop Drawings and other submittals for all components associated with the type of process valve Supplier is furnishing.
3. Components shall be suitable for use in the specified service conditions. Components shall be integrated into the overall assembly by the process valve manufacturer.

1.04 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings
    a. Installation drawings showing orientation of valve in both plan and elevation view. Drawings shall clearly identify valve and its appurtenances, including controls, actuators, valve stems, and other components. Show dimensions of valves and appurtenances in relation to piping and structural and architectural components, where applicable.
    b. Controls for and control characteristics of modulating valves.
    c. Power and control wiring diagrams, including terminals numbers for electric-motor actuators.
    d. Calculations for sizing of electric actuators.
    e. Calculations for sizing of operating mechanism with extension stems.
    f. Calculations for sizing of gear actuators.
2. Product Data

a. Product data sheets.

b. Complete catalog information, including dimensions, weight, specifications, and identification of materials of construction of all parts.

c. Corrosion resistance information to confirm suitability of valve materials for the application. Furnish information on chemical resistance of elastomers from elastomer manufacturer.

d. Cv values and hydraulic head loss curves.

1.05 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading

1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in concrete in ample time to prevent delaying the Work.

2. Inspect boxes, crates, and packages upon delivery to Site and notify Owner's Representative in writing of loss or damage to materials and equipment. Promptly remedy loss and damage to new condition in accordance with manufacturer's instructions.

3. Conform to Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection

1. Keep products off ground using pallets, platforms, or other supports. Store equipment in covered storage and prevent condensation and damage by extreme temperatures. Store in accordance with manufacturer's recommendations. Protect steel, packaged materials, and electronics from corrosion and deterioration.

2. Conform to Section 01 66 00, Product Storage and Handling Requirements.

PART 2 PRODUCTS

2.01 GENERAL

A. Valves, General

1. Provide each valve with manufacturer's name and rated pressure cast in raised letters on valve body.

2. Provide valves with brass or Type 316 stainless steel nameplate attached with Type 316 stainless steel screws. Nameplates shall have engraved letters displaying the following minimum information:

a. Valve size

b. Pressure and temperature ratings

c. Application (other than water and wastewater)

d. Date of manufacture

e. Manufacturer's name

3. Provide valves to turn clockwise to close, unless otherwise specified.

4. Provide valves with permanent markings for direction to open.
5. Manually operated valves, with or without extension stems, shall require not more than 40-pound pull on manual operator to open or close valve against specified criteria. Gear actuator and valve components shall be able to withstand minimum pull of 200 pounds on manual operator and input torque of 300-foot pounds to actuator nut. Manual operators include handwheel, chainwheel, crank, lever, and T-handle wrench.

B. Valve Materials
1. Valve materials shall be suitable for the associated valve's service or application, as shown.
2. Protect wetted parts from galvanic corrosion caused by contact of different metals.
3. Wetted components and wetted surfaces of valves used with potable water or water that will be treated to become potable shall conform to ANSI/NSF 61.
4. Clean and descale fabricated stainless-steel items in accordance with ASTM A380 and the following:
a. Passivate all stainless steel welded fabricated items after manufacture by immersing in pickling solution of six percent nitric acid and three percent hydrofluoric acid. Temperature and detention time shall be sufficient for removing oxidation and ferrous contamination without etching surface. Perform complete neutralizing operation by immersing in trisodium phosphate rinse followed by clean water wash.
b. Scrub welds with same pickling solution or pickling paste and clean with stainless steel wire brushes or by grinding with non-metallic abrasive tools to remove weld discoloration, and then neutralize and wash clean.

C. Valve Joints
1. Exposed Valves: Unless otherwise specified, provide with flanged ends conforming to ANSI B16.1. Pressure class of flanges shall be equal to or greater than specified pressure rating of the associated valve.
2. Buried Valves: Unless otherwise specified, provide with mechanical or push-on joints, restrained or unrestrained, as required by piping with which valve is installed.
3. For stainless steel bolting, except where nitrided nuts are required, use graphite-free anti-seize compound to prevent galling. Strength of joint shall not be affected by using anti-seize compound.

2.02 RESILIENT-SEATED GATE VALVES

A. Manufacturers: Provide products of one of the following:
1. M&H Valve Company
2. US Pipe and Foundry
3. Or equal

B. General

1. Provide valves conforming to AWWA C509 and as specified in this Section.
2. Sizes: Four-inch through 12-inch diameter, 16-inch and 20-inch diameter.
3. Type
   a. Provide non-rising stem (NRS) valves for buried service.
   b. For interior and exposed service, provide outside screw and yoke (OS&Y) rising-stem valves, unless otherwise specified.
   c. Provide position indicators for NRS valves used in exposed service.
4. Minimum Rated Working Pressure
   a. Valves 12-inch Diameter and Smaller: 200 psig
   b. Valves 16-inch and 20-inch Diameter: 150 psig
5. Maximum Fluid Temperature: 150 degrees F
6. Provide valves with fully encapsulated resilient wedges, unless otherwise specified.

C. Materials of Construction: Shall conform to AWWA C509 and shall be as follows:

1. Valve Body, Bonnet, and Stuffing Box: Cast-iron
2. Wedge: Cast-iron, symmetrically and fully encapsulated with molded rubber having minimum 1/8-inch thickness.
3. Stem: Manganese bronze
4. Rubber Items: Buna-N or other synthetic rubber suitable for the application
5. Internal and external bolting and other hardware including pins, set screws, plug, studs, bolts, nuts, and washers shall be Type 316 stainless steel.

D. Interior Coating

1. Valves shall be coated inside. Steel, cast-iron and ductile iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.

E. Testing

1. Test valves in valve manufacturer's shop in accordance with AWWA C509.

F. Gear Actuators for Manually Operated Valves

1. Provide valves with gear actuators conforming to AWWA C500.
2. Size gear actuators for the maximum differential pressures listed in the Valve Schedule at the end of this Section.

2.03 ECCENTRIC PLUG VALVES

A. Manufacturers: Provide products of one of the following:

1. DeZurik
2. Or equal

B. General

1. Provide eccentric-type plug valves each with rectangular ports.

2. Minimum Rated Working Pressure:
   a. Valves 12-inch Diameter and Smaller: 175 psig
   b. Valves 14-inch through 72-inch Diameter: 150 psig
3. Maximum Fluid Temperature: 180 degrees F
4. Minimum Port Area
   a. Valves 20-inch Diameter and Smaller: 80 percent of nominal pipe area.
   b. Valves Larger than 20-inch Diameter: 70 percent of nominal pipe area.
5. Packing and packing gland shall be externally adjustable and accessible without disassembling valve and without removing the actuator.
6. Valves shall provide drip-tight, bi-directional shutoff at rated pressures.
7. Plug shall have cylindrical seating surface eccentrically offset from center of plug shaft. Interface between plug face and body seat, with plug in closed position, shall be externally adjustable in the field with valve in the line while under pressure.
8. Plug shall be supported to top bearing by using spring that is externally adjustable.
9. For sludge service, plug valves shall allow pigging of the piping with line-size pigs.

C. Materials of Construction
1. Body: Cast Iron ASTM A126 Class B, or Ductile-iron ASTM A536 Grade 65-45-12.
2. Plug
   a. Core: Cast Iron ASTM A126 Class B, or Ductile-iron, ASTM A536 Grade 65-45-12.
   b. Plug Facing: Neoprene
   c. For valves up to eight-inch diameter, plugs shall be fully encapsulated with rubber. For valves larger than eight-inch diameter, provide plugs with rubber facing. Minimum thickness of rubber lining shall be 1/8-inch. Rubber hardness shall be a minimum of 70 (Shore A) durometer. Rubber-to-metal bond shall withstand minimum 75-pound pull conforming to ASTM D429 Method B.
3. Seats: Minimum 1/8-inch welded overlay of minimum 90 percent pure nickel on surfaces contacting plug face. Seats shall provide contact area of at least 1/2-inch width all around.
4. Stem Bearings: Sintered, oil impregnated, permanently lubricated of Type 316 stainless steel.
5. Stem Seal: Multiple neoprene V-ring type.
6. All internal and external bolting and other hardware including pins, set screws, plug, studs, bolts, nuts and washers shall be Type 316 stainless steel.

D. Interior Coating and Lining

1. Valves shall be coated inside. Steel, cast-iron, and ductile iron surfaces, except machined surfaces, shall be epoxy-coated in accordance with AWWA C550.

E. Shop Testing

1. Operational Tests
   a. To demonstrate that complete assembly is workable, successfully operate each valve (with actuator mounted directly on valve) three times from fully closed to fully open position and reverse under no-flow condition.
2. Leakage Tests
   a. Test each valve for leaks while valve is in closed position.
   b. Test valves at rated pressures. During test, valves shall be drip-tight. Test duration shall be at least five minutes for valves up to 20-inch diameter and ten minutes for valves larger than 20-inch diameter. Tests shall be repeated successfully with pressure in the unseating direction.
3. Hydrostatic Test: Test valves to an internal hydrostatic pressure equivalent to twice rated pressure of valve. During hydrostatic test, there shall be no leakage through metal, end joints, and shaft seal, nor shall any part be permanently deformed. Duration of hydrostatic test shall be sufficient to allow visual examination for leakage. Test duration shall be at least one minute for valves eight-inch diameter and smaller, three minutes for valves 10-inch through 20-inch diameter, and ten minutes for valves 24-inch diameter and larger.

F. Gear Actuators for Manually Operated Valves

1. Provide gear actuators on buried and exposed valves, except valves four-inch diameter and smaller located less than five feet above operating floor. Gas service valves shall be provided with worm gear actuators.
2. Size gear actuators for the maximum differential pressures listed in the Valve Schedule at the end of this Section.
3. Provide actuators capable of holding associated valves in any intermediate position without creeping or vibrating.
4. Provide valve position indicator on each actuator. Provide stop-limiting devices for open and closed position. For buried and submerged service actuators, provide position indicators in valve box.
5. Provide adjustable stop to adjust seating pressure.
6. Make packing accessible for adjustment without requiring removal of actuator from valve, except for valves in buried and submerged service.
7. Diameter ratio of handwheel or chainwheel and gear sector shall be less than two.
8. For buried and submerged valves, gear actuator shall be grease-packed and designed to withstand submersion, and shall be drip-tight in water 20 feet deep, with self-adjusting packing.
9. Provide each actuator with gearing totally enclosed.

10. Operator shaft and gear sector shall be supported on permanently lubricated bronze or stainless steel bearings.
11. Provide metal-encased spring loaded seals in top and bottom covers of gear housing.
12. Actuators shall be provided to produce indicated torque with maximum pull of 40 pounds on handwheel or chainwheel and maximum input of 150-foot pounds on operating nuts, for both seating and unseating heads equal to maximum differential pressure rating of valve.
13. Actuator components between input and stops shall be designed to withstand, without damage, a pull of 200 pounds for handwheel or chainwheel actuators and input torque of 300-foot pound for operating nuts when operating against stops.
14. Materials of Construction
    a. Housing: Cast-iron, ASTM A126 Class B.
    b. Gear Sector: Cast-iron ASTM A126 Class B, or ductile iron ASTM A536.
    c. Worm Shaft: Steel, AISI 1144, hardened and tempered to an average Rc 40 and within range of Rc 35-45.
    d. Bearings: Bronze oil-impregnated, or stainless steel.
    e. Hardware, including bolts, nuts, washers, set screws, and pins, shall be Type 316 stainless steel.

2.04 RUBBER SEATED BALL VALVES

A. Manufacturers: Provide products of one of the following:
   1. APCO Willamette Valve & Primer Corporation
   2. Henry Pratt Company
   3. Or equal

B. General
   1. Provide valves conforming to AWWA C507 and as specified herein.
   2. Sizes: Six-inch through 48-inch diameter.
   3. Rated Working Pressure: 150 psig.
   4. Maximum Fluid Temperature: 180 degrees F.
   5. Valve body shall have full, unobstructed, circular inlet and outlet port diameters equal to nominal diameter of valve.
   6. Valves shall provide drip-tight bi-directional shutoff at rated pressures.
   7. Valve bodies shall have support legs or pads to support the valve and actuator weight when installed in horizontal pipeline.
   8. Support ball assembly by two-way thrust bearing assembly consisting of stud and thrust collar in grease-packed cavity suitable for lifetime lubrication.
   9. Valve seats shall seal full 360-degree circumference without interruption.
   10. Valve seats shall be field-adjustable around 360-degree circumference and replaceable without dismantling operator, shaft, or ball.

11. Packing shall be self-adjusting, chevron type and shall be accessible without having to dismantle valve.

C. Materials of Construction: Materials of construction shall conform to AWWA C507 and as follows:

1. Body: Gray iron, ductile iron, or cast steel
2. Ball: Gray iron, ductile iron, or cast steel
3. Rubber Seats in Body, Bearing Seal O-Rings: Buna-N or other synthetic rubber suitable for the application.
4. Seating Surface on Ball: Type 316 stainless steel or nickel-chrome
5. Shaft: Type 316 stainless steel
6. Tapered Pins for Attachment of Shaft to Ball: Type 316 stainless steel
7. Bearings: Teflon-lined with fiberglass backing, self-lubricating
8. Thrust Collar and Stud Bolt of Thrust Bearing Assembly: Type 316 stainless steel
9. Shaft Seals: Self-adjusting V-type chevron packing
10. Internal and external bolting and other hardware, including pins, set screws, studs, bolts, nuts, and washers shall be Type 316 stainless steel.

D. Testing

1. Test each valve in manufacturer's shop in accordance with AWWA C507.

E. Interior Coating

1. Valves shall be coated inside. Steel, cast-iron and ductile iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.

F. Gear Actuator for Manual Valves

1. Provide valves with gear actuators conforming to AWWA C507.
2. Size gear actuators for valves 10-inch diameter and smaller for differential pressure equal to rated pressure of valve and port velocity of 35 feet per second.
3. Size gear actuators for the maximum differential pressures listed in the Valve Schedule at the end of this Section.

2.05 TRUNNION MOUNTED BALL VALVES

A. Manufacturers: Provide products of one of the following:

1. Forum Energy Technologies PBV Series 6700
2. Val-Matic Quadrosphere
3. Or approved equal

B. General

1. The ball valves in the dewatered sludge cake service shall be full port ball valve trunnion-mounted designed for high pressure service. The valves shall be ANSI Class 600 with a maximum working pressure of 1,440 psi. The valves shall be API monogrammed and shall be built and audited to API 6D and ANSI standards. The valve shall consist of a full port ball that

rotates on a fixed axis with an upper stem and lower trunnion. The valve shall be a bi-directional flow valve with independent sealing capability on each side of the ball. The valve shall also be a non-lubricated valve, designed for dirty service (high solids applications).

C. Materials of Construction: Except as modified or supplemented herein, materials used in the manufacture of ball valves shall conform to the requirements of ANSI B16.34 and API 6D.

1. Valve Body: Cast steel, ASTM A216, Grade WCB or forged steel, ASTM A105

a. Each valve body shall be provided with Class 600 raised face flanged ends. Actual length of the valves shall be within 1/16 inch (plus or minus) of the theoretical length.

b. Valve body shall be split body, end entry design. Single multi-purpose stem and interchangeable top plates shall permit changing from wrench to gear operator without disturbing any pressure containing parts. Provisions shall be made for emergency sealing for the stem.

c. Valve shall be capable of double block and bleed service as standard; pressure from either side of a closed valve is stopped by seat seal so that the ball cavity may be vented to verify both upstream and downstream seat seal integrity.

2. Valve Stem and Trunnion Stem: Stainless steel, Type 316 or 17-4 PH.

3. Ball: Stainless steel, Type 316

a. Ball shall be full port solid ground ball. Balls shall not be restricted port. Hollow or sleeved balls are not acceptable.

4. Seat Rings Inserts: Polyether Ether Ketone or Nylon.

a. Seats shall be of the cartridge seat design consisting of a seat ring with a seat insert and a body seal with telescoping spring holder member, which assures ball/seat contact.

b. Energizing springs shall be individually cupped to minimize solids deposits from impeding spring action. Provisions shall be made for emergency sealing for the seats.

D. Valve Actuators

1. General

a. Each mainline valve in dewatered sludge cake service shall have an open/close electric actuator suitable for operating the valve against the maximum working pressure.

i. Valve manufacturer is responsible for providing the break torque requirements and any other pertinent design data to the actuator supplier, such that each dewatered sludge cake service valve actuator may be adequately sized by the actuator provider.

ii. Design of the actuator is the ultimate responsibility of the valve actuator manufacturer.

2.06 2-INCH AND LESS BALL VALVES (SLUDGE CAKE SERVICE)

A. Products and Manufacturers: Provide one of the following:
   1. Neles-Jamesbury, Series 4000, Model: 4C 2236XT B1
   2. Or equal

B. General
   1. Service: Sludge Cake (Dewatered Sludge)
   2. Sizes: 2-inch and less diameter
   3. Rated Working Pressure: 1500 psig
   4. Maximum Temperature: 100 degrees F
   5. Operator: Lever
   6. End Connections: Socket Welded

C. Materials of Construction
   1. Body: Carbon Steel. Class 800, ASME B16.34 ASTM A105
   2. Ball: 316 Stainless Steel
   3. Stem: 316 Stainless Steel
   4. Seat: Xtreme Fire-Tite
   5. Seal: TFM & Graphite

2.07 BUTTERFLY VALVES

A. Manufacturers: Provide products of one of the following:
   1. DeZurik
   2. Henry Pratt Company
   3. Or equal

B. General
   1. Provide butterfly valves conforming to AWWA C504 and as specified herein.
   2. Sizes
      a. Flanged: Four-inch through 72-inch diameter.
      b. Mechanical Joint: Four-inch through 48-inch diameter.
   3. Rated Working Pressure: 150 psig, Class 150B
   4. Maximum Fluid Temperature: 150 degrees F
   5. Valves shall provide drip-tight bi-directional shutoff at rated pressures.
   6. Mount valve seats in valve body. Rubber seats for 24-inch diameter and larger valves shall be replaceable in the field.
   7. Valves shall be capable of being maintained in open or partially open position for manual operation, and for automatic operation. When valve disc is maintained, there shall be no chatter or vibration of disc or operating mechanism.
   8. Valve packing shall be replaceable without dismantling valve.
   9. Disc shall be offset from shaft to provide uninterrupted 360-degree seat seal.

C. Materials of Construction: materials of construction shall conform to AWWA C504 and shall be as follows:

1. Body: Cast-iron, ductile iron, or alloy cast-iron
2. Shaft: Type 316 stainless steel
3. Discs
   a. Valves Smaller than 30-inch Diameter: Cast-iron
   b. Valves 30-inch Diameter and Larger: Ductile iron
4. Seats: Buna-N or other synthetic rubber suitable for the application
5. Seating Surfaces: Type 316 stainless steel
6. Bearings
   a. Valves Smaller than 24-inch Diameter: Nylon
   b. Valves 24-inch Diameter and Larger: Fiberglass with Teflon lining
7. Shaft Seals: Externally adjustable, material same as for seats. For services that are either buried or submerged, self-adjusting V-type chevron, material same as for seats.
8. Tapered Pins for Attachment of Shaft to Disc: Type 316 stainless steel.
9. Internal and external bolting and other hardware; including pins, set screws, studs, bolts, nuts, and washers shall be Type 316 stainless steel.

D. Interior Coating

1. Valves shall be coated inside. Steel, cast-iron, and ductile iron surfaces, except machined surfaces, shall be epoxy-coated in accordance with AWWA C550.

E. Testing

1. Test each valve in the manufacturer's shop in accordance with AWWA C504.

F. Gear Actuators for Manual Valves

1. Provide gear actuators conforming to AWWA C540.
2. Gear actuators for valves 20-inch diameter and smaller shall be constructed for 150 psi differential pressure and 16 feet per second port velocity.
3. Size gear actuators for the maximum differential pressures listed in the Valve Schedule at the end of this Section.

2.08 BUTTERFLY VALVES (AIR SERVICE) - OPEN/CLOSE APPLICATIONS

A. Manufacturers: Provide products of one of the following:

1. DeZurik
2. Henry Pratt Company
3. Or equal

B. General

1. Provide valves conforming to AWWA C504 and as specified herein.
2. Sizes: Four-inch through 72-inch diameter

3. Internal Air Temperature Rating: 250 degrees F, minimum
4. Rated Working Pressure: 25 psig, Class 25B
5. Type: Rubber seated
6. Valves shall provide air-tight bi-directional shut-off at rated pressure.
7. Valve seats shall be recess-mounted and securely fastened to valve body.
    a. For 20-inch diameter and smaller valves, seats shall be simultaneously molded in and bonded to valve body. Seats shall withstand pull of 75 pounds under test procedure ASTM D 429 Method B.
    b. For 24-inch diameter and larger valves, seats shall be retained in valve body by mechanical means.
    c. Valves employing complete rubber liners are not acceptable.
8. Valves shall be capable of being held in open or partially open position for manual operation and for automatic operation. When valve disc is so held, there shall be no chatter or vibration of disc and operating mechanism.
9. Valve packing shall be replaceable without dismantling valve.
10. Disc shall be offset from shaft to provide uninterrupted 360-degree seat seal.

C. Materials of Construction: Materials of construction shall conform to AWWA C504, 25B and shall be as follows:
1. Body: Cast-iron
2. Shaft: Type 316 stainless steel
3. Seats: Ethylene Propylene (EPT)
4. Discs: Cast-iron or ductile iron
5. Seating Edges on Disc: Type 316 stainless steel
6. Shaft Bearings: Self-lubricating sleeve type, fiberglass with Teflon lining or fluorosint for valves smaller than 24-inch diameter
7. Shaft Seals: Self-adjusting V-type chevron, Ethylene Propylene (EPT)
8. Tapered Pins for Attachment of Shaft to Disc: Type 316 stainless steel
9. Internal and external bolting and other hardware; including pins, set screws, studs, bolts, nuts, and washers shall be Type 316 stainless steel.

D. Testing
1. Test all valves in manufacturer's shop in accordance with AWWA C504.

E. Gear Actuator for Manual Valves
1. Valves shall be provided with gear actuators conforming to AWWA C504.
2. Gear actuators shall be constructed for minimum differential pressure of 25 psig.

2.09 SWING CHECK VALVES

A. Manufacturers: Provide products of one of the following:
1. APCO Willamette Valve & Primer Corp.
2. Crispin Valve

3. G.A. Industries

B. General

1. Provide valves conforming to AWWA C508 and as specified herein.
2. Sizes: Four-inch through 24-inch diameter
3. Type: Resilient seated
4. Rated Working Pressure
   a. Smaller than 12-inch Diameter: 175 psig
   b. 12-inch Diameter and Larger: 150 psig
5. Provide valves suitable for horizontal or vertical mounting.
6. Check valves shall have clear waterway with full-open area equal to nominal pipe size.
7. Provide check valves with outside adjustable weight and lever.
8. Provide valves larger than six-inch diameter with adjustable air cushion chambers.
9. Valve seats shall be mechanically attached and shall be field replaceable.

C. Materials of Construction: All materials of construction shall conform to AWWA C508 and shall be as follows:

1. Body, Disc, Cover and Gland: Cast-iron or ductile iron
2. Disc Arm: Ductile iron
3. Hinge Shaft: Type 316 stainless steel
4. Hinge Shaft Bushings: Bronze, or Type 316 stainless steel for sewage service.
5. Shaft End Plate: Type 316 stainless steel
6. Body Seat: Type 316 stainless steel
7. Follower Ring for Rubber Seat on Disc: Type 316 stainless steel
8. Disc Center Pin Assembly: Type 316 stainless steel
9. Air Cushion Chamber
   a. Chamber and Plunger: Bronze
   b. Linkages and Pins: Type 316 stainless steel
   c. Air Check Valve and Tubing: Brass or stainless steel
10. Rubber Items
    a. Applications Up to 180-degree F Fluid Temperature: Buna-N or other synthetic rubber suitable for the application.
    b. Applications 180-degrees F and Greater Fluid Temperature: Viton, or other synthetic rubber suitable for the application.
11. Internal and external bolting and other hardware; including pins, set screws, studs, bolts, nuts, and washers shall be Type 316 stainless steel.
12. Gland Packing: Graphite and Kevlar

D. Interior Coating

1. Valves shall be coated inside. Steel, cast-iron and ductile iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.

E. Testing

1. Test each valve in manufacturer's shop in accordance with AWWA C508.
2. Allowable Leakage at Rated Pressures: Zero

2.10 AUTOMATIC PRESSURE REDUCING VALVES

A. Manufacturers: Provide products of one of the following:

1. G.A. Industries, Inc.
2. Or equal

B. General

1. Application: Reduce higher, fluctuating upstream pressure to a lower, steady, downstream pressure within specified range of flow variations.
2. Rated Working Pressure
   a. Smaller than 12-inch Diameter: 250 psig
   b. 14-inch through 36-inch Diameter: 250 psig
3. Sizing Data (to be filled in)
   a. Maximum Flow Rate: X gpm
   b. Minimum Flow Rate: X gpm
   c. Maximum Upstream Pressure: X psig
   d. Minimum Upstream Pressure: X psig
   e. Setpoint Downstream Pressure: X psig
   f. Setpoint downstream pressure shall be field-adjustable over range of near-zero to 110 percent.
4. Valves shall not suffer cavitation damage within five-year period from date of Substantial Completion when exposed to specified operating conditions.

C. Valve Construction

1. Type: Pilot-operated globe or angle-style valves as shown
2. Valves shall include one-piece piston and full-stroke length liner. Seating shall include replaceable resilient seat ring mounted on underside of piston and metal seat integral with liner or attached to valve body.
3. Provide V-ports for pressure control at low flows.
4. Flow area shall be equal to nominal pipe area when valve is fully open.
5. Valves shall provide drip-tight shut-off at rated pressure when closed.
6. Provide removable flanged cover to access valve's internals.
7. Provide indicator rod attached to piston for visual position indication of piston.
8. Pilot control piping shall include the following minimum items:
   a. Needle valve for field adjustment of closing speed.
   b. Pilot valve to adjust required setpoint downstream pressure.

c. Wye strainer with valved blow-off connection.

d. Isolation valves.

D. Materials of Construction

1. Body: Cast-iron, ASTM A126 Class B, or ductile iron, ASTM A536
2. Piston, Liner, Seat Crown, Indicator Rod and Hardware, Vent Tube and Glands: Bronze, ASTM B62.
3. Flexible Items: Nylon reinforced Buna-N, leather or other synthetic rubber suitable for the application
4. Internal and external bolting and other hardware; including pins, set screws, studs, bolts, nuts, and washers: Type 316 stainless steel.
5. Packing: Teflon
6. Control Piping Components (including piping, tubing, fittings, valves, and wye strainer): Brass or bronze with stainless steel wetted trim. Small valves shall conform to Section 40 05 56.

E. Interior Coating

1. Valves shall be coated inside. Steel, cast-iron and ductile iron surfaces shall be epoxy coated in accordance with AWWA C550.

F. Testing

1. Test each assembled valve, except control piping, hydrostatically at 1.5 times rated working pressure of valve for minimum of five minutes per valve.
2. Test each valve for leakage at rated working pressure against closed valve. Test duration shall be minimum 15 minutes and allowable leakage shall be zero.
3. Perform functional test on each valve to verify proper operation at specified performance.

2.11 FIRE HYDRANTS

A. Products and Manufacturers: Provide one of the following:

1. Mueller, Model: Super Centurion
2. Kennedy, Model: Guardian K81D
3. Or equal

B. General

1. Provide fire hydrants conforming to AWWA C502, Underwriters' Laboratories-listed and Factory Mutual approved, and as specified herein.
2. Rated Working Pressure: 175 psig, minimum
3. Rated Hydrostatic Test Pressure: 400 psig, minimum
4. Length of Bury: as shown

C. Construction

1. Type: Three-way fire hydrants with two hose nozzles and one pumper nozzle.
2. Nozzles

a. Provide one 4.5-inch diameter pumper nozzle and two 2.5-inch diameter hose nozzles with NFPA threads.

b. Nozzles shall be O-ring sealed, threaded, and retained with stainless steel locks. Nozzles shall be field replaceable.

3. Main Valve and Drainage Assembly

a. Opening: 5.25-inch diameter

b. Main valve shall be compression type provided with upper and lower metal plate and lower valve plate nut.

c. Barrel drainage shall be through dual drain valves. Opening and closing of main valve shall cause force-flush of dual drain ports.

d. Main valve seat ring shall be easily replaceable from above-ground.

4. Provide an oil filled reservoir for lubrication of stem threads and bearing surfaces. Oil shall be U.S. Food and Drug Administration approved and ANSI/NSF 61-listed, and shall flow freely in temperature range of -60 to 158 degrees F.

5. Provide traffic flange in barrel and safety coupling in stem.

6. Inlet Connection: Six-inch diameter mechanical joint, restrained

D. Materials of Construction: Materials of construction shall conform to the requirements of AWWA C502 and shall be as follows:

1. Upper and Lower Barrels, Shoe, and Bonnet: Cast-iron

2. Stem and Accessories

a. Upper and Lower Stems: Steel

b. Operating Nut: Bronze

c. Safety Coupling: Stainless Steel

3. Nozzles

a. Pumper and Hose Nozzles: Bronze

b. Nozzle Caps: Cast-iron

c. Cap Chains: Steel

4. Main Valve Assembly

a. Main Valve: Rubber

b. Upper Valve Plate: Bronze

c. Lower Valve Plate and Nut: Cast-iron

5. Drain Valves

a. Drain Ring Housing: Cast-iron

b. Drain Ring: Bronze

6. O-ring Gaskets: Rubber

7. External Assembly Bolts: Steel

8. Internal Pins and Other Hardware: Stainless steel, ASTM A276

E. Testing

1. Test each fire hydrant in manufacturer's shop in conformance with AWWA C502.

F. Interior Coating

1. Hydrants shall be coated on the interior. Steel, cast-iron, and ductile iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.

G. Exterior Painting

1. Below- and above-ground painting shall be as specified in this Section.

2.12 ELECTRIC ACTUATORS (OPEN/CLOSE)

A. Manufacturers: Provide products of one of the following:

1. Limitorque
2. Rotork
3. Or equal

B. Application Criteria

1. Ambient Temperature Rating: -20 to +158 degrees F
2. Ambient Humidity: 100 percent
3. Maximum Differential Pressures Across Closed Valves: Refer to Schedule of Valves with Electric Actuators at the end of this Section.
4. Maximum Flows Through Full-Open Valves: Refer to Schedule of Valves with Electric Actuators located at end of this Section.
5. Power Supply: 480-volt, three-phase, 60 Hertz
6. Control Voltage: 120 VAC, single phase, 60 Hertz
7. Torques: As determined by valve manufacturer
8. Duty Cycle: Sixty starts per hour, minimum

C. General

1. Conform to AWWA C540 and this Section.
2. Provide actuator operable with handwheel or chainwheel, even after disengaging and removing electric motor.
3. Provide valves with electric actuators that are located more than five feet above operating floor with separate control panels installed so that panel controls and indicators are approximately five feet above operating floor, at location approved by Owner's Representative. Modify electrical wiring as required for remote location of control panels.
4. Coordinate sizing of each electric actuator with valve manufacturer, who shall furnish valve and associated electric actuator and appurtenances as a unit.
5. Electric actuators shall be suitable for valve orientation as shown.

D. Electric Motor

1. General

a. Provide motors suitable for "open/close" service, with high torque characteristics and minimum 70 degree C temperature rating.

2. Motor Construction
   a. Enclosure: NEMA 6
   b. Insulation: Class F
   c. Service Factor: 1.15
   d. Power Supply: 480-volt, three-phase, 60 Hertz
   e. Motor Size: as determined by manufacturer
   f. RPM: as determined by manufacturer
   g. Provide winding thermostats for overcurrent protection.
   h. Efficiency: High efficiency conforming to NEMA MG 1
   i. Bearings: Anti-friction with minimum B-10 life of 100,000 hours, lifetime pre-lubricated and sealed

E. Actuator Gearing
   1. Housing: Die-cast aluminum or cast-iron
   2. Close-coupled to electric motor.
   3. Input Shaft Gearing: Spur or bevel gear assembly
   4. Output Shaft Gearing: Self-locking worm gears with minimum gear backlash to prevent valve disc chatter or vibration.
   5. Gearing shall be of hardened alloy steel or combination of hardened alloy steel and alloy bronze, accurately cut by hobbing machine.
   6. Lubrication: Grease or oil bath
   7. Bearings: Ball or roller with minimum B-10 life of 100,000 hours, lifetime pre-lubricated and sealed.
   8. Input Shaft: Hardened alloy steel
   9. Provide mechanical stops adjustable to plus-or-minus five degrees at each end of travel.

F. Limit Switches
   1. Provide each actuator with "end of travel" limit switches to allow control of desired end position for each direction of travel.
   2. Provide open and close limit switches geared to drive mechanism and in step at all times, whether unit is operated electrically or manually, and whether or not actuator is powered by electric power supply. Friction devices or set-screw arrangements shall not be used to maintain the setting.
   3. Limit switch gearing shall be appropriately lubricated.
   4. Provide driven mechanism totally enclosed to prevent entrance of foreign matter and loss of lubricant.
   5. Provide each limit switch with four auxiliary contacts. Two contacts shall close and two contacts shall open at a desired end position for each direction of travel.
   6. Switches shall be rated five amperes at 120 volts.

G. Torque Switches

1. Provide adjustable torque switches with each valve actuator. Torque switches shall operate during complete valve cycle without using auxiliary relays, linkages, latches, or other devices.
2. Wire torque switches to de-energize valve actuator motor when excessive torque is developed during each direction of travel.
3. It shall be possible to select the torque switches to control open and close limit positions in each direction of valve travel.
4. Provide dry contacts (five-amp, 120 VAC) for remote high torque alarm.

H. Handwheel and Chainwheel Operation

1. Provide actuator with handwheel (or chainwheel as required) for manual operation, so connected that operation by motor will not cause handwheel or chainwheel to rotate.
2. Should electric power be returned to motor while handwheel or chainwheel is in use, unit shall prevent transmission of motor torque to handwheel or chainwheel.
3. Handwheel or chainwheel shall require no more than 80-pound effort on rim for seating or unseating load, and no more than 60 pounds on running load.
4. Handwheel or chainwheel shall have an arrow and the word "OPEN" or "CLOSE" indicating required rotation. Handwheel or chainwheel shall operate in clockwise direction to close.
5. Chain Operators
   a. Valves more than five feet above operating floor level shall be equipped with chain operators.
6. Handwheels and chain operators shall be as specified in this Section.
7. Provide stem covers for rising stem gate valves as specified in this Section.

I. Controls

1. Provide the following controls in separate compartment integral with actuator.
2. Enclosure: NEMA 6
3. Starter: Combination reversing magnetic starter with circuit breaker and disconnect switch.
4. Control Power Transformer: Provide transformer to transform rated three-phase, 60 Hertz power to 120 volts, single-phase. Transformer shall be complete with grounded and fused secondary and dual primary fuses.
5. Provide "LOCAL/OFF/REMOTE" selector switch. In "LOCAL" position actuator shall be operated by "OPEN/CLOSE/STOP" pushbuttons. In "OFF" position, actuator shall be disabled from local and remote operation. In "REMOTE" position, "open/close/stop" control from remote source shall be enabled.

6. Provide "OPEN/CLOSE/STOP" pushbuttons with hold-to-run or momentary contact selection.
7. Provide "OPEN/CLOSE/STOP" indicating lights and zero-to-100 percent position indication in liquid crystal display window.
8. Provide thermal overload and single-phasing protection of motor.
9. Provide set of dry contacts to remotely indicate that actuator is available for remote operation.
10. Actuator circuit boards shall be rated for high temperature service, minimum 55 degrees C.
11. Provide electrical interlocks as shown.
12. Provide 120 VAC space heater to maintain internal housing temperature at 20 degrees C.

J. Remote-Mounted Control Stations
1. Where required by valve location or as indicated, provide remote control panels.
2. Enclosure: NEMA 4X, Type 316 stainless steel.
3. Provide "LOCAL/OFF/REMOTE" selector switch. In "LOCAL" position actuator shall be operated by "OPEN/CLOSE/STOP" pushbuttons. In "OFF" position, actuator shall be disabled from local and remote operation. In "REMOTE" position, "open/close/stop" control from remote source shall be enabled Provide contact when switch is in "REMOTE" position for remote indication.
4. Provide "OPEN/CLOSE/STOP" pushbuttons with hold-to-run or momentary contact selection.
5. Provide "OPEN/CLOSE/STOP" indicating lights and zero-to-100 percent position indication with liquid crystal display.

K. Testing
1. Test each actuator in manufacturer's shop in conformance with AWWA C540.

2.13 ELECTRIC ACTUATORS (MODULATING)

A. Manufacturers: Provide products of one of the following:
1. Limitorque
2. Rotork
3. Or equal

B. Application Criteria
1. Ambient Temperature Rating: -20 to +158 degrees F
2. Ambient Humidity: 100 percent
3. Maximum Differential Pressures across Closed Valves: Refer to Schedule of Valves with Actuators located at the end of this Section.
4. Maximum Flows Through Full Open Valves: Refer to Schedule of Valves with Actuators located at the end of this Section.

5. Duty Cycle: Continuous (minimum 1,200 starts/stops per hour), unless otherwise specified.
6. Power Supply: 480 VAC, three-phase, 60 Hertz
7. Control Voltage: 120 VAC, single-phase, 60 Hertz
8. Torque: As recommended by valve manufacturer
9. Accepts 4 to 20 mADC input to positioner.

C. General
1. Conform to AWWA C540 and this Section.
2. Provide actuator operable with handwheel even after electric motor has been disengaged and removed.
3. Provide each valve with electric actuators located more than five feet above operating floor with separate control panel installed with controls and indicators approximately five feet above operating floor at location approved by Owner's Representative. Modify electrical wiring as required for remote location of control panels.
4. Coordinate sizing of each electric actuator with valve manufacturer who shall furnish valve and electric actuator as a unit.
5. Electric actuators shall be suitable for valve orientation shown.

D. Electric Motor
1. General
   a. Provide motors suitable for modulating service, of high torque characteristics and minimum 70 degrees C temperature rating.
2. Motor Construction
   a. Enclosure: NEMA 6
   b. Insulation: Class H
   c. Service Factor: 1.15
   d. Power Supply: 480-volt, three-phase, 60 Hertz
   e. Motor Size: as determined by manufacturer
   f. RPM: as determined by manufacturer
   g. Provide winding thermostats for overcurrent protection.
   h. Efficiency: High-efficiency conforming to NEMA MG 1.
   i. Bearings: Anti-friction, B-10 life of 100,000 hours, lifetime pre-lubricated and sealed.

E. Actuator Gearing
1. Housing: Die-cast aluminum
2. Close-coupled to electric motor.
3. Input Shaft Gearing: Spur or bevel gear assembly.
4. Output Shaft Gearing: Self-locking worm gears with minimum gear backlash to prevent valve disc chatter or vibration.
5. Gearing shall be of hardened alloy steel or combination of hardened alloy steel and alloy bronze, accurately cut by hobbing machine.
6. Lubrication: Grease or oil bath.

7. Bearings: Ball or roller with minimum B-10 life of 100,000 hours, lifetime pre-lubricated and sealed.
8. Input Shaft: Hardened alloy steel.
9. Provide mechanical stops adjustable to plus-or-minus five degrees at each end of travel.
10. Provide mechanical position indication.

F. Limit Switches
1. Provide each actuator with "END OF TRAVEL" limit switches to allow control of desired end position for each direction of travel.
2. Provide "OPEN" and "CLOSE" limit switches geared to drive mechanism and in step at all times, whether unit is operated electrically or manually and whether or not actuator is electrically powered. Friction devices or set-screw arrangements shall not be used to maintain setting.
3. Limit switch gearing shall be appropriately lubricated.
4. Provide drive mechanism totally enclosed to prevent entrance of foreign matter or loss of lubricant.
5. Provide each limit switch with four auxiliary contacts. Two contacts shall close and two contacts shall open at desired end position for each direction of travel.
6. Switches shall be rated five amperes at 120 VAC.

G. Torque Switches
1. Provide adjustable double-torque switches with valve actuator.
2. Torque switches shall operate during complete valve cycle without using auxiliary relays, linkages, latches, or other devices.
3. Wire torque switches to de-energize valve actuator motor when excessive torque is developed during each direction of travel.
4. It shall be possible to select torque switches to control open and close limit positions in each direction of valve travel.
5. Provide dry contacts (five-amp, 120 VAC) for remote high torque alarm for automatically controlled valves.

H. Handwheel and Chainwheel Operation
1. Equip actuator with handwheel or chainwheel for manual operation, so connected that operation by motor will not cause handwheel or chainwheel to rotate.
2. Should power be returned to motor while handwheel or chainwheel is in use, unit shall prevent transmission of motor torque to handwheel or chainwheel.
3. Handwheel or chainwheel shall require no more than 80-pound effort on rim for seating or unseating load, and no more than 60-pound effort on running load.
4. Handwheel or chainwheel shall have an arrow and word "OPEN" or "CLOSE" indicating required rotation. Handwheel or chainwheel shall operate in clockwise direction to close.
5. Chain Operators:

a. Provide valves located more than five feet above operating floor with chain operators.

6. Handwheels and chain operators shall be as specified in this Section.

I. Controls

1. Provide following controls in a separate compartment integral with the actuator.
2. Enclosure: NEMA 6
3. Starter: Combination reversing magnetic starter with circuit breaker and disconnect switch.
4. Control Power Transformer: Provide transformer to transform rated three-phase, 60 Hertz power to 120 volts, single-phase. Transformer shall be complete with grounded and fused secondary and dual primary fuses.
5. Provide "LOCAL/OFF/REMOTE" selector switch. In "LOCAL" position actuator shall be operated by "OPEN/CLOSE/STOP" pushbuttons. In "OFF" position, actuator shall be disabled from local and remote operation. In "REMOTE" position, "open/close/stop" control from remote source shall be enabled.
6. Provide "OPEN/CLOSE/STOP" pushbuttons with hold-to-run or momentary contact selection.
7. Provide "OPEN/CLOSE/STOP" indicating lights and zero-to-100 percent position indication in liquid crystal display window.
8. Motor shall be de-energized when valve is jammed.
9. Provide thermal overload and single phasing protection of motor.
10. For monitoring of actuator, provide set of single-pole/double-throw (SPDT) dry contacts. Monitor relay shall indicate that actuator is available for remote operation.
11. Provide each actuator with position controller. Controller shall have the following features:
    a. Receive 4 to 20 mADC analog control signal and position valve in proportion to this signal.
    b. Adjustments for duty cycle, band width, span, and zero.
    c. On loss of control signal valve shall stay in its last position.
    d. Provision for adequate cooling of actuator.
12. Provide actuator with position transmitter capable of producing 4 to 20 mADC output signal. Transmitter shall be standard slidewire (potentiometer) position transducer providing an output corresponding to zero-to-100 percent of travel. Accuracy shall be plus-or-minus one percent of scale. Transmitter shall include integral temperature-compensated, constant-voltage source for slidewire excitation. Transmitter shall be integral to actuator.
13. Supply actuator with circuit boards for high temperature service, minimum 55 degrees C.
14. Provide 120 VAC space heaters to maintain internal housing temperature at 20 degrees C.

J. Remote-mounted Control Stations

1. Where required by valve location or as indicated, provide remote control panels.
2. Enclosure: NEMA 4X, Type 316 stainless steel.
3. Provide "LOCAL/OFF/REMOTE" selector switch. In "LOCAL" position actuator shall be operated by "OPEN/CLOSE/STOP" pushbuttons. In "OFF" position, actuator shall be disabled from local and remote operation. In "REMOTE" position, "open/close/stop" control from remote source shall be enabled Provide contact when switch is in "REMOTE" position for remote indication.
4. Provide "OPEN/CLOSE/STOP" pushbuttons with hold-to-run or momentary contact selection.
5. Provide "OPEN/CLOSE/STOP" indicating lights and zero-to-100 percent position indication with liquid crystal display.

K. Testing

1. Test each actuator in manufacturer's shop in conformance with AWWA C540.

2.14 APPURTENANCES FOR EXPOSED METALLIC VALVES

A. General

1. For valves located less than five feet above operating floor, provide levers on four-inch diameter quarter-turn valves, and provide handwheels on all other valves, unless otherwise shown or specified.
2. For valves located five feet or more above operating floor, provide chain operators.
3. Where indicated, provide extension stems and floorstands.

B. Handwheels

1. Conform to applicable AWWA standards.
2. Material of Construction: Ductile iron, or cast aluminum.
3. Arrow indicating direction of opening and word "OPEN" shall be cast on trim of handwheel.
4. Maximum Handwheel Diameter: 2.5 feet.

C. Chain Operators

1. Chains shall extend to three feet above operating floor.
2. Provide 1/2-inch stainless steel hook bolt to keep chain out of walking area.
3. Materials of Construction:
   a. Chain: Type 316L stainless steel.
   b. Chainwheel: Recessed groove type made out of Type 316 stainless steel.
   c. Guards and Guides: Type 316L stainless steel.
4. Chain Construction
   a. Chain shall be of welded link type with smooth finish. Chain that is crimped or has links with exposed ends is unacceptable.

5. Provide geared operators where required to position chainwheels in vertical position.

D. Crank Operator
   1. Crank operator shall be removable and fitted with rotating handle.
   2. Maximum Radius of Crank: 15 inches.
   3. Materials:
      a. Crank: Cast-iron or ductile iron.
      b. Handle: Type 304 stainless steel.
      c. Hardware: Type 304 stainless steel.

E. Extension Stems and Floor Stands for Gate Valves
   1. Conform to the applicable requirements of AWWA C501 for sizing of complete lifting mechanism.
   2. Bench and Pedestal Floor Stands
      a. For valves requiring extension stems, provide bench or pedestal floor stands with handwheel or crank as indicated. Provide provisions for using portable electric actuator for opening and closing of valves.
      b. Type: Heavy-duty with tapered roller bearings enclosed in a weatherproof housing, provided with positive mechanical seals around lift nut and pinion shaft to prevent loss of lubrication and to prevent moisture from entering housing. Provide lubrication fitting for grease. For valves conveying water that is potable or that will be treated to become potable, grease shall be food-grade and ANSI/NSF 61-listed. Base shall be machined.
      c. Materials of Construction
         i. Housing: Cast-iron, ASTM A126, Class B.
         ii. Lift Nut: Cast bronze, ASTM B98/B98M.
         iii. Grease Fitting: Stainless steel.
         iv. Bolting: Type 316 stainless steel.
   3. Wall brackets for floor stands shall be Type 316L stainless steel construction.
   4. Extension Stems
      a. Materials of Stems and Stem Couplings: Type 316 stainless steel.
      b. Maximum Slenderness Ratio (L/R): 100.
      c. Minimum Diameter: 1.5-inch.
      d. Threads: Acme.
      e. Provide stem couplings where stems are furnished in more than one piece. Couplings shall be threaded and keyed or threaded and bolted and shall be of greater strength than the stem.
      f. Weld to bottom of extension stem a Type 316 stainless steel cap suitable for square end of valve stem.
   5. Bottom Couplings: Ductile iron with Type 316 stainless steel pin and set screw.

6. Stem Guides
    a. Material: Type 316 cast stainless steel with bronze bushing for stem. For submerged service, Type 316 cast stainless steel with stainless steel bushing for stem.
    b. Maximum Stem Length Between Guides: Seven feet.
    c. Stem guides shall be adjustable in two directions.
7. Furnish stem cover of clear butyrate plastic or Grade 153 Lexan with cast adapter for mounting cover to bench and floor stands. Provide stem cover with gasketing and breathers to eliminate water intrusion into operator and condensation within cover. Provide stem cover with mylar tape with legible markings showing valve position at one-inch intervals and open and close limits of valve.

F. Floor Boxes: Provide cast-iron floor boxes for valves that are to be operated from floor above valve. Boxes shall be equal in depth to floor slab. Boxes shall have cast-iron covers and be fitted with bronze bushing.

2.15 APPURTENANCES FOR BURIED METALLIC VALVES

A. Wrench Nuts
1. Provide wrench nuts on buried valves of nominal two-inch size, in accordance with AWWA C500.
2. Arrow indicating direction of opening the valve shall be cast on the nut along with the word "OPEN".
3. Material: Ductile iron or cast-iron.
4. Secure nut to stem by mechanical means.

B. Extension Stems for Non-Rising Stem Gate Valves and Quarter-turn Buried Valves
1. Provide extension stems to bring operating nut to six inches below valve box cover.
2. Materials of Stems and Stem Couplings: Type 316 stainless steel.
3. Maximum Slenderness Ratio (L/R): 100
4. Provide top nut and bottom coupling of ductile iron or cast-iron with pins and set screws of Type 316 stainless steel.

C. Valve Boxes
1. Valve boxes shall be as indicated and as required.
2. Type: Heavy-duty, suitable for highway loading, two-piece telescopic, and adjustable. Lower section shall enclose valve operating nut and stuffing box and rest on valve bonnet.
3. Material: Cast-iron or ductile iron.
4. Coating: Two coats of asphalt varnish conforming to FS TT-C-494.
5. Marking: As required for service.

2.16 ANCHORAGES AND MOUNTING HARDWARE

A. General

1. Comply with Section 05 05 33, Anchor Systems, except as modified in this Section.
2. Obtain bolts, nuts, and washers for connection of valve and appurtenances to concrete structure or other structural members from valve Supplier.
3. Bolts, nuts, and washers shall be of ample size and strength for purpose intended. Anchorages in concrete shall be at least 5/8-inch diameter.
4. Provide stem guide anchorages of required strength to prevent twisting and sagging of guides under load.
5. Materials: Provide bolts and washers of Type 316 stainless steel and nitrided nuts. Bolts shall have rolled threads. Bolts and nuts shall be electropolished to remove burrs.

2.17 TOOLS, LUBRICANTS, AND SPARE PARTS

A. Lubricants: For valves, actuators, and appurtenances requiring lubricants, provide suitable lubricants for initial operation and for first year of use following Substantial Completion. Lubricants for equipment associated with conveying potable water or water that will be treated to become potable shall be food-grade and ANSI/NSF 61-listed.

B. Tools, spare parts, and maintenance materials shall conform with Section 01 78 43, Spare Parts and Extra Materials.

2.18 PAINTING OF EXPOSED VALVES, HYDRANTS, AND APPURTENANCES

A. Exterior steel, cast-iron, and ductile iron surfaces, except machined surfaces of exposed valves and appurtenances, shall be finish painted in manufacturer's shop. Surface preparation, priming, finish painting, and field touch-up painting shall conform to Section 09 91 00, Painting.

2.19 PAINTING OF BURIED VALVES

A. Exterior steel, cast-iron, and ductile iron surfaces, except machined or bearing surfaces of buried valves, shall be painted in valve manufacturer's shop with two coats of asphalt varnish conforming to FS TT-C 494.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine conditions under which materials and equipment are to be installed and notify Owner's Representative in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General

1. Install valves and appurtenances in accordance with:
    a. Supplier's instructions and the Contract Documents.
    b. Requirements of applicable AWWA standards.
    c. Applicable requirements of Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
2. Install valves plumb and level. Install all valves to be free from distortion and strain caused by misaligned piping, equipment, and other causes.
3. Position swing check valves and butterfly valves so that, when valve is fully open, valve disc does not conflict with piping system elements upstream and downstream of valve.

B. Exposed Valves
1. Provide supports for large or heavy valves and appurtenances as shown or required to prevent strain on adjoining piping.
2. Operators
    a. Install valves so that operating handwheels or levers can be conveniently turned from operating floor without interfering with access to other valves, piping, structure, and equipment, and as approved by Owner's Representative.
    b. Avoid placing operators at angles to floors or walls.
    c. Orient chain operators out of way of walking areas.
    d. Install valves so that indicator arrows are visible from floor level.
    e. For motor-operated valves located lower than five feet above operating floor, orient motor actuator to allow convenient access to pushbuttons and handwheel.
3. Floor Stands and Stems
    a. Install floor stands as shown and as recommended by the manufacturer.
    b. Provide lateral restraints for extension bonnets and extension stems as shown and as recommended by manufacturer.
    c. Provide sleeves where operating stems pass through floor. Extend sleeves two inches above floor.

C. Buried Valves
1. Install valve boxes plumb and centered, with soil carefully tamped to a lateral distance of four feet on all sides of box, or to undisturbed trench face if less than four feet.
2. Provide flexible coupling next to each buried valve.

D. Plug Valves
1. Install plug valves that are in horizontal liquid piping with stem horizontal and plugs on top when valve is open. Plug shall be on upstream end when valve is closed.
2. Install plug valves that are in vertical liquid piping with plug at top when closed or as recommended by valve Supplier.
3. Supplier shall tag or mark plug valves to indicate proper mounting position.

3.03 FIELD QUALITY CONTROL

A. Special Inspections under the provisions of Division 01 - Section 01 45 33 - Code Required Special Inspections and Procedures.

B. Supplier's Services

1. Provide services of qualified factory trained service technicians to check and approve installation of the following types of valves:
X (To be filled in).

2. Supplier's serviceman shall perform the following:

a. Supervise unloading of the following equipment:

b. Instruct Contractor in installing equipment.

c. Supervise installation of equipment.

d. Inspect and adjust equipment after installation and ensure proper operation.

e. Instruct Owner's personnel in operating and maintaining the equipment.

3. Manufacturer's representative shall make a minimum of one visit, with a minimum of four hours onsite for each visit. First visit shall be for unloading supervision (if specified) and instruction of Contractor in installing equipment; second visit shall be for assistance in installing equipment; third visit shall be for checking completed installation and start-up of system; fourth visit shall be to instruct operations and maintenance personnel. Representative shall revisit the Site as often as necessary until installation is acceptable.

4. Training: Furnish services of Supplier's qualified factory trained specialists to instruct Owner's operations and maintenance personnel in recommended operation and maintenance of equipment. Training requirements, duration of instruction and qualifications shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.

5. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

3.04 SUPPLEMENTS

A. The supplements listed below, following "End of Section" designation, are a part of this Specification Section:

1. Table 40 05 53-A, Schedule of Valves with Electric Actuators.

END OF SECTION 40 05 53