November 2, 2023 Contract No. 23-13-C

ADDENDUM NO. 2 to CSA 30 & 32 Well Site Improvements And Manganese Treatment, revising the Special Provisions as follows:

TABLE OF CONTENTS

No changes

NOTICE TO BIDDERS

No changes

SPECIAL PROVISIONS

ADD: Section 26 05 73

ADD: Section 40 05 23

DELETE: from Section 26 24 13-3.03:

A. Contractor shall obtain the services of an independent testing company who shall provide quality control and adjustments as well as tests.

REPLACE with:

A. Contractor shall provide quality control and adjustments as well as tests.

DELETE:

2-1.33C (13) Proposal 13(a) through Proposal 13(b) - Exhibit 15-G Local Agency Bidder DBE Commitment (Construction Contracts)

For a Federal-aid contract, bidders must complete and submit so that it is received by Design Services, no later than 4:00 PM on the fifth calendar day after the bid opening if not submitted with the bid.

REPLACE with:

DBE Information – Good Faith Efforts – Proposal 13

Complete and return with bid.

DELETE:

2-1.33C(14) Proposal 14(a) through proposal 14(c) - *Exhibit 15-H DBE Information — Good Faith Efforts*

For a Federal-aid contract, if you have not met the DBE goal, bidders must complete and submit so that it is received by Design Services no later than 4:00 PM on the fifth calendar day after the bid opening if not submitted with the bid.

REPLACE with:

Guidelines for meeting the California state revolving fund programs Disadvantaged Business Enterprise Requirements – Proposal 14

Complete, sign, and return with bid.

DELETE:

2-1.33C(15) Proposal 15(a) through Proposal 15(b) – Exhibit 12-B Bidder's List of Subcontractor (DBE and Non-DBE)

For a Federal-aid contract, bidders must submit so that it is received by Design Services, no later than 4:00 PM on the fifth (5th) calendar day after the bid opening if not submitted with the bid. Fill out as completely as possible.

REPLACE with:

Guaranty – Proposal 15

Does not need to be signed with the bid. Part of the contract which must be signed by the contractor when contract is executed.

DELETE:

2-1.33C(16) Proposal 16 - *Opt out of payment adjustments for price index fluctuations*

Not Used

2-1.33C(17) Proposal 17 – *Guaranty*

Does not need to be signed with the bid. Part of the contract which must be signed by the contractor when contract is executed.

PROPOSAL

No changes

BID BOOK

No changes

AGREEMENT

No changes

PLANS
Changes to the following pages are denoted by a revision cloud and 

DELETE:
Page G2.

REPLACE with**:**
Page G2-1.

DELETE:
Page CD4 and CD5.

REPLACE with**:**
Page CD4-1 and CD5-1.

DELETE:
Page E0.0.

REPLACE with**:**
Page E0.0-1.

DELETE:
Page E1.3.

REPLACE with**:**
Page E1.3-1.

DELETE:
Page E1.4.

REPLACE with**:**
Page E1.4-1.

PROJECT DETAILS

Files listed as available on Design Services webpage have been posted.

END OF ADDENDUM NO. 2

Please attach this Addendum to the inside cover of the Specifications booklet. If you have given the Bidding and Contract Documents to someone else, please forward this Addendum.

11/2/23
Date Signed

Supervising Engineer: _____
Sebastian Artal, PE C76724

FRESNO COUNTY
Department of Public Works and Planning
m/a 2220 Tulare Street, Suite 720
Fresno, CA 93721-2106

Please attach this Addendum to the inside cover of the Specifications booklet. If you have given the Bidding and Contract Documents to someone else, please forward this Addendum.

11/1/2023

Date Signed

Engineer of Record: _____

Nick Jacobson, PE C84909

Provost & Pritchard
455 W Fir Avenue
Clovis, CA 93711

Date Signed

Kevin L. Pezzoni, PE

Digitally signed by Kevin L. Pezzoni, PE
DN: C=US, E=kpezzoni@pezengr.com, O="Pezzoni Engineering, Inc.", CN="Kevin L. Pezzoni, PE"
Date: 2023.11.01 10:03:19-07'00'

Engineer of Record: _____

Kevin Pezzoni, PE 16269

Pezzoni Engineering, Inc
1150 9th Street
Suite 1415
Modesto, CA 95354

SECTION 26 05 73

ELECTRICAL SYSTEM STUDIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes requirements for:

1. Short Circuit Fault Analysis Study.

2. Protective Device Coordination Study.

3. Arc-Flash Hazard Study.

B. Related Sections:

1. Contract documents are a single integrated document, and as such all divisions and sections apply. It is the responsibility of the CONTRACTOR and

its subcontractors to review all sections to ensure a complete and coordinated project.

1.02 REFERENCES

A. Refer to Section 26 05 00.

B. Institute of Electrical and Electronics Engineers (IEEE):

1. 141 - IEEE Recommended Practice for Electric Power Distribution for

Industrial Plants (Red Book).

2. 242 - IEEE Recommended Practice for Protection and Coordination of

Industrial and Commercial Power Systems (Buff Book).

3. 399 - IEEE Recommended Practice for Industrial and Commercial Power

Systems Analysis (Brown Book).

4. 1015 - IEEE Recommended Practice For Applying Low Voltage Circuit

Breakers Used in Industrial and Commercial Power Systems - Corrigendum 1 (Blue Book).

5. 1584 - IEEE Guide for Performing Arc Flash Hazard Calculations.

6. 315 - IEEE Standards Electrical and Electronics Graphic and Letter Symbols and Reference Designations.

7. 902 - IEEE Guide for Maintenance, Operation and Safety on Industrial and Commercial Power Systems (Yellow Book).

C. National Fire Protection Association (NFPA):

1. 70E - Standard for Electrical Safety in the Workplace.

1.03 DEFINITIONS

A. Refer to Section 26 05 00.

1.04 SYSTEM DESCRIPTIONS

A. The Study shall be performed under the direction of a licensed Professional Engineer in good outstanding with the California Board for Professional Engineers and Land Surveyors.

B. General study requirements:

1. Scope:

a. The short-circuit fault analysis, protective device coordination, and arc-flash hazard studies shall include all equipment in the power distribution system including but not limited to:

1) Utility equipment.

2) Switchgear.

3) Generators.

4) Transformers:

a) Including all dry-type transformers.

5) Motor Control Centers.

6) Free standing variable frequency drives and starters.

7) Disconnect Switches.

8) Motors.

9) Panelboards:

a) Including all 240 and 208 volt systems.

10) Vendor Control Panels.

11) HVAC Equipment.

Study Scenarios:

1) The studies shall include all possible electrical system configurations, for example:

a) Operation on normal (utility) source.

b) Operation on generator source.

c) Main-breakers closed, tie breaker open.

d) Either main-breaker open, tie breaker closed.

2. Obtain, for all equipment, the required data for preparation of the study, including, but not limited to:

a. Transformer kilovolt-ampere and impedances.

b. Generator impedances.

c. Generator decrement curves.

d. Bus withstand ratings.

e. Cable and bus data.

f. Protective device taps, time dials, instantaneous pickups, and time delay settings.

3. Obtain the Electric Utility information on the minimum and maximum available fault current, minimum and maximum utility impedances, utility protective device settings including manufacturer and model number, interrupting ratings, X/R ratios, and model information one level above the point of connection:

a. Utility tolerances and voltage variations.

4. The individual performing the studies shall visit the site and collect all necessary field data in order to perform and complete comprehensive electrical system studies.

5. Obtain equipment layouts and configurations from the manufacturer’s final submittal requirements and project layout drawings as required.

6. Bus and conductor data:

   a. Use impedances of the actual installed or specified conductors, unless otherwise indicated.

   b. Use cable and bus impedances calculated at 25 degrees Celsius, unless otherwise indicated.

   c. Use 600-volt cable reactance based on typical dimensions of actual installed or specified conductors, unless otherwise indicated.

   d. Use bus withstand values for all equipment having buses.

   e. Use medium voltage cable reactances based on typical dimensions of shielded cables with 133 percent insulation levels, unless otherwise indicated.

7. Motors:

   a. Each motor shall be individually modeled:

      1) Grouping of motors for fault contribution current is not acceptable.

   b. Motors with variable frequency drives may be assumed to have no contribution to fault current.

8. Use the equipment, bus, and device designations as indicated on the Drawings for all studies.

C. Short-circuit fault analysis study additional requirements:

1. The short-circuit fault analysis shall be performed and submitted in 2 phases:

   a. Initial short-circuit fault analysis:

      1) Based on the Contract Documents and Electric Utility information.

      2) The initial short-circuit fault analysis report shall indicate the estimated available short-circuit current at the line side terminals of

         each piece of equipment covered by the scope of the study.

      3) Provide a list of assumptions used in the initial study.

   b. Final short-circuit analysis:

      1) The final short-circuit fault analysis shall modify the initial analysis as follows:

         a) Utilize the actual equipment provided on the project.

b) Utilize conductor lengths based on installation.

2. Calculate 3-phase bolted fault, line-to-line fault, line-to-ground fault, double line-to-ground fault, short-circuit 1/2 cycle momentary symmetrical and asymmetrical RMS, 1-1/2 and 4 cycle, interrupting symmetrical RMS, and 30 cycle steady state short circuit current values at each piece of equipment in the distribution system.

3. Evaluate bus bracing, short circuit ratings, fuse interrupting capacity and circuit breaker adjusted interrupting capacities against the fault currents, and calculate X/R values:

   a. Identify and document all devices and equipment as either inadequate or acceptable.

4. Calculate line-to-ground and double line-to-ground momentary short circuit values at all buses having ground fault devices.

5. Provide calculation methods, assumptions, one-line diagrams, and source

   impedance data, including Utility X/R ratios, typical values, recommendations, and areas of concern.

D. Protective device coordination study additional requirements:

1. Furnish protective device settings for all functions indicated on the Drawings, including, but not limited to:

   a. Current.

   b. Voltage:

      1) Provide settings for all voltage relays based upon actual Utility and generator tolerances and specifications.

   c. Frequency:

      1) Provide settings for all frequency relays based upon actual Utility and generator tolerances and specifications.

   d. Negative sequence.

   e. Reverse power.

   f. Machine protection functions:

      1) Provide settings for all motor and generator protective relays based on the manufacturer’s recommended protection requirements.

2. Provide log-log form time-current curves (TCC's) graphically indicating the coordination proposed for the system:

    a. Include with each TCC a complete title and one-line diagram with legend identifying the specific portion of the system covered by the particular

        TCC:

        1) Typical time-current curves for identical portions of the system, such as motor circuits, are acceptable as allowed by the ENGINEER.

    b. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics:

        1) These details can be included on the TCC.

    c. Include a detailed description of each protective device tap, time dial, pickup, instantaneous, and time delay settings:

        1) These details can be included in the TCC.

3. TCC's shall include all equipment in the power distribution system where required to demonstrate coordination. Include Utility relay and fuse characteristics, medium voltage equipment protective relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, transformer characteristics, motor and generator characteristics, and characteristics of other system load protective devices:

    a. Include all devices down to the largest branch circuit and largest feeder circuit breaker in each motor control center, main breaker in branch panelboards and fused disconnect switches.

    b. Provide ground fault TCC's with all adjustable settings for ground fault protective devices.

    c. Include manufacturing tolerances and damage bands in plotted fuse and circuit breaker characteristics.

    d. On the TCC's show transformer full load currents, transformer magnetizing inrush, ANSI transformer withstand parameters and transformer damage curves.

    e. Cable damage curves.

    f. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed based on the short-circuit fault analysis study.

    g. Coordinate time interval medium-voltage relay characteristics with upstream and downstream device to avoid nuisance tripping.

4. Site Generation: When site generation (including cogeneration, standby, and emergency generators) is part of the electrical system, include phase and ground coordination of the generator protective devices:

    a. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices.

5. Suggest modifications or additions to equipment rating or settings in a tabulated form.

E. Arc-Flash Hazard Study Additional Requirements:

1. Include the calculated arc-flash boundary and incident energy (calories/square centimeter) at each piece of equipment in the distribution system:

    a. Perform Arc-flash calculations for both the line side and load side of switchgear, motor control center and panelboard main breakers.

    b. Perform arc-flash calculations for all short-circuit scenarios with all motors on for 3 to 5 cycles and with all motors off.

    c. Protective device clearing time shall be limited to 2 seconds, maximum.

2. Provide executive summary of the study results.

3. Provide a detailed written discussion and explanation of the tabulated outputs.

4. Provide alternative device settings to allow the OWNER to select the desired functionality of the system:

    a. Identify the arc-flash energy based upon the criteria of maintaining coordination and selectivity of the protective devices.

5. Perform the arc flash study calculations using both IEEE 1584 and NFPA 70E. Provide both studies in the final report. Provide summary based upon worst case results between IEEE 1584 and NFPA 70E.

6. Perform study with 15 percent arcing fault variation as defined by IEEE 1584.

7. Perform arc-flash scenarios at minimum and maximum utility and generator fault contributions

F. Electrical system study meetings:

1. The individual conducting the short circuit analysis, protective device coordination, and the arc-flash hazard studies shall meet with the OWNER

and ENGINEER 1 time.

2. The purpose of the meeting is to Discuss the OWNER's operational requirements for both normal operation and maintenance.

G. By virtue of the fact that this is a professional study the OWNER reserves the right to modify the requirements of the study to comply with its operational requirements. The protective device coordination study and the arc-flash study shall be modified based on the results of the meetings with the OWNER.

1.05 SUBMITTALS

A. Furnish submittals in accordance with General Conditions.

B. Initial Studies and Reports:

1. Include the following in the initial short circuit current report:

a. List of all devices included in the studies.

b. A description of all operating scenarios.

c. Form and format of arc flash labels.

C. Final Studies and Reports:

1. Format and Quantity:

a. Provide 6 bound copies of all final reports.

b. Provide 3 complete sets of electronic files on CD or DVD media, including electrical system model(s), configuration files, custom libraries, any other files used to perform the studies and produce the reports. Also provide an electronic version of the bound reports in PDF format.

2. Include the sections below in the final report:

a. Copies of correspondence and data obtained from the Electric Utility Company.

b. Letter certifying the inspection and verification of existing equipment.

c. One-line diagrams:

1) The following information shall be included at a minimum:

a) Motor horsepower.

b) Transformer data:

(1) KVA.

(2) Configuration.

c) Cable Data:

(1) Insulation.

(2) Size.

(3) Length.

2) One-line diagrams shall be fully legible at 11-inch by 17-inch size.

d. Include in the short-circuit fault analysis study:

1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.

2) Normal system connections and those, which result in maximum fault conditions.

3) Tabulation of circuit breaker, fuse, and other protective device ratings compared to maximum calculated short-circuit duties.

4) Fault current calculations for the cases run including a definition of terms and guide for interpretation of computer software printouts.

e. Protective device coordination study shall include:

1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.

2) List all requirements used in the selection and setting criteria for any protective devices.

3) Manufacturer’s time-current curves for circuit breakers, fuses, motor circuit protectors, and other protective devices for all new equipment.

4) Time-current curves (TCC’s) graphically indicating the coordination proposed for the system on log-log graphs. At least 3 of the copies shall be in color.

5) Tabulation of relay, fuse, circuit breaker, and other protective devices in graphical form with a one-line diagram to display area coordination.

6) Where coordination could not be achieved, an explanation shall be included in the report to support the statement along with recommendations to improve coordination. Recommended equipment modifications or settings shall be in a tabulated form.

f. Include in the arc-flash study:

1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.

2) Normal system connections and those, which result in maximum arc- flash conditions.

3) Arc-flash raw data, calculations, and assumptions.

4) Arc-flash label data:

a) Identifying the content of each label.

b) Identifying the location of each label.

D. Certification:

1. Submit written certification, sealed, and signed by the professional engineer conducting the study, equipment supplier, and electrical subcontractor stating that the data used in the study is correct.

E. Submit the credentials of the individual(s) performing the study and the individual in responsible charge of the study.

F. The ENGINEER will review all studies and reports. After review, the ENGINEER will make recommendations and/or require changes to be made to the short-circuit analysis, protective device coordination or arc-flash studies. These changes shall be provided as part of the scope of work.

G. Submit course outline for OWNER'S training.

1.06 QUALITY ASSURANCE

A. Qualifications of the entity responsible for electrical system studies:

1. The studies shall be performed, stamped, and signed by a Professional Engineer registered in the state where the project is located.

2. A minimum of 5 years' experience in power system analysis is required for the individual in responsible charge of the studies.

3. The short-circuit analysis, protective device coordination, and arc-flash hazard studies shall be performed with the aid of a digital computer program:

a. Point-to-point calculations are not acceptable.

C. The study shall be performed by an independent firm.

1.07 SEQUENCING

A. Submit the initial short-circuit analysis study before submittal of any electrical equipment.

B. Submit the final short-circuit analysis and protective device coordination studies.

C. First arc-flash meeting.

D. Submit the arc-flash hazard study.

E. Second arc-flash meeting.

F. Third arc-flash meeting and final reports.

G. Label equipment with approved arc flash labels.

H. OWNER's training.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Electrical system study software one of the following:

1. ETAP by Control Technologies.

2. SKM.

2.02 COMPONENTS

A. Arc-Flash Hazard Labels:

1. Dimensions:

a. Minimum 5 inches by 3.5 inches.

2. Materials:

a. Polyester with polyvinyl polymer over-laminate.

b. Self-adhesive.

c. Resistant to:

1) UV.

2) Chemicals and common cleaning solvent resistant.

3) Scuffing.

4) Wide temperature changes.

3. Contents:

a. Short-circuit bus identification.

b. Calculated incident energy (calories/square centimeter) range.

c. Hazard/risk, personnel protective equipment category number.

d. Arc-flash protection boundary.

e. Shock Hazard Boundary:

1) The CONTACTOR may provide separate labels for indication of the shock hazard boundary.

f. Description of the combined level of personnel protective equipment.

4. Color Scheme:

a. For locations above 40 calories/square centimeter:

1) White label with red “DANGER” strip across the top.

2) Black lettering.

b. For locations below 40 calories/square centimeter:

1) White label with orange “WARNING” strip across the top.

2) Black lettering.

PART 3 EXECUTION

3.01 INSTALLATION

A. After review and acceptance of the arc-flash hazard study by the ENGINEER, install all arc-flash hazard labels:

1. Install labels at all locations required by NFPA, ANSI, or IEEE standards.

2. At a minimum install labels in the following locations:

a. The front of each main or incoming service compartment.

b. The front of each low voltage switchgear section.

c. The front of each medium voltage circuit breaker door.

d. The front of each accessible auxiliary or conductor compartment.

e. Each accessible rear or side vertical section.

f. Each motor control center compartment.

g. Each panelboard covered by the study.

h. Each control panel, individual starter or VFD or other equipment covered by the scope of the study.

3. Install labels prior to equipment energization.

B. After review and acceptance of the arc-flash hazard study and coordination study by the ENGINEER, adjust protective device settings per final study prior to equipment energization.

1. Devices which require power for configuration may be set during energization, but before any subfed loads are energized.

2. Ensure that settings for upstream, existing equipment are set prior to energizing new downstream devices.

3.02 FIELD QUALITY CONTROL

A. The individual performing the arc-flash hazard study shall direct the installation of the arc-flash hazard labels:

1. Remove and replace any improperly applied labels.

2. Repair the equipment finish damaged by removal of any label.

3. Install labels to within 1/64 inch of level or plumb across the entire dimension of the label.

3.03 ADJUSTING

A. After review and acceptance of the recommended settings in the Protective Device Coordination Study, make settings in accordance with the manufacturer's instructions.

END OF SECTION

1

SECTION 40 05 23

VALVES AND APPURTENANCES

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section includes materials, testing, and installation of manually operated valves and check valves including gate, butterfly, ball, hose bibbs, globe, check, solenoid, mud valves, vacuum breakers and flap valves.

1.2 RELATED WORK

A. Section 09 90 00 – Painting and Coating

B. Section 40 05 60 – Air-Release and Vacuum-Relief Valves

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM)

B. American Water Works Association (AWWA)

1.4 SUBMITTALS

A. Submit shop drawings in accordance with the General Provisions.

B. As specified in Section 01 33 00 – Submittal Procedures

C. Submit manufacturer's catalog data and detail construction sheets showing all valve parts. Describe each part by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type.

D. Show valve dimensions including laying lengths. Show port sizes. Show dimensions and orientation of valve actuators, as installed on the valves. Show location of internal stops for gear actuators. State differential pressure and fluid velocity used to size actuators. For worm-gear actuators, state the radius of the gear sector in contact with the worm and state the handwheel diameter.

E. Show valve linings and coatings. Submit manufacturer's catalog data and descriptive literature.

F. Submit six copies of a report verifying that the valve interior linings and exterior coatings have been tested for holidays and lining thickness. Describe test results and repair procedures for each valve. Do not ship valves to project site until the reports have been returned by the Owner's Representative and marked "Resubmittal not required.”

1

G. For butterfly valves, show the clear diameter or size of the port. Show the actual area of the port as a percentage of the area as calculated for the nominal valve size.

PART 2 PRODUCTS

2.1 GENERAL

A. Valves are identified in the drawings by size, category and type number. For example, a callout in the drawings of 6" Type-1 butterfly valve refers to Type-1 valve in the butterfly valve category in these specifications, which is a Class 125 rubber seated butterfly valve.

B. All valves installed in potable water applications shall conform to California AB 1953 no-lead regulations and ANSI/NSF Standard 61.

C. Install valves complete with operating handwheels or levers, chainwheels, extension stems, floor stands, gear actuators, operating nuts, chains, and wrenches required for operation.

D. Valves shall have the name of the manufacturer and the size of the valve cast or molded onto the valve body or bonnet or shown on a permanently attached plate.

2.2 VALVE ACTUATORS

A. Provide lever or wrench actuators for exposed valves 6 inches and smaller. For larger valves, provide handwheels.

B. Where manually operated valves (size 4 inches and larger) are installed with their centerlines more than 6 feet 9 inches above the floor, provide chainwheel and guide actuators.

C. Provide 2-inch AWWA operating nuts for buried and submerged valves.

D. Provide enclosed gear actuators on butterfly valves 8 inches and larger, unless electric motorized valve actuators are shown in the drawings. Gear actuators for valves 8 through 20 inches shall be of the worm and gear, or of the traveling nut type. Gear actuators for valves 24 inches and larger shall be of the worm and gear types. Gear actuators for motorized valves shall be of the worm and gear type, regardless of size.

E. Provide gear actuators on gate valves 14 inches and larger, unless electric motorized valve actuators are shown in the drawings. Gear actuators shall be of the bevel or spur gear type. Provide grease case. Gearing shall comply with AWWA C500.

F. Design gear actuators assuming that the differential pressure across the plug, gate, or disc is equal to the test pressure of the connecting piping and assuming a fluid velocity of 16 fps for valves in liquid service and 80 fps for valves in air or gas

service and a line fluid temperature range of 33°F to 125°F unless otherwise required in the detailed valve specifications. Size actuators using a minimum safety factor of 1.5 for valves in open/close service and 2.0 in modulating service.

G. Gear actuators shall be enclosed, oil lubricated, with seals provided on shafts to prevent entry of dirt and water into the actuator. Gear actuators for valves located above ground or in vaults and structures shall have handwheels. The actuators for valves in exposed service shall contain a dial indicating the position of the valve disc or plug. Gear actuators for buried or submerged valves shall have 2-inch-square AWWA operating nuts.

H. For buried or submerged service or valves installed in buried vaults, provide watertight shaft seals and watertight valve and actuator cover gaskets. Provide totally enclosed actuators designed for buried or submerged service.

I. Traveling nut and worm and gear actuators shall be of the totally enclosed design so proportioned as to permit operation of the valve under full differential pressure rating of the valve with a maximum pull of 40 pounds on the handwheel or crank. Provide stop limiting devices in the actuators in the open and closed positions. Actuators shall be of the self-locking type to prevent the disc or plug from creeping. Design actuator components between the input and the stop-limiting devices to withstand without damage a pull of 200 pounds for handwheel or chainwheel actuators and an input torque of 300 foot-pounds for operating nuts when operating against the stop.

J. Handwheel diameters for traveling nut actuators shall not exceed 8 inches for valves 12 inches and smaller and shall not exceed 12 inches for valves 20 inches and smaller.

K. Design actuators on buried valves to produce the required torque on the operating nut with a maximum input of 150 foot-pounds.

L. Valve actuators, handwheels, or levers shall open by turning counterclockwise.

2.3 CAST IRON VALVE BOXES AND RISERS

A. Valve boxes shall be Christy G5 with Christy Iron Covers or equal unless otherwise shown on the Drawings.

B. Risers shall be 8-inch nominal diameter PVC pipe conforming to AWWA C900.

2.4 INDICATOR POSTS

A. Indicator posts for buried gate valves in fire protection service shall be UL listed, FM approved for use on valves of sizes 4 through 12 inches. Provide a target or sign visible through a window on both sides of the post that indicates the open or shut position of the gate valve. Working parts shall be fully enclosed for weather protection. Body shall be cast or ductile iron. Provide post extension if trench is deeper than can be served by manufacturer's standard post. Coat buried portion of

indicator posts per Section 09 90 00, System No. 21. Products: Nibco NIP-1, Stockham Figure G-951, or equal.

2.5 EXTENSION STEMS FOR BURIED AND SUBMERGED VALVE ACTUATORS

A. Where the depth of the valve is such that its centerline is more than 4 feet below grade, provide operating extension stems to bring the operating nut to a point 6 inches below the surface of the ground and/or box cover. Where the valve is submerged, provide operating extension stems to bring the operating nut to 6 inches above the water surface. Extension stems shall be Type 316 stainless steel, solid core, and shall be complete with 2-inch-square operating nut. The connections of the extension stems to the operating nuts and to the valves shall withstand without damage a pull of 300 foot-pounds.

B. Extension stem diameters shall be as tabulated below:

Valve Size (inches)	**Minimum Extension Stem Diameter (inches)**
2	3/4
3, 4	7/8
6	1
8	1 1/8
10, 12	1 1/4
14	1 3/8
16, 18	1 1/2
20, 24, 30, 36	1 3/4
42, 48, 54	2

2.6 FLOOR STANDS, EXTENSION STEMS, AND EXTENSION STEM SUPPORT BRACKETS

A. When required by the installations, provide floor stands and extension stems for operation of valves. Floor stands shall be of the nonrising stem, indicating type, complete with steel extension stems, couplings, handwheels, stem guide brackets, and special yoke attachments as required by the valves and recommended and supplied by the stand manufacturer. Floor stands shall be cast-iron base type: Clow, Figure F-5515; Bingham and Taylor; Stockham; or equal. Handwheels shall turn counterclockwise to open the valves.

B. Provide Type 316 stainless steel anchor bolts.

C. Provide steel extension stems for valves in exposed service. Provide Type 316 stainless steel stems for valves in submerged service.

D. Provide adjustable stem guide brackets for extension stems. The bracket shall allow valve stems to be set over a range of 2 to 36 inches from walls. Provide bushings drilled to accept up to 2-inch-diameter stems. Base, arm, and clamp shall be ductile iron. Coat ductile iron components with fusion-bonded epoxy per Section 09 90 00. Bushing shall be bronze (ASTM B584, Alloy C86400 or C83600). Bolts, nuts, screws, and washers (including wall anchor bolts) shall be Type 316 stainless steel. Provide slots in the bracket to accept 3/4-inch bolts for mounting the bracket to the wall. Products: Trumbull Industries, Inc., Adjustable Stem Guide or equal.

2.7 CHAINWHEELS AND GUIDES

A. Chainwheels and guides shall be Clow Figure F-5680, DeZurik Series W or LWG, Stockham, or equal. Chainwheels and guides shall be galvanized iron or steel. Chains shall extend to within 4 feet of the operating floor. Chains shall be galvanized steel.

2.8 BOLTS AND NUTS FOR FLANGED VALVES

A. Bolts and nuts for flanged valves shall be as described in Section 40 05 00.

2.9 GASKETS FOR FLANGES

A. Gaskets for flanged end valves shall be as described in Section 40 05 00.

2.10 PAINTING AND COATING

A. Coat metal valves located above ground or in vaults and structures the same as the adjacent piping. If the adjacent piping is not coated, then coat valves per Section 09 90 00. Apply the specified prime coat at the place of manufacture. Apply intermediate and finish coats in field.

B. Coat buried metal valves at the place of manufacture per Section 09 90 00, System No. 7**.**

C. Coat submerged metal valves, stem guides, extension stems, and bonnets at the place of manufacture per Section 09 90 00, System No. 1.

D. Line the interior metal parts of metal valves 4 inches and larger, excluding seating areas and bronze and stainless steel pieces, per Section 09 90 00, System No. 1. Apply lining at the place of manufacture.

E. Alternatively, line and coat valves with fusion-bonded epoxy.

F. Coat floor stands per Section 09 90 00.

G. Test the valve interior linings and exterior coatings at the factory with a low-voltage (22.5 to 80 volts, with approximately 80,000-ohm resistance) holiday detector, using a sponge saturated with a 0.5% sodium chloride solution. The lining shall be holiday free.

H. Measure the thickness of the valve interior linings per Section 09 90 00. Repair areas having insufficient film thickness per Section 09 90 00

2.11 PACKING, O-RINGS AND GASKETS

A. Unless otherwise stated in the detailed valve specifications, packing, O-rings, and gaskets shall be one of the following nonasbestos materials:

1. Teflon.

2. Kevlar aramid fiber.

3. Acrylic or aramid fiber bound by nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or equal.

4. Buna-N (nitrile).

2.12 RUBBER SEATS

A. Rubber seats shall be made of a rubber compound that is resistant to free chlorine and monochloramine concentrations up to 10 mg/L in the fluid conveyed.

2.13 VALVES

A. Gate Valves:

1. Type 5—Ductile-Iron Resilient Wedge Gate Valves 4 Through 36 Inches (AWWA C515):

Valves shall comply with AWWA C515 and the following. Valves shall be of the bolted-bonnet type with nonrising stems. Valve stems shall be Type 304 or 316 stainless steel or cast, forged, or rolled bronze. Provide operating nut for buried valves. Provide handwheel for exposed valves. Stem nuts shall be made of solid bronze. Bronze for internal working parts, including stems, shall not contain more than 2% aluminum or more than 7% zinc. Bronze shall conform to ASTM B62 or ASTM B584 (Alloy C83600), except the stem bronze shall have a minimum tensile strength of 60,000 psi, a minimum yield strength of 30,000 psi, and a minimum of 10% elongation in 2 inches (ASTM B584 or B763, Alloy C87600 or C99500). Body bolts shall be Type 316 stainless steel. End connections for exposed valves shall be flanged. End connections for buried valves shall be mechanical joint type.

Provide reduction thrust bearings above the stem collar. Stuffing boxes shall be O-ring seal type with two rings located in stem above thrust collar. Each valve shall have a smooth unobstructed waterway free from any sediment pockets.

Valves shall be lined and coated at the place of manufacture with either fusion-bonded epoxy or heat-cured liquid epoxy. Minimum epoxy thickness shall be 8 mils.

Manufacturers: Clow, AVK, American Flow Control, Waterous, Kennedy, or equal.

B. Butterfly Valves:

1. Thrust Bearings for Butterfly Valves:

Provide thrust bearings to hold the valve disc in the center of the valve seat. No bearings shall be mounted inside the valve body within the waterway. Do not use thrust bearings in which a metal bearing surface on the disc rubs in contact with an opposing metal surface on the inside of the body.

2. Bronze Components in Butterfly Valves:

Bronze components in contact with water shall comply with the following requirements:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum 0.25% (potable use)
Copper + Nickel + Silicon	83% minimum

3. Port Sizes for Butterfly Valves:

For valves 24 inches and smaller, the actual port diameter shall be at least 93% of the nominal valve size. For valves larger than 24 inches, the port diameter shall not be more than 1.25 inches smaller than the nominal valve size. The dimension of the port diameter shall be the clear waterway diameter plus the thickness of the rubber seat.

4. Corrosion-Resistant Materials in Butterfly Valves:

Where AWWA C504 requires “corrosion resistant” material, such material shall be one of the following:

a. Bronze as described above.

b. Type 304 or 316 stainless steel.

c. Monel (UNS N04400).

d. Synthetic nonmetallic material.

5. Seating Surfaces in Butterfly Valves:

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Seating surfaces in valves having motorized actuators shall be stainless steel or nickel-copper per AWWA C504 or nickel-chromium alloy containing a minimum of 72% nickel and a minimum of 14% chromium.

6. Factory Leakage Testing:

Perform factory leakage tests per AWWA C504 on both sides of the seat.

7. Type 1—Flanged, Rubber-Seated Butterfly Valves 4 Through 72 Inches, Class 150B:

Butterfly valves shall be short body, flanged type for exposed valves and valves in vaults or structures, and either flanged or mechanical joint for buried valves. Valve shall conform to AWWA C504, Class 150B. Minimum working differential pressure across the valve disc shall be 150 psi. Flanged ends shall be Class 125, ASME B16.1. Valve shafts shall be stub shaft or one-piece units extending completely through the valve disc. Materials of construction shall be as follows:

Component	Material	Specification
Body	Cast iron or ductile iron	AWWA C504
Exposed body cap screws and bolts and nuts	Stainless steel	ASTM A276, Type 304 or 316
Discs	Cast iron, ductile iron, or Ni-Resist	AWWA C504
Shafts, disc fasteners, seat retention segments, and seat fastening devices	Stainless steel	ASTM A276, Type 304 or 316
Seat material	Buna-N	—

Where the rubber seat is applied to the disc, it shall be bonded to a stainless steel seat retaining ring which is clamped to the disc by Type 304 or 316 stainless steel screw fasteners or secured to a stainless steel seat by a combination of cap screws, a serrated disc retaining ring, and molded shoulders in the seat mating with machined registers in the disc Valves shall be Pratt, DeZurik Series BAW, M&H, Val-Matic, or equal.

C. Ball Valves:

1. Type 3—Bronze Ball Valve Curb Stops, 2 Inches and Smaller, for Water Service:

Ball valve curb stops shall be bronze with male inlet iron pipe threads and female outlet iron pipe threads and shall conform to AWWA C800. Components in contact with water shall be bronze (ASTM B584, Alloys C89833 or C89836). Components not in contact with water shall be bronze (ASTM B62 or ASTM B584, Alloys C83600, C89833, or C89836). Bronze alloys having a maximum lead content of 0.25%, a maximum zinc content of 7.0%, and a minimum copper content of 80% may be substituted for the bronze alloys specified above. Minimum pressure rating shall be 300 psi. Stops shall be Ford Ball Valve Curb Stop B81-777 with straight lever handle or equal.

2. Type 4—Bronze Ball/Corporation Stops, 2 Inches and Smaller, for Water Service:

   Corporation stops shall be bronze with male inlet iron pipe threads and female outlet iron pipe threads and shall conform to AWWA C800. Components in contact with water shall be bronze (ASTM B584, Alloys C89833 or C89836). Components not in contact with water shall be bronze (ASTM B62 or ASTM B584, Alloys C83600, C89833, or C89836). Bronze alloys having a maximum lead content of 0.25%, a maximum zinc content of 7.0%, and a minimum copper content of 80% may be substituted for the bronze alloys specified above. Minimum pressure rating shall be 300 psi. Stops shall be Ford Ballcorp Type FB 1700, James Jones J-1931, or equal.

3. Type 5—Bronze Angle Meter Stops for Water Service:

   Angle meter stops shall be bronze. Components in contact with water shall be bronze (ASTM B584, Alloys C89833 or C89836). Components not in contact with water shall be bronze (ASTM B62 or ASTM B584, Alloys C83600, C89833, or C89836). Bronze alloys having a maximum lead content of 0.25%, a maximum zinc content of 7.0%, and a minimum copper content of 80% may be substituted for the bronze alloys specified above. Minimum pressure rating shall be 150 psi.

   For 1-inch service and smaller, use Ford Ball Meter Valve No. BA13-444W, James Jones J-1966W, or equal. Provide valve with inlet iron pipe threads and meter saddle nut outlet.

   For larger than 1- through 2-inch service, use Ford Ball Meter Valve No. BFA13-666W or BFA13-777W or equal. Provide valve with inlet iron pipe threads and meter flange outlet.

4. Type 6—True Union CPVC Ball Valves:

   Ball valves, 2 inches and smaller, for chemical or water service shall be Schedule 80 full bore design, true union type. Where used in potable water service, the valve shall be ANSI/NSF-61 certified. Valves shall be constructed from CPVC Type IV, ASTM D 1784 Cell Classification 23447 and rated for a pressure of 150 psi at a temperature of 105°F and 235 psi at

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a temperature of 73°F. All O-rings shall be EPDM or FKM as required for the compatibility with the chemical service and seats shall be constructed of PTFE. All valve components shall be replaceable. Valves for sodium hypochlorite and hydrogen peroxide service shall include vented balls. Valves shall be manufactured by Spears Manufacturing, Asahi, Plast-O-Matic, Harrington or equal.

5. Type 7—True Union PVC Ball Valves:

Ball valves, 3 inches and smaller, for chemical or water service shall be Schedule 80 full bore design, true union type. Where used in potable water service, the valve shall be ANSI/NSF-61 certified. Valves shall be constructed from PVC Type I, ASTM D 1784 Cell Classification 12454 and rated for a pressure of 150 psi at a temperature of 105°F and 235 psi at a temperature of 73°F. All O-rings shall be EPDM or FKM as required for the compatibility with the chemical service and seats shall be constructed of PTFE. All valve components shall be replaceable. Valves for sodium hypochlorite and hydrogen peroxide service shall include vented balls. Valves shall be manufactured by Spears Manufacturing, Asahi, Plast-O-Matic, Harrington or equal.

D. Globe Valves, Angle Valves, Hose Valves, Hose Bibbs, and Fire Hydrants:

1. Type 4—Bronze Hose Bibbs:

Hose bibbs of size 1/2 inch, 3/4 inch, and 1 inch shall be all bronze (ASTM B62 or ASTM B584, Alloy C83600) with rising or nonrising stem, composition disc, bronze or malleable iron handwheel, and bronze stem (ASTM B99, Alloy C65100; ASTM B371, Alloy C69400; or ASTM B584, Alloy C87600). Packing shall be Teflon or graphite. Valves shall have a pressure rating of at least 125 psi for cold-water service. Threads on valve outlet shall be American National Standard fire hose coupling screw thread (ASME B1.20.7). Provide atmospheric vacuum breaker conforming to ASSE Standard 1011 and IAPMO code.

2. Dry Barrel Fire Hydrants (AWWA C502):

Refer to Drawings

E. Check Valves:

1. Type 4—Cast-Iron Swing Check Valves 3 Inches and Larger, Class 125:

Swing check valves, 3 inches and larger, shall be iron body, bronze mounted complying with AWWA C508 with the following materials of construction.

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Description	Material	Specification
Disc or clapper seat ring and valve body seat ring	Bronze or brass	ASTM B62 or B584 (Alloy C84400 or C87600)
Body and cap (bonnet)	Cast iron	ASTM A126, Class B
Disc and hinge or arm (valves 4 inches and smaller)	Bronze	ASTM B62 or ASTM B584 (Alloy C84400)
Disc and hinge or arm (valves larger than 4 inches)	Cast iron or bronze	ASTM A126, Class B; ASTM B62.
Hinge pin	Stainless steel	Type 303, 304, or 410 stainless
Cover bolts and nuts	Stainless steel	ASTM A193, Grade B8M; ASTM A194, Grade 8M
Internal fasteners and accessories	Bronze or Type 304 or 316 stainless steel	

Bronze or brass components in contact with water shall comply with the following requirements:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum 0.25% (potable use)
Copper + Nickel + Silicon	83% minimum

Ends shall be flanged, Class 125, ASME B16.1. Minimum valve working pressure shall be 150 psi. Provide check valves with outside lever.

The shop drawing submittal shall include a detail showing how the hinge pin extends through the valve body. Show packing gland, hinge pin gland, cap, and other pieces utilized.

Valves shall be M&H Style, Clow or equal.

2. Type 5—Cast-Iron Swing Check Valves 2 1/2 Inches and Larger for Fire Protection Service:

Swing check valves of sizes 2 1/2 through 12 inches for fire protection service shall be UL listed, FM approved, rated for at least 175 psi nonshock,

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cold water. Ends shall be flanged, Class 125, ASME B16.1. Materials of construction shall be as follows:

Description	Material	Specification
Body and cap	Cast iron	ASTM A126, Class B
Disc	Bronze or cast iron	ASTM B62; ASTM B584, Alloy C83600; or ASTM A126, Class B
Disc bushing, disc ring, and seat ring	Bronze	ASTM B62, or ASTM B584 (Alloy C83600)
Hinge pin	Brass	ASTM B16 or ASTM B21

Valves shall be Stockham G-939, Walworth Figure 8883 F, Nibco F-908, or equal.

3. Type 11—Silent Check Valve 3 Inches and Larger:

Silent check valves, 3 inches and larger, shall be bronze mounted globe style. The seat and plug shall be hand replaceable in the field. Provide resilient seat. Flow area through valve shall be equal to or greater than the cross sectional area of the equivalent pipe size. Valve plug shall be center guided with a through integral shaft and spring loaded for silent shutoff operation. Ends shall be flanged Materials of construction shall be as follows:

Component	Material	Specification
Body	Cast Iron	ASTM A48, Class 30, or ASTM A126, Class B
	Ductile Iron	ASTM A536, Grade 60-45-10
Plug and seal	Bronze	ASTM B62 or B584 (Alloys C83600 or C87600)
Spring	Stainless steel	Type 316 stainless

Valve shall be APCO Series 600 or equal.

F. Flap Valves

1. Type 1—Flap Valves:

Flap valves shall have cast-iron body (ASTM A48 or A126) with bronze (ASTM B62) hinge pin, flap ring, and seat. Ends shall be flanged, spigot end, or hub to match the connecting pipe. Products: Clow F-3012, F-3014, F-3016; Waterous Flap Valves; Waterman Industries; or equal.

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PART 3 EXECUTION

3.1 VALVE SHIPMENT AND STORAGE

A. Provide flanged openings with metal closures at least 3/16-inch thick, with elastomer gaskets and at least four full-diameter bolts. Install closures at the place of valve manufacture prior to shipping. For studded openings, use all the nuts needed for the intended service to secure closures. Alternatively, ship flanged valves 3 inches and smaller in separate sealed cartons or boxes.

B. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic (such as plastic) plugs or caps. Install caps or plugs at the place of valve manufacture prior to shipping. Alternatively, ship valves having threaded openings or end connections in separate sealed cartons or boxes.

C. Store resilient seated valves in sealed polyethylene plastic enclosures with a minimum of one package of desiccant inside. Store resilient seated valves in the open or unseated position. Valves with adjustable packing glands shall have the packing gland loosened prior to storage. Inspect valves at least once per week, replace desiccant if required and repair damaged storage enclosures. Do not store valves with resilient seats near electric motors or other electrical equipment.

D. Inspect valves on receipt for damage in shipment and conformance with quantity and description on the shipping notice and order. Unload valves carefully to the ground without dropping. Use forklifts or slings under skids. Do not lift valves with slings or chain around operating shaft, actuator, or through waterway. Lift valves with eyebolts or rods through flange holes or chain hooks at ends of valve parts.

E. Protect the valve and actuators from weather and the accumulation of dirt, rocks, and debris. Do not expose rubber seats to sunlight or ozone for more than 30 days. Also, see the manufacturer's specific storage instructions.

F. Make sure flange faces, joint sealing surfaces, body seats, and disc seats are clean. Check the bolting attaching the actuator to the valve for loosening in transit and handling. If loose, tighten firmly. Open and close valves having manual or power actuators to make sure the valve operates properly and that stops or limit switches are correctly set so that the valve seats fully. Close valve before installing.

3.2 FACTORY PRESSURE TESTING

A. Hydrostatically test the valve pressure-containing parts at the factory per the valve specification or per the referenced standard. If no testing requirement is otherwise specified or described in the referenced standards, then test with water for 30 minutes minimum at a pressure of 1.5 times the rated pressure but not less than 20 psig. Test shall show zero leakage. If leaks are observed, repair the valve and retest. If dismantling is necessary to correct valve deficiencies, then provide an additional operational test and verify that the valve components function.

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3.3 INSTALLING VALVES - GENERAL

A. Remove covers over flanged openings and plugs from threaded openings, after valves have been placed at the point to which the valves will be connected to the adjacent piping. Do not remove valves from storage cartons or boxes until they are ready to be installed.

B. Handle valves carefully when positioning, avoiding contact or impact with other equipment, vault or building walls, or trench walls.

C. Clean valve interiors and adjacent piping of foreign material prior to making up valve to pipe joint connection. Prepare pipe ends and install valves in accordance with the pipe manufacturer's instructions for the joint used. Do not deflect pipe-valve joint. Do not use a valve as a jack to pull pipe into alignment. The installation procedure shall not result in bending of the valve/pipe connection with pipe loading.

D. Make sure valve ends and seats are clean. Check exposed bolting for loosening in transit and handling and tighten to manufacturer's recommendations. Open and close the valve to make sure it operates properly and that stops or limit switches are correctly set so that the vane, ball, gate, needle, diaphragm, disc, plug, or other seating element seats fully. Close the valve before installing. Check coatings for damage and repair. Handle valves carefully when positioning, avoiding contact or impact with other equipment or structures

E. Prior to assembly, coat threaded portions of stainless steel bolts and nuts with lubricant.

3.4 INSTALLING EXPOSED VALVES

A. Unless otherwise indicated in the drawings, install valves in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the floor with their operating stems vertical. Install valves in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above the floor with their operating stems horizontal.

B. Install valves on vertical runs of pipe that are next to walls with their stems horizontal, away from the wall. Valves on vertical runs of pipe that are not located next to walls shall be installed with their stems horizontal, oriented to facilitate valve operation.

3.5 INSTALLING BURIED VALVES

A. Connect the valve, coat the flanges and place and compact the backfill to the height of the valve stem.

B. Connect the valve, coat the flanges, apply polyethylene encasement, and place and compact the backfill to the height of the valve stem.

C. Place block pads under the riser pipe to maintain the valve box vertical during backfilling and repaving and to prevent the riser pipe from contacting the valve bonnet.

D. Secure the riser pipe with backfill and compact. Install the valve box and pour the concrete collar. In pavement areas pour the collar to 2 inches below the finished pavement grade to allow asphalt concrete to be placed over the collar. In non-paved areas, place the collar to the top of the valve box.

3.6 FIELD COATING BURIED VALVES

A. Coat flanges of buried valves and the flanges of the adjacent piping, and the bolts and nuts of flanges and mechanical joints, per Section 09 90 00, System No. 24.

B. Wrap buried metal valves 6 inches and in two layers of polyethylene conforming to AWWA C105, 8 mils in thickness each. Pass the two sheets of polyethylene under the valve and the coated flanges or joints with the connecting pipe and draw the sheets around the valve body, the valve bonnet, and the connecting pipe. Secure the sheets with plastic adhesive tape about the valve stem below the operating nut and about the barrel of the connecting pipe to prevent the entrance of soil. Fold overlaps twice and tape. Backfill the valve with care to avoid damaging the polyethylene.

3.7 ASSEMBLING JOINTS

A. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseat or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

B. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.

3.8 INSTALLING EXTENSION STEM GUIDE BRACKETS

A. Install at 6 to 8-foot centers. Provide at least two support brackets for stems longer than 10 feet, with one support near the bottom of the stem and one near the top.

3.9 MOUNTING GEAR ACTUATORS

A. The valve manufacturer shall select and mount the gear actuator and accessories on each valve and stroke the valve from fully open to fully closed prior to shipment.

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3.10 FIELD INSTALLATION OF GEAR ACTUATOR

A. Provide the actuator manufacturer's recommended lubricating oil in each actuator before commencing the field testing.

3.11 VALVE FIELD TESTING

A. Test valves for leakage at the same time that the connecting pipelines are hydrostatically tested. See Section 40 05 15 for pressure testing requirements. Protect or isolate any parts of valves, actuators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace any leaking valves and retest.

B. Operate manual valves through three full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. Do not backfill buried valves until after verifying that valves operate from full open to full closed. If valves stick or bind, or do not operate from full open to full closed, repair or replace the valve and repeat the tests.

C. Gear actuators shall operate valves from full open to full close through three cycles without binding or sticking. The pull required to operate handwheel- or chainwheel-operated valves shall not exceed 40 pounds. The torque required to operate valves having 2-inch AWWA nuts shall not exceed 150 ft-lbs. If actuators stick or bind or if pulling forces and torques exceed the values stated previously, repair or replace the actuators and repeat the tests. Operators shall be fully lubricated in accordance with the manufacturer's recommendations prior to operating.

END OF SECTION