

Contract/Technical Specifications

for

**Jordan Valley Water Treatment Plant,
Air Scour Pipe Replacement**

April 2019 Final Bid Set

Volume II of III

PREPARED FOR

Jordan Valley Water Conservancy District

8215 S 1300 W

West Jordan, UT 84088

JWCD Project NO. 4070



**JORDAN VALLEY WATER
CONSERVANCY DISTRICT**



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BC PROJECT NO. 151483

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JWTP Air Scour Pipe Replacement Project

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SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

- A. The work covered under this contract will be performed at the Jordan Valley Water Treatment Plant located at 15305 S 3200 W, Herriman, UT 84065. The plant is located just off the Mountain View Corridor next to a residential area.

1.02 DESCRIPTION OF OWNER'S PROJECT

- A. The overall project will consist of the following new facilities and modifications to existing facilities:
 - 1. Removing and disposing of the existing filter air wash (air scour) piping, valves, actuators, and miscellaneous appurtenances. Some items will be salvaged to the Owner.
 - 2. Cleaning and disinfecting the lower and upper gullet of each filter.
 - 3. Installing new piping, valves, actuators, and miscellaneous appurtenances for a complete and functional project.
- B. Except as specifically noted otherwise, provide and pay for:
 - 1. Insurance and bonds.
 - 2. Labor, materials, and equipment.
 - 3. Applicable sales tax.
 - 4. Tools, equipment, and machinery required for construction.
 - 5. Traffic control and dust control measures.
 - 6. Other facilities and services necessary for proper execution and completion of the Work.

1.03 CONTRACTS

- A. The work will be performed by the General Contractor and subcontractors.
- B. Maintain overall coordination of the Work.
- C. Obtain construction schedules from each subcontractor, and require each subcontractor to maintain schedules and coordinate modifications.
- D. Secure and pay for all permits unless otherwise indicated.
- E. The OWNER will provide the following permits, if required:
 - 1. Utah Division of Drinking Water Operating Permit
- F. Comply with codes, ordinances, regulations, orders, and other legal requirements of public authorities having bearing on the performance of the Work.

1.04 ACTIVITIES BY OTHERS

- A. OWNER, utilities, and others may perform activities within Project area while the Work is in progress.
 - 1. Schedule the Work with OWNER, utilities, and others to minimize mutual interference.
- B. Activities by others which may affect performance of work include:
 - 1. Chemical deliveries
 - 2. Routine maintenance
 - 3. Modifications to the solids drying beds and filter backwash piping.
- C. Cooperate with others to minimize interference and delays.
 - 1. When cooperation fails, submit recommendations and perform Work in coordination with work of others.
- D. When the Work depends for proper execution or results upon work performed by others, inspect and promptly report apparent discrepancies or defects in work performed by others.
 - 1. Assume responsibility for work performed by others, except for defects reported as specified in this paragraph and defects which may become apparent in work performed by others after execution of the Work.

1.05 EARLY OCCUPANCY OF PORTIONS OF WORK

- A. Substantially Complete following portions of Work for OWNER's early occupancy including specified testing, training of OWNER's personnel, and other preparations necessary for OWNER's occupancy or use:
 - 1. Odd filters
- B. Certificates of Substantial Completion will be executed for each designated portion of Work prior to OWNER occupancy.
 - 1. Such certificate of Substantial Completion will describe the portion of the Work to be occupied by OWNER, items that may be incomplete or defective, date of occupancy by OWNER, and other information required by OWNER and CONTRACTOR.
- C. After OWNER occupancy, allow access for OWNER's personnel, access for others authorized by OWNER, and OWNER operation of equipment and systems.
- D. Following occupancy, OWNER will:
 - 1. Provide power to operate equipment and systems.
 - 2. Repair damage caused by OWNER's occupancy.

END OF SECTION

SECTION 01 11 80
ENVIRONMENTAL CONDITIONS

PART 1 GENERAL

1.01 ENVIRONMENTAL CONDITIONS

- A. This section describes the environmental conditions which have been observed at the site of the work and which may reasonably be anticipated throughout the life of the project.

1.02 CLIMATE CONDITIONS

- A. The site of the work is at an elevation of 4730 feet above mean sea level.
- B. Climate conditions are described as follows:

Description	Range of Conditions
Winter	0-30 degrees F
Summer	70-110 degrees F
Air temperature, degrees F	
• Indoors	60-80 degrees F

1.03 ADDITIONAL CONDITIONS

- A. Additional conditions which may be applicable are specified in other sections.

END OF SECTION

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SECTION 01 12 16

WORK SEQUENCE

PART 1 GENERAL

1.01 CONTINUITY OF PLANT OPERATIONS

- A. The Jordan Valley Water Treatment Plant will shut down from December 1, 2019 to February 28, 2020 to accommodate maintenance and construction activities including this Work. Water treatment operation will restart on March 1, 2020.
 - 1. All new piping shall be onsite or in transit within the United States before demolition begins.
 - 2. Demolition shall begin as soon as possible after the plant shuts down. All demolition shall be completed, and work areas cleaned before starting installation of new pipe and equipment.
 - 3. Milestone 1: The odd (north) filters shall be operational by February 28, 2020. Install a blind flange in the East Filter Gallery to isolate the south filters if necessary for scheduling purposes.
 - a. The air scour system and filters must be cleaned, disinfected, and operational at least 7 days before the Milestone to allow enough time for testing.
 - 4. Milestone 2: The south filters shall be operational by April 15, 2020.
- B. Work sequence and constraints:
 - 1. The work sequencing and description of critical events provided in this Section are provided to assist the CONTRACTOR in scheduling and undertaking the Work. They do not include all items affecting completion of the Work but are intended to describe critical events necessary to minimize disruption of the existing facilities and to ensure compliance with water quality permit requirements, and OWNER's water quality standards.
 - 2. The constraints provided in this Section are contractual obligations that limit the CONTRACTOR's activities and the CONTRACTOR's impact to plant operations.

1.02 COMPLIANCE WITH DRINKING WATER PERMIT

- A. The existing facility operates under the terms of a permit issued by the Utah Division of Drinking Water. This permit specifies the water quality limits that the plant must meet prior to discharge of finished water. A copy of the existing permit is on file for review at the Utah Division of Drinking Water.
- B. CONTRACTOR shall bear the cost of penalties imposed on the OWNER for water quality violations caused by actions of the CONTRACTOR, including any and all costs to remedy the situation.

1.03 SUBMITTAL

- A. General shutdown constraints: Comply with shutdown constraints described in general terms as identified in this section.
 - 1. Execute the Work during the scheduled facility shutdown.
 - 2. Constraints apply to activities of construction regardless of process or work area.

3. Activities that disrupt plant or utilities operations must comply with these shutdown constraints.
 4. Provide thorough advanced planning, including pre-planning meetings with CONSTRUCTION MANAGER and having required equipment, materials, and labor on hand at time of shutdown.
 5. OWNER maintains the ability to abort on the day of the scheduled shutdown.
- B. In accordance with Section 01 33 00, the Contractor shall submit a detailed outage plan and time schedule for all operations during the shutdown.
1. Do not begin alterations until CONSTRUCTION MANAGER's written permission has been received.
 2. All shutdown durations presented in this Section are inclusive of drain, disinfection, and refill time and will be measured from the time the plant is no longer producing water until the time the plant resumes producing water. CONTRACTOR shall provide adequate time in schedules for draining and cleanup of filters, as well as disinfection. Significant hydraulic structures, such as filters, or large diameter pipe, require up to one day to drain and one day to refill.

1.04 SEQUENCE AND SCHEDULE OF CONSTRUCTION

- A. The following work sequences, arising from the need to maintain plant operations, have been identified by the OWNER and ENGINEER and are presented for the benefit of the CONTRACTOR. The work sequences presented herein are not meant to be complete nor exhaustive but are intended to define basic project requirements upon which CONTRACTOR may develop overall project schedule.
- B. The construction schedule required in the General Conditions of the Contract Documents shall provide for the following specific conditions:
1. Mobilization. Preparatory work activities to be completed up-front and part of CONTRACTOR mobilization include, but are not limited to:
 - a. Site preparation including field measurement and verification of the existing pipe.
 - b. Shop drawing submittals.
 - c. Ordering and receiving all pipe materials.
 - d. Placement of CONTRACTOR's materials and amenities.
 2. Demolition of air scour pipe.
 - a. CONTRACTOR shall prepare a demolition plan, submit to and coordinate with the CONSTRUCTION MANAGER before starting any demolitions activities. Demolition plan shall include provisions to expose, handle, and dispose of any hazardous materials.
 3. Cleaning and disinfection plan for the lower gulleys.
 4. North filters:
 - a. Replacement of all air scour pipe and valves needed for the north filters to be fully functional and allow for partial plant operation if needed.
 5. South filters:
 - a. Replacement of all air scour pipe and valves need for the plant to be fully functional.
 6. Construction of the maintenance platform in blower room (not required for substantial completion).

- C. The Plan shall be coordinated with the CONTRACTOR's Construction schedule and meet the restrictions and conditions specified in the CONTRACT DOCUMENTS.
- D. The Plan shall describe the Contractor's means and methods for performing the tasks listed above and the length of time required to complete said tasks.

END OF SECTION

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SECTION 01 21 00

ALLOWANCES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Listing of allowance items:
 - a. Related responsibilities of ENGINEER and CONTRACTOR, and procedures.

1.02 ALLOWANCE AMOUNTS

- A. Include following amounts in Contract Price for furnishing products and labor:
 - 1. \$20,000 for hazardous materials abatement not identified in the Contract Documents.
 - 2. \$5,000 for CIM coating supervision by John Hill.

1.03 COSTS INCLUDED AND EXCLUDED IN ALLOWANCES

- A. Costs included in allowances for furnishing products and labor:
 - 1. Net cost of product.
 - 2. Delivery and unloading at site.
 - 3. Applicable taxes.
 - 4. Overhead and profit.

1.04 DUTIES OF CONTRACTOR IN PROVIDING PRODUCTS BY ALLOWANCE

- A. Verify total cost with suppliers, including:
 - 1. Quantity.
 - 2. Complete description of product and services provided under allowance.
 - 3. Unit cost.
 - 4. Total amount of purchase.
 - 5. Taxes and delivery charges.
 - 6. Install cost.

1.05 ADJUSTMENT OF COSTS

- A. When actual cost is more or less than amount of allowance, Contract Price will be adjusted by Change Order.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 32 16
CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 SCOPE

- A. This section specifies the procedures for preparing and revising the critical path method construction schedule used for planning and managing construction activities. The schedule provides a basis for determining the progress status of the project relative to specific dates and completion time.

1.02 DESCRIPTION

- A. The Contractor shall provide a graphic construction schedule prepared by the critical path method of analysis. The critical path schedule shall be prepared from estimates of the required duration and sequence for each item of work and function to be performed. A general guide for preparing such a schedule is contained in "The Use of CPM in Construction, A Manual for Contractors," published by the Associated General Contractors of America.
- B. The schedule shall depict all significant construction activities and all items of work listed in the breakdown of contract prices submitted by the Contractor in accordance with the General Conditions of the Contract Documents. The dependencies between activities shall be indicated so that it may be established what effect the progress of any one activity has on the schedule.
- C. Time for completion and all specific dates as specified in the Contract Documents and sequencing requirements described in Section 01 12 16 shall be shown on the schedule. Activities making up the critical path shall be identified.
- D. No activity on the schedule shall have a duration longer than 21 days or assigned value greater than \$100,000, except activities comprising only fabrication, and delivery may extend for more than 21 days. Activities which exceed these limits shall be divided into more detailed components. The schedule duration of each activity shall be based on the work being performed during the normal 40-hour workweek with allowances made for legal holidays and normal weather conditions.

1.03 SUBMITTAL PROCEDURES

- A. Within 20 days after the date of Notice to Proceed, the Contractor shall complete a construction schedule conforming to paragraph 1.02 Description and representing in detail all planned procurement and on-site construction activities. The schedule shall be prepared on reproducible paper and may be in draft form with legible freehand lines and lettering. Upon completion of the schedule, the Contractor shall submit the original and two copies to the Construction Manager in accordance with Section 01 33 00.
- B. Within 7 days after receipt of the submittal, the Construction Manager shall review the submitted schedule and return one copy of the marked-up original to the Contractor. If the Construction Manager finds that the submitted schedule does not comply with specified requirements, the corrective revisions will be noted on the submittal copy,

returned to the Contractor for corrections and resubmitted as specified in Section 01 33 00.

1.04 SCHEDULE REVISIONS

- A. Revisions to the accepted critical path construction schedule may be made only with written approval of the Contractor and Owner. Changes in timing for activities which are not on the critical path may be modified with written agreement of the Contractor and Construction Manager. A change affecting the contract value of any activity, the timing of any activity on the critical path, the completion time and specific dates as specified in the Contract Documents, and work sequencing (Section 01 12 16) may be made only in accordance with applicable provisions of the General Conditions of the Contract Documents.

1.05 PROJECT STATUS UPDATE

- A. Project status review and update shall be provided each month as specified in the General Conditions of the Contract Documents.

END OF SECTION

SECTION 01 32 33
PHOTOGRAPHIC DOCUMENTATION

PART 1 GENERAL

1.01 PRECONSTRUCTION PHOTOGRAPHS

- A. The Contractor shall provide preconstruction photographs prior to commencement of work on the site to document existing conditions.
- B. Preconstruction photographs shall be taken at locations to be designated by the Construction Manager. The photographer shall be equipped to photograph either interior or exterior exposures, with lenses ranging from wide angle to 135 mm.

END OF SECTION

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SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUBMITTALS

- A. Submittals covered by these requirements include manufacturers' information, shop drawings, test procedures, test results, samples, requests for substitutions, and miscellaneous work-related submittals. Submittals shall also include, but not be limited to, all mechanical, electrical and electronic equipment and systems, materials, reinforcing steel, fabricated items, and piping and conduit details. The Contractor shall furnish all drawings, specifications, descriptive data, certificates, samples, tests, methods, schedules, and manufacturer's installation and other instructions as specifically required in the contract documents to demonstrate fully that the materials and equipment to be furnished and the methods of work comply with the provisions and intent of the contract documents.

1.02 CONTRACTOR'S RESPONSIBILITIES

A. General:

1. The Contractor shall be responsible for the accuracy and completeness of the information contained in each submittal and shall assure that the material, equipment or method of work shall be as described in the submittal. The Contractor shall verify that all features of all products conform to the specified requirements. Submittal documents shall be clearly edited to indicate only those items, models, or series of equipment, which are being submitted for review. All extraneous materials shall be crossed out or otherwise obliterated. The Contractor shall ensure that there is no conflict with other submittals and notify the Construction Manager in each case where his submittal may affect the work of another contractor or the Owner. The Contractor shall coordinate submittals among his subcontractors and suppliers including those submittals complying with unit responsibility requirements specified in applicable technical sections.
2. The Contractor shall coordinate submittals with the work so that work will not be delayed. He shall coordinate and schedule different categories of submittals, so that one will not be delayed for lack of coordination with another. No extension of time will be allowed because of failure to properly schedule submittals. The Contractor shall not proceed with work related to a submittal until the submittal process is complete. This requires that submittals for review and comment shall be returned to the Contractor stamped "No Exceptions Taken" or "Make Corrections Noted."
3. The Contractor shall certify on each submittal document that he has reviewed the submittal, verified field conditions, and complied with the contract documents.
4. The Contractor may authorize in writing a material or equipment supplier to deal directly with the Construction Manager or with the Owner with regard to a submittal. These dealings shall be limited to contract interpretations to clarify and expedite the work.

B. Request for substitution--special equipment:

1. Requests for substitution for equipment specified by manufacturer or manufacturer's model number and listed below shall be in writing and shall be accompanied with

sufficient information to permit the Construction Manager to identify the nature and scope of the request. Information to be provided along with the request for substitution shall include:

- a. All submittal information required for the specified equipment, including all deviations from the specified requirements necessitated by the proposed substitution.
 - b. Materials of construction, including material specifications and references.
 - c. Performance data, including performance curves and guaranteed power consumption, over the range of specified operating conditions.
 - d. Dimensional drawings, showing required access and clearances, including any changes to the work required to accommodate the proposed substitution.
 - e. Where controls are a part of the proposed substitution, piping, process and instrumentation drawings (P&IDs), produced in the project format and with project-specific symbols, along with control descriptions.
 - f. Where controls specified in the project manual require modification to accommodate the proposed substitution, piping, process and instrumentation drawings (P&IDs), produced in project format and with project-specific symbols, with all required modifications clearly highlighted.
 - g. Information and performance characteristics for all system components and ancillary devices to be furnished as a part of the proposed substitution.
 - h. Reproducible contract drawings, marked up to illustrate the alterations to all structural, architectural, mechanical, electrical and HVAC systems required to accommodate the proposed substitution.
 - i. A list of installations of the proposed substitution indicating application, location, owner and date of first use.
- C. Upon receipt of written application for substitution from the Contractor, including the information specified above, the Construction Manager will estimate the cost of evaluating the request and present the estimate to the Contractor. The Contractor is advised that the estimate is based upon the best information available to the Construction Manager at the time; however, the actual cost, based on time and expense, will be documented and applied in the final analysis of the substitution request. If the Contractor wishes to proceed with the request, he shall advise the Construction Manager in writing and submit sufficient additional information as may be requested by the Construction Manager. No evaluation will take place until such time as the Contractor has agreed to the estimate in writing and has authorized the Construction Manager to deduct the cost of the evaluation from monthly progress payments due the Contractor.

1.03 CATEGORIES OF SUBMITTALS

A. General:

- a. Submittals fall into three general categories; Action Submittals - Action Submittals require review and response by the Engineer before the Contractor proceeds with incorporating the equipment, materials, or procedure addressed in a submittal into the work. Review comments for Action Submittals, and the subsequent actions of the Contractor based on the review comments, shall conform to REVIEW ACTION requirements specified in this section.
- b. Informational Submittals- Informational Submittals are examined to verify that the information has been furnished as specified. If the information has not been

furnished as specified the submittal will be returned marked "MAKE CORRECTIONS NOTED" and any deficiencies will be noted. If the information has been furnished as specified the submittal will be returned marked "RECEIPT ACKNOWLEDGED". CSI's informational submittals are similar to what BC formerly called PRODUCT DATA. Note: BC Testing Requirements can be either Action or Information Submittals.

- c. Closeout Submittals – Closeout Submittals consist of documentation that is not available for review at the time Action Submittals are submitted for review or documentation that is typically generated or furnished following incorporation of the equipment, materials, or procedure into the work. Closeout submittals include spare parts inventory listing, spare parts, extra stock materials, special tools and other materials or components that are furnished separate from the installed and completed work. Closeout Submittals require review and response by the Engineer. Closeout Submittal requirements are not satisfied until they have been reviewed and returned marked "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED". BC places Record Drawings and O&M submittals and Spare Parts within the CLOSEOUT SUBMITTAL category. This is a change as BC used to include Spare Parts in Part 3.
2. At the beginning of work, the Construction Manager will furnish the Contractor lists of those submittals specified in the project manual. Two separate lists will be provided: submittals for review and comment and product data (submittals) for information only.
- B. Submittals for review and comment:
1. All submittals except where specified to be submitted as product data for information only shall be submitted by the Contractor to the Construction Manager for review and comment.
- C. Submittals (product data) for information only:
1. Where specified, the Contractor shall furnish submittals (product data) to the Construction Manager for Information only.

1.04 TRANSMITTAL PROCEDURE

- A. General:
1. Unless otherwise specified, submittals regarding material and equipment shall be accompanied by Transmittal Form 01 33 00-A specified in Section 01 99 90. A separate form shall be used for each specific item, class of material, equipment, and items specified in separate, discrete sections, for which the submittal is required. Submittal documents common to more than one piece of equipment shall be identified with all the appropriate equipment numbers. Submittals for various items shall be made with a single form when the items taken together constitute a manufacturer's package or are so functionally related that expediency indicates checking or review of the group or package as a whole.
 2. A unique number, sequentially assigned, shall be noted on the transmittal form accompanying each item submitted. Original submittal numbers shall have the following format: "XXX"; where "XXX" is the sequential number assigned by the Contractor. Resubmittals shall have the following format: "XXX-Y"; where "XXX" is the originally assigned submittal number and "Y" is a sequential letter assigned for

resubmittals, i.e., A, B, or C being the 1st, 2nd, and 3rd resubmittals, respectively. Submittal 25B, for example, is the second resubmittal of submittal 25.

B. Deviation from contract:

1. If the Contractor proposes to provide material, equipment, or method of work which deviates from the project manual, he shall indicate so under "deviations" on the transmittal form accompanying the submittal copies.

C. Submittal completeness:

1. Submittals which do not have all the information required to be submitted, including deviations, are not acceptable and will be returned without review.

1.05 REVIEW PROCEDURE

A. General:

1. Submittals are specified for those features and characteristics of materials, equipment, and methods of operation which can be selected based on the Contractor's judgment of their conformance to the specified requirements. Other features and characteristics are specified in a manner which enables the Contractor to determine acceptable options without submittals. The review procedure is based on the Contractor's guarantee that all features and characteristics not requiring submittals conform as specified. Review shall not extend to means, methods, techniques, sequences or procedures of construction, or to verifying quantities, dimensions, weights or gages, or fabrication processes (except where specifically indicated or required by the project manual) or to safety precautions or programs incident thereto. Review of a separate item, as such, will not indicate approval of the assembly in which the item functions.
2. When the contract documents require a submittal, the Contractor shall submit the specified information as follows:
 - a. One electronic (pdf) copy submitted via email or file transfer.

B. Submittals for review and comment:

1. Unless otherwise specified, within 21 calendar days after receipt of a submittal for review and comment, the Construction Manager shall review the submittal and return one copy of the marked-up reproducible original noted in A above. The reproducible original will be retained by the Construction Manager. The returned submittal shall indicate one of the following actions:
 - a. If the review indicates that the material, equipment or work method complies with the project manual, submittal copies will be marked "NO EXCEPTIONS TAKEN." In this event, the Contractor may begin to implement the work method or incorporate the material or equipment covered by the submittal.
 - b. If the review indicates limited corrections are required, copies will be marked "MAKE CORRECTIONS NOTED." The Contractor may begin implementing the work method or incorporating the material and equipment covered by the submittal in accordance with the noted corrections. Where submittal information will be incorporated in O&M data, a corrected copy shall be provided.
 - c. If the review reveals that the submittal is insufficient or contains incorrect data, copies will be marked "AMEND AND RESUBMIT." Except at his own risk, the Contractor shall not undertake work covered by this submittal until it has been

revised, resubmitted and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

- d. If the review indicates that the material, equipment, or work method does not comply with the project manual, copies of the submittal will be marked "REJECTED - SEE REMARKS." Submittals with deviations which have not been identified clearly may be rejected. Except at his own risk, the Contractor shall not undertake the work covered by such submittals until a new submittal is made and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

C. Submittals (product data) for information only:

1. Such information is not subject to submittal review procedures and shall be provided as part of the work under this contract and its acceptability determined under normal inspection procedures.

1.06 EFFECT OF REVIEW OF CONTRACTOR'S SUBMITTALS:

A. General:

1. Review of contract drawings, methods of work, or information regarding materials or equipment the Contractor proposes to provide, shall not relieve the Contractor of his responsibility for errors therein and shall not be regarded as an assumption of risks or liability by the Construction Manager or the Owner, or by any officer or employee thereof, and the Contractor shall have no claim under the contract on account of the failure, or partial failure, of the method of work, material, or equipment so reviewed. A mark of "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED" shall mean that the Owner has no objection to the Contractor, upon his own responsibility, using the plan or method of work proposed, or providing the materials or equipment proposed.

END OF SECTION

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SECTION 01 35 29

HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES

PART 1 GENERAL

1.01 SAFETY AND HEALTH REGULATIONS

- A. The Contractor shall comply with Safety and Health Regulations for Construction, promulgated by the Secretary of Labor under Section 107 of the Contract Work Hours and Safety Standards Act, as set forth in Title 29, C.F.R. Copies of these regulations may be obtained from Labor Building, 14th and Constitution Avenue N.W., Washington, DC 20013.
- B. The Contractor shall also comply with the provisions of the Federal Occupational Safety and Health Act, as amended.

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SECTION 01 35 41
HAZARDOUS MATERIAL PROCEDURES

PART 1 GENERAL

1.01 SUBMITTALS

- A. Submit laboratory reports, hazardous material removal and disposal plans, and certifications.

1.02 HAZARDOUS MATERIALS PROCEDURES

- A. Hazardous materials are those defined by Utah Code Annotated (UCA) 63-5-6.
- B. When Hazardous Materials Have Been Found:
 - 1. Prepare and initiate implementation of plan of action.
 - 2. Notify immediately OWNER, ENGINEER, and other affected persons.
 - 3. Notify such agencies as are required to be notified by Laws and Regulations with the times stipulated by such Laws and Regulations.
 - 4. Designate a Certified Industrial Hygienist to issue pertinent instructions and recommendations for protection of workers and other affected persons' health and safety.
 - 5. Identify and contact subcontractors and licensed personnel qualified to undertake storage, removal, transportation, disposal, and other remedial work required by, and in accordance with laws and regulations.
- C. Forward to ENGINEER, copies of reports, permits, receipts, and other documentation related to remedial work.
- D. Assume responsibility for worker health and safety, including health and safety of Subcontractors and their workers.
 - 1. Instruct workers on recognition and reporting of materials that may be hazardous.
- E. File requests for adjustments to Contract Times and Contract Price due to the finding of Hazardous Materials in the Work site in accordance with paragraph 4.06, General Conditions.
 - 1. Minimize delays by continuing performance of the Work in areas not affected by hazardous materials operations.

1.03 LEAD PAINT REMOVAL AND DISPOSAL – NOT USED

1.04 ASBESTOS MATERIALS

- A. It is the specific intent of these Contract Documents to exclude from the Work any and all new products or materials containing asbestos. No new products containing asbestos shall be incorporated in the Work.

- B. Asbestos gaskets exist on site. Contractor shall be responsible for safe handling of all asbestos gaskets or other asbestos containing materials (ACMs), whether shown on the drawings or not.
- C. Removal and disposal of existing asbestos gaskets shall be performed by a specialty subcontractor registered by OSHA and certified by the State Contractors Licensing Board. Submit copies of this certification to the ENGINEER. The CONTRACTOR shall be responsible for the proper removal and disposal of all asbestos material.
- D. In the event of the discovery of ACM, the following shall occur:
 - 1. Submit a plan for the removal, containment, and disposal of ACM.
 - 2. Submit abatement license of ACM removal contractor.
 - 3. Removal of existing ACM shall be performed by a firm that is registered by OSHA and certified by the State Contractors Licensing Board and shall be a Licensed Abatement Contractor in the state of Utah.

END OF SECTION

SECTION 01 42 19
REFERENCE STANDARDS

PART 1 GENERAL

1.01 ABBREVIATIONS

- A. Wherever used in the project manual, the following abbreviations will have the meanings listed:

Abbreviation	Meaning
AA	Aluminum Association Incorporated P.O. Box 753 Waldorf, MD 20604
AABC	Associated Air Balance Council 1518 K Street N.W. Washington, DC 20005
AAMA	American Architectural Manufacturers Association 1540 East Dundee Road, Suite 310 Palatine, IL 60067
AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol Street, N.W., Suite 249 Washington, DC 20001
ABMA	American Bearing Manufacturers Association 1200 19th Street N.W., Suite 300 Washington, DC 20036
ACI	American Concrete Institute 22400 West Seven Mile Road P.O. Box 19150, Redford Station Detroit, MI 48219
AEIC	Association of Edison Illuminating Companies 600 North 18th Street P.O. Box 2641 Birmingham, AL 35291
AGA	American Gas Association ATTN: Records 1515 Wilson Boulevard Arlington, VA 22209
AGMA	American Gear Manufacturer's Association, Inc. 1500 King Street, Suite 201 Alexandria, VA 22314
AHA	American Hardboard Association 1210 West Northwest Highway Palatine, IL 60067
AISC	American Institute of Steel Construction One East Wacker Drive, Suite 3100 Chicago, IL 60601

Abbreviation	Meaning
AISI	American Iron and Steel Institute 1101 Seventeenth Street, NW, Suite 1300 Washington, DC 20036
AITC	American Institute of Timber Construction 7012 South Revere Parkway, Suite 140 Englewood, CO 80112
ALSC	American Lumber Standard Committee P.O. Box 210 Germantown, MD 20875
AMCA	Air Movement and Control Association, Inc. 30 West University Drive Arlington Heights, IL 60004
ANSI	American National Standards Institute 11 West 42nd Street, 13th Floor New York, NY 10036
APA	American Plywood Association 7011 South 19th Street Tacoma, WA 98466
API	American Petroleum Institute 1220 "L" Street N.W. Washington, DC 20005
ARI	Air-Conditioning and Refrigeration Institute 4301 North Fairfax Drive, Suite 425 Arlington, VA 22203
ASCE	American Society of Civil Engineers United Engineering Center 345 East 47th Street New York, NY 10017
ASCII	American Standard Code for Information Interchange United States of America Standards Institute 10 East 40th Street New York, NY 10016
ASE Code	American Standard Safety Code for Elevators, Dumbwaiter and Escalators American National Standards Institute 1430 Broadway New York, NY 10018
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc. 1791 Tullie Circle, NE Atlanta, GA 30329
ASME	American Society of Mechanical Engineers 345 East 47th Street New York, NY 10017

Abbreviation	Meaning
ASTM	American Society for Testing and Materials 100 Barr Harbor Drive West Conshohocken, PA 19428
AWPA	American Wood-Preservers' Association 9549 Old Fredrick Road Ellicott City, MD 21042
	or P.O. Box 286 Woodstock, MD 21163-0286
AWS	American Welding Society 550 NW LeJeune Road P.O. Box 351040 Miami, FL 33135
AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235
BOCA	Building Officials and Code Administrators, International, Inc. 4051 West Flossmoor Road Country Club Hills, IL 60478
CALTEST	Materials Manual, State of California, Business and Transportation Agency Department of Public Works State of California, Department of Transportation 6002 Folsom Boulevard Sacramento, CA 95819
CALTRANS	Standard Specifications, State of California, Department of Transportation State of California, Business and Transportation Agency P.O. Box 1499 Sacramento, CA 95807
CBM	Certified Ballast Manufacturers 2120 Keith Building Cleveland, OH 44115
CMAA	Crane Manufacturers Association of America, Inc. (Formerly called: Overhead Electrical Crane Institute) (OECI) 8720 Red Oak Boulevard, Suite 201 Charlotte, NC 28217
CRSI	Concrete Reinforcing Steel Institute 933 N Plum Grove Road Schaumburg, IL 60173
CSA	Canadian Standards Association 178 Rexdale Boulevard Rexdale, Ontario, M9W 1R3, Canada
DEMA	Diesel Engine Manufacturer's Association 30200 Detroit Road Cleveland, OH 44145

Abbreviation	Meaning
DHI	Door and Hardware Institute 14170 Newbrook Drive Chantilly, VA 22021
DIS	Division of Industrial Safety California Department of Industrial Relations 2422 Arden Way Sacramento, CA 95825
EI	Edison Electric Institute 90 Park Avenue New York, NY 10016
EIA	Electronic Industries Association Order from: Global Engineering Documents 18201 McDermott West Irvine, CA 92714
EJMA	Expansion Joint Manufacturers Association 25 North Broadway Tarrytown, NY 10591
ESO	Electrical Safety Orders California Administrative Code, Title 8, Chap. 4, Subarticle 5 Office of Procurement, Publications Section P.O. Box 20191 8141 Elder Creek Road Sacramento, CA 95820
FEDSPEC	Federal Specifications General Services Administration Specification and Consumer Information Distribution Branch Washington Navy Yard, Bldg. 197 Washington, DC 20407
FEDSTDS (see FEDSPECS)	Federal Standards
FM	Factory Mutual Engineering and Research Corporation 1151 Boston-Providence Turnpike P.O. Box 9102 Norwood, MA 02062
HEI	Heat Exchange Institute 1300 Sumner Avenue Cleveland, OH 44115
HI	Hydraulic Institute 9 Sylvan Way, Suite 180 Parsippany, NJ 07054
HPVA	Hardwood Plywood & Veneer Association 1825 Michael Faraday Drive P.O. Box 2789 Reston, VA 22090-2789

Abbreviation	Meaning
IAPMO	International Association of Plumbing and Mechanical Officials 20001 Walnut Drive S Walnut, CA 91789
ICBO	International Conference of Building Officials 5360 Workman Mill Road Whittier, CA 90601
ICEA	Insulated Cable Engineers Association P.O. Box 440 South Yarmouth, MA 02664
IEEE	Institute of Electrical and Electronics Engineers 445 Hoes Lane P.O. Box 1331 Piscataway, NJ 08855
IES	Illuminating Engineering Society of North America 120 Wall Street New York, NY 10017
ISA	Instrument Society of America 67 Alexander Drive P.O. Box 12277 Research Triangle Park, NC 27709
JIC	Joint Industrial Council 7901 West Park Drive McLean, VA 22101
MFMA	Metal Framing Manufacturers Association 401 N. Michigan Avenue Chicago, IL 60611
MILSPEC	Military Specifications Naval Publications and Forms Center 5801 Tabor Avenue Philadelphia, PA 19120
MSS	Manufacturers Standardization Society of the Valve & Fittings Industry, Inc. 127 Park Street, N.E. Vienna, VA 22180
NAAMM	National Association of Architectural Metal Manufacturers 11 South La Salle Street, Suite 1400 Chicago, IL 60603
NACE	National Association of Corrosion Engineers 1440 South Creek Drive Houston, TX 77084
NBC	National Building Code Published by BOCA

Abbreviation	Meaning
NEC	National Electric Code National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincy, MA 02269
NELMA	Northeastern Lumber Manufacturers Association, Inc. P.O. Box 87A Cumberland Center, ME 04021
NEMA	National Electrical Manufacturer's Association 2101 L Street, NW, Suite 300 Washington, DC 20037
NESC	National Electric Safety Code American National Standards Institute 1430 Broadway New York, NY 10018
NFOR	National Forest Products Association (Formerly National Lumber Manufacturer's Association) 1111 19 Street NW, Suite 700 Washington, DC 20036
NFPA	National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincy, MA 02269
NHLA	National Hardwood Lumber Association 6830 Raleigh LaGrange P.O. Box 34518 Memphis, TN 38184-0518
NSF	National Sanitation Foundation 3475 Plymouth Road P.O. Box 130140 Ann Arbor, MI 48113
OSHA	Occupational Safety and Health Act U.S. Department of Labor Occupational and Health Administration San Francisco Regional Office 450 Golden Gate Avenue, Box 36017 San Francisco, CA 94102
PCI	Precast/Prestressed Concrete Institute 175 West Jackson Blvd., Suite 1859 Chicago, IL 60604
PPIC	The Plumbing & Piping Industry Council, Inc. 510 Shatto Place, Suite 402 Los Angeles, CA 90020

Abbreviation	Meaning
RIS	Redwood Inspection Service California Redwood Association 405 Enfrente Dr., Suite 200 Novato, CA 94949
RMA	Rubber Manufacturers Association 1400 K Street NW, Suite 900 Washington, DC 20005
SAE	Society of Automotive Engineers, Inc. 400 Commonwealth Drive Warrendale, PA 15096
SAMA	Scientific Apparatus Makers Association One Thomas Circle Washington, DC 20005
SBC	Standard Building Code Published by SBCCI
SBCCI	Southern Building Code Congress International Inc. 900 Montclair Road Birmingham, AL 35213
SCMA	Southern Cypress Manufacturers Association 400 Penn Center Boulevard, Suite 530 Pittsburg, PA 15235
SDI	Steel Door Institute 30200 Detroit Road Cleveland, OH 44145
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc. P.O. Box 221230 Chantilly, VA 22021
SPI	Society of the Plastics Industry, Inc. 1275 K Street NW, Suite 400 Washington, DC 20005
SPIB	Southern Pine Inspection Bureau 4709 Scenic Highway Pensacola, FL 32504
SSPC	Society for Protective Coatings 40 24th Street, 6th Floor Pittsburgh, PA 15222
SSPWC	Standard Specifications for Public Works Construction Building News, Inc. 3055 Overland Avenue Los Angeles, CA 90034
TEMA	Tubular Exchanger Manufacturer's Association 25 North Broadway Tarrytown, NY 10591
TPI	Truss Plate Institute 583 D'Onofrio Drive, Suite 200 Madison, WI 53719

Abbreviation	Meaning
UBC	Uniform Building Code Published by ICBO
UL	Underwriters Laboratories Inc. 333 Pfingsten Road Northbrook, IL 60062
UMC	Uniform Mechanical Code Published by ICBO
UPC	Uniform Plumbing Code Published by IAPMO
USBR	Bureau of Reclamation U.S. Department of Interior Engineering and Research Center Denver Federal Center, Building 67 Denver, CO 80225
WCLIB	West Coast Lumber Inspection Bureau 6980 SW Varns St. P.O. Box 23145 Portland, OR 97223
WWPA	Western Wood Products Association (Formerly called: West Coast Lumbermen's Association (WCLA)) Yeon Building 522 SW 5th Avenue Portland, OR 97204

END OF SECTION

SECTION 01 45 00
CONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies administrative and procedural requirements for quality control services, field inspections and field testing of constructs required for this project.
- B. The Contractor is responsible for the quality assurance and quality control of their respective work for the construction of this project in accordance with the Contract Documents.

1.02 RELATED SECTIONS- NOT USED

1.03 DEFINITIONS

- A. Quality Control System (QCS): The quality control, assurance, and inspection system established and carried out to ensure compliance with the Plans and specifications.
- B. QCS Supervisor: That person in responsible charge of the work occurring, as designated by the Contractor in the QCS Plan.
- C. QCS Inspector: Responsible, certified personnel inspecting the various constructs at specified milestones and during the project overall and designated by the Construction Manager.
- D. Factory Test: Tests made on various materials, products and component parts prior to shipment to the job site.
- E. Field Tests: Tests and analyses made at or in the vicinity of the job site in connection with the actual construction.
- F. Certified Inspection Report: Reports signed by approved inspectors attesting that the items inspected meet the specification requirements other than any exceptions included in the report.
- G. Certificate of Compliance: Certificate from the manufacturer of the material or equipment identifying said manufacturer, product and stating that the material or equipment meet specified standards and shall be signed by a designated officer of the manufacturer.
- H. Standard Compliance: Condition whereby specified materials or equipment must conform to the standards of organizations such as the American National Standard Institute (ANSI), American Society for Testing and Materials (ASTM), Underwriters Laboratories (UL) or similar organization.
- I. Quality Assurance: The day-to-day, in-process supervisory observations of work and materials conducted by the Contractor to assure that the proper methods and materials are being used and installed by tradesmen.

- J. Source Quality Control: The in-process testing and inspections conducted by the QCS Inspector(s) to verify that the materials, equipment; workmanship and shop manufactured constructs are in compliance with the Contract Documents, applicable Codes and standards.
- K. Field Quality Control: The testing and inspections conducted by the QCS Inspector(s) in the field during and at the completion of each construct to verify that the in-process and completed construction is in compliance with the Contract Documents, applicable Codes and standards.
- L. Special Inspector – A qualified individual employed or retained by an approved agency and approved by the local governing authorities having jurisdiction (AHJ) as having the competency necessary to inspect a particular type of construction requiring special inspection.

1.04 SUBMITTALS

- A. Action Submittals:
 1. Procedures: Section 01 33 00.
 2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
 3. Check-marks (✓) denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined signify compliance with the specification. Include a detailed, written justification for each deviation. Failure to include a copy of this marked-up specification section, along with justification(s) for requested deviations, with the submittal, is cause for rejection of the entire submittal with no further consideration.
 4. Written description of Contractor's proposed QCS plan in sufficient detail to illustrate adequate measures for verification and conformance to defined requirements. The QCS plan and submittal shall include a log showing anticipated inspections, QCS Inspectors, Special Inspections, and source and field Quality Assurance procedures. Submittal of the QCS plan shall be made prior to commencing field work.
 5. Contractor's proposed QCS Supervisor and QCS Inspectors (other than the Special Inspectors provided by Owner), including qualifications, responsibilities, and if requested, references.
 6. Complete structural system information describing Contractor designed structural systems, including sealed calculations, shop and erection drawings, product literature for the various components, International Code Council (ICC) Evaluation Reports for structural components, and a discussion of risk issues associated with the proposed system which could adversely impact overall project completion.
- B. If requested by the Construction Manager during the work, manufacturer's field services and reports.
 1. Informational Submittals:
 2. Procedures: Section 01 33 00.
 3. Manufacturers' field services and reports unless requested by Construction Manager to be submitted for review.

4. Special Inspection reports, unless otherwise directed in each technical specification Section.

1.05 REGULATORY REQUIREMENTS

- A. **GENERAL:** Comply with all Federal, State, and local Codes as referenced herein. Such regulations apply to activities including, but not limited to, site work and zoning, building practices and quality, on and offsite disposal, safety, sanitation, nuisance, and environmental quality.
- B. **SPECIAL INSPECTION:** Special Inspection shall be performed by the Special Inspector under contract with the Owner or registered design professional in responsible charge acting as the Owner's agent in conformance with the IBC. Special Inspection is in addition to, but not replacing, other inspections and quality control requirements herein. Where sampling and testing required herein conforms to Special Inspection standards, such sampling and testing need not be duplicated.
- C. **STRUCTURAL OBSERVATION:** Registered Design Professional shall make visual inspections of the work to assess general conformance with the Contract Documents at significant construction stages and at completion of the structural system in accordance with IBC 1704.6 Structural Observations requirements.

1.06 CONTRACTOR'S RESPONSIBILITIES

- A. Provide, pay for, and coordinate with material testing services.
- B. Monitor quality assurance over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- C. Coordinate with, schedule specified inspections by, and provide normal and customary assistance to the QCS Inspectors and Owner provided Special Inspectors.
- D. Coordinate with, schedule specified structural observations by Engineer, and provide normal and customary assistance to Engineer performing structural observations.
- E. Comply fully with manufacturers' instructions, including each step in sequence.
- F. Should manufacturers' instructions conflict with Contract Documents, request clarification before proceeding from Construction Manager.
- G. Comply with specified standards as a minimum quality for the work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- H. The Contractor shall take all necessary measurements in the field to verify pertinent data and dimensions shown on the Drawings or to determine the exact dimensions of the Work.

1.07 FIELD SAMPLE PROCEDURES

- A. When field samples are specified in a unit of work, construct each field sample to include work of all trades required to complete the field sample prior to starting related field work. Field samples may be incorporated into the project after acceptance by Construction Manager. Remove unacceptable field samples when directed by Construction Manager. Acceptable samples represent a quality level for the work.

1.08 CONTRACTOR DESIGNED STRUCTURAL SYSTEMS

- A. **DESIGN ENGINEERING:** Contractor shall employ and pay for engineering services from a Professional Engineer registered in the State of Utah for structural design of Contractor designed structural systems including but not limited to formwork support, interior wall and ceiling systems, and support systems for fire sprinkler, plumbing, mechanical, and electrical systems and equipment.
- B. **TESTS AND INSPECTIONS OF CONTRACTOR DESIGNED STRUCTURAL SYSTEMS:** Contractor shall pay for preliminary testing of concrete, grout, and mortar mix designs where required by Code or these specifications prior to start of work. Contractor shall pay for required shop and site inspection of Contractor designed structural systems where required by Code or these specifications.

1.09 JOB SITE CONDITIONS

- A. Prepare a schedule to ensure all preparatory work has been accomplished prior to proceeding with current work. Proceeding with the work constitutes acceptance of conditions. Allow adequate time for materials susceptible to temperature and humidity to “stabilize” prior to installation. Establish and maintain environmental conditions (i.e., temperature, humidity, lighting) as recommended by the various material manufacturers for the duration of the work.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

- A. **CONTRACTOR RESPONSIBILITIES:** Provide source quality control according to the reviewed and accepted QCS plan and paragraph 1.06 herein. Coordinate with Construction Manager to facilitate the work of the Testing Laboratory specified in Section 01 45 23 and Special Inspector. Provide ready access to sampling and inspection locations and incidental labor customary in such sampling and inspections. Timely prepare and submit submittals, and revise as indicated by review comments. Comply with technical requirements in each specification Section that applies to the work.
- B. **CONSTRUCTION MANAGER RESPONSIBILITIES:** Review Contractor’s tracking of QCS activities at monthly meetings. Facilitate completion of submittal review per Section 01 33 00. Assist Contractor to ensure that Special Inspection occurs where and when specified.
- C. **ACCEPTANCE CRITERIA:** Acceptable characteristics and quality of a particular item or construct is defined in that item’s or construct’s specification Section.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Field quality control responsibilities of the Contractor and Construction Manager are substantially the same as described in paragraph 2.01, with the exception that this work occurs primarily on the jobsite as the work progresses, and Special Inspection will occur more often than at the source.
- B. Acceptable characteristics and quality of a particular item or construct is defined in that item's or construct's specification Section.

3.02 REGULATORY COMPLIANCE – SPECIAL INSPECTIONS

- A. The types of work requiring Special Inspection are specified in the Construction Documents and required to obtain regulatory approval by State or required by local governing authorities having jurisdiction over the building permit of the project.
- B. Section 01 45 23 describes Testing Laboratory sampling, testing and reporting.
- C. Contractor designed structural systems are subject to the same Special Inspection requirements as all other work.

3.03 CORRECTION OF DEFECTIVE WORK

- A. Any defective or imperfect Work, equipment, or materials furnished by the Contractor which is discovered before the Final Acceptance of the Work, or during a warranty period, shall be removed immediately even though it may have been overlooked by the Engineer and approved for payment. The Contractor shall repair such defect, without compensation, in a manner satisfactory to the Engineer.
- B. Unsuitable materials and equipment may be rejected, notwithstanding that such defective Work, materials and equipment may have been previously overlooked by the Engineer and accepted or approved for payment.
- C. If any workmanship, materials or equipment shall be rejected by the Engineer as unsuitable or not in conformity with the Specifications or Drawings, the Contractor shall promptly replace such materials and equipment with acceptable materials and equipment at no additional cost to Owner. Equipment or materials rejected by the Engineer shall be tagged as such and shall be immediately removed from the site.
- D. The Engineer may order tests of imperfect or damaged Work equipment, or materials to determine the required functional capability for possible acceptance, if there is no other reason for rejection. The cost of such tests shall be borne by the Contractor, and the nature, tester, extent and supervision of the tests will be as determined by the Engineer. If the results of the tests indicate that the required functional capability of the Work, equipment, or material was not impaired, the Work, equipment or materials may be deemed acceptable, in the discretion of the Engineer. If the results of such tests reveal that the required functional capability of the questionable Work, equipment or materials has been impaired, then such Work, equipment or materials shall be deemed imperfect

and shall be replaced. The Contractor may elect to replace the imperfect Work, equipment or material in lieu of performing the tests.

END OF SECTION

SECTION 01 45 23
TESTING AND INSPECTION SERVICES

PART 1 GENERAL

1.01 SUMMARY

- A. **GENERAL REQUIREMENTS:** Comply with the testing and inspection specified in this Section and elsewhere in the Construction Documents. For the purpose of this Section, all references made herein to Testing Agency or Special Inspector shall be referred to as those tests or inspections which will be conducted by an inspector provided by the Owner.
1. The Contractor shall select and employ an independent Testing Agency to conduct the tests and inspections in accordance with applicable standard methods of American Society for Testing and Materials (ASTM) or other standards specified by the local governing authorities having jurisdiction (AHJ) as a requirement of the building permit. The Owner may require other special inspection services to inspect and verify the Work installed is in accordance with the Construction Documents and construction industry standards.
 2. The Contractor shall provide and pay for other inspection and testing services where specified in the Construction Documents or required to obtain regulatory approval by State or AHJ.

1.02 DEFINITIONS

- A. **Special Inspector** – A qualified individual employed or retained by an approved agency and approved by the AHJ as having the competency necessary to inspect a particular type of construction requiring special inspection.
- B. **Testing Agency** - firm responsible for performing specific inspections and/or tests as part of the Special Inspection program.

1.03 QUALITY ASSURANCE

- A. **QUALIFICATIONS:** The inspector for all Work as hereinafter specified shall be a registered Special Inspector employed by an approved inspection and/or Testing Agency in the state of Utah. All inspection personnel used on this Project are subject to being disapproved from the Project at the discretion of the Owner.
1. The Special Inspector shall have the required technical knowledge and experience for the product or construction element being installed.

1.04 DUTIES OF CONTRACTOR'S TESTING AGENCY

- A. **GENERAL:** The Contractor's Testing Agency will conduct testing and inspection services, interpret them, and evaluate the results for compliance with the building permit, the site development permit, and the Construction Documents; agency will report findings to the Owner, Contractor, and AHJ. Testing and inspection services shall be in accordance with applicable standard methods of ASTM or other standards specified by AHJ, the Construction Documents, and construction industry standards.

- B. TESTING AND INSPECTION: Materials to be tested are specified by the building permit and as required by the Construction Documents, as directed by Owner, or required by AHJ. Quantities and extent of tests and inspections shall be as specified and/or required by the Owner's Inspector or AHJ.
- C. NON-CONFORMING WORK: The Owner's Inspector shall document and immediately notify the Contractor and Owner of any Work found defective or not in accordance with the requirements of the Construction Documents. Non-conforming Work shall be corrected.
- D. The Contractor's inspectors are not authorized to do the following:
 - 1. Release, revoke, alter or enlarge on requirements of Construction Documents.
 - 2. Approve or accept any portion of the Work, except as allowed by the special inspection duties delegated by governing AHJ for building permit inspections and testing.
 - 3. Perform any duties of the Contractor.
 - 4. Stop Work.

1.05 COSTS

- A. The Contractor's Testing Agency and Special Inspector costs for initial testing and inspection as specified in the Construction Documents will be paid for by the Contractor. Initial tests and inspections are defined as those required to complete the first tests and inspections specified. Costs for subsequent re-testing and re-inspection of items found not to be in compliance with Construction Documents shall be borne by the Contractor.
- B. Additional tests and inspections not herein specified, but requested by the Owner, shall be paid for by the Owner. However, if the results of such tests or inspections are found to be not in compliance with Construction Documents, the Contractor will be back charged for all costs for initial testing as well as re-testing, re-inspection and Owner's Consultants services.
- C. Costs for additional tests or inspections required because of Contractor changes to reviewed and accepted products or materials provided, or source, or supply shall be borne by the Contractor.
- D. Costs for any Work which is required to correct any deficiencies shall be borne by the Contractor.
- E. Costs of any testing which is required solely for the convenience of Contractor in its scheduling and performance of the Work shall be borne by the Contractor.
- F. Costs for verification testing of Work done without prior notice, with improper supervision, or contrary to construction practice shall be borne by the Contractor.
- G. Costs for testing of materials for which fabrication and mill reports are required but not furnished shall be borne by the Contractor.
- H. The cost, if any, of providing access for inspections and tests shall be considered part of the normal expense of conducting business and therefore non-reimbursable.

- I. In those instances where inspector(s) arrive at the agreed-upon location, at the agreed upon date and time, and find articles to be inspected are not ready for inspection, the inspector(s) shall return to their home office and all expenses incurred shall be borne by the Contractor.

1.06 TESTS AND INSPECTION REPORTS

- A. Copies of Owner and Contractor test and inspection reports shall be distributed at weekly intervals. All reports will be signed by a certified Special Inspector or Professional Engineer registered in the State of Utah, as appropriate. Such reports shall include all tests made, regardless of whether such tests indicate that the material is satisfactory or unsatisfactory; a final report should be submitted documenting corrective work done on of any unsatisfactory material and or work identified in the testing or inspection reports. Samples taken, but not tested, shall also be reported. Records of special sampling operations that are required shall also be reported. Distribute the report to Owner, Engineer, and OHJ.
- B. A report shall be prepared for each inspection and test and shall include:
 1. Date issued.
 2. Project title and number.
 3. Name and signature of inspector.
 4. Date of inspection or sampling and test.
 5. Record of temperature and weather.
 6. Identification of product and Specification Section.
 7. Location in Project.
 8. Type of inspection or test.
 9. Results of inspections and tests, and observations regarding compliance with Laws and Regulations, and standards.

1.07 CONTRACTOR'S RESPONSIBILITIES

- A. **COORDINATION:** It is the Contractor's responsibility to initiate, coordinate, and conform to the required tests and inspections of governing State and AHJ. Inspection of the Work by the Owner's Special Inspectors and/or Testing Agency shall not relieve the Contractor from responsibility for compliance with the Construction Documents requirements. Owner's Special Inspectors and/or Testing Agency and Owner shall have authority to reject Work whenever the provisions of the Construction Documents are not being complied with, and the Contractor shall instruct his employees accordingly.
- B. **ACCESS FOR THE PURPOSE OF INSPECTION:** Ensure the Owner's Special Inspectors and/or Testing Agency have free access to all parts of the Work and to the shops where the Work is in preparation; are provided proper facilities and safe access for such inspection; and are reasonably furnished access, equipment, tools, samples, certifications, test reports, design mixes, storage, and assistance as requested by the Owner's Inspector.
- C. **STORAGE FACILITIES:** Furnish adequate storage facilities as approved by the Owner for the sole use of the Owner's Testing Agency for safe storage and curing of such specimens which must remain on the site prior to transport to the laboratory.

- D. DATA: Furnish records, Contract Drawings and shop drawings, certificates, approved Change Orders, and similar data as required by Owner's Inspectors to perform their work to assure compliance with the Construction Documents.
- E. NOTICE: Furnish notice to Owner and coordinate with Owner's Inspectors a minimum of five (5) working days in advance of all required tests and a minimum of forty-eight (48) hours in advance of all required inspections, unless otherwise specified.
- F. NON-CONFORMING WORK: Remove and replace Non-conforming Work at no additional cost to the Owner prior to Final Completion. Where Non-conforming Work requires design modifications, such re-design shall be performed by the Engineer of Record and costs shall be borne by the Contractor.
- G. CANCELLATIONS: Contractor shall give sufficient advance notice to Owner and Inspectors to allow rescheduling of their work load in the event of cancellation or time extension of any scheduled test or inspection

1.08 TEST FAILURES

- A. GENERAL: The Owner may require re-test of a sampled material when a sample or procedure has failed to pass the required tests. In the event any test or inspection indicates failure of a material or procedure to meet requirements of Construction Documents, all costs for re-testing or re-inspection shall be borne by the Contractor. The Contractor may opt to replace the imperfect Work, equipment or material in lieu of performing the tests.

1.09 REPORT TEST FAILURES

- A. GENERAL: Immediately upon determination of a test failure, the Owner's Inspector shall notify the Owner and Contractor. By the end of the following day the Owner's Inspector shall send written test results to those named on the distribution list.
- B. Contractor shall similarly report test failures to Owner resulting from work of testing agencies provided by the Contractor.

PART 2 - NOT USED

PART 3 - SCHEDULE OF ITEMS REQUIRING TESTING

3.01 SHOP TESTING

- A. Visually inspect 100% of the welds and pipe walls; test 15% of piping per ASTM A380 Part 7 Inspection After Cleaning.

3.02 FIELD TESTING

- A. Visually inspect 100% of the welds and pipe walls; test 5% of piping per ASTM A380 Part 7 Inspection After Cleaning.

END OF SECTION

SECTION 01 66 00
PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 GENERAL

1.01 DAMAGE

- A. Equipment, products and materials shall be shipped, handled, stored, and installed in ways which will prevent damage to the items. Damaged items will not be permitted as part of the work except in cases of minor damage that have been satisfactorily repaired and are acceptable to the Construction Manager.

1.02 PIPE

- A. Pipe and appurtenances shall be handled, stored, and installed as recommended by the manufacturer. Pipes with paint, tape coatings, linings or the like shall be stored to protect the coating or lining from physical damage or other deterioration. Pipes shipped with interior bracing shall have the bracing removed only when recommended by the pipe manufacturer.
- B. Stainless steel items shall only be lifted by padded straps; chains or other methods will not be allowed. Piping shall be cleaned and buffed if damaged to restore the finish.

PART 2 EQUIPMENT

2.01 PACKAGE AND MARKING:

- A. All equipment shall be protected against damage from moisture, dust, handling, or other cause during transport from manufacturer's premises to site. Each item or package shall be marked with the number unique to the specification reference covering the item.
- B. Stiffeners shall be used where necessary to maintain shapes and to give rigidity. Parts of equipment shall be delivered in assembled or subassembled units where possible.

2.02 IDENTIFICATION:

- A. Each item of equipment and valve shall have permanently affixed to it a label or tag with its equipment or valve number designated in this contract. Marker shall be of stainless steel. Location of label will be easily visible.

2.03 SHIPPING:

- A. Vents and other types of openings shall be wrapped or otherwise sealed to prevent contamination by grit and dirt.
- B. Damage shall be corrected to conform to the requirements of the contract before the assembly is incorporated into the work. The Contractor shall bear the costs arising out of dismantling, inspection, repair and reassembly.

2.04 FACTORY APPLIED COATINGS – NOT USED

2.05 STORAGE:

- A. During the interval between the delivery of equipment to the site and installation, all equipment, unless otherwise specified, shall be stored in an enclosed space affording protection from weather, dust and mechanical damage and providing favorable temperature, humidity and ventilation conditions to ensure against equipment deterioration. Manufacturer's recommendations shall be adhered to in addition to these requirements.
- B. Equipment and materials to be located outdoors may be stored outdoors if protected against moisture condensation. Equipment shall be stored at least 6 inches above ground. Temporary power shall be provided to energize space heaters or other heat sources for control of moisture condensation. Space heaters or other heat sources shall be energized without disturbing the sealed enclosure.

2.06 PROTECTION OF EQUIPMENT AFTER INSTALLATION:

- A. After installation, all equipment shall be protected from damage from, including but not limited to, dust, abrasive particles, debris and dirt generated by the placement, chipping, sandblasting, cutting, finishing and grinding of new or existing concrete, terrazzo and metal; and from the fumes, particulate matter, and splatter from welding, brazing and painting of new or existing piping and equipment. As a minimum, vacuum cleaning, blowers with filters, protective shieldings, and other dust suppression methods will be required at all times to adequately protect all equipment. During concreting, including finishing, all equipment that may be affected by cement dust must be completely covered. During painting operations, all grease fittings and similar openings shall be covered to prevent the entry of paint. Electrical switchgear, unit substation, and motor load centers shall not be installed until after all concrete work and sandblasting in those areas have been completed and accepted and the ventilation systems installed.

END OF SECTION

SECTION 01 73 24
DESIGN REQUIREMENTS FOR
NON-STRUCTURAL COMPONENTS AND NON-BUILDING STRUCTURES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Minimum structural requirements for the design, anchorage, and bracing of non-structural components such as architectural/mechanical/HVAC/electrical components, equipment, or systems, and non-building structures such as tanks.
- B. The requirements of this section apply to design of the structural elements and features of equipment and to platforms/walkways that are provided with equipment or non-building structures.
- C. This section applies to non-building structures and non-structural components that are permanently attached to structures as defined below and in ASCE 7.
- D. Design and conform to criteria and design codes listed within this section. Engineering design is not required for attachments, anchorage, or bracing detailed on the Drawings or where the size of attachments, anchorage, or bracing is defined in specific technical specification sections.
- E. The following non-structural components are exempt from seismic design loading requirements of this section.
 - 1. Components in Seismic Design Category A.
 - 2. Furniture (except permanent floor supported storage cabinets over 6 ft tall).
 - 3. Temporary or movable equipment.
 - 4. Architectural components in Seismic Design Category B other than parapets supported by bearing walls or shear walls provided that the component importance factor, I_p , is equal to 1.0.
 - 5. Mechanical and electrical components in Seismic Design Category B.
 - 6. Mechanical and electrical components in Seismic Design Category C provided that the component importance factor, I_p , is equal to 1.0.
 - 7. Mechanical and electrical components in Seismic Design Categories D, E, or F where all of the following apply:
 - a. The component importance factor, I_p , is equal to 1.0;
 - b. The component is positively attached to the structure;
 - c. Flexible connections are provided between the component and associated ductwork, piping, and conduit;
 - d. And either:
 - 1) the component weighs 400 lb or less and has a center of mass located 4 ft or less above the adjacent floor level; or
 - 2) the component weighs 20 lb or less, or in the case of a distributed systems, 5 lb/ft or less.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related section. Additional related sections may apply that are not specifically listed below.
1. Section 05 05 20 Anchor Bolts
 2. Section 05 50 00 Metal Fabrications

1.03 REFERENCES

- A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
Aluminum Design Manual	Aluminum Association, Aluminum Design Manual with Specifications and Guidelines for Aluminum Structures
AAMA	American Architectural Manufacturer's Association
ACI 318	Building Code Requirements for Structural Concrete
ACI 350	Code Requirements for Environmental Engineering Concrete Structures
ACI 350.3	Seismic Design of Liquid-Containing Concrete Structures
AISC 341	Seismic Provisions for Structural Steel Buildings
ACI 360	Specification for Structural Steel Buildings
ASCE 7	Minimum Design Loads for Buildings and Other Structures
ASTM C635	Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
ASTM C636	Installation for Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
AWS D1.1	Structural Welding Code - Steel
AWS D1.2	Structural Welding Code - Aluminum
AWS D1.6	Structural Welding Code - Stainless Steel
AWS D1.8	Structural Welding Code - Seismic Supplement
IBC	International Building Code with local amendments
NFPA-13	Installation of Sprinkler Systems
OSHA	U.S. Dept. of Labor, Occupational Safety and Health Administration
SMACNA	Seismic Restraint Manual Guidelines for Mechanical Systems

1.04 DEFINITIONS

- A. Structure: The structural elements of a building that resist gravity, seismic, wind, and other types of loads. Structural components include columns, posts, beams, girders, joists, bracing, floor or roof sheathing, slabs or decking, load-bearing walls, and foundations.
- B. Non-structural Components: Non-structural portions of a building include every part of the building and all its contents, except the structural portions, that carry gravity loads and that may also be required to resist effects of wind, snow, impact, temperature and

seismic loads. Non-structural components include, but are not limited to, ceilings, partitions, windows, equipment, piping, ductwork, furnishings, lights, etc.

1.05 SUBMITTALS

A. Action Submittals:

1. Procedures: Section 01 33 00.
2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for requested deviations to specification requirements, with the submittal is sufficient cause for rejection of the entire submittal with no further consideration.
4. For structural elements of non-structural components and non-building structures required to be designed per this section, provide drawings and design calculations stamped by a Utah licensed professional engineer qualified to perform structural engineering.
5. List of non-structural components and non-building structures requiring wind and seismic design and anchorage.
6. Shop drawings showing details of complete wind and seismic bracing and anchorage attachment assemblies including connection hardware, and embedment into concrete.
7. Shop drawings showing plans, elevations, sections and details of equipment support structures and non-building structures, including anchor bolts, structural members, platforms, stairs, ladders, and related attachments.
8. Identify interface points with supporting structures or foundations, as well as size, location, and grip of required attachments and anchor bolts. Clearly indicate who will be providing each type of attachment/anchor bolt. Equipment vendor shall design anchor bolts, including embedment into concrete, and submit stamped calculations.
9. Calculations for supports, bracing, and attachments shall clearly indicate design criteria applied. Coordinate concrete embedment calculations with thickness and strength of concrete members. Submit a tabulation of the magnitude of unfactored (service level) equipment loads at each support point, broken down by type of loading (dead, live, wind, seismic, etc.). Indicate impact factors applied to these loads in design calculations.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide materials in conformance with information shown on the Drawings and in other technical specification sections. See individual component and equipment specifications for additional requirements.

2.02 DESIGN CRITERIA

A. Design Codes

Design	Code
Buildings/Structures:	International Building Code 2015 and ASCE 7-10
Reinforced concrete:	ACI 350-06 and ACI 350.3-06 for Concrete Liquid Containing Structures, ACI 318-14 for all other reinforced concrete
Structural steel:	AISC 360-10 and AISC 341-10
Aluminum:	Aluminum Design Manual, Latest Edition
Welding:	AWS Welding Codes, Latest Edition
Occupational health and safety requirements:	OSHA and DOSH

Note: When conflicting requirements occur, the most stringent requirements will govern the design.

B. Design Loads

1. Design non-structural components and non-building structures for the following minimum loads: (Do not apply wind and snow loads to non-structural components and non-building structures that are located inside buildings.)
2. Dead Loads:
 - a. Add an additional allowance for piping and conduit when supported and hung from the underside of equipment and platforms.
 - b. Typical allowance for piping and conduit: 20 psf
3. Live Loads:

Hand/Guard Rails	200 lbs at location that produces maximum load effect
Ladders	300 lbs
Equipment platforms, walkways/catwalks (other than exitways):	100 psf

4. Seismic Loads:

Code:	IBC 2015 & ASCE 7-10
Risk Category:	IV
0.2 Sec. Mapped Spectral Response, S_s :	1.199 g
1.0 Sec. Mapped Spectral Response, S_1 :	0.4 g
Site Class:	D (assumed)
0.2 Sec. Design Spectral Response, S_{DS} :	0.816 g
1.0 Sec. Design Spectral Response, S_{D1} :	0.427 g
Importance Factor (I_e):	1.25
Component Importance Factor (I_p):	1.0, except $I_p=1.5$ for components identified in Section 13.1.3 of ASCE 7
Seismic Design Category	D

- C. Load Combinations
 - 1. Design non-structural components and non-building structures to withstand load combinations as specified in the governing building code. Where the exclusion of live load or impact load would cause a more severe load condition for the member under investigation, ignore the load when evaluating that member.
- D. Deflection
 - 1. Maximum beam deflection as a fraction of span for walkways and platforms: L/240 for total load and L/360 for live load.
 - 2. Maximum total load deflection for equipment support: L/450.

PART 3 EXECUTION

3.01 GENERAL

- A. Make attachments and braces in such a manner that component force is transferred to the lateral force-resisting system of the structure. Base attachment requirements and size and number of braces per calculations submitted by Contractor.
- B. Anchorage of equipment is specified to be made by cast-in anchor bolts in concrete elements unless specifically noted otherwise on the Drawings or other specification sections. Contractor is responsible for remedial work or strengthening (of concrete elements because of superimposed seismic loading) if anchor bolts are improperly installed or omitted due to lack of submittal review or improper placement for any reason, at no additional cost to Owner.
- C. Provide anchor bolts in accordance with Section 05 05 20. Base size of anchor bolts and embedment on submitted calculations.
- D. Submit details of and calculations for anchorages prior to placement of concrete or erection of other structural supporting members. Submittals received after structural supports are in place will be rejected if proposed anchorage method would create an overstressed condition of the supporting member. Contractor is responsible for revisions to anchorages and/or strengthening of structural support so that there is no overstress condition, at no additional cost to Owner.

END OF SECTION

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SECTION 01 75 70
DISINFECTION

PART 1 GENERAL

1.01 DESCRIPTION

- A. Section includes: Cleaning and disinfection requirements for new and existing facilities affected by the Work.
- B. Disinfection shall be completed prior to placing equipment into service or exposing them to operating facilities used for potable water.
- C. Once disinfected, Contractor shall protect the facilities from contamination and shall re-disinfect if contamination occurs.

1.02 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. C651 - Disinfecting Water Mains.
 - 2. C652 - Disinfection of Water Storage Facilities.
 - 3. C653 - Disinfection of Water Treatment Plants.
- B. U.S. Environmental Protection Agency (EPA):
 - 1. Method 524.2 Measurement of Purgeable Organic Compounds in Water by Capillary Column Gas Chromatography/Mass Spectrometry.
 - 2. Safe Drinking Water Act (SDWA).

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Procedure: Section 01 33 00.
 - 2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
 - 3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 - 4. Disinfection test plan which details procedure to be utilized to disinfect the facilities including:
 - a. Method and locations of disinfectant application.
 - b. Locations of sampling points.
 - c. Method of flushing and location of flushing ports (as appropriate for method of chlorination).
 - d. Method of de-chlorination (as appropriate for method of chlorination).

- e. Disposal location for chlorinated water (as appropriate for method of chlorination).
- 5. Disinfection reports and include the following:
 - a. Date issued.
 - b. Project name and location.
 - c. Treatment subcontractor's name, address, and phone number.
 - d. Type and form of disinfectant used.
 - e. Time and date of disinfectant injection start.
 - f. Time and date of disinfectant injection completion.
 - g. Test locations.
 - h. Initial and 24-hour disinfectant residuals in milligrams per liter for each outlet tested.
 - i. Time and date of flushing start.
 - j. Time and date of flushing completion.
 - k. Disinfectant residual after flushing in milligrams per liter for each outlet tested.
- 6. Bacteriological reports and include the following:
 - a. Date issued.
 - b. Project name and location.
 - c. Laboratory's name, certification number, address, and phone number.
 - d. Time and date of water sample collection.
 - e. Name of person collecting samples.
 - f. Test locations.
 - g. Time and date of laboratory test start.
 - h. Coliform bacteria test results for each outlet tested.
 - i. Certification that water conforms or fails to conform to bacterial standards of SDWA.
 - j. Bacteriologist's signature and bacteriological laboratory's evidence of certification.

1.04 QUALITY ASSURANCE

- A. Certifications
 - 1. Bacteriological and physical chemistry laboratory certification shall be by state in which Project is located.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Protect chlorine and bacteriological samples against damage and contamination.
- B. Maintain caution labels on hazardous materials.
- C. Maintain storage room dry and with temperatures as uniform as possible between 60 degrees Fahrenheit and 80 degrees Fahrenheit.

1.06 PROTECTION

- A. Provide necessary signs, barricades, and notices to prevent persons from accidentally consuming water or disturbing system being treated.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Disinfectant: Free chlorine in liquid, powder, tablet, or gas form in accordance with AWWA C653.
- B. Dechlorination agent: Sulfur dioxide, sodium bisulfate, sodium sulfite, or sodium thiosulfite in accordance with AWWA C653.

PART 3 EXECUTION

3.01 PRELIMINARY CLEANING

- A. Complete hydrostatic/leakage tests prior to disinfection.
- B. Clean all newly constructed and/or modified facilities, including filters and conveyance facilities, such as pipes and channels at the plant, in accordance with AWWA C653 and the following:
 - 1. Remove all debris and material not associated with the structure or process prior to disinfection.
 - 2. Clean all wall, floor, ceiling, and attached surfaces by use of high- pressure water jet, sweeping, scrubbing, or equally effective means.
 - 3. Remove all water, paint flakes, sediment, dirt, and foreign material accumulated during cleaning.
 - 4. Remove by sweeping, scrubbing, and high-pressure water jet, soil and debris from water pipes and channels in accordance with AWWA C651.
 - 5. Protect surfaces from adverse environmental exposure between the preliminary cleaning and the disinfection stages.
- C. Prior to chlorination, clean all newly constructed and/or modified facilities to be disinfected in accordance with AWWA C651, C652, or C653, as applicable.

3.02 SURFACES TO BE DISINFECTED

- A. All interior surfaces of the filters, filter channels downstream of the media, etc., including the ceilings, that are new or may have been contaminated during construction.
- B. All wetted surfaces associated with conveyance elements, such as pipes and channels that connect to the filters, that are new or may have been contaminated during construction.
- C. Any existing wetted surface downstream of the filters that may have been contaminated during the construction process.
- D. Piping systems that are used to convey water, solutions, or chemicals to potable water facilities.

3.03 DISINFECTION OF PIPES AND STRUCTURES IN CONTACT WITH POTABLE WATER

- A. Cleaning:
 - 1. Remove by flushing or other means, soil and debris from the pipes in accordance with AWWA C652 prior to chlorination.
- B. Inspection:
 - 1. Verify that water system is completed and cleaned of soil and debris prior to chlorination.

2. Start disinfection when conditions are satisfactory.
- C. System treatment:
1. Perform disinfection of water lines and structures in accordance with AWWA C651, C652, and C653, and as specified in this Section.
 2. Test for disinfectant residual at each of following locations and other locations in accordance with submitted disinfection test plan:
 - a. Ends of piping runs.
 - b. Remote outlets.
 - c. Tanks.
 - d. At least 2 outlets on each building floor where directed.
 - e. Drain lines.
 - f. Filters and effluent channels and piping.
 3. Maintain disinfectant in system for appropriate 6-hour or 24-hour interval in accordance with AWWA C652.
 4. When disinfectant residual is less than 10 milligrams per liter after 24 hours, repeat system treatment.
- D. Stainless steel piping:
1. Modify procedures for disinfection of stainless-steel piping and appurtenances as necessary to avoid causing corrosion, pitting, or attack of stainless steel materials.
 - a. Clean each pipe, fitting, or accessory with micro-fiber swab dampened with standard potable water before installation. Super-chlorinated water shall not be used on any stainless-steel piping.
 - b. Plug the ends of the assembly until a new item is to be added to the assembly.

3.04 REPAIRS OR CONNECTIONS TO EXISTING LINES

- A. Clean and sterilize the interior surfaces of new piping, fittings, equipment, and appurtenances to be installed in an existing potable water system or connected to an existing system.
- B. Clean and sterilize the existing pipe or facilities for a minimum distance of 3 pipe diameters back from the ends of the pipe. Plug the ends of the line when work is not being performed on the pipe.
- C. Perform sterilization by swabbing each item with a concentrated chlorine solution.
 1. Each piece is to be disinfected prior to being assembled for installation in the existing pipe.
 2. Disinfect each piece just prior to assembly to help prevent recontamination.
 3. Plug the ends of the assembly until a new item is to be added to the assembly.
 4. Store disinfected materials on blocks to prevent contact with the ground.

3.05 FLUSHING

- A. Remove disinfection water from the facilities as appropriate for the type of disinfectant and method used for disinfection.

- B. Flush facilities with potable water containing no more disinfectant residual than the active distribution system or 1.0 milligrams per liter, whichever is greater (as appropriate for method of chlorination).
- C. Continue flushing until water at designated flushing ports contains disinfectant residual equal to concentration specified above.

3.06 DISPOSAL OF CHLORINATED WATER

- A. Dispose of chlorinated water in accordance with the submitted disinfection test plan and applicable requirements of federal, state, county, and city having jurisdiction over disposal of hazardous wastes in location of the Project and disposal site.

3.07 BACTERIOLOGICAL TEST

- A. Test for the presence of total coliform bacteria. If none of the samples show the presence of total coliform bacteria, the unit may be placed in service.
- B. Instruct bacteriological laboratory to collect water samples no sooner than 24 hours after start of disinfection of each facility.
- C. A minimum of 24 hours after flushing system and within 24 hours before the unit is placed in service, collect bacteriological quality samples at each of following locations and other locations in accordance with the submitted disinfection test plan and Standard Methods for the Examination of Water and Wastewater:
 - 1. Sand Filter Outlet
- D. Analyze water samples in accordance with Standard Methods for Examination of Water and Wastewater.
- E. When bacteriological test proves water quality to be unacceptable, repeat disinfection treatment process until water meets quality standards for disinfection.

END OF SECTION

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SECTION 01 99 90
REFERENCE FORMS

PART 1 FORMS

1.01 DESCRIPTION

- A. The forms listed below and included in this section are referenced from other sections of the project manual:

Form No.	Title
01 33 00-A	Submittal Transmittal Form
01 45 20-A	Equipment Test Report Form
01 78 23-A	Operation and Maintenance Transmittal Form
01 78 23-B	Equipment Record Form
01 78 23-C	Equipment Record Form
09 90 00-A	Coating System Inspection Checklist
26 05 00-A	Wire and Cable Resistance Test Data Form
26 05 00-B	Installed Motor Test Data Form
26 05 00-C	Dry Transformer Test Data Form
26 05 00-D	Motor Control Center Test Form
26 05 00-E	Medium Voltage Motor Starter Test Form
26 05 00-F	Medium Voltage Switchgear Test Form
26 05 00-G	Protective Relay Test Form
26 05 00-H	Low Voltage Switchgear Test Form
26 05 00-I	Medium Voltage Load Interrupter Switch Test Form
26 05 00-J	Liquid-Filled Transformer Test Form
26 05 00-K	Automatic Transfer Switch Test Form
26 05 00-L	Neutral Grounding Resistor Test
40 61 13-A	Loop Wiring and Insulation Resistance Test Data Form
40 61 13-B	Control Circuit Piping Leak Test Form
40 61 13-C	Controller Calibration Test Data Form
40 61 13-D	Panel Indicator Calibration Test Data Form
40 61 13-E	Recorder Calibration Test Data Form
40 61 13-F	Signal Trip Calibration Test Data Form
40 61 13-G	Field Switch Calibration Test Data Form
40 61 13-H	Transmitter Calibration Test Data Form
40 61 13-I	Miscellaneous Instrument Calibration Test Data Form
40 61 13-J	Individual Loop Test Data Form
40 61 13-K	Loop Commissioning Test Data Form
43 05 11-A	Manufacturer's Installation Certification Form
43 05 11-B	Manufacturer's Instruction Certification Form
43 05 11-C	Unit Responsibility Certification Form
43 05 13-A	Rigid Equipment Mount Installation Inspection Checklist
43 05 21-A	Motor Data Form

01 33 00-A. SUBMITTAL TRANSMITTAL FORM

Submittal Transmittal

Submittal Description:	Submittal No: ¹	Spec Section:
------------------------	----------------------------	---------------

	Routing	Sent	Received
Owner:	Contractor/CM		
Project:	CM/Engineer		
	Engineer/CM		
Contractor:	CM/Contractor		

We are sending you:

- Attached
- Under separate cover via _____
- Submittals for review and comment
- Product data for information only

Remarks: _____

Item	Copies	Date	Section No.	Description	Review action ^a	Reviewer initials	Review comments attached

^aNote: NET = No exceptions taken; MCN = Make corrections noted; A&R = Amend and resubmit; R = Rejected
Attach additional sheets if necessary.

Contractor

Certify either a or b:

- a. We have verified that the material or equipment contained in this submittal meets all the requirements, including coordination with all related work, specified (no exceptions).
- b. We have verified that the material or equipment contained in this submittal meets all the requirements specified except for the attached deviations.

No.	Deviation

Certified by: _____

Contractor's Signature: _____

¹See Section 01 33 00-1.04. A, Transmittal Procedure.

01 78 23-A. OPERATION AND MAINTENANCE TRANSMITTAL FORM

Date:	Submittal No: ²
To:	Contract No:
	Spec. Section:
	Submittal Description:
Attention:	From:

Checklist	Contractor		Construction Manager	
	Satisfactory	N/A	Accept	Deficient
1. Table of contents				
2. Equipment record forms				
3. Manufacturer information				
4. Vendor information				
5. Safety precautions				
6. Operator prestart				
7. Start-up, shutdown, and postshutdown procedures				
8. Normal operations				
9. Emergency operations				
10. Operator service requirements				
11. Environmental conditions				
12. Lubrication data				
13. Preventive maintenance plan and schedule				
14. Troubleshooting guides and diagnostic techniques				
15. Wiring diagrams and control diagrams				
16. Maintenance and repair procedures				
17. Removal and replacement instructions				
18. Spare parts and supply list				
19. Corrective maintenance man-hours				
20. Parts identification				
21. Warranty information				
22. Personnel training requirements				
23. Testing equipment and special tool information				

Remarks:

Contractor's Signature :

² See Section 01 33 00-1.04.A, Transmittal Procedure.

09 90 00-A COATING SYSTEM INSPECTION CHECKLIST

Project Name			
Owner		Coating System Manufacturer (CSM)	
General Contractor (GC)		Coating System Applicator (CSA)	
Area or Structure		Location within Structure	
Coating System (eg E-1)		Coating Type (eg Epoxy, etc.)	

Coating System Inspection Checklist

Step	Description		Name	Signature	Date
1	Completion of cleaning and substrate decontamination prior to abrasive blast cleaning.	GC QC			
		CSM QC			
		CSA QC			
2	Installation of protective enclosure of structure or area and protection of adjacent surfaces or structures that are not to be coated.	GC QC			
		CSM QC			
		CSA QC			
3	Completion of ambient condition control in structure or building area and acceptance of ventilation methods in structure or Area.	GC QC			
		CSM QC			
		CSA QC			
4	Completion of Surface Preparation for Substrates to Be Coated.	GC QC			
		CSM QC			
		CSA QC			
5	Completion of Primer Application.	GC QC			
		CSM QC			
		CSA QC			
6	Completion of Concrete Repairs If Required and Related Surface Preparation Rework Prior to Coating System Application.	GC QC			
		CSM QC			
		CSA QC			
7	Completion of Concrete Filler/ Surface Application to Concrete.	GC QC			
		CSM QC			
		CSA QC			
8	Completion of First Finish Coat Application and of Detail Treatment at Transitions or Terminations.	GC QC			
		CSM QC			
		CSA QC			

Coating System Inspection Checklist

Step	Description		Name	Signature	Date
9	Completion of Second Finish Coat Application and of Detail Treatment at Transitions and Terminations.	GC QC			
		CSM QC			
		CSA QC			
10	Completion of Full and Proper Cure of Coating System.	GC QC			
		CSM QC			
		CSA QC			
11	Completion of Testing of Cured Coating System including Adhesion, Holiday (Continuity) Testing and Dry Film Thickness.	GC QC			
		CSM QC			
		CSA QC			
12	Completion of Localized Repairs to Coating System Following Testing.	GC QC			
		CSM QC			
		CSA QC			
13	Final Acceptance of Coating System Installation Including Final Clean-Up Complying with Specification Requirements and the CSM's Quality Requirements.	GC QC			
		CSM QC			
		CSA QC			

26 05 00-A. WIRE AND CABLE RESISTANCE TEST DATA FORM

Wire or Cable No.: _____ Temperature, °F: _____

Location of Test	Insulation resistance, megohms
1.	
2.	
3.	
4.	
5.	
6.	
7.	

CERTIFIED _____ Date _____

Contractor's Representative

WITNESSED _____ Date _____

Owner's Representative

40 61 13-A. LOOP WIRING AND INSULATION RESISTANCE TEST DATA FORM

Loop No.: _____

List all wiring associated with a loop in table below. Make applicable measurements as indicated after disconnecting wiring.

Wire No.	Panel Tie	Field TB	Continuity Resistance ^a		Insulation Resistance ^b			
			Cond./ Cond.	Cond./ Shield	Shield/ Gnd.	Shield/ Cond.	Cond./ Gnd.	Shield/ Shield
A			--	(A/SH)				
B			(A/B)	--				
C			(A/C)	--				
D			(A/D)	--				
etc.								

NOTES:

- a. Continuity Test. Connect ohmmeter leads between wires A and B and jumper opposite ends together. Record resistance in table. Repeat procedure between A and C, A and D, etc. Any deviation of ± 2 ohms between any reading and the average of a particular run indicates a poor conductor, and corrective action shall be taken before continuing with the loop test.
- b. Insulation Test. Connect one end of a 500 volt megger to the panel ground bus and the other sequentially to each completely disconnected wire and shield. Test the insulation resistance and record each reading.

CERTIFIED _____ Date _____

Contractor's Representative

WITNESSED _____ Date _____

Owner's Representative

40 61 13-C. CONTROLLER CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No.: _____

Input: _____ Process Variable (PV) Scale: _____

Output: _____ Output Scale: _____

PV Scale Calibration

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				
				% Deviation Allowed:

Connect output to PV for following tests:

Set Point (SP) Indicator Accuracy			Output Meter Accuracy			Controller Accuracy		
SP	PV Reading	Expected % Dev.	Actual Reading	Expected Reading	Actual % Dev.	OUTPUT	OUTPUT	% Dev.
(0%)								
(50%)								
(100%)								
% Deviation Allowed:			% Deviation Allowed:			% Deviation Allowed:		

CERTIFIED _____ Date _____

Contractor's Representative

WITNESSED _____ Date _____

Owner's Representative

43 05 11-A. MANUFACTURER'S INSTALLATION CERTIFICATION FORM

Contract No: _____ Specification section: _____

Equipment name: _____

Contractor: _____

Manufacturer of equipment item: _____

The undersigned manufacturer of the equipment item described above hereby certifies that he has checked the installation of the equipment and that the equipment, as specified in the project manual, has been provided in accordance with the manufacturer's recommendations, and that the trial operation of the equipment item has been satisfactory.

Comments: _____

Manufacturer

Contractor

Signature of Authorized Representative

Signature of Authorized Representative

Date

Date

43 05 11-B. MANUFACTURER'S INSTRUCTION CERTIFICATION FORM

Contract No:	Specification Section:
--------------	------------------------

Equipment name:

Contractor:

Manufacturer of equipment item:

The undersigned manufacturer certifies that a service engineer has instructed the wastewater treatment plant operating personnel in the proper maintenance and operation of the equipment designated herein.

Operations Check List (check appropriate spaces)

Start-up procedure reviewed	
Shutdown procedure reviewed	
Normal operation procedure reviewed	
Others:	

Maintenance Check List (check appropriate spaces)

Described normal oil changes (frequency)	
Described special tools required	
Described normal items to be reviewed for wear	
Described preventive maintenance instructions	
Described greasing frequency	
Others:	

Manufacturer

Signature of Contractor Representative Date

Signature of Authorized Representative

Date

Signature of Authorized Representative Date

43 05 11-C. UNIT RESPONSIBILITY CERTIFICATION FORM

JVWTP AIR SCOUR PIPING REPLACEMENT PROJECT

CERTIFICATE OF UNIT RESPONSIBILITY
FOR SPECIFICATION SECTION _____

In accordance with Section 43 05 11-1.02 Unit Responsibility of the contract documents, the undersigned manufacturer of driven equipment ("manufacturer") accepts unit responsibility for all components of equipment furnished to the Project under specification Section _____, and for related equipment manufactured under sections _____, _____, and _____.

We have reviewed the requirements for sections 43 05 11 and 43 23 03 (where applicable) and all sections referencing this (these) section(s), including but not limited to drivers, supports for driving and driven equipment and all other specified appurtenances to be furnished to the Project by manufacturer. And, we have further reviewed, and modified as necessary, the requirements for associated variable speed drives and motor control centers. We hereby certify that all specified components are compatible and comprise a functional unit suitable for the specified performance and design requirements whether or not the equipment was furnished by us. We will make no claim nor establish any condition that problems in operation for the product provided under this specification Section _____ are due to incompatibility of any components covered by this Certificate of Unit Responsibility. Nor will we condition or void any warranty for the performance of the product of this specification Section _____ due to incompatibility of any components covered under this Certificate of Unit Responsibility.

Our signature on this Certificate of Unit Responsibility does not obligate us to take responsibility for, nor to warrant the workmanship, quality, or performance of related equipment provided by others under specification sections _____, _____, and _____. Our obligation to warranty all equipment provided by us shall remain unaffected.

Notary Public

Name of Corporation

Commission expiration date

Address

Seal:

By:

Duly Authorized Official

Legal Title of Official

Date

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SECTION 03 60 00

GROUTING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Section includes: Grout for column base plates, other structural supports, equipment bases, reinforcing bar dowels, surface repair, grout toppings, patching of fresh concrete, and uses other than masonry.

1.02 RELATED SECTIONS - NOT USED

1.03 REFERENCES:

- A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ASTM C109	Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm Cube Specimens)
ASTM C230	Flow Table for Use in Tests of Hydraulic Cement
ASTM C307	Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing
ASTM C939	Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
ASTM C531	Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
ASTM C579	Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing and Polymer Concretes
ASTM C882	Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
ASTM C942	Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C1107	Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
ASTM C1181	Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts
ASTM E329	Agencies Engaged in Construction Inspection, Testing, or Special Inspection
COE CRD-C611	Flow of Grout for Preplaced Aggregate Concrete
COE CRD-C621	Non-shrink Grout
IBC	International Building Code

1.04 SUBMITTALS

A. Action Submittals

1. Procedure: Section 01 33 00:
2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
4. Complete product literature, including mixing, handling and placement instructions for the following: Cementitious non-shrink grout, epoxy grout, adhesive for reinforcing bar dowel grouting, concrete repair mortar, and prepackaged cement grout products to be used on the project.
5. Mix design for cement grout that is not prepackaged, including product data for aggregates and cement.
6. Current ICC Evaluation Service reports for adhesives used for reinforcing dowels.
7. Installer certification in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program for installers of horizontal or upwardly inclined reinforcing bar dowels grouted using adhesive.
8. Certified test results verifying the compressive strength, shrinkage and expansion requirements specified herein.

1.05 QUALITY ASSURANCE

A. Quality Control by Contraction

1. Provide the services of an independent testing laboratory which complies with the requirements of ASTM E329 if a product other than those listed below is proposed and test data is not available from the supplier to demonstrate equivalence to the specified grout. The testing laboratory shall sample and test the proposed grout materials. Costs of testing laboratory services shall be borne by the Contractor.
2. Adhesive anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads shall be continuously inspected during installation by a Special Inspector.
 - a. The Special Inspector shall furnish a report to the Engineer, Owner's Representative and Building Official that the work covered by the report has been performed and that the materials used and the installation procedures used conform with the approved Project Manual and the Manufacturer's Printed Installation Instructions (MPII).

B. Certifications

1. Installer certification shall be in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program for installers of horizontal or upwardly inclined reinforcing bar dowels grouted using adhesive.

- C. Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter as selected by the Engineer to insure continued compliance with these Specifications.
 - 1. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C579, Method B, at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days and any other time period as appropriate.
 - 2. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days, 28 days and any additional time period as appropriate.

- D. Manufacturer Qualifications
 - 1. Manufacturer shall have a minimum of five years' experience of producing products substantially similar to that required and shall be able to submit documentation of at least five satisfactory installations that have been in successful operation for at least five years each.
 - 2. When required, provide services of manufacturer's full-time employee, factory-trained in handling, use, and installing the products required, with at least five years of experience in field applications of the products required.

PART 2 PRODUCTS

2.01 CEMENTITIOUS NON-SHRINK GROUT

- A. The grout material shall be an approved ready to use mixture requiring only water for use at the job site. The 2-inch cubes shall have a minimum compressive strength of 3,000 psi at 7 days and 7,000 psi at 28 days.

- B. Cementitious non-shrink non-metallic aggregate grout shall be:
 - 1. BASF, Masterflow 928
 - 2. Euclid Chemical Company, Hi-Flow Grout
 - 3. Five Star Products, Inc., Five Star Grout
 - 4. Sika Corporation, SikaGrout 212
 - 5. Approved Equal

- C. Non-shrink grout shall conform to CRD-C 621 and ASTM C1107, Grade B or C when tested at a maximum fluid consistency of 30 seconds per ASTM C939 at temperature extremes of 45 degrees Fahrenheit and 90 degrees Fahrenheit and an extended working time of 15 minutes. Grout shall be ANSI/NSF-61 certified for use with potable water.

- D. Fluid grout shall pass through the flow cone, with continuous flow, one hour after mixing.

2.02 EPOXY GROUT FOR EQUIPMENT MOUNTING – NOT USED

2.03 ADHESIVE FOR GROUTING REINFORCING BAR DOWELS – NOT USED

2.04 CONCRETE REPAIR MORTAR – NOT USED

2.05 CEMENT GROUT – NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine and accept existing conditions before beginning work.

3.02 CEMENTITIOUS NONSHRINK GROUT

A. Non-shrink, cementitious, nonmetallic aggregate grout shall be used for column base plates, structural bearing plates, and all locations where the general term “non-shrink grout” is indicated on the Drawings. Grout shall be placed and cured in accordance with the manufacturer's instructions.

B. Non-shrink cementitious grout shall not be used as a surface patch or topping. Non-shrink cementitious grout must be used in confined applications only.

3.03 EPOXY GROUT FOR EQUIPMENT MOUNTING – NOT USED

3.04 ADHESIVE FOR GROUTING REINFORCING BAR DOWELS – NOT USED

3.05 CONCRETE REPAIR MORTAR – NOT USED

3.06 CEMENT GROUT – NOT USED

END OF SECTION

SECTION 05 05 20

ANCHOR BOLTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Bolts and all-thread rods used to attach structural elements and equipment to concrete. Included are cast-in-place and post-installed anchors (adhesive systems and wedge type expansion anchors), nuts and washers.
- B. Cast-in-place and post-installed anchors shall be Type 316 stainless steel unless noted otherwise.

1.01 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
 - 1. Section 01 73 24 Design Requirements for Nonstructural Components and Nonbuilding Structures
 - 2. Section 03 60 00 Grouting

1.02 REFERENCES

- A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ACI 318	Building Code Requirements for Structural Concrete
ASTM A193	Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A320	Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service
ASTM A563	Carbon and Alloy Steel Nuts
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Stainless Steel Nuts
ASTM F844	Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F1554	Anchor Bolts, Steel, 36, 55, 105-ksi Yield Strength
IBC	International Building Code with local amendments

1.03 SUBMITTALS

- A. Action Submittals
 - 1. Procedures: Section 01 33 00.

2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
4. Anchor bolt placement plans.
5. Anchor bolt, nut, and washer material information, including material certifications.
6. Record copy of design calculations and details showing the required diameter, length, embedment, edge distance, confinement, anchor reinforcement, anchor bolt sleeves, connection redesign, and other conditions, stamped and signed by a Professional Engineer currently registered in the state of Utah. Calculations shall comply with the provisions of ACI 318-14, Chapter 17. Assume compressive strength of existing concrete is 3,000 psi unless otherwise noted.
7. Submit record copy of proof loading test results within five days after test.
8. Product Data:
 - a. ICC Evaluation Service Reports for post-installed adhesive type anchors and expansion (wedge type) anchors when allowed. Products shall be ICC approved for use in cracked concrete in high seismic areas (Seismic Design Category D, E and F).
 - b. Product data indicating load capacity charts/calculations.
 - c. Chemical resistance.
 - d. Temperature limitations.
 - e. Manufacturers written installation instructions.
9. Installer certification for horizontal or upwardly inclined adhesive anchors in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program.

1.04 QUALITY ASSURANCE

- A. Quality Assurance By Owner
 1. Special inspection of anchor bolts shall be performed by the Special Inspector under contract with the Owner and in accordance with IBC Chapter 17.
 2. A five percent sample of installed post-installed anchors shall be proof-loaded by an independent laboratory contracted by the Contractor. The quantity of samples and locations shall be coordinated with the Owner's Representative.
 3. Adhesive anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads shall be continuously inspected during installation by a Special Inspector.
 4. The Special Inspector shall furnish a report to the Engineer, Owner's Representative, and Building Official that the work covered by the report has been performed and that the materials used and the installation procedures used conform with the approved Project Manual and the Manufacturer's Printed Installation Instructions (MPII).

B. Certifications

1. Installer certification shall be in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program for installers of horizontal or upwardly inclined adhesive anchors.

PART 2 PRODUCTS

2.01 GENERAL

- A. Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 1/4 inch. Minimum anchor bolt diameter shall be 1/2 inch. Anchor bolts for equipment mounting and vibration isolation systems shall be provided as specified in Sections 43 05 13 and 43 05 18, respectively.
- B. Tapered washers shall be provided where mating surface is not square with the nut.
- C. Anchor bolts shall be cast-in-place anchors unless post-installed anchors are specified or shown on the Drawings. Substitution of post-installed anchors will not be permitted unless specifically requested by the Contractor and approved by the Engineer.

2.02 PERFORMANCE/DESIGN CRITERIA

- A. Anchor bolts for equipment shall be designed by the equipment manufacturer to include equipment operational loads combined with seismic and wind forces when applicable. Design criteria provided in Section 01 73 24.
- B. Design anchor bolts for support and bracing of non-structural components and non-building structures for loading specified in Section 01 73 24.

2.03 MATERIALS

- A. Anchor bolt materials shall be as specified in the following table:

Material	Specification
Stainless Steel Anchor Bolts	ASTM A193 or A320, Type 316
Stainless Steel Threaded Rods	ASTM F593, Type 316
Stainless Steel Nuts	ASTM A194 Heavy Hex Nuts, Type 316 ASTM F594 Heavy Hex Nuts at Adhesive Anchors, Type 316
Stainless Steel Washers	Type 316 to match bolt material
Carbon Steel Anchor Bolts	ASTM F1554, Grade 36, Hot Dip Galvanized
High-Strength Carbon Steel Anchor Bolts	ASTM F1554, Grade 55, Weldable per Supplementary Requirement S1, Hot Dip Galvanized
Carbon Steel Nuts and Washers	ASTM A563 and F844, Heavy Hex, Hot-Dip Galvanized
Concrete Adhesive Anchors	Hilti "HIT-RE 500v3", Simpson Strong-Tie "SET-XP", or approved equal, with Type 316 Stainless Steel threaded rods
Concrete Masonry Adhesive Anchors	Hilti "HIT-HY 70", Simpson Strong-Tie "SET-XP", or approved equal, with Type 316 Stainless Steel threaded rods
Concrete Masonry Expansion (wedge) Anchors*	Hilti "KWIK BOLT 3", or approved equal, Type 316 Stainless Steel

Material	Specification
Concrete Expansion (wedge) Anchors *	Hilti "KWIK BOLT TZ", or approved equal, Type 316 Stainless Steel

**Post installed anchors shall always be an adhesive type anchor system except where noted otherwise or when Contractor makes a request for a specific application and Engineer approves.*

2.04 STAINLESS STEEL FASTENER LUBRICANT (ANTI-SEIZING)

- A. Anti-seizing Lubricant for Stainless Steel Threaded Connections:
 1. Suitable for potable water supply.
 2. Formulated to resist washout.
 3. Acceptable manufacturers are Bostik, Saf-T-Eze, or equal.

2.05 ANCHOR BOLT SLEEVES

- A. Provide anchor bolt sleeves as shown on design drawings and as required by equipment manufacturer's design.
 1. Provide high density polyethylene plastic sleeves of single unit construction with deformed sidewalls such that the concrete and grout lock in place.
 2. The top of the sleeve shall be self-threading to provide adjustment of the threaded anchor bolt projection.
 3. Acceptable manufacturers are Contec, Wilson, or equal.

PART 3 EXECUTION

3.01 GENERAL

- A. Anchor bolts shall be cast-in-place anchors unless post-installed anchors are specified or shown on the Drawings.
- B. Grouting of anchor bolts using plastic sleeves with non-shrink or epoxy grout, where specified, shall be in accordance with Section 03 60 00.
- C. The threaded end of anchor bolts and all-thread rods shall be long enough to project through the entire depth of the nut and if too long, shall be cut off at 1/2-inch beyond top of nut and ground smooth.

3.02 CAST-IN-PLACE ANCHOR BOLTS

- A. Anchor bolts to be embedded in concrete shall be placed accurately and held in correct position using templates while the concrete is placed.
- B. After anchor bolts have been embedded, their threads shall be protected by grease and the nuts run on.

3.03 ADHESIVE ANCHOR BOLTS

- A. Note that adhesive anchors shall not be substituted for cast-in-place anchor bolts unless the adhesive anchors have been specified or shown on the Drawings, or approval has been obtained from the Engineer that substitution of adhesive anchors is acceptable for

the specific use and location. Use of adhesive anchors shall be subject to the following conditions:

1. Limit to locations where intermittent or continuous exposure to the following is extremely unlikely:
 - a. Acid concentrations higher than 10 percent
 - b. Chlorine gas
 - c. Machine or diesel oils
2. Limit to applications where exposure to the following is extremely unlikely:
 - a. Fire
 - b. Concrete or rod temperature above 120 degrees F
3. Overhead applications (such as pipe supports) shall not be allowed unless approved by the Engineer and installation is by an Installer specially certified for overhead applications.
4. Approval from Engineer for specific application and from supplier of equipment to be anchored, if applicable.
5. Anchor diameter and material shall be per Contract Documents or equipment manufacturer's specifications. Anchor shall be threaded or deformed the full length of embedment and shall be free of rust, scale, grease, and oils.
6. Embedment depth shall be as specified or as required by the equipment manufacturer.
7. Follow the anchor system manufacturer's installation instructions.
8. Holes shall have rough surfaces created by using a hammer drill with carbide bit. Core drilled holes are not allowed.
9. Holes shall be blown clean with oil-free compressed air and be free of dust or standing water prior to installation. Follow additional requirements of the adhesive manufacturer.
10. Concrete and air temperature shall be compatible with curing requirements of adhesives per adhesive manufacturer's instructions. Anchors shall not be placed in concrete when the temperature is below 25 degrees F.
11. Anchors shall be left undisturbed and unloaded for full adhesive curing period, which is based on temperature of the concrete.

3.04 EXPANSION ANCHORS

- A. Expansion (wedge type) anchors shall not be substituted for cast-in-place anchor bolts or adhesive anchors unless approved by the Engineer for a specific application. Use of expansion anchors shall be subject to conditions 4 through 9 as specified above for adhesive anchors. Expansion anchors shall not be used in a submerged condition or in mounting of equipment subject to vibration or cyclic motion.

3.05 REINFORCING STEEL CONFLICTS WITH POST-INSTALLED ANCHOR INSTALLATION

- A. When reinforcing steel is encountered in the drill path, slant drill to clear obstruction and provide beveled washer to match angle of anchor. Drill shall not be slanted more than 10 degrees.

- B. Where slanting the drill does not resolve the conflict, notify the Owner's Representative and resolve the conflict to the satisfaction of the Owner's Representative in consultation with the Engineer.
- C. Abandoned post-installed anchor holes shall be cleaned and filled with non-shrink grout and struck off flush with adjacent surface.
- D. The costs of determining and executing the resolution shall be borne by the Contractor. The determination and execution of the resolution shall not result in additional cost to the Owner.
- E. Reinforcing steel in masonry shall not be damaged.
- F. In order to avoid or resolve a conflict, locate embedded reinforcing steel using non-destructive methods and/or redesign the attachment.
 - 1. Redesign shall be done by the Contractor's Professional Engineer currently registered in the state of Utah.
 - 2. Calculations and details for redesign shall be submitted.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
1. Custom fabricated metal items and certain manufactured units not otherwise indicated to be provided under work of other specification sections.
 2. Seat angle frames
 3. Ladders, ladder cages, and safety posts
 4. U-channel concrete inserts
 5. Pipe sleeves
 6. Miscellaneous metal fabrications not covered elsewhere

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
1. Section 01 73 24 Design Requirements for Nonstructural Components and Nonbuilding Structures
 2. Section 05 05 20 Anchor Bolts

1.03 REFERENCES

- A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
Aluminum Design Manual	The Aluminum Association, Aluminum Design Manual with Specifications and Guidelines for Aluminum Structures
AISC 303	Code of Standard Practice for Steel Buildings and Bridges
AISC 360	Specification for Structural Steel Buildings
AISC Steel Construction Manual	American Institute of Steel Construction, Manual of Steel Construction
ANSI A14.3	Standard for Ladders - Fixed - Safety Requirements
ASTM A36	Carbon Structural Steel
ASTM A48	Gray-Iron Castings
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A108	Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A123	Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A193	Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

Reference	Title
ASTM A194	Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A240	Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A276	Stainless Steel Bars and Shapes
ASTM A283	Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A307	Carbon Steel Bolts, Studs, and Threaded Rod 60000 psi Tensile Strength
ASTM A312	Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A320	Alloy-Steel Bolting Materials for Low Temperature Service
ASTM A325	Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength
ASTM A380	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM A384	Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
ASTM A489	Carbon Steel Lifting Eyes
ASTM A500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A554	Welded Stainless Steel Mechanical Tubing
ASTM A563	Carbon and Alloy Steel Nuts
ASTM A572	High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A653	Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process
ASTM A780	Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings
ASTM A786	Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
ASTM A793	Rolled Floor Plate, Stainless Steel
ASTM A924	Steel Sheet, Metallic-Coated by Hot-Dip Process
ASTM A992	Structural Steel Shapes
ASTM A1011	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
ASTM B209	Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B210	Aluminum and Aluminum-Alloy Drawn Seamless Tubes
ASTM B211	Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire
ASTM B221	Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B241	Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B308	Aluminum-Alloy 6061-T6 Standard Structural Profiles
ASTM B429	Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM B632	Aluminum-Alloy Rolled Tread Plate
ASTM D1056	Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM F436	Hardened Steel Washers
ASTM F468	Nonferrous Bolts, Hex Cap Screws, SocketHead Cap Screws and Studs for General Use
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Stainless Steel Nuts
AWS D1.1	Structural Welding Code - Steel
AWS D1.2	Structural Welding Code - Aluminum

Reference	Title
AWS D1.6	Structural Welding Code - Stainless Steel
OSHA 29 CFR 1910.27	Fixed Ladders
OSHA 29 CFR 1926.502	Fall Protection Systems Criteria and Practices
SSPC SP5	White Metal Blast Cleaning
IBC	International Building Code

1.04 DEFINITIONS

- A. Galvanize: Hot-dip galvanize per ASTM A123 or ASTM A153, per Section 05 05 14.

1.05 SUBMITTALS

- A. Action Submittals:

1. Procedures: Section 01 33 00
2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
4. Manufacturer's product data.
5. Detailed Shop Drawings:
 - a. Fabrication drawings showing layouts, connections to structural system, and anchoring details.
 - b. Erection and installation drawings indicating thickness, type, grade, class of metal, coating system and dimensions.
 - c. Construction details, reinforcement, anchorage, and installation with relation to the building construction.
6. Welding procedures and welder certificates and qualifications.
7. U-Channel Concrete Inserts: Manufacturer's product description and allowable load tables.
8. Passivation method for stainless steel fabrications.

1.06 QUALITY ASSURANCE

- A. Qualifications

1. Fabricator shall have a minimum of five years' experience in fabrication of metal specified.

- B. Certificates

1. Certified welding procedures and welding operators in accordance with AWS. Welding operator certificates shall be no more than one-year old and the welder shall have used the welding process to be performed within the last six months.
- C. The use of salvaged, reprocessed or scrap materials will not be permitted.
- D. Shop Assembly: Items in the shop shall be preassembled to the greatest extent possible, so as to minimize field splicing and assembly of units. Units shall be disassembled only to the extent necessary for shipping and handling limitations. Units shall be clearly marked for reassembly and coordinated installation.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Avoid damage during delivery and handling of fabrications.
- B. Store off the ground on skids or other supports to keep items free of dirt and other foreign debris and to protect against corrosion.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials for miscellaneous metalwork are specified in the following table.

Material	Specification
Steel	
Sheets, plates and shapes (except W shapes)	ASTM A36
W shapes	ASTM A992
Pipe	ASTM A53, Grade B
Square/rectangular tubing	ASTM A500, Grade B
Headed Anchor Studs	ASTM A108
Carbon steel bolts	ASTM A307, Grade A
High strength bolts	ASTM A325 (Type 1)
Nuts	ASTM A563
Washers	ASTM F436
Stainless Steel	
Sheet and Plates	ASTM A240, Type 316 or 316L
Shapes, bars, and similar items	ASTM A276, Type 316 or 316L
Pipe	ASTM A312, Type 316 or 316L
Headed Anchor Studs	ASTM A276, Type 316L
Bolts	ASTM F593, Type 316
Nuts	ASTM F594, Type 316
Aluminum	
Sheets and plates	ASTM B209, Type 6061-T6

Material	Specification
Bars, flats and similar items	ASTM B211 or B221, Type 6061-T6
Shapes	ASTM B308, Type 6061-T6
Round tubing and pipe	ASTM B241, Type 6061-T6
Square and rectangular tubing	ASTM B221, Type 6063-T52
Pipe	ASTM B211 or B241, Type 6061-T6
Bolts, Stainless Steel	ASTM F593, Type 316
Nuts, Stainless Steel	ASTM F594, Type 316
Checker Plate	
Steel	ASTM A786
Stainless steel	ASTM A793, Type 304
Aluminum	ASTM B632, Type 6061-T6
Other steel items	
Iron castings	ASTM A48
Eyebolts	ASTM A489
Threaded rods	ASTM A36

2.02 FABRICATION

A. General

1. Conform to AISC or Aluminum Association standards as applicable. Where Code defined loads apply, also conform to IBC requirements.
2. Shop and field welding shall conform to the requirements of AISC, the Aluminum Design Manual, and applicable AWS procedures and specifications as required by the material being welded.
3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt, tight, flush, and hairline. Remove burrs and weld splatter. Ease exposed edges to small uniform radius.
4. Holes shall be punched 1/16 inch larger than the nominal size of the bolts, unless otherwise specified. Whenever needed, because of the thickness of the metal, holes shall be subpunched and reamed or shall be drilled.
5. Fabrication, including cutting, drilling, punching, threading and tapping required for fabrications or adjacent work, shall be performed prior to galvanizing.

B. Seat Angle Frames

1. Provide recessed seat angle frames for grating and floor plates. Miter corners to ensure accurate fit. Match depth of recess with grating or floor plate thickness. Anchor frames in concrete with headed studs. Steel angle support frames shall be stainless steel, ASTM A276, Type 316, unless indicated otherwise.

C. Ladders

1. Aluminum Ladders: Ladders shall be vendor supplied pre-engineered aluminum ladders. Ladders shall be fabricated of alloy 6063-T6. Rungs shall have non-slip grip surface. Finish shall be anodized. Fabricate ladders with rails, rungs, landings and

cages to meet applicable requirements of OSHA 29 CFR 1910.27. Rungs shall be a minimum clear length of 16 inches, uniformly spaced at a maximum of 12 inches and plug welded into side rails. Install ladders so that the distance from the centerline of rungs to the finished wall surface is not less than 7 inches nor more than 12 inches. Provide clip angle supports bolted to the side rail at the top. Provide intermediate clip angle lateral supports at a maximum of 10 feet on center.

D. U-Channel Concrete Inserts

1. U-Channel Concrete Inserts shall be [galvanized or stainless steel] conforming to attachment hardware and materials attached. Channels shall be 1 5/8 inch wide by 1 3/8 inch deep with a minimum thickness of 0.105 inches. Channels shall be open-bottom with curved or lipped flange edges to engage standard nuts and connection hardware. Load rating shall meet or exceed a 2,000 pound point load at 12 inch minimum spacing. Provide standard accessories and hardware per manufacturers recommendations.

E. Pipe Sleeves

1. Unless otherwise indicated on the Drawings, fabricate pipe sleeves from schedule 40 steel pipe with 3/16 inch thick by 3 feet wide seep ring continuously seal welded to the outside of the pipe. Galvanize after fabrication in accordance with ASTM A123.

F. Other Miscellaneous Steel Metalwork

1. Other miscellaneous steel metalwork including embedded and non-embedded steel metalwork, hangers and inserts shall be as specified or shown on the Drawings, and shall be galvanized after fabrication unless otherwise noted.

2.03 FINISHES

A. Galvanizing

1. Galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing in accordance with ASTM A123, ASTM A153, ASTM A653 or ASTM A924, Z275 G90, as applicable. Galvanize anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.
2. Repair damaged Zinc-Coated surfaces with galvanizing repair method and paint conforming to ASTM A780 or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Owner's Representative.
3. Safeguard against warpage and distortion during galvanizing of steel in accordance with ASTM A384. Straighten items after galvanizing so that they are straight, free of racking and distortion.

B. Shop Painting

1. Prepare and coat surfaces in accordance with standard manufacture specifications.
2. Steel to be embedded in concrete shall be free of dirt and grease.

C. Aluminum Surfaces

1. Surface condition aluminum before finishes are applied. Remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2. Aluminum finishes for unexposed sheet, plate and extrusions may have mill finish as fabricated.
 3. Provide other aluminum items with a standard mill finish.
 4. Provide a coating thickness not less than that specified for protection.
 5. Provide decorative type finishes for items used in interior occupied locations or architectural type finish for items used in exterior locations.
 6. Provide a polished satin finish on items to be anodized.
- D. Stainless Steel Passivation
1. Stainless steel to be cleaned, descaled, and passivated after fabrication in accordance with ASTM A380. Passivate to remove iron compounds from the surface of the stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify measurements at the site. Include field dimensions in shop drawings.
- B. Examine and accept existing conditions before beginning work.

3.02 PREPARATION

- A. Make provisions for erection loads with temporary bracing. Keep work in alignment.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates.

3.03 INSTALLATION

- A. Install items plumb, level and square, accurately fitted, and free from distortion or defects. Install rigid, substantial, and neat in appearance.
- B. Allow for erection loads and provide temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Fieldwork shall not be permitted on galvanized items. Drilling of bolts or enlargement of holes to correct misalignment will not be allowed.
- D. Protect encased or embedded dissimilar metals (both metals must be encased or embedded) from galvanic corrosion by means of pressure tapes, coatings or isolators.
- E. Place metalwork to be embedded in concrete accurately and hold in correct position while the concrete is placed or, if indicated, form recesses or blockouts in the concrete. Thoroughly clean the surfaces of metalwork in contact with or embedded in concrete.
- F. Seat angles, supports and guides: Set seat angles for grating and supports for floor plates so that they maintain the grating and floor plates flush with the floor.
- G. Ladder Safety Post: Comply with manufacturer's installation instructions.

- H. Pipe Sleeves: Provide where pipes pass through concrete or masonry. Holes drilled with a rotary drill may be provided in lieu of sleeves in existing walls. Provide a center flange for water stoppage on sleeves in exterior or water bearing walls. Provide a rubber caulking sealant or a modular mechanical unit to form a watertight seal in the annular space between pipes and sleeves.
- I. U-Channel Concrete Inserts: Provide as indicated for pipe supports and where otherwise specified or shown on Drawings.
- J. Fastening to Construction-In-Place: Provide anchorage devices and fasteners where necessary for fastening fabricated items to construction-in-place. Design anchorage devices in accordance with Section 01 73 24. Anchor bolts to be in accordance with Section 05 05 20.
- K. Railing: Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing required by design loads and as limited on Drawings. Plumb posts in each direction.

3.04 REPAIR/RESTORATION

- A. Galvanized
 - 1. Maximum area to be repaired shall not be more than 1/2 of 1 percent of the surface area or 36 sq. in. per ton of piece weight, whichever is less. Damage in excess of this requirement shall be repaired by stripping and recoating entire piece.
 - 2. Clean damaged areas to SSPC-SP5. Repair with zinc-rich paint in accordance with the manufacturer's instructions and with ASTM A780, Annex A2. Minimum thickness requirements shall be in accordance with ASTM A123.
 - 3. Use zinc-rich repair paint. Acceptable manufacturers:
 - a. LPS, Cold Galvanize
 - b. ZRC Worldwide, ZRC Galvilite
 - c. Approved Equal
- B. Painted
 - 1. After installation, clean and touch up damaged areas with the same materials used for the shop coat.

3.05 FIELD QUALITY CONTROL

- A. Electrolytic Protection
- B. Protect dissimilar metals from galvanic corrosion by means of pressure tapes, coatings, or isolators. Aluminum in contact with concrete or grout shall be protected with a heavy coat of bituminous paint.
- C. Stainless Steel
 - 1. During handling and installation, take necessary precautions to prevent carbon impregnation of stainless steel members.
 - 2. After installation, visually inspect stainless steel surfaces for evidence of iron rust, oil, paint, and other forms of contamination.

3. Remove contamination in accordance with requirements of ASTM A380.
4. Brushes used to remove foreign substances shall utilize only stainless steel or nonmetallic bristles.

END OF SECTION

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SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. This section specifies general requirements for electrical work. Detailed requirements for specific electrical items are specified in other sections but are subject to the general requirements of this section. The electrical drawings and schedules included in this project manual are functional in nature and do not specify exact locations of equipment or equipment terminations.

B. Definitions:

1. Elementary or Schematic Diagram:
 - a. A schematic (elementary) diagram shows, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement. The schematic diagram facilitates tracing the circuit and its functions without regard to the actual physical size, shape, or location of the component devices or parts.
2. One-Line Diagram:
 - a. A one-line diagram shows by means of single lines and graphical symbols the course of an electrical circuit or system of circuits and the components, devices or parts used therein. Physical relationships are usually disregarded.
3. Block Diagram:
 - a. A block diagram is a diagram of a system, instrument, computer, or program in which selected portions are represented by annotated boxes and interconnecting lines.
4. Wiring Diagram or Connection System:
 - a. A wiring or connection diagram includes all of the devices in a system and shows their physical relationship to each other including terminals and interconnecting wiring in an assembly. This diagram shall be (a) in a form showing interconnecting wiring only by terminal designation (wireless diagram), or (b) a panel layout diagram showing the physical location of devices plus the elementary diagram.
5. Interconnection Diagram:
 - a. Interconnection diagrams shall show all external connections between terminals of equipment and outside points, such as motors and auxiliary devices. References shall be shown to all connection diagrams which interface to the interconnection diagrams. Interconnection diagrams shall be of the continuous line type. Bundled wires shall be shown as a single line with the direction of entry/exit of the individual wires clearly shown. Wireless diagrams and wire lists are not acceptable.
 - 1) Each wire identification as actually installed shall be shown. The wire identification for each end of the same wire shall be identical. All devices and equipment shall be identified. Terminal blocks shall be shown as actually installed and identified in the equipment complete with individual terminal identification.

- 2) All jumpers, shielding and grounding termination details not shown on the equipment connection diagrams shall be shown on the interconnection diagrams. Wires or jumpers shown on the equipment connection diagrams shall not be shown again on the interconnection diagram. Signal and DC circuit polarities and wire pairs shall be shown. Spare wires and cables shall be shown.
6. Arrangement, Layout, Or Outline Drawings:
- a. An arrangement, layout, or outline drawing is one which shows the physical space and mounting requirements of a piece of equipment. It may also indicate ventilation requirements and space provided for connections or the location to which connections are to be made.

1.02 QUALITY ASSURANCE

A. References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
NECA-1	National Electrical Contractors Association – Standard Practices for Good Workmanship in Electrical Contracting
NFPA	National Fire Protection Association
NFPA-70	National Electrical Code (NEC)
NFPA-70E	National Electrical Safety Code (NESC)
ACI 318	Building Code Requirements for Structural Concrete

B. Identification of Listed Products:

1. Electrical equipment and materials shall be listed for the purpose for which they are to be used, by an independent testing laboratory. Three such organizations are Underwriters Laboratories (UL), Canadian Standards Association (CSA), and Electrical Testing Laboratories (ETL). Independent testing laboratory shall be acceptable to the inspection authority having jurisdiction.
2. When a product is not available with a testing laboratory listing for the purpose for which it is to serve, the product may be required by the inspection authority, to undergo inspection at the manufacturer's place of assembly. All costs and expenses incurred for such inspections shall be included in the original contract price.

C. Factory Tests:

1. Where specified in the individual product specification section, factory tests shall be performed at the place of fabrication and performed on completion of manufacture or assembly. The costs of factory tests shall be included in the contract price.

1.03 SUBMITTALS

A. The following submittals shall be provided in accordance with Section 01 33 00:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.
2. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.
3. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
4. Catalog cuts of equipment, devices, and materials requested by the individual specification sections. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
5. Catalog cuts shall be assembled in a folder. Each folder shall contain a cover sheet, indexed by item, and cross-referenced to the appropriate specification paragraph.
6. Interconnection diagram: The Contractor shall prepare interconnection diagrams depicting all cable requirements together with their actual terminations as specified in paragraph 1.01 Definitions.
7. Conduit layout drawings indicating size, location, and support, for all conduits other than single runs of 1-inch diameter or less cast in concrete construction.
 - a. Conduit layout drawings shall illustrate a system which conforms to the requirements of paragraph 3.01 Conduits in Concrete Construction.
 - b. For layouts that do not conform to paragraph 3.01 Conduits in Concrete Construction, provide engineering design and calculations signed and sealed by a Professional Engineer registered in the state of the project. Engineering design and calculations shall demonstrate that the proposed layout does not impair or significantly reduce the design structural strength.
8. Safety disconnect switch list including legend with equipment tag, equipment description, and power feeder circuit source and location information.

1.04 DRAWINGS

- A. Where the Contractor is required to provide information on drawings as part of the specified work, such drawings shall be prepared on 22-inch by 34-inch drafting media

complete with borders and title blocks clearly identifying project name, equipment and the scope of the drawing.

- B. Drawing quality and size of presentation shall be such as to permit 50 percent reduction of such drawings for insertion in operation and maintenance manuals.

1.05 PROJECT/SITE CONDITIONS

- A. General: Unless otherwise specified, equipment and materials shall be sized and derated for the ambient conditions specified in Section 01 11 80.
- B. Seismic:
 - 1. Electrical equipment, supports, and anchorage shall be designed and installed in accordance with the seismic design requirements specified in Section 01 73 24.

1.06 STORAGE OF MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be stored as specified in Section 01 66 00. Equipment and materials to be located indoors shall be stored indoors and sealed with plastic film wrap.

1.07 NOT USED

1.08 NOT USED

1.09 NOT USED

PART 2 PRODUCTS

2.01 EQUIPMENT AND MATERIALS

- A. General:
 - 1. Equipment and materials shall be new and free from defects. All material and equipment of the same or a similar type shall be of the same manufacturer throughout the work. Standard production materials shall be used wherever possible.

2.02 WIRE MARKERS

- A. Each power and control conductor shall be identified at each terminal to which it is connected. Conductors size No. 10 AWG or smaller shall have identification sleeves. Conductors No. 8 AWG and larger shall use cable markers of the locking tab type. Tabs shall be white plastic with conductor identification number permanently embossed.
- B. The letters and numbers that identify each wire shall be machine printed on sleeves with permanent black ink with figures 1/8 inch high. Sleeves shall be yellow or white tubing and sized to fit the conductor insulation. Shrink the sleeves with hot air after installation to fit the conductor.
- C. Conductor and Wire Marker Manufacture:
 - 1. TMS Thermofit Marker System by Raychem Co
 - 2. Sleeve style wire marking system by W. H. Brady Co.

3. Approved equal.

2.03 NOT USED

2.04 NAMEPLATES

- A. Nameplates shall be made from laminated phenolic plastic.
 1. Nominal size: 3/4 inch high by 2 inches long.
 2. Black backgrounds with 3/16-inch white letters.
 3. Fastened using self-tapping stainless steel screws.
- B. Abbreviations shall be submitted to the Construction Manager prior to manufacture because of space limitations. Nameplate adhesives will not be permitted on the outside of enclosures.

2.05 TERMINAL BLOCKS

- A. Unless otherwise specified, terminal blocks shall be panhead strap screw type. Terminals shall be provided with integral marking strips that permanently identify with the connecting wire numbers as shown on the drawings:
 1. Terminal blocks for P-circuits (power 208-600 volts)
 - a. Rated not less than the conductor current rating
 - b. Rated less than 600 volts AC.
 2. Terminal blocks for C-circuits and S-circuits:
 - a. Rated not less than 20 amperes
 - b. Rated less than 600 volts AC.
 3. Terminals shall be tin-plated.
 4. Insulating material shall be nylon.

2.06 PRODUCT DATA

- A. The following information and product data specified under individual specification sections shall be provided in accordance with Section 01 33 00.
 1. Applicable operation and maintenance information on an item-by-item basis. Operation and maintenance information shall be provided at the time of equipment, device, or material site delivery. Full-size drawings shall be reduced to 11 x 17 inches.
 2. Test results for motors and electrical systems. A file of the original test results shall be maintained by the Contractor. Prior to acceptance of work, the resulting file shall be provided to the Construction Manager.

2.07 CONDUIT

- A. Conduit shall be Galvanized Rigid Steel (GRS) per the following:
 1. Compliance: ANSI and UL
 2. Finish: Hot-dip galvanized after fabrication, inside and outside. Smooth finished surfaces.
 3. Manufacturers: Allied Tube and Conduit Corp., Wheatland Tube Co., or equal.

4. Minimum size: Unless otherwise specified, 3/4 inch for exposed, 1 inch for embedded, encased or otherwise inaccessible.
5. Fittings:
 - a. Locknuts, Rings, Hubs:
 - 1) Hot-dip galvanized insulated throat with bonding locknut or ring,. The hubs shall utilize a neoprene "O" ring and provide a watertight connection. O-Z Gedney, CHM-XXT, or equal
 - b. Unions:
 - 1) Electro-galvanized ferrous alloy type Appleton UNF or UNY, Crouse-Hinds UNF or UNY, or equal. Threadless fittings are not acceptable.
 - c. Conduit Bodies:
 - 1) Ferrous alloy type with screw taps for fastening covers to match the conduit system. Gaskets shall be made of neoprene.
6. Boxes:
 - a. Indoor:
 - 1) Type FD cast ferrous for all device boxes and for junction boxes less than 6 inches square.
 - b. Outdoor:
 - 1) Type FD cast ferrous for all device boxes and for junction boxes less than 6 inches square.
 - c. Corrosive:
 - 1) NEMA 4X stainless steel or nonmetallic, as specified.
7. Elbows:
 - a. 3/4" thru 1-1/2" – Factory fabricated or field bent.
 - b. 2" thru 6" – Factory fabricated only.
8. Conduit Bodies:
 - a. 3/4" thru 4" – Malleable iron, hot-dip galvanized, unless otherwise noted. Neoprene gaskets for all access plates. Tapered threads for conduit entrances.
9. Expansion Fittings:
 - a. Expansion fittings in embedded runs shall be watertight with an internal bonding jumper. The expansion material shall be neoprene allowing for 3/4-inch movement in any direction.
10. Manufacturers:
 - a. Appleton, Crouse-Hinds, Hubbell, O. Z. Gedney, or equal.
11. Installation:
 - a. Rigid steel conduit shall be made up tight and with conductive thread compound. Joints shall be made with standard couplings or threaded unions. Steel conduit shall be supported away from the structures using hot-dip galvanized malleable iron straps with nesting backs or framing channel.
 - b. Conduit entering boxes shall be terminated with a threaded hub with a grounding bushing.
 - c. Exposed male threads on rigid steel conduit shall be coated with zinc-rich paint.

2.08 WIRE

- A. Wire shall be type THWN/THHN per the following:
 - 1. Voltage: 600 volts
- B. Conductor Material: Bare annealed copper; stranded per ASTM B8
- C. Insulation: THWN/THHN, 90 degree C dry, 75 degree C wet, Polyvinyl Chloride (PVC) per UL 83.
- D. Jacket: Nylon
- E. Flame Resistance: UL 83
- F. Manufacturer(s): Okonite, Okoseal-N, series 116-67-XXXX; or equal.

PART 3 EXECUTION

3.01 GENERAL

- A. Construction:
 - 1. The work under Division 26 shall be performed in accordance with these specifications.
 - 2. Refer to the National Electrical Contractors Association's (NECA) National Electrical Installation Standards (NEIS) for Standard Practices for Good Workmanship in Electrical Contracting (NECA-1) as a minimum baseline of quality and workmanship for installing electrical products and systems that defines what is meant by "neat and workmanlike" as required by the National Electrical Code Section 110-12. Specified requirements supersede NECA practices.
 - 3. Electrical layout drawings are diagrammatic, unless otherwise detailed or dimensioned. The Contractor shall coordinate the location of electrical material or equipment with the work.
 - 4. Major electrical openings may compromise the structural integrity of the slab and wall elements. Major electrical openings are defined as openings or penetrations greater than two times the wall thickness in any dimension, and include duct bank transitions into a building through structural elements. Major electrical openings shall be constructed according to standard details on the drawings, up to an opening dimension of three feet. For opening dimensions greater than three feet, construct walls and slabs as specifically detailed on the drawings for that case. Major electrical openings proposed by the Contractor shall be submitted to the Structural Engineer of Record for the project for review.
 - 5. Minor changes in location of electrical material or equipment made prior to installation shall be made at no cost to the Owner.
- B. Housekeeping:
 - 1. Electrical equipment shall be protected from dust, water and damage. Motor control centers, switchgear, and buses shall be wiped free of dust and dirt, kept dry, and shall be vacuumed on the inside within 30 days of acceptance of the work.
 - 2. Electrical equipment temporarily exposed to weather, debris, liquids, or damage during construction shall be protected as specified in Section 01 66 00.

C. Motor Connections

1. Verify that the motors are purchased with the correct size motor termination boxes for the circuit content specified as shown on the power single line diagrams or submit custom fabrication drawing indicating proposed motor termination box material, size, gasket, termination kit, grounding terminal, motor lead connection method, and motor terminal box connection/support system. Verify the motor termination box location prior to raceway rough-in.

D. 600 VOLT CONDUCTOR AND CABLE

1. Conductors in panels and electrical equipment shall be bundled and laced at intervals not greater than 6 inches, spread into trees and connected to their respective terminals. Lacing shall be made up with plastic cable ties. Cable ties shall be tensioned and cut off by using a tool specifically designed for the purpose such as a Panduit GS2B. Other methods of cutting cable ties are unacceptable.
2. Conductors crossing hinges shall be bundled into groups not exceeding 10 to 15 conductors and protected using nylon spiral flexible covers to protect conductors. Provide oversized plastic panel wiring duct within panels and panelboards.
3. Slack shall be provided in junction and pull boxes, handholes and manholes. Slack shall be sufficient to allow cables or conductors to be routed along the walls. Amount of slack shall be equal to largest dimension of the enclosure. Provide dedicated electrical wireways and insulated cable holders mounted on unistrut in manholes and handholes.
4. Raceway fill limitations shall be as defined by NEC and the following:
 - a. Lighting and receptacle circuits may be in the same conduit in accordance with de-rating requirements of the NEC. Lighting and receptacle circuits shall not be in conduits with power or control conductors. Signal conductors shall be in separate conduits from power conductors. Motor feeder circuits shall be in separate conduits including small fan circuit unless combination fan-light fixture.
 - b. Power conductors derived from uninterruptible power supply systems shall not be installed in raceways with conductors of other systems. Install in separate raceways.
 - c. Splices and terminations are subject to inspection by the Construction Manager prior to and after insulating.
 - d. Motor terminations at 460-volt motors shall be made by bolt-connecting the lugged connectors.
 - e. In-line splices and tees, where approved by the Construction Manager, shall be made with tubular compression connectors and insulated as specified for motor terminations. Splices and tees in underground handholes or pull boxes shall be insulated using Scotch-cast epoxy resin or Raychem splicing kits.
 - f. Terminations at solenoid valves, 120 volt motors, and other devices furnished with pigtail leads shall be made using self-insulating tubular compression connectors within the termination box.
 - g. Terminations at valve and gate motor actuators shall be made directly into the actuator where possible. Power termination shall be made in the actuator power disconnect. Control and signal cable may be routed to a termination box near the actuator on 20-ampere rated terminal strips with label identification for the control and signal conductors. Single wire control conductors and analog cable

(SIC or MIC) then installed in flexible conduit to the actuator control and signal termination compartments.

3.02 TESTING

A. General:

1. Prior to energizing the electrical circuits, insulation resistance measurements tests shall be performed using a 1000-volt megohmmeter to verify the conductor is acceptable for use on the project. The test measurements shall be recorded and provided in accordance with paragraph 1.03.

B. Insulation Resistance Measurements:

1. General:

- a. Insulation resistance measurements shall be made on conductors and energized parts of electrical equipment. Minimum acceptable values of insulation resistance shall be in accordance with the applicable ICEA, NEMA or ANSI standards for the equipment or material being tested, unless otherwise specified. The ambient temperature at which insulation resistance is measured shall be recorded on the test form.

2. Conductor And Cable Tests:

- a. The phase-to-ground insulation resistance shall be measured for all circuits rated 120 volts and above except lighting circuits. Measurements may be made with motors and other equipment connected. Solid state equipment shall be disconnected, unless the equipment is normally tested by the manufacturer at voltages in excess of 1000 volts DC.

C. Pre-Functional Test Checkout:

1. Prior to functional testing, all protective devices shall be adjusted and made operative.
2. Submit a description of the proposed functional test procedures prior to the performance of functional checkout.
3. Prior to energization of equipment, perform a functional checkout of the control circuit.
 - a. Checkout:
 - 1) Energizing each control circuit.
 - 2) Operating each control device, alarm device, or monitoring device.
 - 3) Operate each interlock to verify that the specified action occurs.
4. Verify motors are connected to rotate in the correct direction. Verification may be accomplished by momentarily energizing the motor, provided the Contractor confirms that neither the motor nor the driven equipment will be damaged by reverse operation or momentary energization.

3.03 RECORD DOCUMENTS

- #### **A. Contract documents shall be maintained and annotated by the Contractor during construction, including the record drawings.**

END OF SECTION

SECTION 40 05 01

PIPING SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. This section specifies the general requirements for selection, and supply of pipe materials, fittings, appurtenances, expansion control, supports, and seismic restraints for process, mechanical, plumbing, and utility piping systems. Installation, inspection, and testing are also specified in this Section.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures
- B. Section 01 66 00 – Product Storage and Handling Requirements
- C. Section 01 73 24 – Design Requirements for Non-Structural Components and Non-Building Structures
- D. Section 40 05 07 – Hangers and Supports for Process Piping

1.03 REFERENCES

- A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section prevail.

Reference	Title
ANSI B16.21	Nonmetallic Flat Gaskets for Pipe Flanges
ANSI B31.1	Power Piping
ANSI B31.3	Process Piping
ANSI B31.9	Building Services Piping
ANSI Z223.1	National Fuel Gas Code
ANSI/ISA-S70.01	Quality Standard for Instrument Air
ASME B1.1	Unified Inch Screw Threads
ASME Section IX	Boiler and Pressure Vessel Code; Welding and Brazing Requirements
ASTM F37	Sealability of Gasket Materials
ASTM F104	Nonmetallic Gasket Materials
ASTM F152	Tension Testing of Nonmetallic Gasket Materials
AWWA C651	Disinfecting Water Mains
CAN/CGA B149.6	Code for Digester Gas and Landfill Gas Installations
EJMA	Expansion Joint Manufacturer's Association
UPC	Uniform Plumbing Code

1.04 DEFINITIONS

- A. Terminology used in this Section conforms to the following definitions:
1. Maximum pressure: The greatest continual pressure at which the piping system is designed to operate.
 2. Test pressure: The hydrostatic, air, or gas pressure used to determine system compliance.
 3. Take down coupling: Pipe couplings that facilitate disassembly of piping systems without damage or demolition of piping system components.
 4. Embedded/Encased piping: Piping enveloped in reinforced concrete, typically under structures and under roadways, where specified on the drawings.

1.05 SUBMITTALS

- A. Action Submittals:
1. Procedures: Section 01 33 00.
 2. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 3. For each piping system, submit document listing pipe, fittings, linings, coatings, valves, flexible connectors, expansion joints, couplings, bolts, gaskets, restraints, and other items provided for each applicable pipe size and category.
 4. Welding: Prior to commencing any welding of steel or stainless steel pipe, supports, and/or structural attachments, provide a written description of welding techniques, including, but not limited to, materials, methods, and quality control. Indicate in the submittal that the welding technique has been reviewed for each piping service and certify that the technique is acceptable for the intended service. Written procedures to be stamped and sealed by a Professional Engineer registered in the State of Utah and qualified for welding design.
 5. Submit piping shop drawings and layout drawings for piping systems. Indicate assembly details, location and placement of unions and flanges, fittings, valves, flushing connections, drains, sample taps, cathodic protection, seismic restraint system, expansion joints, guides, anchors, hangers, supports, and the provisions for thrust restraint, as well as any other pertinent details and appurtenances for all piping, including wall and floor penetrations, where applicable, in that area. Include details of connections to new and existing equipment, piping and structures. Submit original layouts by the Contractor; photocopies of Contract Drawings are not acceptable.

- B. Informational Submittals:
 - 1. Procedures: Section 01 33 00
 - 2. Pre-Construction Data:
 - a. Product Samples: Where specified or when directed by the Construction Manager, provide mill test results or product samples.
 - b. Prior to the commencement of welding, submit current and complete documentation of the welder's qualifications.
 - c. Safety plans for pneumatic pressure testing.

1.06 QUALITY ASSURANCE

- A. Review the drawings prior to installation of piping, conduit services, and fixtures. Identify any conflicts and cooperate with the Construction Manager to determine the adjustments necessary to resolve conflicts.
- B. Confirm the routing of each section of pipeline with other services prior to commencement of installation. Advise the Construction Manager of any conflicts with existing services or services yet to be installed. Where necessary, amend the routing of pipework to avoid conflict and confirm with the Construction Manager.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Procedures: Section 01 66 00 for Shipment and Storage.
- B. Deliver pipe, fittings, and specials to site using loading methods which do not damage pipe or linings, or coatings.
- C. Piping materials delivered to site will be clearly marked to indicate size, type, class/schedule and coatings.
- D. Until ready for incorporation in the work, store on site as recommended by the piping materials manufacturer to prevent damage, undue stresses, or weathering.
- E. Store materials at least 8 inches above ground. Provide sufficient supports to prevent undue bending.
- F. Cover openings in piping, and temporarily seal to protect from contamination.
- G. Protect materials and equipment from damage due to environmental conditions. Use protective cover, and protect from surface water by elevating above floor or surrounding grade.
- H. Protect unfinished work at end of each workday from damage, contamination and moisture by use of plugs, caps or covers.
- I. Protect piping and valves from damage pending performance of system tests.
- J. Use proper implements, tools, and facilities for the proper protection of the pipe. Exercise care in the installation so as to avoid damage to pipe, linings, and coatings.

- K. Inspect each pipe and fitting prior to installation. Do not install damaged pipe or pipe with damaged protective coatings or linings.
- L. Prevent entry of foreign matter during handling, assembling, and installation. Use compressed air, wire brush, solvent and other acceptable means to remove all foreign matter from inside of pipe prior to installation. Remove residual scale, dirt and other foreign matter from interior of piping before final connections are made.

1.08 PIPING SYSTEM DESIGN

- A. Provide shop drawings of all piping for review before releasing for fabrication.

1.09 COORDINATION – NOT USED

PART 2 PRODUCTS

2.01 PIPE MATERIALS - GENERAL

- A. All pipe materials to be new, free from defects and conforming to the requirements and standards identified in the Contract Drawings and related sections.
- B. New and existing piping is designated by process service rather than pipe material. Existing pipe material types may not be the same as material types specified for new piping. Investigate connections to existing piping and provide suitable connections, including electrical isolation, as necessary.
- C. Fittings and Coupling Compatibility: To assure uniformity and compatibility of piping components, furnish fittings and couplings for grooved-end or shouldered-end piping systems from the same manufacturer.

2.02 MATERIAL FOR PIPING SUPPORT, SEISMIC RESTRAINTS AND PIPE ANCHORS – NOT USED

2.03 PIPE AND VALVE COMPATIBILITY

- A. Coordinate the selection of pipe materials, linings, and end connections so that valves operate properly over their entire range (e.g., sufficient disk clearance for butterfly valves). Support wafer style valves or spectacle flanges between flanges of equal inside diameter.

2.04 BONDING JUMPERS – NOT USED

2.05 JOINTS – GENERAL

- A. Provide joints for disassembly within 3.0 ft of any connection to equipment, on both sides of structural penetrations, and within 2.0 ft of all threaded end valves.
- B. Unless otherwise specified on the drawings or in equipment specifications, adapt all equipment connections to a flanged connection compatible with the connected piping system.
- C. Flexible Joints at Structural Joint Crossings: Provide a flexible joint (or joints) on all piping crossing structural joints.

2.06 FLANGES AND OTHER COUPLINGS

- A. Pipe connections are specified in the Contract Drawings.
- B. General requirements for flanges are as follows:
 - 1. Flange face to be flush with flat-faced companion flanges on flat-faced valve or equipment flanges.
 - 2. Provide flat-faced flanges on each side of butterfly valves.
 - 3. For steel piping, provide weld neck flanges on both sides of wafer or lug body valves.
- C. Slip-on flanges that are attached to a pipe by means of set screws and gaskets (uni-flange, etc.) are not acceptable.

2.07 FITTINGS – GENERAL

- A. Fittings are specified in the Contract Drawings.
- B. Provide eccentric reducers in horizontal lines with the flat side on top, unless specified otherwise on the drawings (e.g., flow meters in horizontal runs requiring submergence).
- C. Provide concentric reducers in vertical lines, unless otherwise specified on the drawings.
- D. Provide reducers upstream and downstream of flow measurement devices to adapt line size to the specified flow measurement device dimension. Coordinate with the specific instrument requirements.
- E. Provide long radius (greater than or equal to 1.5 x nominal diameter) elbows unless otherwise specified on the drawings.

2.08 GASKET MATERIALS

- A. For flat faced flanges, use full-face gaskets. Conform to ANSI B16.21.
- B. Gasket material for piping system are as follows:
 - 1. EPDM: ethylene-propylene-diene-terpolymer 70 durometer
 - 2. Nitrile: nitrile (Buna N)

2.09 DISSIMILAR METAL CONNECTIONS

- A. Provide isolation for connections to dissimilar metals. Use full-face isolation gaskets, sleeves, and washers for flanged connections.

2.10 CATHODIC PROTECTION – NOT USED

2.11 STRUCTURAL ELEMENT PENETRATIONS – NOT USED

2.12 PIPE MARKERS, DETECABLE WARNING TAPE, AND TRACER WIRE – NOT USED

PART 3 EXECUTION

3.01 PREPARATION

- A. Prior to installation, inspect, and field measure to ensure that previous work is not prejudicial to the proper installation of piping.
- B. The Drawings are, in part, diagrammatic, make all minor modifications to suit installed equipment and structural element locations and elevations and coordinate with electrical construction.
- C. Provide details of connections to new and existing equipment, piping, and structures in piping layout drawing submittals. Unless otherwise specified on Drawings, piping fitting angles and vertical and horizontal pipe locations shall be determined by Contractor.
- D. Piping arrangements indicated on the drawings have been estimated from the approximate configuration of the type of equipment listed in the equipment specifications. If the equipment to be provided does not have the same configuration, modify the piping arrangement as necessary. Include any piping modifications in shop drawings submitted prior to fabrication or installation.

3.02 PIPE SUPPORT, ANCHORAGE, AND SEISMIC BRACING

- A. Provide pipe supports as specified and as needed to adequately support all piping.
- B. Seismic bracing:
 - 1. A lateral and longitudinal brace shall be provided every 25 feet within the East Pipe Gallery. Maximum brace length shall be 10 feet.
 - a. Existing pipe supports in the East Gallery shall be seismically braced as shown on the drawings.
 - 1) Seismic brace shall be 1-5/8-inch wide by 3-1/4 inch deep carbon steel framing channel, Unistrut P5000, B-Line B11, Superstrut H-1200, KinLine No. 8212, or approved equal.

3.03 PIPING CONNECTIONS TO MACHINES

- A. Align piping at machine connections in all planes to permit insertion of bolts at bolted connections or coupling screwed connections without using jacks, come-a-longs or other mechanical means to align field piping with the connections at the machines.
- B. Do not force bolts into mating flange bolt holes. Align flange bolt holes to permit insertion of bolts by hand (without tools, hammering, or prying).
- C. Use of 'dutchmen' mitered sections or similar specials to achieve the required alignment with machine connections are strictly prohibited.

3.04 JOINT AND COUPLING OPTIONS

- A. Provide pipe connection (joint and coupling) options as specified in Drawings.
- B. If a Drawings lists several connection options, then any of the listed options may be used for a particular pipe material, but the selected option shall be used consistently. For example, if flanged or grooved connections are specified and grooved are represented on the Drawings, then flanged may be installed in lieu of the grooved couplings specified on the drawings.
- C. Field welding of stainless steel pipe is not allowed.
- D. Provide rigid, non-rotating connections at all valves and equipment.

3.05 SMALL BORE UTILITY PIPING – NOT USED

3.06 BONDING – NOT USED

3.07 SEWER AND DRAIN PIPING – NOT USED

3.08 SLEEVES

- A. Unless otherwise noted in the specified pipe penetration details or otherwise approved by the Construction Manager, provide sleeves where piping passes through a wall, floor, or ceiling.

3.09 PIPE JOINTS AND CONNECTIONS

- A. Field cuts for stainless steel pipe are not permitted.
- B. Welding procedures, welder certification/qualification, and weld testing per ASME Section IX, Boiler and Pressure Vessel Code.
- C. Coat gasket with gasket manufacturer's recommended lubricant between flange faces. Use only NSF-61 certified lubricant.

3.10 TAKEDOWN COUPLINGS

- A. Takedown Couplings: Provide takedown couplings at the locations specified on the Drawings in accordance with this Section.
- B. Provide takedown couplings at changes in piping direction and where specified in the Drawings on straight runs of pipe.
- C. Provide screw unions, flanged or grooved end coupling type joints as takedown couplings.
- D. Use flanged or grooved end joints on pipelines 1.5-inch diameter and larger.

3.11 INSTALLATION OF BURIED PIPE AND PIPE BELOW STRUCTURES – NOT USED

3.12 EXPOSED INSTALLATION

- A. Install pipe support system to adequately secure the pipe and to prevent undue vibration, sag or stress.
- B. Install expansion joints where specified on the Drawings, to allow for piping expansion and contraction.
- C. Install expansion loops or bends where specified, to allow for proper pipe expansion. Construct expansion loops with long radius welded bends.
- D. Provide temporary supports as necessary during construction to prevent overstressing of equipment, valves or pipe.
- E. Accurately cut all piping for fabrication to field measurements.
- F. Install pipes in straight alignment and parallel to wall. Do not exceed 3/8-in variance over 30 ft from the true alignment, in any direction.
- G. Fabricate and assemble pipe runs so that the pipework is not stressed to achieve the desired alignment and that no stresses are transferred to equipment or equipment flanges. Undo and subsequently remake all pipework connections where so instructed by the Construction Manager to ensure that unintended springing does not occur. Take care not to damage equipment, valves, or flanges.
- H. Do not cut or weaken the building structure to facilitate installation of piping.
- I. In parallel pipe runs, offset flanges and/or grooved joint fittings by a minimum of 8 inches longitudinally to allow for proper access.
- J. Provide pipe markers for all exposed pipe.

3.13 THREADED JOINTS- NOT USED

3.14 FLANGED JOINTS

- A. Maintain consistent flange bolt hole positions along the entire length or run of the pipe.
- B. For pipe installed with a horizontal axis, position flange bolt holes so that the vertical centerline of the flange face bisects the arc between flange bolt holes (“Two-Holed”).
- C. For pipe installed with a vertical axis, position flange bolt holes so that the horizontal centerline of the flange face bisects the arc between flange bolt holes and is perpendicular to the closest structural wall (“Two-Holed”).
- D. Clean flanges and gaskets prior to connection.
- E. Lubricate gaskets with gasket manufacturer’s recommended lubricant and apply anti-seize compound to all bolts.

- F. Bring flanges into close parallel and lateral alignment.
- G. Tighten bolts progressively. Proceed from side to side of the flange.
- H. Use proper length bolts for each size flange on flanged connections. Washers may not be used to take up excess bolt length. Provide approximately two full threads bolt projection beyond nuts. Bolts with excessive length of exposed threads will not be permitted. All-thread rod is not acceptable for bolting flanges.
- I. When joining steel to cast iron flanges, take care to avoid damage to the cast iron flange. Ensure both flanges are flat-faced and use full face gaskets.
- J. Align flanges which connect piping to mechanical equipment to close parallel and lateral alignment prior to tightening bolts. Do not place strain on the equipment.
- K. Allow a minimum of 6 inches' clearance to face or 8 inches to edge of flange to wall, floor, or ceiling unless otherwise specified.

3.15 INSULATION - NOT USED

3.16 FLEXIBLE HOSE CONNECTORS - NOT USED

3.17 EXPANSION JOINTS

- A. Accurately align pipelines to receive expansion joints before installing the joint. Do not stretch, compress or offset the joint to fit the piping. Install expansion joints in accordance with manufacturer's instructions prior to releasing preload.
- B. Align and install each expansion joint in accordance with EJMA standards and with the manufacturer's written instruction; properly guide and anchor all expansion joints. No lateral movement is permitted on compensator type expansion joints.
- C. On rubber expansion joints, check bolt tightness, and tighten where necessary one week after Commissioning is completed.

3.18 REPAIR/RESTORATION - NOT USED

3.19 FIELD QUALITY CONTROL - NOT USED

3.20 TESTING

- A. Provide 24 hours notice prior to testing.
- B. Do not insulate or conceal work until piping systems are tested and have met all required criteria.
- C. Complete any required weld tests.
- D. Supply all water, air, and inert gases required for pressure testing.
- E. Supply all pumps, compressors, gauges, etc. required for testing.

- F. Install air threadolets, air relief valves, and line fitting valves as necessary to complete testing. Remove after testing and plug threadolets.
- G. Cap or plug all lines which are normally open ended. Remove on completion of testing.
- H. Provide all temporary thrust restraints necessary for testing. Remove upon completion of testing.
- I. Test all existing piping where it connects to new piping to the first valve in the existing piping. Repair any failures in existing piping which occur as a result of the test after informing the Construction Manager of such failure.
- J. Isolate all pumps and low pressure equipment and appurtenances during testing so as not to place any excess pressure or thrust forces on the equipment.
- K. Where defective material or equipment is identified, repair or replace using new material.
- L. Flush and drain liquid pipes after pressure tests. Purge all gas pipes after pressure tests using inert gas.
- M. Dispose of flushing water in manner approved by the Construction Manager, which causes no damage to buildings or siteworks.

3.21 HYDROSTATIC PRESSURE TESTING OF LIQUID LINES – NOT USED

3.22 PNEUMATIC PRESSURE TESTING

- A. Use nitrogen gas or oil free dry air to test piping systems where nitrogen or air is the specified testing medium in the Drawings.
- B. Submit a testing plan and a safety plan for each piping system that will be pressure tested with nitrogen gas or oil free dry air. Do not perform pressure testing with air or nitrogen until a favorable review of the safety plan and testing plan for the piping system has been returned from the Construction Manager. Comply with all workplace safety and pressure vessel safety codes and guidelines.
- C. Provide a separate pressure relief valve for pneumatic pressure testing.
- D. Locate pressure relief valve within visual range of the test gauge and with exhaust to a safe location.
- E. Set relief valve at not more than full test pressure plus 10 percent.
- F. Continuously monitor and control testing to assure personnel safety and piping integrity.
- G. Remove all personnel from areas where piping will be subjected to pressure tests and prevent entry into testing areas until test pressure has been relieved.
- H. Protect installed work from potential damage from pressure testing failures. The Contractor is responsible for any damage or injury resulting from failed pressure testing with air or nitrogen.

- I. When using nitrogen or air to test steel or stainless steel pipelines, gradually introduce the test gas up to a pressure of 45 psig or 1/3 of specified test pressure, whichever is less.
- J. While maintaining this pressure, test lines for leaks using soapy water.
- K. When the line is free from leaks at this pressure, increase by increments of 50 psig or 1/3 of specified test pressure (whichever is less) to the specified test pressure.
- L. After each increment, retest using soapy water; take corrective action as necessary.
- M. When the system is free from leaks at the test pressure, depressurize the system slowly.
- N. To prevent the entrance of water or moisture into the medium source, disconnect the test source from the system and cap.
- O. Where specified, maintain nitrogen pad after testing until the line is put into service. Label any piping for which a pad is provided and maintained.
- P. Provide oil free air with a relative humidity of zero for testing. Provide all fittings, adaptors, accessories, and the pressure regulator and throttling valve that are suitable for pressure testing with air and rated for 300 psig service.

3.23 PRESSURE TESTING OF GAS, AIR, AND VAPOR LINES

- A. Hydrostatically or pneumatically pressure test, as specified in the Drawings, all lines normally used for the conveyance of gas, air, and/or vapor in accordance with ASME procedures for testing pressure piping.
- B. For gas and air lines to be hydrostatically tested, check support system to ensure it is capable of withstanding loads imparted by test method. Provide any additional supports necessary in a manner acceptable to the Construction Manager. At the Construction Manager's request, provide calculations indicating design of temporary support system.
- C. Test pressures are identified in the Drawings.
- D. Do not exceed the maximum specified leakage rate during the test period for all other systems tested with air.
- E. Remake all joints which display leakage and retest.

3.24 TESTING OF HAZARDOUS GAS AND LIQUID LINES – NOT USED

3.25 CLEANING AND FLUSHING

- A. After installation and prior to testing, perform initial cleaning of process and utility lines. Clean piping greater than 6 inches and less than 24 inches by passing a tightly fitting cleaning ball or swab through the pipeline, unless specified otherwise. Lines greater than 24 inches may be cleaned manually or with a cleaning ball or swab. Give lines smaller or equal to 6 inches an initial flush or purge.

3.26 DISINFECTION

- A. Flush and disinfect lines intended for potable water service or in contact with potable water after testing in accordance with AWWA C651.

END OF SECTION

SECTION 40 05 07

HANGERS AND SUPPORTS FOR PROCESS PIPING

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. This section specifies hangers and supports for all piping systems specified in Section 40 05 01. This section does not include pipe supports for fire sprinkler systems, pipe anchors, guides or seismic restraints.

B. Operating Conditions:

1. The hangers and supports specified in this section are provided to resist pipe loads occurring primarily in the downward (gravity) direction. For the purpose of pipe hanger and support selection, this section establishes pipe support classifications based on the operating temperatures of the piping contents. Pipe support classifications are as follows:
 - a. Hot Systems
 - 1) A - 1. 120 degrees F to 450 degrees F
 - b. Ambient Systems
 - 1) B. 60 degrees F to 119 degrees F

C. Hanger and Support Selection:

1. The Contractor shall select pipe hangers and supports as specified in the project manual. Selections shall be based upon the pipe support classifications specified in this section and any special requirements which may be specified in the project manual.
2. The Contractor shall review the piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the type of support to be used at each hanger point.
3. Hangers and supports shall withstand all static and specified dynamic conditions of loading to which the piping and associated equipment may be subjected. As a minimum, consideration shall be given to the following conditions:
 - a. Weights of pipe, valves, fittings, insulating materials, suspended hanger components, and normal fluid contents.
 - b. Weight of hydrostatic test fluid or cleaning fluid if normal operating fluid contents are lighter.
 - c. Reaction forces due to the operation of safety or relief valves.
 - d. Wind, snow or ice loadings on outdoor piping.
4. Hangers and supports shall be sized to fit the outside diameter of pipe, tubing, or, where specified, the outside diameter of insulation.
5. Where negligible movement occurs at hanger locations, rod hangers shall be used for suspended lines, wherever practical. For piping supported from below, bases, brackets or structural cross members shall be used.
6. Hangers for the suspension of size 2 1/2 inches and larger pipe and tubing shall be capable of vertical hanger component adjustment under load.

7. The supporting systems shall provide for and control the free or intended movement of the piping including its movement in relation to that of connected equipment.
8. Where there is horizontal movement at a suspended type hanger location, hanger components shall be selected to allow for swing. The vertical angle of the hanger rod shall not, at any time, exceed 4 degrees.
9. There shall be no contact between a pipe and hanger or support component of dissimilar metals. Prevent contact between dissimilar metals when supporting copper tubing by use of copper-plated, rubber, plastic or vinyl coated, or stainless steel hanger and support components.
10. Unless otherwise specified, existing pipes and supports shall not be used to support new piping.
11. Unless otherwise specified, pipe support components shall not be attached to pressure vessels.
12. Stock hanger and support components shall be used wherever practical.

1.02 REFERENCES

- A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AISC Manual of Steel Construction	American Institute of Steel Construction, Manual of Steel Construction, Allowable Stress Design - 9th Ed.
FEDSPEC WW-H-171e-78	Hangers and Supports, Pipe
MFMA-2-91	Metal Framing Standards Publication
MSS SP-69-91	Pipe Hangers and Supports - Selection and Application
MSS SP-58-93	Pipe Hangers and Supports - Materials, Design and Manufacture

PART 2 PRODUCTS

2.01 ACCEPTABLE PRODUCTS

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

SP-58. Metal framing system components shall conform to the metal framing manufacturers' Association Standard MFMA-2.

2.02 MATERIALS

A. General:

1. Unless otherwise specified, pipe hangers and supports, structural attachments, fittings and accessories shall be hot-dip or mechanically galvanized after fabrication. Nuts, bolts and washers may be zinc-plated except for those subject to moisture or corrosive atmosphere, which shall be type 304 stainless steel.

B. Pipe Hangers and Supports:

1. Type 1 - Clevis Pipe Hanger: Clevis hangers shall be carbon steel with configuration and components equivalent to MSS and FEDSPEC Type 1.
 - a. Steel pipe (insulated) - shall be B-Line B3100, Grinnell Fig. 260, or equal, with insulation shield.
 - b. Steel pipe (uninsulated) - shall be B-Line B3100, Grinnell Fig. 260, or equal.
 - c. Cast and ductile iron pipe - shall be B-Line B3102, Grinnell Fig. 590, or equal.
 - d. Copper pipe (uninsulated) - shall be B-Line B3104 CT, Grinnell Fig. CT-65, or equal.
 - e. Copper pipe (insulated) - shall be B-Line B3100, Grinnell Fig. 260, or equal, with insulation shield.
 - f. Plastic pipe - shall be B-Line B3100 C, Carpenter & Patterson Fig. 100PVC, or equal.
2. Type 2 - "J" Pipe Hanger: Hangers shall be carbon steel with configuration and components equivalent to MSS Type 5.
 - a. Steel pipe - shall be B-Line B3690, Grinnell Fig. 67, Michigan model 418, or equal.
 - b. Copper and plastic pipe - shall be Michigan model 419, Unistrut J 1205N series, or equal.
3. Type 3 - Double Bolt Pipe Clamp: Pipe clamp shall be carbon steel, with configuration and components equivalent to MSS and FEDSPEC Type 3.
 - a. Steel pipe (insulated) - shall be B-Line B3144, Grinnell Fig. 295, or equal, with insulation shield. Insulation shield is optional for hot and ambient systems.
 - b. Steel pipe (uninsulated) - shall be B-Line B3144, Grinnell Fig. 295, or equal.
 - c. Copper pipe (insulated only) - shall be B-Line B3144, Grinnell Fig. 295, or equal, with insulation shield.
4. Type 4 - Adjustable Roller Hanger: Rollers shall be cast iron, yoke and cross bolt shall be carbon steel. Configuration and components shall be equivalent to MSS Type 43 and FEDSPEC Type 44.
 - a. Steel pipe (insulated) - shall be B-Line B3110, Grinnell Fig. 181, or equal, with insulation shield.
 - b. Steel pipe (uninsulated) - shall be B-Line B3110, Grinnell Fig. 181, or equal.
 - c. Copper pipe (insulated only) - shall be B-Line B3110, Grinnell Fig. 181, or equal, with insulation shield.
 - d. Plastic pipe - shall be B-Line B3110, Grinnell Fig. 181, or equal.

5. Type 5 - Single Pipe Roll: Rollers and sockets shall be cast iron, cross rod shall be steel. Configuration and components shall be equivalent to MSS Type 41 and FEDSPEC Type 42.
 - a. Steel pipe (insulated) - shall be B-Line B3114, Grinnell Fig. 171, or equal, with insulation shield.
 - b. Steel pipe (uninsulated) - shall be B-Line B3114, Grinnell Fig. 171, or equal.
 - c. Plastic pipe - shall be B-Line B3114, Grinnell Fig. 171, or equal.
6. Type 6 - Framing Channel Pipe Clamp: Pipe clamps shall be steel with galvanized finish and material thickness as listed below:
 - a. Steel pipe (uninsulated) - Pipe size 3/8 inch and 1/2 inch shall be 16 gage; 3/4 inch through 1 1/4 inches shall be 14 gage; 1 1/2 inches through 3 inches shall be 12 gage; 3 1/2 inches through 5 inches shall be 11 gage; 6 and 8 inches shall be 10 gage; Michigan model 431, Powerstrut PS 1100, Unistrut P 1109 series, or equal.
 - b. Steel pipe (insulated) - Pipe clamp shall be as described in paragraph 2.02 Steel Pipe (Uninsulated) with insulation shield.
 - c. Copper (uninsulated) and plastic pipe - Pipe size 3/8 inch and 1 inch shall be 16 gage; 1-1/4 inches and 1-1/2 inches shall be 14 gage; 2 inches through 3 inches shall be 12 gage; 4 inches shall be 11 gage; clamp shall be copper-plated, plastic coated or lined with dielectric material; Michigan model 432, Powerstrut PS 1200, Unistrut P 2024C and P 2024PC series, or equal.
 - d. Copper pipe (insulated) - Pipe clamp shall be as described in paragraph 2.02 Steel Pipe (Uninsulated) with insulation shield.
7. Type 7 - U-BOLT: U-bolts shall be carbon steel with configuration equivalent to MSS and FEDSPEC Type 24.
 - a. Steel pipe (uninsulated) - shall be Grinnell Fig. 137, B-Line B3188, or equal.
 - b. Steel pipe (insulated) - shall be Grinnell Fig. 137, B-Line B3188, or equal, with insulation shield.
 - c. Cast and ductile iron pipe - shall be Grinnell Fig. 137, B-Line B3188, or equal.
 - d. Copper pipe (uninsulated) - shall be Carpenter & Patterson Fig. 222 CT, B-Line B3501 CT, Grinnell Fig. 137C, or equal.
 - e. Copper pipe (insulated) - shall be Grinnell Fig. 137, B-Line B3188, or equal, with insulation shield.
 - f. Plastic pipe - shall be Grinnell Fig. 137C, Michigan model 151, B-Line B3188 C, or equal.
8. Type 8 - Adjustable Pipe Roll Support: Rollers and sockets shall be cast iron, cross rod and support rods shall be carbon steel.
 - a. Steel pipe (insulated) - shall be B-Line B3122, Grinnell Fig. 177, or equal, with insulation shield.
 - b. Steel pipe (uninsulated) - shall be B-Line B3122, Grinnell Fig. 177, or equal.
 - c. Copper pipe (insulated only) - shall be B-Line B3122, Grinnell Fig. 177, or equal, with insulation shield.
 - d. Plastic pipe - shall be B-Line B3122, Grinnell Fig. 177, or equal.
9. Type 9 - Welded Pipe Stanchion: Minimum material thickness shall be standard schedule carbon steel pipe, cut to match contour of the pipe elbow. Use of this support shall be limited to ambient systems only.

10. Type 10 - Pipe Stanchion Saddle: Saddles and yokes shall be carbon steel and comply with MSS Type 37 and FEDSPEC Type 38.
 - a. Steel pipe (insulated) - shall be Carpenter & Patterson Fig. 125, B-Line B3090, or equal, with insulation shield.
 - b. Steel pipe (uninsulated) - shall be Carpenter & Patterson Fig. 125, B-Line B3090, or equal.
 - c. Cast and ductile iron pipe - shall be Carpenter & Patterson Fig. 125, B-Line B3090 NS, or equal.
 - d. Copper pipe (uninsulated) - shall be Carpenter & Patterson Fig. 125, B-Line B3090, or equal, with insulation shield or lined with dielectric material.
 - e. Copper pipe (insulated) - shall be Carpenter & Patterson Fig. 125, B-Line B3090, or equal, with insulation shield.
 - f. Plastic pipe - shall be Carpenter & Patterson Fig. 125, B-Line B3090, or equal.
11. Type 11 - Offset Pipe Clamp: Pipe clamp shall be carbon steel with configuration and components as specified and shall be of standard design manufactured by a pipe hanger component manufacturer.
 - a. Steel pipe (insulated) - shall be B-Line B3148, Grinnell Fig. 103, or equal, with insulation shield.
 - b. Steel pipe (uninsulated) - shall be B-Line B3148, Grinnell Fig. 103, or equal.
 - c. Cast and ductile iron pipe - shall be B-Line B3148 NS, Grinnell Fig. 103, or equal.
 - d. Copper pipe (insulated) - shall be B-Line B3148, Grinnell Fig. 103, or equal, with insulation shield.
 - e. Copper pipe (uninsulated) - shall be B-Line B3148, Grinnell Fig. 103, or equal, lined with dielectric material.
 - f. Plastic pipe - shall be B-Line B3148, Grinnell Fig. 103, or equal.
 - g. Vertical pipe support applications shall be as specified above except that insulation shields shall not be used for insulated pipe.
12. Type 12 - Riser Clamp: Riser clamp shall be carbon steel with configuration and components equivalent to MSS and FEDSPEC Type 8.
 - a. Steel pipe (insulated) - shall be B-Line B3373, Grinnell Fig. 261, or equal.
 - b. Steel pipe (uninsulated) - shall be B-Line B3373, Grinnell Fig. 261, or equal.
 - c. Cast and ductile iron pipe - shall be B-Line B3373, Grinnell Fig. 261, or equal.
 - d. Copper pipe (insulated) - shall be B-Line B3373 CT, Grinnell Fig. CT-121, Michigan model 511, or equal.
 - e. Copper pipe (uninsulated) - shall be B-Line B3373 CT, Grinnell Fig. CT-121, Michigan model 511, or equal.
 - f. Plastic pipe - shall be B-Line B3373, Grinnell Fig. 261c, or equal.
13. Type 13 - Framing Channel Pipe Strap: Pipe strap shall be carbon steel, with configuration equivalent to MSS Type 26.
 - a. Steel pipe (uninsulated) - shall be Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal.
 - b. Steel pipe (insulated) - shall be Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal, with insulation shield.
 - c. Copper pipe (uninsulated) - shall be Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal, with insulation shield or lined with dielectric material.

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

C. Rack and Trapeze Supports:

- 1. General: Unless otherwise specified, trapeze and pipe rack components shall have a minimum steel thickness of 12 gage, with a maximum deflection $1/240$ of the span.
- 2. Type 20 - Trapeze Pipe Support: Trapeze pipe support cross members shall be framing channel as specified in paragraph 2.02 Framing Channel. Flat plate fittings shall be 1 5/8-inch square carbon steel of standard design manufactured by framing channel manufacturer, Unistrut P2471, B-Line B202-2, or equal.
- 3. Type 21 - Pipe Rack Support: Post and cross members shall be framing channel as specified in paragraph 2.02 Framing Channel. Pipe rack fittings shall be carbon steel, of standard design manufactured by framing channel manufacturer. 90-degree fittings shall be gusseted Unistrut P2484, B-Line B844, or equal. Post base fittings shall be as specified in paragraph 2.02 Type E - Framing Channel Post Base.

D. Structural Attachments:

- 1. Type A - Malleable Iron Concrete Insert: Concrete inserts shall be malleable iron and comply with MSS and FEDSPEC Type 18. Grinnell Fig. 282, Carpenter & Patterson Fig. 108, or equal.
- 2. Type B - Side Beam Bracket: Bracket shall be malleable iron and comply with MSS Type 34 and FEDSPEC Type 35. Grinnell Fig. 202, B-Line B3062, or equal.
- 3. Type C - Malleable Beam Clamp With Extension Piece: Clamp and extension piece shall be malleable iron, tie rod shall be steel. Beam clamp shall comply with MSS and FEDSPEC Type 30. Grinnell Fig. 218 with Fig. 157 extension piece, B-Line B3054, or equal.
- 4. Type D - Steel Beam Clamp With Eye Nut: Beam clamp and eye nut shall be forged steel. Configuration and components shall comply with MSS and FEDSPEC Type 28. Grinnell Fig. 292, Carpenter & Patterson Fig. 297, or equal.
- 5. Type E - Framing Channel Post Base: Post bases shall be carbon steel, of standard design manufactured by framing channel manufacturer. Single channel: Unistrut P2072A, B-Line B280, or equal. Double channel: Unistrut P2073A, B-Line B281, or equal.
- 6. Type F - Welded Beam Attachment: Beam attachment shall be carbon steel and comply with MSS and FEDSPEC Type 22. B-Line B3083, Grinnell Fig. 66, or equal.
- 7. Type G - Welded Steel Bracket: Bracket shall be carbon steel and comply with MSS Type 32 and FEDSPEC Type 33 for medium welded bracket. Heavy welded bracket shall comply with MSS Type 33 and FEDSPEC Type 34.
- 8. Type H - Cast Iron Bracket: Bracket shall be cast iron, Carpenter & Patterson Fig. 340, or equal.
- 9. Type J - Adjustable Beam Attachment: Beam attachment shall be carbon steel, Carpenter & Patterson Fig. 151, B-Line B3082, or equal.
- 10. Type K - Double Channel Bracket: Wall channel shall be single channel framing channel as specified in paragraph 2.02 Framing Channel. Cantilever bracket shall be a carbon steel double framing channel assembly, Unistrut P2542 through P2546, B-Line B297-12 through B297-36, or equal.

11. Type L - Single Channel Bracket: Wall channel shall be single channel framing channel as specified in paragraph 2.02 Framing Channel. Cantilever bracket shall be a carbon steel single framing channel assembly, Unistrut P2231 through P2234, B-Line B198-6, B198-12, B196-18 and B196-24, or equal.
12. Type M - Wall Mounted Channel: Wall channel shall be single channel framing channel as specified in paragraph 2.02 Framing Channel.
13. Type N - Pipe Stanchion Floor Attachment: Baseplate shall be carbon steel with 1/2 inch minimum thickness. Anchor bolt holes shall be 1/16 inch larger than the anchor bolt diameter. The space between the baseplate and the floor shall be filled with nonshrink grout.

E. Accessories:

1. Hanger Rods: Rods shall be carbon steel, threaded on both ends or continuous threaded and sized as specified.
2. Weldless Eye Nut: Eye nut shall be forged steel and shall comply with MSS and FEDSPEC Type 17. Eye nut shall be Grinnell Fig. 290, B-Line B3200, or equal.
3. Welded Eye Rod: Eye rod shall be carbon steel with eye welded closed. Inside diameter of eye shall accommodate a bolt diameter 1/8 inch larger than the rod diameter. Eye rod shall be Grinnell Fig. 278, B-Line B3211, or equal.
4. Turnbuckle: Turnbuckle shall be forged steel and shall comply with MSS and FEDSPEC Type 13. Turnbuckle shall be Grinnell Fig. 230, B-Line B3202, or equal.
5. Framing Channel: Framing channel shall be 1 5/8 inches square, roll formed, 12-gage carbon steel. Channel shall have a continuous slot along one side with in-turned clamping ridges. Single channel: Unistrut P1000, B-Line B22, or equal. Double channel: Unistrut P1001, B-Line B22A, or equal. Triple channel: Unistrut P1004A, B-Line B22X, or equal.

2.03 THERMAL PIPE HANGER SHIELD – NOT USED

2.04 PRODUCT DATA

- A. Hanger and support locations and components shall be indicated on the piping layout drawings.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT LOCATIONS

- A. The Contractor shall locate hangers and supports as near as possible to concentrated loads such as valves, flanges, etc. Locate hangers, supports and accessories within the maximum span lengths specified in the project manual to support continuous pipeline runs unaffected by concentrated loads.
- B. At least one hanger or support shall be located within 2 feet from a pipe change in direction.
- C. The Contractor shall locate hangers and supports to ensure that connections to equipment, tanks, etc., are substantially free from loads transmitted by the piping.

- D. Where piping is connected to equipment, a valve, piping assembly, etc., that will require removal for maintenance, the piping shall be supported in such a manner that temporary supports shall not be necessary for this procedure.
- E. Pipe shall not have pockets formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves and fittings.

3.02 INSTALLATION

- A. Welded and bolted attachments to the building structural steel shall be in accordance with the requirements of the AISC Manual of Steel Construction. Unless otherwise specified, there shall be no drilling or burning of holes in the building structural steel.
- B. Hanger components shall not be used for purposes other than for which they were designed. They shall not be used for rigging and erection purposes.
- C. The Contractor shall install items to be embedded before concrete is poured. Fasten embedded items securely to prevent movement when concrete is poured.
- D. Embedded anchor bolts shall be used instead of concrete inserts for support installations in areas below water surface or normally subject to submerging.
- E. The Contractor shall install thermal pipe hanger shields on insulated piping at required locations during hanger and support installation. Butt joint connections to pipe insulation shall be made at the time of insulation installation in accordance with the manufacturer's recommendations.
- F. Hanger and support components in contact with plastic pipe shall be free of burrs and sharp edges.
- G. Rollers shall roll freely without binding.
- H. Finished floor beneath Type N structural attachments and framing channel post bases shall be roughed prior to grouting. Grout between base plate and floor shall be free of voids and foreign material.
- I. Baseplates shall be cut and drilled to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.
- J. Plastic or rubber end caps shall be provided at the exposed ends of all framing channels that are located up to 7 feet above the floor.

3.03 ADJUSTMENTS

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

END OF SECTION

SECTION 40 05 07.13
SEISMIC RESTRAINTS FOR PIPING

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. This section specifies seismic restraints for bracing all piping systems specified in Section 40 05 01. This section does not include seismic restraints for fire sprinkler systems.

B. Definitions:

1. Longitudinal direction--direction parallel to the pipe axis.
2. Lateral direction--direction perpendicular to the pipe axis.

C. Operating Conditions:

1. The seismic restraints specified in this section are provided to resist pipe movements and loads occurring as a result of an earthquake or other seismic event.
2. Unless otherwise specified, all piping shall have bracing to resist seismic loading caused by forces applied at the individual pipe's center of gravity. Seismic loading shall be 0.375 g acting in the lateral and longitudinal directions and 0.17 g acting simultaneously in the vertical directions.

D. Restraint Selection:

1. Unless otherwise specified, the Contractor shall select, locate and provide seismic restraints for piping in accordance with the project manual.
2. The Contractor shall review the piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the restraint to be used at each point.
3. Seismic restraints may be omitted from the following installations:
 - a. Gas piping less than 1-inch inside diameter.
 - b. Piping in boiler and mechanical rooms less than 1 1/4-inch inside diameter.
 - c. All other piping less than 2 1/2-inch inside diameter.
 - d. All piping suspended by individual hangers 12 inches or less in length from the top of the pipe to the bottom of the support for the hanger.
4. Piping systems shall not be braced to dissimilar parts of a building or to dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.
5. Restraints shall be sized to fit the outside diameter of the pipe, tubing, or, where specified, the outside diameter of insulation.
6. There shall be no contact between a pipe and restraint component of dissimilar metals. The contractor shall prevent contact between dissimilar metals when restraining copper tubing by the use of copper-plated, rubber, plastic or vinyl coated, or stainless steel restraint components.
7. Branch lines shall not be used to brace main lines.

8. Seismic bracing shall not limit the expansion and contraction of the piping system.

1.02 QUALITY ASSURANCE

A. References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI A58.1-82	Minimum Design Loads for Buildings and Other Structures
AISC Manual of Steel Construction	American Institute of Steel Construction, Manual of Steel Construction, Allowable Stress Design - 9th Edition
FEDSPEC WW-H-171e-78	Hangers and Supports, Pipe
MFMA-2-91	Metal Framing Standards Publication
MSS SP-58-93	Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69-91	Pipe Hangers and Supports - Selection and Application
SMACNA, PPIC	Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems

B. Approval:

1. Seismic restraint load calculations specified in paragraph 3.01 shall be reviewed and signed by a structural engineer registered in the State of Utah.

PART 2 PRODUCTS

2.01 ACCEPTABLE PRODUCTS

- A. Standard pipe restraints and components shall be manufactured by Carpenter & Patterson, B-Line, Kin-Line, ITT Grinnell, Michigan, Pipe Shields Incorporated, Superstrut, Unistrut, or equal. Pipe restraint materials shall conform to the requirements of MSS SP-58 and MFMA-1.

2.02 MATERIALS

A. General:

1. Unless otherwise specified, restraints, including braces, pipe and structural attachments, shall be hot-dip galvanized after fabrication. Nuts, bolts and washers, fittings and accessories, may be mechanically zinc-coated except for those subject to moisture or corrosive atmosphere, which shall be type 304 stainless steel.
- B. Pipe Attachments:
1. Type 1s: Clevis Restraint Attachment: Clevis attachment shall be Type 1, clevis pipe hanger, as specified in Section 40 05 07-2.02 Pipe Hangers and Supports.
 2. Type 3s: Double Bolt Restraint Clamp: Restraint clamp shall be Type 3, double bolt pipe clamp, as specified in Section 40 05 07-2.02 Pipe Hangers and Supports.
 3. Type 4s: Roller Restraint Attachment: Roller attachment shall be Type 4, adjustable roller hanger, as specified in Section 40 05 07-2.02 Pipe Hangers and Supports. Hold down strap shall be carbon steel and sized as follows: pipe size 1 inch through 2 inch shall be 1 inch by 1/8 inch thick, pipe sizes 2 1/2-inch through 4 inch shall be 1 1/4-inch by 3/16 inch thick, 6 inch pipe shall be 2 inch by 3/16 inch thick, 8 inch pipe shall be 2 1/2-inch by 3/16 inch thick, 10-inch through 16-inch pipe shall be 2 1/2-inch by 1/4 inch thick, 20-inch pipe shall be 3 inch by 1/4 inch thick, and 24-inch pipe shall be 3 inch by 3/8 inch thick.
 4. Type 7s: U-Bolt Restraint: U-bolt restraint shall be Type 7, U-bolt, as specified in Section 40 05 07-2.02 Pipe Hangers and Supports.
 5. Type 13s: Framing Channel Strap Restraint: Strap restraint shall be Type 13, framing channel pipe strap, as specified in Section 40 05 07-2.02 Pipe Hangers and Supports.
 6. Type 14s: Pipe Clamp Restraint: Pipe clamp shall be carbon steel, with configuration and components equivalent to MSS and FEDSPEC Type 4. Rod attachment and longitudinal brace connection stud shall be carbon steel, fabricated and welded by the manufacturer.
 - a. Steel pipe (insulated)--shall be Superstrut No. S-720, Kin-Line No. S475, or equal, with insulation shield.
 - b. Steel pipe (uninsulated)--shall be Superstrut No. S-720, Kin-Line No. S475, or equal.
 - c. Cast and ductile iron pipe--shall be Superstrut No. S-720, Kin-Line No. S475, or equal.
 - d. Copper pipe (insulated)--shall be Superstrut No. S-720, Kin-Line No. S475, or equal, with insulation shield.
 - e. Copper pipe (uninsulated)--shall be Superstrut No. S-720, Kin-Line No. S475, or equal, with insulation shield or dielectric lining.
 - f. Plastic pipe--shall be Superstrut No. S-720, Kin-Line No. S475, or equal.
- C. Trapeze Restraints:
1. General: Unless otherwise specified, trapeze members shall have a minimum steel thickness of 12 gage, with a maximum deflection 1/240 of the span.
 2. Type 20s: Single Channel Lateral Restraint: Trapeze restraint cross member shall be 1 5/8-inch square carbon steel framing channel, Unistrut P1000, B-Line B22, Superstrut A-1200, or equal. Pipe attachments shall be Type 13s or Type 7s specified in paragraph 2.02 Pipe Attachments. Rod stiffeners and lateral brace shall be as specified in paragraph 2.02 Braces and Fittings.

3. Type 21s: Double Channel Lateral Restraint: Trapeze restraint cross member shall be a double channel manufactured assembly such as Unistrut P1001, B-Line B22A, Superstrut A-1202, or equal. Pipe attachments shall be Type 13s or Type 7s specified in paragraph 2.02 Pipe Attachments. Rod stiffeners and lateral brace shall be as specified in paragraph 2.02 Braces and Fittings.
4. Type 22s: Double Channel Longitudinal Restraint: Trapeze restraint cross member shall be a double channel manufactured assembly such as Unistrut P1001, B-Line B22A, Superstrut A-1202, or equal. Pipe attachments shall be Type 13s or Type 7s specified in paragraph 2.02 Pipe Attachments. Rod stiffeners, longitudinal and lateral braces shall be as specified in paragraph 2.02 Braces and Fittings.

D. Braces and Fittings:

1. Seismic Brace Fitting: Seismic brace fitting shall be manufactured for use with industry standard framing channel. The fitting shall be carbon steel, welded construction, two-piece linked fitting. A means to reduce noise and vibration transmission between the linked fitting parts shall be provided. Seismic brace fittings shall be Superstrut C-749N series seismic brace, Kin-Line No. 633 seismic connector fitting, or equal.
2. Hanger Rod Stiffener Assembly: Rod stiffener channel shall be 1 5/8-inch square carbon steel framing channel, Unistrut P1000, B-Line B22, Superstrut A-1200, or equal. Rod stiffener clamps shall be complete with channel nut and shall be Superstrut ES-142, Kin-Line No. 635, or equal.
3. Type A1 Seismic Brace: Seismic brace shall be 1 5/8-inch square carbon steel framing channel, Unistrut P1000, B-Line B22, Superstrut A-1200, Kin-Line No. 4112, or equal.
4. Type A2 Seismic Brace: Seismic brace shall be 1 5/8-inch wide by 3 1/4-inch deep carbon steel framing channel, Unistrut P5000, B-Line B11, Superstrut H-1200, Kin-Line No. 8212, or equal.

E. Structural Attachments:

1. General: Unless otherwise specified, hanger rod structural attachments shall be as specified in Section 40 05 07. Structural attachments for longitudinal and lateral seismic braces shall be as specified in paragraph 2.02 Structural Attachments.
2. Type SA-1 Attachment: Brace fitting shall be as specified in paragraph 2.02 Braces and Fittings. Concrete anchors shall be as specified in Section 05 05 23 with embedment and location dimensions as specified.
3. Type SA-2 Attachment: Brace fitting shall be as specified in paragraph 2.02 Braces and Fittings. Concrete anchors shall be as specified in Section 05 05 23 with embedment and location dimensions as specified. Framing channel shall be as specified in paragraph 2.02 Accessories.
4. Type SA-3 Attachment: Brace fitting shall be as specified in paragraph 2.02 Braces and Fittings. Cap screw, lockwasher and hex nut materials and finish shall be compatible with structural steel material.
5. Type SA-4 Attachment: Brace fitting shall be as specified in paragraph 2.02 Braces and Fittings.
6. Type SA-5 Attachment: Brace fitting shall be as specified in paragraph 2.02 Braces and Fittings. Four-inch x 3-inch x 3/8-inch angle shall be carbon steel.

F. Accessories:

1. Hanger Rods: Rods shall be carbon steel, threaded on both ends or continuous threaded and sized as specified.
2. Framing Channel: Framing channel shall conform to the Metal Framing Manufacturers Association standard MFMA-1. Framing channel shall be roll formed, 12-gage carbon steel. Channel shall have a continuous slot along one side with in-turned clamping ridges. Channel shall be Unistrut P1000 series, B-Line B22 series, Superstrut A-1200 series, or equal.
3. Rod Coupling: Rod coupling shall be carbon steel, with sight hole in center of coupling body, Grinnell Fig. 135, Superstrut H-119, or equal.

2.03 THERMAL PIPE HANGER SHIELD

- A. Thermal shields shall be provided at seismic restraint locations on pipe requiring insulation. Thermal pipe hanger shields shall be as specified in Section 40 05 07-2.03. Stainless steel band clamps shall be provided on thermal shields at longitudinal pipe restraint locations.

2.04 PRODUCT DATA

- A. The following information shall be provided as specified in Section 01 33 00:
 1. Seismic restraint locations and legend as specified in paragraph 3.01.
 2. Load calculations as specified in paragraph 1.02 Approval.

PART 3 EXECUTION

3.01 PIPE RESTRAINT LOCATIONS

- A. The first seismic restraint on a piping system shall be located not more than 10 feet from the main riser, entrance to a building or piece of equipment.
- B. Cast iron pipe shall be braced on each side of a change in direction of 90 degrees or more. Joints in risers shall be braced or stabilized between floors.
- C. No-hub and bell and spigot cast iron soil pipe shall be braced longitudinally every 20 feet and laterally every 10 feet.
- D. Lateral bracing for one pipe section may also act as longitudinal bracing for the pipe section connected perpendicular to it, if the bracing is installed within 24 inches of the elbow or tee of the same size.
- E. Seismic restraint locations and components shall be indicated on the piping layout drawings. The Contractor shall provide a legend giving load information and restraint component selection at each restraint location.

3.02 INSTALLATION

- A. Rod stiffener assemblies shall be used at seismic restraints for hanger rods over 6 inches in length. A minimum of two rod stiffener clamps shall be used on any rod stiffener assembly.

- B. Lateral and longitudinal bracing shall be installed between 45 degrees above and 45 degrees below horizontal, inclusive, relative to the horizontal centerline of the pipe.
- C. Welded and bolted attachments to the building structural steel shall be in accordance with the requirements of the AISC Manual of Steel Construction. There shall be no drilling or burning of holes in the building structural steel without approval of the Construction Manager.
- D. Embedded anchor bolts shall be used instead of concrete inserts for seismic brace installations in areas below water surface or normally subject to submerging.
- E. The Contractor shall install thermal pipe hanger shields on insulated piping at required locations during restraint installation. Butt joint connections to pipe insulation shall be made at the time of insulation installation in accordance with the manufacturer's recommendations.
- F. Restraint components in contact with plastic pipe shall be free of burrs and sharp edges.
- G. Rollers shall roll freely without binding.
- H. Plastic or rubber end caps shall be provided at the exposed ends of all framing channels that are located up to 7 feet above the floor.

END OF SECTION

SECTION 40 05 23

STAINLESS STEEL PROCESS PIPE AND TUBING

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies stainless steel pipe and fittings.

1.02 QUALITY ASSURANCE

A. References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI B31.3	Process Piping
ASME Section IX	Boiler and Pressure Vessel Code; Welding and Brazing Requirements
ASTM A480	General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
AWWA M11	Steel Pipe-A Guide for Design and Installation
AWWA C227	Bolted, Split-Sleeve Restrained and Non-Restrained Couplings for Plain-End Pipe
AWWA C606	Grooved and Shouldered Joints
CSA W48.3	Low Alloy Steel Covered Electrodes for Shielded Metal Arc Welding

1.03 SUBMITTALS

A. Action Submittals:

1. Procedures: Section 01 33 00.
2. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be

underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The DISTRICT shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

3. Piping layout drawings as specified in Section 40 05 01.
4. Manufacturers' product data, catalog cuts, typical installation details, and dimensions. Indicate on the submittal each piping system where the product will be used.
5. Pipe wall thickness calculations for pipe fabricated per AWWA C220. Steel pipe design calculations conform to AWWA M11.
6. Pipe wall thickness and reinforcement calculations for fittings fabricated per AWWA C226. Fabricated steel pipe fitting design calculations conform to AWWA M11.
7. Calculations for any pipe and fittings that are not fabricated per one of the components standards listed in the specified ASME B31 code.
8. Submit calculations for engineered flange face rings in accordance with Appendix D of ASME Section VIII Division 1.

B. Informational Submittals:

1. Procedures: Section 01 33 00.
2. Manufacturers' certificates of compliance with specified industry standards.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Procedures: Section 01 66 00 for Shipment and Storage.
- B. Deliver pipe and fittings with end protectors in place. Do not remove protectors until materials are about to be installed.
- C. Prevent carbon steel contamination of stainless steel pipe and fittings during storage, handling, fabrication, and installation. Remove any carbon steel contamination found during construction.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All pipe system materials to be new, free from defects and conforming to the requirements and standards specified in this Section and the Contract Drawings.
- B. Pipe.
 1. Use pickled and annealed sheet or plate for manufacture of fabricated stainless steel pipe.
 2. Finish.
 - a. 8-gage through 16-gage material: No. 1 or 2B per ASTM A480.

- b. 3/16-inch and heavier plate material: No. 1 mill finish per ASTM A480, "Hot-Rolled or Cold-Rolled, and Annealed or Heat Treated, and Blast Cleaned or Pickled."

2.02 SHOP-FABRICATED STAINLESS STEEL PIPE AND FITTINGS.

1. Furnished by a single manufacturer who is experienced and qualified in the manufacture and fabrication of the items to be provided.
 2. Manufacture using Weld Procedure Specifications (WPS) that have been qualified under ASME Section IX. Document qualifications in Procedure Qualification Reports (PQR). Use only certified welders who have successfully completed performance qualification tests per ASME Section IX for manufacture of stainless steel pipe.
- B. Flanges.
1. Pipe mating flanges shall be of the same standard, class, and series.
 2. Material: Conforming to ASTM A182-F316L.
 3. Dimensions: ASME B16.5.
 4. Type:
 - a. Slip-on or weld-neck type, unless otherwise noted.
 - b. Provide weld-neck flanges at flanged, lugged, and wafer valves.
 - c. Where lap-joint flanges are allowed, backing ring shall match the material of the pipe.
 - d. Compatible valves shall have specified rating and matching drilling pattern.
 5. Gaskets:
 - a. Full face type for plain faced flanges.
 - b. Pipe 10 inches and less in diameter: 1/16 inch.
 - c. Pipe 12 inches and larger in diameter: 1/8 inch.
 6. Bolts, Washers, and Nuts:
 - a. Apply anti-seize to stainless steel bolts before turning nut on flange bolts.
 - b. Bolt length per ANSI B16.5.
 - c. Threads per ANSI B1.1, standard coarse thread series; Class 2A bolts, Class 2B nuts.
 - d. Material:
 - 1) Service over 100 degrees Fahrenheit or with any compressed gasketing or graphite gasketing materials:
 - a) ASTM A193 Grade B8M Class 2 bolts
 - b) ASTM A194 Grade 8M heavy hex nuts
 - 2) Service at any lower temperature and with any other gasketing materials:
 - a) ASTM A320 Grade B8M Class 1 bolts
 - b) ASTM A194 Grade 8M heavy hex nuts
 - e. Where washers are required, match material to the associated bolts.
- C. Grooved couplings and fittings.
1. Flexible and rigid coupling with pipe grooves compliant with AWWA C606.

2. When pipe wall thickness does not meet the minimum requirements of AWWA C606 for rolled or cut groove joints, provide shoulder ends per the requirements of AWWA C606.
 3. Candidate manufacturers.
 - a. Victaulic
 - b. Gruvlok
 - c. Approved equal.
 4. Coatings: Use stainless steel grooved couplings to match stainless steel pipe. Where stainless steel grooved couplings are not available, coat couplings
 - 1) Coating shall be an epoxy coating per AWWA C210, NSF-61, Tnemec Series 22, Sherplate PW, or Approved Equal.
- D. Bolted split sleeve couplings.
1. AWWA C227 compliant sleeve with single or double arch cross section of the same material as pipe. Body thickness equal to or greater than that of connecting pipe wall thickness.
 2. Candidate manufacturers.
 - a. Victaulic, Style 231S through 234S.
 - b. Victaulic 77S
 - c. Approved equal.
- E. Expansion Joints.
1. Where specified, expansion joint couplings shall be Flanged Rubber Expansion Joints Style 1101 by General Rubber or approved equal.
 - a. Unfilled arch
 - b. EPDM rubber with polyester tire cord
 - c. Stainless steel gusset, rods, and nuts
 - d. Control Unit
 - 1) Outer Washer, Inner Bare (W/B)

2.03 SHOP FABRICATION

- A. Metal forming processes.
1. Use pinch rolls with a hard chrome finish to form cylinders. Thoroughly clean the rolls using Avesta BlueOne™ 130 Pickling Paste or approved equal, prior to roll forming the pipe. Alternatively, provide a protective barrier between the stainless steel plate/sheet and the plate rolls during the forming process.
 2. Provide a protective barrier between pipe welding rollers and the stainless steel pipe cylinder. Alternately, new rollers or rollers that have been turned down on a lathe to provide a new and clean working face may be used.
- B. All saws, drills, files, wire brushes, grinding wheels, etc. will be free of carbon contamination and designated for stainless steel use only.
- C. Provide nonferrous, stainless steel, or rubber-lined pipe storage and fabrication racks.
- D. Use nylon slings or straps for handling stainless steel piping.

- E. Preparation of surfaces to be welded.
 - 1. Surfaces of joints to be welded are to be free from mill scale, slag, grease, oil, paint, rust, and other foreign material.
 - 2. Use only stainless wire wheels and grinding wheels that have not come into contact with carbon steel.
 - 3. Flame cutting or any use of oxy-acetylene gas cutting tools is prohibited. Use plasma arc torch with a nitrogen or argon-hydrogen carrier gas, laser or waterjet processes for cutting and plate beveling.
 - 4. Air arc and gas backgouging are prohibited. Use grinding and plasma gouging methods to achieve full penetration welds.

- F. Welding.
 - 1. Welding and production processes are to conform to ASME B31.3.
 - 2. Use of Solar Flux is prohibited.
 - 3. Use of FCAW welding is prohibited.
 - 4. Pipe and fittings with wall thickness up to 11-gage (1/8-inch): weld using the GTAW process.
 - 5. Pipe and fittings with wall thicknesses greater than 1/4-inch may be welded using an automated SAW process.
 - 6. Pipe and fittings with wall thickness greater than 11-gage (1/8-inch): Bevel and complete root pass using the GTAW process, followed by subsequent passes with the GTAW, GMAW, or Metallic Arc SMAW process.
 - 7. Filler material:
 - a. Add only ELC wire grades to provide a cross section at the weld equal to or greater than the parent metal.
 - b. SMAW electrodes to conform to CSA W48.3.
 - 8. Make weld deposit smooth and evenly distributed and with a crown of no more than 1/16-inch on the I.D. and 3/32-inch on the O.D. of the piping. Concavity, undercut, cracks, or crevices are not permitted.
 - 9. Full penetration butt welds: provide inert gas shielding to the interior and exterior of the joint.
 - 10. Lap joints: provide full thickness seal welds on both joints.

- G. Remove excessive weld deposits, slag, spatter, and projections by grinding. Grind welds smooth on gasket surfaces. Tack welds, clips, and other attachments.
 - 1. Repair nicks, gouges, notches, and depressions in the base metal in the area before the joint weld is made.
 - 2. Remove tack welds, clips, and other attachments and repair defects, except where the tack welds occur within the weld area and these tack welds do not exceed the size of the completed weld. Remove cracked tack welds.
 - 3. Grind those areas to be repaired down to clean metal and then repair by building up with weld metal. Grind the repaired areas smooth to form a plane surface with the base metal.

- H. Defects and repairs.
 - 1. Remove welds with cracks, slag inclusions, porosity, undercutting, incomplete penetration, or which are otherwise deficient in quality or made contrary to any provisions of these specifications, by chipping or grinding throughout their depth to clean base metal.
 - 2. Do not perform calking or peening of welds to correct defects.
 - 3. Enlarge welds found deficient in dimension but not in quality by additional welding after thoroughly cleaning the surface of previously deposited metal and the adjoining plate.
 - 4. Remove weld deposits, slag, weld spatter, and projections into the interior of the pipe by grinding.
- I. Cleaning (pickling) and passivation:
 - 1. Following shop fabrication of pipe sections, straight spools, fittings, and other piping components, clean (pickle) and passivate fabricated pieces.
 - 2. Clean (pickle) and passivate in accordance with ASTM A 380 or A 967.
 - a. If degreasing is required before cleaning to remove scale or iron oxide, cleaning (pickling) treatments with citric acid are permissible.
 - 1) However, these treatments must be followed by inorganic cleaners such as nitric acid/hydrofluoric acid.
 - b. Passivation treatments with citric acid are not allowed.
 - 3. Finish requirements: Remove free iron, heat tint oxides, weld scale, and other impurities, and obtain a passive finished surface.
 - a. After all shop operations have been completed, pipe and fittings shall be pickled and passivated in manufacturer's plant per ASTM A380 and scrubbed and washed until discoloration and possible iron picked up from manufacturing process are removed.
 - 1) Treat all welded joints with Avesta BlueOne™ 130 Pickling Paste or approved equal and rinse with clean water.
 - 2) If rusting of embedded iron occurs, pickle the affected surface with Avesta BlueOne™ 130 Pickling Paste or approved equal.
 - 3) Rinse clean using Avesta FinishOne Passivator 630 or approved equal.

PART 3 EXECUTION

3.01 GENERAL

- A. Field welding.
 - 1. Use couplings and prefabrication of pipe systems at the factory to eliminate field welding.
- B. Use wooden scaffolding and/or ladders if possible to gain access to work areas. If metal scaffolding and/or ladders must be used, tape or otherwise shield the contact points between scaffolding/ladders and the stainless steel.
- C. After installation, wash and rinse all foreign matter from the piping surface. Adhere to the passivation manufacturer's recommendations and local regulations for safety and disposal of any waste chemicals.

3.02 REPAIR/RESTORATION

- A. Per Section 40 05 01 and as specified herein.
- B. Restore areas damaged or discolored by handling, iron contamination or soiled to a uniform surface finish and consistently clean surface with methods specified for shop fabrication.
- C. Identifying spool piece marks shall be removed with paint thinner or solvents and the entire stainless steel surface shall be washed with detergent and hot water and rinsed clean.

3.03 COMPONENT TEST PHASE

- A. Per Section 40 05 01.

END OF SECTION

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SECTION 40 05 57.23
POWERED ACTUATORS

PART 1 GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. This section specifies powered actuators for valves and gates and actuator appurtenances.
- B. Types:
 - 1. For use in the control valve schedule in this section, powered actuators are defined as follows:

Actuator Type (ACTUSPEC)	Service	Definition
EQTI	Isolating (Open-Close)	Electric motor quarter-turn

1.02 REFERENCES

- A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM A519	Seamless Carbon and Alloy Steel Mechanical Tubing
ASTM B584	Copper Alloy Sand Castings for General Applications
JIC P-1	Pneumatic Standards for Industrial Equipment and General Purpose Machine Tools
NEMA ICS-2	Industrial Control Devices, Controllers and Assemblies

1.03 SUBMITTALS

- A. The following information shall be provided in accordance with Section 01 33 00:
 - 1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each

paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. Manufacturer's catalog information and other data confirming conformance to design and material requirements.
3. Application sheets and schedules for each valve and actuator showing required mounting, operating torque for valve, torque capacity of actuator, and power or air pressure requirements. Valve identification (tag) number shall be clear for each application.
4. List of components being provided for each valve, actuator and positioner.

PART 2 PRODUCTS

2.01 GENERAL

- A. Actuators shall be factory-mounted on the valve or gate and provided as a unit. Each valve body or actuator shall have cast thereon the word "OPEN," an arrow indicating the direction to open, and flow direction arrows.

2.02 POWERED ACTUATORS

- A. General:
 1. Actuators shall be sized to produce an operating torque equal to twice the maximum required valve operating torque under the specified flow conditions.
 2. Actuators shall remain in the last position upon failure or loss of signal.
- B. Electric Actuators
 1. General: Unless otherwise specified, electric actuators shall be provided in accordance with the following requirements.
 2. Actuators shall be:
 - a. As specified in Paragraph 3.04 Valve Actuator Specification Sheets (ACTUSPEC)
 3. Motor: Actuator motors shall be heavy duty, specifically designed for valve or gate actuator service. Motors shall be of totally-enclosed, non-ventilated construction. Motor shall have an internal space heater with nominal rating of 25-watts. Motors shall incorporate:
 - a. Four-pole 1800 RPM or provide pole-speed as required for the application.
 - b. Suitable for use with 460 volt, 3-phase, 60-Hertz power with +/- 10% voltage fluctuation.
 - c. NEMA Class F insulation.

- d. Thermistor for thermal protection embedded in the motor windings.
 - e. Automatic motor overload relay reset.
 - f. Four conduit openings.
4. Enclosure: Motor and electrical enclosures shall be NEMA-4X Weatherproof and rated for the application and environmental conditions specified in section 01 11 80
 5. Motor Starter: Actuator shall be provided with a three-phase full voltage reversing starter rated at 30-amperes both mechanically and electrically interlocked with overload protection or elements in each of the three poles.
 - a. Control Transformer shall be epoxy encapsulated and impregnated and rated at a minimum of 75VA with 120Vac secondary and other required secondary voltages of 18 Vac and 12 Vac as required, with short-circuit and overload protection.
 6. Gearing: Gearing shall be double-reduction, with a helical gear and pinion forming the first reduction and a worm and worm gear forming the second. The helical gear and pinion shall be fabricated from heat-treated alloy steel with hobbled and finished shaved teeth. The worm shall be fabricated from heat-treated alloy steel, ground, carburized and hardened. The worm gear shall be fabricated from high tensile strength bronze with hobbled teeth.
 - a. The stem nut shall be fabricated from high tensile strength bronze and shall be the two-piece type, when possible. All gearing shall be designed to withstand a 100 percent overload.
 7. Torque Switch: Electric actuators shall be provided with a double-torque switch set to disengage motor power at 75 percent of the shaft's design torque. The torque switch shall operate in both the opening and closing directions and shall operate during the complete cycle without the use of auxiliary relays, linkages, latches, or other devices.
 - a. Each side of the torque switch shall have a numbered dial for set point adjustment. A calibration tag shall be mounted near each switch for correlating the dial settings with output torque.
 8. Manual Actuator: Electric actuators shall be provided with a handwheel for manual operation. The handwheel shall not rotate during motor operation nor shall a locked motor prevent manual operation. Motor or manual selection shall be accomplished by a positive declutching knob or lever which will disengage the motor and motor gearing mechanically but not electrically. Prohibit manual and motor simultaneously operation. Hand operation shall not require more than 100 pounds of rim effort at maximum torque.
 - a. Valves installed more than 10 feet above the floor shall include a chain-wheel operator with a rope to engage the declutching knob or lever from the floor as shown on the drawings.
 9. Hammer Blow Device: Electric actuators shall be provided with a built-in lost-motion device that allows sufficient travel of the worm gear, prior to engaging the stem nut, for the motor to reach full speed. This action shall impart a "hammer blow" to start the valve or gate in motion in either direction. The load shall be shared equally by two lugs cast integrally on the drive sleeve.
 10. Conduit Openings: Electric actuators shall be provided with power conduit opening and control conduit opening.
 11. Actuator Orientation: Actuators in the West Gallery shall have components oriented so the that operation of the manual operator and declutch lever can be done as specified in paragraph 3.01 Powered Actuators.

2.03 ACTUATOR APPURTENANCES

A. Identification Tags:

1. Each powered actuator shall be provided with a 16-gage stainless steel identification tag that bear the equipment description and tag number of the actuator, as specified. Characters shall be 1/4 inch, die-stamped. Identification tags shall be securely attached to the actuator in a readily visible location using stainless steel screws or wire.

2.04 PRODUCT DATA

- ### **A. The following information, and technical data for all equipment specified in this section shall be provided in accordance with Section 01 33 00.**
1. Testing procedures and forms specified in paragraph 3.02 General Requirements.
 2. Training Certification.
 3. Operating and maintenance data.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Installation shall be as specified herein. Valve actuators shall be located so that they are readily accessible for operation and maintenance.
 - a. Valve actuator support systems shall not be attached to handrails, process piping, or mechanical equipment.
 - b. Valve actuators mounting shall not be located where shock or vibration will impair their operation.

B. Powered Actuators:

1. General: Powered actuators shall have the operation of their manual operating accessory, where possible, located between 48 inches and 60 inches above the floor or a permanent work platform
 - a. Manual operating accessory shall be a chainwheel and declutch mechanism.
 - b. Actuators shall be oriented to allow operation of declutch mechanism via a heavy-duty polyester cord accessible between 48 inches and 60 inches above the floor.
 - c. The clutch shall automatically re-engage for automatic operation when the actuator is motorized.
2. Identification Tags: Tags shall be located in a clearly visible location on the valves. If necessary, reposition and reattachment with stainless steel screws or wire.

3.02 TESTING

A. General Requirements:

1. Testing shall be performed in accordance with Section 01 45 23, and this section. No required test shall be applied without prior notice to the Construction Manager to witness any test. At least 14 days before the commencement of any testing activity, a detailed step-by-step test procedure, complete with forms for the recording of test

results shall be provided. All equipment necessary to perform the required tests shall be provided.

3.03 TRAINING

- A. Operation and maintenance training for the equipment provided under this section shall be provided for the Owner's personnel. Training shall be certified on Form 43 05 11-B specified in Section 01 99 90.

3.04 ACTUATOR SPECIFICATION (ACTUSPEC) SHEET

Actuator Type: EQTI - 460 Vac, 3-Phase, 60-Hertz

Description: Electric Quarter-turn Isolation valve actuator

Construction: Actuators shall be Limitorque Type L120, with "T" Series 90 degree gear actuator or Limitorque electronic model MXA; modified as necessary to provide the specified features and to meet the specified operating requirements.

Gear Box: 90-degree gear actuator.

Controller: An unfused disconnect type combination starter in compliance with NEMA ICS.

Controls: Control power shall be provided by an integral 120 volts AC, single-phase control transformer. The transformer shall be sized to operate at not more than 80 percent of rating with the connected load shown. The transformer shall have protective secondary fusing.

Actuators shall be provided with an integral control station that includes an "OPEN" pushbutton, a "CLOSE" pushbutton, and a "STOP" pushbutton.

Momentary operation of the "OPEN" or "CLOSE" pushbutton shall cause the actuator to drive the valve or gate to the appropriate limit.

Momentary operation of the "STOP" pushbutton shall cause the actuator to stop. Terminals for remote "OPEN" and "CLOSE" pushbuttons shall be provided.

Position Switches:

Actuators shall be provided with a minimum of two rotor-type switch assemblies containing a minimum of 8 contacts. When shown on the electrical drawings, the actuator shall have 16 contacts, 4 on each of 4 rotors.

Position switches shall be heavy-duty, open-contact type, with rotary wiping action. Contacts shall be rated at 3 amps at 120 volts AC. Position switches and gearing shall be an integral part of the actuator. Position switch gearing shall be of the intermittent type and shall allow switch set

points to be set at any point of travel between fully open and fully closed.

Switches shall not be subject to breakage or slippage due to over-travel. The position switch assembly shall be enclosed in its own housing.

END OF SECTION

SECTION 40 05 64
BUTTERFLY VALVES

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. This section specifies butterfly valves for air, gas, steam and water service.

1.02 REFERENCES

- A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings
ASTM A48	Gray Iron Castings
ASTM A108	Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A216/A216M	Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service
ASTM A276	Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A436	Austenitic Gray Iron Castings
ASTM A536	Ductile Iron Castings
AWWA C504	Rubber-Seated Butterfly Valves

PART 2 PRODUCTS

2.01 GENERAL PURPOSE AWWA BUTTERFLY VALVES – NOT USED

2.02 HIGH PERFORMANCE WAFER-STYLE BUTTERFLY VALVES

- A. Manufacturers: One of the following:

1. DeZurik BHP
 2. Neles-Jamesbury 815LO
 3. Tyco-Keystone K-LOK Figure 362
 4. Or equal; substitutions as approved by Owner
- B. Cleaning and handling: Clean, seal, package, and handle valves for air service in strict accordance with CGA Standard G-4.1.
- C. Valve body:
1. Material: Type 316 stainless steel, ASTM A 351, Grade CF8M.
 2. Body design: Wafer style body with boltholes in accordance with ASME B16.1, Class 125 and Class 150 flange drilling dimensions.
- D. Disc:
1. Offset disc.
 2. Material: Type 316 stainless steel, ASTM A 351, Grade CF8M.
- E. Shaft and bearings:
1. Shaft: Type 316 stainless steel.
 2. Shaft bearings: Self-lubricating sleeve type, Teflon with stainless steel or fiberglass backing.
- F. Disc pins: Secure valve disc to shaft by means of solid, smooth-sided, taper or dowel pins, Type 316 stainless steel:
1. Extend pins through shaft and mechanically secure in place.
- G. Seats:
1. Material: Teflon, or Teflon with titanium back-up ring.
 2. Seat retainer insert: Type 316 stainless steel.
- H. Valve shaft packing:
1. Adjustable V-ring Teflon packing with Type 316 stainless steel packing gland.

2.03 OPERATORS

- A. General:
1. Valves shall have powered actuators in accordance with this section and Section 40 05 57.23.
- B. Type:
1. Manual operators for valves shall be of the traveling nut, rack and pinion, or worm gear type. Operators shall be equipped with adjustable mechanical stop-limiting devices to prevent overtravel of the disc in the open and closed positions and shall be self-locking and designed to hold the valve in any intermediate position between full open and full closed. Valve operator components shall withstand an input torque of 300 ft-lbs at the extreme operator positions without damage. A handwheel or chain wheel shall be provided for each operator as required in Section 40 05 57.23.

2.04 COATING – NOT USED

PART 3 EXECUTION

3.01 INSTALLATION

- A. Valves shall be installed in accordance with the manufacturer's recommendations.
- B. Install valves with valve shafts horizontal, unless a vertical shaft is required to suit a particular installation, and unless a vertical shaft is indicated on the Drawings.
- C. Install pipe spools or valve spacers in locations where butterfly valve disc travel may be impaired by adjacent pipe lining, pipefittings, valves, or other equipment.

END OF SECTION

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SECTION 40 71 00
FLOW MEASUREMENT

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section specifies requirements for instrumentation elements that quantitatively convert the measured variable energy into a form suitable for measurement and process measurement accessories.
- B. This section specifies requirements for process parameter transmitters, associated indication devices, and accessories.
- C. This section specifies requirements for process activated switches, devices, and accessories.

1.02 REFERENCES

- A. Reference Standards:
 - 1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section prevail.
 - 2. Unless otherwise specified, references to documents mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids).
 - 3. If referenced documents have been discontinued by the issuing organization, references to those documents mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.
 - 4. Where document dates are given in the following listing, references to those documents mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
IEEE 100	Standard Dictionary of Electrical and Electronics Terms
ISA S20	Specification Forms for Process Measurement and Control Instrumentation, Primary Elements, and Control Valves
ISA S51.1	Process Instrumentation Terminology
ISA TR20.00.01	Specification Forms for Process Measurement and Control Instruments Part 1: General Considerations
NEMA ICS 1	General Standards for Industrial Control and Systems

1.03 QUALITY ASSURANCE

- A. Manufacturer: Equipment furnished under this section shall be the products of firms regularly engaged in the design and manufacture of such equipment for a minimum of five years.
- B. Installer: Installation, calibration and testing of equipment furnished under this section shall be performed by qualified, skilled, Certified Technicians who are regularly engaged in such activities involving systems of similar complexity.

1.04 ENVIRONMENTAL CONDITIONS

- A. Equipment provided under this section shall be suitable for operation under ambient conditions described in Section 01 11 80.

1.05 SUBMITTALS

- A. Submittals shall be provided as specified in Sections 01 33 00, including:
 - 1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
 - 2. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.
 - a. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.
 - b. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 - 3. A copy of the contract document Control Diagrams and Process and Instrumentation Diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.
 - 4. If no changes are required, the drawing or drawings shall be marked "no changes required". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.
 - 5. Marked Contract Document Mechanical and/or Electrical Plan drawings, sections, and details showing sensor installation locations and details. Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.
 - a. Marked product literature of all equipment and features to be provided.

- b. Installation drawings for only the transmitters, sensors, and mounting accessories to be provided.
 - c. Electrical and signal connection drawings for only the transmitters and sensors to be provided.
 - d. List of miscellaneous items, cables, spare parts, that will be provided in accordance with INSTRUSPEC sheet requirements.
 - e. Marked product literature for surge protectors.
- B. Marked product literature of all equipment and features.
 - C. Installation details for the process switches and mounting accessories.
 - D. Electrical and signal connection drawings for process switches and devices.

PART 2 PRODUCTS

2.01 INSTRUMENTATION SPECIFICATION SHEETS (INSTRUSPEC)

- A. General requirements for instruments specified in this section are specified on the INSTRUSPEC sheets in the Appendix at the end of this section.
- B. Application requirements are specified in the Instrument Index, and/or on the drawings.

2.02 SYSTEM EQUIPMENT

- A. General:
 - 1. In accordance with Section 01 33 00, the General Conditions of the Contract Documents, drawings, information, and technical data for all equipment as, required in this section shall be provided. All required product data for this section shall be included in one complete package.
- B. Process switches and devices shall comply with the following requirements:
 - 1. Contact outputs used for alarm actuation shall be normally-closed or normally-opened as required by the process condition to open to initiate the alarm.
 - 2. Contact outputs used to control equipment shall be normally-opened and shall close to start the equipment.
 - 3. Contacts monitored by solid state equipment such as programmable controllers or annunciators shall be hermetically sealed and rated for switching currents from 20 to 100 mA at 24 volts DC.
 - 4. Contacts, monitored by electromagnetic devices such as mechanical relays, shall be rated as NEMA ICS 2, designation B300.
 - 5. Double barriers provided between switch elements and process fluids such that failure of one barrier will not permit process fluids into electrical enclosures.
 - 6. Switch electrical enclosures rated as NEMA 250, Type 4 minimum.
 - 7. Switch range shall be selected so that the specified set point is at least 30 percent but not more than 70 percent of the span, between the upper range limit and the lower range limit.
- C. Measuring elements and transmitters shall comply with the following requirements:

1. Measured parameter output indicators complying with any transmitter that does not include an integral indicator. Indicators, whether integral or separate, shall be calibrated in process units, and engraved on the indicator scale plate.
2. The two-wire type transmitters shall have operating power derived from the signal transmission circuit.
3. Transmitters shall meet specified performance requirements with load variations within the range of 0 to 600 with the power supply at a nominal 24 volts DC with the default range of 0 to 100% corresponding to 4 to 20 madc.
4. Transmitter output shall increase with increasing measurement.
5. Time constant shall be adjustable from 0.5 to 5.0 seconds for transmitters used for flow, level transmitters used for flow measurement, or pressure measurement.
6. Transmitter output shall be galvanically isolated via electro-mechanical or optical technology.
7. Transmitter enclosures shall be rated NEMA 250, Type 4, unless otherwise specified.
8. Two-wire transmitter located in a facility area classified as hazardous per the NFPA and the NEC shall be made safe by means of an intrinsic safety barrier as specified.
9. Four-wire transmitters shall be isolated from the process and power or provided with a loop-powered signal current isolator connected in the output signal circuit.

2.03 PROCESS PARAMETER OUTPUT INDICATOR

- A. Provide digital LED or LCD indicators that integral to the instrument housing where available from the manufacturer. Displays shall be scaled in engineering units, over the calibrated range of the instrument. Calibrate the indicator scale in process units.
- B. Analog output indicators shall be 2.5-inch milli-ammeter with 90-degree movement enclosed in a NEMA 7/9 rated meter case. Provide indicators with accuracy within two percent of span. Provide a diode to maintain loop continuity for indicator removal.

2.04 NOT USED

2.05 SIGNAL CURRENT ISOLATOR

- A. Isolator shall provide galvanic isolation of milliampere transmission signals from transmitters. Isolator shall be housed in a NEMA 250, Type 4/7 conduit body and derive operating power from the signal input circuit.
- B. Input and output signals shall be 4 to 20 milliamperes, and error shall not exceed 0.1 percent of span. Input resistance shall not exceed 550 ohms with an output load of 250 ohms.
- C. Isolator shall be Moore Industries SCX 4-20madc to 4-20madc / 5.5VPL / -RF DIN rail mounted with maximum 250 ohm output impedance, or equal.

2.06 PRODUCT DATA

- A. Additional Information:
 1. The following product data shall be provided:
 - a. Flow calculation for each differential-type flow element.

- b. Record documentation shall include the data sheets specified in this section.
- B. The following data provided in accordance with Section 01 33 00:
- 1. Operating and maintenance information. Including final reviewed submittal and separate record of all final configuration, jumper, and switch settings for each instrument.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Process Connections:
- 1. Process taps shall comply with API RP551. Root valves shall be provided at taps, except temperature taps and pump discharge pressure taps. Process connections shall be arranged such that instruments may be readily removed for maintenance without disruption of process units or draining of large tanks or vessels.
 - 2. Unions or flange connections shall be provided as necessary to permit removal without rotating equipment. Where process taps are not readily accessible from instrument locations, a block valve shall be provided at the instrument. Block valves shall also be provided for each instrument where multiple instruments are connected to one process tap.
- B. Electrical Connections:
- 1. Final connections between rigid raceway systems and instruments shall be made with jacketed flexible conduit with a maximum length of 2 feet.

3.02 INSTALLATION

- A. General:
- 1. General requirements for the installation of primary elements specified in this section are listed on INSTRUSPEC sheets.
- B. Process Connections:
- 1. General: Unless otherwise specified, process taps shall comply with Section 40 05 01. Process connections shall be arranged such that instruments may be readily removed for maintenance without disruption of process units or draining of large tanks or vessels. Unions or flange connections shall be provided as necessary to permit removal without rotating equipment.
 - a. Where process taps are not readily accessible from instrument locations, an isolation valve shall be provided at the instrument.
 - b. Isolation valves shall be provided for each instrument where multiple instruments are connected to one process tap.
 - c. Pipe between the process connection and instruments shall be 1/2-inch stainless steel with treatment material for easy removal, as specified herein.
 - 2. Safety Instruments: No valves shall be installed at pressure taps for safety instruments. Safety instruments shall not be connected to the same process tap as instruments used for control, indication, or recording except when annular chemical seals are used.
 - 3. Root Valves: Root valves shall be provided at all process taps, except as follows:

- a. Temperature taps, where valves are unnecessary.
 - b. Pump discharge pressure taps where no instrument is permanently
 - c. installed. Isolation valves shall be provided.
 - d. Process taps for safety instruments.
 - e. Where gauge valves are provided.
 - f. Where chemical seals are used.
4. Gauge Valves: Gauge valves shall be provided for each pressure gauge tap except where chemical seals are used.

C. Tubing:

1. Tubing shall be installed on supports spaced not more than 3 feet apart and shall run parallel of perpendicular to walls structural members, or intersections of vertical planes and the ceiling. Unless otherwise shown, tubing shall follow building surfaces closely or shall be carried in trays or conduit.
2. Tubing shall not be supported from piping or equipment except at process taps or connections to the device served. Tubes supported directly on concrete surfaces shall be spaced at least 1/8 inch from the concrete. Tubing support shall be one-hole malleable iron clamps with clamp backs as required. Bends shall be formed to uniform radii without flattening.
3. Ends of tubing shall be square-cut and de-burred before installation in fittings. Fittings shall be used for splices, connections, and turns near final connections. Bulkhead fittings shall be used when tubing enters a panel.

D. Electrical Connections:

1. Final connections between rigid raceway systems and instruments shall be made with jacketed flexible conduit with a maximum length of 2 feet.

3.03 TESTING

A. Perform tests for each area or system in the following sequence:

1. Performance testing
2. Loop testing
3. Functional testing
4. Operational testing

B. Group equipment and I/O based on the relationship of the equipment to operate safely as specified, including full automatic and manual control and monitoring through the control system. Equipment and I/O in a given area or system shall pass testing prior to proceeding to the next set of tests in the sequence above.

3.04 PROCESS CONNECTIONS:

1. Process connection piping and tubing shall be tested in accordance with Section 40 05 01.

PART 4 APPENDIX - INSTRUSPECS

4.01 INSTRUSPECS

- A. General requirements for instruments specified in this section are listed on INSTRUSPEC sheets herein. Application requirements are specified in the Instrument Index, and/or on the drawings.

Table A

INSTRUSPEC Symbol	Instrument description	Instrument function
FAPT	Averaging Pitot Tube (Annubar) Flow Transmitter	Flow Measurement

4.02 INSTRUMENT IDENTIFICATION: FAPT

- A. Instrument Function: Flow Measurement
- B. Instrument Description: Averaging Pitot Tube (Annubar) with remote readout
- C. Power Supply: As specified in paragraph 2.02.
- D. Signal Input: Process
- E. Signal Output: Analog transmission signal as specified in paragraph 2.02.
- F. Process Connection: flanged.
- G. Product Requirements:
1. Signal Converter/Transmitter:
 2. Indicator: LCD indicator, scaled in engineering units, capable of scrolling to display flowrate, pressure, temperature, or analog output, as configured.
 3. Accuracy: $\pm 1\%$ of flowrate of gas or steam.
 4. Analog Outputs: One 4-20 mA into a minimum of 600Ω .
 5. Networks: HART protocol.
 6. Enclosure: NEMA 4X remote mount
 7. Temperature Limits: -40 to 185 °F.
 8. Accessories: Provide all necessary mounting hardware and interconnecting cable length, as required. Provide handheld programming device, or programming software and cable length as required.
 9. Acceptable Manufacturer:
 - a. Rosemount 3051CFA with remote readout Rosemount 751A ma.
 - b. Accepted equal.
- H. Sensor:
1. Type: Averaging pitot tube (Annubar) with an integral RTD and remote readout.
 2. Process Connection: flanged
 3. Temperature Limits: up to 500 °F.
 4. Wetted Materials: 316 SS

- I. Execution:
 - 1. Installation: Install in accordance with manufacturer's instructions.
 - a. Install conduit from remote redout to sensor as shown on the drawings.
 - 2. Transmitter and sensing element assembled by the manufacturer and supplied as a unit.

END OF SECTION

SECTION 40 05 65.29
DOUBLE-DISK CHECK VALVES

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section specifies flapper type (double leaf) check valves of the center pivot, flapper type (double leaf), spring type. The valve shall fit as a wafer or flange between piping flanges.

1.02 REFERENCES

- A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A276	Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A278	Gray Iron Castings for Pressure Containing Parts for Temperatures up to 650 Degrees F
ASTM A351/A351M	Steel Castings, Austenitic for High-Temperature Service

PART 2 PRODUCTS

2.01 ACCEPTABLE PRODUCTS

- A. Valves shall be Flexi-Hinge Valve Co., Inc., Flexi-Hinge check valve series, or equal.

2.02 MATERIALS

- A. Valve design:
 - 1. Dual valve plates with replaceable elastomeric member which acts as both a hinge and a seal.
 - 2. Elastomeric member secured to valve plates with clamping plates and fasteners.

3. Full port, seatless and springless design. Eliminate leakage when valve plates are fully closed with elastomeric member in full contact with interior surface of valve port.
4. Flanged ASME Class 125 end connections or wafer style valve body.

B. Materials of construction shall be as follows:

Component	Material
Body	Stainless Steel, ASTM A351, Type 316
Disc	Aluminum bronze
Seal	Silicone
Spring, hinge pin and stop pin	No spring

C. Materials specified are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least the same qualities as those specified for the purpose.

2.03 MANUFACTURE

- A. End connections shall be flat or plain faced. Seating shall be resilient.
- B. Unless otherwise specified, valves shall, as a minimum, conform to the following pressure ratings:

<u>Working pressure, psig</u>
<u>150</u>

2.04 PRODUCT DATA

- A. Manufacturer's product data shall be provided in accordance with Section 01 33 00.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Flapper type (double leaf) check valves shall be installed in accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 40 73 00
PRESSURE, STRAIN, AND FORCE MEASUREMENT

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section specifies requirements for instrumentation elements that quantitatively convert the measured variable energy into a form suitable for measurement and process measurement accessories.
- B. This section specifies requirements for process parameter transmitters, associated indication devices, and accessories.
- C. This section specifies requirements for process activated switches, devices, and accessories.

1.02 REFERENCES

- A. Reference Standards:
 - 1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section prevail.
 - 2. Unless otherwise specified, references to documents mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids).
 - 3. If referenced documents have been discontinued by the issuing organization, references to those documents mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.
 - 4. Where document dates are given in the following listing, references to those documents mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
IEEE 100	Standard Dictionary of Electrical and Electronics Terms
ISA S20	Specification Forms for Process Measurement and Control Instrumentation, Primary Elements, and Control Valves
ISA S51.1	Process Instrumentation Terminology
ISA TR20.00.01	Specification Forms for Process Measurement and Control Instruments Part 1: General Considerations
NEMA ICS 1	General Standards for Industrial Control and Systems

1.03 QUALITY ASSURANCE

- A. Manufacturer: Equipment furnished under this section shall be the products of firms regularly engaged in the design and manufacture of such equipment for a minimum of five years.
- B. Installer: Installation, calibration and testing of equipment furnished under this section shall be performed by qualified, skilled, Certified Technicians who are regularly engaged in such activities involving systems of similar complexity.

1.04 ENVIRONMENTAL CONDITIONS

- A. Equipment provided under this section shall be suitable for operation under ambient conditions described in Section 01 11 80.

1.05 SUBMITTALS

- A. Submittals shall be provided as specified in Sections 01 33 00, including:
 - 1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
 - 2. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.
 - a. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.
 - b. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 - 3. A copy of the contract document Control Diagrams and Process and Instrumentation Diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.
 - 4. If no changes are required, the drawing or drawings shall be marked "no changes required". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.
 - 5. Marked Contract Document Mechanical and/or Electrical Plan drawings, sections, and details showing sensor installation locations and details. Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.
 - a. Marked product literature of all equipment and features to be provided.

- b. Installation drawings for only the transmitters, sensors, and mounting accessories to be provided.
 - c. Electrical and signal connection drawings for only the transmitters and sensors to be provided.
 - d. List of miscellaneous items, cables, spare parts, that will be provided in accordance with INSTRUSPEC sheet requirements.
 - e. Marked product literature for surge protectors.
- B. Marked product literature of all equipment and features.
 - C. Installation details for the process switches and mounting accessories.
 - D. Electrical and signal connection drawings for process switches and devices.

PART 2 PRODUCTS

2.01 INSTRUMENTATION SPECIFICATION SHEETS (INSTRUSPEC)

- A. General requirements for instruments specified in this section are specified on the INSTRUSPEC sheets in the Appendix at the end of this section.
- B. Application requirements are specified in the Instrument Index, and/or on the drawings.

2.02 EQUIPMENT

- A. General:
 - 1. In accordance with Section 01 33 00 the General Conditions of the Contract Documents, drawings, information, and technical data for all equipment as required in this section shall be provided. All required product data for this section shall be included in one complete package.
- B. Process switches and devices shall comply with the following requirements:
 - 1. Contact outputs used for alarm actuation shall be normally-closed or normally-opened as required by the process condition to open to initiate the alarm.
 - 2. Contact outputs used to control equipment shall be normally-opened and shall close to start the equipment.
 - 3. Contacts monitored by solid state equipment such as programmable controllers or annunciators shall be hermetically sealed and rated for switching currents from 20 to 100 mA at 24 volts DC.
 - 4. Contacts, monitored by electromagnetic devices such as mechanical relays, shall be rated as NEMA ICS 2, designation B300.
 - 5. Double barriers provided between switch elements and process fluids such that failure of one barrier will not permit process fluids into electrical enclosures.
 - 6. Switch electrical enclosures rated as NEMA 250, Type 4 minimum.
 - 7. Switch range shall be selected so that the specified set point is at least 30 percent but not more than 70 percent of the span, between the upper range limit and the lower range limit.
- C. Measuring elements and transmitters shall comply with the following requirements:

1. Measured parameter output indicators shall be provided with any transmitter that does not include an integral indicator. Indicators, whether integral or separate, shall be calibrated in process units, and engraved on the indicator scale plate.
2. The two-wire type transmitters shall have operating power derived from the signal transmission circuit.
3. Transmitters shall meet specified performance requirements with the power supply at a nominal 24 volts DC with the default range of 0 to 100% corresponding to 4 to 20 madc.
4. Transmitter output shall increase with increasing measurement.
5. Time constant shall be adjustable from 0.5 to 5.0 seconds for transmitters used for flow, level transmitters used for flow measurement, or pressure measurement.
6. Transmitter output shall be galvanically isolated via electro-mechanical or optical technology.
7. Transmitter enclosures shall be rated NEMA 250, Type 4, unless otherwise specified.
8. Two-wire transmitter located in a facility area classified as hazardous per the NFPA and the NEC shall be made safe by means of an intrinsic safety barrier as specified.
9. Four-wire transmitters shall be isolated from the process and power or provided with a loop-powered signal current isolator connected in the output signal circuit.

2.03 PROCESS PARAMETER OUTPUT INDICATOR

- A. Provide digital LED or LCD indicators integral to the instrument housing where available from the manufacturer. Displays shall be scaled in engineering units, over the calibrated range of the instrument. Calibrate the indicator scale in process units.
- B. Analog output indicators shall be 2.5-inch milli-ammeter with 90-degree movement enclosed in a NEMA 7/9 rated meter case. Provide indicators with accuracy within two percent of span. Provide a diode to maintain loop continuity for indicator removal.

2.04 NOT USED

2.05 SIGNAL CURRENT ISOLATOR

- A. Isolator shall provide galvanic isolation of milliampere transmission signals from transmitters. Isolator shall be housed in a NEMA 250, Type 4/7 conduit body and derive operating power from the signal input circuit.
- B. Input and output signals shall be 4 to 20 milliamperes, and error shall not exceed 0.1 percent of span. Input resistance shall not exceed 550 ohms with an output load of 250 ohms.
- C. Isolator shall be Moore Industries SCX 4-20madc to 4-20madc / 5.5VPL / -RF DIN rail mounted with maximum 250 ohm output impedance, or equal.

2.06 PRODUCT DATA

- A. Additional Information: The following product data shall be provided:
 1. Flow calculation for each differential-type flow element.
 2. Record documentation shall include the data sheets specified in this section.

- B. The following data provided in accordance with Section 01 33 00:
 - 1. Operating and maintenance information including final reviewed submittal and separate record of all final configuration, jumper, and switch settings for each instrument.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Process Connections:
 - 1. Process taps shall comply with API RP551. Root valves shall be provided at taps, except temperature taps and pump discharge pressure taps. Process connections shall be arranged such that instruments may be readily removed for maintenance without disruption of process units or draining of large tanks or vessels.
 - 2. Unions or flange connections shall be provided as necessary to permit removal without rotating equipment. Where process taps are not readily accessible from instrument locations, a block valve shall be provided at the instrument. Block valves shall also be provided for each instrument where multiple instruments are connected to one process tap.
- B. Electrical Connections: Final connections between rigid raceway systems and instruments shall be made with jacketed flexible conduit with a maximum length of 2 feet.

3.02 INSTALLATION

- A. General:
 - 1. General requirements for the installation of primary elements specified in this section are listed on INSTRUSPEC sheets.
- B. Process Connections:
 - 1. General: Unless otherwise specified, process taps shall comply with Section 40 05 01. Process connections shall be arranged such that instruments may be readily removed for maintenance without disruption of process units or draining of large tanks or vessels. Unions or flange connections shall be provided as necessary to permit removal without rotating equipment.
 - a. Where process taps are not readily accessible from instrument locations, an isolation valve shall be provided at the instrument.
 - b. Isolation valves shall be provided for each instrument where multiple instruments are connected to one process tap.
 - c. Pipe between the process connection and instruments shall be 1/2-inch stainless steel with treatment material for easy removal, as specified herein.
 - 2. Safety Instruments: No valves shall be installed at pressure taps for safety instruments. Safety instruments shall not be connected to the same process tap as instruments used for control, indication, or recording except when annular chemical seals are used.
 - 3. Root Valves: Root valves shall be provided at all process taps, except as follows:
 - a. Temperature taps, where valves are unnecessary.
 - b. Pump discharge pressure taps where no instrument is permanently

- c. installed. Isolation valves shall be provided.
 - d. Process taps for safety instruments.
 - e. Where gauge valves are provided.
 - f. Where chemical seals are used.
4. Gauge Valves: Gauge valves shall be provided for each pressure gauge tap except where chemical seals are used.

C. Tubing:

- 1. Tubing shall be installed on supports spaced not more than 3 feet apart and shall run parallel or perpendicular to walls structural members, or intersections of vertical planes and the ceiling. Unless otherwise shown, tubing shall follow building surfaces closely or shall be carried in trays or conduit.
- 2. Tubing shall not be supported from piping or equipment except at process taps or connections to the device served. Tubes supported directly on concrete surfaces shall be spaced at least 1/8 inch from the concrete. Tubing support shall be one-hole malleable iron clamps with clamp backs as required. Bends shall be formed to uniform radii without flattening.
- 3. Ends of tubing shall be square-cut and de-burred before installation in fittings. Fittings shall be used for splices, connections, and turns near final connections. Bulkhead fittings shall be used when tubing enters a panel.

D. Electrical Connections:

- 1. Final connections between rigid raceway systems and instruments shall be made with jacketed flexible conduit with a maximum length of 2 feet.

3.03 TESTING

A. Perform tests for each area or system in the following sequence:

- 1. Performance testing
- 2. Loop testing
- 3. Functional testing
- 4. Operational testing

B. Group equipment and I/O based on the relationship of the equipment to operate safely as specified, including full automatic and manual control and monitoring through the control system. Equipment and I/O in a given area or system shall pass testing prior to proceeding to the next set of tests in the sequence above.

3.04 PROCESS CONNECTIONS:

- A. Process connection piping and tubing shall be tested in accordance with Section 40 05 01.

PART 4 APPENDIX - INSTRUSPECS

4.01 INSTRUSPECS

- A. General requirements for instruments specified in this section are listed on INSTRUSPEC sheets herein. Application requirements are specified in the Instrument Index, and/or on the drawings.

Table A

INSTRUSPEC Symbol	Instrument description	Instrument function
AFPG	Air Filter Pressure gage	Pressure Measurement
PGT	Gage Pressure Transmitter	Pressure Measurement

4.02 INSTRUMENT IDENTIFICATION: AFPG

- A. Instrument Function: Pressure measurement
- B. Instrument Description: Air Filter Pressure gage
- C. Power Supply: N/A
- D. Signal Input: N/A
- E. Signal Output: N/A
- F. Process Connection: 1/8-inch male NPT
- G. Product Requirements: Pressure gages shall measure up to 20 inches of water with reset button. Pressure gage manufactures:
1. Fluid Technology 81-1234
 2. or equal.
- H. Execution:
1. Installation: Install in accordance with manufacturer's instructions and the recommendations of API RP551 to the specified requirements.
Unless otherwise specified, pressure instruments shall be located as close as practical to the process tap but shall be positioned to permit observation and maintenance. Pressure gages may be supported from the process tap if this location permits observation from the floor or a permanent work platform.

4.03 INSTRUMENT IDENTIFICATION: PGT

- A. Instrument Function: Pressure Measurement
- B. Instrument Description: Gage Pressure Transmitter
- C. Power Supply: As specified in paragraph 2.02
- D. Signal Input: Process

- E. Signal Output: Analog transmission signal as specified in paragraph 2.02
- F. Process Connection: 1/2-inch female NPT flange adapter
- G. Product Requirements:
 - 1. Pressure Transmitter: Capacitance or piezoresistive type.
 - 2. Wetted Parts: Type 316 stainless steel.
 - 3. Range: 100:1.
 - 4. Accuracy: 0.075 percent of calibrated span.
 - 5. Static Pressure Rating: 2,000 psi.
 - 6. Indicator: LCD display.
 - 7. HART standard data communication protocol
 - 8. Acceptable Manufacturer:
 - a. Rosemount 3051CG.
 - b. Accepted equal.
- H. Execution:
 - 1. Installation: Install in accordance with manufacturer's instructions and the Engineer's installation detail.
 - 2. Root valves provided at all process pressure taps.
 - 3. Gauge valves provided at the instrument where the instrument is not within sight of the root valve or where two or more instruments are connected to a single tap.
 - 4. Safety instruments shall not be connected to the same process tap as instruments used for control, indication, or recording.
 - 5. Pressure instruments located as close as practical to the process tap and be positioned to permit observation and maintenance.
 - 6. Pressure instruments shall not be supported from process piping.
 - 7. Pressure instruments for use with integral seals, or remote seals and capillary tubing provided by a single manufacturer, and all components factory-assembled prior to shipping.
- I. Seals:
 - 1. Type: Diaphragm,
 - 2. Process Connection: 3-1/2 inch saddle style, flush surface or inline style.
 - 3. Diaphragm and Wetted Parts: Type 316L stainless steel unless otherwise specified.
 - 4. Upper Housing and Mounting Flange: Type 316L stainless steel. Lower Housing: Type 316 stainless steel
 - 5. Temperature Limit, High Side: -40 to 300 degrees F
 - 6. Acceptable Manufacturer:
 - a. Rosemount 1199.
 - b. Accepted equal.
- J. Capillary option:
 - 1. Seal Location: High pressure side of transmitter, direct mounting.
 - 2. Fill Fluid: DC 200 Silicone

3. Capillary Seal Connection Material: Type 316 stainless steel armored sleeving

END OF SECTION

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