SECTION 11000

EQUIPMENT GENERAL PROVISIONS

# GENERAL

## WORK OF THIS SECTION

### This section specifies the general requirements for all the equipment shown and specified in these Contract Documents. Where more stringent requirements are specified in the individual equipment specification sections, the more stringent requirements shall apply.

## REFERENCE CODES AND STANDARDS

### The Work of this section shall comply with the codes listed below. Except where the specific version is specified, the codes shall be of the latest versions:

#### California Mechanical Code, latest edition.

#### California Plumbing Code, latest edition.

#### International Fire Code

#### California Electrical Code, latest edition.

#### California Building Code 2016 (CBC)

### Except as otherwise indicated, the applicable standards of the following organizations apply to the Work of this section:

#### American Society for Testing and Materials

#### American Public Health Association

#### American National Standards Institute

#### American Society of Mechanical Engineers

#### American Water Works Association

#### American Society of Heating, Refrigerating, and Air Conditioning Engineers

#### American Welding Society

#### National Fire Protection Association

#### National Electrical Manufacturers Association

#### American Bearing Manufacturers Association

#### American Gear Manufacturers Association

#### Mechanical Power Transmission Association

#### Rubber Manufacturers association

#### Hydraulic Institute

#### Underwriters Laboratories

### The current editions of the following apply to the Work of this section:

#### AGMA 6010-E – Standard for Spur, Helical, Herringbone, and Bevel Enclosed Drives

#### ASME B16.1 – Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800

#### ASME B16.5 – Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy, and Other Special Alloys

#### ASME B18.2.2 – Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)

#### ASME B46.1 – Surface Texture

#### ASME S12.6 – Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors

#### ASME B1.20.1 – General Purpose Pipe Threads (Inch) ASME B31.1 Power Piping

#### ASME B31.3 – Process Piping

#### ASTM A36 – Standard Specification for Carbon Structural Steel

#### ASTM A48 – Specification for Gray Iron Castings

#### ASTM A108 – Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality

#### ASTM A193 – Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

#### ASTM A194 – Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

#### ASTM A283 – Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates

#### ASTM A304 – Standard Specification for Carbon and Alloy Steel Bars Subject to End-Quench Hardenability Requirements

#### ASTM A479 – Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels

#### ASTM A536 – Standard Specification for Ductile Iron Castings

#### ASTM A582 – Standard Specification for Free-Machining Stainless Steel Bars

#### ASTM B108 – Standard Specification for Aluminum-Alloy Permanent Mold Castings

#### ASTM B505 – Standard Specification for Copper Alloy Continuous Castings

#### ASTM B582 – Standard Specification for Nickel-Chromium-Iron-Molybdenum- Copper Alloy Plate, Sheet, and Strip

#### ASTM B584 – Standard Specification for Copper Alloy Sand Castings for General Applications

#### AWWA D100 – Welded Steel Tanks for Water Storage

#### AWWA C206 – Field Welding of Steel Water Pipe

#### NFPA 70 – National Electrical Code

## RELATED WORK

#### Section 01300: Shop Drawings and Submittals

#### Section 01783: Operating and Maintenance Data

#### Section 01810: Start-up Testing and Commissioning

## SUBMITTALS

### Submittals shall comply with Section 01300 and shall include the following:

#### Manufacturer's product data including catalog cuts.

#### Equipment name, identification number and specification numbers.

#### Shop drawings showing details, dimensions, anchorage details, and installation of equipment with all special fittings and appurtenances.

#### Shipping weights.

#### Calculations of equipment anchorage forces and anchorage details.

#### Certification that the single manufacturer accepts the indicated unit responsibilities.

#### Parts list with materials of construction.

#### List of installations and telephone numbers, where identical equipment has been used. At least one installation is required.

#### Documentation of experience of specialist who will perform torsional and vibration analysis.

#### Wiring and control diagrams for all equipment, panels, and instrument components.

#### Seismic anchorage calculations and details for equipment as outlined in subsection 2.03 C of this section.

#### Calculations and drawings for required revisions as outlined in subsection 2.02 B of this section.

## O&M MANUAL

### O&M manual shall comply with Section 01300, Section 01783, and shall include the following:

#### Manufacturer's catalog including installation instructions.

#### Manufacturer's operating and maintenance procedures including lubricating instructions.

#### Manufacturer's certification that products comply with the indicated requirements.

#### Certification that products have been factory-tested.

#### Certification that the Work has been field-tested and the Work complies with the indicated requirements.

#### Equipment tolerances and required clearances.

#### Electrical data including control and wiring diagrams.

#### Address and telephone number of local service representative.

## SERVICES OF MANUFACTURER

### Service of Manufacturer shall include the following:

#### Witness the installation of equipment,

#### Physical checkout; shop, field and functional testing, in accordance with Section 01810.

#### Perform field adjustments to certify that the equipment installation and operation comply with the Specifications.

### Training of DISTRICT’s Personnel:

#### A factory trained service representative of the manufacturer shall train DISTRICT’s Personnel in the operation and maintenance of the equipment, including step-by- step troubleshooting with necessary test equipment. Training shall be specific to the models of equipment provided.

#### The representative shall have at least 2 years’ experience in training. A resume for the representative shall be submitted to the CONSTRUCTION MANAGER.

#### Training shall be scheduled, on the date specified by the DISTRICT, a minimum of 4 weeks in advance of the first session.

#### Proposed training material, including detailed outlines for each lesson, training handouts and performance evaluations for each trade group indicated shall be submitted, in compliance with Section 01300, to the CONSTRUCTION MANAGER for review. All comments shall be provided via CONSTRUCTION MANAGER and shall be incorporated into the material prior to the training session.

#### Training materials shall remain with the trainees.

#### The DISTRICT may videotape the training sessions for later use.

### Service of Manufacturer shall include the following:

#### Service: The manufacturer shall have a factory-employed service staff which is able to respond in emergency situations within 24 hours during the equipment warranty period.

## FACTORY TESTING

### Product Testing: Products shall be tested at the factory in compliance with Section 01810.

## UNIT RESPONSIBILITY

### Equipment systems made up of two or more components shall be provided as a unit by a responsible manufacturer. Unless otherwise indicated, the CONTRACTOR shall obtain each system from the manufacturer of the driven equipment, which the manufacturer shall provide all components of the system to enhance compatibility, ease of construction and efficient maintenance without altering or modifying the CONTRACTOR’s responsibilities under the contract documents including selection and performance of all equipment systems as indicated.

## TORSIONAL AND VIBRATION ANALYSIS

### **Torsional Analysis:** The Contractor shall submit to the CONSTRUCTION MANAGER a torsional and lateral vibration analysis of the following equipment. The analysis shall be performed by a specialist with 5 years' experience in this type of work and approved by the CONSTRUCTION MANAGER.

#### All blowers and compressors, and pumps with drives of 50 horsepower and over.

#### All vertical pumps with universal joints and extended shafts.

#### All equipment with variable speed drives, 5 horsepower and over.

#### All other equipment where indicated.

### The torsional natural frequency of the drive train must be avoided by ±25 percent by any exciting frequency of the equipment throughout the operating range.

### **Vibration Analysis:** In the bid price the Contractor shall include at least two site visits of the above-mentioned specialist, during construction and testing of equipment, to analyze and measure the amount of equipment vibration and make his written recommendation for keeping the vibration at a safe limit. This testing shall also include an analysis of bearing temperatures of all installed equipment which should fall within the manufacturers recommended limits for normal operation.

## HORSEPOWER RATINGS

### Horsepower ratings specified and/or shown for the proposed equipment are in accordance with the best information available at the moment of design. In the event any equipment item proposed by the Contractor should require motors with larger horsepower rating than indicated on Electrical Drawings, it shall be the Contractor's responsibility to provide the proper control equipment, required modifications to motor control centers, starting equipment, feeder and branch circuit, and accessories as required to make the installation comply with the electrical code and to prevent excessive voltage drop without additional cost to the DISTRICT.

## Flow analysis

### The CONTRACTOR shall provide a flow analysis of all installed pumps to ensure design flowrates are achieved. The CONTRACTOR/manufacture shall provide all necessary equipment required to verify pump operation and functionality to meet the design specifications to the satisfaction of the DISTRICT.

## EQUIPMENT WARRANTY

### The Contractor shall furnish and replace, without cost to DISTRICT, all equipment parts that are defective or show undue wear within one (1) year from the date of Notice of Completion unless extended periods of warranty for specific pieces of equipment are specified in the specific equipment section. In addition to performance guarantees, all processes or systems shall comply with the requirements of applicable portions of the Sections of these Specifications describing those systems.

# PRODUCTS

## GENERAL

### **General:** Only products meeting the indicated requirements shall be provided.

### **Manufacturers:** Products shall be new, of current manufacture, with full manufacturer’s warranty from date of commissioning and shall be the products of reputable manufacturers specializing in the manufacture of such products.

### **Products:** Materials shall be suitable for the intended purpose and free of defects and shall be recommended by the manufacturer for the application indicated.

## GENERAL REQUIREMENTS

### **Arrangement:** The arrangement of equipment shown on the drawings is based upon information available to the DISTRICT at the time of design and is not intended to show exact dimensions peculiar to a specific manufacturer. The drawings are, in part, diagrammatic, and some features of the illustrated equipment installation may require revisions to meet actual equipment installation requirements. Where in the notes in the Drawings and Specifications indicate that the arrangement, dimensions, elevations and design data are provided “for information only”, those notes have the same meaning as this paragraph.

### External supports, foundations, connected piping and valves shown may have to be revised from original design documents to accommodate the equipment provided. The Contractor will be responsible for the design and construction of such revisions. No additional payment will be made to Contractor for such revisions and associated construction. Substantiating calculations and drawings shall be submitted to CONSTRUCTION MANAGER for review and approval prior to beginning the work.

### **Noise Level:** When in operation, no piece of equipment shall exceed the OSHA noise level requirements for a one-hour exposure.

### **Service Factors:** Service factors shall be applied in the selection and design of mechanical power transmission components where so indicated in individual sections. When not indicated there, minimum service factors shall be 1.25, except for gears and gear drives as specified herein.

### **Welding:** Except as otherwise indicated, welding shall comply with AWWA D100 and AWWA C206 and the following:

#### Composite fabricated steel assemblies which are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds and shall prevent entrance of air or moisture.

#### Welding shall be by the metal-arc method or gas-shielded arc method described in the American Welding Society's "Welding Handbook" as supplemented by other AWS standards. Qualification of welders shall comply with AWS Standards.

#### In assembly and during welding, the component parts shall be clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall comply with the AWS code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance with uniform weld contours and dimensions. Sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

### **Identification of Equipment Items:** Each item of equipment shall have a legible identifying mark corresponding to the equipment number indicated.

### **Vibration Level:** Except as otherwise indicated, equipment subject to vibration shall be provided with restrained spring-type vibration isolators or pads complying with the manufacturer's written recommendations.

### **Shop Fabrication:** Shop fabrication shall be performed in accordance with the shop drawings.

### **Tolerances:** The variation in length of members without machine finished ends and which are to be framed shall not exceed 1/16-inch for members 30 feet or less and shall not exceed 1/8-inch for members over 30 feet.

### **Machine Finish:** The type of finish shall be the most suitable for the application in micro- inches complying with ASME B46.1. The following finishes shall be used:

#### Surface roughness of surfaces in sliding contact shall not exceed 63 micro-inches.

#### Surface roughness shall not exceed 250 micro-inches except where a tight joint is indicated.

#### Surface roughness for other mechanical parts shall not exceed 500 micro-inches.

#### Surface roughness of contact surfaces of shafts and stems which pass through stuffing boxes and contact surfaces of bearings shall not exceed 32 micro-inches.

### **Safety Devices:** The completed Work shall include all necessary permanent safety devices, such as machinery guards, emergency stops and similar items required by OSHA, Cal- OSHA, and other federal, state, and local health and safety regulations.

## EQUIPMENT COMPONENTS AND ANCHORAGE

### **Equipment Components:** Equipment components and anchorage shall be designed for static, dynamic, wind, and seismic loads.

### **Seismic Restraints:** All manufactured equipment supplied under this Contract shall be designed, constructed and anchored to resist stresses produced by seismic forces specified in this section. Equipment that does not vibrate during normal operation shall be rigidly attached. Equipment that vibrates during normal operation shall be attached by means of isolators with mechanical stops that limit movement in all directions unless it can be demonstrated by calculations that such stops are not required. Equipment or portions of equipment that move during normal operation shall be restrained with mechanical devices that prevent displacement by seismic loads unless it can be demonstrated by calculations that such restraints are not required.

### Design for seismic forces shall be as required by the latest version of the California Building Code (CBC). Seismic anchorage shall be designed and detailed by a civil or structural engineer registered in the State of California. Calculations for equipment anchorage must include all reactions at anchorage points and conclusion on the anchor size and material, available edge distance, and minimum embedment depth based on 3000 psi concrete.

### **Equipment Foundations:** Equipment foundation shall be as shown on Design Drawings.

### **Lifting Lugs:** Equipment weighing over 100 pounds shall be provided with lifting lugs.

### **Anchor Bolts:** Anchor bolts shall be Type 316 stainless steel, size as recommended by the manufacturer and verified by anchorage calculations above.

## PIPE HANGERS, SUPPORTS, AND GUIDES

### Pipe connections to equipment shall be supported, anchored, and guided to minimize stresses and loads on equipment flanges and equipment. Supports and hangers shall comply with the requirements of Section 15020.

## FLANGES AND PIPE THREADS

### Flanges on equipment shall comply with ASME B16.1, Class 125; or B16.5, Class 150, unless otherwise indicated. Threaded flanges and fittings shall have standard taper pipe threads complying with ASME B1.20.1.

## COUPLINGS

### Flexible couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to minimize shock loads. Misalignment shall not be greater than tolerances identified by manufacturer. Where required for vertical shafts, 3-piece spacer couplings or universal type couplings for extended shafts shall be installed.

### The equipment manufacturer shall recommend the size and type of coupling required for each specific application.

### Taper-lock bushings may be used where indicated.

### Where universal type couplings are indicated, they shall be of the needle bearing type construction, equipped with commercial type grease fittings.

## SHAFTING

### **General:** All shafting shall be continuous between bearings and shall be sized properly to transmit the power required. Keyways shall be provided in accordance with standard practice.

### **Materials:** Shafting materials shall be selected for the type of service and torque transmitted and the effect of corrosive gases, moisture, and fluids shall be considered. Materials shall conform to the following:

#### **Low carbon cold-rolled steel shafting:** ASTM A108, Grade 1018.

#### **Medium carbon cold-rolled shafting:** ASTM A108, Grade 1045.

#### **Corrosion-resistant shafting:** Stainless steel or Monel, whichever is most suitable for the intended service.

### **Differential Settlement:** Where differential settlement between the driver and the driven equipment is indicated, an extension shaft with 2 sets of universal type couplings shall be provided.

## BEARINGS

### Bearings shall conform to the standards of the American Bearing Manufacturers Association (ABMA).

### Bearing selection shall include the following criteria: fitting practice, mounting, lubrication, sealing, static rating, and housing strength.

### Re-lubricatable type bearings shall be equipped with a hydraulic grease fitting in an accessible location.

### All lubricated-for-life bearings shall be factory-lubricated with the manufacturer's best recommended grease to ensure maximum bearing life and best performance.

### Except where otherwise indicated, bearings of process equipment shall have a minimum L- 10 life expectancy of 50,000 hours for intermittent service, and 100,000 hours for continuous service, with the exception of commercially manufactured appliances, small package heating and air conditioning equipment, which shall be furnished with the bearings with L- 10 life expectancy of not less than 20,000.

### Bearing housings shall be of cast iron or steel and the bearing mounting arrangement shall be in accordance with the published standards of the manufacturer. Split-type housings may be used.

### Sleeve-type bearings shall have a Babbitt or bronze liner.

## GEARS AND GEAR DRIVES

### Except as otherwise indicated, gears shall be of the helical or spiral-bevel type, designed and manufactured in accordance with AGMA Standards, with a minimum service factor of 1.7, a minimum L-10 bearing life of 60,000 hours and a minimum efficiency of 94 percent. Worm gears shall not be used.

### Gear speed reducers or increasers shall be of the enclosed type, oil- or grease-lubricated and fully sealed, with a breather to allow air to escape but keep dust and dirt out. The casing shall be of cast iron or heavy-duty steel construction with lifting lugs and an inspection cover for each gear train. An oil level sight glass and an oil flow indicator shall be provided and installed for easy reading.

### Gears and gear drives as part of an equipment assembly shall be shipped fully assembled for field installation.

### Material selections shall comply with AGMA values and the manufacturer's recommendations. Input and output shafts shall be properly designed for the service and load requirements. Gears shall be computer-matched for minimum tolerance variation. The output shaft shall have 2 positive seals to prevent oil leakage.

### Oil level and drain location shall be readily accessible. There shall be sufficient clearance and access for oil collection container during services of all gearboxes. Oil coolers or heat exchangers with all required appurtenances shall be included where indicated.

### Where gear drive input or output shafts connect to couplings or sprockets, the gear drive manufacturer shall supply a matching key.

## DRIVE CHAINS

### Power drive chains shall be commercial type roller chains complying with ASME standards and of materials best suited for the process fluid.

### A chain take-up or tightener shall be provided in every chain drive arrangement.

### A minimum of one connecting or coupler link shall be provided with each length of roller chain.

## SPROCKETS

### **General:** Sprockets shall be used in conjunction with chain drives and chain-type material handling equipment.

### **Materials:** Except as otherwise indicated, sprockets shall comply with the following:

#### Sprockets with 25 teeth or less, normally used as a driver, shall be medium carbon steel in the 0.40 to 0.45 percent carbon range.

#### Type A and B sprockets with 26 teeth or more, normally used as driven sprockets, shall be minimum 0.20 percent carbon steel.

#### Large diameter sprockets with Type C hub shall be cast iron conforming to ASTM A48, Class 30.

### Sprockets shall be accurately machined to ASME Standards. Sprockets shall have deep hardness penetration in tooth sections.

### Finish bored sprockets shall be provided complete with keyseat and set screws.

### Sprockets shall be of the split type or shall be provided with taper-lock bushings.

### Idler sprockets shall be provided with brass or Babbitt bushings, complete with oil hole and axial or circumferential grooving. Steel collars with set screws in both sides of the hub shall be provided.

## V-BELT DRIVES

### V-belts and sheaves shall be of the best commercial grade and shall conform to ASME, MPTA, and RMA Standards.

### Sheaves shall be machined from gray cast iron.

### Sheaves shall be statically balanced. In applications where excessive vibration is expected, sheaves shall be dynamically balanced. Sheaves operating at belt speeds exceeding 6,500 fpm shall be of materials and construction recommended by the manufacturer.

### Sheaves shall be provided complete with taper-lock or quick disconnect bushings as required.

### Finish bored sheaves shall be provided complete with keyseat and set screws.

### Sliding motor bases shall be provided to adjust the tension of V-belts.

## DRIVE GUARDS

### Power transmission, prime movers, machines, shaft extensions, and moving machine parts shall be guarded. The guards shall be constructed of minimum 10 gauge expanded, flattened stainless steel with smooth edges and corners, and securely fastened. Where required for lubrication or maintenance, guards shall have hinged and latched access doors. Guards more than four (4) feet off ground shall be fabricated of aluminum or other lightweight materials.

## FLEXIBLE CONNECTORS

### Flexible connectors shall be installed in piping connections to engines, blowers, compressors, and other vibrating equipment and in piping systems in accordance with the requirements of the ASME B31.1/ASME B31.3 as applicable. Two flexible connectors separated by a spool piece shall be provided at all locations where piping joins equipment or exits a structure.

## INSULATING CONNECTIONS

### Insulating bushings, unions, couplings, and flanges, shall comply with the requirements of Section 15000.

## GASKETS AND PACKINGS

### Gaskets shall comply with the requirements of Section 15000.

### Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron-type "V" packing shall be Garlock No. 432, John Crane "Everseal," or equal.

### Packing around rotating shafts (other than valve stems) shall be pre-formed packing rings with Teflon lantern ring or mechanical seals, as specified and recommended by the manufacturer.

## FASTENERS AND MISCELLANEOUS METALS

### All bolts dimensions shall comply with ASME B 18.2.1 and bolts’ material shall comply with ASTM A193 B8M Class 2 stainless steel AISI 316; all nuts’ dimensions shall comply with ASME B 18.2.2 and nuts’ material shall comply with ASTM A194 8M stainless steel AISI 316. Miscellaneous metals shall comply with Section 05500.

## TOOLS AND SPARE PARTS

### **Tools:** The Work includes one complete set of special tools recommended by the manufacturer for maintenance and repair of each separate type of equipment; tools shall be stored in toolboxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

### **Spare Parts:** All equipment shall be furnished with the manufacturers' recommended spare parts, or as indicated in the individual equipment sections.

### Spare parts shall be tagged by project equipment number and identified as to part number, equipment manufacturer, and subassembly component (if appropriate). Spare parts subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping. Spare parts with individual weights less than 50 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a wooden box with hinged wooden cover and locking hasp. Hinges shall be strap type. The box shall be painted and identified with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts." A neatly typed inventory of spare parts shall be taped to the underside of the cover. A complete list of all spare parts shall be provided to the DISTRICT including the following information:

#### Name of associated equipment.

#### Associated equipment number.

#### Manufacturer.

#### Manufacturer part number.

#### Supplier or local vendor.

#### Estimated cost of part.

## NAMEPLATES

### Equipment nameplates of Type 316 stainless steel shall be engraved or stamped and fastened to the equipment in accessible locations with stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings. The Contractor shall provide barcode labels stating the equipment tag as shown on the P&ID’s drawings. The barcode label shall be securely attached to the equipment by means of clip. The barcode format shall be provided by the DISTRICT.

## WIRING AND CONTROL DIAGRAMS

### Point-to-Point wiring and control diagrams shall be furnished for all equipment, panels, and instrument components in accordance with the requirements of Section 01300.

### Point-to-point wiring and control schematic diagrams shall conform to the format and content requirements contained in Section 01300.

## OVERLOAD PROTECTION

### **General:** Where indicated, mechanical or electronic overload protection devices shall be installed on equipment.

### **Mechanical System:** The overload protection shall be a mechanical device designed to provide reliable protection in the event of excessive overload. It shall be a ball detent type designed for long term repeatability and life. It shall be infinitely adjustable by a single adjusting nut which shall be tamperproof and incorporate a torque monitoring and control system. It shall activate an alarm set for 85 percent, and a motor cutout switch set for 100 percent of maximum continuous running torque. A visual torque indicator shall be provided and oriented so that it may be read from the walkway. The dial shall be calibrated from 0 to 100 percent of maximum continuous running torque. The design of the torque limiter should initiate the mechanical disengagement of the drive upon overload. Each unit shall be suitable for outdoor and corrosive environments with a protective finish, corrosion inhibiting lubricants and a stainless steel cover.

### **Electronic System:** Overload protection may be an Electronic Torque Monitoring Control System capable of displaying torque, rpm's, one level of overload, and two levels of overload of the drive system. It shall incorporate a time-delay for startup and a voltage monitoring and compensation circuit for up to +15 percent variation.

### The overload device shall have an enclosure suitable for outdoor installation at temperatures of 0-70 degrees C, and relative humidity up to 95 percent. A visual torque dial shall be provided and oriented so that it can be easily read from the walkway.

### The torque monitoring system shall be calibrated to include: alarm and shut down the system in the event the torque drops to 50 percent of normal running; alarm at 85 percent of maximum continuous running torque and shut down the motor at maximum continuous running torque of the equipment. The system shall be calibrated at the factory of the equipment manufacturer and it shall be capable of monitoring twice the maximum continuous running torque of the equipment.

### **Definition:** For the purpose of these Specifications, "maximum continuous running torque" shall be defined as the lesser of: the motor continuous running torque rating, the gear drive continuous running torque rating, or the driven mechanism continuous running torque rating, not exceeding a service factor of 1.0.

## MANUFACTURERS

### Overload protection devices shall be manufactured by the following, or approved equal:

#### American Autogard Corporation

#### Ferguson Machine Company

## CONTROL PANELS

### Control panels to be furnished by equipment manufacturers shall meet the requirements specified in the applicable sections of Divisions 11, 13 and 16. In addition to the control and monitoring requirements specified in the individual equipment specifications sections, the control panels shall have the necessary instrumentation to meet the control, monitoring and interface with existing plant DCS requirements set forth in Division 13 and the Instrumentation Drawings whether such requirements are specified in the individual equipment specification sections or not.

# EXECUTION

## PRODUCT DELIVERY, STORAGE, AND HANDLING

### **Delivery of Materials:** Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.

### **Storage:** Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

### **Protection of Equipment:** Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment with anti-friction or sleeve bearings shall be stored in weathertight storage facilities prior to installation. For extended storage periods, plastic equipment wrappers shall not be used to prevent accumulation of condensate in gears and bearings.

## INSTALLATION

### **General:** Products and equipment shall be installed in accordance with the manufacturer's written installation instructions.

### **Alignment:** Equipment shall be properly aligned and operate free from defects including binding, scraping, vibration, end-shaft runout, or other defects. Drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be bolted in position and neat in appearance.

### **Lubricants:** The installation includes oil and grease for initial operation.

## COUPLINGS

### Couplings shall be installed in accordance with the manufacturer's installation instructions.

## INSULATING CONNECTIONS

### Insulating connections shall be installed in accordance with the manufacturer's instructions.

## PIPE HANGERS, SUPPORTS, AND GUIDES

### Hangers, supports, and guides shall be installed in compliance with ASME B31.1/B31.3 as applicable, and with Section 15020.

## PACKAGED EQUIPMENT

### When any system is provided as pre-packaged equipment, coordination shall include space and structural requirements, clearances, utility connections, signals, outputs and features required by the manufacturer including safety interlocks.

## FIELD TESTING

### **Testing:** Products shall be field-tested, in accordance with Section 01810, for compliance with the indicated requirements.

### **Witnesses:** The DISTRICT and the CONSTRUCTION MANAGER (at the option of either) reserves the right to witness field tests.

## PROTECTIVE COATING

### Equipment shall be painted and coated in accordance with Section 09800. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.

END OF SECTION