

DIVISION 11

SPECIALITY EQUIPMENT

SECTION 11-A

AUTOMATIC FILTERS

110000 GENERAL

The Contractor shall furnish and install automatic filter equipment as indicated on the Plans and as specified. All equipment shall be provided to make a usable system for the filtering and self cleaning of secondary water.

Provisions specified in Section 14-A are applicable to this Section.

110010 SERVICE REQUIREMENTS

The equipment shall be assembled, painted, tested, and adjusted in the manufacturer's shop before shipment as far as practical. All working parts shall be arranged for convenient inspection, lubrication, adjustment, repair, or replacement. All connections shall be provided with the necessary appurtenances to facilitate easy connection of piping and electrical. No special fittings or adapters shall be needed by the installer in the field.

110014 PIPING & EQUIPMENT

The drawings show a suggested system for the installation of the filters, waste piping and electrical. The supplier shall verify that proposed connections will match the supplied filters.

Material such as castings, forgings, and stampings shall have a safety factor of five or more with regard to ultimate strength.

110100 AUTOMATIC FILTERS

Where shown on the Plans, specified, or elsewhere approved by the Engineer, automatic self-cleaning filters shall be furnished and installed by the Contractor. Filters shall be capable of delivering uninterrupted water supply during cleaning stage. Cleaning mechanism shall be brush-type with a 3-inch flush valve.

Automatic filters shall be constructed with a corrosion resistant, epoxy-coated carbon steel body filter housing with epoxy-coated cast iron flushing valve. Filter screens and cleaning mechanisms shall be 316 stainless steel. Filter screen shall be designed for the removal of particles **200 microns** in size. Filter housing shall be supplied with 150 pound steel flanged ends in accordance with ANSI B16.5. Seals shall be natural rubber or Teflon.

The control system shall consist of a pressure differential switch which transmits an electric signal to activate an electronic controller which initiates the flushing cycle. The flushing valve shall be operated by means

of a hydraulic/pneumatic solenoid. Wiring box shall be a NEMA 4 enclosure. Control voltage shall be 24V AC. Cleaning mechanism shall be operated by a minimum size 1½ HP electric motor designed for 480 V 60 Hz.

Flushing cycles shall be programmable to initiate cycle according to pressure differential measurements and timed sequences. The control system shall be capable of PLC monitoring for continuous flushing. A flushing counter shall be provided with each unit and an alarm signal indicating malfunction. The allowable working pressure range shall be from **30 psi to 150 psi** maximum. The automatic filter shall be capable of delivering the optimum desired flow for the degree of filtration required.

Automatic self-cleaning filter units shall be AMIAD “EBS” or equal as approved by the Engineer.

110120 AUTOMATIC FILTER SCHEDULE

<u>Location</u>	<u>Flow</u>	<u>Quantity</u>	<u>Style</u>	<u>Size</u>	<u>Screen</u>
Filter #1 (existing)	1,000 gpm	1	EBS	8"	200 Micron
Filter #2	1,000 gpm	1	EBS	8"	200 Micron

110130 CONTROL PANEL

An existing three filter control panel is located in the prefabricated garage and is currently controlling the operation of Filter #1. All internal equipment and controls necessary to operate the new Filter #2 shall be installed in the existing panel. The control panel door shall be modified with the controls push buttons and labels to operate Filter #2 independently from Filter #1.

110200 TESTING

After complete installation of each filter, the equipment shall be field tested at its rated capacity. The equipment shall be operated through a complete flush cycle to determine how it will perform under the differential pressure and timed operation. Defects in the equipment shall be corrected. Testing shall be done in the presence of the Engineer.

*** END OF DIVISION 11 - SECTION A ***

DIVISION 12

PUMPS

SECTION 12-A

GENERAL REQUIREMENTS FOR PUMPS

120101 GENERAL

The Contractor shall furnish, install, and test all pumps and drives as indicated on the Plans, or as specified herein. It is the intent of these Specifications to obtain pumps and drives of highest quality construction only, for heavy-duty continuous service or for intermittent service, whichever imposes the most severe service on the pump. Equipment of lesser quality will not be accepted. The Engineer shall be the sole judge as to the quality of the equipment that will be accepted. Pumps are not intended to necessarily be standard units. Pumps will be installed at an elevation of approximately 4450 feet above sea level and shall be suitable for use at such altitude.

In addition to this section of the Specifications the pump shall conform to the applicable requirements of other Contract Documents including the following Divisions of the Specifications:

DIVISION 1	-	SPECIAL CONDITIONS
DIVISION 9	-	FINISHES
DIVISION 14	-	MECHANICAL EQUIPMENT
DIVISION 15	-	PIPING
DIVISION 16	-	ELECTRICAL
DIVISION 17	-	INSTRUMENTATION

Each pump shall be furnished as a complete, ready-to-install unit by a single supplier, including but not limited to pump, motor, mountings, and (if so specified and equipped) variable speed drive, and/or drive shaft assembly. All pumps for the same service shall be of one make and manufacturer and identical in all respects and characteristics. Unless otherwise noted, controls for variable speed drives shall be supplied with the pump.

Pumps that have mechanical defects or do not meet the requirements for head-capacity, horsepower, efficiency, and vibration requirements will be rejected, and shall be replaced without additional cost to the Owner for furnishing, removal, reinstallation, and retesting. Mechanical defects shall include excessive vibration, improper balancing of any rotating parts, improper tolerances, binding, excessive bearing or motor heating, defective materials, including materials that do not conform to the Specifications, improper fitting of parts, and any other defect which will in time damage the pump or unreasonably impair its efficiency or operation.

Pump friction losses, including entrance, column, shaft, and discharge losses shall be added to the total dynamic heads that are specified under each pump in order to get the head that the impeller must pump against. Pump head-capacity curves shall indicate that these losses have been included.

120110 CONSTRUCTION

Any bronze used in the manufacture of any pump shall not contain more than 2 percent aluminum nor more than 6 percent zinc.

Impellers, cases, seals, shafts, bearings, and any other item which does not comply with these Specifications as to its metallurgy, material, or hardness shall be replaced without additional cost to the Owner. Except for submerged or special service pumps, or as approved by the Engineer, pumps or adjacent piping within 3 inches of its pump flange shall be tapped at the suction and discharge for pressure gauges. Where packing gland drains are required or where water flushing or sealing of packing glands or mechanical seals is specified or shown, the Contractor shall furnish and install all necessary piping and valves. Except for submerged or special service pumps, or as approved by the Engineer, all pumps shall be provided with drip pans piped to drains.

120120 INSTALLATION

Before installation, the Contractor shall furnish five sets of installation instructions and five sets of lubrication instructions for each type of pump. These instructions shall include detailed instructions for adjustment and recommendations for the proper type of lubricant.

Pumps shall be installed and adjusted as specified and in accordance with the manufacturer's recommendations and in such manner that connecting piping will not impose any strain whatever on any pump. Pumps shall be set upon level, fully grouted foundations, so that connecting flanges, screwed connections, or flexible connections will meet without strain or distortion. Pump foundation pads shall be doweled and keyed to the floor slab upon which it rests. The pump leveling nuts shall be blocked out during grouting of foundations, the grout allowed to set for no less than three days, the leveling nuts loosened and following by grouting of the blockouts, with nonshrink grout. Any other proposed method of installation shall be submitted for the Engineer's approval prior to installation. Pumps shall be level when installed.

120128 TESTING

A certified factory test shall be made on the pump. The Contractor shall furnish to the Engineer three copies each of the test. Tests shall be made on six points of the head-capacity curve, with the points spanning the full range of TDH. The curves supplied shall show the head, capacity, efficiency, and brake horsepower. In making the tests, the total dynamic head as described in Section 120202 shall be used, and efficiencies shall be based on this description of the total dynamic head.

120130 MOTORS

Motors shall be as specified in each Section of this DIVISION 12, and as specified in Section 14-A. The rated horsepower and full-load amps shall not be exceeded at any point on the pump curve within the specified operating range of the pumps.

120140 TESTS

In addition to the tests required by DIVISION 14, each pump and driver, unless otherwise specified, shall be field tested for compliance with these Specifications as to head-capacity and horsepower. Where specified, each pump shall be factory tested at the place of manufacture.

Factory tests shall include head-capacity, efficiency, and brake horsepower. Four copies of certified test results shall be submitted to the Engineer for approval before the pump is delivered to the jobsite. Unless otherwise specified, the Contractor shall furnish all manpower, facilities, power, and equipment required for making tests. Field and factory tests shall be conducted in accordance with the latest requirements of the Hydraulic Institute Standards. Pumps with variable speed drives shall be tested at maximum speed, and at the average and minimum speeds listed under the specification for the pumps. A copy of actual test data shall be furnished to the Engineer.

In case factory testing of pumps provided is not specified, certified test curves for pumps of the same type as provided shall be submitted with the shop drawings.

120145 VIBRATION

Tests for acceptable vibration shall be made, at no additional cost to the Owner, in the field on each pump system, which in the opinion of the Engineer, seem to have excessive vibration. All field tests shall be running tests with the pump pumping the product for which it is intended and each pump system shall be tested separately with no other pumps running. All testing shall be done in the presence of the Engineer.

Amplitude as used in this Specification, shall mean total peak-to-peak displacement. The required test for acceptable vibration will be the measurement of this peak-to-peak displacement and will be performed with an IRD Vibration Meter, Model 306; Bently-Nevada TK-8; or equal.

No pump, complete with drive system, in place at the jobsite, shall exceed acceptable field vibration limits given in the latest revisions of the Hydraulic Institute Standards, no limits (if any) stated under the individual pump specification. All pumps shall be free of static unbalance; shall be free of dynamic unbalance up to the maximum speed of the pump and drive system; shall be free of torsional vibration from 10 percent below the minimum speed to 10 percent above the maximum speed of the pump and drive system; and shall be free of apparent unbalance caused by defective bearings, by close fittings parts which may rub on the rotating parts intermittently, or by loose discs or rotor parts, unbalanced loads, or by oil whip.

120147 WARNING SIGNS

Warning signs shall be furnished and installed as specified in Section 14-A.

120148 EQUIPMENT GUARDS

Equipment guards shall be furnished and installed as specified in Section 14-A.

120149 PAINTING

Requirements for painting of equipment shall be as specified in DIVISION 9.

120150 SHOP DRAWINGS

The Contractor shall submit for review to the Engineer, sufficient literature, detailed specifications, and drawings to show dimensions, make, style, speed, size, type, horsepower, head-capacity, efficiency, materials used, design features, internal construction, weights, and any other information required by the Engineer for review of all pumping equipment. For pumps, certified test curves shall be submitted showing this specified data. No pumping equipment will be accepted, and installation will not be allowed, until such review has been completed.

Shop drawings submitted for review also shall include electrical diagrams, schematic control diagrams, and a detailed description of how the control system is to function. Submittal information for control panels to be furnished with equipment shall be in accordance with the head "Control Panels" below.

Additional requirements for information to be included with shop drawings are specified with the particular piece of equipment.

As specified in DIVISION 1, SPECIAL CONDITIONS, copies of each approved shop drawing shall be submitted to the Engineer, prior to completion of the Contract, for each piece of equipment or each system. This shall include all drawings, lists, schedules, etc., larger in size than 11-inch by 17-inch, for all pumping equipment.

120160 OPERATING MANUALS

The Contractor shall furnish acceptable bound operating, installation, and maintenance instructions covering each component and each assembly furnished under this Contract in accordance with DIVISION 1, SPECIAL CONDITIONS. Manuals of instruction shall be furnished prior to equipment delivery.

The operating, installation, and maintenance instructions shall include as a minimum the following data for each item furnished hereunder.

- A. Lubrication Schedule, if required.
- B. Recommended preventive maintenance procedures and schedules.
- C. Recommended spare parts.
- D. Parts lists by generic title, material of construction, and identification number (actual manufacturer's number, not supplier's).
- E. Disassembly and reassembly instructions.
- F. Recommended troubleshooting and start-up procedures.
- G. Electric schematics.
- H. List of special tools and description of use, as specified previously.

In addition, the instructions shall include prints of the installation drawings.

120161 CONTROL PANELS

Where specified for an individual system or piece of equipment, a control panel shall be furnished with the equipment. Control panels shall conform to the requirements of DIVISION 16 and as specified herein.

Control panels shall be furnished with all components within the panel rigidly mounted, all wiring within the panel brought to terminal blocks, and all control air lines within the panel bulkheaded. Pressure gauges, pressure reducing valves, and three-way ball valves shall be mounted on the front of the panel. Pressure gauges shall be 4-1/2-inch diameter, panel-mounted units with ranges as specified or as indicated on the Plans. The panels shall be ANSI 61, light gray.

All lights, instruments, valves, and other equipment mounted on the control panels shall have an identifying label on them. These labels shall be black phenolic or lamicoïd plastic with white letters and shall be fastened to the control panel with round head stainless steel screws.

Prior to fabrication of the control panels, the Contractor shall submit shop drawings of the control panels, including the proposed layout of all equipment to be installed in the control panels, to the Engineer for review.

*** END OF SECTION 12-A ***

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DIVISION 12

LINE SHAFT PUMP

SECTION 12-B

120300 GENERAL

A vertical turbine pump with motor shall be furnished, installed, and tested. The pump shall conform to all applicable requirements of AWWA E 101, Part A, and to the supplementary specifications contained herein.

The plans indicate the dimensions and design of the pump. It is the Contractor's and the pump manufacturer's responsibility to fabricate the pump to fit the physical dimensions of the pump structure and the performance of the pump shall be guaranteed for the known conditions of the pump structure and piping.

The pump shall be capable of operating against a closed discharge valve for not less than two minutes without excessive vibration, binding, rubbing of rotating parts, or damage to pump, motor, or drive.

The head-capacity curve for the pump shall be as steep as practicable within the constraints of this section, and shall exhibit a continuously rising characteristic to shutoff head, with no points of zero or slope reversal.

The pumping head shall be the total dynamic head, which in these Specifications shall be sum of the static head plus the friction head above the pump discharge outlet plus the velocity head at the discharge outlet. The pumping head does not include the losses in the entrance, column, or discharge elbow.

The rated efficiencies shall include the losses in the suction bell, in the pump column, and in the discharge elbow, and the efficiency curve plotted on the manufacturer's pump curves shall be on this basis regardless of the manufacturer's normal practice. The pumps will be field tested on this basis.

120392 OPERATING CONDITIONS

LOW ZONE PUMP

	<u>Pump No. 2</u>
Pump design capacity	<u>1000</u> gpm
Speed	<u>1760</u> rpm
At total dynamic head not including column and other minor losses	<u>55</u> feet
Elevation of pump wet well floor	<u>4439.17</u> feet
Elevation of pump discharge centerline	<u>4455.80</u> feet
Bowl efficiency at design of not less than	<u>78</u> percent
Minimum number of bowls	<u>2</u>

HIGH ZONE BOOSTER PUMP

Pump No. 2

Speed	<u>1760</u> rpm
Suction head	<u>31</u> feet
Elevation of pump can bottom	<u>4445.23</u> feet
Elevation of pump discharge centerline	<u>4455.80</u> feet
Minimum number of bowls	<u>3</u>

Condition #1 (Design Point)

Pump capacity	<u>625</u> gpm
Discharge head	<u>153</u> feet
Required total dynamic head	<u>122</u> feet
Bowl efficiency of not less than	<u>81</u> percent

Condition #2

Pump capacity	<u>480</u> gpm
Discharge head	<u>171</u> feet
Required total dynamic head	<u>140</u> feet
Bowl efficiency of not less than	<u>78</u> percent

Condition #3

Pump capacity	<u>700</u> gpm
Discharge head	<u>141</u> feet
Required total dynamic head	<u>110</u> feet
Bowl efficiency of not less than	<u>79</u> percent

120305 MOTOR

The motor shall be a vertical hollow shaft squirrel-cage, induction type, with roller or ball bearings, rated for the pump so that the rated full-load current of the motor will not be exceeded at any point within the specified operating range of the pump. The motor shall comply with NEMA MG-1 Standards, and shall be equipped with steady bushing, space heaters, rodent guards, and shall be as follows with the data shown on the nameplate. Motor shall be premium efficient inverter duty rated.

A suitable base of cast iron or fabricated steel shall be provided for mounting the driver and supporting pump column. The 1.15 service factor shall be in excess of the HP rating of the motor and shall not be included as part of the HP rating of the motor. The motor shall have a cast iron frame and end brackets and space heater. The motor shall have a connection box of cast iron, split and rotatable in 90° steps. The motor shall be the proper size to drive the pump continuously over the specified operating range without exceeding its rating. The motor shall have a thrust bearing of ample capacity to carry the weight of all rotating parts plus the hydraulic thrust and shall be an integral part of the motor. The bearings shall be sized that the average life rating is not less than five years on continuous operation under maximum rated load of the motor pump assembly. The motor shall be provided with a steady bushing. The motor shall be capable of two cold and one hot start per hour without overheating the electrical components. Motor sound pressure levels shall not

exceed 83 dba (mean, A-weighted) at one meter (RE. 0.0002 microbar) for free field conditions. Sound levels shall be measured in accordance with IEEE Standard No. 85 and certified test results shall be submitted to the Engineer for review. The motor shall be as manufactured by General Electric, U.S. Motors, Yasakawa or approved equal.

LOW ZONE PUMP MOTOR

		<u>Pump No. 2</u>
Horsepower	Not less than	<u>20</u>
Speed	At rated load	<u>1760 rpm</u>
Voltage		<u>480 v</u>
Phase		<u>3</u>
Hertz		<u>60</u>
Service factor		<u>1.15</u>
NEMA design		<u>B</u>
Minimum insulation		<u>Class B</u>
Ambient temperature		<u>40°C</u>
Enclosure		<u>WP-1</u>
Efficiency (Minimum)		<u>93</u>
Power factor (Minimum)		<u>87</u>

HIGH ZONE BOOSTER PUMP MOTOR

		<u>Pump No. 2</u>
Horsepower	Not less than	<u>25</u>
Speed	At rated load	<u>1760 rpm</u>
Voltage		<u>480 v</u>
Phase		<u>3</u>
Hertz		<u>60</u>
Service factor		<u>1.15</u>
NEMA design		<u>B</u>
Minimum insulation		<u>Class B</u>
Ambient temperature		<u>40°C</u>
Enclosure		<u>WP-1</u>
Efficiency (Minimum)		<u>93</u>
Power factor (Minimum)		<u>87</u>

120310 DISCHARGE HEAD

The discharge head shall be fabricated steel (ASTM A53 Grade B pipe and ASTM A36 Steel plate). The discharge shall be a groove end (flexible type) connection as noted on the Plans. Lifting lugs of sufficient strength to support the weight of the complete unit must be provided.

The baseplate shall not be less than 1-inch thick designed to connect to anchor bolts. The upper flange shall have the same diameter as the electric motor and shall have a minimum thickness of 3/4-inch. Windows in the outer shell shall be as small as possible but of sufficient size to permit working on the stuffing box. The

stuffing box shall be a packed type provided with a collection box and drain. The drain shall be piped to the same sump through the concrete. The discharge head shall have a two piece top shaft. The coupling and all of its component parts shall be capable of transmitting 150 percent of the shaft torque and also be capable of carrying all vertical thrusts with a liberal factor of safety. This arrangement shall permit removal of the seal and sleeve without disturbing the piping or the drive.

120320 DISCHARGE COLUMN ASSEMBLY

The column pipe shall be not less than 8-inch diameter steel pipe, (ASTM A53 Grade B) minimum 3/8-inch wall thickness. The pipe shall be furnished in interchangeable sections not over 10 feet in length with lathe cut straight butt joint threads and machine threaded sleeve type couplings. The pump supplier shall verify that the pump assembly is designed to withstand all weights caused by the depth of the pump.

The discharge column shall be coated inside and outside with an polyamide epoxy coating in conformance with section 090143.03 EPOXY COATING. System shall be a minimum of 10 mils.

The line shafting shall be turned, ground and polished 416 stainless steel to operate the pump without distortion or vibration and shall be tested for straightness to 0.002 inches accuracy. The shafts shall be furnished in interchangeable sections not over 10 feet in length and shall be coupled with extra strong threaded stainless steel couplings machined from solid bar stainless steel. Threads shall be lathe cut and the ends of the shaft shall be machine faced. Line shaft shall not be reduced in size through the stuffing box.

The minimum line shaft shall be 1-inch. A bearing shall be located a maximum of 5 feet from the pump and the discharge head.

The column assembly shall have bronze guides fitted into the pipe coupling and retained by the butted pipe ends. Each guide shall contain a water lubricated, cutlass rubber bearing designed for vertical turbine pump service. Bearing shall be spaced at a maximum of ten feet.

120330 BOWL ASSEMBLY

The pump bowls shall be stainless steel or of high tensile strength close grained cast iron, free from blow holes, sand holes and all other faults, accurately machined and fitted to close dimensions. The maximum outside diameter of the bowls shall be fitted to each well application of best design. The water passageways shall be lined with hard porcelain or other material to provide smooth water flow and maximum pump efficiency. The impeller shaft shall be of 416 stainless steel or better with one bearing on each side of every impeller. Bearings shall be either of all high lead bronze construction or a combination of high lead bronze and rubber designed for water lubrication but bearings of "rubber only" will not be acceptable. Suction case bearing shall be grease packed and fully enclosed and protected against entry of sand or abrasives. A sand collar shall be installed above the top bowl to prevent abrasive wear.

The bottom bearing housing shall be cast as an integral part of the bottom case. The housing shall have sufficient vertical depth to allow the pump shaft to move downward as the impeller face, casing, or clearance parts wear. The bottom bearing shall be packed with a nonsoluble hydraulic grease or lubricant that will not break down or dissolve and find its way into the pump stream. Such grease or lubricant shall not need replacement for the life of the pump. The bearing housing shall be provided with a cap or plug to prevent the escape of any lubricant used. The bottom bearing shall be bronze as specified for the line shaft bearing.

Impellers shall be of bronze with not more than six percent zinc content or stainless steel and shall be of the enclosed type. Enclosed impeller type bowls shall be provided with impeller seal rings or bowl wearing rings of replaceable hardened material of an alloy found to be highly resistant wear. Impellers shall be accurately fitted and dynamically balanced and shall be fastened securely to the impeller shaft in such a manner that they cannot loosen in service. Both bowls and impellers shall be designed with open end smooth water passages to secure efficient operation and to prevent air or sand locking. Sufficient lateral adjustment shall be provided in the design of the bowl assembly to permit proper impeller adjustments and to insure proper operation of the pumping unit.

120360 PUMP INSTALLATION

The Contractor shall install the pump, motor and pump starter panel according to the manufacturer's recommendations. The Contractor will finish and install leads through conduits between the pump motor and pump starter panel. Installation shall conform to the latest applicable rules and regulations of the Utah State and Local Electrical Code and the National Electrical Code, and other applicable codes. Where codes conflict, the requirements of the code legally applicable shall be followed. Workmanship shall be of the highest grade.

120370 CHECK, TEST AND START

The Contractor shall provide the services of qualified, factory authorized mechanic or mechanics as needed to check, test and start the pumps. He shall be responsible to make certain the equipment is properly installed, aligned, wired, operating, etc. The qualifications of the mechanic shall be such that the manufacturers can certify in writing that the installation is proper and correct, and that the equipment is operating properly. A letter from the factory authorized representative shall be provided indicating the pump and motor have been installed and tested in accordance with the manufacturer's recommendations. The Contractor shall provide four (4) sets of "As-Constructed" drawings acceptable to the Engineer prior to final payment.

*** END OF SECTION 12-B ***

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DIVISION 14

MECHANICAL EQUIPMENT

SECTION 14-A

GENERAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

140101 GENERAL

Specifications contained in this part of the Specifications shall apply to all items of mechanical equipment the same as if these provisions were contained in the individual section of the Specifications for the equipment or any other Division herein.

Provisions specified in other parts of the Specifications apply to this Division. Applicable provisions are included in:

- DIVISION 1 - SPECIAL PROVISIONS
- DIVISION 5 - METALS
- DIVISION 9 - FINISHES
- DIVISION 15 - PIPE AND PIPING SYSTEMS
- DIVISION 16 - ELECTRICAL
- DIVISION 17 - INSTRUMENTATION

All items of equipment shall be the product of a manufacturer experienced in the design, construction, and operation of equipment for the purpose required, and who shall have established a record of successful operation of such equipment manufactured or produced by them. When two or more units of equipment for the same purpose are required, they shall be products of the same manufacturer.

Equipment shall be made up of parts which are designed to act as a unit; and the manufacturer shall guarantee that when the component parts are assembled into the final unit, these parts will fit and operate satisfactorily. The equipment manufacturer's responsibility shall extend to the selection and mounting of gear drive units, motors or other prime movers, accessories, and auxiliaries required for proper operation.

If necessary, modifications shall be made in manufacturer's standard product to make it conform to the specific requirements of the Plans and Specifications and to requirements contained in regulations issued by public agencies.

All equipment shall include all production line improvements made to the delivery or contract date.

All mechanical items shall be rated heavy-duty by the manufacturer.

Elevation of this project above sea level is approximately 4450 feet. All mechanical equipment shall conform thereto. Structural steel shall conform to ASTM A 36. Iron castings shall be tough close-grained gray iron castings in accordance with ASTM A 48.

Parts of equipment shall be amply proportioned for all stresses which may occur during operation and for any additional stresses which may occur during fabrication, transportation, handling, and erection. Bearings, unless otherwise specified, shall be designed such that at maximum loadings the AFBMA B-10 rating is not less than 40,000 hours.

The furnishing and installation of equipment shall include testing, painting, checking levels and alignment, furnishing and placing of lubricants of whatever type, and furnishing of factory-trained service mechanics or engineers where specified. All equipment when finally installed shall be complete and ready for operation without binding or overloading of critical components or motors. The Contractor shall furnish at no extra cost to the Owner all appurtenances, piping, valves, fittings, wiring, supports, hangers, and other devices as are required to place the equipment in first-class operating condition and in a neat and workmanlike manner.

Fasteners for aluminum shall be stainless steel. Steel, other than stainless steel, shall be isolated from aluminum with stainless steel, neoprene, or other approved material.

Bronze, which will be in contact with water or any liquid, used in the manufacture of any equipment, shall not contain more than 2 percent of aluminum nor more than 6 percent of zinc.

Manufacturers or suppliers of equipment furnished under this Contract shall guarantee said equipment for one year following the date of acceptance of the completed Contract by the Owner.

140105 SHOP DRAWINGS

The Contractor shall submit shop drawings on all mechanical equipment to be furnished under this Contract. The number of copies submitted shall be as specified in DIVISION 1. Prior to submitting the drawings, the Contractor shall review the information for completeness. Only complete information will be reviewed by the Engineer, and only after the Contractor has signified his approval of the information. Additional provisions on shop drawings are specified in DIVISION 1.

Shop drawings shall consist of a cover sheet, which indicates drawing number, and specifications page and number to which referenced, intended use and data summary, outline drawings, cut-away drawings, parts lists, material specification lists, and all information required to substantiate that the proposed equipment meets the Specifications. In some special cases reproducible transparencies of shop drawings shall be furnished in addition to the specified number of copies. Shop drawings submittals will not be considered complete if cut-away or assembly drawings with part and material specification lists are not included.

Shop drawings for motors shall include published dimension sheets and shall include a motor data sheet which shows all the motor characteristics, including horsepower, voltage, code letter, design letter, service factor, enclosure, and insulation. All characteristics of the motor shall be shown on the data sheet which shall have been reviewed and found acceptable by the Engineer prior to delivery of the motor.

The Contractor shall provide calculations and details on all parts individually and severally to show that the equipment offered satisfies the performance, strength, vibration, and other requirements of these Specifications.

140106 OPERATION AND MAINTENANCE MANUALS

The Contractor shall furnish four (4) copies of operation and maintenance manuals for each system or item as specified in DIVISION 1. These manuals shall be broken down into sections and indexed. The sections shall include Mechanical Equipment, Automatic and Special Valves, Control Systems, Electrical, and others as necessary. Under each section there shall be a description of the operation and maintenance, lubrication schedules, and installation instructions of each item. All sections shall be labeled and each item shall be sub-labeled. There shall be included in the front of each booklet an index laminated with plastic on both sides for rough use. Each booklet shall be bound in clear covered 3-ring binders and delivered prior to installation of any operating equipment. No acceptance of any equipment will be made until the complete manuals have been submitted, evaluated, and found acceptable. One Contractor's copy of the complete manual shall be at the jobsite available for use by field personnel and the Engineer during installation, start-up, and testing of the equipment.

The operation and maintenance manuals shall include, as a minimum, the following data for each item of mechanical, electrical, and instrumentation equipment. Information not applicable to equipment installed in the work shall be excluded.

1. Recommended start-up and trouble shooting procedures
2. Disassembly and reassembly instructions
3. Lubrication schedule
4. Recommended preventative maintenance procedures and schedules
5. Recommended spare parts
6. Parts lists, by generic title and identification number, complete with section views of each assembly
7. Name, address, and telephone number of nearest supplier and spare parts warehouse

In addition, the O&M manuals shall contain reproducible prints of the Contract record wiring diagrams, schematics, and installation drawings required under the Electrical and Instrumentation Specifications.

140110 INSTALLATION OF EQUIPMENT

Installation of equipment shall not begin until the instructions covering that part of the equipment, as specified hereinbefore, have been supplied to the Engineer.

Equipment shall be installed complete and ready to operate. In the installation of equipment none but mechanics skilled in the various trades shall be employed.

Welding shall be by electric arc and shall be done by qualified welders in accordance with applicable welding codes.

Metal work to be embedded in concrete shall be accurately placed and held in correct position while the concrete is being placed. The surface of all metal work to be in contact with concrete shall be thoroughly cleaned immediately before concrete is placed. Anchor bolts shall be cast in place when the concrete is poured. Anchors shall be installed as recommended by the manufacturer to develop the full strength of the bolt. No use shall be made of flush shells or concrete anchors.

Anchor bolts for heavy equipment, unless otherwise detailed, shall be encased in metal tubing as indicated on the Plans. Pump and other similar foundations shall be left 1 inch below the grade of machine base unless otherwise noted on the Plans. After the proper setting of machine for alignment and grade, the recess below the base, together with recess between the anchor bolt and the metal tube, shall be grouted and carefully finished with nonshrink grout as specified in DIVISION 3.

Moving parts of equipment and machinery shall be carefully installed, tested for operation, and adjusted so that all parts move freely and function to secure satisfactory operation.

Piping required for proper operation of equipment shall be furnished and installed. Piping layouts may require modification from that indicated on the Plans depending on equipment furnished. All costs for piping or piping modifications required to suit the particular equipment furnished shall be borne by the Contractor.

140111 ALIGNMENT OF MOTORS AND EQUIPMENT

In every case where a drive motor is connected to a driven piece of equipment by a flexible coupling, the coupling halves shall be disconnected and the alignment between the motor and the equipment checked and corrected after the complete unit has been leveled on its foundation, and again after grout has set and foundation bolts have been tightened.

In general, checking and correcting the alignment shall follow the procedures set up in the Standards of the Hydraulic Institute, Instructions for Installation, and Operation and Maintenance of Centrifugal Pumps. Equipment shall be properly leveled and brought into angular and parallel alignment.

Equipment bases shall not be grouted nor foundation bolts finally tightened until all piping connections are complete and in satisfactory alignment with no strain transmitted to the equipment.

After the seven-day test has been run successfully, the Contractor shall dowel the motor and equipment in accordance with the manufacturer's recommendations.

140118 PAINTING

Equipment shall be painted in accordance with the requirements of DIVISION 9.

140120 MOTORS

Motors shall be manufactured in accordance with NEMA Standards and shall be as specified herein unless otherwise specified in the individual equipment specifications. Not all motors are intended to be standard design motors; some motors may require special features in order to meet specified requirements.

Motors, unless otherwise specified, shall be constant-speed, squirrel-cage, induction type with roller or ball bearings in accordance with NEMA Standards and as specified in DIVISION 16; and shall be 460-volt, 3-phase, 60-Hertz for the mechanical equipment. Two-speed motors shall be dual winding.

Motors 1 horsepower and larger shall be insulated for wet area application. The winding shall be given a minimum of three (3) dips and bakes of insulating varnish and shall receive a sealer coat of epoxy or silicone. The nameplate shall read "Special Class B or F Epoxy or Silicone Insulated."

The individual Sections will generally indicate enclosure required for each application. The following shall govern in case enclosure is not specified.

Electric motors which are mounted inside and protected from the weather: horizontal motors shall be of splashproof construction with stainless steel rodent screens. Vertical motors shall be WP-1 enclosure with stainless steel rodent screens.

Electric motors which are exposed to the weather or severe moisture conditions; horizontal and vertical motors shall be totally enclosed constructed. Totally enclosed motors shall have drain holes at the lowest point in the case for condensate drainage.

The service factor for motors shall be as specified in the various Sections. If not specified, it shall be at least 1.15. The maximum applied load shall not exceed the nameplate horsepower. The amperage at maximum applied load shall not exceed the full-load nameplate amperage value.

All motors shall be rated at 40 degrees C ambient with not more than 55 degrees C rise and shall have a minimum of Class B insulation as specified before for full horsepower motors. Fractional horsepower motors shall have Class B insulation.

Single-phase motors, unless otherwise specified, shall be rated 40 degrees C ambient.

Motors shall conform to the latest ANSI, NEMA, and IEEE Standards for motors of the specified class and rating. Unless specified otherwise for a particular piece of equipment, motor bearings shall be of the anti-friction type with an AFBMA B-10 life rating of not less than 25,000 hours for integral horsepower motors and 10,000 hours for fractional horsepower motors; motor bearings shall be grease or oil lubricated with convenient provisions for inspection and servicing.

All motors except for hoisting equipment, heat pumps, unit heaters, sump pumps, and sloop and lube oil transfer pumps shall be special high efficiency type. The minimum full load motor efficiency and power factor for high efficiency type motors shall be as listed hereinafter. Full load efficiency and power factor shall be shown on the nameplate.

<u>Hp</u>	<u>rpm</u>	<u>Full Load Rating, Percent</u>		<u>Hp</u>	<u>rpm</u>	<u>Full Load Rating, Percent</u>	
		<u>Eff.</u>	<u>PF</u>			<u>Eff.</u>	<u>PF</u>
1	1,800	84.0	79	30	3,600	91.0	91
	1,200	78.5	75		1,800	93.0	86
					1,200	92.4	85
1-1/2	3,600	81.5	91	40	3,600	91.7	90
	1,800	84.0	79		1,800	93.0	87
	1,200	82.5	75		1,200	93.0	85
2	3,600	84.0	89	50	3,600	91.7	91
	1,800	84.0	79		1,800	94.1	87
	1,200	84.0	68		1,200	93.0	86
3	3,600	82.5	89	60	3,600	92.4	90
	1,800	88.5	85		1,800	94.1	87
	1,200	86.5	74		1,200	93.6	86
5	3,600	86.5	86	75	3,600	93.0	92
	1,800	88.5	86		1,800	94.1	87
	1,200	87.5	85		1,200	94.1	86
7-1/2	3,600	86.5	88	100	3,600	93.6	90
	1,800	90.2	85		1,800	94.5	90
	1,200	88.5	85		1,200	94.1	86
10	3,600	87.5	90	125	3,600	93.6	90
	1,800	90.2	86		1,800	95.0	90
	1,200	86.5	85		1,200	94.5	90
15	3,600	89.5	88	150	3,600	94.1	90
	1,800	91.7	85		1,800	95.0	90
	1,299	90.2	85		1,200	94.5	90
20	3,600	90.2	90	200	3,600	94.1	93
	1,800	91.7	86		1,800	95.0	90
	1,200	91.0	85		1,200	94.5	87
25	3,600	91.0	90	250	3,600	94.1	93
	1,800	93.0	87		1,800	94.5	87
	1,200	92.4	85				

Motor sizes noted in the individual equipment specifications and the plans are estimates only, and it is the responsibility of the equipment manufacturers and of the Contractor to furnish motors, electrical circuits, and

equipment of ample horsepower capacity to operate the equipment without exceeding the rated nameplate full-load current at rated nameplate voltage, or overheating at maximum load capacity under the most severe operating service of the equipment.

Where not shown on the Plans or in these Specifications, the manufacturer of each piece of motorized equipment shall inform the Engineer and the Contractor in writing as to the size and type of electrical controls required to properly operate the equipment. Location of conduit boxes of motors shall be shown on the manufacturer's drawings.

Motors larger than 1 horsepower shall not be aluminum construction.

140140 ELECTRICAL WORK

Unless specified otherwise in the following parts on mechanical equipment, all electrical work, materials, and equipment shall conform to the provisions under DIVISION 16, ELECTRICAL. It shall be the responsibility of the Contractor to provide complete electrical systems sized to suit the equipment furnished and installed.

140150 LUBRICATION FITTINGS

All lubrication fittings shall be brought to the outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housing, or guards. Fittings shall be accessible from safe, permanent walk or walk areas without ladders or scaffolds. Fittings for underwater bearings shall be brought above the water surface with stainless steel tubing and mounted on edge of structure above. Fittings shall be Lincoln "Bullneck" Hydraulic Surface Check Fittings, Lincoln Engineering Company, St. Louis, Missouri, or equivalent. Lubrication fittings shall be mounted together wherever possible. They shall not be individual fittings field-mounted together, but use shall be made of factory-mounted multiple fitting assemblies located in convenient areas. Connection from multiple fitting assemblies to point of use shall be minimum 3/16-inch stainless steel tubing, securely mounted parallel with equipment lines and protected where exposed to damage.

140160 MACHINERY AND EQUIPMENT GUARDS

Approved guards for all machinery drives, pulleys, or rotating shafting shall be detailed and furnished by the Contractor. Such guards shall be neatly and substantially constructed, adequately supported from adjacent framing, and shall be provided in all cases. While all such guards are not indicated in detail on the Plans, the Contractor is assumed to be familiar with the requirements of Cal-OSHA, and any applicable local regulations regarding machinery guards or safety devices. All guards shall be sized so that pulleys 15 percent over size may be installed. The width of the guard shall be such as to allow one additional belt to be added in the future. The frame shall be covered with expanded aluminum for heat dissipation. The Contractor shall assume the responsibility for detailing these items and submitting shop drawings to the Engineer for approval. Guards shall be constructed of 6061-T6 aluminum unless otherwise indicated. All guards shall be isolated so no dissimilar metals come in contact.

140170 TESTING

Before testing, all equipment and mechanisms shall be filled by the Contractor with the proper oil and grease as recommended by the equipment manufacturer. Contractor shall furnish all personnel, chemicals, and other necessary items as are required for the initial testing of equipment.

Each piece of equipment shall be operated by the Contractor for at least 8 hours after installation, unless the Engineer is satisfied that shorter test periods are adequate. This does not relieve the Contractor of responsibility in the event of failure, binding, overloading, overheating, or other malfunction of the equipment after initial testing is performed. Final test operation shall be as specified in DIVISION 1.

140180 SPECIAL TOOLS

All special tools that are required to assemble, disassemble, repair, and maintain any item of mechanical equipment shall be furnished with the equipment. Special tools shall include any type of tool that has been specifically made for use on an item of equipment for assembly, disassembly, repair, and maintenance. When special tools are provided, they shall be marked or tagged, and a list of such tools shall be included with the maintenance and operation instructions describing use of each marked tool.

*** END OF DIVISION 14 - SECTION A ***