

GEAR PUMPS – SKID MOUNTED

1. GENERAL

1.1 Scope of Work

- .1 Supply, installation, testing, and Performance Verification of skid-mounted, pre-piped, pre-wired and pressure tested chemical feeding equipment shown and specified, complete with metering pumps, control panels, piping, strainers, valves, calibration columns, frames and accessories to feed chemicals, complete and operable, in accordance with the requirements of the Specifications.

1.2 References

- .1 Pumps shall be in compliance with the appropriate sections of the following codes:
 - .1 NSF International, Standard 61 - Drinking Water System Components
 - .2 AGMA
 - .3 AISC, American Institute of Steel Construction.
 - .1 Type 416 Stainless Steel.
 - .2 Type 1035 Steel.
 - .3 Type 1045 Carbon Steel.
 - .4 Type 4140 Alloy Steel.
 - .4 AISI
 - .5 ABMA
 - .6 ASME
 - .7 ANSI
 - .8 ASTM:
 - .1 A48/A48M, Standard Specification for Gray Iron Castings.
 - .2 A53/A53M, Standard specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - .3 A276, Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
 - .4 A576, Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.

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- .5 B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .6 B148, Standard Specification for Aluminum Bronze Sand Castings.
- .7 B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
- .10 Canadian Electrical Code
- .11 CSA
- .12 EEMAC
- .13 ESA
- .14 IEEE
- .15 ISA
- .16 NEC
- .17 NEMA
- .18 NFPA
- .19 SSPC
- .20 Manitoba Building Code
- .21 Canadian Plumbing Code.
- .22 OSHA

1.3 Definitions

- .1 Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.4 Contractor Submittals

- .1 Shop Drawings:
 - .1 Make, model, weight, and horsepower of each equipment assembly.
 - .2 Complete catalog information, descriptive literature, specifications, and identification of materials of construction.

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- .3 Performance data curves showing head, capacity, and pump efficiency over the entire operating range of the pump.
- .4 Detailed drawings showing the equipment dimensions, size, and locations of connections and weights of associated equipment.
- .5 Power and control wiring diagrams, including terminals and numbers.
- .6 Complete motor nameplate data, as defined by NEMA, motor Manufacturer, and including any motor modifications.
- .7 Materials of construction
- .8 Describe related appurtenances
- .2 Quality Control Submittals:
 - .1 Factory Functional and Performance Test Reports.
 - .2 Manufacturer's certification of compliance that the factory finish system is identical to the requirements specified herein.
 - .3 Special shipping, storage and protection, and handling instructions.
 - .4 Manufacturer's printed installation instructions.
 - .5 Suggested spare parts list to maintain the equipment in service for a Period of 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
 - .6 List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
 - .7 Operation and maintenance manual.

1.5 Shipment, Protection, and Storage

- .1 Ship pre-assembled to the degree possible.
- .2 Provide storage instructions indicating specific requirements to ensure there is no uneven wear, distortion or weathering of components.
- .3 Identify all other special storage requirements.

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2. PRODUCTS

2.1 General

- .1 Supplements at the end of this Section list Acceptable Manufacturers, and where specified, models. This acceptance does not in any way relieve the Contractor or Manufacturer from providing models that meet all requirements of these specifications, and that fit within the piping and equipment layout shown in the Drawings.
- .2 The supply of gear pumps under this Section shall come from a single Manufacturer.

2.2 Pump Skids

- .1 General:
 1. The pumps shall come with factory fabricated pump skids as shown in the P&IDs and described herein. The pumping skids includes metering pumps, strainers, controls, calibration column, backpressure valves, pressure relief valves, ball valves, pressure gauges, low flow switches, check valves, and all associated piping and fittings, in accordance with the Drawings.
 2. The ferric chloride, sulphuric acid and sodium hydroxide pump skids shall each contain three (3) pumps. The pump skids shall be constructed of steel, FRP, or PVC frames suitable for the chemical service and shall be sized appropriately to fit in the designated location in their respective chemical feed rooms, as shown on the Drawings. All equipment shall be frame mounted. Mounting to back boards will not be accepted.
 3. All components of the chemical feed pump skids including pump, speed controller, motor, and related appurtenances unit shall be pre-plumbed and pre-wired.
 4. All actuated valves shall have 120/1/60 power supply
- .2 Accessories:
 - .1 Supply and Install inline flow meters to measure the chemical flow from each metering pump. Flow meter shall be capable of accurately measuring flows as shown in the Supplements at the end of this Section. Flow meter wetted components to be chemically resistant to service being used. Meters to meet Division 17 Specifications.
 - .2 Each pump skid shall be Supplied with pre-piped calibration column and pressure relief valve. The calibration column shall be constructed of material which is compatible with the chemical and shall be complete with a vented top cap and shall be graduated in milliliters.

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- .3 Be responsible for selecting pumps, motors and VFDs which will be capable of meeting the head, pressure, and max/min. flow and accuracy requirements of the system. Take into account the specific gravity, viscosity, corrosivity and temperature of the fluid being pumped.
- .4 The pumps shall provide a constant flow rate for a particular drive speed and provide linear pulsation free output flow.
- .5 The driven magnet shall be an encapsulated assembly mounted on the end of the pump shaft. The drive magnet assembly shall rotate around the containment can as a result of the magnetic force.
- .6 Each pump shall be of the suction shoe design.
- .7 Construct the pump parts in contact with the chemical being pumped from materials suitable for the chemical application. For Ferric Chloride and Sodium Hydroxide, at a minimum, construct the pump of the following materials:
 - .1 Pumps: hardened titanium construction
 - .2 Wear plates: ceramic
 - .3 Shafts: ceramic
 - .4 Gears: Teflon or Ryton
- .8 For Sulphuric Acid, at a minimum, construct the pump of the following materials:
 - .1 Pumps: Alloy 20 construction
 - .2 Shafts: Alloy 20
 - .3 Gears: Teflon or Ryton
- .9 Supply and Install pressure relief valve and backpressure regulating valve for each pump discharge, sized for the maximum pump flow with an adjustable pressure range. Valve material to be compatible with the chemical being pumped.
- .10 Supply and Install pumps suitable for connection to a VFD.
- .11 Motors to be designated IEEE Chemical Industry - Severe Duty TEFC (CISD-TEFC). Motors shall be VFD rated.
- .12 A local control panel for each pump skid shall be Supplied and Install as shown on the Drawings. Each panel will include a 4-20 mA loop powered speed indicator wired direct from the VFD output, start / stop switch and push buttons to raise and lower the speed of the pump. Refer to typical starter schematic for details.
- .13 Supply and Install motors suitable for 600 V/3 phase/60 Hz power supply.

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- .14 Supply and Install a floor-mounted support frame for the skid assembly. Fabricate support frame of chemically resistant FRP or chemically resistant epoxy coated carbon steel. Provide sufficient strength to allow the support frame to carry the full weight of all of the skid components when full of chemical.
- .15 Supply and Install lubricants of the type recommended by the equipment Manufacturer in sufficient quantity to fill all lubricant reservoirs and to replace all consumption during testing, start-up and operation prior to Substantial Performance. Lubrication systems and lubrications shall be certified to ANSI/NSF Standard 61, to be compatible with potable water use.

2.3 Pumping Accuracy

- .2 Supply a minimum pumping accuracy of $\pm 5\%$ over the operating full range for each combined pump, motor and variable frequency controller system.
- .3 Combined pump, motor and VSD controller system to be capable of a minimum of 100:1 flow control turndown.

2.4 Piping and Valves

- .1 Supply and Install Schedule 80 PVC piping and valves for the ferric chloride and sodium hydroxide pumping skids and in accordance with Section 15200 – Piping Insulation. Supply and Install flanges on the inlet and outlets to the skid.
- .2 Supply and Install 316L stainless steel piping and valves for the sulphuric acid pumping skid and in accordance with Section 15200 – Piping Insulation. Supply and Install flanges on the inlet and outlets to the skid.
- .3 Supply and Install valves and appurtenances of material suitable for the specified chemicals, in accordance with Sections 15202 – Process Valves and Operators.
- .4 Supply and Install instrumentation and flow meters in accordance with Division 17.

2.5 Pump Skid Operation

- .1 The Ferric Chloride feed pumps shall operate as follows:
 - .1 Two duty and one standby pump delivers ferric chloride to the two parallel raw water headers at the pretreatment area of the WTP.
 - .2 The control of the ferric chloride flow is based on the flow proportional to the totalized raw water flow signal for that train, from each of the four individual basin inlet flow meters in that train. There is one duty ferric chloride pump per train and the PLC uses the totalized flow signal from each train to provide flow proportional chemical dosing control of one duty ferric chloride metering pump. If an entire train is turned off at the Master PLC, the duty ferric chloride dosing pump assigned to that train is locked out.

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- .2 The Sulphuric Acid feed pumps shall operate as follows:
 1. Two duty and one standby pump deliver sulphuric acid through an injector within each of the two parallel raw water headers at the pretreatment area of the WTP.
 - .2 The control of the sulphuric acid flow is based on the flow proportional to the totalized raw water flow signals from each of the eight basin inlet flow meters. Similar to ferric chloride pumps if the entire train is turned off at the Master PLC, the duty sulphuric acid dosing pump is locked out.
- .3 The Sodium Hydroxide feed pumps shall operate as follows:
 - .1 Two duty and one standby pump delivers sodium hydroxide to the line upstream of the Clearwell for pH and alkalinity adjustment.
 - .2 The sodium hydroxide dosage varies depending on the pH and alkalinity of the water. A compound control loop based on the totalized water flow from the chlorine contact channel and chlorine contact channel effluent pH are used to control the sodium hydroxide feed pumps to maintain a user-defined pH set point between 7.5 and 7.8. A compound loop process controller with feed forward capabilities (based on the totalized effluent flow rate) and feedback capabilities (based on the average pH of treated water) will provide control of the duty metering pump.
- .4 The pump Manufacturer shall Supply and Install all wiring and conduit within each skid package. Cables between skids shall be Supplied and Installed as described in Division 16.

2.6 Factory Finishing

- .1 Supply and Install, prime, and finish coat in accordance with Section 11901 – Factory Applied Protective Coatings, or request a deviation for approved equal at Shop Drawing submittal for Manufacturer's standard coating.

2.7 Spare Parts and Maintenance Materials

- .1 Supply the following spare parts for each pump skid:
 - .1 One (1) service set (including gears, shoes, bearings (if required) and O-rings).
 - .2 One (1) set of ceramic wear parts.
- .2 Supply a list of spare parts which would be expected to be required over a period of five years under normal conditions. At the Contract Administrator's request, provide a price for the listed parts.

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3. EXECUTION

3.1 Installation by Contractor

- .1 Installation will be by the Contractor in accordance with the Manufacturer's printed installation instructions. Installation includes but is not limited to:
 - .3 Adjust pump assemblies such that the driving units are properly aligned, plumb, and level with the driven units and all interconnecting shafts and couplings. Do not compensate for misalignment by use of flexible couplings.
 - .4 Connect suction and discharge piping without imposing strain to pump flanges.

3.2 Field Finishing by Contractor

- .1 Provide field finishing with touch ups for equipment as specified in Section 09901 – Painting and Finishing – Process Mechanical.

3.3 Field Quality Control by Contractor

- .1 Functional Tests: Conduct on each pump.
 - .1 Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
 - .2 Flow Output: Measured by WTP instrumentation and storage volumes.
 - .3 Operating Temperatures: Monitor bearing areas on pump and motor for abnormally high temperatures.
- .2 Performance Test: In accordance with Hydraulic Institute Standards and/or more stringent requirements as described herein for operating conditions indicated in supplemental equipment data sheets.

3.4 Manufacturer's Representative Field Services

- .1 Verify satisfactory delivery of the equipment by completing Form 100, illustrated in Section 01650 – Equipment Installation.
- .2 Instruct Contractor in the methods and precautions to be followed in the installation of the equipment. Certify the Contractor's understanding by completing Form 101, illustrated in Section 01650 – Equipment Installation.
- .3 Arrange for a technically qualified Manufacturer's Representative to attend the installation work, certify correct installation, train operating and maintenance staff and undertake the testing of the system for sufficient periods, to ensure the equipment is installed, operated, and maintained in accordance with the Manufacturer's recommended procedures.

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- 4 The minimum periods of Site attendance as total number of business days for all equipment are identified in the following table along with the form to be completed on each of these trips.
- 5 The total number of trips will depend on the Contractor's schedule. The cost of additional trips, to be determined by the Contract Administrator, will be borne by the Contractor. Arrange for a technically qualified Manufacturer's Representative to attend the installation work, certify correct installation, train operating and maintenance staff and undertake the testing of the system for sufficient periods, to ensure the equipment is installed, operated, and maintained in accordance with the Manufacturer's recommended procedures.

Item	Description	Total number of days	Form
1	Equipment Delivery	1	100
2	Installation Assistance	1	101
3	Witnessing of Equipment Installation	2	102
4	Assistance in Equipment Performance Testing	4	103
5	Operator and Maintenance Training	4	T1

3.5 Installation Witnessing

- 1 The Contractor shall ensure that equipment is installed plumb, square and true within tolerances specified by the Manufacturer's Representative and as indicated in the Contract Documents.
- 2 The Manufacturer's Representative shall ensure the equipment is installed as required to provide satisfactory service.
- 3 The Manufacturer's Representative and the Contractor are to cooperate to fulfill the requirements for a successful installation as documented by Form 102, illustrated in Section 01650 – Equipment Installation.

3.6 Equipment Performance Testing

- 1 The Manufacturer's Representative shall ensure that each pump, including all component parts, operates as intended.
- 2 The Manufacturer's Representative shall demonstrate satisfaction of requirements specified herein.

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- .3 The Manufacturer's Representative and the Contractor are to cooperate to fulfill the requirements for successful testing of the equipment as documented by Form 103, illustrated in Section 01650 – Equipment Installation.

2.8 Training

- .1 The Manufacturer's Representative shall provide the services of factory trained instructors for the purpose of training the City's personnel in the proper operation and maintenance of the equipment as documented by Form T1. Conform to the requirements of Section 01650 – Equipment Installation.

3.8 Supplements

- .1 The supplements listed below, following "END OF SECTION," are a part of this Specification.
- .2 Data Sheets:
 - .1 Ferric Chloride Gear Pumps: Tag Nos. P-S160A, P-S170A, P-S180A
 - .2 Sulphuric Acid Gear Pumps: Tag Nos. P-S230A, P-S240A, P-S250A
 - .3 Sodium Hydroxide Gear Pumps: Tag Nos. P-S350A, P-S360A, P-S370A

END OF SECTION

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SUPPLEMENT 1 – FERRIC CHLORIDE GEAR PUMPS

PARAMETER	VALUE
Tag No. (s)	P-S160A, P-S170A, P-S180A
No. of Pumps	2 duty, 1 standby
Commodity	Ferric Chloride
Specific Gravity	1.34
Concentration (%)	39
Solids Concentration Range (%)	N/A
Solids Concentration Operating Range (%)	N/A
Minimum Volumetric Flow Rate (litres/hour) per Pump	60
Maximum Volumetric Flow Rate (litres/hour) per Pump	660
Backpressure (kPa) (excludes losses internal to pump)	250
Minimum Pump Flow Turndown Ratio	100:1
Pump Operation Duration (h/d)	24
Flow Operating Range (L/hr)	60 - 660
Fluid Temperature Operating Range (°C)	0.5 - 25
Driver Voltage (V/phase/frequency)	600/3/60
Speed (max)	N/A
Motor Suitable for VFD	Yes
Minimum Pump Efficiency at Design Point (%)	80%
Acceptable Manufacturers	Micropump Series 220

N/A – not applicable.

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SUPPLEMENT 2 – SULPHURIC ACID GEAR PUMPS

PARAMETER	VALUE
Tag No. (s)	P-S230A, P-S240A, P-S250A
No. of Pumps	2 duty, 1 standby
Commodity	Sulfuric Acid
Specific Gravity	1.83
Concentration (%)	93
Solids Concentration Range (%)	N/A
Solids Concentration Operating Range (%)	N/A
Minimum Volumetric Flow Rate (litres/hour) per Pump	6
Maximum Volumetric Flow Rate (litres/hour) per Pump	225
Backpressure (kPa) (excludes losses internal to pump)	350
Minimum Pump Flow Turndown Ratio	100:1
Pump Operation Duration (h/d)	24
Flow Operating Range (L/hr)	6 – 225
Fluid Temperature Operating Range (°C)	0.5 – 25
Driver Voltage (V/phase/frequency)	600/3/60
Speed (max)	N/A
Motor Suitable for VFD	Yes
Minimum Pump Efficiency at Design Point (%)	80%
Acceptable Manufacturers	Micropump Series 220

N/A – not applicable.

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SUPPLEMENT 3 – SODIUM HYDROXIDE GEAR PUMPS

PARAMETER	VALUE
Tag No. (s)	P-S350A, P-S360A, P-S370A
No. of Pumps	2 duty, 1 standby
Commodity	Sodium Hydroxide
Specific Gravity	1.54
Concentration (%)	50
Solids Concentration Range (%)	N/A
Solids Concentration Operating Range (%)	N/A
Minimum Volumetric Flow Rate (litres/hour)	435
Maximum Volumetric Flow Rate (litres/hour) Combined Duty Pumps	1,425
Backpressure (kPa) (excludes losses internal to pump)	250
Minimum Pump Flow Turndown Ratio	100:1
Pump Operation Duration (h/d)	24
Flow Operating Range (L/hr)	100 - 1500
Fluid Temperature Operating Range (°C)	12-30
Driver Voltage (V/phase/frequency)	600/3/60
Speed (max)	N/A
Motor Suitable for VFD	Yes
Minimum Pump Efficiency at Design Point (%)	80%
Acceptable Manufacturers	Micropump Series 220

N/A – not applicable.