.5 Motors for variable frequency systems are not to deliver more than 80% of the motor's service factor rating by any load imposed by the driven machine at any specified operating condition or any condition imposed by the driven machine's performance curve at maximum operating speed.

.6 Ensure motors have adequate cooling capacity when operating through the entire speed range capacity of the drive.

2.9 Vertical Motors

.1 Unless otherwise specified, provide full voltage vertical motors with a Type P base specifically designed for vertical installation.

.2 Universal position motors are not acceptable.

.3 Provide vertical motors with solid shafts unless specified otherwise.

.4 Provide thrust bearing rating compatible with the loads imposed by the driven equipment.

2.10 Two Speed Motors

.1 Provide two speed motors with separate windings. Single winding two speed motors are not acceptable.

2.11 Power Factor Correction Capacitor Sizing

.1 Confirm the maximum capacitor size which may be connected to motors 37.5 kW and larger, on constant speed drives.

2.12 Finishes

.1 Finish motors in accordance with Division 16.

2.13 Equipment Identification

.1 Provide equipment identification in accordance with Division 11 and Division 16.

.2 Nameplates

.1 Provide motor nameplates on engraved or stamped stainless steel. Include information enumerated in NEMA Standard MG1, paragraph 10.37, 10.38 or 20.60, as applicable.

.2 Additionally, indicate:

.1 The AFBMA L-10 rated life for the motor bearings for motors 37.5 kW and larger.

.2 The nominal efficiency for all motors.

.3 Class, division, group and UL frame temperature limit code for explosion-proof motors.

.4 Permanently fasten nameplates to the motor frame and position to be easily visible for inspection.

2.14 Spare Parts

.1 Provide spare parts in accordance with Section 11005.

3. EXECUTION

3.1 Manufacturers Representative

.1 All motors are supplied as an integral component of some other item of equipment. The manufacturer's representative for that equipment is responsible for the supervision of installation, site testing, and commissioning of the motor as part of the equipment as specified in other sections. Ensure that the motor manufacturer's representative informs both the representative for the equipment and the installer of requirements for the motor, installation, testing and commissioning.

3.2 Installation

.1 Dry the motor if dampness is present, in accordance with manufacturer's recommendations.

.2 Install or ensure the motor is properly installed to provide satisfactory service.

.3 Make connections as indicated. Use liquid-tight PVC jacketed flexible conduit between rigid conduit and motor.

.4 Make flexible conduit long enough to permit movement of motor over entire length of slide rails, when applicable.

.5 Check for correct direction of rotation, with motor uncoupled from driven equipment.

.6 Align and couple motor to driven machinery to manufacturers instructions, using only correct parts such as couplings, belts, sheaves, as provided by manufacturer.

.7 Install anchor devices and setting templates in accordance with Division 3.

3.3 Testing

.1 Perform tests and document results in accordance with Division 16.

3.4 Testing and Commissioning

.1 Ensure the motor operates as intended during testing of the individual equipment and during process commissioning.

END OF SECTION

PROCESS PUMPS – GENERAL REQUIREMENTS

1. GENERAL

1.1 Description

.1 This section defines the general requirements for the supply and supervision of installation and commissioning of all pumps required for this project.

1.2 Definitions

.1 The terms in the specification generally comply with the definitions of the Hydraulic Institute.

.2 Definitions:

.1 Efficiency: Pump efficiency is calculated as the delivered hydraulic power divided by the electrical power at the inlet box of the pump. Take full account of mechanical and electrical losses.

.2 Performance Curve: The performance curve is a graph of the flow delivered (L/s, x-axis) in relation to the discharge head (metres, y-axis). It generally denotes efficiencies as isopleths and may include NPSH requirements as a function of the flow.

.3 BEP: The BEP (Best Efficiency Point) is the point in the pump performance curve where the pump operates at its highest efficiency.

.4 Rating Point: The pump rating point is the combination of discharge head and flow that the pump must satisfy. It typically is determined on the basis of all duty pumps (one or more, depending on the service) operating simultaneously against the worst system conditions (typically maximum headloss, minimum suction head, maximum discharge head, etc.). This condition is listed in the detailed pump specification and must be satisfied by the pump supplied.

.5 Low Head Point: The low head point is the combination of head and flow that corresponds to the least head the pump might operate against. It is determined on the basis of only one duty pump operating against the system conditions which would produce the least discharge pressure (typically minimum headloss, maximum suction head, minimum discharge head, etc.). The minimum system head is shown or described for each pump. The manufacturer must ensure that the pump can operate satisfactorily, without cavitation in the pump casing or over-stressing of the motor, at the intersection of the pump curve and the minimum head curve, or low head point.

.6 Low Speed Point: The minimum flow and head conditions against which a variable speed pump is expected to operate.

.7 NPSH (Net Positive Suction Head): The total pressure (atmospheric) at the pump suction. The available NPSH is the pressure available at the pump suction and is a function of site atmospheric pressure and suction piping losses. Required NPSH is the pressure required at the pump suction to ensure cavitation due to water column separation does not occur. Required NPSH shall be defined by the pump supplier at the pump inlet connection whether that be at the casing or at the face of a suction reducer/ elbow supplied as an integral part of the pump.

.8 Minimum Diameter Passing: Solids handling pumps have listed a minimum diameter passing. A sphere of this size must be capable of passing from the pump intake to the discharge.

1.3 Submittals

.1 Shop Drawings: Submit in accordance with Section 01300 and Section 11005. For all pump shop drawings, in addition to the requirements of Section 11005, include the following specific details:

.1 Performance curve for the pumping unit(s) superimposed on the system curve for the particular pumping application. Where the system curve is not included in the specifications, request this information from the Engineer when required. With the performance curve, include efficiency isopleths and NPSHR variation with flow. Where required in the specific pump sections, the performance curve should be certified in accordance with Hydraulic Standards.

.2 Motor operating data, including motor and insulation ratings, start-up and operating current ratings, operating voltage and amperage tolerances, description of construction complete with illustrative drawings, and any other pertinent information.

.3 List of materials of construction, detailing the component parts of the pump(s), their materials of construction, and reference specifications for those materials.

.4 Required ancillary services including, but not limited to electrical, seal water, and drains. The sizes, ratings, and any other pertinent information related to these services.

.5 Installation instructions indicating assembly and mounting requirements, alignment and assembly tolerances, and points of connection for ancillary services (electrical, seal water, drains, etc.).

.6 Start-up instructions including lubricant requirements, electrical requirements, etc.

.2 Operating and Maintenance Data: Provide for incorporation in operation and maintenance manual as specified in Section 01300. Include the following:

.1 Complete description of operation

.2 General arrangement and detailed drawings

.3 Wiring diagrams for power and control schematics

.4 Parts catalogues with complete list of repair and replacement parts with section drawings, illustrating the connection and the parts manufacturer's identifying numbers.

.3 Number of weeks prior to shipment that Engineer will be required to supply final conditions of flow and head for trimming the impeller. Manufacture casings to the conditions given on the system head curves, but complete final trim of the impellers according to the flow and head supplied for this pump on or before a date agreed on between Contractor and the Engineer.

1.4 Coordination

.1 Coordinate with other Divisions to ensure there are no conflicts in the work.

1.5 Shipment, Protection and Storage

.1 Ship pre-assembled to the degree that is possible. Inform installer of any site assembly requirements.

.2 Securely fasten heavy wood blanks to the pump flanges. Use blanks that are larger diameter than the flange. Protect machined surfaces against rusting. Protect threaded connections with threaded plugs or caps. Protect open, plain pipe ends with caps.

.3 Where pumps are to be stored on-site for any period of time exceeding one week, instruct site staff of specific requirements to ensure there is no uneven wear or distortion of pump component parts.

.4 Identify any special storage requirements.

2. PRODUCTS

2.1 Pump Performance Requirements

.1 Provide pumps that are suitable for continuous duty.

.2 Select impellers for fixed speed pumps that permit operation at an efficiency within 5 percent of the efficiency at the Best Efficiency Point.

.3 For variable speed pumps, select pump speed and impeller diameter which allow operation from the Rating Point to the Low Speed Point at efficiencies within 10% of efficiency at the Best Efficiency Point.

.4 Ensure that motors are sufficiently sized to drive pumps at a maximum speed when the head is as defined for the low head point.

.5 Provide pumps capable of operating at 30% of the flow at the rated capacity with good efficiency without exceeding the motor horsepower, and capable of operating at any point on its characteristic curve, to where that curve intersects the low head point, without exceeding motor power rating.

2.2 Pressure Sensing

.1 Supply a means of measuring inlet and outlet pressure with each pump, except as noted.

.2 For centrifugal pumps handling clean water, provide gauges for the inlet and outlet of each pump. Mount on the connections described for equipment in Section 11005.

.3 For submersible pumps, provide only one gauge for mounting on the discharge of the pump on a weldolet installed outside, but within 2 metres of the wetwell.

.4 For centrifugal pumps handling sewage, sludge, grit, or effluent water, provide one pressure sensor and one gauge for each pump. Refer to standard details for mounting requirements.

.5 For positive displacement pumps (diaphragm, piston, etc.), provide full pipe diameter annular ring pressure sensor for both the suction and discharge, complete with gauges and connections for instrumentation devices.

.6 Refer to Division 17 for instrument specifications for gauges and pressure sensors.

2.3 Pump Seals

.1 Provide double mechanical seals, as scheduled, unless otherwise noted in the pump data sheets.

.2 Provide non-destructive, self-aligning seals of the stationary design with require no wearing sleeve for the shaft.

.3 Material of construction:

Type of Service	Metal Parts	Spring(s)	O-Rings	Faces
Potable water	316 or 317L Stainless Steel	316 or Hastelloy C	Buna-N or Viton	Silicon Carbide on Carbon
Sewage	316 or 317L Stainless Steel	316 or Hastelloy C	Viton	Sintered Silicon Carbide on Carbon
Secondary Sludge (RAS), WAS, TWAS, and SUB	316 or 317L Stainless Steel	316 or Hastelloy C	Viton	Tungsten Carbide on Sintered Silicon Carbide
Primary Sludge	316 or 317L Stainless Steel	316 or Hastelloy C	Viton	Tungsten Carbide on Sintered Silicon Carbide

.4 Approved manufacturers are:

.1 Durametalic
.2 John Crane
.3 Chesterton

2.4 Bearings

.1 Refer to Section 11005.

2.5 Protective Guards

.1 Provide a protective guard for all couplings and keys, drive belts, or other exposed rotating devices. As a minimum, conform to the requirements of Section 11005.

2.6 Couplings

.1 For all pumps other than submersible and where noted otherwise in the detailed specifications, provide flexible, double disc, spacer type couplings between the pump shaft and driver shaft conforming with Section 11005.

.2 Design couplings so that the pump unit can be disassembled without disturbing face piping.

2.7 Pipeline Couplings

.1 Where shown on the drawings, provide single arch flexible couplings at the suction and discharge of pumps. Refer to Section 15053, Clause 2.2.5.

2.8 Shafts

.1 Design shafts to absorb 1.15 times the rated power of the motors required to drive the pumps when the pump is fitted with maximum size impellers.

2.9 V-Belt Drives

.1 Do not use V-belt drives unless specified or shown on the drawings.

.2 Conform to the requirements of Section 11005.

2.10 Spare Parts

.1 For each pump, provide for one spare mechanical seal or packing kit (as applicable) and one set of pump bearings.

.2 For each centrifugal pump type and size, provide a single impeller, wear plate, suction ring (if replaceable), one pump shaft, and nut.

.3 Meet additional spare parts requirements as stated in detailed equipment specification sections.

2.11 Factory Performance Testing

.1 Where required for specific pumps, as noted in the sections related to those pumps, factory performance test all pumps.

.2 Conduct factory performance testing in compliance with the Hydraulic Institute Standards.

.3 Inform the Engineer at least three weeks prior to the factory testing to allow for the Engineer's attendance.

.4 Certify test results and summarize findings in a short report. Submit report within three weeks of completing factory tests.

.5 Where the pump(s) does not satisfy the specified performance requirements within the tolerances specified by the Hydraulics Institute, redesign, modify, and retest the pump(s), all at no additional cost.

.6 Do not ship the pump(s) until the test result report has been submitted to the Engineer.

2.12 Protective Coatings

.1 Factory prime all pumps in accordance with Section 09905. Finish coat submersible pumps in the factory in accordance with Section 09905.

3. EXECUTION

3.1 General

.1 Comply with the requirements of the specific sections for the pumps to be provided.

3.2 Installation

.1 Comply with the requirements of Section 11020 and any special requirements listed in the specific sections related to each pump.

3.3 Testing

.1 Field test all pumps greater than or equal to 3.7 kW, and smaller units where noted, to verify performance.

.2 Provide temporary connections, flow monitoring, pressure monitoring, ammeters, and temporary tankage required for the performance of the tests.

.3 Flow Metering

.1 Where possible, use fill and draw techniques to determine the amount of flow conveyed during the test period. Ensure that the volumes are sufficient for at least 5 minutes of pump operation at the flows that are to be tested, other than run-out.

.2 Where permanent flow meters are installed on the downstream piping, they may be used to measure the flow during testing when accepted by the Engineer. Ensure that the permanent flow meters are calibrated to within five percent of the rated flow of the pump to be tested prior to testing.

.3 Temporary metering may be used if accepted by the Engineer. Temporary meters must have an accuracy of plus or minus 5 percent, at the rated flow of the pump, to be acceptable.

.4 Where other methods are not possible or where directed, use dye testing to determine the flow during the test periods. Dye testing is to be conducted by an agency acceptable to the Engineer. Measured flows during the testing will be certified by a qualified Engineer to be within five percent of the actual flows.

.4 Pressure Monitoring

.1 Do not use permanent gauges for pressure monitoring during tests. Temporary test gauges can be connected to the permanent gauge taps.

.2 Use gauges with sufficient accuracy to measure anticipated pressures on pump discharges within 2.5%. Where pump suction draws from an open tank or wet well, test gauge must be capable of measuring pressure at pump suction within 1.0 kPa.

.3 Provide evidence of pressure gauge calibration within 3 months of conducting tests.

.5 Test pump(s) at a minimum of three flow conditions, typically corresponding to the rating point flow, 75% of that flow, and 120% of that flow. At each test point, measure flow, pressure, and amperage. In addition, verify run-out conditions.

.6 For variable speed pumps, conduct the tests at two speeds, typically 100% of the design speed and 30% of the design speed

.7 Field Test Report

.1 Compile field test results into a report for submittal to the Engineer.

.2 Describe test set-up and measurement devices used to conduct the tests.

.3 For each pump, list the specified performance requirements and field test results. Show field test results (flow, pressure, power draw) superimposed on the performance curve provided with the submission.

.8 Where field tests do not verify compliance with specified performance requirements, investigate cause for noncompliance, undertake remedial work as required to bring pump into compliance, or replace the pump and all necessary ancillaries, and retest to prove compliance. All work required to bring the pump into compliance is the responsibility of the Contractors.

END OF SECTION

SELF-PRIMING SEWAGE PUMPS

1. GENERAL

1.1 Description

.1 This Section specifies the supply and supervision of the installation, testing, and commissioning of horizontally mounted, self priming, centrifugal pumps, designed specifically for handling raw, unscreened, domestic sanitary sewage.

1.2 Submittals

.1 Shop Drawings: Submit in accordance with Section 01300 and Section 11005.

.2 Operation and Maintenance Data: Provide data for incorporation in the Operation and Maintenance Manual as specified in Section 01300. Include complete operation description together with general arrangement and detailed drawings, wiring diagrams for power and control schematics, parts catalogue with complete list of repair and replacement parts with Section drawings illustrating the connections and identifying numbers.

1.3 Coordination

.1 Coordinate design, supply and installation of pumps and motors.

1.4 Shipment, Protection, and Storage

.1 Ship pre-assembled to the degree that is practical.

.2 Identify special storage requirements. Store on site until ready for incorporation into the work using methods recommended by the manufacturer to prevent damage, undue stress or weathering.

1.5 Warranty

.1 Pump shaft seal shall be warranted for minimum of 4 yrs from substantial completion. Should seal fail within first year, manufacturer shall be obligated, upon notification, to furnish new seal, without charge to OWNER, F.O.B. factory. Cost of replacement seals to OWNER thereafter will be on prorated as follows:

Failure Within	Percentage of New Seal Price
2 years	25%
3 years	50%
4 years	75%

2. PRODUCTS

2.1 Description

.1 Pumps shall be horizontal, self-priming centrifugal type, designed specifically for handling raw, unscreened, domestic sanitary sewage.

2.2 Acceptable Manufacturers

.1 Gorman Rupp

2.3 Capacities and Performance

.1 Specific pumps are listed in the detailed specification sheets at the end of this section. Required performance data and system curves are presented.

2.4 Raw Wastewater Lift Pumps

.1 Size: 150 mm diameter suction and a 150 mm diameter discharge connection.

.2 Construction:

.1 Construct areas of pump casing and volute, which are exposed to sewage, of cast iron of no lesser grade than Class 30.

.2 Impeller:

.1 Impeller shall be two-vaned, semi-open, non-clog, cast-in-ductile iron with integral pump out vanes on back shroud. Impeller shall thread onto pump shaft and be secured with lockscrew.

.3 Seal:

.1 Seal pump shaft against leakage by mechanical seal. Both stationary sealing member and mated rotating member shall be of tungsten titanium carbide alloy. Each of matted surfaces shall be lapped to flatness of 1/2 light band (5.8 millionths of in.), as measured by optical flat under monochromatic light. Stationary seal seat shall be double floating so that faces will not lose alignment during periods of shock loads that will cause deflection, vibration, and axial movement of pump shaft.

.2 Lubricate seal with oil from separate, oil-filled reservoir. Do not use oil to lubricate both shaft seal and shaft bearings.

.4 Shaft Bearings:

.1 Anti-friction ball or tapered roller bearings, of ample size and proper design to withstand radial and thrust loads which can reasonably be expected during normal operation.

.2 Lubricate bearings from separate reservoir.

.3 Pump designs, in which same oil lubricates both shaft bearings and shaft seal, are not acceptable.

.5 Configuration:

.1 Pumps shall be belt driven. Size sheaves and belts for horsepower ratings. Provide guards with belt driven system.

.3 Internal Passages:

.1 Openings, internal passages, and internal recirculation ports shall be large enough to permit passage of sphere 3 in. in dia and any trash or stringy material.

.2 Screens or internal devices that interfere with maintenance or with priming and performance of pump are not permitted.

.4 Serviceability:

.1 Special Tools:

.1 No special tools shall be required for replacement of any components within pump.

.2 Cover Plate:

.1 Equip pump with removable cover plate, allowing access for service and repairs without removing suction or discharge piping.

.3 Wear Plate and Rotating Assembly:

.1 Fit pump with replaceable wear plate. Replacement of wear plate, impeller, seal, and suction check valve shall be accomplished through removable cover plate. Entire rotating assembly, which includes bearings, shaft, seal, and impeller, shall be removable as unit without removing pump volute or piping.

.4 Suction Check Valve:

.1 Provide suction valve that can be removed or installed through removable cover plate opening, without disturbing suction piping. Function of check valve shall be to eliminate repriming with each cycle. Pumps requiring suction check valves to prime or reprime are not acceptable.

.5 Impeller Clearance Adjustment:

.1 Means shall be provided for external adjustment of clearance between impeller and wear plate. Entire rotating assembly shall move as one unit to enable clearances to be adjusted. Clearance adjustment by means of moving shaft, thereby affecting seal, are not acceptable.

.6 Air Release Valves:

.1 Equip pump with one automatic air release valve, designed to permit escape of air to atmosphere during initial priming or unattended repriming cycles. Upon completion of priming or repriming cycle, valve shall close to prevent recirculation. Valves shall provide visible indication of valve closure, and shall operate solely on discharge pressure. Valves which require connection to suction line are not acceptable.

.2 Valve parts exposed to sewage shall be constructed of cast-iron, stainless steel, or similar corrosive resistant materials. Diaphragms, if used, shall be fabric-reinforced neoprene or similar inert material.

.3 Provide cleanout port, 3 in. or larger in dia, for ease of inspection, cleanout, and service.

.4 Valves shall be field adjustable for varying discharge heads.

.7 Gauge Kit:

.1 Equip pump with glycerin-filled compound gauge to monitor suction pressure, and glycerin-filled pressure gauge to monitor discharge pressures. Gauges shall be minimum of 4 in. in dia, and shall be graduated in feet water column. Rated accuracy shall be 1% of full scale reading. Compound gauges shall be graduated from -30 ft to 30 ft water column minimum. Pressure gauges shall be graduated 0 to 140 ft water column minimum.

.2 Mount gauges on resilient panel and frame assembly secured to pumps or piping. Provide hoses and fittings, and shutoff valve installed in each gauge inlet at point of connection to suction and discharge pipes.

.8 Motors:

.1 Motor types, voltages, service conditions and power ratings are indicated in the detailed pump specification sheets at the end of this section.

.2 Provide motors that comply with the provisions of Section 11205.

.3 Variable speed drives are specified in Division 16. Certify compatibility between pump motor and drive manufacturers as specified in Section 11205.

2.5 Protective Coatings

.1 Factory prime and finish in accordance with Section 09905.

2.6 Spare Parts

.1 In addition to the spare parts required in Section 11300, provide the following:

.1 One bearing set per pump.

.2 One seal per pump

2.7 Source Quality Control

.1 Factory Tests:

.1 Perform factory certified test on each pump in accordance with test requirements of Hydraulic Institute.

.2 Test shall determine capacity, head, power input, efficiency, and water hp.

.3 Minimum of 6 points shall be taken including rated condition and shut-off.

.4 Submit certified performance curves.

.5 Subject pumps to hydrostatic test and provide certification of hydrostatic test. Hydrostatic pressure shall be not less than 1-1/2 times shut-off pressure of pump.

.6 Prior tests on similar or identical pumps not acceptable.

.2 Reprime Test:

.1 Each pump shall be capable of reprime lift of 19 ft while operating at selected speed and selected impeller dia. Reprime lift is defined as static height of pump suction centerline above liquid that pump will prime and delivery within 5 min on liquid remaining in pump casing after delivering pump is shut down with suction check valve removed.

.2 Install 10 ft length of 1 in. pipe between pump and discharge check valve. Line shall be open to atmosphere at all times to duplicate air displacement rate of typical pump station fitted with air release valve.

.3 No restrictions shall be present in pump or suction piping, which could serve to restrict rate of siphon drop of suction leg. Suction pipe configuration for reprime test shall incorporate minimum horizontal run of 4-1/2 ft and one 90E elbow.

.4 Impeller shall be set at clearances recommended by manufacturer in pump service manual.

.5 Reprime lift repeatability shall be demonstrated by five sequential reprime cycles.

.6 Liquid to be used for reprime test shall be water.

3. EXECUTION

3.1 Installation

.1 Install pumps as per manufacturer's recommendations.

.2 Ensure that each pump is installed to provide satisfactory service.

3.2 Testing

.1 Ensure that each pump, including all component parts, operates as intended.

.2 Refer to Section 11300 for testing requirements.

3.3 Commissioning

.1 Conform to the requirements of Section 01735

END OF SECTION

DETAILED PUMP SPECIFICATION

Description: Self-Priming Lift Pumps

Tag Number: P-101, P-102

Design Conditions :

Liquid:	Raw Sewage
Liquid temperature:	10 to 20°C
Solids content:	0 to 15,000 mg/L
Atmospheric pressure:	101 kPa
Solids passing:	75 mm

Rating Point:

Rating Point Design Flow	44 L/s
Rating Point TDH (Nominal)	18 m

Construction:

Suction Connection:	150 mm
Discharge Connection:	150 mm
Flange Rating:	Class 125
Seals:	Single Mechanical, Flushless
Impeller Type:	Two or three vane
Impeller Material:	Hardened High Chrome Iron, 450 BHN
Casing Material:	Cast Iron, ASTM A48 Class 30

Driver:

Drive Type:	Belt Drive and Variable Speed Motor
Motor Type:	TEFC
Voltage/Phase/Frequency:	600 V/3-phase/60 Hz
Motor Size:	30 kW (40 hp)
Motor Synchronous Speed:	1800 RPM
Maximum Pump Speed:	1550 RPM

Accessories:

Automatic Air Release Valve

Design Standard:

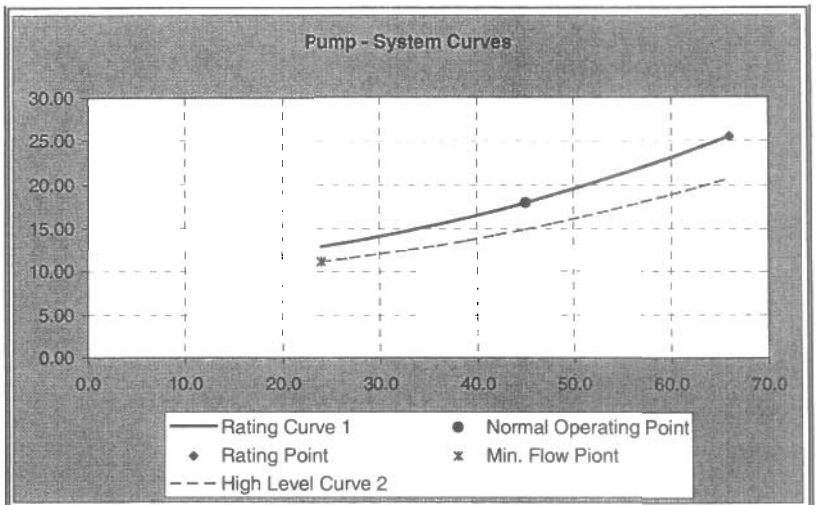
Gorman Rupp – Model T6A-3-B

Acceptable Products:

Gorman Rupp

DETAILED PUMP SPECIFICATION

System Curve: Lift Pumps



Flow (L/s)	Rating Curve 1 TDH (m)	High Level Curve 2 TDH (m)	Comments	Tag Numbers P101, P102
24.0	12.95	11.10	Low Head Point	
27.0	13.50	11.52		
30.0	14.11	11.99		
33.0	14.78	12.50		
36.0	15.50	13.05		
39.0	16.27	13.64		
42.0	17.09	14.27		
45.0	17.97	14.94	Normal Operating Point	
48.0	18.90	15.64		
51.0	19.87	16.39		
54.0	20.90	17.18		
57.0	21.98	18.00		
60.0	23.11	18.86		
63.0	24.28	19.76		
66.0	25.51	20.70	Rating Point	

Notes:
1. Pumps operate as lead/lag.
2. Pump selected must be able to handle all conditions within operating range of 24 to 66 L/s, via VFD.

END OF SECTION

IDENTIFICATION

1. GENERAL

1.1 Work Included

.1 Identification of equipment, motors, vessels, valves, ferrous, non-ferrous, and insulated piping.

1.2 Submittals

.1 Submit list of plates for review prior to engraving.

.2 Submit colour board for approval, a minimum of three weeks prior to painting.

2. PRODUCTS

2.1 Equipment Nameplates

.1 Provide metal equipment nameplates on each piece of manufacturer's equipment, mechanically fastened, with raised or recessed letters.

.2 Provide Underwriters' Laboratories and/or CSA registration plates, as required by respective agency.

.3 Provide manufacturer's nameplates indicating size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors.

2.2 Equipment - Project Identification

.1 Supply and install black laminated identification plates with 12 mm high white letters on all equipment installed under this contract. Include the unit name and tag number.

2.3 Valving

.1 Provide all valves with a 32 mm diameter brass tag with 12 mm black engraved numbers complete with non-ferrous chains or 'S' hooks.

.2 Consecutively number valves in distinct systems in accordance with piping and instrumentation drawings.

.3 Furnish a directory consisting of a typewritten valve list showing the tag number, valve location, and its use. The directory may be made up in sections to suit the respective plant area or system.

2.4 Piping

.1 Paint all piping installed under this Contract, with identifying pipe markers designating the pipe service and the direction of flow, except for stainless steel pipe and aluminum recovered pipe which shall be banded and identified. Refer to Section 09905.

.2 Either paint or self adhesive decals are acceptable pipe markers.

.3 Direction arrows are to be 150 mm long by 70 mm wide for piping with an outer diameter 75 mm or larger, including insulation. Use 100 mm long by 20 mm wide for smaller diameters. Abbreviations for names of the pipe service are provided in the drawings.

2.5 Colour Coding

.1 Apply the colour coded system identification on the following items:

.1 All uninsulated piping and valves.

.2 All canvas and cotton insulated coverings.

.3 All pumps – coat pumps with the colour identifying the material being pumped.

.4 Paint all motors blue.

.2 Identification consists of the following:

.1 Full coating of non-stainless steel pipes and valves to the colour designated for the commodities being conveyed.

.2 Coat non-submerged process equipment to match the colour code of the material being processed.

.3 Paint valve handles, chain wheels, and similar appurtenances black.

.3 Identification colours shall be as directed by the Engineer and shall match existing, whenever possible. For factory finished equipment, the identification colours shall be identified by the Engineer during the shop drawing submission stage.

.4 Piping, ductwork, conduit and support identification colours and description shall match the existing schedule. Original colours indicated are from the Mobil Chemical line of products.

IDENTIFICATION/ DESCRIPTION LEGEND	COLOUR	ABBREVIATIONS USED ON DRAWINGS
Compressed Air	White 28-W-9 & 1 Black Band	CA
Drain	Black 28-J-5	DR
Instrument Air	White & 1 Black Band	INA
Raw Sewage	Charcoal	RS

IDENTIFICATION/ DESCRIPTION LEGEND	COLOUR	ABBREVIATIONS USED ON DRAWINGS
Sample Line	Same colour as line being sampled	SAL
Vent	Black 28-J-5	VNT
Process Equipment	Blue 28-B-15	
Supports	Black 28-J-5	

3. EXECUTION

3.1 Nameplates

.1 Locate nameplates so that they are easily read. Do not insulate or paint over plates.

3.2 Fasteners

.1 Attach plates to the equipment with sheet metal screws or nuts and bolts (adhesive is not acceptable).

.2 Fasten plates in conspicuous locations. On hot or cold surfaces where plates cannot be mounted, provide standoffs.

3.3 Piping

.1 On completion of protective coatings or finish painting, neatly stencil on yellow, green or white backgrounds, as appropriate, directional flow arrows and the pipe service or attach pipe marking labels.

.2 Provide pipe identification in readily visible locations. Identify pipes at each of the following locations:

.1 At each valve

.2 On both sides of wall penetrations

.3 At floor and roof penetrations

.4 On each leg of branches

.5 Every 10 m along continuous runs.

END OF SECTION