

Frame Mounted End Suction Pump With Integrated Variable Frequency Drive Specifications

Part I – GENERAL

1.1 WORK INCLUDED

A. Contractor shall furnish and install Grundfos end suction frame mounted pump, Grundfos Model LFE complete with pump, motor with integrated variable frequency drive (VFD), base frame, coupling and coupling guard in accordance with manufacturer's recommendations and plans.

1.2 REFERENCE STANDARDS

The work in this section is subject to the requirements of applicable portions of the following standards:

- A. HI – Hydraulic Institute
- B. ANSI – American National Standards Institute
- C. ASTM – American Society for Testing and Materials
- D. IEEE – Institute of Electrical and Electronics Engineers
- E. NEMA – National Electrical Manufacturers Association
- F. NEC – National Electrical Code
- G. ISO – International Standards Organization
- H. UL – Underwriters Laboratories, Inc.
- I. CSA –Canadian Standards Association
- J. OSHA – Occupational Safety & Health Administration
- K. ASME – American Society of Mechanical Engineers
- L. IEC– International Electrotechnical Commission
- M. ETL – Electrical Testing Laboratories

Part 2 – PRODUCTS

2.1 FRAME MOUNTED END SUCTION PUMPS

- A. Furnish and install frame mounted end suction pumps as per plans and pump schedule.
- B. The pump, integrated VFD motor, base frame, coupling and coupling guard shall be factory assembled at the pump manufacturer's facility. The pump manufacturer shall have complete unit responsibility.

2.1.1 PUMPS

- A. The pumps shall be flexible coupled, base mounted, single stage, end suction top discharge design, cast iron stainless steel fitted construction specifically designed for high performance.
- B. The pumps shall have the following features:

1. All pumps shall be of the back pull-out design so that the rotating element can be removed from the casing without disconnecting the suction or discharge piping. The casing material shall be close-grained cast iron ASTM A48 - Class 30 with a minimum tensile strength of 30,000 P.S.I. Volute shall have integrally cast suction and discharge connections, gauge ports at nozzles, and vent and drain ports. Pumps with specific speed greater than 1600 shall have double volute casing. Pumps with discharge size 3" and larger shall have suction splitter to reduce pre-rotation and improve efficiency. Casings shall be designed for scheduled working pressure and can withstand hydrostatic test at 150% of the maximum working pressure under which the pump could operate at design speed.
2. Pumps with impeller diameter larger than 5" shall be fitted with bronze renewable case wear rings.
3. Pumps with discharge size 2.5" and larger shall have full flanged connections on both suction and discharge. Suction and discharge flanges shall be drilled to ANSI Class 125# standards and be machined flat face.
4. Pumps with discharge sizes 2" and below shall have NPT threaded connection.
5. Pump shall be mounted on a heavy-duty cast-in-one-piece cast iron bearing frame with integrally cast feet to mount on a common base frame.
6. The bearing frame shall be of the back pull-out design and supply support for heavy-duty single row, double shield, deep groove greased for life ball bearings. The pump shaft shall be adequately supported by the pump bearings to limit the shaft deflection to 0.002 inches. Bearing shall provide a minimum L10 life of 20,000 hours.
7. The pump shaft shall be of solid, stress-proof steel AISI 1144 with Bronze sleeves covering the wetted area of the shaft.
8. The pump manufacturer shall recommend the proper mechanical seal based on the pressure, temperature and liquid outlined on the equipment schedule. Mechanical seals, at a minimum, shall have ceramic stationary seats, carbon rotating rings, Buna elastomers and stainless steel hardware. Application of a mechanical seal shall be internally flushed type, without requiring external flushing lines. Seals shall be capable of being inspected and easily replaced without removing the piping or volute.
9. Impeller shall be of the enclosed francis vane type, single suction design, made of Stainless Steel 304 (UNS S30400), both hydraulically and dynamically balanced to ISO 1940-1:2003 balance grade G6.3 and keyed to the shaft. The impeller shall be trimmed to meet the specific hydraulic requirements.
10. Pump Construction. The standard material of construction for the pump shall be as below. Special material shall be available as option to suit the liquid pumped.
 - Volute: Cast iron ASTM A48 - Class 30
 - Case Wear ring: Tin Bronze ASTM B584-90500
 - Impeller: Stainless Steel 304 (UNS S30400)

- Shaft: Stressproof Steel AISI 1144
 - Shaft Sleeve: Bronze III932 C89835
 - Mechanical Seals: Carbon – Ceramic with Buna Elastomers and Stainless Steel hardware
 - Bearings: Greased for life Heavy duty Single row Ball bearing
 - Bearing Frame: Cast iron ASTM A48 - Class 30
- C. A flexible coupling shall be employed between the pump and motor. A coupling capable of absorbing torsional vibration and of operating in variable speed applications shall be provided. An optional Spacer Coupler shall be available in order to allow for replacement of mechanical seals and bearings without disturbing pump volute or movement of the pump's motor with VFD and electrical connections.
- D. The pump manufacturer shall provide an OSHA approved coupling guard, which shall be mounted between the pump and motor.
- E. Base frame shall be cast iron or welded structural steel with securely welded cross members and integral drip pan. The minimum base plate stiffness shall conform to ANSI/HI 1.3-2000, section 1.3.5.3 for *Horizontal Base Plate Design* standards. Bases shall be groutable.
- F. Pump rotation shall be clockwise as viewed from the motor end.
- G. Pump shall be of a maintainable design for ease of maintenance and should use machine fit parts that are easily disassembled.
- H. Each pump shall be painted with one coat of high quality factory approved paint and name-plated before shipment from the factory.
- I. Pumps shall be manufactured and assembled in an ISO-9001 certified facility.

2.1.2 INTEGRATED VARIABLE FREQUENCY DRIVE MOTOR

- A. Each motor shall be of the Integrated Variable Frequency Drive design consisting of a motor and a Variable Frequency Drive (VFD) with a built-in pump system controller. The complete VFD/motor assembly shall be built and tested as one unit by the same manufacturer.
- B. The VFD/motor shall have an IP55 (TEFC) enclosure rating as a complete assembly. The motor shall have a standard NEMA C-Face, Class F insulation with a Class B temperature rise.
- C. The VFD shall be of the PWM (Pulse Width Modulation) design using up to date IGBT (Insulated Gate Bipolar Transistor) technology.
- D. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of the motor. The motor current shall closely approximate a

sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump control and to eliminate the need for motor de-rating.

- E. The VFD shall have, as a standard component, an RFI filter (Radio Frequency Interference) to minimize electrical noise disturbances between the power electronics and the power supply. The VFD/motor shall meet all requirements of the EMC directive concerning residential and light industry equipment (EN 61800-3).
- F. The VFD shall have a minimum of two skip frequency bands which can be field adjustable.
- G. The VFD shall have internal solid-state overload protection designed to trip within the range of 125-150% of rated current.
- H. The VFD/motor shall include protection against input transients, loss of AC line phase, over-voltage, under-voltage, VFD over-temperature, and motor over-temperature. The motor over-temperature protection shall consist of three series connected PTC thermistors, one for each motor phase.
- I. The VFD/motor shall provide full nameplate output capacity (horsepower and speed) within a balanced voltage range.
- J. Automatic De-Rate Function: The VFD/motor shall reduce speed during periods of overload allowing for reduced capacity pump operation without complete shut-down of the system. Detection of overload shall be based on continuous monitoring of current, voltage and temperature within the VFD/motor assembly.
- K. The VFD/motor shall have, as a minimum, the following input/output capabilities:
 - 1. Speed Reference Signal: 0-10 VDC, 4-20mA
 - 2. Digital remote on/off
 - 3. Fault Signal Relay (NC or NO)
 - 4. Fieldbus communication port (RS485)
- L. Motor drive end bearings shall be adequately sized so that the minimum L10 bearing life is 17,500 hours at the minimum allowable continuous flow rate for the pump at full rated speed.

2.1.3 PUMP SYSTEM CONTROLLER AND USER INTERFACE

- A. The pump system controller (Proportional-Integral) shall be an optional component of the integrated variable frequency drive motor developed and supported by the pump manufacturer.
- B. The pump system controller shall have an easy to use interface mounted on the VFD/motor enclosure. Pump system start/stop and set-point adjustment shall be possible through the use of two push buttons located on the drive enclosure.
- C. The VFD/motor shall be capable of receiving a remote analog set-point (4-20mA or 0-10 VDC) as well as a remote on/off (digital) signal.
- D. Pump status and alarm state shall be indicated via two LED lights located on the VFD/motor enclosure.
- E. Advanced programming and troubleshooting shall be possible via an infra-red hand held programmer or a field connected personal computer. Pump system programming (field adjustable) shall include as a minimum the following:

System Pressure set-point, psig	System start pressure, psig
System Stop pressure, psig	Minimum Pump Speed, %
Pressure Transducer supply/range	Maximum Pump Speed, %
System Time (Proportional Gain)	Integral Action Time

- F. The infra-red programmer shall be capable of displaying the following status readings:

Pump Status (on, off, min., max.)	System Set-point, psig
Actual system pressure, psig	Remote set-point, %
Pump speed, rpm	VFD/Motor input power, kW
VFD/Motor total cumulative kWh	VFD/Motor total operating hours

- G. The infra-red programmer shall also be capable of displaying the following alarms, with the last five alarms stored in memory:

Loss of sensor signal	Loss of external set-point signal
Under-voltage & Over-voltage	Motor overload (blocked pump)
Motor over-temperature	Drive over-temperature

Drive Over-current

2.1.4 SEQUENCE OF OPERATION

The system controller shall receive an analog signal [4-20mA] from the pressure transducer indicating the actual system pressure. When a flow demand is detected (system pressure drops below the start pressure) the VFD/motor shall start and increase speed until the actual system pressure matches the system set-point. As flow demand changes (increases or decreases), the speed of the pump shall be adjusted to maintain the system set-point pressure.

2.2 INSTALLATION

The pump shall be installed per manufacturer's recommendations. The pumps shall be realigned by the contractor, according to the standards of the Hydraulics Institute, after grouting of the base and connection of piping.

2.3 TESTING

Where noted on schedule, pumping equipment may require one or more of the following:

Certified Performance test

Hydro static test

NPSH Test

Any other factory test as noted in the pump Schedule

The testing shall be in accordance with Hydraulic Institute level B or the latest HI standard as noted in the pump schedule.

2.4 WARRANTY

The warranty period shall be a non-prorated period of 24 months from date of installation, not to exceed 30 months from date of manufacture. Warranty shall cover against defective material and/or faulty workmanship.

END OF SECTION