

End Suction Split Coupled Pump with Integrated Variable Frequency Drive Specifications

Part I – GENERAL

1.1 WORK INCLUDED

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

B. Pump unit shall have machined registered fits between volute, motor bracket and motor. No factory or field alignment shall be required on this pump unit.

C. The coupling design shall permit replacement of mechanical seal without requiring removal of the drive motor.

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
- N. NSF – National Sanitation Foundation

Part 2 – PRODUCTS

2.1 End Suction Split Coupled Pumps with Integrated VFD

- A. Furnish and install end suction split coupled pumps with Integrated VFD 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 split coupled, base mounted, single stage, end suction top discharge design, cast iron stainless steel fitted construction.
- 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 vesconite 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 structural steel base with cast iron motor deck and a ductile iron pump support.
 6. The pump shaft shall be of solid stainless steel AISI 303.
 7. 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.
 8. Recirculation line of nylon tubing with brass fitting shall be provided to vent the mechanical seal and cool the bushing (shaft bearing).
 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: Vesconite
- Impeller: Stainless Steel 304 (UNS S30400)
- Shaft: Stainless Steel AISI 303
- Coupling: 2011-T3, 2017-T4, or 2024-T351 Aluminium
- Motor Bracket: Cast Iron ASTM A48- Class 30
- Bushing (shaft bearing): Vesconite
- Pump Support: Ductile Iron ASTM 536- Class 65
- Mechanical Seals: Carbon – Ceramic with Buna Elastomers and Stainless Steel hardware
- Recirculation Line: Nylon Tubing with Brass Fittings

C. Pump shall be connected to the drive motor by a rigid, aluminum, axially split coupling capable of withstanding all torsional, radial and axial loads. The coupling design shall facilitate alignment of the motor and pump shaft.

D. The base shall be of bolted construction. The motor deck shall be cast iron with ductile iron pump support. The side rail shall be structural steel. The minimum stiffness of the base shall conform to ANSI/HI 1.3-2000, section 1.3.5.3 for *Horizontal Base Plate Design* standards. Bases shall be groutable.

E. Pump rotation shall be clockwise as viewed from the motor end.

F. Pump shall be of a maintainable design for ease of maintenance and should use machine fit parts that are easily disassembled.

G. Each pump shall be painted with one coat of high quality factory approved paint and name-plated before shipment from the factory.

H. Where noted on schedule the pump shall also be NSF-61 certified.

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. Two Analog Inputs: 0-10 VDC or 4-20mA
 - 2. One Analog Output
 - 3. Four Digital Inputs
 - 4. Fault Signal Relay (NC or NO)
 - 5. 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 | |

H. Control Modes:

| | |
|--------------------------------|----------------|
| Constant differential pressure | Constant curve |
| Constant pressure | Constant flow |
| Constant temperature | Constant level |

2.1.4 SEQUENCE OF OPERATION

The system controller shall receive an analog signal [4-20mA] from the transducer indicating the actual system pressure, flow, level, etc. As demand changes the VFD/motor shall increase or decrease the speed until the actual system matches the system set-point.

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