

SECTION 16483 MOTOR VARIABLE FREQUENCY DRIVE

PART 1 GENERAL

1.1 SUMMARY:

- A. Extent of drive work is indicated by drawings and schedules.
- B. Types of drives specified in this section include the following:
 - 1. Variable Frequency Drives
- C. Installation requirements in Part 3, shown in lighter type, shall be included with installation contract.

1.2 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacture of motor starters, of types, ratings and characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects utilizing motor starters similar to that required for this project.

1.3 SUBMITTALS:

- A. Product Data: Submit manufacturer's data.
- B. Shop Drawings: Submit layout drawings showing accurately scaled equipment locations and spatial relationships to associated motors.
- C. Wiring Diagrams: Submit wiring diagrams showing connections to electrical power panels, feeders, and equipment. Clearly differentiate between portions of wiring that are manufacturer-installed and portions to be field-installed.
- D. Maintenance Data: Submit O & M Manuals.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide motor starters of one of the following (for each type and rating of motor starter):
 - 1. Graham
 - 2. Robocon
 - 3. Allen Bradley

2.2 MOTOR VARIABLE FREQUENCY DRIVES:

- A. General: Except as otherwise indicated, provide motor drives and ancillary components which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation.

- B. Variable Frequency Drives:
1. Drive shall convert the constant frequency AC line voltage to a variable frequency, variable voltage AC output suitable for control of a standard NEMA design B induction motor over a 6:1 speed range.
 2. Variable Frequency Drives shall have the following features.
 - a. Controller input 460 volts, 3 phase, 60 Hz.
 - b. Controller output: 0-460 volts, 3 phase, 0-60 Hz.
 - c. Controller type: PWM or six step type, designed to minimize harmonic generated noise in the motor.
 - d. Enclosure type: NEMA 1.
 - e. AC line fused disconnect or circuit breaker.
 - f. AC line reactors in the drive cabinet for protection against line notching and surges without requirement for an input isolation transformer. Maximum total harmonic distortion shall not exceed 3 percent per IEEE 519.
 - g. Metal oxide varistors on incoming line for transient protection.
 - h. Control power and customer interface and bypass controls transformer with fused primary and 120V fused secondary.
 - i. Manual speed potentiometer, HAND-OFF-AUTO switch, and 4-20 milliamp, fully isolated and suitable for grounded or ungrounded input signal.
 - j. Instantaneous overcurrent shutdown with indicator light when current exceeds 200 percent.
 - k. Inverse characteristic time-overcurrent overload protection for the motor sized in accordance with NEC requirements.
 - l. Drive shall be capable of withstanding random application of an output short circuit without damage to output devices or fuses.
 - m. Input phase loss and under-voltage protection.
 - n. Torque/current limit control which will slow the motor without tripping when the motor is subjected to an overload, or slow the acceleration ramp when accelerating a high inertia load.
 - o. Troubleshooting and diagnostic features:
 - 1) Exterior drive door-mounted devices shall include:
 - a) Percent full load motor current display.
 - b) Output frequency and/or percent-speed meter.
 - 2) LED indicators for instantaneous overload, motor overload GTO or SCR status, current limit, over-temp, phase loss, under-voltage, ground-fault and other drive functions.
 - 3) Indicator lights on PC boards to indicate correct operation (or failure). Include current limit light.
 - p. UL listed.
 3. Variable frequency drives designated "with bypass" on drawings shall be equipped with a bypass device to allow for total isolation of the drive unit for service while providing for temporary operation of the motor. This shall include:

- a. A main disconnect switch in the bypass enclosure with a door interlock handle. This disconnect shall provide positive shutdown of all power to both the bypass circuitry and the VFD.
- b. A VFD output contactor and a constant speed contactor.
- c. A three pole motor overload relay with heaters connected to shut down the motor in both the VFD and bypass modes.
- d. A timing relay adjustable 5-30 seconds to prevent rapid switching from bypass to VFD modes.
- e. A control relay and terminal blocks which will allow two-wire, start-stop control of the motor from a single remote contract in both VFD and BYPASS (AUTO) modes of operation.
- f. A control relay and terminal blocks to allow connection of remote interlock shutdown contacts such as freezestats, smoke detectors, etc. When this interlock loop is opened, operation of the motor shall be disabled in both VFD and bypass modes.
- g. A four position oiltite selector switch shall be provided, VFD-OFF-BYPASS(AUTO)-BYPASS(MANUAL).
- h. Indicator lights on the face of the bypass panel shall be provided as follows. Indicators shall be long life neon, LED, or transformer type incandescent types.
 - 1) "POWER ON"
 - 2) "MOTOR ON VFD"
 - 3) "MOTOR ON BYPASS CONTROL"
 - 4) "MOTOR OVERLOAD"
 - 5) "INTERLOCK SHUTDOWN"
- i. 120V control power transformer with fused secondary and primary. Bypass mode operation shall be independent of VFD control power.
- j. VFD output contactor shall be wired to allow a controlled VFD deceleration ramp to stop.
- k. Panel shall be arranged to allow power-off maintenance of the VFD while motor is operating on bypass. Bypass circuitry in the same compartment as the VFD will not be allowed.
- l. Drive to be constructed so that all electrical components are accessible when drive is in operation.
- m. Provide individual adjustment settings for entry slope (minimum and maximum) speed points when drive is in AUTO. All settings to be adjustable over 50 percent of the speed range. Minimum/maximum speed points to be effective in HAND and AUTO modes.
- n. Auto restart of the VFD after incoming power or drive fault.
- o. When shown with by-pass, auto by-pass after 3rd fault within 15 minutes.

- p. Drives must be designed for the available line fault current.
- q. Drive to include one set of form C relay contacts that are energized when drive fault occurs.

PART 3 EXECUTION

3.1 INSTALLATION OF MOTOR VARIABLE FREQUENCY DRIVES:

- A. Install motor drives as indicated, in accordance with equipment manufacturer's written instructions and with recognized industry practices; complying with applicable requirements of NEC, UL and NEMA standards, to insure that products fulfill requirements.
- B. Coordinate with other work including motor and electrical wiring/cabling work, as necessary to interface installation with other work.
- C. Tests:
 - 1. Before shipment, each variable frequency drive shall be completely adjusted, operationally tested and given an extended burn-in at maximum rated enclosure temperature while running a loaded motor.
 - 2. The manufacturer shall provide a factory trained field service engineer for start-up coordination. Allow for two independent trips to the site. The first time will be for a thorough check of units and running at manual mode. The second time will be for testing and operating units in automatic and manual modes.
 - 3. After successful completion of start-up and operation of all drives for a minimum of 72 hours, the manufacturer's field service engineer shall also schedule and instruct a demonstration, training and maintenance course. This training is to take place at the jobsite and is directed to the Owner's division facilities and maintenance personnel for a minimum of eight hours. Schedule of this training shall be coordinated with the Owner field representative. Provide the Owner's field representative with three (3) sets of an updated wiring diagram and manual of maintenance and operation at least one (1) week in advance of schedule date for distribution to training participants.
 - 4. Document measured THD from 0-100 percent load and submit to verify THD is below specified level.
- D. Interlock With Controls:
 - 1. Provide a N.O. auxiliary contact to signal control that the drive is in operation.
 - 2. Provide, internal to the drive, start/stop control circuit terminal connections to insert a dry contact from control to initiate the start/stop on automatic mode.
 - 3. Drive shall be capable of interlocking with control equipment so that equipment can be regulated from 0-100 percent speed.
- E. Installation:
 - 1. Anchor free-standing units to floor slab or housekeeping pad with 1/2" minimum diameter anchor bolts. Bolts and washers shall be sufficient to resist shear and uplift produced by force equal to one-half of the equipment mass applied horizontally at center of gravity.

2. For wall mounted units, provide all necessary blocking, channels and other hardware for securing to walls, or other parts of building structure.

END OF SECTION 16483