

FACILITIES STANDARD

NAME: Variable Frequency Drive
NUMBER: 15958

ORIGINAL DATE: 03-01-94
REVISION DATE: 05-08-03

PURPOSE:

1. The general purpose of each Facilities Standard is to provide minimal criteria for construction materials at University facilities regarding code compliance, warranty, approved products, execution and uniformity.
2. To protect the health and safety of patients, visitors, students, faculty and staff, in addition to protecting non-project UAB property, all construction must be in accordance with: NFPA 241 safeguarding construction, alteration and demolition operations; Standard Building Code, Chapter 33, regarding site work, demolition and construction; NFPA 101 Life Safety Code.
3. Construction safety is the responsibility of the contractor in accordance with the regulations and codes of the agency having jurisdiction, and according to the guidelines adapted by OSHA.
4. The **Variable Frequency Drive Standard** establishes a series of guidelines for specifying this particular item on any construction project at the University. ***This Facilities Standard is not to be regarded as a specification.***

GENERAL:

1. Variable frequency drives shall be CSA certified and comply with the latest applicable standards of IEEE, and NEMA. As a minimum the full load output of the drive shall be equal to the equivalent motor HP as listed in NEC. The drive and all accessories or options shall be listed by either Underwriters Laboratory (UL) or Electrical Testing Laboratory (ETL), and equipment and installation shall comply with the National Electric Code.
2. Variable frequency drives shall be provided with a 3-year warranty from the date of start-up. The 3-year warranty period will be to total of the standard warranty plus extended warranty. Contractor shall coordinate with the drive supplier as necessary to allow drive to be installed, started, and in service within 60 days of the date the order for the drive is placed. The required in service date shall be as dictated by the UAB Project Manager. The warranty shall include all costs of on-site labor, parts, materials and travel.
3. Variable frequency drives shall be provided for all centrifugal fans above five horsepower, except for those systems that are constant volume by design, such as

toilet exhausts that do not vary in volume or static pressure. Systems that vary in air quantity by design, such as variable air volume distribution, or systems that have medium or high efficiency filters that change static pressure as they load, shall be provided with drives.

4. Large capacity pumps supplying systems with varying water quantities or head shall be provided with drives. Application of drives to such systems should be discussed with the Resident Mechanical Engineer prior to use.
5. The drive shall consist of a diode bridge rectifier, filter network, a fixed Direct Current (DC) voltage link and a transistorized inverter output section. Input power factor shall be no less than 0.95 under all conditions. The output shall be sine-weighted pulse-width modulated waveform for reduced harmonic heating of the motor. The drive and motor shall be, in general, purchased as a package unit. Acceptable Pulse Width Modulation (PWM) type drive vendors are: Danfoss-Graham, Square-D, Yaskawa-Magnetec, and ABB.
6. The following features shall be provided with the drive: NEMA rated contactors, motor overload relay, emergency shutdown of the drive which will immediately disconnect the motor, automatic restart upon return of power following outage. Drive shall be programmable for automatic reset for under voltage, over voltage, current limit, inverter overload and motor overload.
7. The drive shall withstand without failure or need for fuse replacement any of the following: output short circuit; ground fault or open circuit; input under voltage; loss of phase; transients caused by switching; DC over voltage; over-temperature; instantaneous overload or sustained overload up to 150% for up to sixty seconds or 110% continuous.
8. If the manufacturer recommends isolation transformers, or AC line reactors, the Contractor shall provide them.
9. It is preferable for drive parameters to be field adjustable without the need for proprietary programming tools, cables, or external interfaces. If such proprietary items are required, the contractor shall provide them with the drive and provide training in their use.
10. The drive shall provide a three-phase voltage with varying frequency output. The voltage/hertz pattern shall be selectable to that best suited to the motor. The drive shall automatically adjust this relationship during operation for the maximum operating efficiency according to speed and load.
11. Input and/or output control circuits shall be electrically isolated by use of optical isolators to prevent unwanted ground loops or feedback from other electronic control equipment. A built-in RS-485 port fully equipped for serial communication

shall be specified. Input and/or output control signals will be the type described in UAB Facilities Standard No. 15951, Type I Controls.

12. The following features shall be provided: Acceleration and deceleration time adjustment from 1-3600 seconds; front of panel hand/off/auto switch with manual frequency control for hand; dry contact closure output signal for paralleling of other equipment; ramp to start and ramp to stop by external dry contact closure; frequency indication (Hertz preferably) on front of panel; operating pilot light and drive fault light on front of panel; emergency stop provided by external contact closure. Provide elementary or schematic wiring diagram showing only the interface wiring terminations.
13. The drive shall include a bypass circuit so that when activated it will bypass the Variable Frequency Drive (VFD) and electrically isolate the VFD for removal and/or repair while allowing the system to operate in the bypass mode, and vice versa, without being exposed to line voltage. The bypass circuit must include all external safeties connected to the VFD. The bypass circuit will include overload protection. Indicator lights, which show if the unit is in bypass mode, are required on the front of the drive panel. Bypass arrangement for 50 HP and larger shall be provided with soft-start starter in series with the bypass contactor, and with electronic overload protection in bypass and VFD modes. Bypass arrangement for motors smaller than 50 HP shall be provided with across the line contactor.
14. In order to reduce repair part stock, the control and operational circuits for the drive will be interchangeable between different size drives from five to one hundred horsepower.
15. Motors used in variable speed installation shall be rated for inverter duty, and so marked on the nameplate.
16. The Contractor shall provide UAB Maintenance and UAB Energy Management a copy of all available operation and maintenance manuals and wiring diagrams published for the VFD. A permanent laminated document shall be attached to the drive with all user configurable settings that are required to be input at initial start-up.

PRODUCTS:

See item 5 above.

EXECUTION:

1. Careful attention shall be given to the placement of the fan static pressure sensor and pump differential sensor, which controls the variable frequency drive output. The Engineer shall closely coordinate with the Test and Balance Contractor and specify the location of the sensors to allow the best possible energy savings.
2. Checks shall be made to assure that the VFD installation does not cause voltage reflection, harmful harmonics, or electrical interference. Filters shall be installed if recommended by the manufacturer to prevent such electrical interference.

END OF STANDARD

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