FRANKLIN AID

Franklin Electric

Franklin Application/Installation Data (AID) ... For The Professional Driller-Installer

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Variable Frequency Drives

Judging by the number of phone calls our Hotline receives on this topic, the use of variable frequency drives (VFDs) must be growing by leaps and bounds. In the last 18 months, we have averaged 15 calls per week regarding Franklin Electric's submersible motors and VFDs. As a result, we decided it was time to answer some of these questions in the scope of a Franklin AID.

The concept behind VFDs is actually quite simple. The RPM of an AC motor is dependent on the frequency of the voltage applied to the motor. In the case of a two-pole motor,

RPM = frequency x 60 seconds/minute x (1-slip).

In North America line voltage frequency is 60 Hz, and slip is typically about 4%. Therefore, in standard applications,

60 Hz x 60 x 96% = 3450 RPM.

We can see from the above formula that if we can control the frequency applied to the motor, we can control the speed of the motor. This is exactly the concept behind variable frequency drives.

Although VFDs have been used for many years in the oil recovery business, their use has only recently been gaining strength in the water systems industry. Part of their popularity has to do with the fact that the systems are generally fairly affordable, but much of it is related to the flexibility a VFD can offer.

Simply put, a VFD provides its owner a system that can be tailored to specific needs. A prime example was an installer who called our Hotline while designing a water system for a campground. He was primarily concerned with the peak water demand the system would experience during the July 4th weekend. Fifty-one weeks a year, the campground could get by with a small system.

One weekend each year, however, the campground demanded much higher volumes. The installer needed a way to buy a bigger pump/motor combination for the holiday weekend without having to pay for a severely oversized system the rest of the year. Someone suggested he check into a variable speed system, and he called our Hotline to see if it was possible to change the speed on a Franklin submersible motor. Here is what we told him:

While Franklin's single-phase submersible motors are designed only for full voltage/full frequency operation, **Franklin's three-phase submersible motors can be operated with VFDs provided certain guidelines are addressed and followed.** VFDs are available from many sources ranging from large electrical equipment manufacturers to the same companies that manufacture three-phase pump panels. Franklin Electric does not endorse any specific manufacturer; rather, we specify basic guidelines that allow our submersible motors to be compatible with almost any VFD. These guidelines must be followed carefully, as most VFDs are factory configured for above-ground motors, and some default settings may cause a deep well submersible motor to fail.

Load Capability As in standard applications, pump loads should not exceed motor nameplate maximum amps at any time.

Volts/Hz Use the motor's nameplate voltage and frequency as the basis for selecting the VFD's base settings. Remember, though, that motor nameplate voltage is typically 4% to 5% less than the supply voltage. When the motor says 460 Volt/60Hz and the VFD says 480 Volt/60 Hz, both refer to the same power supply.

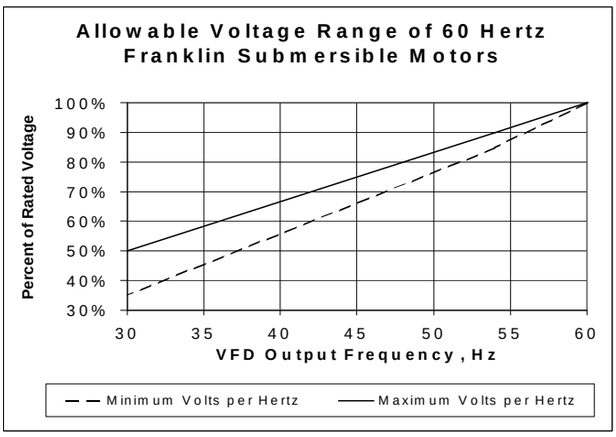
Many drives have means of increasing efficiency at reduced pump speeds by lowering motor voltage. This is the preferred operating mode. The following table shows

Coming Soon!

For years Franklin Electric has promoted the use of test meters to ensure proper motor installation, as well as for effective troubleshooting. For your convenience, beginning in August these tools will be available directly from our website.

Keep watching for the symbol at the right!

www.franklin-electric.com



the relationship of voltage to frequency at reduced speeds.

Caution: Do not exceed rated voltage if the motor is operated above rated frequency.

Frequency Range Continuous between 30 and 60 Hertz (Hz). Operation at lower frequency can cause motor bearing failure, while operation at higher frequency can raise internal hydraulic losses to an unacceptable level. Franklin Engineering must specifically approve any application above 60 Hz.

Motor Current Limits Load no higher than motor nameplate maximum amps. For 50 Hz ratings with 1.0 service factor, nameplate maximum amps are rated amps. See Overload Protection below.

Motor Overload Protection Overload protection in the VFD (or separately furnished) must trip within 10 seconds at 5 times motor maximum nameplate amps in any line, and ultimately trip within 115% of nameplate maximum amps in any line.

Carrier Frequency Applicable to PWM (pulse width modulated) drives only. These drives often allow selection of the carrier frequency. Use a carrier frequency at the low end of the available range.

Start and Stop One second maximum ramp-up and ramp-down times between standstill and 30 Hz.

Power from the VFD during this ramp-up or ramp-down cycle will not exceed that for normal operation. *Stopping by coast-down is preferable.*

Successive Starts Allow 60 seconds or more before restarting motor.

Subtrol-Plus Franklin's Subtrol-Plus protection systems *ARE NOT USABLE on VFD installations*. This is because the non-sinusoidal wave shape output from the VFD is not compatible with the Subtrol.

Filters or Reactors Required if all three of the following conditions are met: 1) Voltage is 380 or greater. 2) Drive uses IGBT or BJT switches (rise-times < 2 msec). 3) Cable from drive to motor is more than 50 feet.

The objective is to limit voltage peaks at the motor terminals to 1000V. Reactors (up to 3% impedance) or filters should be selected in conjunction with the drive manufacturer and must be specific to VFD operation. *A low-pass filter is preferable.*

Cable Lengths For long runs, set the VFD voltage 5% higher than the motor rating. If a reactor is used, a higher voltage drop will occur between the VFD and the motor. To compensate, cable lengths shown in the Franklin AIM Manual cable charts must be reduced to 60% of the value shown.

Cooling Flow Rates Franklin submersible motors require a minimum cooling flow of water. Typically, installations are variable-flow, variable-pressure. In these installations, minimum flow rates must be maintained at nameplate frequency per the AIM Manual. In variable-flow, constant pressure installations, minimum flow rates must be maintained at the lowest flow condition.

Miscellaneous While Franklin three-phase motors are commonly used with VFDs, they are not declared "Inverter Duty" motors per NEMA MG-1, Part 31 standards. However, Franklin's submersible motors can be used with VFDs without problems and/or warranty concerns provided these guidelines are followed. If you have any questions regarding these guidelines, please call the Service Hotline.

TOLL-FREE HELP FROM A FRIEND

Phone Franklin's toll-free SERVICE HOTLINE for answers to your installation questions on submersible pump motors. When you call, a Franklin expert will offer assistance in troubleshooting submersible systems and provide immediate answers to your motor application questions.

Franklin Electric SERVICE HOTLINE 800-348-2420 FAX 219-827-5102
www.franklin-electric.com

Franklin Electric
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