WHAT IS A VARIABLE FREQUENCY DRIVE?

Variable Frequency Drives (VFD) are electronic controllers that adjust the speed of an electric motor by modulating the frequency of the power that is delivered to the motor, matching the speed of the motor to the actual requirements of the process.

Most vacuum systems that are driven with an electric motor operate at full speed even when the vacuum system does not require its full capacity to meet vacuum demand. Mechanical devices such as vacuum switches to stop and start the system or vacuum relief valves to bleed air into the system are often used to regulate the amount of vacuum. This process creates extra wear on the vacuum system by producing excessive stop-starts or uses unnecessary energy by running full speed and bleeding in relief air. **By using a VFD to control the speed of the vacuum system motor to match vacuum demand can save up to 50% of the energy cost required to operate the system.**

To better understand how a VFD operates, it is important to first understand how a fixed-speed electric motor functions.

Alternating current (AC) motors run at speeds determined by the number of poles in the motor and the frequency of the AC supply called the synchronous speed. The synchronous speed is measured in RPM where RPM = (120 x F) / P where:

RPM = revolutions per minute
F = frequency in hertz
P = number of poles (an even number as poles are always paired)

For example:
A 4-pole motor that is running at 60 hertz will have a synchronous speed of 1800 RPM
(120 x 60) / 4
That same motor running at 50 hertz will have a synchronous speed of 1500 RPM
(120 x 50) / 4

Most standard AC motors are designed to operate at a fixed, rated frequency and speed. At this fixed speed, the built-in cooling system will keep the motor from overheating. When operated as an adjustable speed device at slower speeds, the motor cooling action will be reduced. On such applications, the motor may need to be a motor specifically designed for AC drive operation. Motors used on a VFD system are usually three-phase induction motors.

All AC drives convert AC to DC then use various switching techniques to invert the DC into a variable-voltage, variable-frequency AC output. When the VFD starts the motor, it initially applies a low frequency and voltage to the motor to avoid high inrush current that would occur if the motor was started by simply applying voltage with a switch. The frequency and voltage are increased at a controlled rate to ramp up the motor without drawing excessive current.

The VFD also controls the frequency and voltage as the motor stops, allowing the motor to ramp down at a controlled rate. When the frequency approaches zero, the motor is shut off.

The VFD's built-in microprocessor regulates the speed of the motor by reacting to input from the process (in our case from input voltage provided by a vacuum transducer) and applying that input to the set points that have been programmed into the VFD.