
*“Often Imitated, Never Duplicated”*

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Variable Frequency Drives (VFD) are used in many application in which there is mechanical equipment powered by motors; the drives provide extremely precise electrical motor control, so that motor speeds can be ramped up and down, and maintained, at speeds required; doing so utilizes only the energy required, rather than having a motor run at constant (fixed) speed and utilizing an excess of energy.

Here are several additional benefits users realize when operating motors with drives:

**1 - Controlled Starting Current** -- When an AC motor is started "across the line," it takes as much as seven-to-eight times the motor full-load current to start the motor and load. This current flexes the motor windings and generates heat, which will, over time, reduce the longevity of the motor.

A VFD starts a motor at zero frequency and voltage.

As the frequency and voltage "build," it "magnetizes" the motor windings, which typically takes 50-70% of the motor full-load current. Additional current above this level is dependent upon the connected load, the acceleration rate and the speed being accelerated. The substantially reduced starting current extends the life of the motor, when compared to starting across the line. The customer payback is less wear and tear on the motor (motor rewinds), and extended motor life.

**2 - Reduced Power Line Disturbances** -- Starting an AC motor across the line, and the subsequent demand for seven-to-eight times the motor full-load current, places an enormous drain on the power distribution system connected to the motor. Typically, the supply voltage sags, with the amplitude of the sag being dependent on the size of the motor and the capacity of the distribution system. These voltage sags can cause sensitive equipment connected on the same distribution system to trip offline due to the low voltage. Items such as computers, sensors, electronic switches, and contactors are voltage sensitive and, when subjected to a large AC motor line started nearby, can drop out. Using a VFD eliminates this voltage sag, since the motor is started at zero voltage and ramped up.

**3 - Lower Power Demand on Start** -- If power is proportional to current-times-voltage, then power needed to start an AC motor across the line is significantly higher than with a VFD. This is true only at start, since the power to run the motor at load would be equal regardless if it were fixed speed or variable speed. The issue is that some distribution systems are at their limit, and demand factors are placed on agricultural and industrial customers, which charges them for surges in power that could rob other customers or tax the distribution system during peak periods. These demand factors would not be an issue with a VFD control system.

**4 - Controlled Acceleration** -- A VFD starts at zero speed and accelerates smoothly on a customer-adjustable ramp. On the other hand, an AC motor started across the line is a tremendous mechanical shock both for the motor and connected load. This shock will, over time, increase the wear and tear on the connected load, as well as the motor. This initial start-up shock will significantly reduce the life of motor and related components.

**5 - Adjustable Operating Speed** -- Use of a VFD enables optimizing of a process, making changes in a process, allows starting at reduced speed, and allows remote adjustment of speed by programmable controller or process controller.

**6 - Adjustable Torque Limit** -- Use of a VFD can protect machinery from damage, and protect the process or product (because the amount of torque being applied by the motor to the load can be controlled accurately). An example would be a machine jam. With an AC motor connected, the motor will continue to try to rotate until the motor's overload device opens (due to the excessive current being drawn as a result of the heavy load). A VFD, on the other hand, can be set to limit the amount of torque so the AC motor never exceeds this limit.

**7 - Controlled Stopping** -- Just as important as controlled acceleration, controlled stopping can be important to reduce mechanical wear and tear.