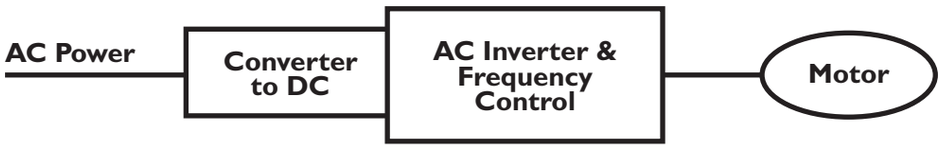
Adjustable Speed Drives

If you have a system using a motor that serves a varying load, an Adjustable Speed Drive (ASD) may benefit you. Examples of such systems are fans that reduce flow for non-design conditions or pumps that use control valves to vary flow. ASDs tailor motor performance to match present conditions. Advantages include:

- Energy savings
- Improved process flow
- Softer/easier motor starting
- Faster response than valves or dampers

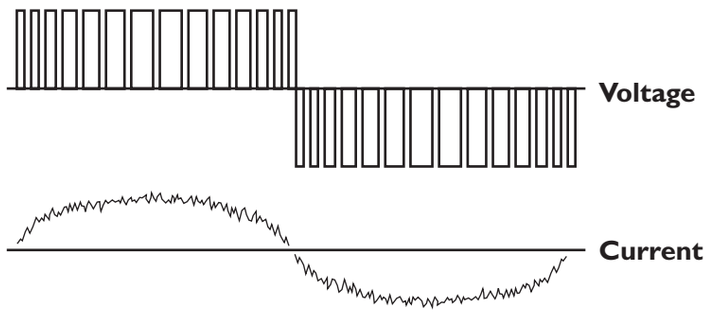
Induction motors account for over 90% of the motor horsepower in use today. The frequency of the electrical power running it determines an induction motor's speed. Sixty cycles per second will run a meter at full speed. An ASD reduces the frequency of the electrical power to the motor, reducing motor speed and saving energy in systems with a varying load.

An ASD varies the electrical frequency to the motor to regulate its speed. (See Diagram 1.) They reduce motor speed by converting the standard 60 cycles-per-second, alternating current (AC) electrical power to direct current (DC). The ASD then uses an inverter to convert the DC back to varying frequencies of AC power, which controls the motor speed. ASDs are sometimes called variable frequency drives or adjustable drives.



Adjustable Speed Drive – Diagram 1

The most common type of ASD uses pulse width modulation to vary the frequency of the alternating current. (See Diagram 2.) The advantages of the pulse width modulation method over other types of drives include better efficiency, a higher power factor, larger speed ranges and lower motor heating.



ASD Voltage and Current Waveforms – Diagram 2

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The following table shows the theoretical power required as the motor speed and system flow decrease.

Variable Speed Drive Table

Speed	Flow	Power Required
100%	**100%**	**100%**
90%	90%	72.9%
80%	80%	51.2%
70%	70%	34.3%
60%	60%	21.6%
50%	**50%**	**12.5%**
40%	40%	6.4%
30%	30%	2.7%

The table shows that reducing motor speed results in a reduction in the power required. Significant energy savings are the result. For example, to reduce the flow from 100 percent to 50 percent cuts the required power to 12.5 percent. Eight times less power is used (8 = 100% power/12.5% power). The power required drops exponentially when motor speed is reduced, providing you with substantial energy savings.

ASD energy savings are estimated using computer analysis. The overall ASD energy savings is calculated as the theoretical energy savings minus the losses due to running the ASD and the drop in motor efficiency at lower speeds.

Examples of savings

Lift station

A Northwest paper mill continuously operated one 100 hp and two 75 hp lift station sump pumps. To improve efficiency, the three motors were replaced with a single premium efficiency 75 hp motor with an ASD. One of the existing 75 hp motors was left as a backup. Sizing the installation properly and controlling the motor with an ASD reduced the electric bill by $9,400 per year. At that level of energy savings and with a utility incentive, the new motor had less than a four-year payback.

High school hydronic system

A high school added ASDs to their chilled and hot water circulation system. The ASDs reduced pumping energy by 60 percent. In addition to adding the drives, the school upgraded and revised several pumps to further increase efficiency. The simple payback is less than seven years.

Cooling tower

Equipping cooling tower fans with ASDs resulted in energy savings that equalled a payback of less than three years. With the ASDs, the fan speed is as low as 30% in mild weather conditions. The cooling tower upgrade also led to better equipment operation.

Other notes

ASD installation

Follow the manufacturer's recommendations for installation. Drives that are located too far from the motor can cause insulation stress on motor windings and motor damage.

Harmonics

ASDs, computers, lighting ballasts and other electric power users cause harmonics, a constant, non-linear energy waveform. To correct any harmonics problems, the source must be identified and the harmonics must be broken down into their individual frequencies. Filtering or trapping measures can then be applied. If possible, ASDs should be designed and equipped to minimize their harmonics.

ASDs and constant torque motor loads

Constant torque loads, such as conveyors, drilling/milling machines and reciprocating compressors may benefit from ASDs. These loads need to be studied carefully to insure that the ASD is capable of proper equipment starting and that the energy savings result in an acceptable payback. Manufacturer information and resources should be consulted to insure proper application and use of the drive.

For more information, please call 1-888-221-7070.

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