Energy Efficient Motors

Save money by using Premium Efficiency Motors & Variable Speed Drives

Since electric motors in commercial facilities run many hours per year, there is tremendous energy saving potential in motor driven pumps, fans and compressors. Modern state-of-the-art equipment is more energy efficient than older equipment and improves overall operational efficiency. Energy (kWh) and demand (kW) savings can be achieved by converting standard motors to new premium efficiency motors. Precise design and construction using high quality materials make a major difference in efficiency. Typically when a motor is rewound there are efficiency losses. Therefore, a "premium" efficiency motor replacement is a solid energy savings investment over rewinding. Typical replacements will payback in 6-12 months with life cycle cost savings 10-15 times the cost of the new motor.

The National Electrical Manufacturers Association (NEMA) has developed a procedure for labeling three phase motors with an average efficiency rating. The Table below shows the NEMA MG1-1993 "Nominal" efficiencies generally recognized as "premium efficiency" motors. The efficiencies listed below are based on three phase power. Motor efficiencies vary between manufacturers, and it is sound business practice to shop around for the highest efficiency possible. It is important to note that when a motor is retrofitted that there may be issues regarding remote overheat protection circuitry and the circuit capacity for a higher inrush current.

Motor Size (Horsepower)	1200 RPM Recommended	1200 RPM Best Available	1800 RPM Recommended	1800 RPM Best Available	3600 RPM Recommended	3600 RPM Best Available
1	82.5	85.5	85.5	86.5	78.5	80.4
1.5	87.5	87.5	86.5	87.5	85.5	87.5
2	88.5	88.5	86.5	86.5	86.5	87.5
3	89.5	90.2	89.5	89.5	88.5	89.5
5	89.5	90.2	89.5	90.2	89.5	89.5
7.5	91.7	91.7	91.7	91.7	91	91.7
10	91.7	92.4	91.7	91.7	91.7	91.7
15	92.4	92.4	92.4	93	91.7	91.7
20	92.4	93	93	93.6	92.4	92.4
25	93	93	93.6	94.1	93	93.6
30	93.6	93.6	93.6	94.5	93	93.6
40	94.1	94.5	94.1	94.5	93.6	94.1
50	94.1	94.5	94.5	95	94.1	94.1
60	94.5	95	95	95.4	94.1	94.5
75	95	95	95.4	95.4	94.5	95
100	95.4	95.4	95.4	95.4	95	95.8
125	95.4	95.8	95.4	96.2	95.4	95.8
150	95.8	96.2	95.8	96.2	95.4	96.2
200	95.8	95.8	96.2	96.5	95.8	96.2
250	95.6	95.8	96.2	96.5	95.9	96.5
300	95.4	96.2	96.1	96.5	95.8	96.2
350	94.5	95	96.2	96.3	94.8	95.8
400	94.5	95	95.8	96.2	94.5	95.8
450	94.5	95.4	94.5	95	94.5	95.4
500	94.5	95.4	94.5	95.4	94.5	95.4

Variable Speed Drives

Variable speed drives provide a potential for reduced pump and fan energy requirements at reduced speeds. There are several types of variable speed drives including solid-state frequency inverters, eddy current clutches, and mechanical drives. Of these, solid-state inverters are among the most efficient and should be considered as an alternative to other types of volume control such as fan discharge dampers and inlet valves.

With regard to variable speed drives, standard AC motors operating at a frequency of 60 Hz will operate at a constant speed determined by the number of poles it has. However, if the input frequency can be varied according to speed (load) requirements, a wide range of motor speeds are available according to the following formula:

$$rpm = \frac{120xf}{p}$$

Where **p is the number of poles** and **f is the frequency in Hertz**, and **rpm is the number of revolutions per minute.** The basic components of an AC variable frequency drive are a converter to change AC to DC and an inverter to change the DC to AC through the required frequency range.

In addition to customer benefits of substantial operating cost savings derived from the use of high-efficiency electric motors and variable speed drives, variable speed drives offer such additional benefits as controlled acceleration and lengthening the life of belts, pulleys, and bearings; soft starting, reducing peak-starting current, and demand charges; high power factor, reducing power factor penalty charges, and reduced fan and pump noise and vibration at reduced speeds.

Smaller motors are inherently less efficient than large motors, but with the high power consumption in large motors, even small increases in efficiency over the life of the motor can result in substantial cost savings. Although high-efficiency motors are up to 30 percent more expensive than standard motors, simple paybacks in less than 2 years can be easily attained depending on the application. However, a careful interpretation of efficiency data should be made prior to selections. Due to the tremendous improvements in motor design technique, the reliability of motors has also improved considerably. Motor life now varies from 10 to 15 years.