When to Purchase Premium Efficiency Motors

Consider premium efficiency motors for new motor procurements when specifying motor-driven equipment, repairing or rewinding failed standard efficiency motors, or as replacements for older, operable lower efficiency motors. This is particularly important when the existing motor has been rewound or is oversized and underloaded.

In August 2001, the National Electrical Manufacturers Association (NEMA) introduced a premium energy-efficiency motor standard. Under this program, a motor may be marketed as a premium efficiency motor only if it meets or exceeds a set of NEMA minimum full-load efficiency levels.

The premium efficiency motor standards apply to NEMA Design A and B, three-phase, low-voltage induction motors rated between 1-and 500-horsepower (hp) and 250- to 500-hp, medium-voltage motors designed for service at 5,000 volts or less. Covered products include foot-mounted motors with speeds of 1,200, 1,800, and 3,600 revolutions per minute (RPM) with open drip-proof, explosion-proof, or totally enclosed fan-cooled (TEFC) enclosures. The standard also covers severe-duty, wash down, International Electrotechnical Commission (IEC) metric frame motors, and brake motors.

Under the Energy Independence and Security Act of 2007 (EISA), the mandatory minimum nominal full-load efficiency for general-purpose motors rated below 1,000 volts with a power rating up to 200 hp was raised to the premium level. The premium efficiency requirement applies to motors purchased alone, imported into the United States, or purchased as a component of another piece of equipment.

Table 1. Annual Savings for Premium versus Old Standard Efficiency Motors

Horsepower	Motor Efficiency at 75% Load		Annual Savings from Using a Premium Efficiency Motor	
	Old Standard Efficiency Motor	Premium Efficiency Motor	Annual Energy Savings, kWh	Dollar Savings $/year
10	86.7	92.2	3,105	250
25	89.9	93.8	5,160	410
50	91.6	95.0	8,630	690
100	92.2	95.3	15,680	1,255
200	93.3	96.2	29,350	2,350

Note: Based on purchase of a 1,800 RPM TEFC motor in operation 8,000 hours per year (hrs/year) at 75% load at an electrical rate of $0.08/kilowatt-hour (kWh).

Suggested Actions

- Inventory all in-service and spare motors in your plant. Focus on general-purpose, low-voltage standard efficiency motors between 10 and 500 hp that are in operation 2,000 or more hrs/year. Collect nameplate and application data, then measure the supply voltage and amperage on all three phases for in-service motors.
- Establish a motor repair/replace policy to achieve cost-effective energy efficiency results. Identify and tag motors for appropriate action. For example: “Replace upon failure with a premium efficiency motor” or “Repair at failure following model repair specifications.”
- Adopt model repair “best practices,” such as American National Standards Institute/ Electrical Apparatus Service Association (ANSI/EASA AR100-2010), for all motors rated below 1,000 volts.

EISA also requires that NEMA Design B motors with power ratings between 201 and 500 hp “shall have a full-load efficiency that meets or exceeds the NEMA Energy Efficient motor standards” (see Table 12-11 of NEMA MG 1-2011). The EISA motor efficiency mandate took effect in December 2010.

Premium efficiency motors are particularly cost effective when annual operation exceeds 2,000 hours, utility rates are high, motor repair costs are a significant fraction of the price of a replacement motor, or electric utility motor rebates or other conservation incentives are available. Annual energy savings are dependent upon operating profile, duty cycle, and efficiency gain. Table 1 gives examples of annual savings due to installing premium efficiency motors instead of continuing to operate old standard efficiency motors.

Example

An old, 75-hp standard efficiency, boiler forced-draft fan motor is to be replaced with a premium efficiency motor. The existing motor operates at an average load of 75% for 8,000 hrs/year with efficiency (η_{std}) of 92%. Determine the annual energy savings if the replacement premium efficiency motor has an efficiency (η_{PE}) of 95.5% and electricity is priced at $0.08/kWh.

Energy Savings $= \text{hp} \times \%\ \text{load}/100 \times 0.746\ \text{kW/hp} \times \text{hrs/year} \times (100/\eta_{std} - 100/\eta_{PE})$
$= 75 \times 0.75 \times 0.746 \times 8{,}000 \times (100/92 - 100/95.5) = 13{,}373\ \text{kWh/year}$

Cost Savings $= 13{,}373\ \text{kWh/year} \times \$0.08/\text{kWh} = \$1{,}070/\text{year}$

Over a 10-year operating period for a 75-hp motor, the purchase price might represent just 2% of the total motor installation and operating costs. Energy and maintenance costs account for the remaining 98%. Even a small improvement in motor operating efficiency can produce significant energy and cost savings, and provide a rapid return on investment.

Resources

National Electrical Manufacturers Association (NEMA)—Find additional information on the NEMA premium standards, visit *www.nema.org.*

Electrical Apparatus Service Association (EASA)—See guidelines on motor repair/rewind practices at *www.easa.com*

Motor Decisions Matter—Download a motor management planning kit at *www.motorsmatter.org* for tips on an in-plant motor inventory, decision rules, critical planning, and motor replacement.

U.S. Department of Energy (DOE)—For more information on motor and motor-driven system efficiency and to download the MotorMaster+ software tool, visit the Advanced Manufacturing Office (AMO) website at *manufacturing.energy.gov.*

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Energy Efficiency & Renewable Energy

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