HIGH - EFFICIENCY MOTORS

Consider specifying high-efficiency motors for new equipment and when standard motors require replacement or repair.

The major advantage of high-efficiency motors (HEMs) is the energy savings they provide. They use from 1% to 4% less electricity than standard motors and are generally more reliable, last longer and result in lower transformer loading. HEM design enhancements include:

- 20% to 60% more copper and up to 35% more high-quality electrical steel laminations
- lower loss rotor bar design; and
- optimized manufacturing methods and production techniques that reduce losses.

Benefits of Choosing High-Efficiency Motors

- extended winding and bearing life
- increased ability to cope with short-term overloads
- capable of withstanding higher voltage fluctuations or phase imbalance

LIFE-CYCLE COSTING

Consider both initial cost and energy consumption over the life of the motor.
Wherever possible, companies should try to purchase the most efficient motors available. When it comes to electric motors, the true measure of what the item will really cost is seen only when we examine both initial price and operating costs.

Purchasing High Efficiency Motors (HEMs): Rules of Thumb

- specify HEMs for new installations operating more than 3500 hours per year
- select HEMs for motors that are loaded greater than 75% of full load
- buy new HEMs instead of rewinding old, standard-efficiency motors
- specify HEMs when purchasing equipment packages
- use HEMs as part of a preventive maintenance package

MOTOR INSTALLATION AND APPLICATION CONSIDERATIONS

Changes in application can change the performance of the system.

Power Factor

An induction motor requires both real and reactive power to operate. The real power (kW) produces work and heat. The reactive power (kVAR) establishes the magnetic field in the motor.

Induction motors are the principle cause of poor power factor. Electric utilities often levy a penalty for power factors that fall below a certain level, typically 90%. Some strategies for correcting poor power factor include:

- minimizing operation of idling or lightly loaded motors;
- ensuring correct supply of rated voltage and phase balance; and
- installing capacitors to decrease reactive power loads.

Efficiency Gains versus Motor Speed

A motor’s rotor turns slightly slower than the rotating magnetic field in the stator. The difference between these two speeds is called the slip speed. For centrifugal loads, even a minor change in speed translates into a significant change in flow and energy consumption. When replacing standard motors, select an HEM of the same or lower speed when possible. If necessary, adjust sheaves and pulleys to capture the full energy savings benefits.

Motor Sizing

Motor efficiency is fairly constant down to approximately 50% of rated load, below which it drops off quickly. Care should be exercised in leaving an adequate but not excessive safety margin. The motor should be sized for the peak load expected. Oversized motors can significantly increase costs since all electrical components must be sized to the motor rating. Using HEMs makes additional sense because
they are more efficient across a wider load range than standard motors.

MOTOR POLICY

Develop a motor policy to help assure continued productivity and efficiency.

The purpose of a motor policy is to help plant personnel manage their motor systems in order to minimize lost production time and expense. A motor policy has three distinct aspects: planning, replacement guidelines and repair procedures.

The following information can help design a policy that is suitable to your needs. Values shown are typical industry norms.

Planning

Sometimes in trying to get a motor back into service as quickly as possible, decisions are made that satisfy the short-term goal but negatively impact long-term efficiency and motor life. Implementing a comprehensive motor policy can help avoid this situation.

- All motors operating one or more shifts per day should be inventoried, assigned an individual equipment number and catalogued. Records should include nameplate rpm and hours of operation.

- Spare motors should be inventoried and assigned an individual equipment number. Recorded information should include nameplate data and the application(s) for which the motor is suitable.

- A plan should be developed for replacing all motors, including the source (inventory, supplier and repair) and the type of replacement motor (HEM, standard, repaired).

- All motors to be discarded should be partially dismantled, with the nameplate removed to prevent reuse, and disposed of in an environmentally suitable manner.

- The purchase of motors and repairs should be conducted with a selected number of high-quality suppliers who provide value-added services to ensure lowest total cost.

- Motors supplied with new equipment must meet Canada’s Energy Efficiency Regulations. The full load nominal efficiency must be equal to or higher than those shown on the table in Section 5.2. Motors must also be designed for the voltage and frequency in which they will operate.

- New equipment purchases should specify that HEMs are used.
- Motors will be ordered based on CSA-C390 test standards.

Repair or Replacement Guidelines

When a motor fails or burns out, maintenance personnel have three options to consider:

- the cost of rewinding considering the age of the motor, its general condition, the availability of a new motor and special mechanical and electrical features;

- rewinding versus purchasing a new standard motor; and
- purchase of a new, high-efficiency motor.

Select the hours that the motor operates and draw a horizontal line until it intersects with the average electric cost curve, draw a line down until it intersects the motor size of the _ axis. Any motor size to the left should be replaced with a HEM, any motor size to the right should be rewound.

Motors to be Refurbished

- No motor with a defective stator core should be rewound. If the core cannot be restored to its original integrity, the motor should be replaced with an HEM.
- Motors that are 100 hp or larger with an annual operating time of less than 4000 hours should be rewound if core iron specifications are acceptable.
- Motors that are 50 hp or more should be rewound a maximum of three times, after which the motor should be replaced.
- All motors below the repair/replace breakpoint, as determined by the chart above (20 hp in this example), should be replaced with new HEMs and, not be rewound.
- No standard efficiency motor should be rewound if the cost of the repair exceeds 60% of the cost of an HEM.

Repair Procedures and Specifications

- Motor repair shops should be ISO 9000 registered.
- Companies may pay a nominal fee to shops for the testing, tearing down and quoting for a motor repair when a decision is made to purchase a new motor from another source.
- Repair the motor to its original design with respect to number of turns, winding design and coil configuration, wire cross-sectional area, bearing size and type and insulation quality.
- Damaged cores should be repaired or replaced.
- Stripping should occur in an oven with a water-quench temperature-suppression system with temperature not exceeding 400ºC (750ºF).
- The repair shop should endeavour to determine the cause of failure and report its findings.

Impact of Rewinding on Efficiency

The quality of workmanship and materials used in a motor rewind can vary significantly. The impact of a poorly rewound motor may not be immediately apparent; however, the results can include greater energy consumption and shorter life due to higher operating temperatures. When selecting a repair shop, consider its capabilities, experience and workmanship – not just the cost.

Reference:
http://oee.nrcan.gc.ca/infosource/pdfs/M92-165_1999E.pdf