Motor System Maintenance and Management

Part 2

Motor and Driven Equipment Selection

This presentation is the second of a ten part series on Motor System Maintenance and Management for industrial and manufacturing facilities. In this presentation, we will be discussing the second of seven Key Performance Indicators, or KPI's, that measure a world-class motor system maintenance and management program and the best practices to implement it.

The presentation and materials come from over twenty years of motor-system maintenance and management research and development by Dr. Penrose and other industrial and manufacturing resources.

My name is Dr. Penrose and I am the president of SUCCESS by DESIGN and the executive director of the institute of electrical motor diagnostics. I have over 20 years in the reliability and maintenance industry including specializing in the development of motor system maintenance and management programs. In this presentation, we will explore many of the questions that I use when evaluating and establishing programs.

Following this presentation, you are encouraged to complete the survey that covers the scoring for the second KPI.

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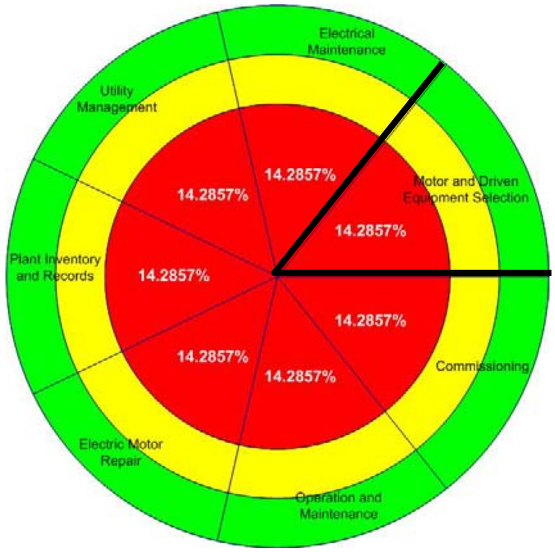
Seven Key Components



There are seven key components to the development of a world-class motor system maintenance and management program. These components include:

-Electrical Maintenance

-Motor and Driven Equipment Selection

-Commissioning

-Operation and Maintenance

-Electric Motor Repair

-Plant inventory and records

-Utility management

Within each area, the points are weighted to 100% with less than desireable being under 70 percent and world class being over 85 percent.

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Best Practices

- Repair vs Replace Decisions
- Purchasing Decision
- Motor Sizing
- Speed Changes and Motor Upgrades
- Motor Failure as an Opportunity

There are several best practices to consider for motor and driven equipment selection.

These best practices include repair versus replace decisions, purchasing decisions, motor sizing, speed changes and motor upgrades. Finally, you must consider motor failure as an opportunity, not a negative. Each of these opportunities provides the ability to make improvements to the motor system step by step.

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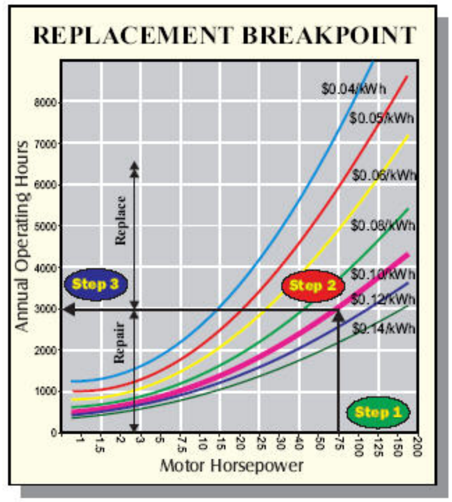
Repair vs Replace

- Energy Improvement?
- Reliability Improvement
- When to Replace
  - Economics
  - Energy
  - Number of Rewinds
- Motor Census
- U-Frame to T-Frame



One of the first, and most important best practices, involves the development of a repair versus replace program for electric motors. This has traditionally been thought of as an energy improvement. However, while energy can provide a financial incentive to make a repair versus replace decision, the real reason is to improve the reliability of the machine.

When is it best to replace a motor instead of repair it? There are a number of components involved in the decision. The first is economics. Many companies set a value of 50 to 75% of the replacement cost of the motor as a decision point. If the repair cost is greater than the selected percentage, then the motor is replaced.

Energy is another consideration. If the simple payback based upon the difference in annual operating cost is below a specific value, say two years, then the motor is replaced. Other approaches include a more stringent analysis based upon the financial tools of such software programs as the US Department of Energy's MotorMaster Plus.

The number of rewinds that a motor has had performed on it is a consideration, as well. Some will state that if a motor has been rewound two or three times, it should be replaced. Usually, a best practice that combines all three methods, as well as understanding the availability of a replacement, should be considered.

The best way to begin such a program is to perform a motor census. This means that all motors and associated equipment should be cataloged and priorities set. Then each system can be evaluated to the selected best practice approach for repair versus replace.

An important consideration when making decisions relates to the lower voltage U-Frame machines. These types of machines are larger and heavier than their T-frame counterparts, but were obsoleted in 1968. When making a decision to replace a U-frame motor with a T-Frame motor, it is important to understand that many manufactures make a retro-fit base so that the holes in the foot pattern of the motor line up. Also, the shaft center height and diameter will be smaller than the U-Frame, which means that the coupling or sheave may have to be replaced with the right sized components.

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Purchasing Decision

- What is considered in electric motor and driven equipment purchasing?
- What financial method is used to select the equipment?

A best practice related to purchasing new or replacement motors is essential. A number of things need to be considered when making the actual purchase. These should include:

1. Is the frame size the same as the original. If not, what modifications will have to be made, or is there another motor available?
2. Is there a minimum efficiency that is expected? Should it be energy efficient or premium efficient?
3. Is the motor the correct size for the application?
4. Does it require adjustment to the overloads? Or, other adjustments?
5. What is the availability of the motor?

As part of the comparison, does the company just select the lower initial motor cost? Or, does it consider life cycle costing based upon cash flow or a simple payback analysis? As mentioned previously, simple tools exist for assisting in making good financially and energy sound decisions.

In most cases, a purchasing specification is developed and followed as part of the best practice.

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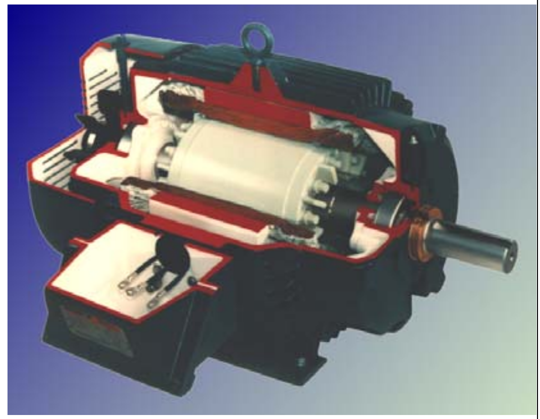
Motor Sizing

- Very important for efficiency and reliability
- Optimum size:
  - 75 to 100% load
  - Starting requirements
- Specify Premium Efficient motors
  - The myth



Motor sizing is absolutely important to both energy and the reliability of the system, itself.

The optimum size of an electric motor, for efficiency purposes, is 75 to 100 percent of the running torque requirement. This provides the peak efficiency for the system as most motors' peak efficiencies tend to fall in that range. However, there are certain starting and running requirements that must be considered:

1. Some motors are sized larger so that they are able to start the load and get it up to speed. It is important to consider this when looking at resizing the motor on a machine.
2. Variable torque loads such as pumps, fans or compressors have to be considered. For instance, if the motor speed is greater than the original motor then there may be a change required such as a change in sheave diameters.

When considering premium efficient motors and the proper sizing. Some original designers will have sized the motor for a little 'extra' for multiple types of applications. In other instances, they may have oversized the motor load because of the reliability of energy and premium efficiency motors myth.

Some years ago, a very large motor user had problems with motors at one of their plants. They pulled one motor out and sent it to a national lab for analysis. The national lab provided an answer and published an IEEE paper stating that energy and premium efficient motors were not reliable and were sensitive to power anomallies because of a very small airgap. In reality, the lab was provided a close-coupled pump motor that had a standard energy marketing sticker on it the manufacturer put on everything. At MotorChallenge 2005, several of the manufacturers and I had a discussion with the national lab investigator. Several motors that were premium and energy efficient were selected and had tests performed on them, as well. A second IEEE paper was published stating that the previous paper was erroneous. However, it was too late, the damage was done.

In reality, there tends to be more material, a better core steel, better bearings and fits, optimized fans, better insulation systems and more that actually improve the reliability of the newer machines.

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SUCCESS by DESIGN provides training and reliability services in such areas as:

- motor system maintenance and management programs,
- condition-based maintenance and reliability-centered maintenance,
- PM optimization,
- maintenance effectiveness reviews,
- Industrial assessments,
- Energy and alternative energy projects,
- And more

For additional information, contact SUCCESS by DESIGN

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