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Managing Motors and Reliability

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Many are aware of the use of motor circuit analysis and infrared imaging in a predictive maintenance program for motors. A program that, when performed properly, increases uptime, reliability and productivity, ultimately impacting the thing most managers want to see: lowered or stabilized maintenance costs. However there may not be an understanding or awareness of the benefits and impact an effective motor management system can have on that cost.

This paper will show basic key elements for a motor management system and hopefully provide an understanding of why a motor management system is much more than just a reliability and testing program. In fact, motor reliability and testing are two key components that make a significant contribution to a motor management system.

Short Story

There was once an employee that asked lots of questions. This caused much consternation among the bosses and fellow workers as well. Aha! The bosses thought, we will promote him, then he can answer his own questions! They continued on, happily thinking this was the answer; however, to their chagrin more questions followed.

In the meantime this newly promoted supervisor was given approximately nine hats to wear. One of them was the “Motor Shop”! So where else could one start? With a little bit of authority that accompanied the promotion, a team was created! A few questions got answered, a few things changed. Before anyone knew it, a motor management system began taking shape.

The first six months were very difficult indeed, and another twelve rough months would pass. After eighteen months a faint glimmer of light could be seen at the end of this tunnel. Though people had fought tooth and nail against, a few eyes began to flutter and some popped open when it was pointed out that repair, inventory and purchase costs had been reduced approximately one million dollars. Suddenly the questions and ideas put forth and actions taken no longer seemed so trivial!

Looking back one could see the well-traveled road littered with the debris of good intentions, false assumptions, erroneous information, insufficient information, etc. All this and more created a climate where bad decisions were made and money wasted. As an example, the first practice stopped in those first eighteen months was repairing motors for nine hundred dollars that only cost two hundred dollars when new. This was only the tip of the iceberg! Energy consumption issues were later added to the equation, as well as other reliability principles and testing.

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What is it?

Managing motor assets require that a motor's location, function, repair, testing and reliability history be documented. Preferably in one place! This documentation should be easily accessed for research and used to assist in making correct and appropriate repair/replace decisions. Motor testing does not create a motor management system but should be a key component.

Key Components

At a minimum a motor management system should have the following components:

- Motor Manager: someone in charge and accountable
- Storage: outdoors is not acceptable
- Preferred and accountable repair facility
- Repair specifications for the repair facility to use
- Cost-saving contract for purchasing new motors from a primary vendor
- Reliability testing: off-line, on-line, infrared and even vibration
- Acceptance testing of repaired motors and new motors if possible
- Tracking motors from purchase through scrap and history in between
- Decision Tree for determining repair versus replacement
- System to address energy consumption and efficiency

Who's in charge?

The person in charge (motor manager) does not have to be a motor expert, however, they should be somewhat knowledgeable of motor basics. They also need knowledge of the motor contract with the preferred new motor vendor and the preferred motor repair facility. The motor manager manages all aspects of motor purchases, repairs, modifications, history and disposition. The motor manager should be a member of the site equipment reliability team and should interface often with the reliability manager on matters pertaining to motor testing and reliability. Managing motors does not have to be the only area of responsibility of the motor manager. They can wear other hats as well!

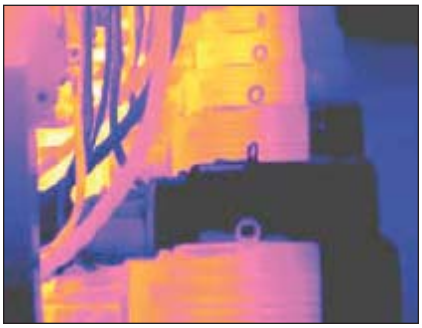
Once an effective motor management system has been in operation for a time and employees and other managers become educated as to how it works it should become easier to manage.

Storage

Motors should never be stored outdoors. Ideally they should be stored in a climate-controlled facility. Climate controlled storage facilities are rare.

Warehouse personnel are normally tasked with the day-today activities of normal motor storage from receiving, issuing to and shipping to the repair shop. Personnel should be familiar with how to handle and store motors to avoid incidental damage during the storage process.

Large AC motors (high voltage) sometimes need special handling and storage areas. Motors with internal heaters should be connected to a voltage source while in storage to keep windings dry.



Repairs

Every effort should be made to identify a preferred and accountable motor repair facility within a reasonable driving distance. Preferred meaning a facility that can handle just about everything that is sent to them. They should not object to inspection visits and should warranty their work in some manner and work with the customer on all levels of repair. Repair quality and reliability should be the guiding criteria.
A contract with a preferred repair facility can be negotiated to reduce repair cost over what it may have been. An ideal situation would be that the repair facility is also a dealer for the preferred new motor vendor.

Then there are the "special", "one-of-a-kind" and "non-standard" motors that have to be dealt with. Has anyone seen the suffix TY, TCY, TZ, TCZ or etc. (example: 286TCZ)? If so, they are the "non-standard" variety and might only be acquired from an OEM, not the motor manufacturer. If the OEM is totally out of business (not acquired by another company) a replacement motor may not be available. Having the right repair facility can come in handy with these motors. Also having an understanding of what alternatives are available and knowledge of what to use as a substitute, things can keep running!

New

Anyone operating without a preferred new motor vendor contract could be losing money. A contract with a preferred new motor vendor may reduce purchase prices by twenty to forty percent. Large corporations may already have a contract with a preferred new motor vendor. This should be followed whenever possible within the guidelines.

Reliability

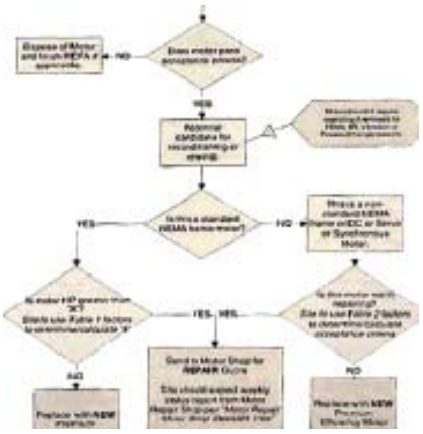
Reliability consists of many things such as Engineering, testing and inspection:

- Engineering: Is the motor designed and/or repaired to perform the task it is asked to do?
- Testing: Motors and their circuits.
- Infrared: Baseline images and temperatures of 'normal' are very important.
- Vibration: Baseline data.

When testing or inspecting a motor it is important to ask, "Is this the motor I think it is" or "was this the same one that was there the last time"?

A motor reliability and testing technician should not be considered the motor management manager. However, the technician is a key partner in the management of motor assets as well as maintenance managers, mechanics, warehouse personnel, purchasing personnel, etc.

The reliability and testing technician should also have a working relationship with the preferred repair vendor to assist in problem resolutions.



Decision Tree

Every motor management system should have a decision tree. The tree should be used to assist in making repair or replace decisions. The decision tree to the left is for representation only. It is not complete and also relies on information from a table and another decision tree that are site specific.

Most decision trees I have seen lack one important item—at least in my estimation. This is a branch or section to help determine whether a motor should be equipped with a roller bearing on the shaft end. This is a critical decision for motors driving equipment through belts. Do not construe this to mean that all motors driving belts should have a roller bearing on the shaft end. Each case should be considered separately as to whether a roller bearing would be applicable. This issue is also very important when making a purchase decision for a new motor.

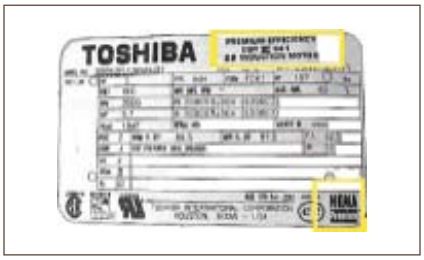
Tracking

Tracking a motor from birth to burial is difficult at best. A properly functioning and effective motor management system makes it easier and can pay for itself in man hours saved, energy efficiency, reduced inventory and—above all—reliability.

A key element to tracking is assigning a unique identification to each motor. The identification should not be removable. I prefer engraving the unique identifier on a motor. Engravings are not easily removed and remain legible for years of service and more often than not will outlast the motor.

The area where the J-box is mounted normally provides a large enough surface areas do other areas on the motor. Do not engrave end bells with identifiers in the event an end bell is replaced. The engraving should be as deep as possible and legible. Stamping is not recommend because there is a risk of cracking the casting. Relying on the nameplate for identification can be frustrating, especially if the nameplate is removed or becomes unreadable because of corrosion, etc. Motor shops often install a replacement nameplate but only the basic information is put on it and other important information may be lost if not recorded somewhere else.

There are a number of ways to set up an identifier but it should be uniform and not change from year to year. For example a numeral system based on the year and the sequence the motor arrived can be assigned along with a letter designation for the name of the site, e.g. 99-035V. The 99 means it was 1999. The 035 means it was the 35th motor identified in 1999. The V stands for the name of the plant site. If it was an older motor that had not yet been identified it would be assigned the next sequential number.



History

History is a sequential documentary of the life (birth to burial) of a motor. It is a very important piece to help determine whether to repair or replace a motor. Normally a motor stator cannot withstand many burnouts and rewinds without the core becoming degraded. Without a history, it is very difficult to know how many times it has been rewound, much less what else has been done to it or where it has been.

Reconditioned = Bearings, machining, cleaning, painting and etc.

Overhauled = Rewound along with reconditioned items.

History can be kept in many forms and is normally tailored to a particular site or company. Whatever form it takes it has to be easily used and not fragmented in different places to get a complete picture.

A number of motor testing systems allow for history entry and retention. However they present some limitations in regard to documenting a complete birth to death history, especially if there is no formal motor management system in place. History then becomes fragmentary and sometimes of little use unless diligently administered.

History is the life-blood of any motor management system and can make or break it.

Efficiency

In this day of increasing energy costs, particularly electricity, it pays to be energy conscious. According to the U.S. Department of Energy: Electric motors consume a large percentage of electricity used in industry across the U.S. On average, approximately 63% of industrial electricity is consumed by electric motors. This percentage can reach 75% or more in certain industries. Also motors can consume five to twelve times their initial purchase cost in energy per year. If one considers that a 25-horsepower motor, running 24/7 can consume up to $15,000 in energy per year and a 100 horsepower motor can consume up to $56,000 in energy per year, even small reductions in energy consumption per motor could result in substantial savings. Additionally, in the case of motors up to approximately 50 horsepower, the savings difference between using a standard efficient motor versus a premium efficient motor could pay for the premium efficient motor in one year. Every year after that would be money in the pocket!

Repair practices and quality can significantly influence energy consumption over original design. A rewound motor, especially if it were poorly done, can significantly increase energy consumption compared to the original "as built" specifications. A very important item to consider when making repair and replace decisions.

Conclusion

Having attended and participated in motor management seminars and motor management training sessions normally lasting two to three days, I realize this paper and presentation cannot deal with every scenario and address every aspect of motor management. However I do hope they will be of help in developing more awareness concerning the issue of motor management and its complexities.

A motor management system, functioning at all levels, makes life easier, reduces cost, reduces inventory and reduces energy usage. This keeps everyone happy, including the reliability and testing technician. Take it from someone who has been there on both sides.

History Sample:

ID: 99-035V	**Shop #172986**	**50-1780-326TPH**	**S/N: none**
US Electric	460v 65 FLA	90-eff 82-pf	56 Bars 48 Slots

Note: Open style, vertical mount, shaft down, oil bath top bearing

02/15/1999 – New motor: PO 14598V:Acceptance ck good:Test Run o.k.
02/20/1999 – Installed: 40628971P: #1 River water pump: w/o V179263
10/31/2003 – Removed 40628971P: Grinding noise: No oil: w/o V613578
11/15/2003 – From Repair:Acceptance ck good: Reconditioned
05/16/2004 – Installed: 40628972P: #2 River water pump: w/o V798642