Selected Bibliography on Electric Motor Repair

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A good pamphlet on the motor replacement decision process. There is a strong focus on the importance of efficiency and helpful information on getting a quality repair job. A number of charts and lists give rules of thumb for the decision-maker who does not have the time for an in-depth quantitative analysis.

Available through Electrical Apparatus Service Association, St. Louis, MO.
A study report describing how proper motor repair can prevent any loss of efficiency in rewinding. This guide is aimed at service centers to help them maintain efficiency levels.

A comprehensive textbook intended for electricians and industrial maintenance personnel. It gives a very thorough explanation of the principles upon which motors run and covers details of their construction, winding configurations, controls, etc. This is a good start for someone, starting from any level, to acquire a reasonably thorough knowledge of motor design, applications, and repair.

Broadly discusses environmental impacts of DSM. Includes a good section on the comparative environmental impacts of motor rewinding vs. new motor manufacture.

Discussion of 5 fault zones to look at during troubleshooting (power circuit, insulation, stator, rotor, rotor/stator relationship). If maintenance personnel miss any of these zones, they could miss the problem, as well as lose credibility for their fault detection skills.

Summary of actions taken primarily by EASA responding to legislation and issues pertaining to rewound motor efficiency.

Provides economic analysis tools for choices involving new motor purchase, motor replacement, or repair.
Focuses on three-phase electric motor maintenance and repair issues, with comments on the interaction with electronic drives.

Summary of current issues and research pertaining to motor repair.

Summarizes EASA Core Loss Study results.

Analysis of the effects of motor repair on efficiency. Laboratory testing of 23 50-hp motors sent to 23 motor repair shops showed that drop in efficiency was directly related to work practices, mainly due to the stator characteristics and poor bearing lubrication.

Report on study by GE of increased core losses from poor quality rewinds.

Describes “Surge Test” technique. This technique is used to detect errors in the rewound motor as well as diagnosing faults in failed motors.

Describes testing and inspection of motor relay, circuit protectors & fuses.

Good overview of techniques used in a good motor repair shop to optimize reliability and efficiency.

Describes recommended rewind techniques for optimum efficiency (and reliability) based on rewinding experience.

Describes efficiency benefits of mechanical winding removal at below 300°F, rather than burnout; also trickle varnishing.

EASA, *How to Get the Most From Your Electric Motors*. Electrical Apparatus Service Association, St. Louis, MO 1997.
Guidelines on application, maintenance, cleaning, and testing of motors. Includes information on repair vs. replacement.

EASA, *Recommended Practice for the Repair of Electrical Apparatus*, EASA AR100-1998, Electrical Apparatus Service Association, St. Louis, MO.
Formerly called a “standard,” this document describes record keeping, tests, analysis and general guidelines for the repair of electrical motors and generators. It is widely considered to be the foundation for a quality electric motor repair.
EASA, *Can Energy Efficient Motors Be Rewound Satisfactorily?* EASA Tech Note 26, Electrical Apparatus Service Association, St. Louis, MO. Reprint of an article by Professor David Walters in the February/March 1998 EASA *Currents* newsletter. Provides test evidence that proper rewinding can maintain original efficiency.

“Electric motor tester diagnoses problems, prevents downtime.” *Oil & Gas Journal*, Vol. 96, No. 8, February 23, 1998, p. 69-70. Results from a new motor circuit evaluator (MCE) tester used to troubleshoot problems and provide diagnostic results and data trends on electric motors.

**Electrical Apparatus**
This journal of electromechanical and electronic applications and maintenance offers extensive reporting on electric motor repair in every issue.


Lahaie, S., *Evaluation of Electric Motor Repair Procedures*. Canadian Electricity Association, Montreal, Quebec (Canada), CEA 9205 U 984, December 1996. A study of repair procedures on low voltage induction motors in the 1 to 500 horse-power range. Includes a practical guidebook on quality motor repair procedures, testing verification, and equipment requirements that minimize degradation of efficiency.


In-depth description of “Surge Testing,” with specific testing program recommendations.

Discusses the typical kinds of problems that lead to motor inefficiency or failure. Also discusses how to determine when it makes economic sense to upgrade to an energy-efficient motor, and whether an adjustable speed drive or other advanced control system will give you the results you seek. It covers all aspects of motor systems including motor repairs, and predictive & preventive maintenance. Nine useful appendices are included, such as a procedure for motor repair shop evaluation, model electric motor repair specifications, and forms and checklists for tracking a motor through a quality repair.

Discussion of motor bearing maintenance for optimizing reliability.

Summary of considerations for selecting energy-efficient motors for specific applications.

Comprehensive guidebook on motor systems management. It covers systems management from the electrical distribution system to the driven load.

Overview of impacts of rewinds on motor efficiency.

Good overview of impacts of rewinds on motor efficiency. Also disputes that motors lose efficiency merely because of aging.

A master list of activities and resources in the industrial motor systems market. It covers product manufacturers, references and standards, government associations, trade associations, and much more.

A very comprehensive reference that promotes a strong emphasis on energy efficiency. Chapter 10 covers all aspects of the motor repair and rewind process. Emphasis is placed upon efficiency and performance. Alternative methods are reviewed in terms of their convenience, environmental effects, and impact on motor efficiency. Studies on efficiency of rewound motors are reviewed and summarized.

Describes use of a motor winding analyzer to predict and prevent insulation problems before they occur.

Common mechanisms that can degrade insulation systems, analyzing the root cause of failures, and design and application considerations.


Discusses specific repair requirements for explosion proof motors.


This book provides very thorough coverage of electric motor design, efficiency, application, maintenance, and repair.


A comprehensive and critical look at motor insulation testing. The various popular tests are compared in terms of what they can find and the stress they impose on the motor. Temperature effects and the behavior of different insulation materials are discussed.


What surge comparison testing is, and what it isn’t. This testing for variations is used mainly to diagnose insulation condition, but it will also reveal improper winding connections unrelated to dielectric integrity.


Author describes his program to establish motor repair standards.


A good general approach to troubleshooting, this makes use of a medical analogy to discuss diagnosis of motor systems problems. The reader is encouraged to think creatively and with appropriate skepticism toward hearsay information.

*NEMA Standards Publication No. MG 1-1998, Motors and Generators*, National Electrical Manufacturers Association, Rosslyn, VA

This major standard of the National Electrical Manufacturers Association covers the design and performance standards of electric motors. It is a must for any serious motor systems manager.


Advice for evaluating motor circuits to maximize reliability.


Analysis of methods and procedures for rewinding electric induction motors. Emphasis on efficient and reliable motor repairs that comply with CSA 390 standards.

Presents a recommended repair specification meant to reduce the chance of inverter duty failure with VFD-driven motors.


Introduces techniques for reducing turn-around time including mechanical stripping, automated winding, and trickle varnish impregnation.


Outlines recommended motor and motor control maintenance program.


Report on study by EASA on impact of stator winding burnout temperature on motor efficiency.


Description of software that can guide troubleshooting and repair of motors and generators.


History and summary of IEEE Standard 1068, pertaining to motor repair for the petroleum and chemical industries.


Describes predictive testing for large (power plant) motors.


Recommendations for motor regreasing.


Fact sheet discussing efficiency of rewound motors, and arguing for replacement of failed motors whenever possible.


First published in 1904, this is considered by some to be the “bible” on electric motor repair. Detailed text and illustrations covering single phase, polyphase, and DC motors and generators, and motor controls.


Report noting that motor labeling and efficiency requirements established by EPACT will affect only general-purpose motors built after October 24, 1997.


Schueler, Vince, and Johnny Douglass, (Washington State Energy Office), Quality Electric Motor Repair: A Guidebook for Electric Utilities. Prepared for Bonneville Power Administration, Portland, OR (DOE/BP-2747, 1995) and Electric Power Research Institute, Palo Alto, CA (TR-105730, 1996). Information and tools that utilities can use to raise the quality of electric motor repair practices in their service territories. Also an excellent guide for the motor end user.


Yung, Chuck, “Why end play must be checked in ball bearing motors.” *Electrical Apparatus*, v. 51, n. 3, March 1998, p. 37-38. Since most service shops test-run repaired motors for a relatively brief time, under no-load conditions, it is important that technicians understand a few basics about end play. The end play must be checked to ensure that the bearings are not pre-loaded when the motor reaches operating temperature.


Zeller, Markus, “Rewound High-Efficiency Motor Performance.” *Guides to Energy Management*, BC Hydro, August 1992. This is a landmark study, forming the basis for assumptions about efficiency degradation following rewinding. Ten 20 horsepower motors were failed and rewound in separate shops in a study sponsored by BC Hydro. Each motor's efficiency was tested per CSA C390 (the Canadian equivalent to IEEE 112B) before and after failure and rewinding. The before and after efficiencies were recorded and the motors were autopsied to explain changes in efficiency.
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