The importance of stator core loss testing before and after burn-off process

By Steve Skenzick

By this time we should all know that stator core loss testing is a required part of a quality rewind. A core loss test before and after burn-off is specified in the EASA Recommended Practice for the Repair of Rotating Electrical Apparatus (ANSI/EASA AR100-2010) and The Effect of Repair/Rewinding on Motor Efficiency; EASA/AEMT Rewind Study and Good Practice Guide to Maintain Motor Efficiency. I would like to share some core loss testing experiences we have had over the years in our service center.

At our service center, we learned the hard way about the benefits of core loss testing at least one time in the rewind process. That was before we purchased our first core loss tester more than 25 years ago. It was a little late to save that job, but as a result it was a very beneficial learning experience.

Lessons learned
A motor manufacturer realized that it had manufactured some 4- and 6-pole motors rated 200, 300, and 350 hp that had defective laminations. The manufacturer conducted a recall/ replacement on the motors, intending to destroy the defective ones. Our customer either had one of these motors and was not aware of the recall or possibly located the motor through surplus or a salvage company that was likewise unaware of or possibly ignored the recall. We wound the motor twice in three days before we asked questions of the right people. That was when a representative of the manufacturer told us about the recall. We changed our process and began core testing after the burn-off oven process on all rewinds.

Rebates add incentive
In addition to post-burn-off process core testing, there are advantages of using pre-burn-off core loss testing and assessing the results. We are located in the western U.S., and along with western Canada, have a rewind initiative started by Northwest electric utilities and the Bonneville Power Administration that provides monetary rebates for doing things right during repair/rewinding such as: core testing before and after burn-off; identifying core deficiencies due to a failure event; processing the stator at acceptable controlled temperatures; calibrating tools and instruments; and participating in professional development such as that provided by EASA.

We began participating in this initiative in 2007. The idea was that if a motor core was healthy and the stator carefully rewound, based on the EASA/AEMT Rewind Study and Good Practice Guide, it would retain its reliability and original nominal efficiency value avoiding increased energy consumption.

Learning from other members
We then started seeing some problems with faulty cores before or after the burn-off processing. As a regional group, we were talking with other EASA members and started to find that other service centers had similar experiences. Until we started sharing our findings, we were all thinking it was just a random faulty stator or that maybe we had done something wrong during testing.

Through this contact with other service centers beyond our service territory, we started to find that others experienced the same kind of negative test results. A number of motors had stator lamination teeth bent inside-outward (flared) at both ends after burn-off, indicating a possible stress relief step that had been missed when manufactured. This led to asking questions of manufacturers about core plate; we soon learned that all motor laminations and inter-laminar insulation are not the same.

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out by core loss testing. And there were stators that we would not rewind because they failed the core test.

These scenarios left us in the unenviable position of having to explain to a customer that their critical motor was not repairable after only one rewind; and that a new replacement was 16 to 20 weeks out.

First determine if core usable

We have a water treatment plant customer with four 125 hp motors that had two of their motors rewound twice before with, we believe, proper temperature in a controlled burn-off. However, they failed the core test when they needed to be rewound a third time. Thus, there is a real need to core test before and after the burn-off process to determine that the core is usable. Interestingly, we see stators during the post-burn-off process that have core losses go down below the initial pre-burn-off process test. In my opinion, this is proof that a healthy core rewound right can be as efficient and reliable as the original motor.

For motors coming into your service center, it is important to know and document that the stator core is good to start with, or whether it has been received in a defective condition. Before- and after-stripping core tests (see Figures 1 and 2), establish a benchmark and proof of the as-received condition — almost an insurance policy. Also, core testing a motor to be reconditioned that may have a suspect core is an additional use of a good available tool.

If we receive a motor for reconditioning that hasn’t previously been through our service center and it fits the characteristics of the motors we have seen lamination problems with, we core-loss test the stator as part of our reconditioning process, especially if there is evidence of a previous rewind.

Accurate iron measurements

In our service center, we were concerned about obtaining exact measurements to perform the core loss test on a good winding that was still in place. Getting accurate iron measurements for a “winding in” core test is important. However, if you’re checking a stator that is the same, or very similar to other like stators, you may be able to use previous test results for comparison. The important comparison numbers you need are the stator ID, OD, back iron, and slot depth. The tooth width is important in winding design flux calculations but not necessary in core loss calculations. Also, data that you have taken and stored on a computer is a good place to look for comparable data.

Like our water plant customer, at certain times of the year they may need 3 to 4 of their pumps running to keep up with demand. Losing one becomes a major concern let alone waiting weeks for a replacement motor; putting their facility in an effluent creek without a paddle. If rewinding a reconditioned motor would not be economically feasible due to core or other major failure event damage, we find it best to alert the customer of that and that this might be the best time to locate and budget for a replacement. In keeping with good “motor management” and marketing practices, we provide replacement information including model, availability, freight options and price.

Concluding remark: The more you do the easier it gets; and the better the job you end up with. ☛

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