Electric Motor Rewinding

Does your electric motor just need rewinding? Or...is there more you need to know?

You've been having trouble with your electric motor, and you've just heard back from the shop: it needs to be rewound. What is electric motor rewinding and why would they say it's necessary? What happens to a motor that causes it to need rewinding? And what's this talk about VPI versus "dip and bake" insulation -- are they even necessary? Does it matter where you take your electric motor for rewinding? If those are the kinds of questions that are bothering you, then you have come to the right place.

Why Your Motor May Need Rewinding

If you've been told that your electric motor needs rewinding, that means the coils are shorted, grounded, or otherwise damaged. There here can be a wide variety of issues behind motor failures that necessitate rewinding, and most of them make themselves known in the form of failed insulation and/or grounded/shorted coils.

Insulation failures can take several different forms, including windings that have shorted turn-to-turn or phase-to-phase, coil-to-coil, or grounding at the edge of the slot. These particular issues can usually be traced back to contamination, abrasion, voltage surges, overall age of the machine, or vibration.

Thermal deterioration is another common cause of motor insulation failures. Basically, it is caused when the insulation overheats due to poor connections in the motor terminal, a locked rotor resulting in high currents in the stator, excessive load demands that exceed the motor's rating, or excessive reversals and starts.

What is Involved in Rewinding an Electric Motor

Electric motor rewinding involves three basic steps: removal or stripping of the winding (coils), Inserting and connecting new winding (coils), and insulating the

complete winding. The rewinding process is not necessarily as simple as it may sound, however.

Gathering Winding Data

A technician will need to gather winding data as most motors have significant differences in their windings even if they are the same horsepower, speed, and voltage. This data includes: the number of slots, wire size, number of coils, number of turns per coil, critical dimensions, bracing, and insulation parameters. This data is used to replicate the original motor as well as suggest design improvements to improve performance and extend the mean time to failure. This data should be checked to either the EASA Winding Data Verification program or other programs that are available to confirm the winding arrangement meets or exceeds the nameplate data and performance of the motor.

This is an important step as someone could have previously rewound the motor incorrectly and if you do not verify the data, you could copy the prior repair shops mistake. Verifying the data helps to prevent this from happening.

Burnout and Stripping

After all the key information has been gathered, the existing motor windings are stripped out of the motor core. This starts with putting the stator of the motor into a high temperature oven typically referred to as a burnout or burnoff oven. You need to make sure the oven is recording oven temperature and part temperature to ensure the motor doesn't get too hot and damage the core insulation. The oven should also have a water suppression system to help keep the heat from getting too far out of line. This burnout step can take up to multiple days for larger units and results in the insulation essentially being reduced to ash. The next step, once its cooled down, is to physically remove the windings from the stator core, typically referred to as stripping. Most times you are gathering winding data before and after the stripping process. A core-loss test should be performed prior to the oven process as well as afterwards to ensure the integrity of the core iron insulation.

Making the Coils

What follows is the actual making of the coils. Key parameters of this process include layering, wire tension, and keeping count of the number of turns on

the coil. Please keep in mind that the process varies when you are making random wound coils versus form wound coils. Random wound coils are made in a repair shop using buckets of magnet wire and winding heads to make the correct length coil. Form coils are made by a manufacturer that specializes in form coils and has the correct wire, tapes, press equipment, spreading equipment, testing capabilities, etc.

Winding Insertion and Connecting

Once the coils are made, they are installed in the stator slots and then connected. When inserting coils, the process varies whether you are working on a random wound winding or a form coil winding but it is the same basic process of inserting coils and insulation into the core of the motor. You then must connect the coils together to form the complete winding. Blocking and bracing of the winding is an important factor to note in this process. If a winding is not braced properly, the mechanical movement can cause winding failure.

Testing the Coil Windings

Multiple tests are run during the entire rewinding process to ensure the integrity and quality of the coil windings. These tests are performed in accordance with IEEE and EASA standards. After the rewinding process is complete, the insulation process (sometimes referred to as varnishing) follows.

Insulating a New Winding in an Electric Motor

Besides providing electrical insulation, the varnish used also keeps the coils from moving, bonds the multiple coils together, and protects the windings from contamination.

One of two approaches can be used for applying the insulation to the newly wound coils: the more traditional varnish dip and bake or the technologically advanced vacuum pressure impregnation process (VPI). For larger or higher voltage electric motors you may also see B-stage (resin-rich) coils.

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Varnish dip, sometimes called varnishing or “dip and bake,” involves warming the new winding, dipping it in a vat of varnish (this could be water based or an epoxy based), and then heating it in an oven to fully cure the varnish or resin. This is the traditional method for repair shops after a rewind is complete. The traditional varnish dip is also used when a motor is reconditioned. However, on new windings a simple varnish dip should be replaced by Vacuum Pressure Impregnation.

Vacuum Pressure Impregnation

With VPI, highly controlled vacuum and pressure cycles are used to penetrate and coat the windings with a 4 to 5 ml build of solventless epoxy resin. The reason why it is replacing the more traditional varnish approach lies in the advantages it provides: it provides superior performance in harsh environments, it increases efficiency through better heat transfer, is less susceptible to contamination, and reduces coil vibration. Many repair shops have not made the significant investment in the VPI systems. Unfortunately these shops can not offer this, advanced, solution. However, this should be the preferred method that is used.

B-Stage Coils on Electric Motors

Some large, motors (12KV to 15KV range) use B-stage coils. B-stage coils are resin-rich coils that are manufactured with epoxy tape and have a reputation for being durable and long-lasting. For motors that already use B-stage coils, it is often better to implement the traditional approach to insulating coils as opposed to VPI. An experienced electric motor technician can give you advice in this area.

Conclusion

Have you been told that your electric motor needs rewinding? At HECO, we don’t just rewind your motor -- we carefully study its design so that we can suggest modifications that will make it less likely to break down in the future and provide even better performance. We are EASA accredited and follow the strictest procedures for repair and reconditioning that allow us to provide you with the highest quality repairs that will reduce the M&O costs for your electric

motor powertrain. Contact us today and let us help you with all your powertrain needs!