Medium Voltage Motor Rewinds

Understanding possible modifications for your rewinds can save lots of headaches in the future.

Your medium voltage motor went down, and the shop is telling you that it needs rewinding. What is rewinding? How complicated is the process? You heard that you might need something called VPI instead of varnish dip -- is that true? If these are your questions, then here are your answers.

Medium Voltage Motors

Before we go any further, it would probably be wise to establish what is considered a medium voltage motor. Medium voltage motors are motors between 600 V and 7.2 kV, with the most common voltages being 2.3 kV, 4 kV, 4.16 kV, 6.6 kV, and 7.2 kV. These are usually form coil wound motors, and many times they are custom motors. That said, there are still plenty of standard medium voltage motors, and that includes most ANEMA motors (which are medium voltage or high voltage).

Why Your Medium Voltage Motor Probably Needs Rewinding

When someone tells you that your electric motor needs rewinding, that means the motor coils are shorted, grounded, or otherwise damaged. There are quite a few causes behind this and these causes make themselves known in the form of shorted coils and/or damaged insulation.

Insulation failure usually takes the form of windings that have shorted phase-to-phase, coil-to-coil, turn-to-turn, or grounding along the edge of a slot. These types of failures can usually be traced back to things like voltage surges, contamination of the coils, abrasion, vibration, or just the natural aging of the machine (e.g., oxidation).

There can also be thermal issues involved with electric motor insulation failures: a locked rotor causes high currents in the stator, the insulation overheats because of poor connections in the motor terminal, the motor is subjected to excessive reversals and starts, or there have been excessive load

demands on the motor. Here's a general rule of thumb: for every 10°C increase in winding temperature, the winding life is reduced by 50%.

Rewinding a Medium Voltage Electric Motor

There are three major steps to rewinding an electric motor: removing the old winding, winding, and insulating the new winding. This description of the rewinding process is deceptively simple, however. And if you want to prevent the same type of failure from happening again, then the windings may need to be redesigned to improve thermal performance or to address other issues.

Coil and Winding Inspection

The coil inspection process starts with an inspection of the existing coils. This includes details like the number of slots, the size of the wire, the number of coils, how many turns per coil, information about bracing, insulation parameters, and dimensions that are critical to the existing design. Based on this information, the technicians can either duplicate the original coil design or use the info as a starting point for a redesign.

Another important step in the rewind process is gathering winding data which can be used to improve the original winding design. The data gathered should be checked using either the EASA Winding Data Verification program or other programs that are available to confirm the winding arrangement. This type of verification confirms that the winding design meets or exceeds the nameplate data and performance of the motor -- which is important because someone could have previously rewound the motor incorrectly. Verifying the winding data helps to prevent the same mistake from occurring again.

Burnout and Stripping

At some point, the insulation is completely burnt off the windings in a specially designed oven that reduces the insulation to ash. This can be time-consuming, especially for larger motors. Note that most of the time winding data is gathered before and after the stripping process. A core-loss test should be performed prior to the oven process as well as afterward to ensure the integrity of the core iron insulation.

Coil Manufacturing

Coil manufacturing is typically performed by a machine-controlled system that keeps track of details such as wire tension, the number of turns in the coil, and layering. This process does vary depending on whether the motor needs random wound coils or form wound coils. Random wound 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.

Coil Insertion and Connecting

Once the coils are complete, they are installed in the stator slots and then connected. When inserting coils, the process will vary depending on whether the coils use random wound windings or form coil windings, but the process basically remains the same. Once the coils are installed, they must be connected to form the complete winding. Blocking and bracing of the winding is an important factor to note in this process as if a winding is not braced properly, the mechanical movement can cause winding failure.

During the rewinding process, there are multiple tests performed in accordance with IEEE standards to ensure the integrity and quality of the windings.

Insulating the Coils

There are two basic approaches 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. Besides providing electrical insulation, the varnish also protects the windings from contamination, keeps the coils from moving, and bonds the multiple windings together.

Varnish Dip

Varnish dip involves dipping the windings (which have been warmed) into a vat of epoxy varnish, then heating the windings in an oven to fully cure the epoxy. This is the traditional method for repair shops after a rewind is complete and 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 (VPI)

With VPI, the insulation is applied with extreme precision followed highly controlled vacuum pressure which is used to penetrate and coat the windings with a 4 to 5 ml build of solventless epoxy resin. VPI has several distinct benefits over the varnish dip method: VPI results in superior performance in harsh environments, effectively increases efficiency via better heat transfer, is much less susceptible to damage by contamination, and reduces coil vibrations.

Conclusion

Have you been told that your medium voltage electric motor needs rewinding? At HECO, we won't just rewind your motor -- we study its design to suggest modifications that will make it less likely to break down in the future and provide even better performance in the present. HECO is also EASA accredited, which means we follow the strictest procedures for repair and reconditioning. That allows 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!