

# High Voltage Electric Motor Rewinding

Know the difference between VPI & B-stage insulation for your rewinds

## High Voltage Motor Rewinds

You have a 13.8 kV electric motor that you've just been informed needs a rewind. The electric motor repair shop has given you two options: VPI or B-stage insulation. You need to understand what the difference is between the two insulation systems, which one fits your budget, and would likely be the best long term solution for your high voltage motor. This article may not answer all your questions for your specific electric motor rewinding, but it will give you the information about how these methods differ and when one is preferred over the other.

## What Counts as a High Voltage Motor?

When we are referring to high voltage motors, we mean electric motors that have a voltage between 12 kV and 15 kV. Not only do these motors involve higher voltages but they are also large motors in terms of physical size & weight, which can cause them to be a serious challenge for many electric motor shops to work with.

## Insulation: The Major Issue with High Voltage Motor Rewinds

The major issue with high voltage electric motor rewinds involves the rotor/stator coil insulation, which is critical for reliable performance. There are two options when it comes to performing a **rewind/insulation process** on a high voltage motor: VPI (vacuum pressure impregnation) and B-stage coils. While both methods accomplish the same end goal (i.e. coil insulation), the insulation systems involved couldn't be more different.

## Vacuum Pressure Impregnation

In the **VPI process**, a preheated stator or rotor is lowered into the VPI pressure chamber and a vacuum is drawn. The vacuum removes all air & draws a solventless epoxy resin into the chamber until the stator or rotor is completely submerged. Then the process is reversed and pressure is applied until the insulation system is completely impregnated with the resin, after which the unit is removed and baked to cure the resin in a curing oven. The result of the VPI process is a 4 to 5 mil build of insulating resin and an almost void-free insulation system for your motor's windings. It is a somewhat newer process that has been improved & perfected for lower voltage motors, but can still have issues with resin penetration for medium to higher voltage motors.

## B-Stage Coil Insulation

When it comes to high voltage motors, the alternative to VPI is known as B-stage insulation systems. B-stage coils have been used to insulate motor windings for large generators and motors for the last 100 years. The B-stage process includes the use of resin rich coils that are manufactured with epoxy loaded mica tapes. The slot portion of these coils are "Hot Pressed" and cured while the remaining portions of the coil are uncured and still flexible for the winding process. Eventually the completed winding is cured in a baking oven to finish the process. It is a time tested & durable insulation system for high voltage motors and typically lasts for 50+ years.

## VPI vs B-Stage Insulation for High Voltage Motors

Let's pause for a moment and compare VPI to B-stage coils:

- The concern for many with **VPI for high voltage motors** is that the life expectancy is not well known as these systems are relatively new, as compared to the well-documented and proven fifty year life expectancy of B-stage coils.
- For larger motors, the size of available VPI tanks limits the physical size of motor that can be processed; this is not an issue with B-stage coils.

- The VPI resin and coil & winding insulation must be compatible to use in the VPI process, where this concern is not present with B-stage insulation as the resin is built into the mica tapes.
- When using the VPI process, resin penetration is critical and many parameters (i.e. temperature, pressure, # of layers of tape & pressure applied, etc.) can impact the level of penetration. With B-stage coils, the insulation is already resin rich (after hot pressing the slot section and baking the whole unit) and only needs an additional spray coating or treatment of varnish/resin on the end turns and blocking to complete the system.
- Green (uncured) VPI coils cannot be tested at full voltage (due to uncured tapes); this is not a problem with B-stage coils.
- Patches or coil repair is not possible with VPI windings but is possible with B-stage coils.
- When a winding fails in a system using VPI, that winding has to be processed in a burn out oven -- which can cause damage to the stator laminations if not properly controlled leading to a stator restack; this is not the case with B-stage coils where stripping is much easier and involves more controllable temperatures.
- B-stage coils do cost more than VPI, but are expected to last much longer; the longevity of VPI on high-voltage motors is not as well documented (it has only been used on high voltage motors for about 20 years) and notably there have been insulation system failures with such large motors.

## Should I Go With VPI or B-Stage Insulation?

Both VPI and B-stage coils can be used for high voltage electric motor rewinds. The key thing to keep in mind is that both of these methods are available, regularly used, and successful. B-stage coils are the older, more traditional method and probably the best option if you are working with an older motor -- switching from B-stage to VPI coils on an older model motor is not recommended and can be risky. VPI is still a valid option for high voltage motors (as long as performed by a reputable source) and can be more cost

effective if your electric motor repair shop has a VPI tank that can fit your motor.

## **HECO is Your Expert on High Voltage VPI & B-stage Insulation**

At HECO, we are very knowledgeable and experienced when it comes to insulation systems for electric motors. We've been doing VPI since 1981 -- and compiled many years of data, based on in-house testing. We've also been performing high voltage motor rewinds (11KV to 13.8KV) for over 25 years and perform both high voltage VPI and high voltage B-stage rewinds. In addition, we have testing capabilities of up to 13.8KV, 4000kVA and lathe machining capabilities up to 96" swing, 20' long, and up to 80,000 lbs, so we can repair the largest of rotating components. Contact us today and let us help you find the best solution for your high voltage electric motor!