TELEDYNE HASTINGS INSTRUMENTS
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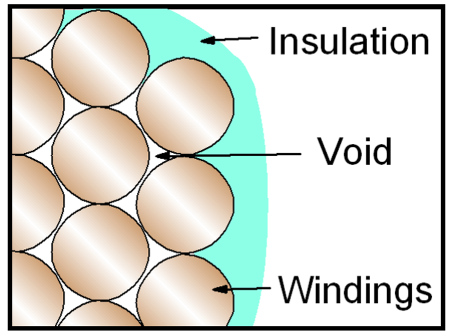
Vacuum Pressure Impregnation (VPI) Systems

Using the Teledyne Hastings HVG-2020A Piezo Vacuum Gauge for VPI Measurements

Vacuum pressure impregnation (VPI) is an important application for applying insulating materials, as well as producing void-free castings. A typical example is the encapsulation of windings in electric motors. If an insulating resin is simply "painted" on a winding, the result will be a network of uninsulated voids between the winding layers. Applying pressure may force some insulation into the voids, but the subsequent release of that pressure will cause the trapped gas to expand again, causing voids to reappear (Figure 1).

Figure 1 Formation of Voids in Winding Insulation

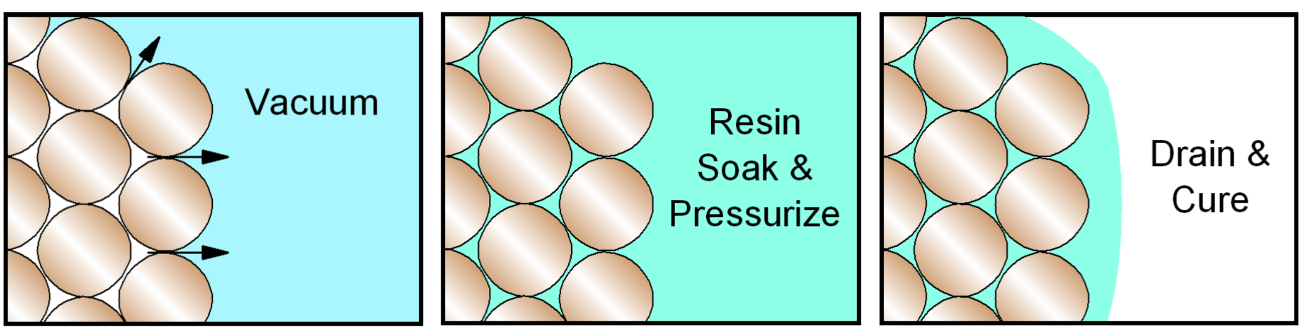


These voids in the insulation can lead to motor failure due to movement of the wiring during operation. Also, in high voltage applications, these air-filled gaps can serve as sites for corona discharge formation, leading to losses in efficiency and resulting in further weakening of the dielectric.

The proper method to prepare windings, and other potted devices for impregnation, is to begin by applying vacuum. The VPI process is shown in Figure 2.

1. The first step is to load the assembly into a vacuum/pressure chamber and apply vacuum to remove air from the voids between the windings. A suitable pressure for this step is 5 Torr.
2. The next step involves a two-part soak. While under vacuum, the insulating resin is introduced into the chamber from a storage vessel. The vacuum provides the additional benefit of removing any air bubbles that may be present in the resin. After a dwell period, the chamber is pressurized to 85-95 psig for another period of time. This pressurization forces the resin into the previously evacuated voids in the winding layers.
3. After another dwell period, the pressure is relieved and the surplus resin is returned to the storage vessel. With the chamber at atmospheric pressure, it is opened and the assembly is removed. This process results in void-free application of the insulating resin on the windings.

Figure 2 Vacuum Impregnation Process



Step 1 **Step 2** **Step 3**

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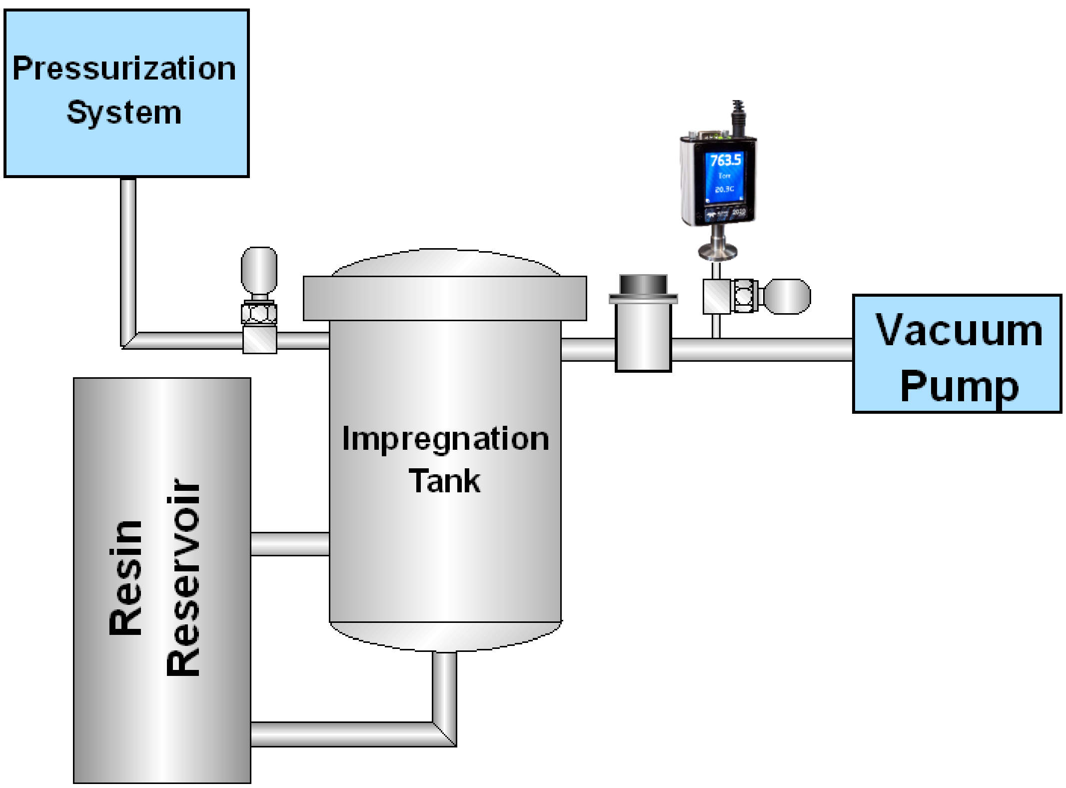
For measurement and control of the vacuum step of the impregnation process, Teledyne Hastings recommends the HVG-2020A Piezo Vacuum Gauge as the ideal instrument. The HVG-2020A comes standard without display, but when desired, it can be configured with a built-in screen (Figure 3) or connected to separate, panel-mounted display (Teledyne Hastings' THCD-101).

Figure 3 HVG-2020A

Figure 4 shows a schematic of a VPI system with the HVG-2020A installed behind an isolation valve. During the evacuation and low pressure, "wetted" portion of the process, the HVG-2020A is open to the vacuum pump and impregnation tank. For process control, an analog output signal from the HVG-2020A connects to the system's analog input programable logic controller (PLC) for scaling setpoints (digital communication can also be used). During the pressurization step, the isolation valve is closed to protect the HVG-2020A from exceeding its 30 psig overpressure limit.

Figure 4 VPI System



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