Vacuum/Pressure Impregnation Process

VPI (Vacuum Pressure Impregnation) is a process that uses vacuum and pressure to seal voids in various parts, devices, or materials including porosity in castings that may need to be used in a leak tight service or need a smooth uniform surface for improved machinability, and electrical windings of motors, generators, transformers and other electrical equipment that require sealing from moisture, solvents, or corrosive agents as well as providing an improved insulating barrier during its electrical operation, and for impregnating wood with various resins so that it will stand up longer to various environments without degrading or failing.

![Figure 1 - VPI System](image1)

The VPI process begins by placing the parts, in some cases which have been preheated, within a vacuum tight chamber or autoclave and pulling a vacuum normally below 10 mmHgA, and in some cases to 1 mm Hg, to remove both air and moisture from all of the pores, crevices, and internals of the parts or material that could trap gas or vapor and cause a bubble to form later that could lead to problems or even failure of the part. After the parts are outgassed they are then submerged into a liquid resin or varnish preservative that has also been preevacuated of all gas bubbles and that fills all of the voids to provide resistance to attack from moisture, chemicals, heat, or electric fields. With the vacuum system isolated from the chamber, the pressure within the chamber is then increased, normally above atmosphere and in some cases several atmospheres using compressed air to insure the liquid preservative is fully driven within the tiniest voids. After holding pressure for some time, the chamber is vented back to atmosphere and the parts are then raised out of the liquid and the excess allowed to drain off. Then the parts are allowed to cure, normally by placing them in a preheated oven for some time before removal and cool down. The treated parts are now sealed against internal leakage or external attack from a harsh environment, and being free of voids allows for improved heat transfer or better machinability in the case of metal components.

![Figure 2 - Dry Vacuum](image2)

Vacuum System Design

Tuthill has provided many vacuum systems for VPI and most have been oil sealed Rotary Piston Pumps or Booster/ Rotary Piston for larger systems as well as in some cases Booster/Liquid Ring Pumps sealed with oil or a solvent compatible with the process resin. Normally with these systems...
systems, the vacuum equipment needs to be protected from process liquid carryover and knockout (K.O.) traps or condenser/K.O. traps are used. The oil sealed pumps will eventually require an oil change out due to some process contamination. The advantage of the Booster/Liquid Ring system is its ability to more readily cope with process carryover since it does not require internal lubrication and could use a process compatible solvent as sealant. Dry pumps could also be used and offer the advantage of not having a sealing liquid that could be contaminated, but would need to be equipped with a solvent purge system so that the internals could be periodically cleaned of baked on process material due to the elevated discharge temperatures. Whatever the process requires, Tuthill can provide the best vacuum solution in pumping equipment (wet or dry), protective devices, and experience.

To learn more about Vacuum/Pressure Impregnation Systems for your application contact our technical sales team vacuum@tuthill.com.