

Many metallurgical/materials high temperature processes need to be carried out either under vacuum or protective atmosphere. Throughput (pumping speed), vacuum level and the quality (level of "contaminants") of the atmosphere dictate the type and size of the pumping system required.

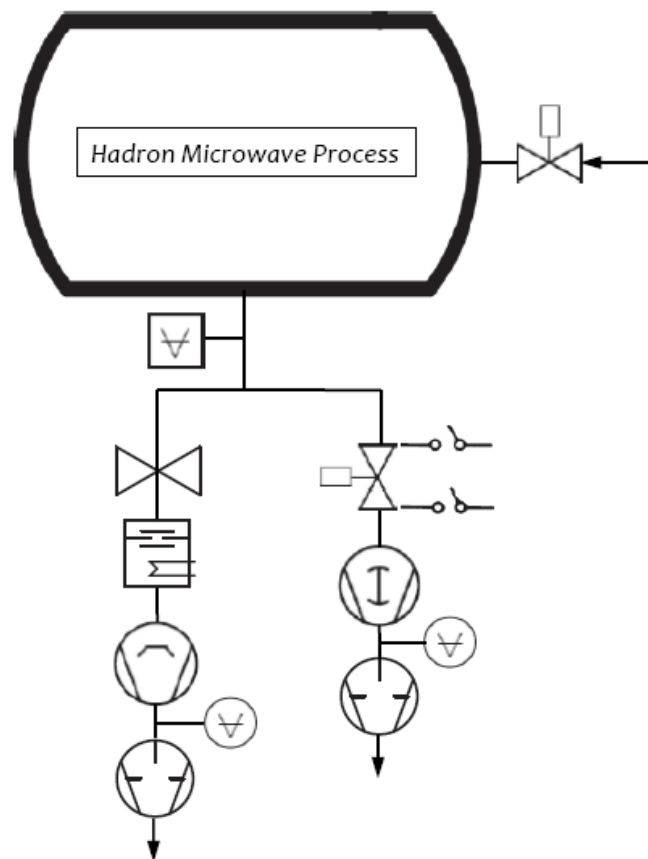
Background

At Hadron we design and fabricate microwave systems for applications that require controlled atmosphere conditions from high pressure to high vacuum. Our expertise includes vessel design, selection of flanges, sensors, gas delivery and pumping systems. The selection of such components is based on the process requirements.

In this briefing we discuss pumping system options. Vacuum pumps are used to reduce the gas pressure within a certain volume and they do so by removing gas particles from the vessel. There are two basic classes of pumps that can be used to achieve this:

- i) Gas transfer pumps: where the gas particles are compressed via one or several stages and exhausted into the atmosphere.
- ii) Entrapment pumps: where the particles that are to be removed condense or bond by other means (e.g. chemically) to a solid surface.

For most of our applications gas transfer pumps are recommended. The following pages discuss the available options that are offered with our systems.

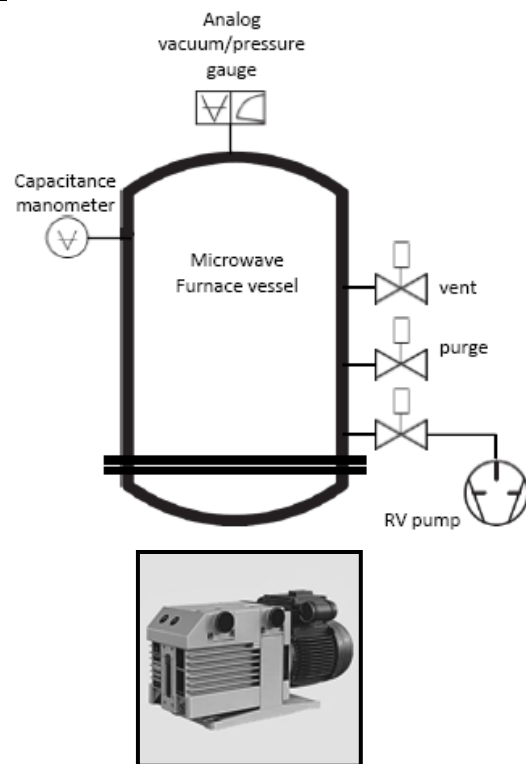


Medium Vacuum ($1 > p \geq 10^{-3}$ mbar)

Application: melting and casting and arc furnaces

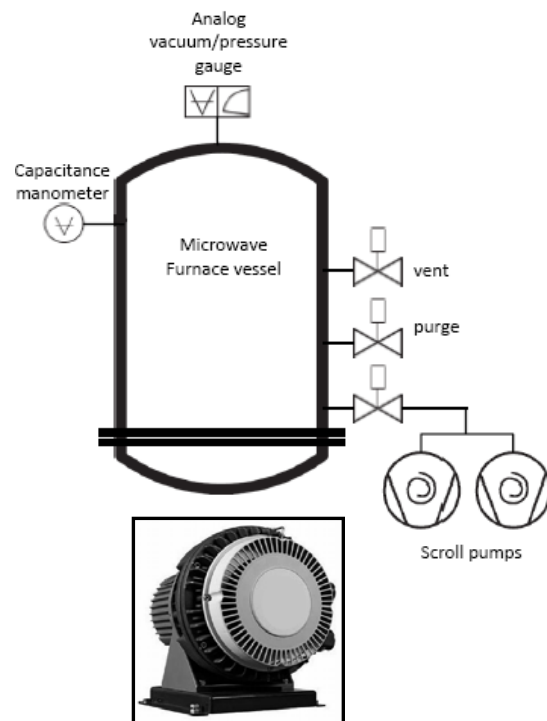
1. **Rotary vane (RV) pumping system:** RV pumps produce vacuum by compressing gas from the vessel and exhausting it to atmosphere. This is accomplished via rotating vanes mounted to a rotor within a cylindrical housing. Seal and lubrication are provided by oil. This is an economical way of producing vacuum levels down to $<2 \times 10^{-3}$ mbar range (depending on the vessel and internal components). The main drawback of this type of pump is that at lower pressures oil backstreaming may occur. This is not significant enough to cause problems for many types of processes and can be minimized by the addition of baffles or molecular sieve type devices.

Application: melting and casting of metallic components or other microwave processes that do not require dry pumping. Pumping speeds available are suitable for small or medium size vessels or systems where pumping time is not critical.



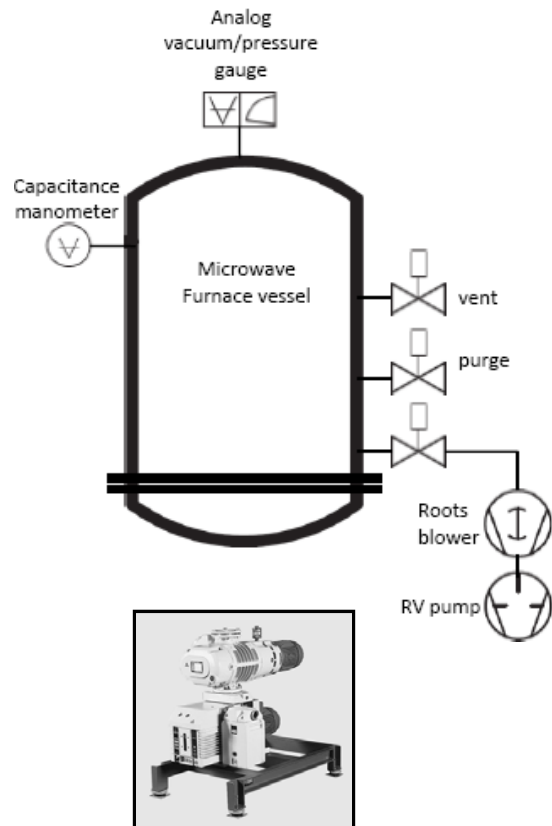
2. **Scroll pump system:** also known as scroll compressors, these pumps use two (or more) interleaved Archimedean spiral-shaped scrolls to produce vacuum. These pumps achieve base pressures $\leq 5 \times 10^{-2}$ mbar (3.75×10^{-2} Torr), *i.e.* they are not as efficient as RV pumps, but they do not use oil and hence do not present backstreaming problems.

Application: melting and casting of metallic components or other microwave processes that require dry pumping but not very low base pressures. Pumping speeds available are suitable for small vessels (for single pumps) medium size vessels if two or more pumps are mounted in parallel (see schematics).



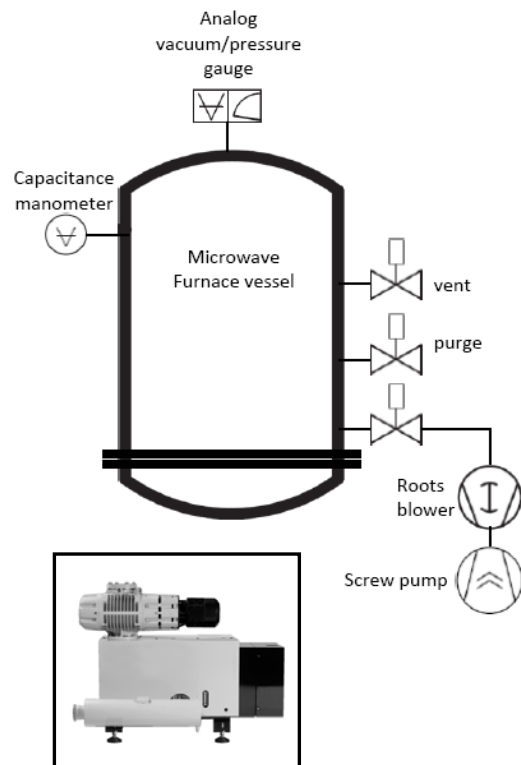
3. *Roots blower /RV pumping package:* Roots blowers are dry compressing rotary displacement pumps and, as such, do not use oil other than as a lubricant. In the standard set up the roots blower is placed between the rotary vane pump and the vacuum vessel. As previously discussed RV pumps use oil as a means of sealing internal surfaces but the roots blower works as a barrier for any backstreaming of oil to the chamber. This set up is so effective in preventing oil backstreaming that it is used in some semiconductor vacuum deposition systems (such as plasma enhanced chemical vapor deposition) where even small amounts (ppm level) of oil contaminants would cause processing problems. The roots blower and RV pump package provide higher pumping speeds than RV or scroll pumps within all pressure regimes and are capable of achieving pressures $<8 \times 10^{-4}$ mbar.

Application: melting and casting of metallic components or other microwave processes that require dry pumping. Pumping speeds available are suitable for medium and large vessels.



4. *Roots blower/ Screw pump package:* This “package” is similar to pumping system 3 but with a screw type dry pump as a back-up pump for the roots blower. This pumping package is completely “dry” and is capable of achieving the same vacuum level as system 3, *i.e.* $<8 \times 10^{-4}$ mbar. However, these are typically large (high pumping speed) pumps with an elevated price.

Application: microwave plasma processes, crystal growth, melting and casting of metallic components or other microwave processes that require extra clean pumping. Pumping speeds available are suitable for medium and large vessels.

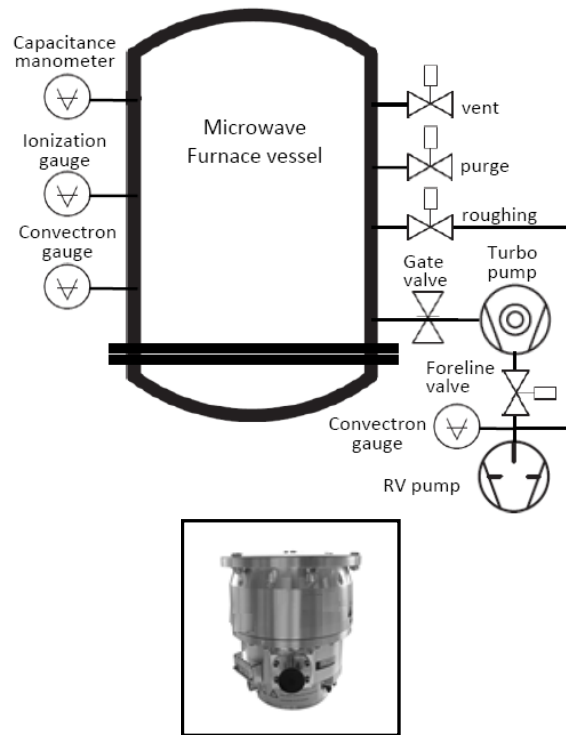


High Vacuum ($10^{-3} > p > 10^{-7}$ mbar)

Application: Annealing of metals, melting, zone melting and crystal growth

5. **Turbo molecular pump:** Turbomolecular pumps operate and generate pressures in the high to ultra-high vacuum regimes. These pumps cannot be used to evacuate a system from atmosphere but are used in conjunction with either RV or scroll pumps – see diagram on the right. Turbomolecular pumps employ multiple stages of rotor/stator pairs mounted in series. The rotors spin at high speeds and upon hitting the gas molecules the blades impart momentum to these particles in the direction of the lower stages successively compressing them up to the level of fore-vacuum pressure at which pressure they are pumped by the backing pump and exhausted to atmosphere.

Application: microwave plasma processes, crystal growth, melting and casting of metallic components or other microwave processes that require high vacuum. Pumping speeds available are suitable for small, medium and large vessels.



Please call for further information and quotes
