APPLICATION NOTE

# THE GAS BALLAST ON A OIL SEALED ROTARY VANE PUMP

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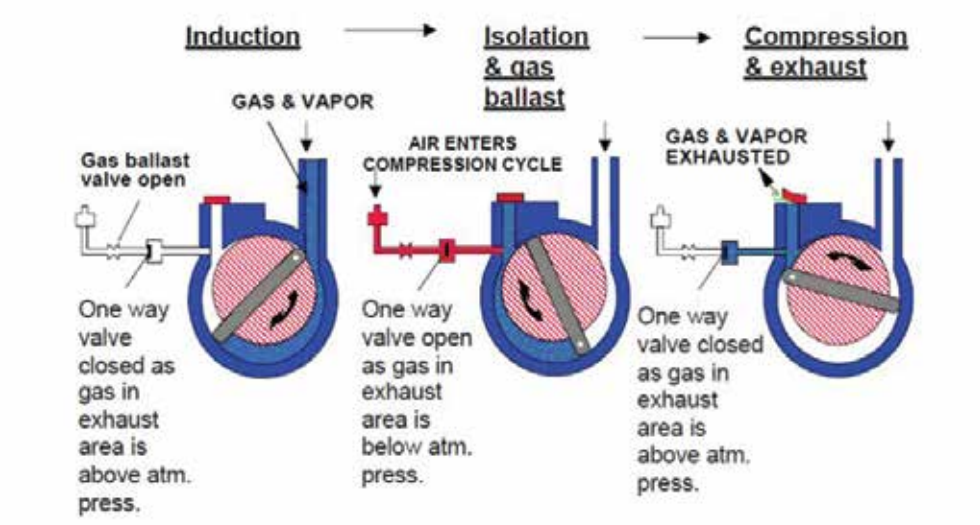
## What is a gas ballast?

Vacuum pumps designed for pumping vapours are generally equipped with a 'gas ballast' control. The gas ballast allows a controlled amount of gas, generally air from outside the pump, to be introduced into the pumping mechanism. Typical applications would include rotary evaporation, distillation and gel drying. Vacuum pumps can be run continually with gas ballast though some method of 'oil-return' should be employed in oil sealed pumps.




## What does the gas ballast do?

The gas ballast flow helps to 'dilute' the vapour inside the pumping mechanism, preventing for example water vapour from condensing as it is compressed up to atmospheric pressure. This allows the pump to recover much faster to its ultimate pressure than if gas ballast is not used. Additionally gas ballast allows a higher volume of vapour to be pumped than without it as it helps prevent condensation inside the pump.

Introducing gas ballast does impact the ultimate pressure of the pump by about a decade, but this change is academic when vapour is present inside the pump because the vapour is what limits the pressure, not the pump. Gas ballast adapters can also be fitted to allow inert gas, most commonly nitrogen or argon to be used instead of air, where potentially flammable gases or materials are present that could react with the oxygen in air.

## How does the gas ballast work?

Gas ballast should generally be run all the time that vapour is being passed through the vacuum pump. If vapour is being pumped, the vacuum pump's ultimate pressure will be limited, not by ultimate pressure performance of the pump itself, but by the vapour pressure of the material being processed. Care should be taken to ensure that air/oxygen is not introduced if any of the process materials are flammable.

A most common vapour for vacuum pumps to handle is water vapour. Water has a saturated vapour pressure of ~24 mbar (18 Torr) at 20 °C (70 °F), this is the lowest pressure the pump can attain until all the water is pumped away. Allowing water vapour to condense inside a pump will make the time to recover ultimate pressure much longer than if it remains in vapour phase. This is because it has to be re-evaporated before it can be pumped out and that takes much more energy and time than if the water remains in vapour phase. Condensed water vapour can also degrade an oil sealed rotary vane pump oil quite quickly.

The RV range of Oil Sealed Rotary Vane pumps provide a unique 'mode selection' option allowing accelerated oil conditioning after exposure to condensables. Vacuum pumps are quoted with a Maximum Water Vapour Handling Capacity, usually in grams/hour. This parameter is determined by the gas ballast flow rate, the running temperature of the pump and the pressure at which the exhaust valve of the pump opens.

An oil sealed vacuum pump running gas ballast for long periods of time should be fitted with a device designed to return oil back into the oil box while a large flow of gas goes through the pump. Gas ballast oil return accessories are available. Oil free pumps "dry pumps" do not need these as they do not have oil within the vacuum envelope.

Exceeding an oil sealed vacuum pumps maximum water vapour pumping tolerance will result in water condensing inside the pump itself. If the oil is becoming “milky” in colour while pumping vapour, this indicates water vapour is condensing inside the pump. Taken to an extreme, the apparent oil level can actually go up if a significant amount of water has condensed inside the pump, it is best to change the oil at this point. Running gas ballast will allow the pump to recover from this situation, and eventually allow the pump to reach its original ultimate pressure.

Scroll pumps designed with vapour handling in mind also have gas ballast controls. While there is no oil inside a dry scroll pump, exceeding the maximum water vapour tolerance, or pumping vapour with a cold pump, will result in vapour condensing inside the pump making recovery to ultimate pressure longer. Running the gas ballast in exactly the same way as on oil sealed pump, will allow a scroll pump to “clean up”, or recover to best ultimate pressure much faster than just “dead heading” the pump.

Shutting down a vacuum pump with water or other condensed vapours will cause corrosion and damage to the inside of the pump mechanism, requiring repairs to be undertaken to return the pump back to “new” performance. Equally pumping condensible vapours with a cold pump will lead to condensation in the mechanism. The recommendation is to operate the pump at normal running temperature before and after pumping vapours, for between 30 and 60 minutes.


Edwards RV oil sealed rotary vane pump showing mode selector

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