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Application Note Number 10: Using the Extorr during Pump-down

Abstract: The Extorr probe has unique advantages in following the pressure changes during pump-down of a vacuum chamber. Not only can the probe follow partial pressures below 10^{-4} torr but it can also measure total pressures with the built in Pirani and Ion gauges all the way up to atmospheric pressure.

With the Extorr, the user is never without the proper tool for trouble shooting a vacuum system. The typical RGA will tell you nothing about why your system is having problems with pump-down until you get down to 99.9999 % of where you want to go. With the Extorr there is a built in convection type Pirani gauge. A reduced rate of evacuation will be immediately obvious.

Some problems, such as a sudden leak caused by a particle on a loading door O-ring, can suddenly appear.

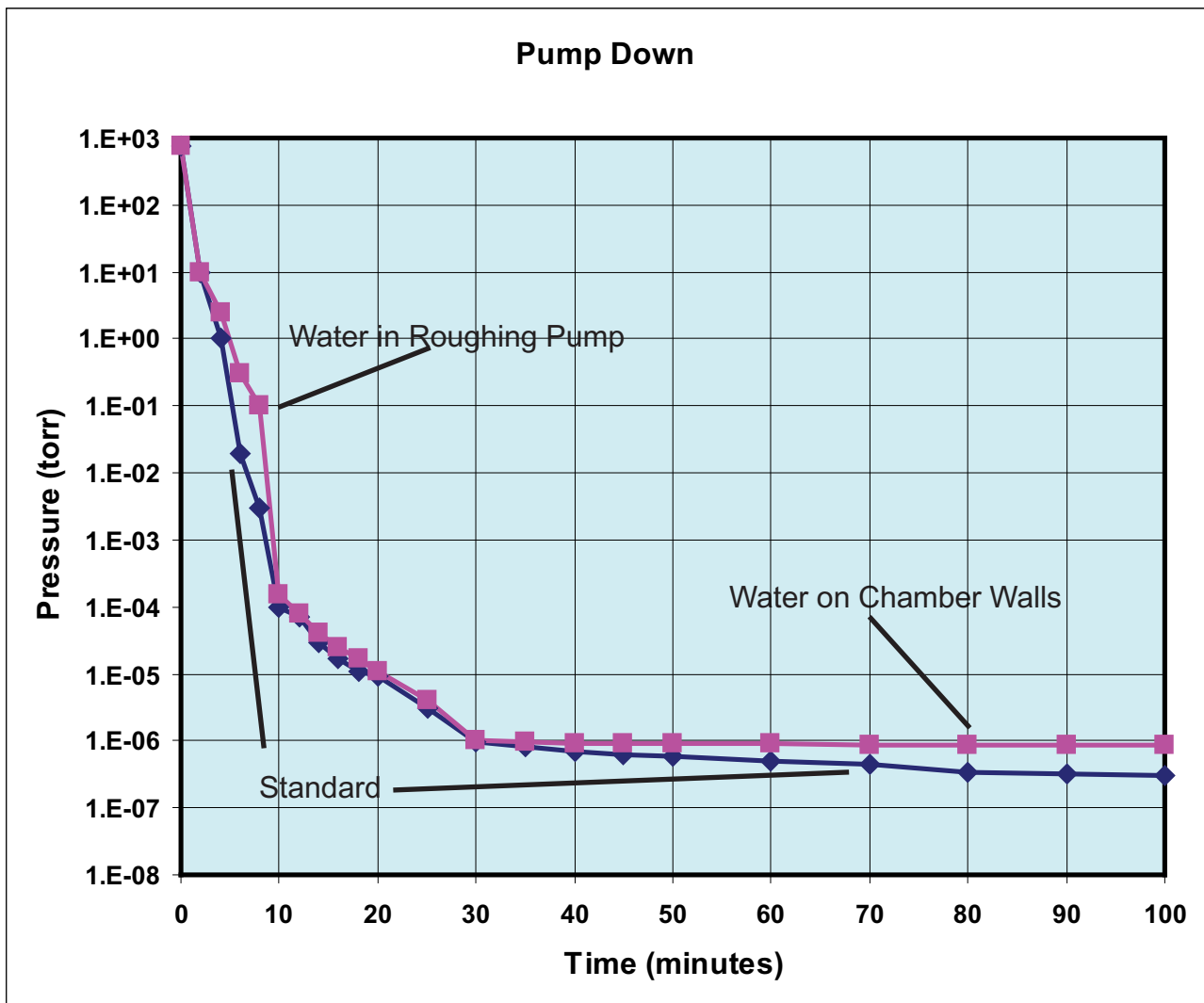
By using a leak tracing gas with a high Pirani sensitivity (that is high thermal conductivity) such as hydrogen, helium, argon and Freon, leaks as small as 10^{-4} atm-cc/sec can be sensed and located. This can eliminate the need for a very expensive leak detector.

Other problems, such as water in a roughing pump, will slowly creep up on the user. If pump-down pressure rate data is recorded, changes in this data from pump-down to pump-down may be used to point out potential vacuum problems.

A pump-down curve is simply a series of pressure vs. pump-down time observations. These are usually graphed by hand or by supplying tabular data to a plotting program. These graphs are extremely useful for monitoring and interpreting system performance.

All systems should have a pump-down curve which was recorded when the system was operating properly. This curve is then used as the "standard," to which any newly generated curve will be compared. If, at any point during a pump-down, the shape of the curve varies, there must be an explanation. A continuing deviation in the same direction may be an early warning of problems building up.

The Extorr generates these curves and allows the user to compare pump-down rates. The graph shows two separate pump-downs as recorded using the built-in Pirani and ion gauges. The blue line represents a new system which has been baked and taken back up to air using a dry nitrogen backfill. After several weeks of cycling the system the pump-down curve is now as shown in magenta. A pump-down lag due to water in the roughing pump is observed. A further lag at lower pressures due to water on the chamber walls may also be seen.



In the field of vacuum technology, the residual gas analyzer is the accepted tool for monitoring performance and trouble-shooting a vacuum system. Once the system has gotten down to a pressure range where the quadrupole is operational, mass spectra can be taken to display the molecular species left in the vacuum chamber. At this point the standard RGA modes are invoked. If the system displays a 28 and 32 peaks in a 4 to one ratio an air leak is suspected and standard RGA leak tracing techniques may be applied. These standard methods are covered elsewhere in these application notes.