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Designing innovative vacuum gauges and controllers for over 30 years

APPLICATION NOTE: SCIENTIFIC CRYOGENIC WORK

ABSTRACT:

In the Cryogenic industry, we find that Hastings vacuum gauge thermocouple tubes are often found permanently mounted in cryogenic vessels. It might make sense to have a battery operated vacuum gauge that enables you to walk along a cryogenic vessel, and measures the vacuum at that point. The range of interest is between 10mTorr and 100mTorr. Our most popular products for this application are the battery operated Model 100H, and the Model DVG-6 panel mount AC version for permanent installations.

INTRODUCTION:

The DIGIVAC Model 100 series gauges are compact digital vacuum sensing instruments. The DIGIVAC Model 100H is a portable digital vacuum instrument that reads from 1 millitorr (1×10^{-3} Torr) up to 760 Torr, with the standard varian 531 tube.

Andrew Harris, Professor at the University of Maryland uses cryogenics as the coolant to do component testing at temperatures around 70K. He pumps out the vacuum jacket of a small vessel for liquid cryogenics to 1×10^{-4} to 1×10^{-5} Torr. This vacuum jacket gives insulation between the contents and the outside air. The idea Harris is using is the same idea that is used by other



cryogenic service people where the vacuum void created by the vacuum jacketed vessels or vacuum jacketed pipe acts as a thermal barrier.

Vacuum as a thermal barrier works by pulling out all the molecules so they can't transport heat from the outside wall to the inside wall. The phenomenon behind this is a mean free path, or the distance a molecule travels before hitting another molecule or wall. The more pressure, the shorter the mean free path, and the lower the pressure higher the vacuum: the longer the mean free path. Since Andrew's vessel is small, the mean free path in a smaller volume requires a lower pressure to work effectively. To reduce the atmospheric convection heating of the cryogen in typical industrial applications, the vacuum jacket should be well into the micron/milliTorr region.

UNDERSTANDING THE DESIGN:

The Model 100H has a clear display screen that shows range up to 1999 milliTorr. It includes a Hastings DV-6M sensor, and is a portable gauge for cryogenic servicing of vacuum jacketed pipe. This instrument comes in a rugged case and uses a "D" type of battery to increase battery change intervals.



FLEXIBILITY OF APPLICATION:

The Model 100H operates by measuring the temperature rise of an electrically heated thermocouple exposed to a vacuum. As vacuum increases, or, as absolute pressure decreases, fewer and fewer molecules of gas are available to cool the thermocouple. With fewer molecules, the air temperature rises and the thermocouple gauge thus senses the vacuum. A precision reference inside the Model 100H in conjunction with an integrated circuit amplifier controls the electrical excitation of the sensor filament. In gauges that use hastings tubes, a precision temperature compensated AC square wave oscillator is included in the electronics. The voltage response of the thermocouple is piped through a CPU and is translated to the current vacuum reading.

PERFORMANCE OF THE PRODUCT:

This gauge is ideal for the person that needs wide range accuracy, but requires the rugged portability and ease of use that this battery powered gauge offers. It can be easily switched between milliTorr, uBar or PA pressure units on the fly. The 100H is a favorite for cryogenic applications where the hastings gauge tube is often permanently mounted on pipes and vessels.



Conclusion: DigiVac Thermocouple Gauges are designed to meet the demands of field use, where: ruggedness, repeatability, and accuracy are required to get the job done. The Model 100H is ideal for enabling you to walk along a cryogenic vessel and measure the vacuum at that point due to its battery power, portability, and compatibility with cryogenic work.