TELEDYNE HASTINGS INSTRUMENTS
Everywhereyoulook™

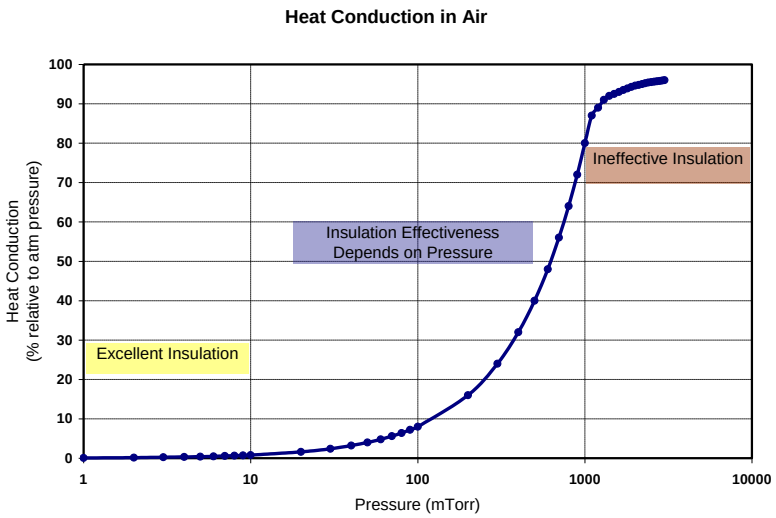
Ensuring a Vacuum Jacket is Working Properly

The technique of using a vacuum guard or barrier to thermally insulate a cryogenic or refrigerant tank is straightforward: remove the air from around an object and eliminate conductive heat transfer. However, in practice, the method is only effective if the less than 1/1000th of the air remains in the space! In other words, if the pressure is only slightly above 1 Torr, the insulating value of the jacket is worthless. As shown in Figure 1, the insulating effectiveness improves as the pressure is reduced below 1 Torr and is essentially "perfect" at pressures below 10 mTorr. (Radiation and conduction through mechanical connections will then dominate the heat transfer.) Consequently, to assess how well a jacket is doing its job, you need to know what its pressure is. If the pressure is above 1 Torr, there is very little benefit; if it's in the mTorr range, then all is well.

Method

To effectively measure pressure in the mTorr range, a vacuum dial gauge is simply not sensitive enough. All of the effects related to insulating occur while the needle is resting on the "0" of the dial (remember we need to know how much of the last 1/1000th of an atmosphere is left). For this reason, a specialized vacuum gauge that measures the thermal conductivity of the gas in the jacket is used to infer the pressure. Called a thermal conductivity, thermocouple, or TC gauge, this gauge is an effective and reliable way to ensure the insulating properties of the jacket. When you think about it, a thermal conductivity gauge uses the best technology for this application, because it directly measures how well the vacuum is insulating.

Figure 1 Heat Conduction in Air Chart



To implement a simple scheme for continuously monitoring a vacuum jacket for stationary application (e.g. LNG, cryogenic bulk tank, or vacuum-jacketed pipe), the gauge tube and readout electronics can be permanently installed on the vacuum containment. For outdoor installations, the tube can be mounted on the tank with the electronic readout located remotely. In some situations, monitoring is only done periodically (dipstick check). This may be the case on a cryogenic tank truck or rail car where the tube is typically installed in a permanent location and checked with a hand-held, battery operated electronic unit.

Sales/Support: 800-950-2468 • **Main**: 757-723-6531
804 Newcombe Ave. Hampton, VA 23669
http://www.teledyne-hi.com/

While the ideal installation location of gauge tube(s) depends on the configuration of the system, some general guidelines should be considered. When periodic checks are made with a hand-held readout, the tube should be installed in an accessible location. Additionally, technical considerations would dictate that the gauge tube be located near anticipated leak points or moving seals like valve stems or rotary feed-throughs. In actively pumped vacuum jacket systems, installing a gauge tube near the pump will not necessarily indicate when leaks begin to adversely affect the performance of the jacketing. The pressure at the pump will always be the best (lowest) reading, while the information you need to know, is the worst pressure. For this reason, locations in remote branches or dead-end sections are ideal for ensuring that adequate insulating properties are maintained.

Instrument Choice

Teledyne Hastings offers several versions of TC gauge tubes, each designed to satisfy specific requirements. For general purpose monitoring of vacuum jacketed pipes, bulk tanks and dewars in controlled environments (indoor facilities), the DV-6M thermocouple gauge tube is a cost-effective device with a measurement range of 1 to 1000 mTorr. For installations that may have excessive vibration or mechanical shock, a ruggedized version of the tube is available as the DV-6R. For use in the harshest environments, a weatherproof stainless steel version, the DV-6S, is the best choice. Its additional features include a removable, tethered metal cap to protect the electrical connector pins. All variations of the DV-6 come standard with 1/8" NPT for easy installation on the jacket enclosure.

A vacuum reading is obtained from any of the DV-6 tubes using either a dedicated electronic display or handheld battery operated readout. The Hastings' DCVT provides continuous monitoring with an easy to read LED display. For periodic vacuum checking of one or more tubes, the hand-held HPM 4/5/6 is recommended. For convenience, it is powered by a 9V battery and can be connected to any DV-6 tube for an instant reading. To ensure the most accurate measurement, the DB-20 Reference Tube (with NIST Traceable calibration) can be used to validate the electronic calibration.

Teledyne Hastings' Vacuum Products			
DCVT-6	HPM 4/5/6	DV-6R	DV-6S
			

For Information on all Teledyne Hastings' Vacuum Measurement and Mass Flow Instruments, visit our website:

www.teledyne-hi.com

or contact us at +1-757-723-6531