Kurt J. Lesker Company
VACUUM MART™ DIVISION

Convection Enhanced Pirani Vacuum Gauge
Contamination and Cleaning Instructions
275, 275i, and 300 Series

Overview

The most common cause of all vacuum gauge failures is contamination of the sensor. Noisy or erratic readings, the inability to set zero or atmosphere, and total gauge failure, are all possible indications of gauge contamination.
Contamination can be generally characterized as either:

A) a reaction of process gases with sensor elements, or
B) an accumulation of material on the sensor elements

Sensors that fail due to chemical reaction are generally not salvageable. Sensors that fail due to condensation, coatings, or particles may possibly be restored by following the cleaning procedure described below. In cases where cleaning cannot resolve the issue due to excessive contamination, the gauge has to be replaced.

Contamination

A) Reactive Gases: If process gases react with the materials of construction of the sensor, the result is corrosion and disintegration of the sensor over time. Plasma etching and other reactive semiconductor processes are examples where this failure mode is common. In this instance, cleaning cannot solve the problem, because the sensor has been destroyed; the gauge or module must be replaced.

If you experience this failure mode quickly or frequently, you should consider a different vacuum gauge for your application. Thermal vacuum gauges may be available with different sensor materials that are not as reactive with your particular process gases. Or you may consider a different type of gauge, such as a capacitance diaphragm gauge, which exposes only stainless steel or ceramic to the gases.

There is no material that is universally chemical resistant; your choice of vacuum gauge (as well as all other vacuum components) should take into consideration the potential reactions between your process gases and the materials of construction. Consider what effect water vapor will have when combined with your process gases because a finite amount of water will enter the chamber during venting to atmosphere.

B) Condensation, Coatings, and Particles: If the failure is due to an accumulation of material in the sensor, you may be able to restore your gauge or module by cleaning. Contamination may be as simple as condensed water, or as difficult as solid particles.

Condensation: Some gases (such as water vapor) can condense on sensor surfaces, forming a liquid coating that changes the rate at which heat is removed from the sensor (which changes the calibration). The sensor can often be restored simply by pumping on the gauge between process cycles. A dry N_2 purge will help speed up drying, or the gauge may be gently heated, provided temperature doesn't exceed the specified limit (150ºC with cables or electronics removed).

Coatings: Some gases can condense on sensor surfaces, forming a solid coating, which again changes the rate at which heat is removed from the sensor. Some of these coatings may be removed using an appropriate solvent, following the procedure described below.
Particles: Particles generated by the process may enter the gauge during the process cycle or during the venting cycle. The result is interference with heat removal from the sensor. The cleaning procedure described below may be able to remove particles from the gauge. However, particulate contamination is the most difficult to remove as particles can become stubbornly trapped inside the gauge.

In some processes, solid particles are created during the process, throughout the chamber, including inside the gauge. Particles tend to form on cooler surfaces, such as in a gauge at room temperature. You may slow down the build-up of particles in the gauge, by keeping the gauge warm (within specified limits) during the process cycle. More commonly, particles in the process chamber are swept into the gauge during the vent cycle. Lesker gauges have a screen built into the gauge port, to help keep the largest particles out of the gauge. In very dirty applications, or where particles are small enough to get through the screen, an additional filter installed on the inlet may help prolong gauge life further.

C) Cleaning Procedures Caution: Cleaning chemicals and their handling pose a variety of health, safety, and environmental issues. Protect yourself, your co-workers, and your surroundings, by using protective clothing (gloves, eyewear, etc.), performing the cleaning in a well-ventilated area, and disposing of waste materials in a responsible manner.

Cleaning solvents: To be effective, the cleaning agent should be one that is likely to remove the suspected contaminant. It must also be compatible with the gauge materials of construction. Alcohol and water are recommended cleaning solvents, as they are compatible with most vacuum systems and components and will remove many contaminants commonly found in vacuum processes, such as pump oil. However, depending on your particular contamination, you may need to use a more aggressive solvent.

Cleaning procedure:

1. With the gauge port up, pour your cleaning solution into the gauge port until it is full. Note: The fine mesh of the port screen may not allow the solution into the gauge tube because of surface tension effects. You may need to insert a small tool into the gauge vacuum port to push the port screen slightly away from the tube wall to allow solvent into the gauge. ("Slightly away" means less than about a millimeter.) Make sure the tool is not plated with high vapor pressure material such as zinc plating.

2. Let the solution sit for a while, 10-20 minutes should be sufficient. Gentle agitation will help disperse the solution throughout the gauge, but do not shake the gauge vigorously. (While the Lesker gauge is constructed to be rugged, it was not designed to withstand forces exerted by liquids in motion.)

3. With the gauge port down, pour the solution out of the gauge and leave it to drain and dry for several hours or overnight. Warming the gauge, and/or pumping on it, will speed up the drying time.

4. When you are sure the gauge is completely dry, install it on a vacuum system, apply power, and run through the calibration setup. Pump the gauge below 10^{-4} Torr and confirm that the zero/vacuum can be set. If zero is ok, raise pressure and set the atmosphere adjustment.
   a. If both zero and atmosphere can be set properly, you have successfully cleaned your gauge.
   b. If zero or atmosphere cannot be set, the gauge has been contaminated beyond recovery and must be replaced. (You can try cleaning it again, but if the first pass doesn't recover the gauge, additional cleanings are not likely to succeed.)

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