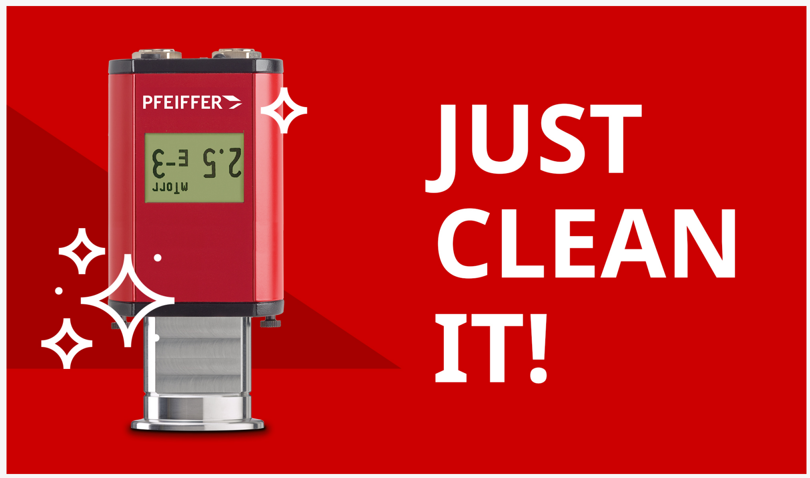
Industry Guide Outlines Best Practices for Cleaning Vacuum Gauges Across All Major Types

Contamination degrades vacuum gauge accuracy over time. This guide covers cleaning methods for piezoresistive, capacitive, Pirani, and cold cathode gauges



Just clean it!

ASSLAR, GERMANY, May 15, 2026 /EINPresswire.com/ -- Vacuum gauges are essential for controlling pressure in processes such as thin-film coating or heat treatment. When their readings are even slightly off, coating thickness can deviate from target values, response times may change, or measurements can no longer be compared reliably. Over time, these gauges gradually collect dust, oil, or chemical residue since they often operate in demanding environments. This step-by-step accumulation of contamination can negatively affect accuracy. To counteract this process, this article explains how to properly clean common types of vacuum gauges.

Vacuum gauges are high-precision instruments used to measure pressure. They provide readings of total pressure – from rough to ultra-high vacuum – making them essential for monitoring, controlling, and maintaining vacuum processes. Different types of gauges are required depending on the vacuum system and the vacuum level.

Why gauges become contaminated
Over time, vacuum gauges accumulate contaminants from the process environment during operation. Inside the vacuum gauge, heat and reactive gases can trigger chemical reactions that form insulating layers on sensor surfaces. These layers interfere with heat transfer, electron flow, or gas interaction – depending on the gauge type – and distort the readings. The longer the gauge remains in use, the more these deposits build up, resulting in even more significant measurement inaccuracies. To ensure reliable measurement results for the long term, it is essential to regularly clean the vacuum gauge.
Before beginning any cleaning work, there is a golden rule: Never touch vacuum-exposed

surfaces with bare hands. This is especially important for high vacuum and ultra-high vacuum systems. Fingerprints leave behind thin layers of oils, salts, and moisture, which form a film on the metal surface. When the gauge heats up during operation or is exposed to ions in high vacuum conditions, these residues can burn into the surface and create hard, carbonized spots. Such spots interfere with the normal flow of heat or electrons across the sensor surface and can distort the pressure reading. To prevent this, always wear clean gloves, particularly when assembling the gauge after cleaning.

You will also need the following items:

- Lint-free paper towels
- Cotton swabs
- Isopropyl alcohol (also known as isopropanol or 2-propanol)

Work in a clean, well-lit area with good ventilation to remove solvent vapors, which can evaporate during cleaning and form potentially harmful or flammable mixtures in the air. A tidy workspace reduces the risk of recontamination, ensuring that freshly cleaned sensors are not exposed again to dust, oils, or residues from other tools.

Different gauge types require specific cleaning procedures, as their sensor principles and materials respond differently to contamination. The following sections provide step-by-step guidance on the proper care of each instrument.

1. Piezoresistive gauges

These gauges measure pressure directly and independently of the gas type by detecting how much force the gas inside a system applies to a thin, flexible diaphragm inside the gauge. When the pressure in the vacuum chamber changes, the diaphragm bends slightly, causing a mechanical strain in the sensor element. This strain changes the electrical resistance of the element, which the gauge measures and converts into a precise pressure reading. Piezoresistive gauges are used in the rough vacuum range up to about 1 hPa (mbar).

The internal design of the vacuum gauge is relatively simple, consisting mainly of the diaphragm and the measuring element, with no moving parts or components that heat up significantly. This makes the gauge mechanically robust and less sensitive to handling during cleaning.

In industrial environments, contamination often comes from the process gas itself or from oil mist and fine dust particles that are drawn in from vacuum pumps. These deposits can usually be removed with organic solvents such as isopropyl alcohol, which effectively dissolves oily residues without harming elastomer seals or sensor materials.

Cleaning procedure:

1. Pour a few drops of solvent into the gauge tube.
2. Gently shake the device.
3. Pour out the solvent.
4. Repeat the procedure until no more dirt appears in the liquid.

Afterwards, dry the gauge by connecting it to a vacuum pump or vacuum system. When the vacuum pump starts evacuating, the reduced pressure helps residual solvent evaporate quickly and completely – even from narrow gaps and fine sensor structures.
However, a singular rinsing alone is rarely sufficient to remove all contaminants. Thin layers of oil or reactive deposits often cling tightly to the diaphragm or sensor surfaces, even after multiple solvent applications. Because mechanical cleaning could deform or scratch the diaphragm, the only reliable way to improve cleanliness is through regular rinsing – but only if contamination is detected. Consistent repetition gradually dissolves and removes remaining residues, ensuring stable, reproducible measurement results and extending the service life of the gauge.

2. Capacitive gauges
These gauges also use a flexible diaphragm that responds to the differential pressure between the vacuum being measured and a stable reference vacuum. As the pressure in the vacuum chamber changes, the diaphragm bends slightly. This bending alters the distance between the diaphragm and a fixed electrode, which changes the electrical capacitance between them. The gauge measures this capacitance change and converts it into an exact pressure reading.

Because the diaphragm is extremely thin and the measuring forces are very small, these instruments are highly sensitive and must be handled with great care during cleaning to avoid mechanical or chemical damage.
A contaminated capacitive gauge may show a drifting zero point – meaning it no longer accurately displays the current atmospheric pressure as the zero point. This offset gradually distorts all subsequent readings, making them appear higher or lower than the real value. Since such deviations can only be detected by comparing the gauge to a calibrated reference gauge, they often remain unnoticed for long periods.

Cleaning procedure:
1. Perform the standard zero-point adjustment according to the instruction manual. This step sets the gauge to read “zero pressure” when the pressure in the system equals atmospheric pressure.
2. If the zero point remains unstable – meaning the gauge does not reliably indicate “zero pressure” – remove the instrument from the system. Visually inspect areas where contamination is most likely: the flange, the inner wall of the connecting tube, and any filter elements.
3. If contamination is visible, gently wipe a small area of the inner gauge walls with a cotton swab moistened with isopropanol.
   - If the residue transfers easily to the swab, cleaning is likely to succeed. If not, it indicates the contamination is strongly adhered or chemically resistant. In this case, partial cleaning may not restore accuracy, and the gauge may continue to give unstable readings or drift over time. The gauge should therefore be replaced.
4. Proceed as for the piezoresistive gauge: fill in a small amount of solvent into the gauge, let it sit briefly, gently tilt the gauge, and pour the liquid out.

5. Repeat until the solvent comes out clean.
6. Allow the gauge to dry thoroughly, ideally by connecting it to a vacuum system overnight.

After drying, again perform a zero-point adjustment. Observe the reading over time. If the zero point still drifts or remains unstable, the diaphragm may be permanently contaminated or damaged, and the gauge should be replaced.

3. Pirani gauges
Pirani gauges measure pressure by detecting how effectively gases conduct heat. Since this method relies on gas properties, Pirani gauges and the gauges mentioned below are called gas-type dependent. At the heart of the Pirani gauge is a small, heated filament whose temperature changes depending on the surrounding gas density. When more gas molecules are present, they absorb more heat from the filament, causing its temperature to drop. Conversely, the higher the vacuum is, the fewer molecules are present to carry away heat, so the filament stays hotter. The gauge measures these temperature changes and converts them into a pressure reading.
The filament in a Pirani gauge is typically a fine tungsten wire, about one micrometer thick, coiled to increase its surface area. During operation, it is heated to roughly 100 °C above the surrounding temperature. At these temperatures, oil vapors or other hydrocarbons from the vacuum system can decompose and form a hard, carbon-like layer that bakes firmly onto the wire surface. This contamination insulates the filament and changes how it transfers heat, leading to incorrect pressure readings. Because the wire is extremely thin and fragile, any mechanical cleaning attempt would almost certainly break it. So, it is important to handle the gauge carefully while cleaning.

Cleaning procedure:
1. Cleaning should be done only by rinsing with high-purity alcohol. Pour the solvent carefully along the inner wall of the gauge tube, letting it flow down
naturally so it spreads gently over the filament without direct impact.
2. Do not shake or swirl the gauge. After a short contact time, pour the solvent out in the same careful way – tilting the gauge slowly so that the liquid
drains smoothly without sudden movement.

After rinsing, connect the gauge to a running vacuum system, ideally overnight. The reduced pressure accelerates the evaporation of any remaining solvent or moisture from inside the gauge body and around the filament. Drying under vacuum prevents residual liquid from leaving behind microscopic residues when the vacuum gauge is later heated. Skipping this step can cause erratic readings or permanent damage to the filament once the gauge is in use again.

Once dry, perform a zero-point calibration as described in the instruction manual.

4. Cold cathode gauges
Cold cathode gauges measure pressure by creating tiny electrical reactions between gas molecules. Inside the gauge are two metal electrodes and a magnetic field. When high voltage is

applied, a potential difference between electrodes is created. This gives electrons the energy to move – like a push that sets them in motion. These moving electrons spiral between the electrodes and collide with gas molecules, knocking out more electrons and forming charged particles – ions.

The number of ions formed depends on how many gas molecules are present – in other words, on the pressure inside the vacuum chamber. At low vacuum levels, more gas molecules are available, so more ions are produced, resulting in a stronger ion current. At high vacuum levels, the gas density decreases, fewer ions are generated, and the current drops. The gauge converts this ion current into a pressure reading.

Cold cathode gauges are mechanically simpler than hot cathode gauges. Their construction usually allows partial disassembly because they are sealed with O-rings instead of welded joints. This simplicity makes cleaning feasible when contamination occurs.

Cleaning procedure:

1. Remove any protective grid or inlet filter located at the gauge flange and visually assess the level of contamination. Deposits typically appear as iridescent to dark-brown layers on the inner wall.
2. If necessary, detach the electronics and disassemble the gauge following the manufacturer's instruction manual.
3. Use fine-grained polishing fleece (for example Scotch-Brite™ grade 400 or 1000) to gently remove the deposits.
   - o Work concentrically on sealing surfaces to avoid grooves across the O-ring seat.
4. Always wear protective gloves during this work. This protects both the operator from dust and the parts from fingerprints and skin acids.
5. Replace components that are difficult to clean, such as ignition aids or damaged elastomer seals.
6. After polishing, remove all dust using isopropyl alcohol and lint-free wipes.
7. Reassemble the dry parts according to the instruction manual, using a service kit if available.

Before restarting the vacuum gauge:

- Test it for leaks with a helium leak detector. No background signal should increase when helium is sprayed on sealing points or electrical feedthroughs (target leak rate $< 10^{-10}$ Pa m^3/s).
- Let the gauge outgas on a vacuum system for one to two hours before putting it back into service.

5. Hot cathode gauges

Hot cathode gauges are used for measuring high and ultra-high vacuum levels. Inside the gauge, a tiny heated wire – the cathode – emits electrons. These electrons are accelerated toward a positively charged grid. As the electrons move, they collide with gas molecules. Each collision can knock an electron out of the molecule, creating a positively charged ion. This can happen repeatedly, producing more and more ions. Like cold cathode gauges, the number of ions produced depends on how many gas molecules are present. This ion current is measured and

converted into a pressure reading.
The sensor within this gauge contains extremely fine and delicate components – cathode, grid, and anode – made of thin wires and metal supports that operate at high temperatures. Because of their fragility and the complex geometry, these parts cannot be cleaned mechanically without destroying the gauge.

Contamination occurs when reactive gases or vapors come into contact with the hot components. The heat and ion bombardment cause chemical reactions that form solid, insulating layers on the electrodes. These deposits block the flow of electrons and ions, making the gauge unresponsive or inaccurate. Once such residues have built up – often from vacuum pump oil, O-ring vapors, or process gases – they become hard, polymerized, or even glass-like. Solvents have little effect on these deposits.
Because the sensor structure is so fine and the contamination cannot be removed effectively, a fouled hot cathode gauge must normally be replaced rather than cleaned.

Summary
Cleaning vacuum gauges requires patience, precision, and respect for the instrument’s design. Some gauges, like diaphragm or cold cathode types, can often be cleaned successfully. Others – especially those with very fine internal structures such as Pirani or hot cathode gauges – may better be replaced when contaminated.
When in doubt, consult the manufacturer’s service documentation or consider replacement rather than risking damage to a delicate sensor.

Dr Sandra Thirtle-Höck
Pfeiffer Vacuum+Fab Solutions
+49 64 418021460
email us here
Visit us on social media:
LinkedIn
YouTube
