SEMI F20 13MM PRESSURE SENSOR

Application Brief

Honeywell

HIGH PURITY AND ULTRA-HIGH PURITY APPLICATIONS

Ensuring process integrity and enhancing product yield through controlled environments and contamination-free processes

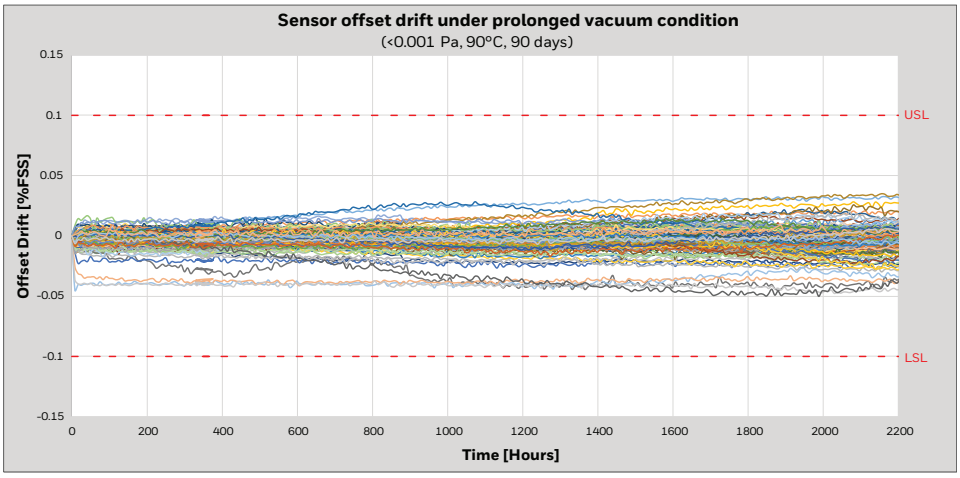
Products under High Purity (HP) and Ultra-High Purity (UHP) applications follow strict cleanliness standards and are exposed to a controlled manufacturing environment.

These applications include *semiconductor manufacturing, thin-film deposition, food and beverage processing & packaging, aircraft manufacturing, medical device manufacturing, nano drug development, biopharmaceutical production, material analysis labs, research and development labs*, etc. to name a few.

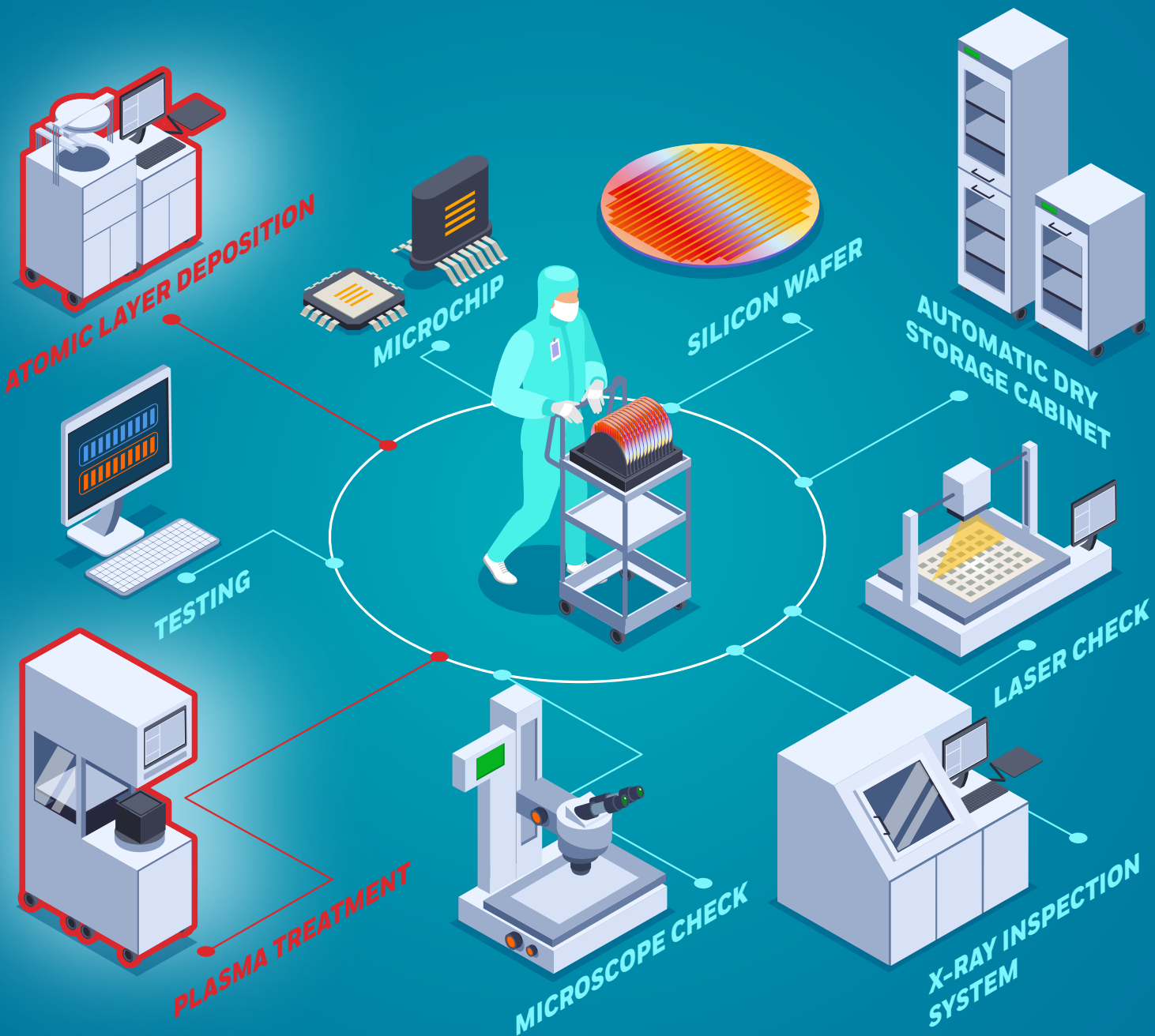
The presence of impurities in these applications, above certain size or concentration, can negatively impact the end outcome. Special steps should be taken when selecting the raw material or the process components or designing the cleanrooms as the presence of unexpected elements in the manufacturing flow can produce product with poor quality and low yield, resulting in financial losses. In certain processes, the reaction process can get compromised resulting in undesirable byproducts.

For example, in thin-film deposition or sub-micron layer deposition process for semiconductor wafer or solar panel or LED display manufacturing, impurities from gases, liquids, or components can result in defective integrated circuits and panels. The yield fallout, which typically happens during the late stages of manufacturing, can increase the product cost. Similarly, the presence of certain impurities that are above the defined concentration levels in food and beverage industry or biopharmaceutical manufacturing can result in process contamination.

In material analysis labs or R&D labs, impurities introduced by the raw material or components can result in erroneous results and interpretation. As a result, the manufacturing setup of HP and UHP products adhere to very strict universal cleanliness standards. These standards are followed not only by the raw material suppliers but also by the components and sensors manufacturers that are part of the process flow and instrumentation systems design.



SEMICONDUCTOR PRODUCTION



UNIVERSAL STANDARDS

For HP and UHP applications, some of the commonly used standards and notations are considered below. These standards specify the cleanliness requirements for not only the raw materials such as air, liquid, gases, material composition percentages, but also for the tools and components. Some of the key specifications are covered below.

- **Raw material composition and process flow components:** The SEMI standard is highly relevant for sensors and component suppliers who service the semiconductor industry. Established in 1973, it standardized the dimension of the wafers. Over time, multiple other specifications have been incorporated.
  - **SEMI F19:** This specification covers the surface condition requirements for wetted surface of stainless-steel components. For more details visit the SEMI F19 link.
  - **SEMI F20:** This specification covers the requirements for 316L components used in HP and UHP applications. For more details visit the SEMI F20 link.
- **Air:** ISO14644-1 is a universally recognized standard that is used for establishing air cleanliness in cleanrooms. It defines classification ISO1 – ISO 9, with ISO 1 being the cleanest. They are classified from Class 1 to Class 100,000 depending on the size and concentration of the impurities. More details can be found in this ISO link
- **Industrial gas:** The "nines" scale or the "N" nomenclature uses a logarithmic scale often used to define purity levels for gases. This is denoted by the number of consecutive nines expressed as a percentage. For example – N1.0 represents 90 % purity of materials, N2.0 represents 99 % purity, N6.0 represents 99.9999 % purity and so on.

SEMI F20 COMPATIBLE PRESSURE SENSOR

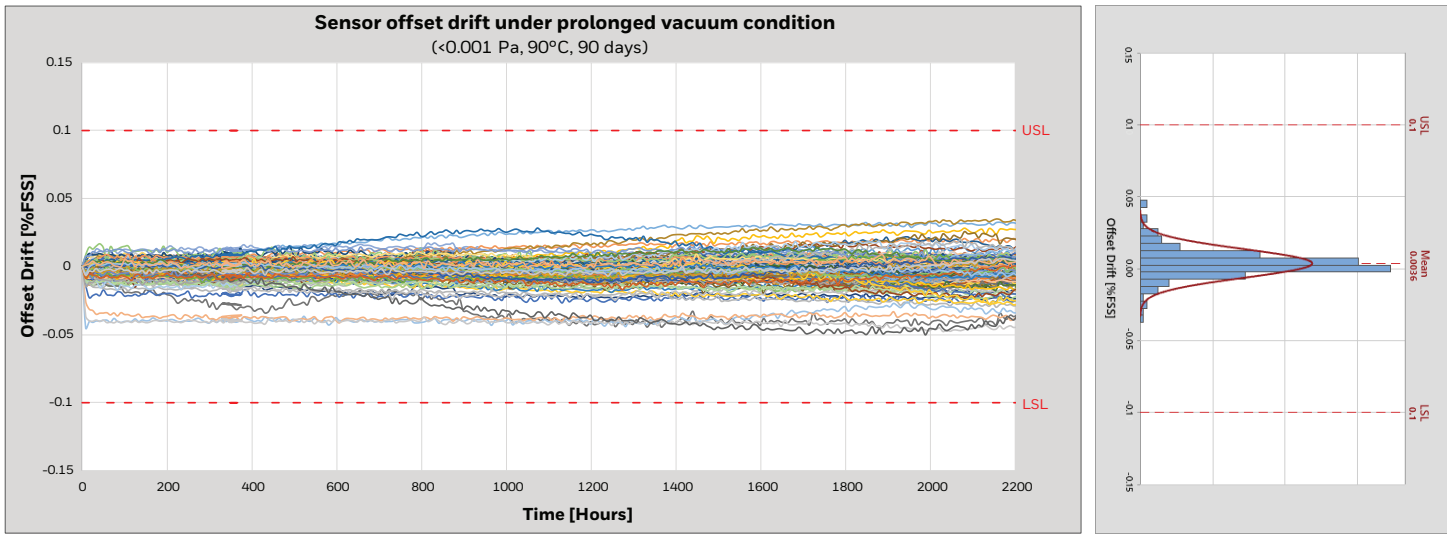
The Honeywell latest oil-filled, media-isolated 13V Series stainless-steel pressure sensors is specially designed for UHP applications that involve measurement of gases and liquid flow in harsh environments. The rugged, media-isolated package incorporates a Honeywell proven piezoresistive semiconductor chip in an oil-isolated housing. This design has proven to be highly reliable, stable, and accurate.

Designed with a SEMI F20-compatible ring and diaphragm, this sensor exhibits exceptional corrosion resistance and can withstand the aggressive nature of the halogenated gases that are commonly encountered in semiconductor manufacturing process. The 13V Series is specially designed to minimize the offset drift under prolonged vacuum conditions making it an ideal choice for critical industrial applications where vacuum condition is common between multiple runs.

Laser welding of the ring and ball ensures reliable sealing and protection against environmental factors while maintaining accurate pressure measurement. These sensors feature high life-cycle capability and are designed for further package integration in OEM (Original Equipment Manufacturer) applications.

KEY SPECIFICATIONS

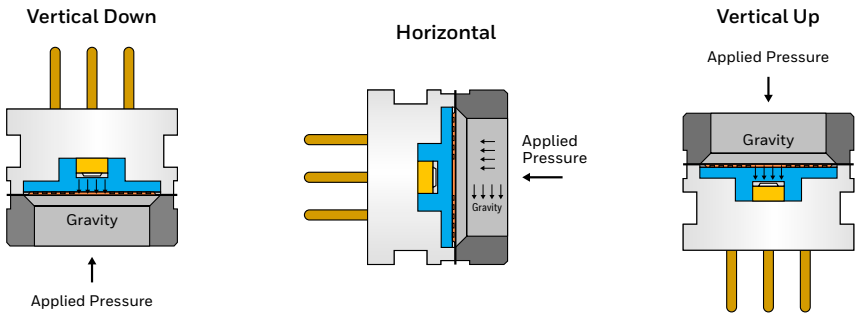
1. Offset drift under extreme vacuum conditions



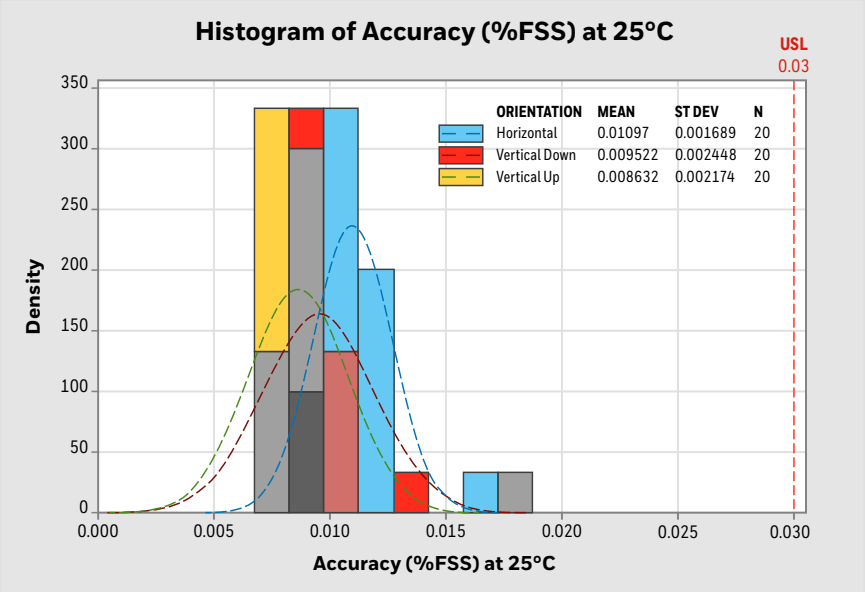
In semiconductor wafer processing, precise quantities of multiple gas types need to be delivered at different flow rates during etching and vapor deposition process. Precise flow measurement is essential for accurate control of gas mixture used for deposition, passivation, or preventing oxidation. The outlet pressure can vary from extreme vacuum (<0.001 Pascal) to above atmospheric pressure (1200 Torr) condition. In addition to the Total Error Output, the offset drift directly influences the measurement accuracy, calibration stability, environmental sensitivity, performance consistency, and long-term reliability.

The 13V sensor is specifically designed to operate reliably under extreme vacuum conditions and elevated temperatures making it versatile for etching and vapor deposition application. The graph above shows the excellent offset drift (< ±0.1 % FSR) of SEMI F20 sensors for 90 days at high-temperature vacuum (<0.001 Pascal, 90°C).

2. Output change due to re-orientation



The orientation of an oil-filled pressure sensor can significantly influence its readings due to gravity acting on the internal oil column. The additional pressure exerted by the oil-fill layer can vary due to the impact of gravity. Depending on the sensor orientation, this pressure can be opposing, orthogonal, or aiding the applied pressure. The summation of this error pressure along with the applied pressure gets transmitted from the diaphragm to the piezoresistive element. For a poorly designed pressure sensor, the offset can change significantly going from one orientation to the other.



The graph above shows minimal change to sensor output when the product orientation is changed.

The 13V pressure sensor is designed with optimized oil volume for efficient pressure transfer with minimal impact to the offset, ensuring minimal output variation and consistent performance regardless of orientation. The graph on the previous page shows minimal shift to the sensor output when the product is re-oriented.

3. SEMI F20 material composition

TABLE 1. SEMI F20 MATERIAL COMPOSITION

Element (wt%)	C	Mn	P	S	Si	Cr	Ni	Mo
SEMI F20 UHP	≤0.03	≤1.50	≤0.045	≤0.010	≤0.75	16-18	10-15	2-3
Element (wt%)	**Cu**	**Ti**	**Ca**	**Se**	**Al**	**N**	**Nb**	**Fe**
ACB40RGL	≤0.30	≤0.02	≤0.02	≤0.02	≤0.01	≤0.10	≤0.05	Blance

This specification above outlines the metallurgical cleanliness standards and material composition requirements for 316L stainless steel intended for use in the production of components in general-purpose, high-purity, and ultra-high-purity chemical (gas or liquid) distribution systems.

The wettable media of the 13V pressure sensor uses raw materials which adhere to the strict standards as shown in the table above ensuring that the sensor is of the highest quality.

CONCLUSION

Exceeding expectations: The 13V pressure sensor redefines excellence.

The SEMI F20 13V pressure sensor sets the benchmark for both performance and quality, as evidenced by the data above. Rigorous testing and analysis highlight the Honeywell commitment to excellence, ensuring the product consistently meets and exceeds customer expectations.

The 13V pressure sensor enhances process integrity by ensuring ultra-clean performance, significantly reducing contamination risks. It boosts production yield and cost-efficiency by minimizing fallout in late-stage manufacturing. It also ensures accurate results in R&D and material analysis, while supporting compliance with global cleanliness standards.

For detailed specifications, refer to the Datasheet and for applications, refer to the Flyer.

⚠WARNING IMPROPER INSTALLATION

- Consult with local safety agencies and their requirements when designing a machine control link, interface and all control elements that affect safety.
- Strictly adhere to all installation instructions.

Failure to comply with these instructions could result in death or serious injury.

WARRANTY/REMEDY

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship during the applicable warranty period. Honeywell's standard product warranty applies unless agreed to otherwise by Honeywell in writing; please refer to your order acknowledgement or consult your local sales office for specific warranty details. If warranted goods are returned to Honeywell during the period of coverage, Honeywell will repair or replace, at its option, without charge those items that Honeywell, in its sole discretion, finds defective. **The foregoing is buyer's sole remedy and is in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose. In no event shall Honeywell be liable for consequential, special, or indirect damages.**

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