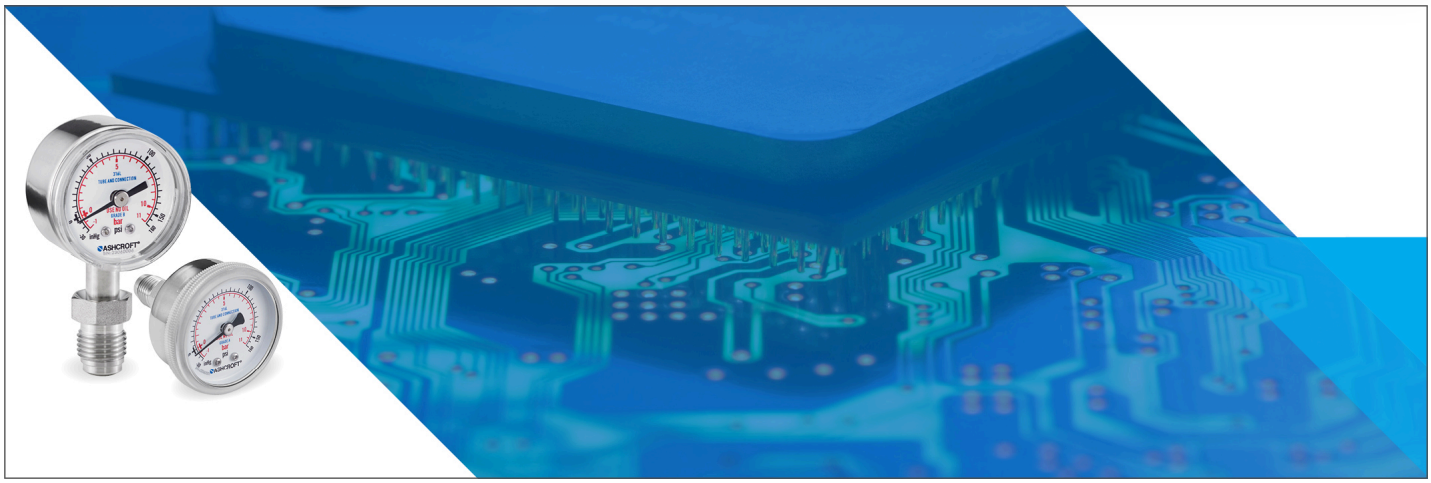


By: Eric Deoliveira, Product Marketing Leader on February 26th, 2024

How to Select a UHP Pressure Gauge for Semiconductor Applications

PRESSURE GAUGE | SEMICONDUCTOR INDUSTRY | HIGH PURITY

When you think of semiconductors, you may picture all the ways they make our lives easier. After all, we rely on semiconductor applications every day for conveniences like cell phones, computers, cars and other electronic devices. But for those of you who work in semiconductor manufacturing, you also know the demanding and challenging nature of making them.

The hazardous nature of the manufacturing process requires stringent protocols, approvals and specialized equipment that can perform with precision and accuracy under harsh conditions. So, when it comes to monitoring the distribution of ultra-high purity (UHP) gases flowing through the process, choosing the right pressure gauge is critical.

As a product lead at Ashcroft – a recognized authority in pressure and temperature instrumentation - I have been working with Ultra High Purity (UHP) Pressure Gauges for several years. In my role, I am often asked how to choose the right UHP gauge for these kinds of applications. Of course, my answer is, it depends.

In this article, I will review how and where semiconductors are made, the role UHP gases play in the manufacturing

process and the specific features you will need when choosing a pressure gauge for UHP applications.

When you are finished reading, you will also see additional resources that you can use as a reference on the topic of high purity.

Why UHP pressure gauges are important to semiconductor manufacturing.

At a very high level, producing semiconductors is a multi-layered, complex process. It begins with a 99% pure silicon ingot that is cut into blank silicon wafers. Each wafer is then meticulously transformed into hundreds and thousands of microelectronic units with circuit designs and patterns etched onto the surface of each one.

At the core of these processes is the use of many different ultra-high purity (UHP) gases, including hydrogen. Although these gases are extremely dangerous if not handled properly, they play a pivotal role in protecting semiconductor components from damage caused by moisture, oxygen or other contaminants in the atmosphere. The primary purpose of these gases is to always maintain the purity of the circuits.

Here's how the UHP gas is distributed:

- Gas delivery systems are used to inject the UHP gases into the process from a specified source such as a cylinder to the chamber that holds the wafers.
- The delivery typically directs the gases at high pressure and reduces pressure in the process chamber to near or below atmospheric pressure.
- The pressure is measured during the process to ensure the delivery system is functioning properly.

Monitoring the safe and efficient distribution of the gases flowing through the system takes a very specific kind of instrument. UHP pressure gauges, for example, must be made to withstand the harsh conditions of the manufacturing process while offering accurate and repeatable readings throughout every stage of the application to help maintain maintaining purity in the system.

Primary features to look for in a UHP pressure gauge.

Whenever you are dealing with harsh applications, you will want your pressure instrument to have specific characteristics:

A durable design. The manufacturing process involves rugged conditions with shock, vibration, pressure spikes and other challenges. Your pressure gauge must be made to withstand these conditions, so it won't get damaged in the process.

Corrosion-resistant material. Exposure to harsh gases like hydrogen can cause embrittlement in certain metals. This phenomenon causes brittleness due to loss of ductility. High-purity 316L Stainless steel is often recommended because it is resistant to corrosion and has a strong resistance to embrittlement.

Sized to fit. The size of the pressure gauge is another important consideration. Sometimes smaller is better, especially when you need to consider the process and support equipment that is close in proximity.

Accurate readings. Maintaining consistent pressure is paramount in these delicate operations, so be sure to look

for a gauge that meets the minimum application requirements.

Repeatable results. Trusting that your gauge will consistently give you the same results whenever it is tested. Be sure to use the same testing tool to confirm repeatability.

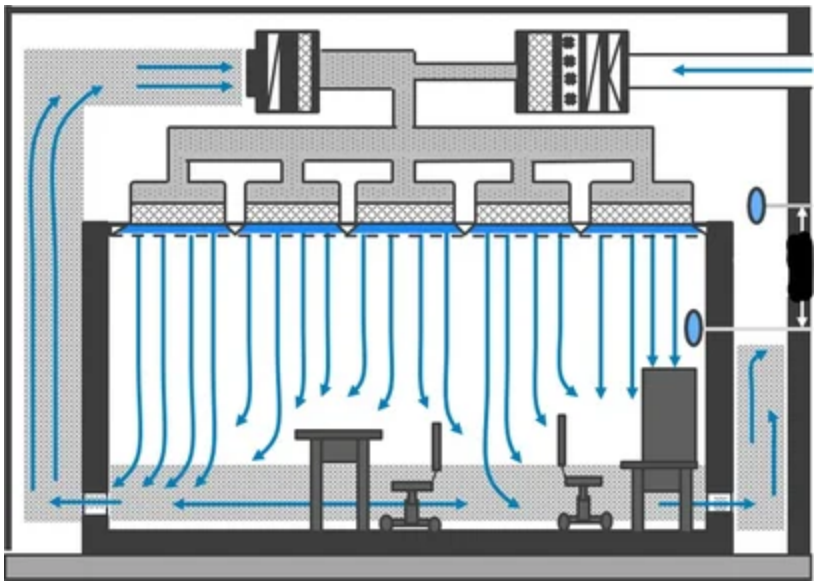
Ultra smooth surfaces. While your UHP gauge must provide accurate and repeatable measurements, it must also ensure that it does not introduce any foreign particles into the cavities of the process. That means any portion of the gauge that is exposed to the UHP gases must be cleaned extensively and have a shiny, smooth surface. The smoother the surface, the less likely unwanted moisture or particles will stick to the instrument.

The use of cleanrooms in semiconductor manufacturing

As we stated earlier, maintaining maximum cleanliness and purity is a top priority for both the manufacturing process and the instruments used in these applications. The risk of contamination during the manufacturing is high. This is why semiconductor cleanrooms are used to maintain the quality and purity of the microchips.

Cleanrooms are contamination-controlled environments. They use high-efficiency particulate air (HEPA) filters to maintain a specified size and concentration of airborne particles per cubic meter. The concentration and size of the particulates allowed in the space are determined by the level of cleanliness that is needed in the application. Cleanroom classifications are based on International Organization for Standardization (ISO) standards and range from Class 1 (cleanest) to Class 100,000. In semiconductor manufacturing, the most commonly used is Class 10,000.

Figure 1: Example of airflow in semiconductor cleanroom.



Remember, when selecting pressure instruments for semiconductors and other electronic manufacturing applications, be sure they also meet the high-quality standards necessary for ultra-high-purity gas delivery systems. All instruments used for this purpose should be made with 316 stainless steel and wetted components that are manufactured and packed in cleanrooms to prevent contamination and provide exceptional quality and reliability.

Stay informed of changes in semiconductor manufacturing

It is widely expected that the semiconductor industry will continue to experience significant growth in the coming years. To meet the challenge of increasing demand suppliers have begun tapping into emerging technologies including artificial intelligence (AI), autonomous driving, the Internet of Things (IoT) and 5G for example, to help increase transistor density, improve reliability, and reduce production and purchasing costs.

If you want to learn more about ultra-high purity pressure gauges, Ashcroft has a number of articles, videos and guides in our resource center. Here are a couple you might find interesting.

- Ashcroft High Purity Measurement Solutions
- Product Review: HPS High-Purity Pressure Gauge with Reed Switch

Reach out today to talk to one of our industry experts and get all your pressure gauge questions answered. Or, download our guide to learn more:

About Eric Deoliveira, Product Marketing Leader

Eric Deoliveira is a Product Marketing Leader at Ashcroft, Inc. He is currently responsible for pressure gauges, sanitary gauges, high-purity gauges, diaphragm seals and isolation rings. He’s been with Ashcroft since 2015 and spent 3 years as a Product Support Engineer for Mechanical Temperature before transitioning into the Product Manager role. Eric enjoys coming up with solutions for customer problems and introducing new products to satisfy the needs of the market. When not working on his products, he is out golfing in the summer and skiing in the winter.