



CERAMIC PRESSURE SENSORS 101

Why, When, and Where to Use Them





A pressure sensor is a device employed to measure the pressure of gases and liquids. These sensors are used in a wide range of applications, from altitude sensing in rockets to pressure switching in water networks. In some cases, pressure sensors may need to be used in harsh conditions, high temperature applications, or corrosive environments. But conventional pressure sensors may not be suited for such applications. This is where ceramic pressure sensors come into play.

Ceramic Pressure Sensor Construction

Ceramic pressure sensors owe their sturdiness to the unique construction techniques employed in their production. The use of thick film technology ensures superior robustness while allowing for optimal stability and cost efficiency. To create absolute and sealed gauge sensors, a smooth membrane is attached to the base. Or, for cost-sensitive applications, inexpensive, single piece (monolithic) designs are available.

Ceramic sensors can be easily incorporated into systems using inexpensive, simple O-rings. Usually, these types of pressure sensors have a 96% ceramic composition, allowing them to withstand harsh environments and severe pressure and temperature conditions. The ceramic composition can even be increased to 99% when a higher degree of protection is required. And for optimal environmental resistance, a more expensive sapphire composition can be utilized. The exact composition will depend on the unique requirements of the operating media.

The Benefits of Ceramic Pressure Sensors

Ceramic diaphragms are significantly stronger than stainless steel diaphragms and can therefore last much longer. They also cost less than an equivalent oil-filled stainless steel sensor. Because no oil movement is involved in ceramic sensors, the diaphragm does not need to be thin and fragile. And since the diaphragm is not contaminated by oil, the risk of wasting an entire batch of sensors due to oil leaks is eliminated.

“The relatively high strength of these sensors also reduces the drift that can occur in sensors after multiple cycles of operation.”



Put simply, ceramic pressure sensors operate at their calibrated values longer than other conventional models. Plus, ceramic is inherently resistant to corrosion and abrasion from particles, making these sensors compatible with most process media. Ceramic types can also withstand higher operating temperatures and pressures but are sensitive enough to measure low pressures while tolerating high overpressures.

When to Use Ceramic Pressure Sensors


Due to these unique advantages, ceramic sensors can be used in a wide range of industries for various purposes. For instance, the automotive industry employs these sensors to measure oil levels. In other types of transportation equipment, ceramic sensors are often used for hydraulic systems and emissions control. Or, in process industries, these versatile sensors may be used to measure the flow rate of the working fluid or measure the level of fluid in:

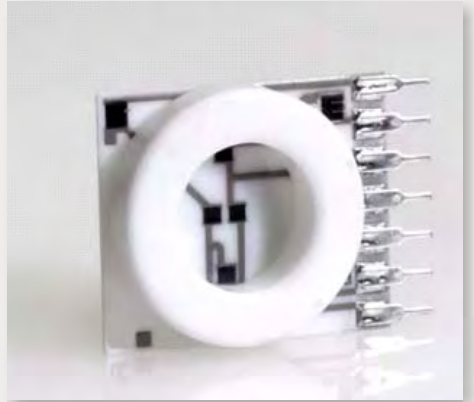
- Water Reservoirs
- Wastewater Control
- Industrial Chemical Processes

For applications in which a large number of pressure cycles must be tolerated, ceramic pressure sensors' high strength makes them an ideal fit. Plus, their compatibility with a wide array of working media makes them well-suited for applications in the HVAC industry, oil and natural gas industries, heavy manufacturing, and the food and beverage sector. (It should be noted that NSF certification for food and beverage applications is often the customer's responsibility.)

Types of Ceramic Pressure Sensors

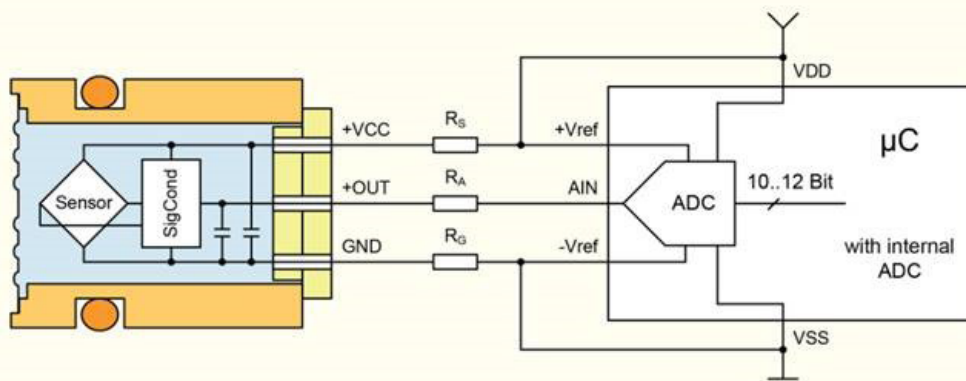
The particulars of the application at hand will determine the best type of ceramic pressure sensor to employ. Below are a few comparisons of some of the most common types of ceramic sensors.

- Flush Mount vs. Monolithic** — The key difference between these is that flush mount sensors have a flat, smooth surface exposed to the pressure media. An ideal example is the Metallux ME501/505 model, which can measure pressures as low as 0.5 bar and as high as 800 bar. A monolithic sensor, meanwhile, has an indentation in the center of the exposed side. A flush mount sensor is suitable when absolute or sealed gauge sensors are needed, as it has a fixed reference; plus, it has no dead volume of pressure media.
 

Monolithic Sensor
- Piezoresistive vs. Capacitive** — The Metallux ceramic pressure sensors designed for high pressure applications are either piezoresistive or capacitive. While both types are highly media-compatible and corrosion-resistant, capacitive sensors are preferred when the sensor must be able to tolerate high overpressure values while accurately measuring very low pressures. The ME52X, for instance, can measure values as low as 60 mbar.
- Pressure Type** — In addition to providing gauge, sealed gauge and absolute versions, we can now also provide ceramic differential pressure sensors. These sensors are unique in that they make use of just one sensor, rather than two, to measure differential pressure. In this way, there is only ever one error to consider, thereby improving overall system accuracy.
- Amplified vs. Unamplified** — Customers who are well-versed in designing their own systems and have the technical ability to amplify a transducer signal on their own may prefer an unamplified ceramic sensor, which must be amplified and calibrated for use. But users who want a calibrated, amplified sensor can choose from a range of completely calibrated and temperature-compensated sensor models; ratiometric, non-ratiometric, current loop, and I2C sensors can all be directly integrated into systems. The ideal sensor for a specific application will depend on a range of other factors as well. For instance, a sensor with mV output is ideally suited for customers looking to amplify and calibrate the sensor independently — giving them a great degree of control over pressure range and output accuracy. For other applications, a fully calibrated 4-20 mA or I2C sensor that has two levels of accuracy will be better suited.
 

ME800 Differential Pressure Sensor

- Ratiometric vs. Non-Ratiometric** – When using ratiometric sensors, if users supply the analog-to-digital converter (ADC) and the sensors with the same power supply at 5V, both components will have the same reference. This means the effect of the power supply variation does not affect the conversion of sensor output digital conversion. The sensors and the ADC have the same power supply (same voltage reference). If the voltage changes, the output of the sensor will change too, but because the ADC uses the same V_{dd} reference, the digital conversion is not affected. This scenario is very common in automotive applications. If users are working with 5V when using Metallux ceramic sensors, they must use ratiometric (0.5V to 4.5V output). If users are working with 12V or more, they must use non-ratiometric (0-10V output). The best option may also depend on the specific electronics to which the sensor is connected, as not all electronics are able to manage a signal higher than 5V.



The size of the sensor, which ranges from 9 mm diameter to 32.4 mm diameter at Servoflo, can also play a key role in the selection process. With its groundbreaking size, the new ME900 9 mm sensor is especially useful when working with tight spaces or small areas. Besides being small, this new sensor comes prepackaged, precalibrated and pre-amplified. Customers only have to add their own cable. The uniquely small size also allows for fast time to market and optimal ease of use, allowing the sensor to be utilized in applications in which size was previously prohibitive.



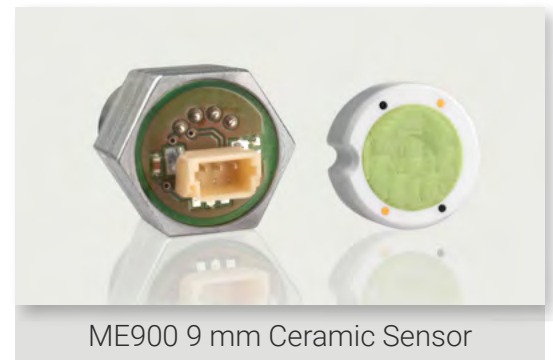
Packaging Your Ceramic Pressure Sensor

Ceramic sensors are available for purchase as the element only (in which users package the devices themselves) or as a completely packaged transducer. Our special evaluation mounting kit, MEKIT0400, helps customers test pressure sensors as well as perform offset calibration after packaging.

“The team of experts at Servoflo can work with you to design the ideal packaging solution for your unique application.”

Reasons to Package Yourself

- You have no space for the whole body of an off-the-shelf transducer. In these situations, some customers integrate the ceramic sensor element directly into their application, such as the inside of a pump or manifold.
- You are an experienced transducer manufacturer.
- You have in-house knowledge and skills.
- You are dealing with a high-volume application, which may make it more economical to package yourself.



ME900 9 mm Ceramic Sensor

Reasons to Buy a Packaged Transducer

- You have no packaging expertise.
- A standard package is acceptable (i.e., there is enough space in the application at hand).
- Sensor usage is low.
- You require a faster time to market.
- You require private labeling solutions.
- You are looking for easier logistics; with packaged solutions, there is no need to source multiple items, such as wires, connectors, and packaging materials.
- You are seeking industry-standard fittings; these come with all packaged options.
- Your application is best-suited to available specialty sensors; in many situations, making use of these sensors is just more practical than creating one yourself.



Packaged Transducer

Servoflo offers an oil-free stainless steel pressure sensor for heavy-duty applications in which any amount of leakage is unacceptable. Unlike ceramic sensors, these models feature a stainless steel sensor element, eliminating the need for O-rings. Our stainless steel sensors also come in their own housings. The sensor is soldered to the housing eliminating any possible leakage. In case of overpressure, the sensor membrane will deform but not burst.

Learn More

Whatever your specific pressure sensing needs, Servoflo's Metallux series of ceramic sensors has a model ideally suited to your application. We also have a broad range of board level pressure sensors for benign air applications. In addition to pressure sensors, we offer a range of environmental sensors, sensor signal conditioning solutions, and micro pumps.

To learn more about our product line, or for expert help finding the right solution at the right price, [contact the team](#) today.



Stainless Steel Pressure Sensor



About Servoflo

Servoflo Corporation is a provider of pressure sensors, mass flow sensors, environmental sensors, sensor signal conditioning, and micropumps. For 30 years, our services have helped companies solve their sensing measurement needs in a variety of applications including medical, industrial, HVAC, instrumentation and much more. No one else can match our wide product line and customer expertise.

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