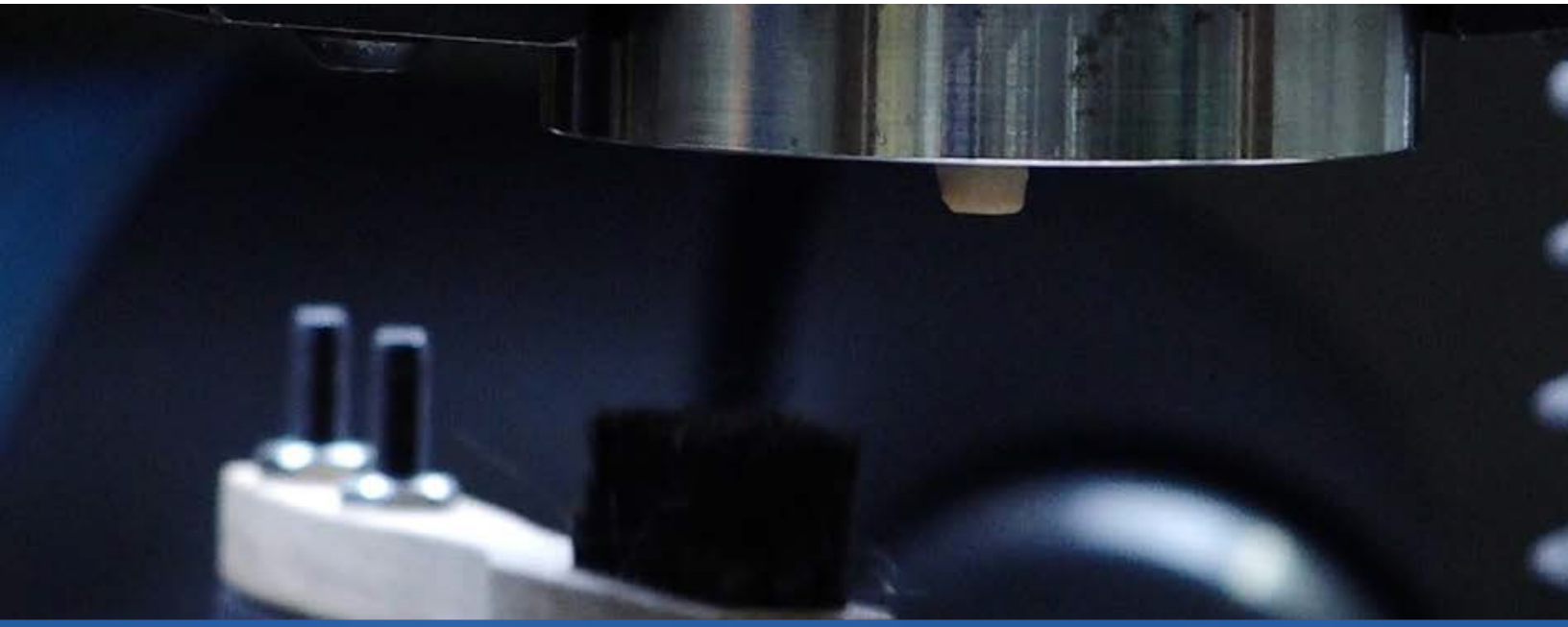
HUDSON DEEP DRAW

A PRECISION GROUP Company



Metal Diaphragm Manufacturing

Metal Diaphragm Manufacturing

Metal diaphragms are thin, circular metal plates that exhibit elastic deformation in response to pressure or force. In fluid control systems, these components are used as seals to contain a fluid within a system while simultaneously protecting the fluid from outside contaminants. Their flexible nature allows them to change their shape to accommodate various amounts of pressure or axial loading.

Hudson Technologies is an industry-leading designer and fabricator of metal diaphragms used in high-precision applications. In this eBook, we provide an overview of metal diaphragms and how our manufacturing capabilities and in-depth technical expertise can help you meet your diaphragm needs.

Metal Diaphragm Basics

Offering a unique combination of strength and flexibility, metal diaphragms are an ideal sealing solution for a range of critical fluid-based operations. Their benefits include:

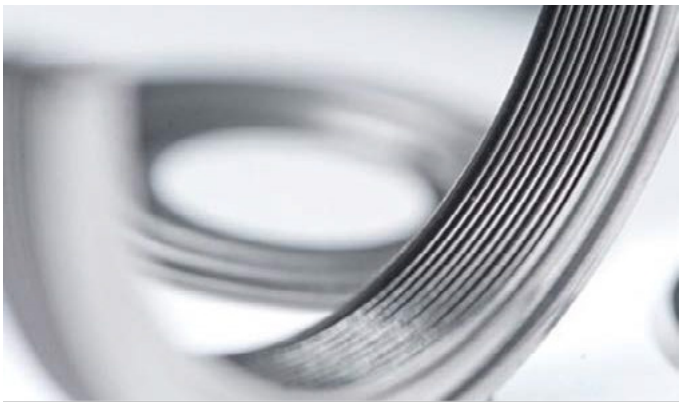
- **Reliable performance.** Metal diaphragms are designed to provide reliable performance across thousands of cycles.
- **Tolerant of extreme environments.** With their durable metal constructions, metal diaphragms can tolerate high temperatures, corrosion, and other extreme operating environments.
- **Linear range.** Metal diaphragms achieve an impressive linear range while providing a high level of mechanical sensitivity.

Most metal diaphragms are fabricated by forming a thin sheet of metal into a ripple configuration to maximize flexibility. With our diverse design options and fabrication methods, Hudson Technologies can optimize each metal diaphragm for its intended application. Our capabilities include:

- **Shape.** Metal diaphragms can be flat, corrugated, or domed depending on their intended use.
- **Diameter.** Diaphragms can be fabricated with diameters ranging from 0.200” to 18.00”. Our high-sensitivity low-pressure and low-sensitivity high-pressure diaphragms can be manufactured with outer diameters ranging from 1.000” to 3.000”.
- **Materials and thickness.** Our material options include stainless steel, Inconel®, Haynes® 242®, Hastelloy®, titanium, Monel®, and 17-7 PH stainless steel, and we can fabricate diaphragms with material thicknesses ranging from 0.001” to 0.018”
- **Equipment.** Our in-house manufacturing equipment includes hydraulic presses ranging from 150-500 tons and OBI presses ranging from 60-75 tons.

Types of Metal Diaphragms

Metal diaphragms are available in various types to meet specific pressure, cycle life, and deflection requirements. These include:



Foil Diaphragms

Made from aluminum, copper, tin, and other malleable metals, foils are thin metal sheets with thicknesses ranging from 0.0005” to 0.005”. Materials with thicknesses under 0.0005” are classified as converter foils. Foil diaphragms have several important industrial applications, including:

- **Food and pharmaceutical operations.** Foil diaphragms prevent metallic pressure sensors from contaminating product streams in food and pharmaceutical applications.
- **Pneumatic systems.** In pneumatic systems with air bearings, foil diaphragms allow small pressure changes to be eliminated rather than transferred.
- **Pressure regulation.** Foil diaphragms are often used to help regulate pressure by converting motion into computer-readable communication.
- **Overpressure protection.** When used as protective barriers and predictable failure points, foil diaphragms provide robust and reliable protection against overpressure.

Corrugated Diaphragms

Corrugated diaphragms are the most versatile and commonly used type of metal diaphragm. Compared with flat metal diaphragms, corrugated diaphragms provide much higher levels of pressure sensitivity and a larger linear range. Their uses include:

- Pressure regulation
- Converting motion into measurable communication with machinery
- Providing an effective barrier between opposing forces in liquids and gases

High-Sensitivity Low-Pressure Diaphragms

High-sensitivity low-pressure diaphragms are designed for applications requiring a diaphragm that will flex or move in response to a relatively low amount of applied pressure. Common applications include:

- Sensitive aerospace components such as altimeters
- Pressure sensor isolation in food processing and pharmaceutical manufacturing

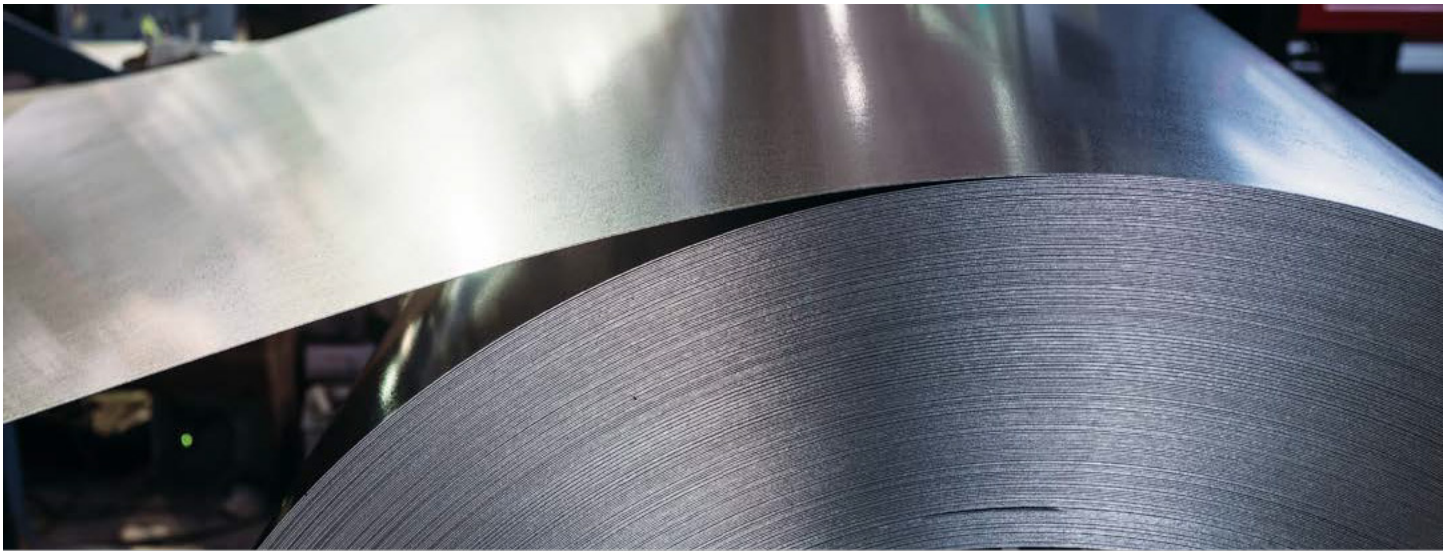
Low-Sensitivity High-Pressure Diaphragms

Low-sensitivity high-pressure diaphragms are used when the diaphragm needs to remain securely in place, even under high levels of pressure. Common applications include:

- Pressure regulation in pressure-based equipment
- Gas-liquid barriers and failure points for overpressure protection

Metal Pressure Transducer Diaphragms

Metal pressure transducer diaphragms convert pressure fluctuations into a measurable electrical signal that can quantify changes in pressure. These specialized diaphragms are used to sense and create motion in a range of mechanical devices, medical instruments, and industrial equipment. For example, metal pressure transducer sensors and diaphragms are key components of the industrial machinery used to direct semiconductor chips through the fabrication process.



Applications & Industries

Metal diaphragms aid in fluid sealing, pressure regulation, and pressure sensing in a range of critical industrial and commercial applications, including:

- Automotive Systems
- Aviation/Aerospace Systems
- Implantable Medical Devices
- Irrigation Processes
- Semiconductor Manufacturing
- Commercial Batteries
- Relay Cases
- Edge-Welded Bellows

Diaphragm Manufacturing Specifications, Materials, and Tolerances

At Hudson Technologies, we use the deep drawn stamping process to manufacture our metal diaphragms. This process is ideal for quickly producing large volumes of identical parts and is one of the most cost-effective manufacturing processes for metal diaphragms. Another benefit of the deep drawn stamping process is its ability to produce lightweight parts with exceptional strength, which is key in metal diaphragm manufacturing. It can also handle virtually any part geometry, no matter how complex.

Our specialized tooling and advanced power press technology allow us to create high-quality custom metal diaphragms for practically any application. Our capabilities include:

Diaphragm types:

- Rings
- Solids

Machinery:

- Hydraulic presses
- OBI presses

Tolerances:

- Diameter: 0.200” to 18.00”
- Thickness: 0.001” to 0.018”

Materials:

- Stainless steel grades 350, 316L, 304L, and 3467
- Inconel® grades 718 and 625
- Haynes® 242® alloy
- Hastelloy®
- Titanium grades 1 and 2
- Monel®
- 17-7 PH stainless steel
- Precious metals
- Other materials

Diaphragm Manufacturing from Hudson Technologies

Metal diaphragms play an important role in pressure regulation, pressure sensing, and mechanical sealing in a range of high-pressure, high-temperature, and corrosive fluid-based systems. Working with a qualified and experienced metal diaphragm fabricator is key for achieving a diaphragm design that will provide the required functionality while tolerating the conditions of the operation.

As a stand-alone manufacturer of metal diaphragms, Hudson Technologies is uniquely positioned to provide custom metal diaphragms that meet each customer's technical specifications, quality requirements, and budget. Whether you require a single prototype or high-volume production run, we have the equipment flexibility, material selection, and design experience to meet your needs.

Our services and capabilities include:

- **Sophisticated deep drawn stamping equipment**
- **KANBAN and inventory management**
- **Engineering and design assistance**
- **Large in-house tool facility and tooling creation services**
- **Environmentally responsible manufacturing processes focused on minimizing waste**

To learn more about our metal diaphragm fabrication capabilities, please contact us today, check out our capabilities, or visit our metal diaphragms page.