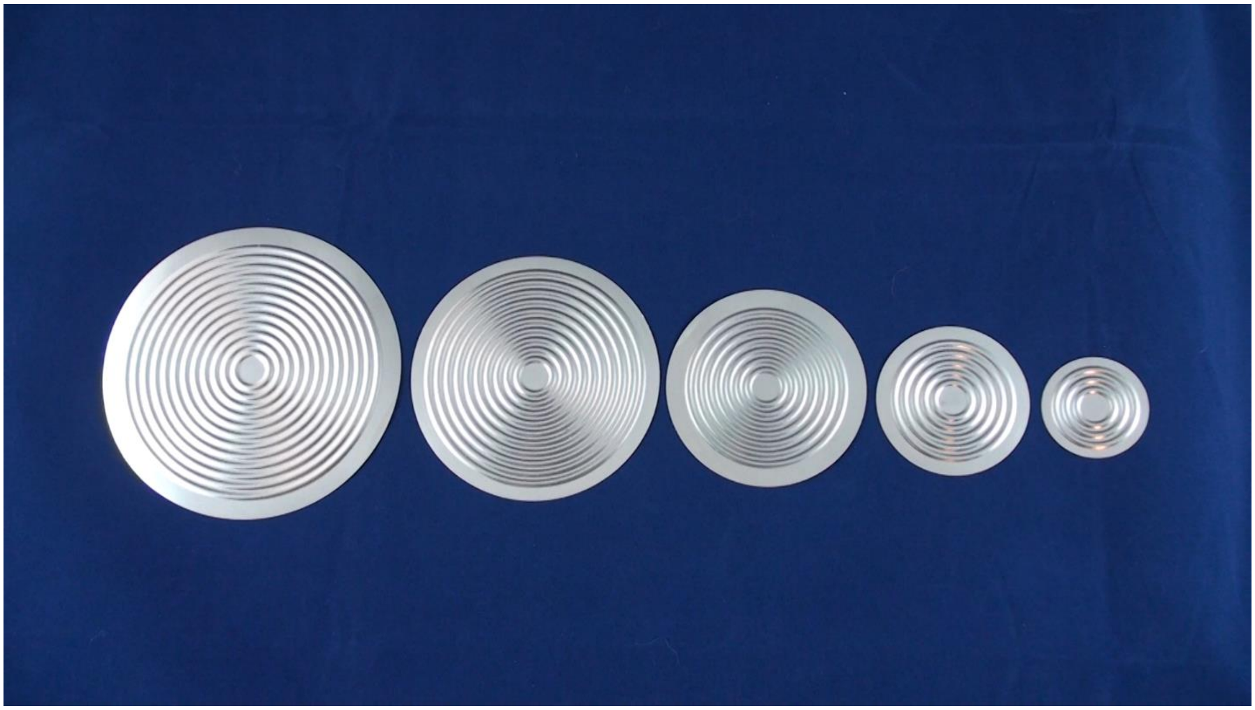
Stamped diaphragm technical information

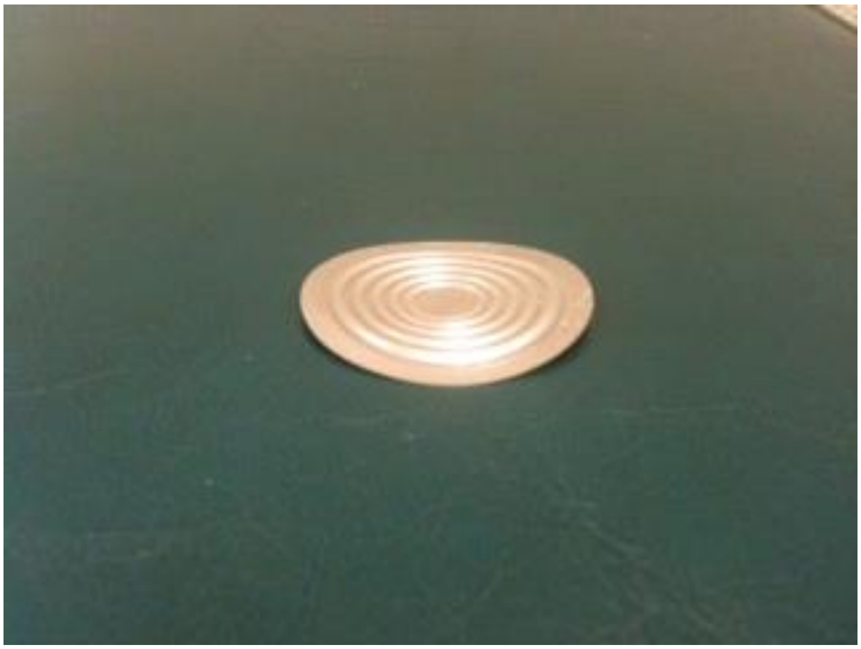
Diaphragms are semi elastic individual wafers with unique properties made from metal or elastomers that produce a predictable spring rate. For this discussion we are referring to round, concentric ringed, thin metal diaphragms. The amount of deflection and number of cycles are designed into the diaphragm utilizing material science, part shape and size that is tailored to a particular application to measure pressure, movement and thermal change as examples.



This discussion will focus on a metal stamped diaphragm that will describe the inherent traits or characteristics of the diaphragm after metal forming and trimming has taken place.

When any material is stamped and formed, the material will exhibit certain traits or characteristics that either must be predicted in the tooling design or corrected after the part is made.

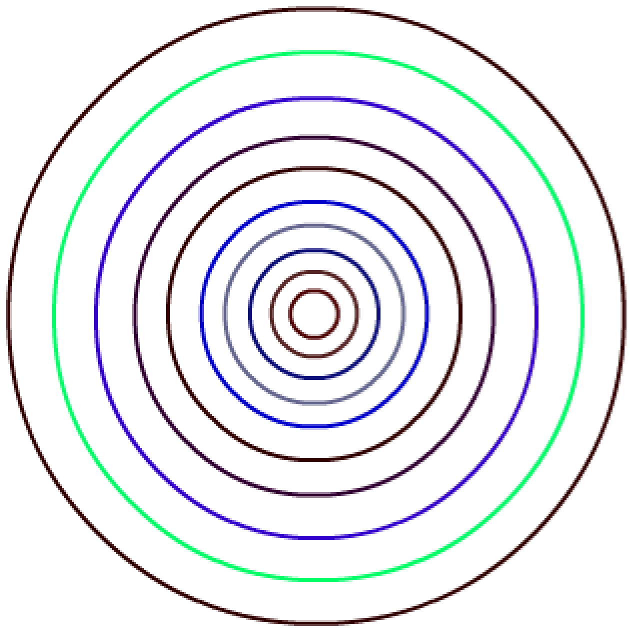
Specifically to stamped diaphragms we will discuss the typical characteristics that are considered a normal condition.

Camber- 

This condition is also known as potato chipping which is a spring back condition that occurs after the diaphragm is formed. This condition affects the flatness of the part in an unrestrained state. We consider a normal amount of camber to not exceed 2% of the actual outside diameter of the part. An example would be if we have a diaphragm that has a 1.000" diameter the typical camber would not exceed .020" The greatest effects to the amount of camber in a part is the part design, tool design, and material type.

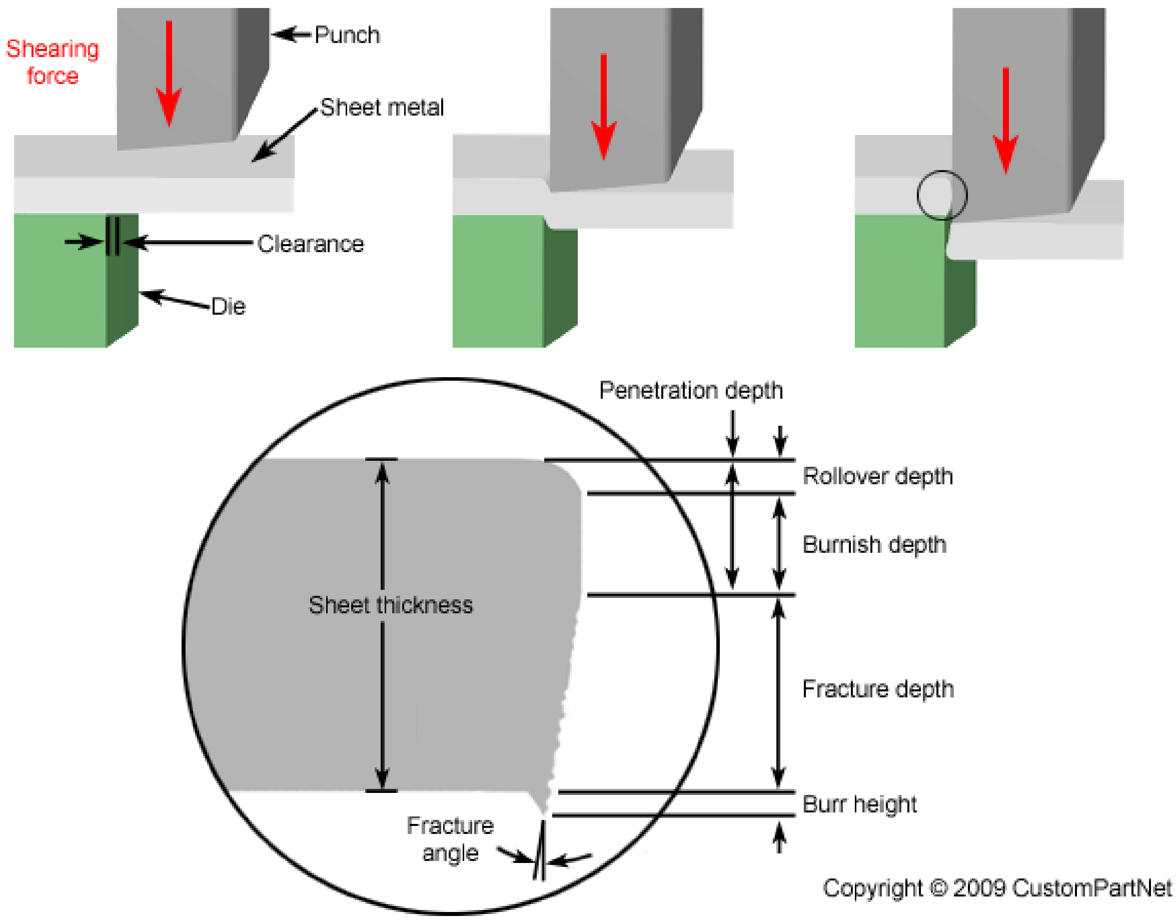
In most applications, camber is not a major issue since most diaphragms are restrained in their application typically by clamping or welding and held to a flat state in the assembly.

Concentricity-



The typical stamped diaphragm has convolutions or concentric rings formed into the part, they control deflection and cycle life. These are controlled by the tooling design and forming method. In order for the diaphragm to perform to design assumptions, the formed rings, inner diameter and outer diameters must run true to one another. We consider normal concentricity to be within .002” for all features on the diaphragm.

Edge burr-



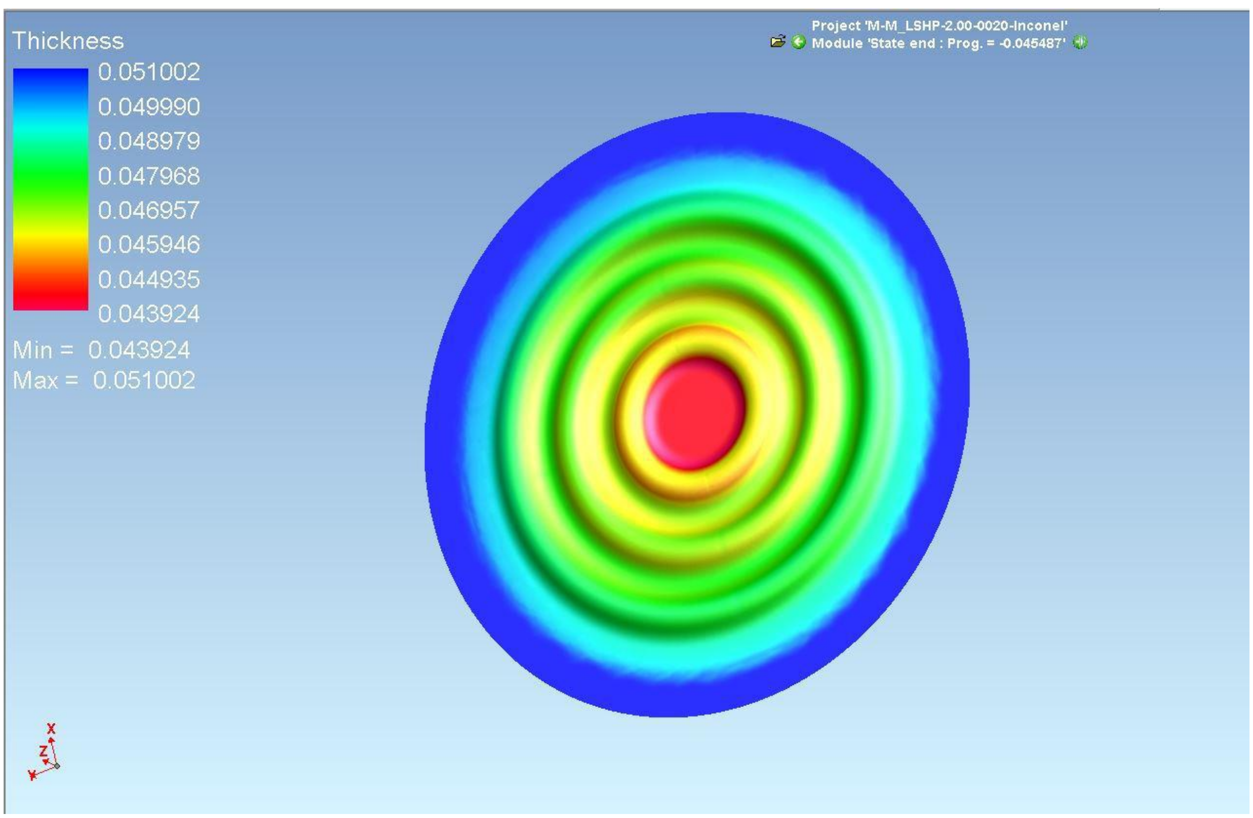
Stamping creates an edge burr. The height, type, and direction of burr are controlled by design, tooling and the equipment used to stamp the diaphragm. The type of material also has a role in edge burr condition. Hudson generally controls burr height to 30% of the actual material thickness. An example would be for .002” thick material, the edge burr would be held to .0006” in height.

Types of tooling-

Hudson uses two different tooling methods to form metal diaphragms. For prototype and production parts that are greater than .0015” thick and <50,000 piece annual volume we consider a tooling strategy using metal to rubber tooling. This is a specific design that works very well in these production parameters. The tooling is a relatively inexpensive, fast method to produce high quality parts.

For parts that are <.0015” thick or very high production volume, we consider a high precision metal to metal tool as the best choice. Metal to metal tooling offers the ability for precision alignment to hold exact requirements for burr height, geometry, and very long tool life for working with very thin material and high volume.

Diaphragm design and development-



Metal diaphragms are used in a wide array of consumer and industrial applications. Each application has a unique set of parameters that require unique solutions. Hudson has developed the expertise to offer FEA (Finite Element Analysis) with an addition of metal forming software that allows us to create a virtual application environment to test the performance of the diaphragm relative to requirements and predict any metal forming issues due to feature geometry.

Inspection methods-

Diaphragms are measured using two main methods; part controlled or die controlled measurements. Because of the delicate nature of most diaphragms, the typical contact method of measuring a feature is not practical due to part alteration from contact pressure. Laser scanning of the part or the actual tooling becomes necessary to validate dimensions. Because of diaphragm camber from the manufacturing process we typically prefer to validate dimensions of the tooling which makes the assumption that the part mirrors the tooling dimensions. In addition to tooling validation, the outside diameter, perimeter burr height and thickness of the diaphragm are measured. Some customers require the actual part be laser scanned for dimensions. This usually includes the need for special fixturing and a hold down method that mimics how the part will be restrained in its application in order to measure the part profile.

Packaging-

Because of the delicate nature of most diaphragms, packaging and handling become as critical as producing the part. Hudson can develop with the customer for any special packaging requirements. Typically for most applications the parts are shipped in plastic tubing and foam sandwich where applicable.

Stocking-

For long term commitments with forecasts, Hudson can provide stocking programs for raw material and parts that enable fast delivery of your diaphragm. Domestically and globally.