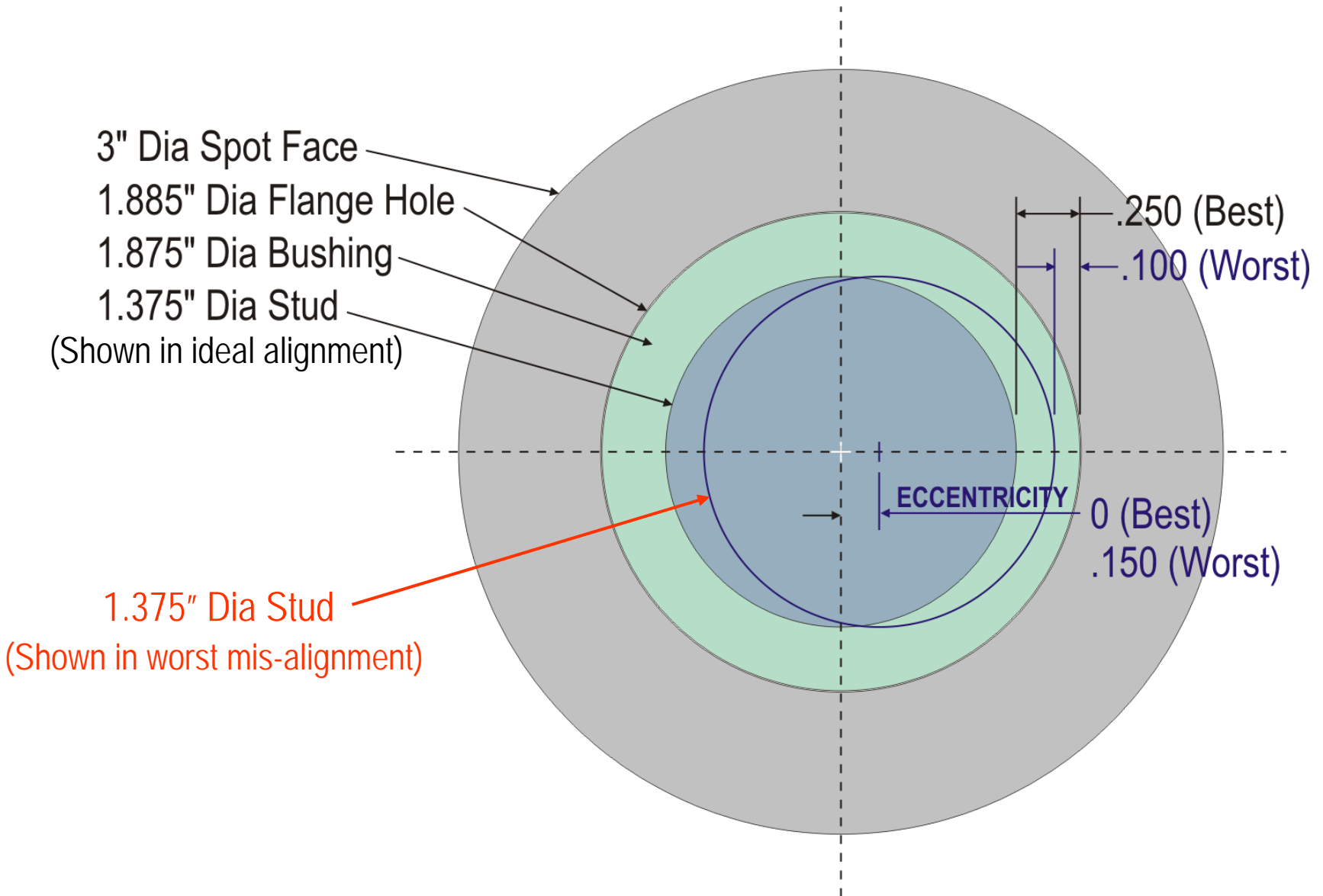
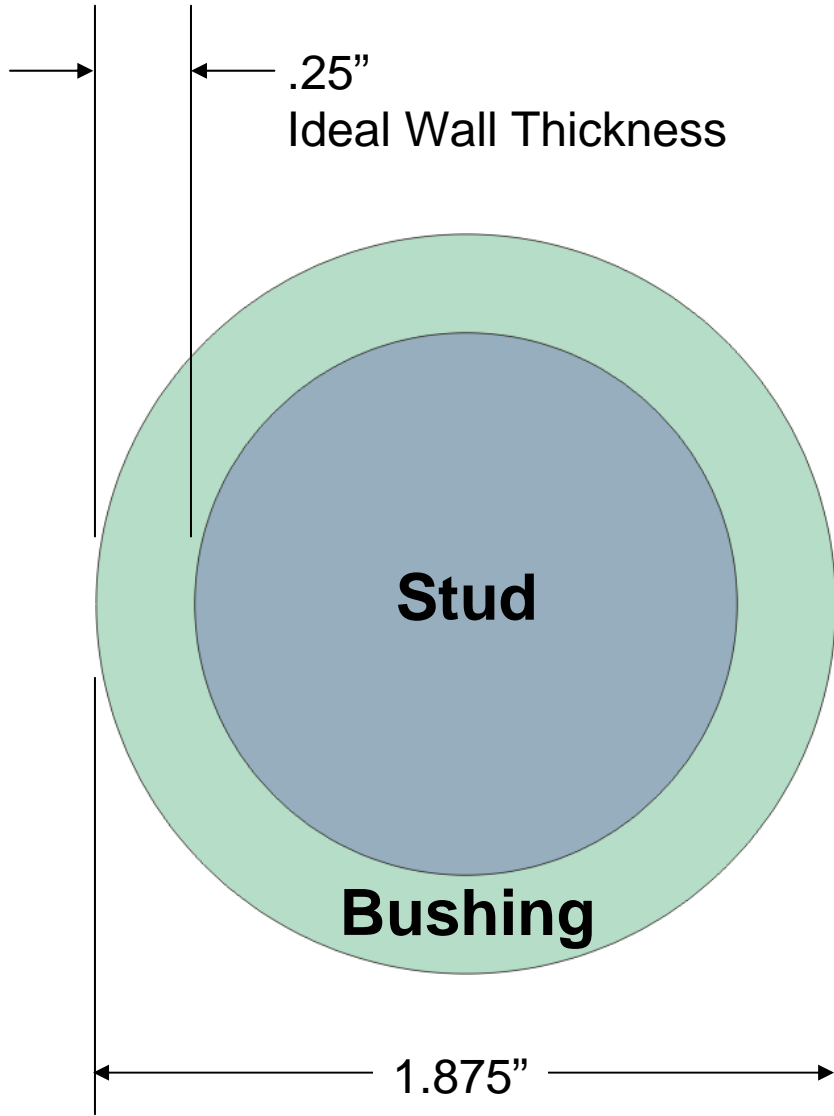


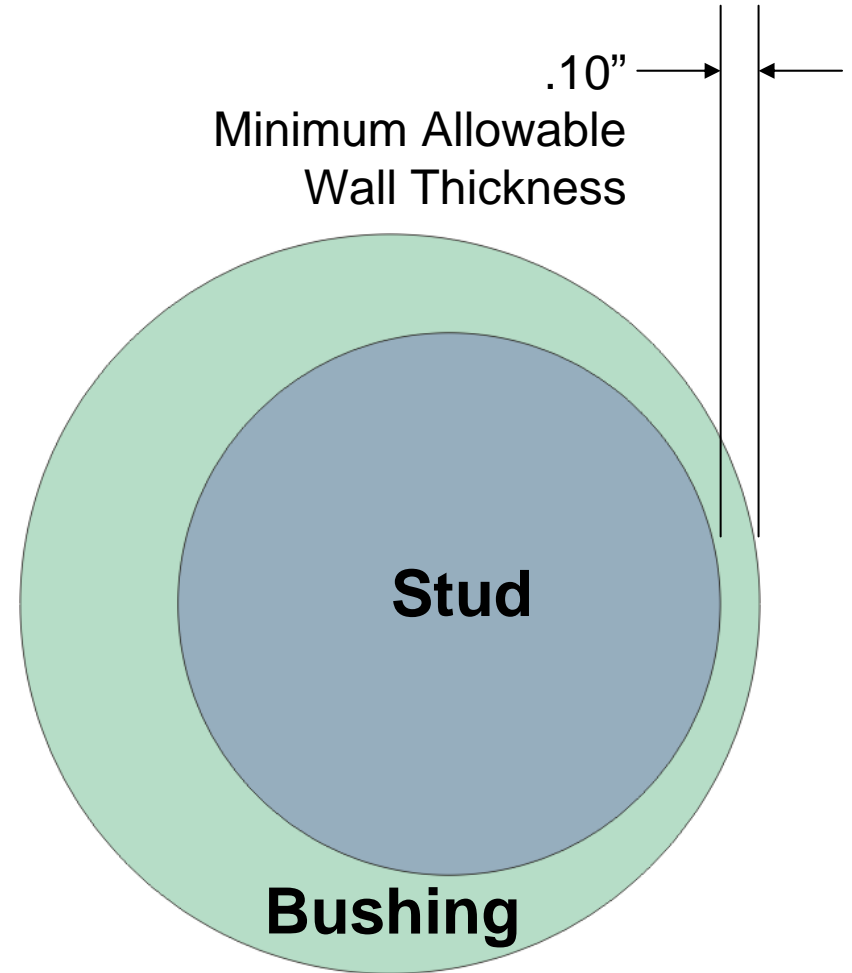
Offset of stud CL to the hole CL



Perfect Alignment



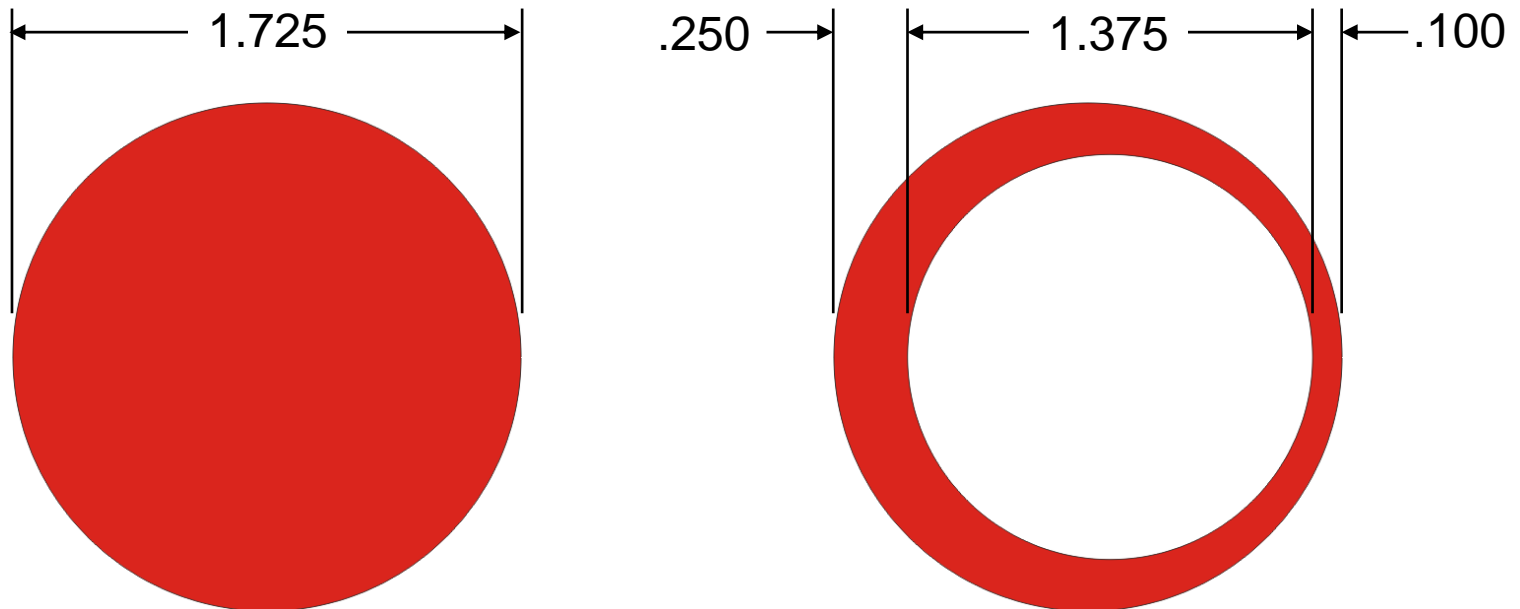
Extreme Mis-Alignment



Designing a gage to measure the center offset of 2 holes

1.375" (bored stud diameter)
+ .250" (ideal wall thickness)
+ .100" (minimum wall thickness)

1.725" outer diameter of gage

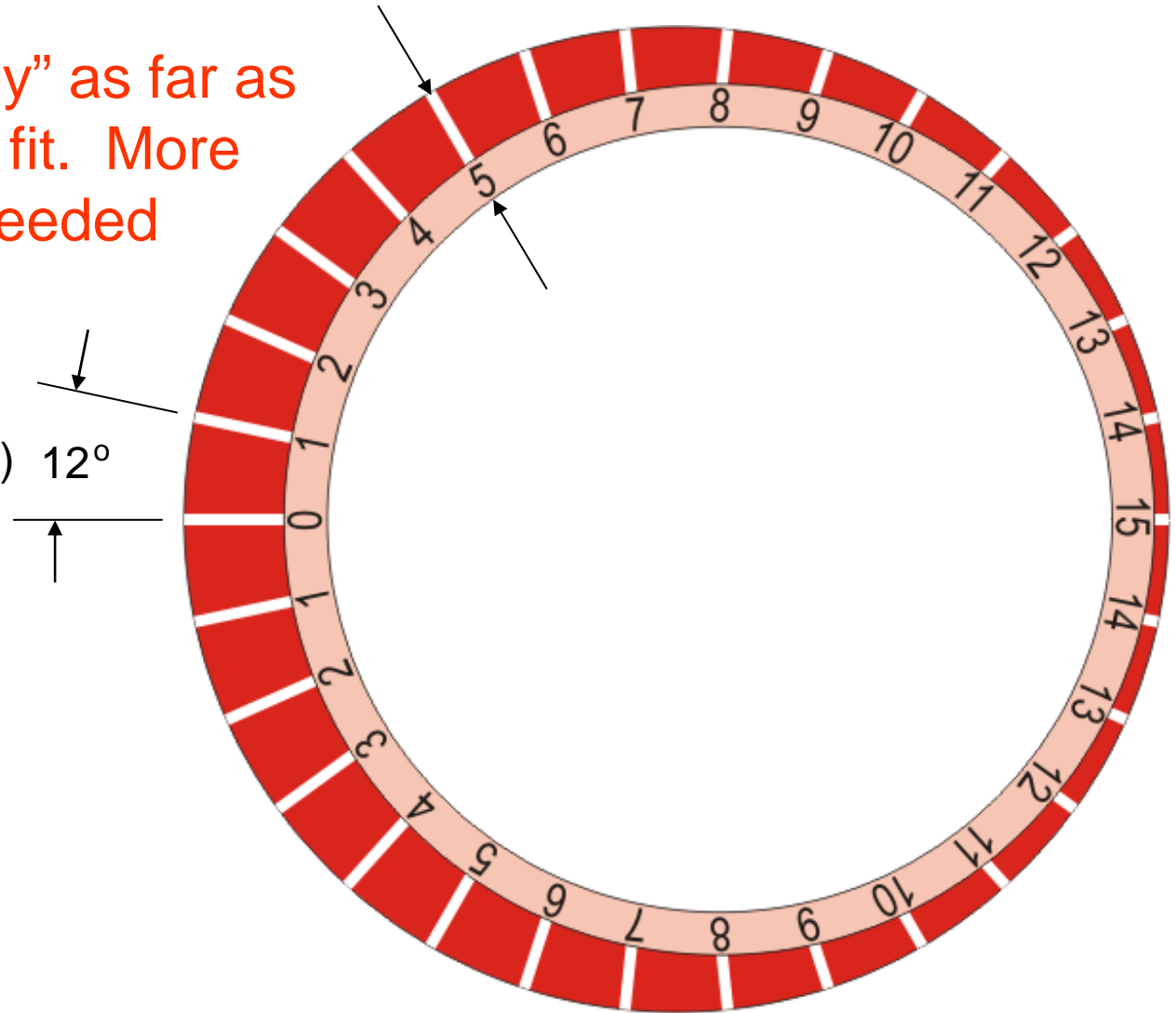


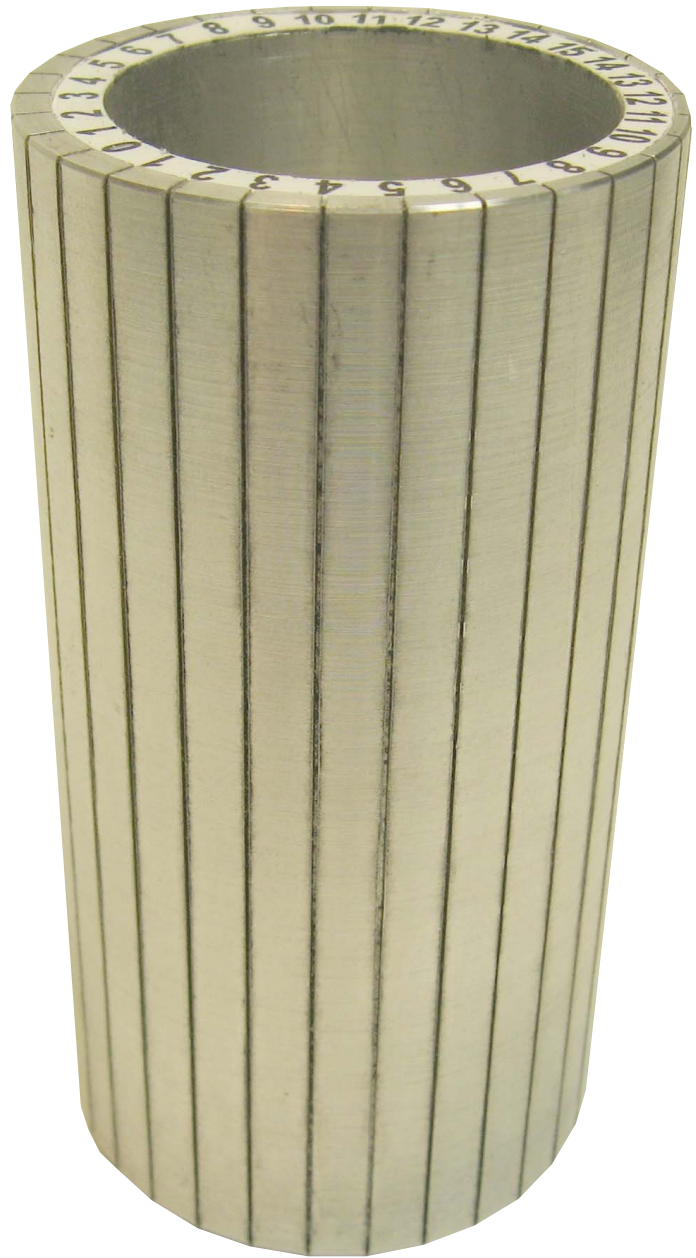
$.250 - .100 = .150$ (difference in wall thicknesses)

$.150 / 15 = .010$ difference per division

.010 is too “sloppy” as far as a good, accurate fit. More increments are needed

(15 divisions each side) 12°





Determining the gage increments

Take the average of the wall thicknesses

$.250$ (thickest wall) + $.100$ (thinnest wall) = $.350 / 2 = .175$ (average)

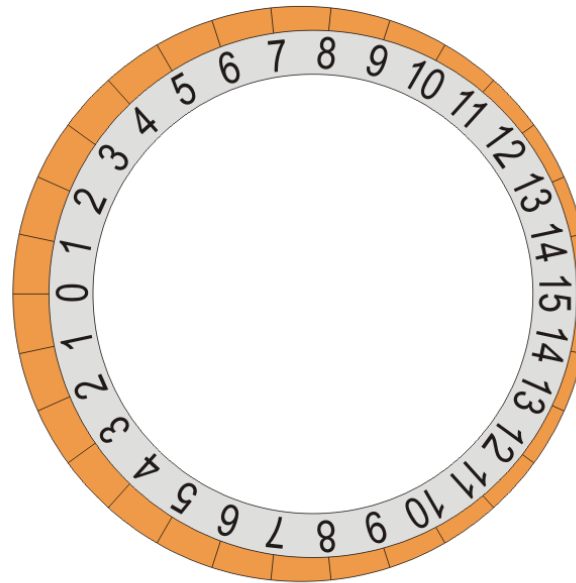
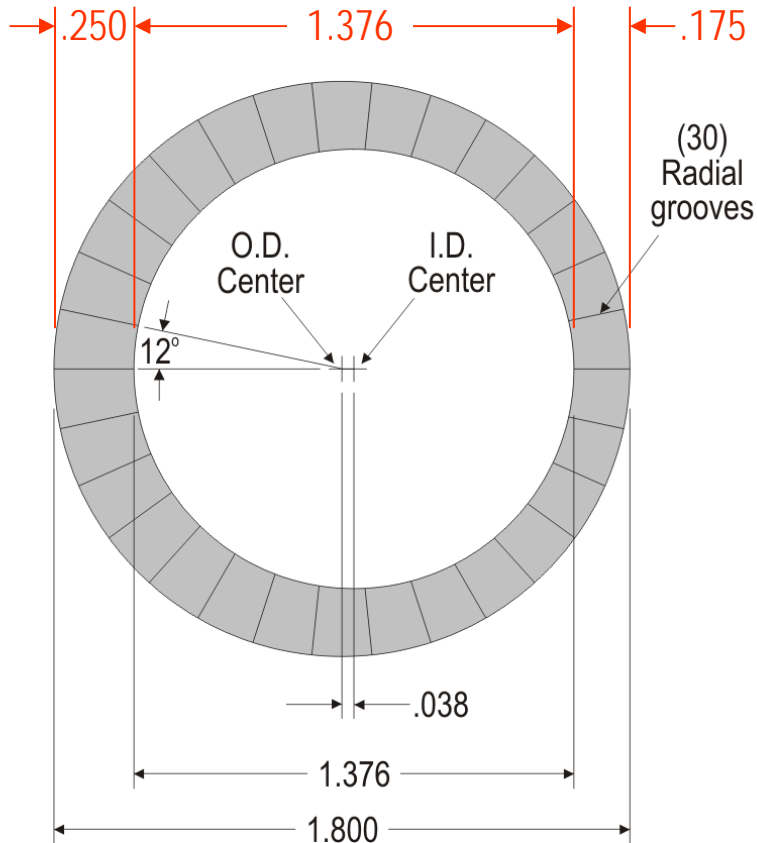
Make 2 gages

One gage measures thickness from $.250$ to $.175$

One gage measures thickness from $.175$ to $.100$

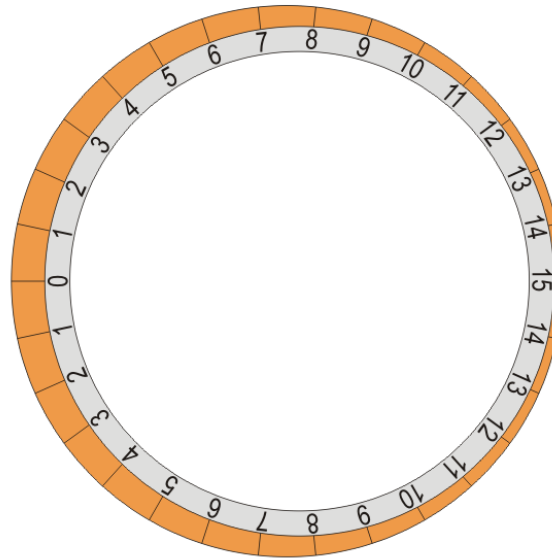
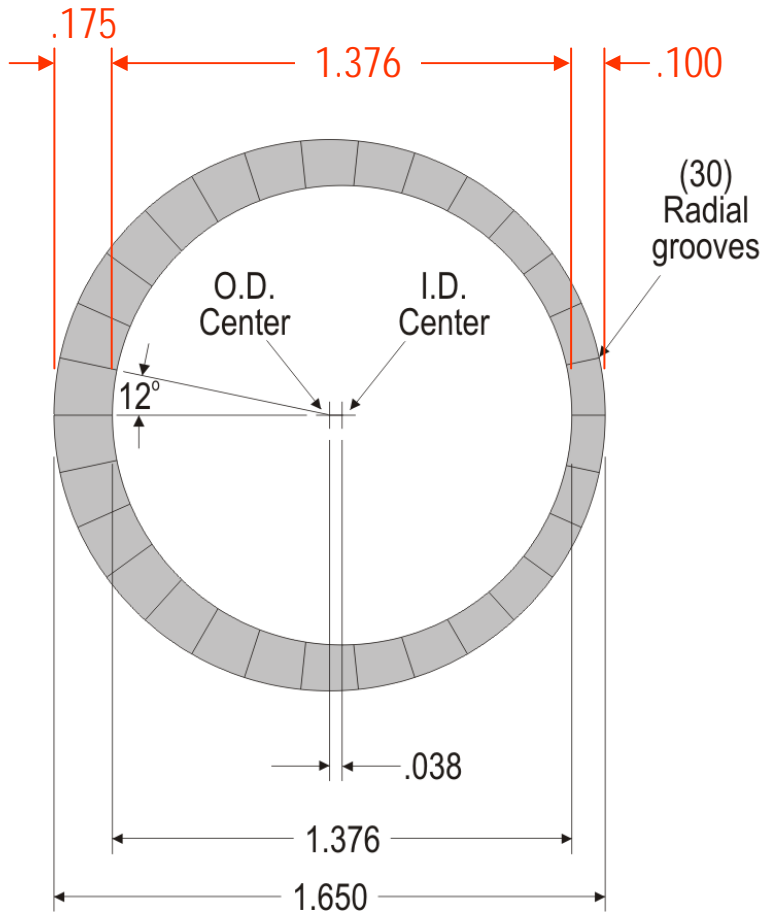
By using the same number of increments on the gages, the smaller and more accurate each increment becomes.

Gage to measure from .250 to .175



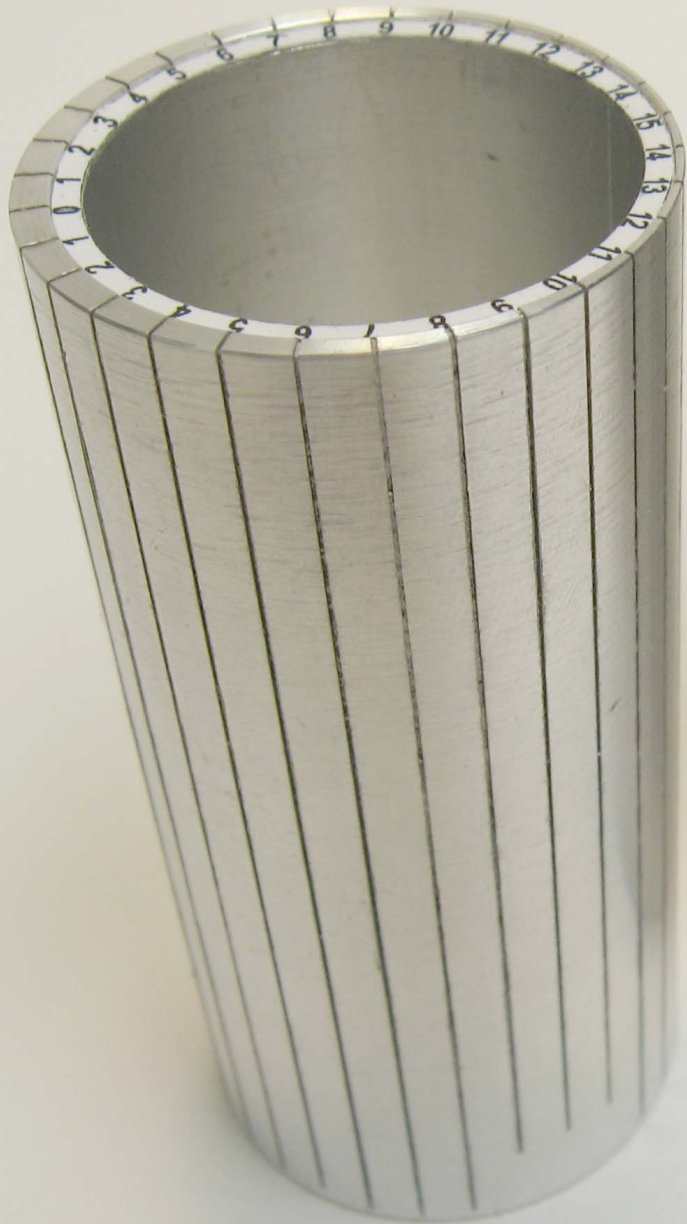
Hole No.	Min. Wall	Center Offset
(15)	.175	(.075)
(14)	.176	(.074)
(13)	.178	(.072)
(12)	.183	(.067)
(11)	.188	(.062)
(10)	.194	(.056)
(09)	.202	(.048)
(08)	.210	(.040)
(07)	.217	(.033)
(06)	.225	(.025)
(05)	.232	(.018)
(04)	.238	(.012)
(03)	.243	(.007)
(02)	.247	(.003)
(01)	.249	(.001)
(00)	.250	(.000)

Gage to measure from .175 to .100

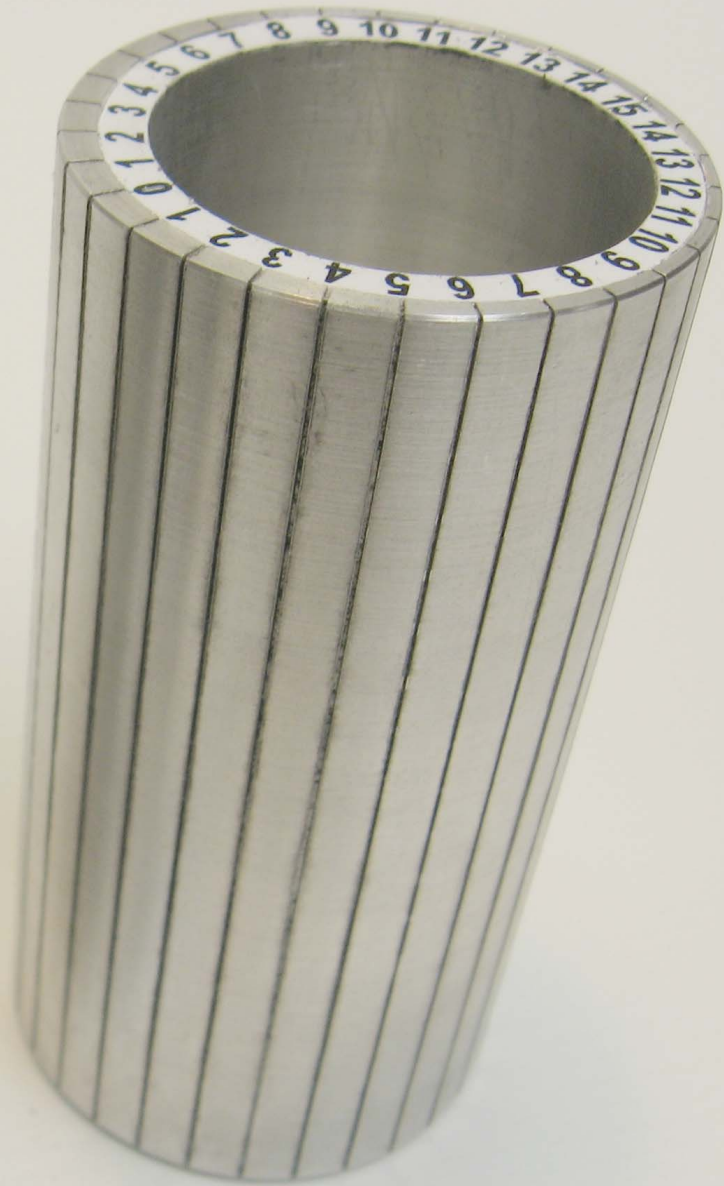


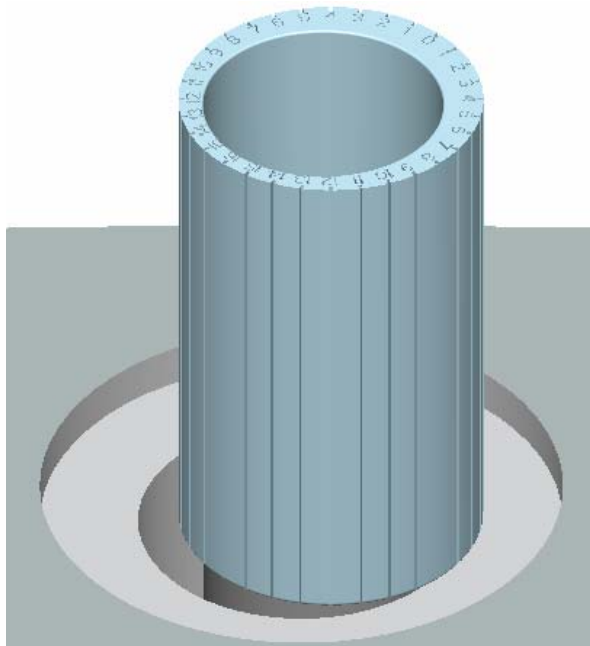
Hole No.	Min. Wall	Center Offset
(15)	.100	(.150)
(14)	.101	(.149)
(13)	.103	(.147)
(12)	.108	(.142)
(11)	.113	(.137)
(10)	.119	(.131)
(09)	.127	(.123)
(08)	.135	(.115)
(07)	.142	(.108)
(06)	.150	(.100)
(05)	.157	(.093)
(04)	.163	(.087)
(03)	.168	(.082)
(02)	.172	(.078)
(01)	.174	(.076)
(00)	.175	(.075)

.175 to .100 gage

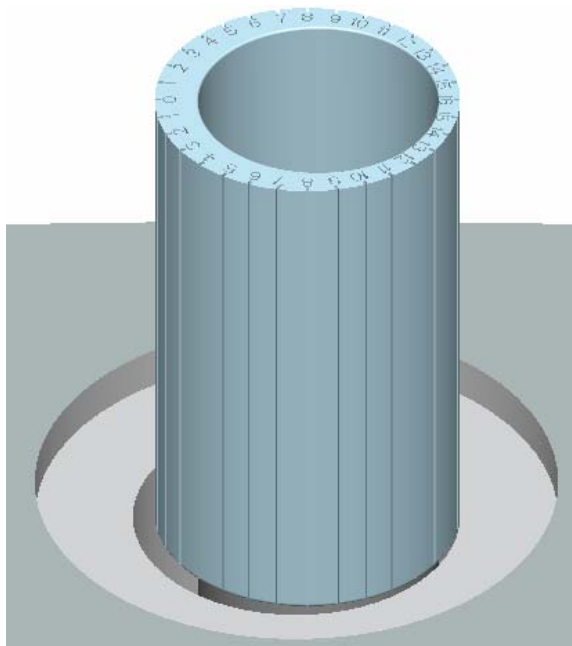


.250 to .175 gage

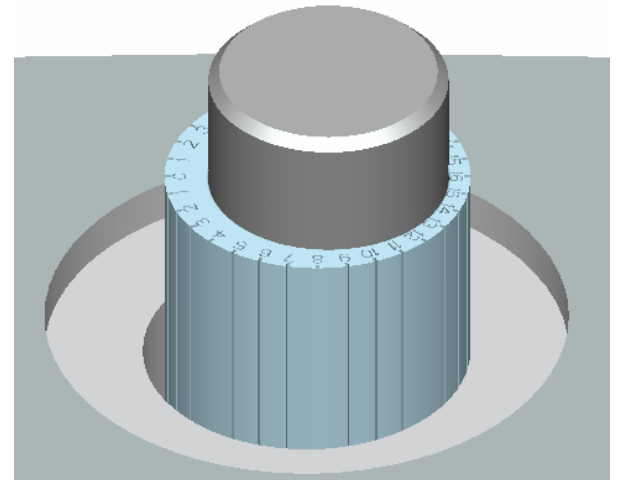




Slide gage
onto stud

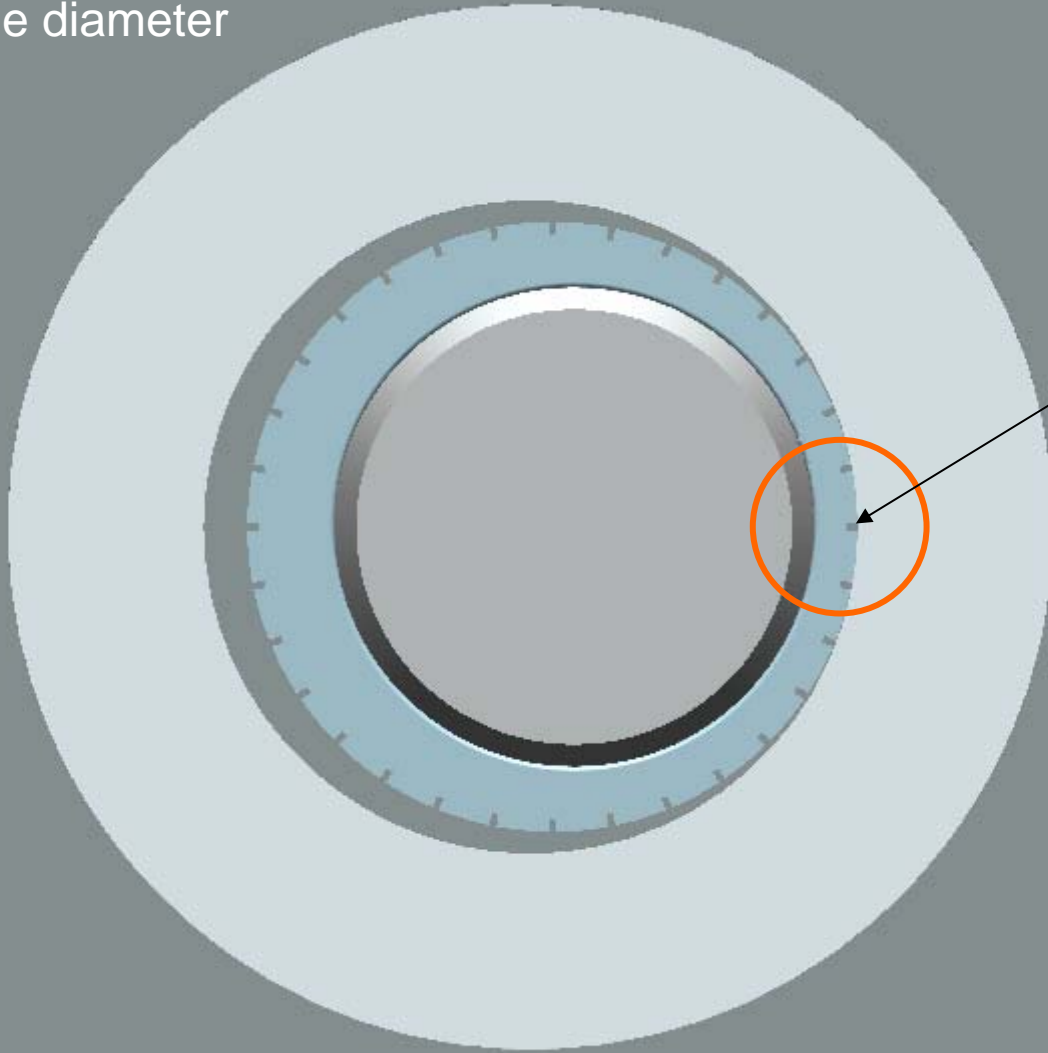


Rotate gage
until it fits into
hole wall



Slide gage
into hole

Top view showing the gage rotated until it is tangent with the hole diameter

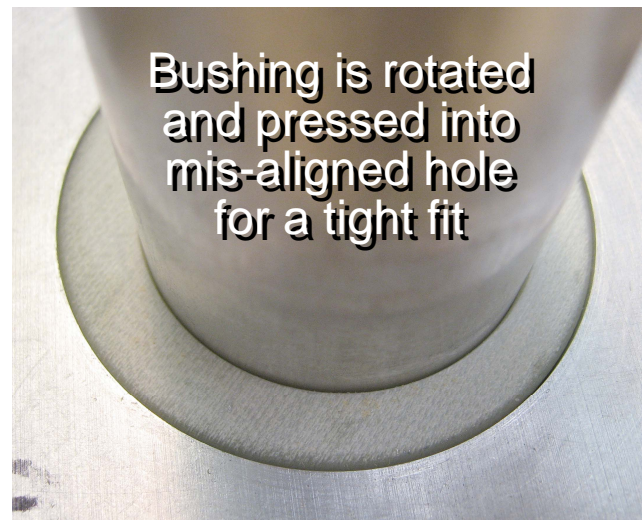
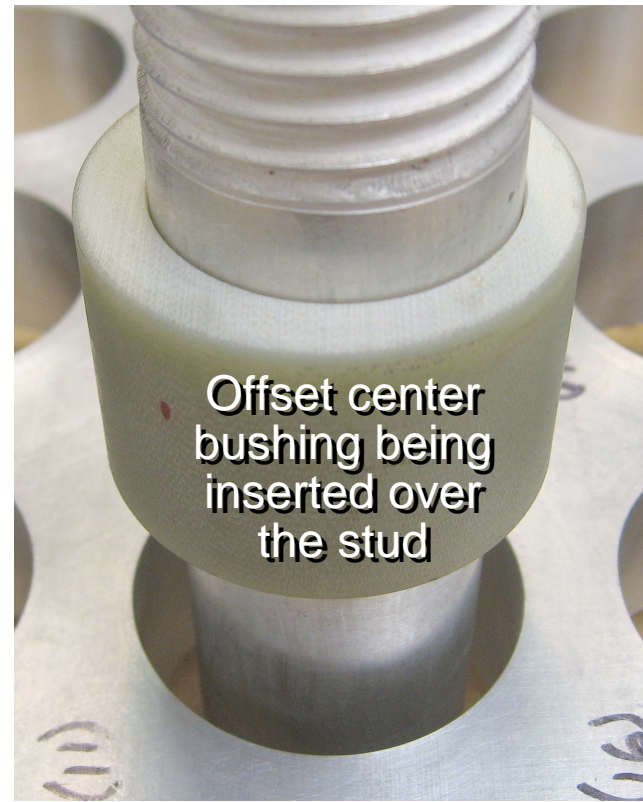
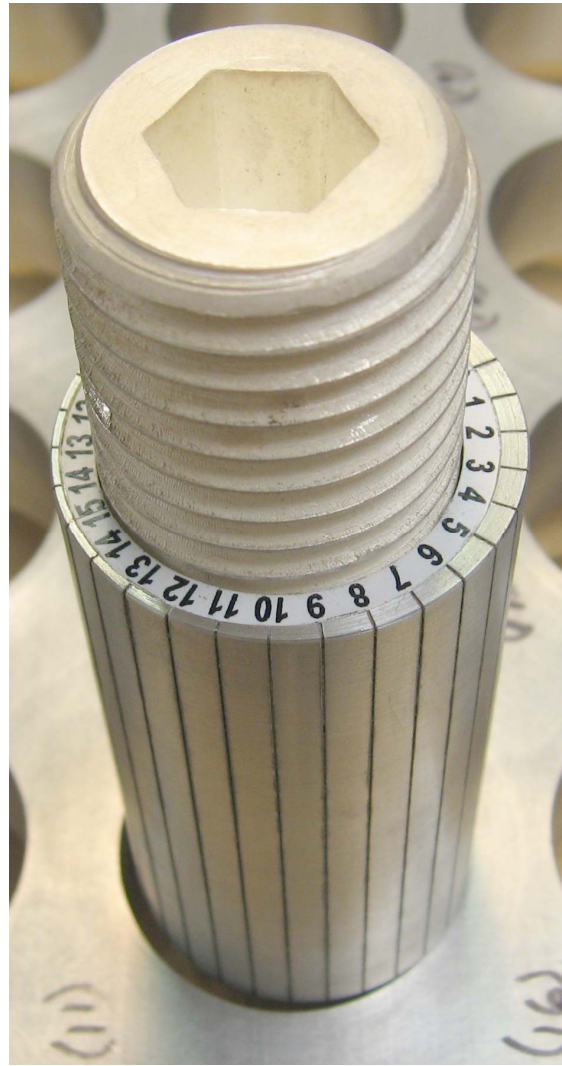
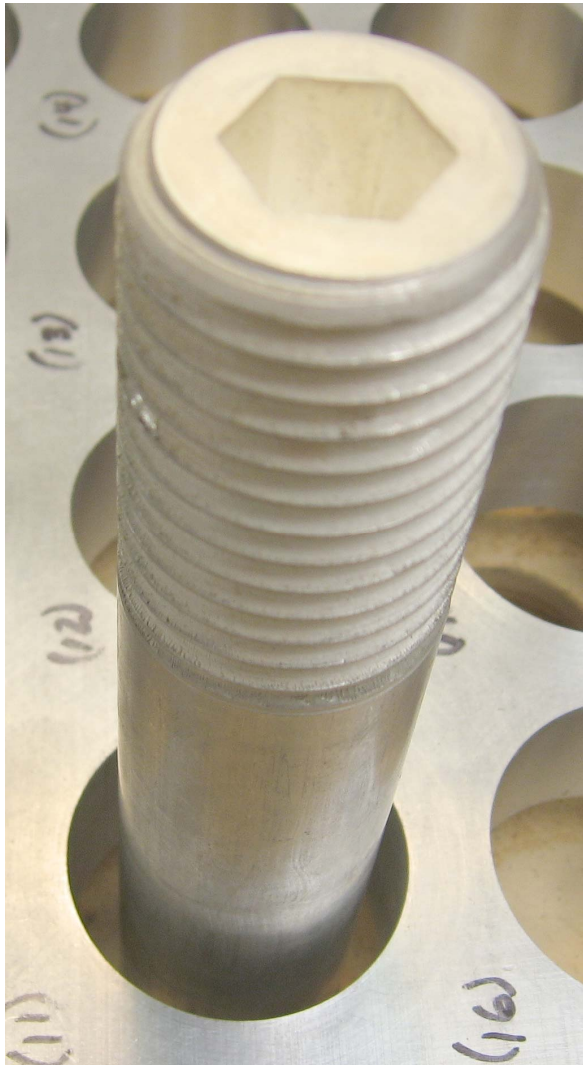


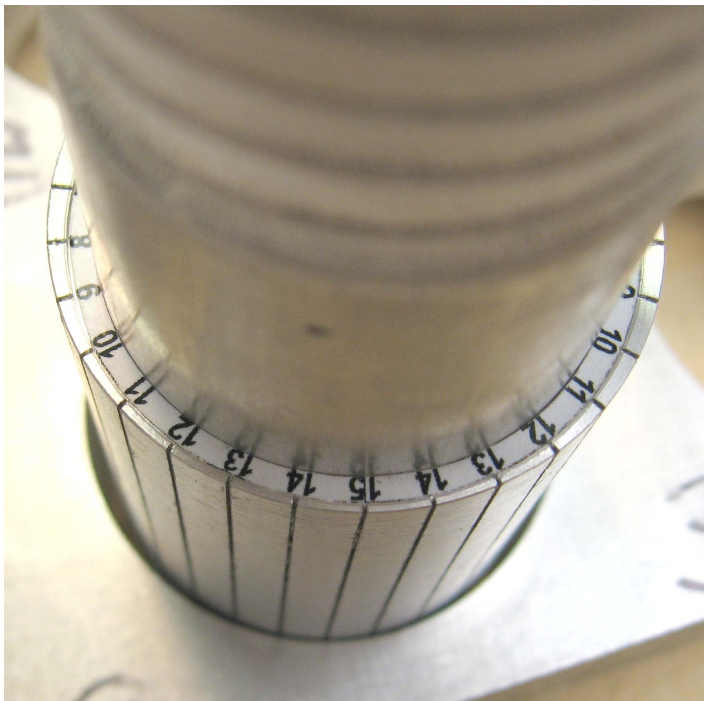
Determine the hole number on the gage relating to where the gage and hole are tangent, the gage will not rotate any further. This number specifies the amount of offset of centers by referring to the chart.

A test block with slightly varying flange hole sizes



Shows a mis-aligned stud in a hole being measured with the bushing gage for the 2 centers offset





Shows the most mis-aligned hole to stud situation.

What appears to be a gap, is a shadow from the chamfers on the bushing

