pfRICH Mirror Mounting

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pfRICH Engineering/Design Meeting

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Machinery's Handbook 27th Ed. (p. 1667)

- "The general rule is to use dowel-pins of the same size as the screws used in fastening the work."
- "The length of the dowel pin should be about 1.5 – 2 times the diameter in each plate or part to be doweled."
- "For locating dies*, the diameter of the dowel pin should never be less than 0.25""
  - *We're not locating a die, but we generally need a tight tolerance to repeatedly mount the mirrors and attempt to maintain the alignment.

Simple design guide: Alignment dowels

- https://www.linkedin.com/pulse/simple-design-guide-alignment-dowels-steven-weinberg

- This article discusses how to plan for a slip fit and interference fit for alignment dowels.
- The pro-tip included at the end is to slot one of the two slip fit dowel holes on the axis of the holes. i.e. one of the receiving holes is a slot to make up for positional hole tolerance / manufacturing problems.

Engineer’s Edge

- https://www.engineersedge.com/dowel_pin.htm

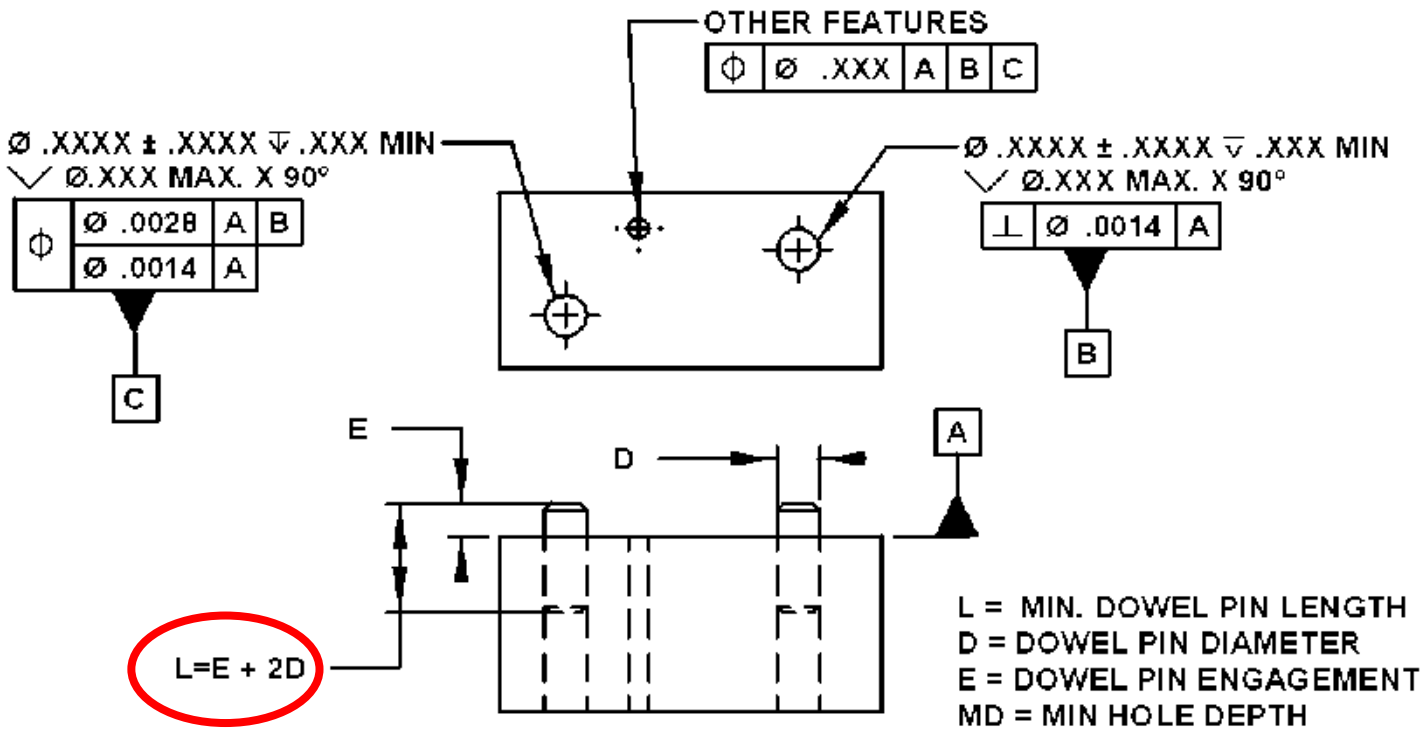
General

- Typical material is 6061-T651, per QQ-A-250/11 or similar aluminum alloy for the base mating components.
- Dowel Pin - are stainless steel 304, 306, 18-8 etc .. or similar.
- Application - These fits are for location or alignment applications between two components. Some shear load is acceptable, designer should determine acceptable stress limits for their particular application.

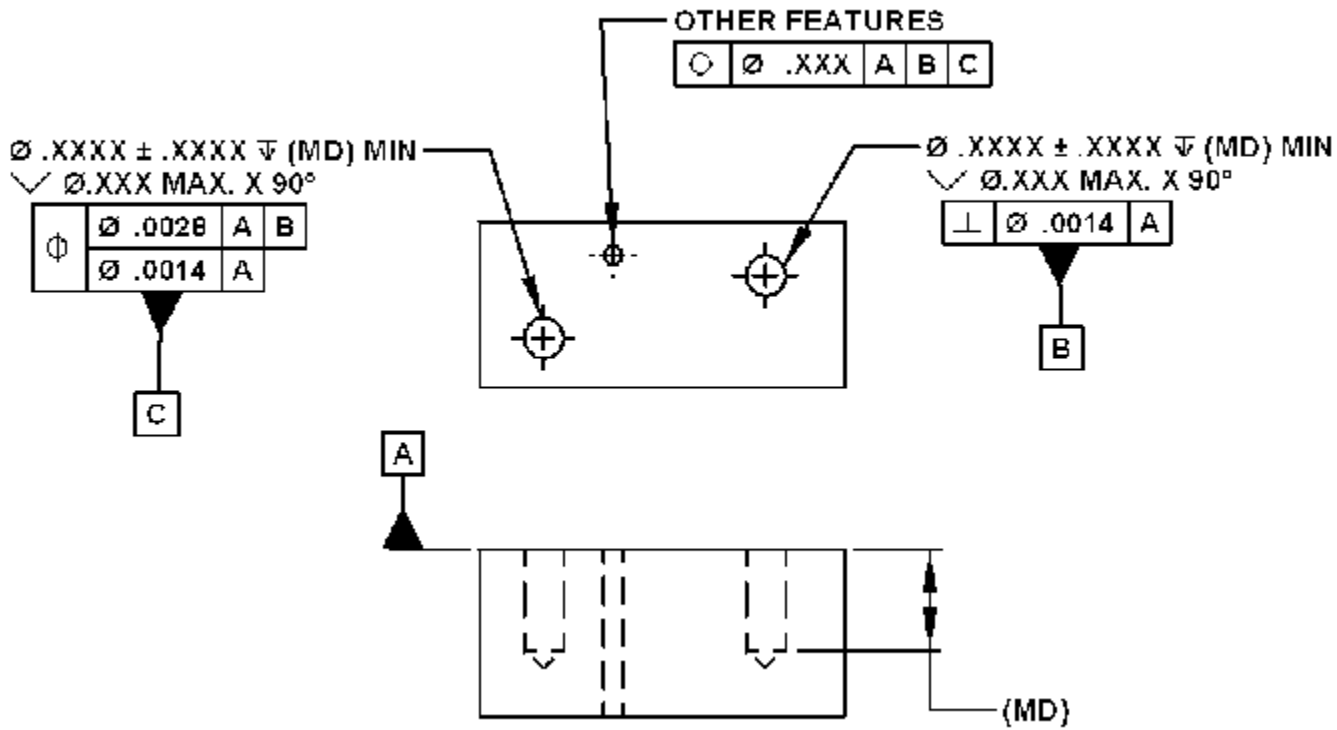
Dowel Pin "D" Diameter	Press Fit Hole	Slip Fit Hole	Hole Depth "MD" MIN.	Pin Engagement "E"
.031	Dia .0305 +/-.0005 V Dia .040 MAX. X 90°	Dia .0320 +/-.0005 V Dia .040 MAX. X 90°	.055 +/-.010	.025 +/-.010
.062	Dia .0620 +/-.0005 V Dia .080 MAX. X 90°	Dia .0635 +/-.0005 V Dia .080 MAX. X 90°	.070 +/-.010	.040 +/-.010
.094	Dia .0935 +/-.0005 V Dia .120 MAX. X 90°	Dia .0955 +/-.0005 V Dia .120 MAX. X 90°	.095 +/-.010	.060 +/-.015
.125	Dia .1245 +/-.0005 V Dia .160 MAX. X 90°	Dia .1265 +/-.0005 V Dia .160 MAX. X 90°	.110 +/-.010	.075 +/-.015
.187	Dia .1870 +/-.0005 V Dia .240 MAX. X 90°	Dia .1895 +/-.0005 V Dia .240 MAX. X 90°	.145 +/-.010	.110 +/-.015
.250	Dia .2495 +/-.0005 V Dia .315 MAX. X 90°	Dia .2520 +/-.0005 V Dia .315 MAX. X 90°	.175 +/-.010	.140 +/-.015

- These illustrations are toleranced per ASME Y14.5M - 1994 and ASME Y14.5-2009
- Units are in Inches

Press Fit


OTHER FEATURES
⌖ Ø .XXX A B C
Ø .XXXX ± .XXXX ↧ .XXX MIN
Ø.XXX MAX. X 90°
⌖ Ø .0028 A B
Ø .0014 A
C
Ø .XXXX ± .XXXX ▽ .XXX MIN
Ø.XXX MAX. X 90°
⊥ Ø .0014 A
B
E
D
A
L=E + 2D
L = MIN. DOWEL PIN LENGTH
D = DOWEL PIN DIAMETER
E = DOWEL PIN ENGAGEMENT
MD = MIN HOLE DEPTH

Slip Fit


OTHER FEATURES
○ Ø .XXX A B C
Ø .XXXX ± .XXXX Ⓢ (MD) MIN
Ø.XXX MAX. X 90°
⌖ Ø .0028 A B
Ø .0014 A
C
Ø .XXXX ± .XXXX Ⓢ (MD) MIN
Ø.XXX MAX. X 90°
⊥ Ø .0014 A
B
A
(MD)

Mirror Design Considerations

- Dowel Material: SS (non-magnetic)
  - Ti for final
  - SS for prototype
- Due to the material thickness requirements, it seems that the dowel will be pressed into the mirror (typically using an arbor press not a striking tool [hammer]). Do we have a way to fixture the mirror to accept the dowels?
- Use of a flat vent dowel pin to allow air to escape during installation (assumes a blind hole on the mirror)
  - The blind hole is optional, but there would need to be a way to stop the dowel from being inserted too far. Two drilling operations? The cost of the flat vent dowel isn’t expensive, probably less than an extra drilling operation.

Mirror Design Considerations (Cont'd)

- Thermal cycling of the mirrors during bakeout… how much stress is induced in the pin during an interference fit? Will it crack the mirror?
  - Question to be answered with simulation
  - 120C for 3 weeks for bakeout
- Any issue with having the dowels in place during coating? Since the mirror is fragile after the coating, the dowels and sleeves will likely need to be installed prior to coating.

Dowels and Holes

- Assuming a ¼” dowel (see highlighted section, slide 2):
  - OAL of dowel should be (min): 0.655” (slide 5)
    - Standard size: ¼” x ¾”
- Press Fit (mirror side):
  - Diameter: .2495” (+/-.0005”)
  - Hole depth: 0.75” – 0.14” = 0.61” (+/- 0.015”)
- Slip Fit (sensor plane side):
  - Diameter: .2520” (+/-.0005”)
  - Hole depth: 0.175” (+/-0.010”)
- **At least 1” away from any edge of the mirror**

Fit and Tolerance

- Press Fit
  - Size of dowel: 0.2501-0.2503”
  - Size of press fit hole: 0.2490-0.2500”
  - Loosest fit: 0.0001” interference
  - Tightest fit: 0.0013” interference
- Slip Fit
  - Size of dowel: 0.2501-0.2503”
  - Size of slip fit hole: 0.2515-0.2525”
  - Loosest fit: 0.0024” clearance
  - Tightest fit: 0.0012” clearance

Flat-Vent Pull-Out Dowel Pin

18-8 Stainless Steel, 1/4" Diameter, 3/4" Long

2-D PDF

$8.30 Each

In stock

97365A110

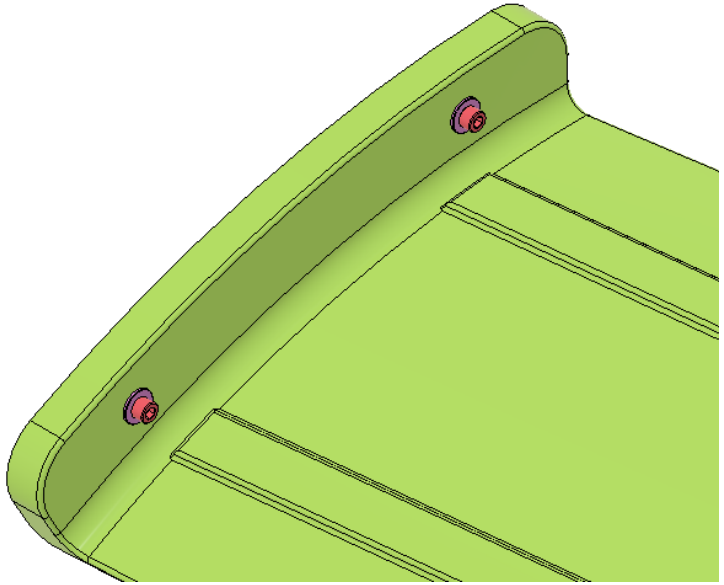
Each

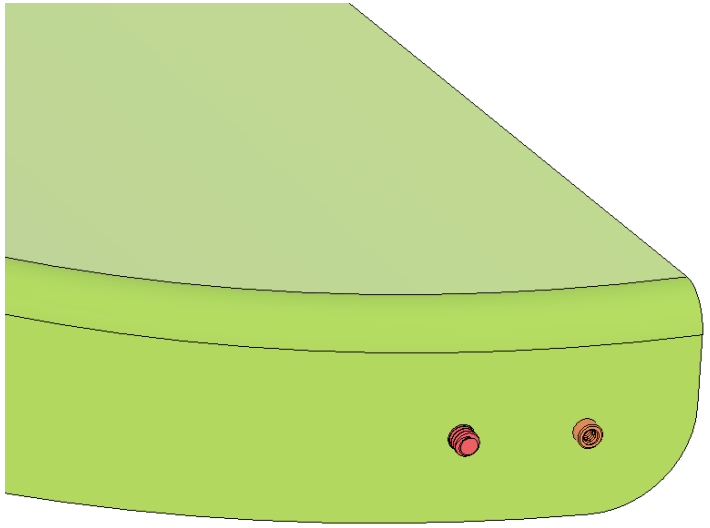
ADD TO ORDER

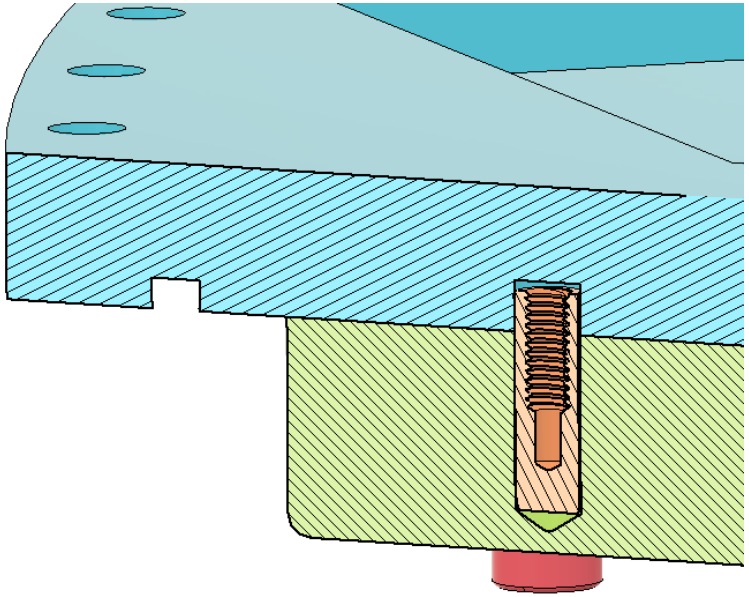
Learn more about our Solidworks Add-In

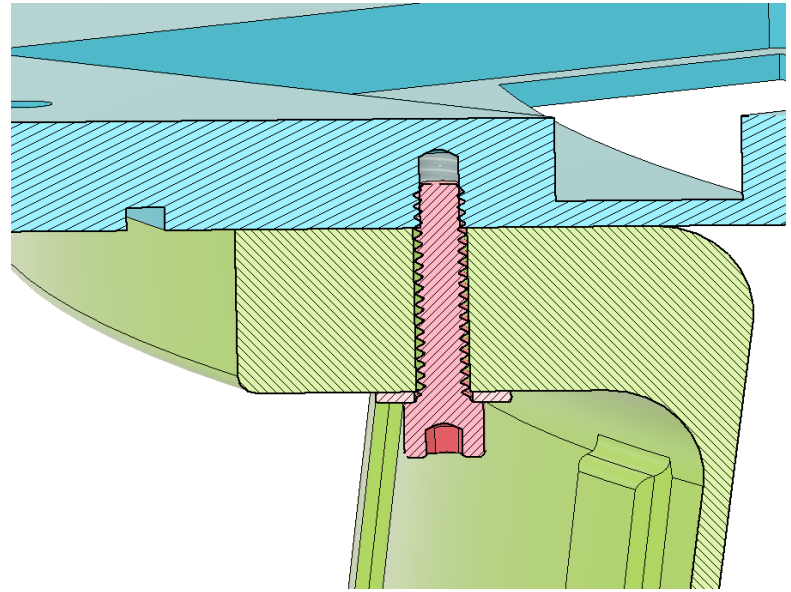
Pin Type	Dowel
End Type	Plain
Head Type	Tapped
Shaft Type	D-Profile
End Shape	Chamfered
System of Measurement	Inch
Material	18-8 Stainless Steel
Length	3/4"
Diameter	1/4"
Diameter Tolerance	0.0001" to 0.0003"
Thread Size	8-32
Min. Hardness	Rockwell C47
Breaking Strength	Not Rated
Tolerance Rating	Standard
Passivation	Not Passivated
Specifications Met	ASME B18.8.2
RoHS	RoHS 3 (2015/863/EU) Compliant
REACH	REACH (EC 1907/2006) (01/17/2022, 223 SVHC) Compliant
DFARS	Not Specialty Metals Compliant
Country of Origin	United States
USMCA Qualifying	No
Schedule B	731829.0000
ECCN	EAR99
Related Products	Puller Handles Tips Optional Extensions

In Practice: Outer Mirror

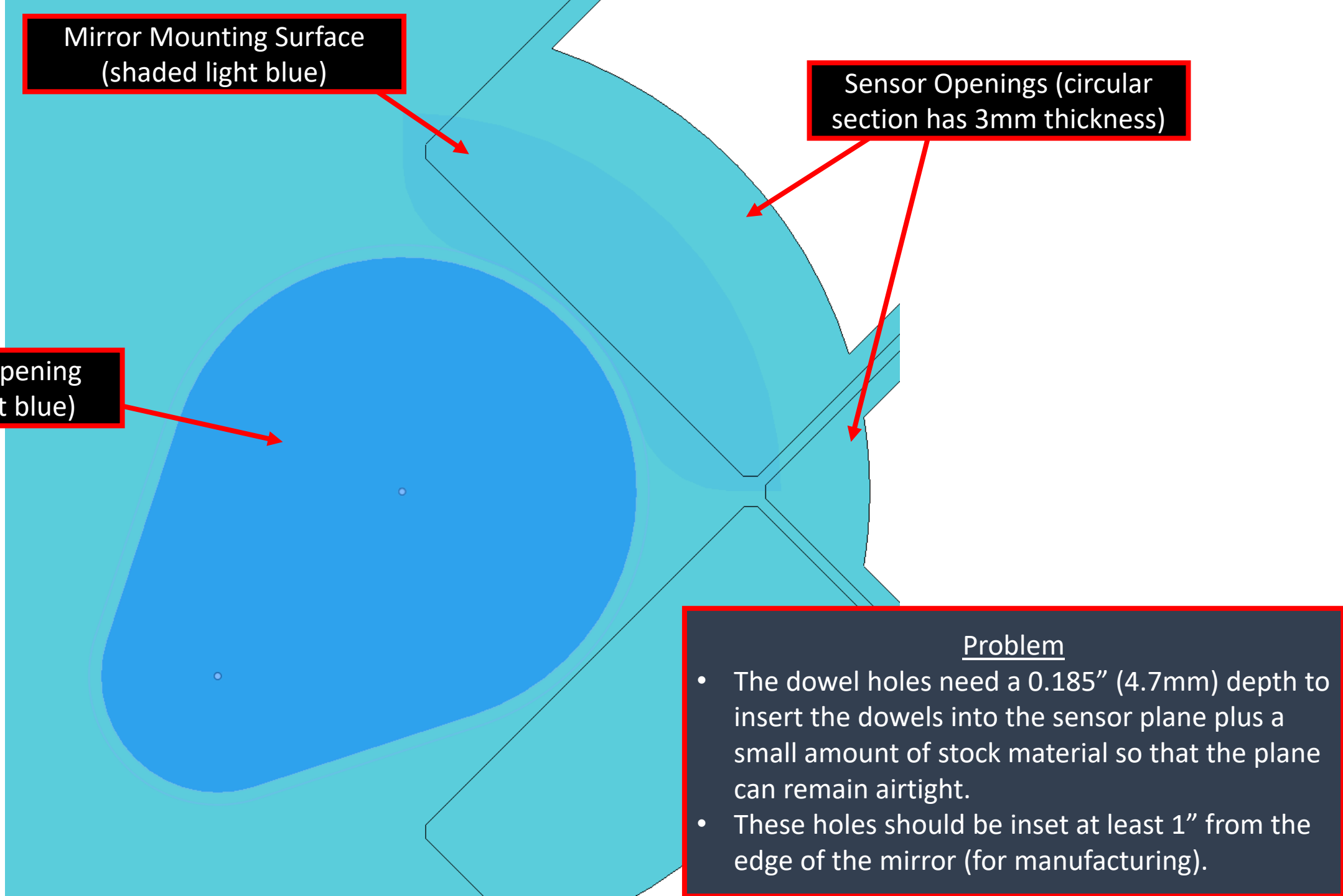








Inner Mirror:



Problem

- The dowel holes need a 0.185” (4.7mm) depth to insert the dowels into the sensor plane plus a small amount of stock material so that the plane can remain airtight.
- These holes should be inset at least 1” from the edge of the mirror (for manufacturing).

Inner Mirror Solutions

- Make the sensor plane universally thicker?
  - This effect would cause problems in Z-… either a shorter expansion volume or a smaller clearance for services between the pfRICH and the EEEMCAL
- Make the sensor plane locally thicker?
  - Physics issues as well as the additional complexity and cost of machining
- Affix the inner mirror to the inner beam pipe tube
  - Locational accuracy / perpendicularity to the sensor plane accuracy becomes less stable.
- HRPPD location?
  - Moving the HRPPD away from the beam pipe in order to create clearance for the mirror mounting would likely cause physics issues.
- Other solutions that I'm missing?
  - I'm open to suggestions…

Inner Mirror Solutions

- **For prototyping only:** we can create a larger flange by encroaching on the inner beam pipe tube (since it doesn't exist in the prototype version) solving the problem for now.
- The mirror cannot be segmented into 4 equal pieces for the final detector design anyway due to the geometry of the inner beam pipe tube.

Questions/Comments/Concerns?