Magnetic field and temperature monitoring in nTMM
Plan for testing cable assembly

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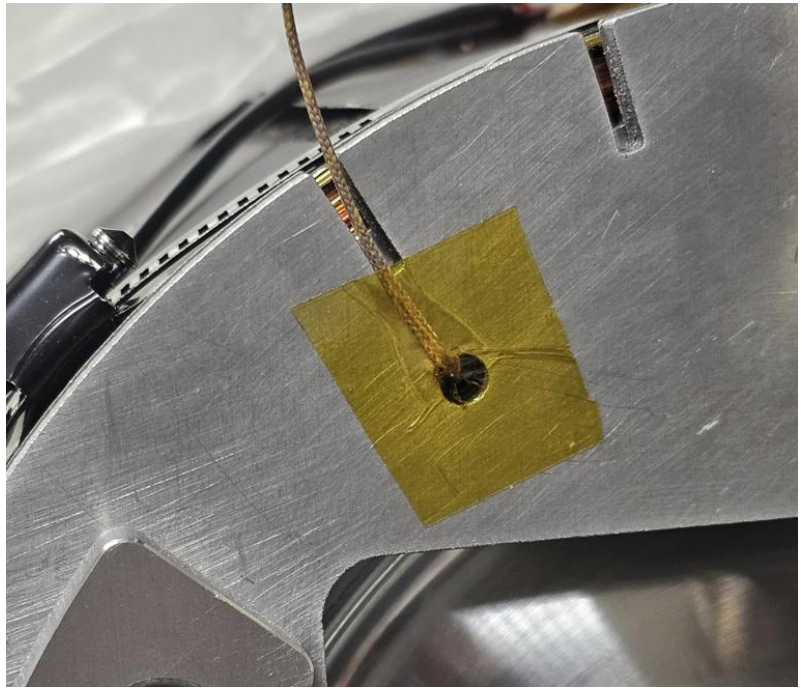
- nTMM experiment requirements : for $n \to n' \to n$ effect we expect regeneration peak in the detector counting above background at 26 Gauss. The natural width of the peak from Quantum Mechanics is ~ 0.15 Gauss FWHM. While scanning with magnetic field (by current) in the range from 25 Gauss to 27 Gauss we should choose steps smaller than the FWHM of the expected peak not to miss the effect. Our magnetic field step size should be 0.03 Gauss (i.e. 5 times smaller than FWHM). We should search for the effect at each value of magnetic field with one hour (or half hour ?) exposure. Thus, we need to make (27-25)/0.03 $\cong 69$ steps by 1 hour each.

- Stability of magnetic field (current, temperature) should be monitored to provide relative variation of parameters to be less than $0.03/25 = 0.0012$ (better than ~ 0.1%) for one hour run. This relative stability should be equally important in nTMM experiment for magnetic field and for density of gas inside the vessel.

Temperature monitoring. For constant-volume magnet vessel the gas density should remain constant.
Ideal gas EOS: $pV = \frac{m}{\mu}RT$ and density: $\rho = \frac{m}{V} = \frac{p\mu}{RT}$ - change of temperature changes pressure but not the density.
However, temperature variation changes the volume of Aluminum vessel and therefore the gas density:
$\Delta V/V = 3\alpha\Delta T$, where α is thermal coefficient of linear expansion of Al: $\alpha = 23 \times 10^{-6}$ /℃

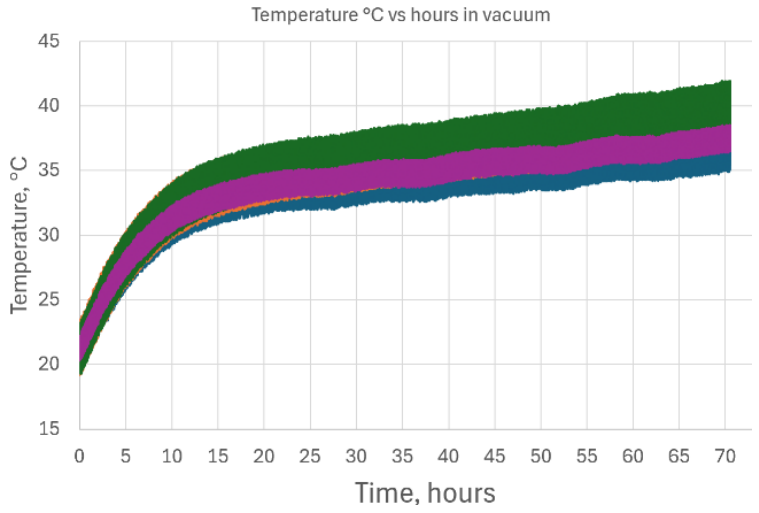
$$\frac{\Delta U_F}{U_F} = \frac{\Delta\rho}{\rho} = -\frac{\Delta V}{V} = 3 \cdot 23 \times 10^{-6} \cdot 1℃ = 6.9 \times 10^{-5}/℃$$

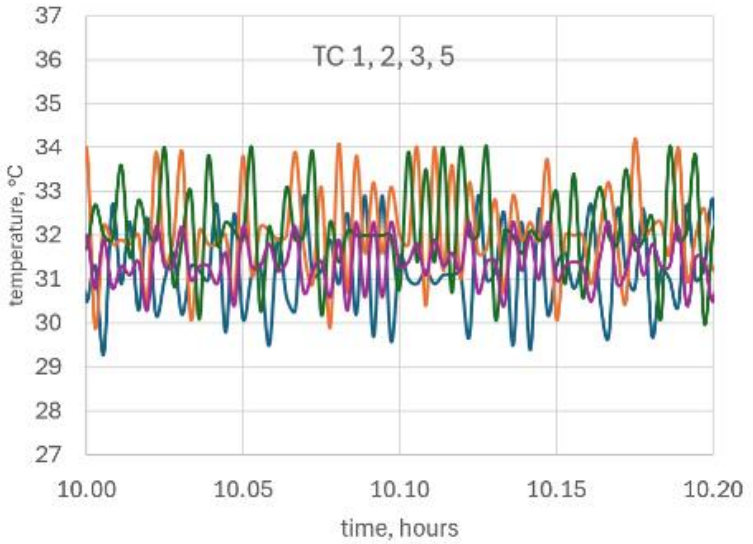
From last year tests at ORNL we expect that temperature of the magnet body with power dissipation ~ $24\ W$ in vacuum will rise by ~42℃ and might change by several ℃ during 25-27 Gauss field scan. We plan to install 4 thermocouples on the magnet flanges (2 on each side) and test this connection in Lab 211.



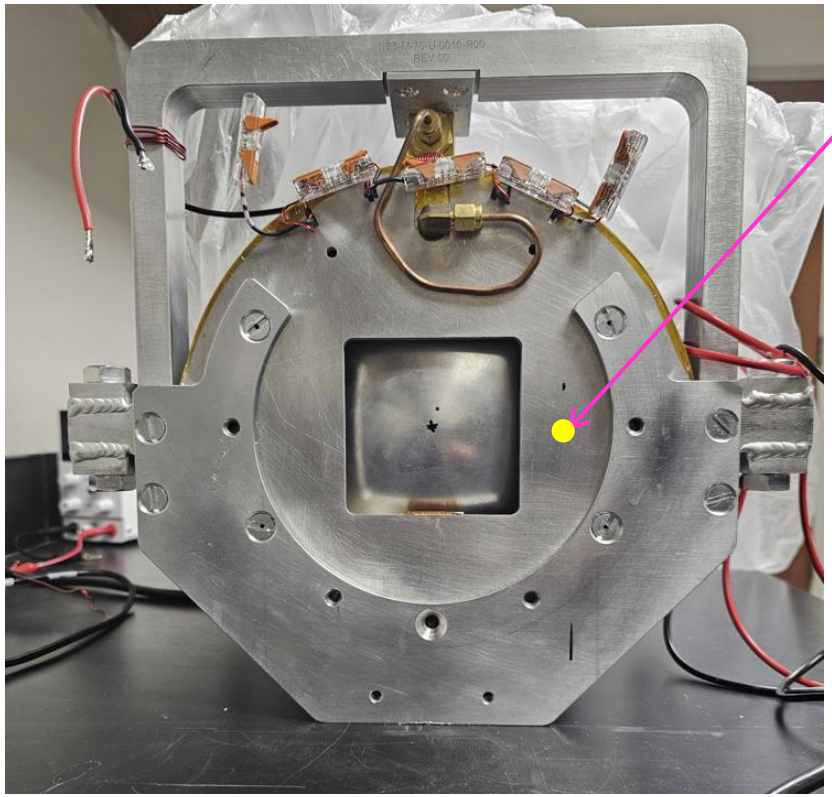
John : better use screws to provide thermal contact

During experiment at HFIR temperature will be recorded for 8 thermocouples by 8-channel data logger, that will store eight temperatures sampled every 10 s (interval is variable) for all duration of experiment. Logger is battery operated. Data in .csv format can be downloaded at the end.





Magnetic field monitoring. We can not put magnetometers inside the vessel to measure magnetic field ~ 26 Gauss. When we measure outside but close to the axis the field is ~ 6-9 Gauss, but we can not keep magnetometer on the axis in the neutron beam.

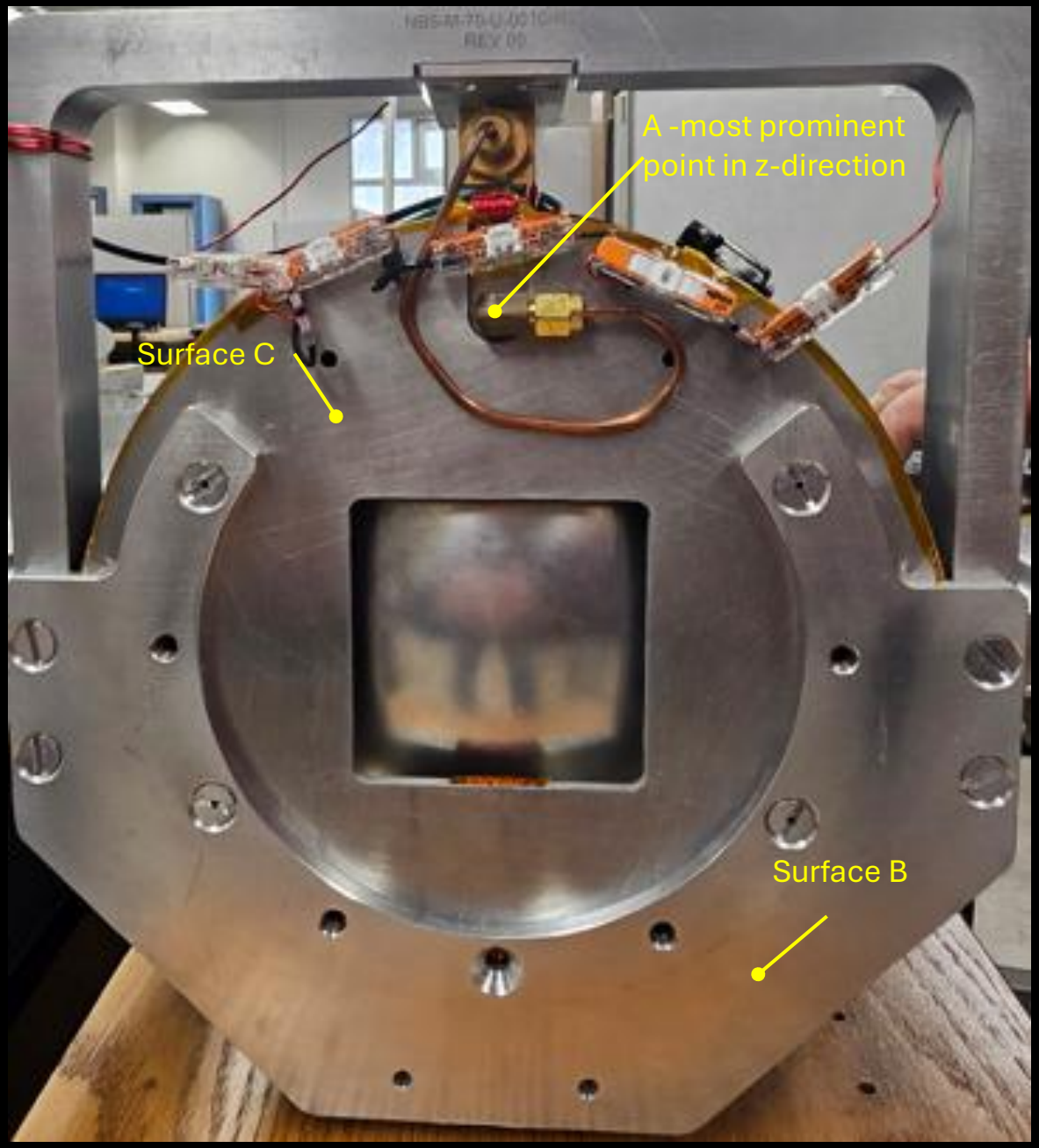


Axial field measured here as ~ 2.5 Gauss can be used for monitoring

We have two types of magnetometer (same physical size) and connector.

1. ±49 G range, 16-bit, Hall Effect (tested at UKY)
2. ± 4 (8,12,16) G, 16-bit, magneto-resistive (tested at UTK)

Readout via 4-wire cable through feedthrough to Raspberry Pi mounted on feedthrough (air side) with WI-FI connection to the server.



Measured distances along z – beam axis

A to C = 0.50”
A to B 0.25”

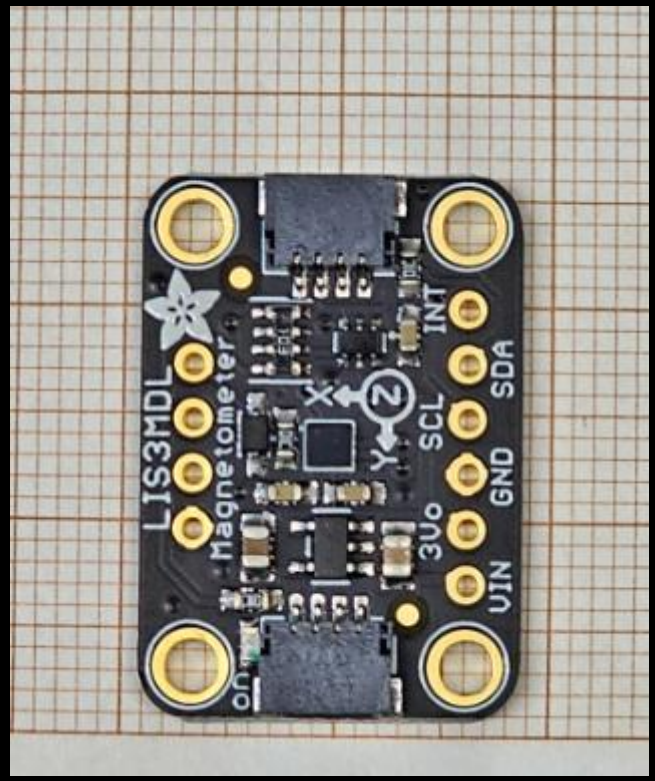
Magnet 2, US

90 mm

Al plate
1/8” thick

Magneto-
meter
(behind
the plate)

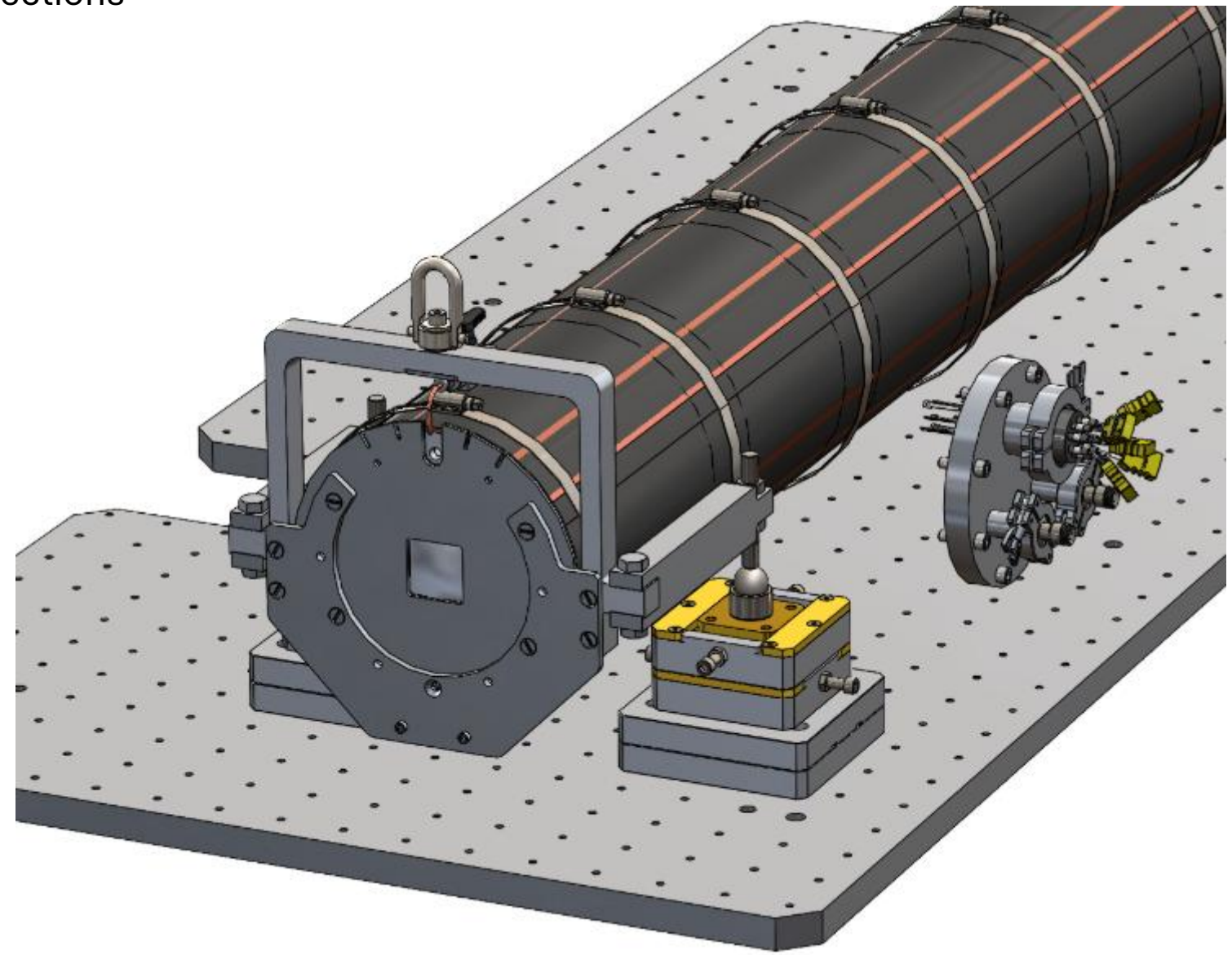
Similar Al
screw

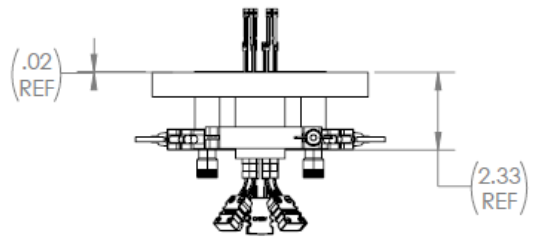


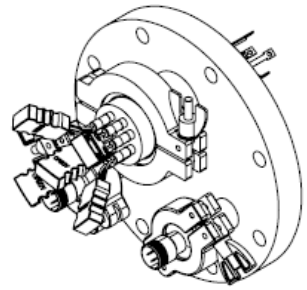
New Project for 211 Lab

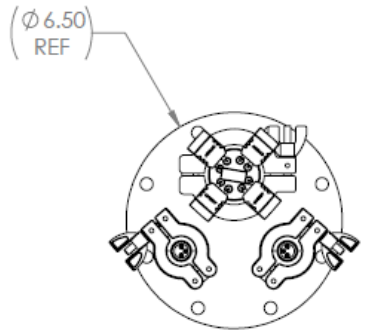
Prototype and test all magnet connections through feedthrough flange.
Connections per magnet:

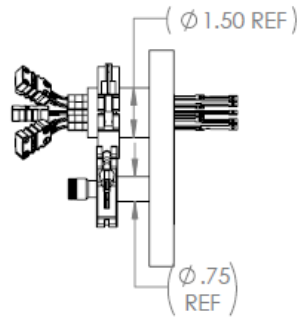
- main magnet current (2)
- main coil degaussing (2)
- side coil degaussing (2)
- thermocouples (4 pairs)
- magnetometer (4)

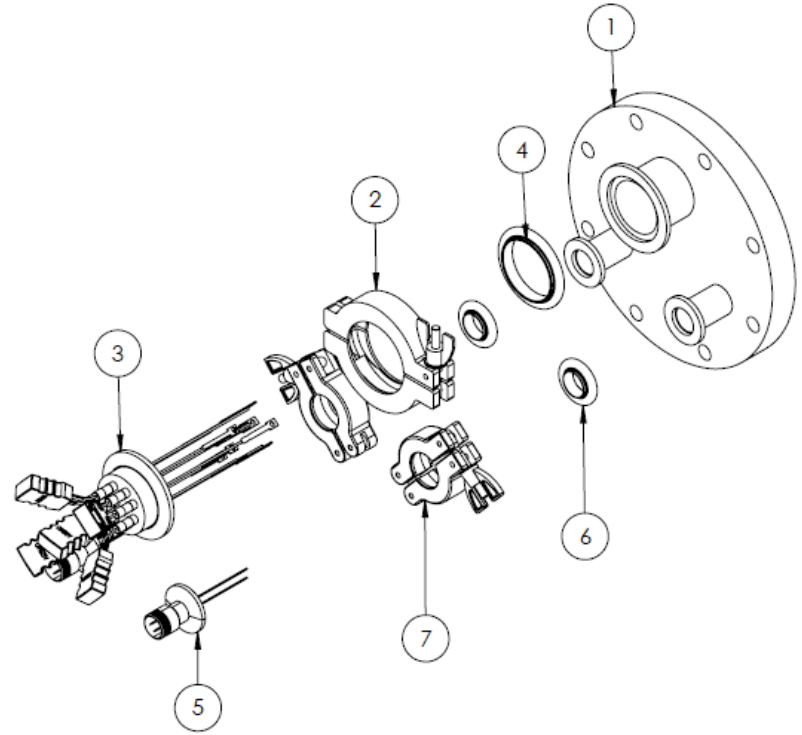












ITEM NO.	PartNo	DESCRIPTION	QTY.
1	NB5-M-70-U-0037-R00	GP-SANS FEEDTHROUGH WINDOW	1
2	QF40-150-C (LESKER)	CLAMP,ALUMINUM,QF40,CAST 1-1/2"	1
3	TFT5KY00008B (LESKER)	THERMOCOUPLE FEEDTHROUGH, SINGLE ENDED, 5 PAIR TYPE K, MINI PLUG STYLE ATM CONNECTOR, MOUNTED ON A QF40 FLANGE	1
4	QF40-150-ARB (LESKER)	CENTERING RING,ALUM,QF40,BUNA	1
5	A1622-1-QF (MPF PRODUCTS)	MULTIPIN FEEDTHROUGH, 3 PINS, 500 VOLTS, 3.5 AMPS PER PIN, 0.032" DIA CONDUCTORS, 1.18" QF / KF FLANGE	2
6	QF16-075-ARB (LESKER)	CENTERING RING,ALUM,QF16,BUNA	2
7	QF16-075-C (LESKER)	CLAMP,ALUMINUM,QF16,CAST 1/2" & 3/4"	2

PHYSICS DIVISION

OAK RIDGE NATIONAL LABORATORY
OAK RIDGE, TN 37831

DIMENSIONS ARE IN INCHES
TOLERANCES UNLESS SPECIFIED:
ANGULAR: ±0° 30'
TWO PLACE DECIMAL ± 0.01
THREE PLACE DECIMAL ± 0.003
SURFACE FINISH: 128 MICRO-INCH MAX ALL MACHINED SURFACES
BREAK ALL SHARP EDGES

MATERIAL
SEE BOM

NEXT ASSEMBLY
NB5-M-70-U-0001-R00

	NAME	DATE
DRAWN	Isaiah Wallace	Digitally signed by Isaiah Wallace Date: 2024.10.07 13:48:48 -04'00'
CHECKED	John C. Ramsey	Digitally signed by John C. Ramsey Date: 2024.10.07 13:55:25 -04'00'
APPROVED	Yuri Kamyshkov	digitally signed by yuri kamyshkov Date: 2024.10.07 14:02:07 -04'00'
REVIEWED		

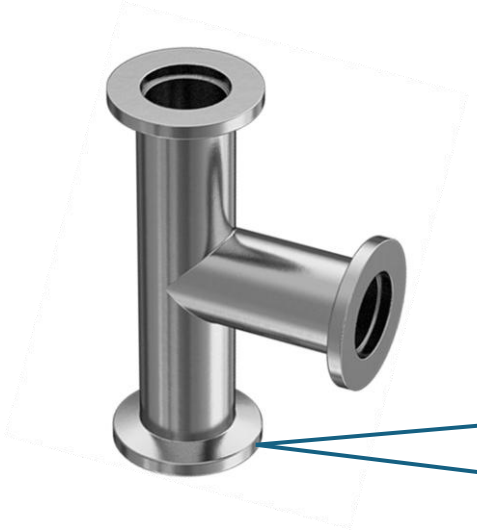
COMMENTS:

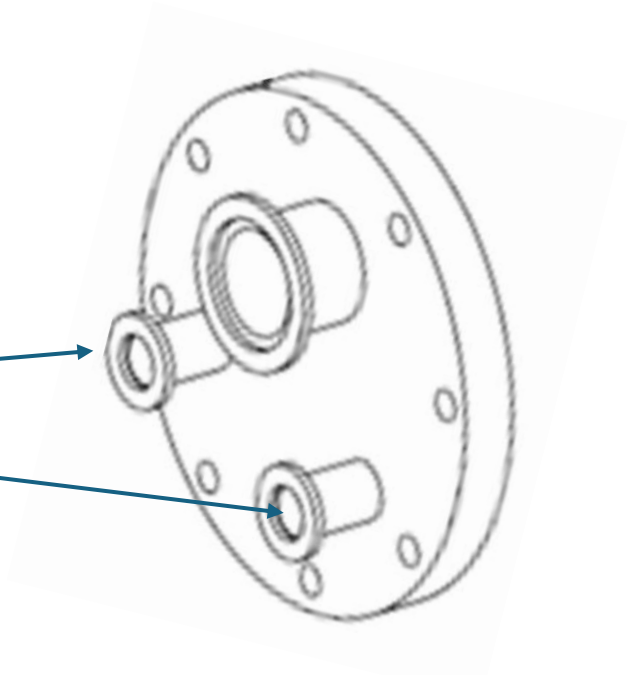
nTMM@HFIR

NB5-M-70-U-0036-R00 (GP SANS WINDOW ASSEMBLY)

SIZE	DWG. NO.	REV.
B	NB5-M-70-U-0036-R00	00

SCALE:1:3 | WEIGHT: 3.10 LB | SHEET 1 OF 1





Matt: use “80/20”
Al extrusion instead