Tritium Target Design

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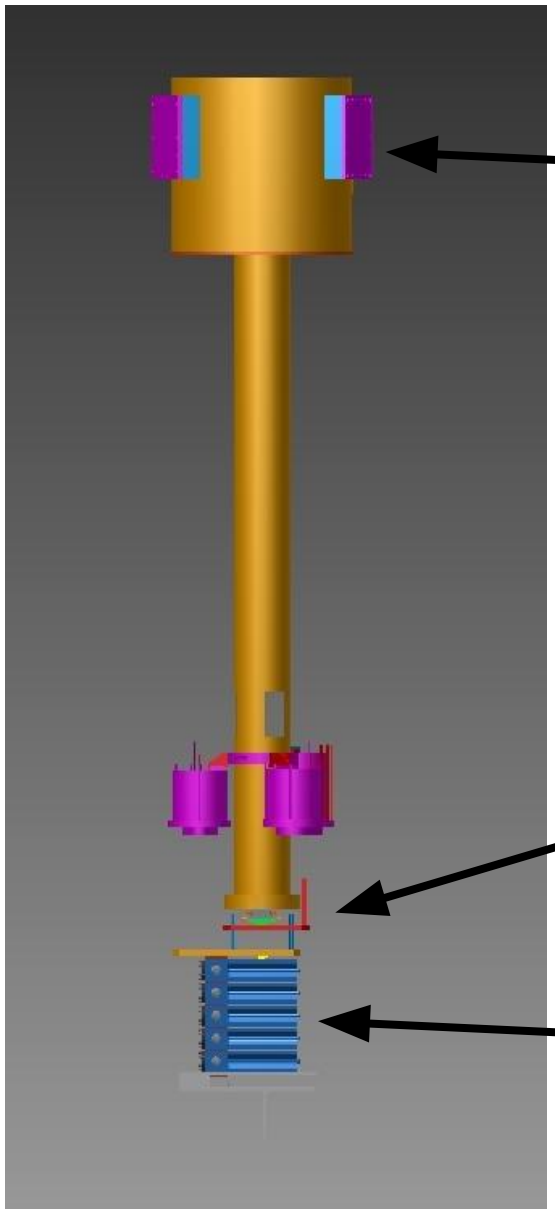
Basic Design

- Target Cells
  - New sealed cells with gas only
- Positioning system/cryostat
  - Reuse the Hall A target lifter and positioning system
  - remove loops and cells
- Scattering chamber
  - Reuse the current Hall A scattering chamber
  - Might be close for 12.5 deg
- Vent system
  - Stack for T2 release
  - All pumps and exhaust systems to be connected
  - Active fan powered vent
- Beamline
  - FSD on raster
  - Collimator
  - Be isolation window

Complete target stack



Cryostat

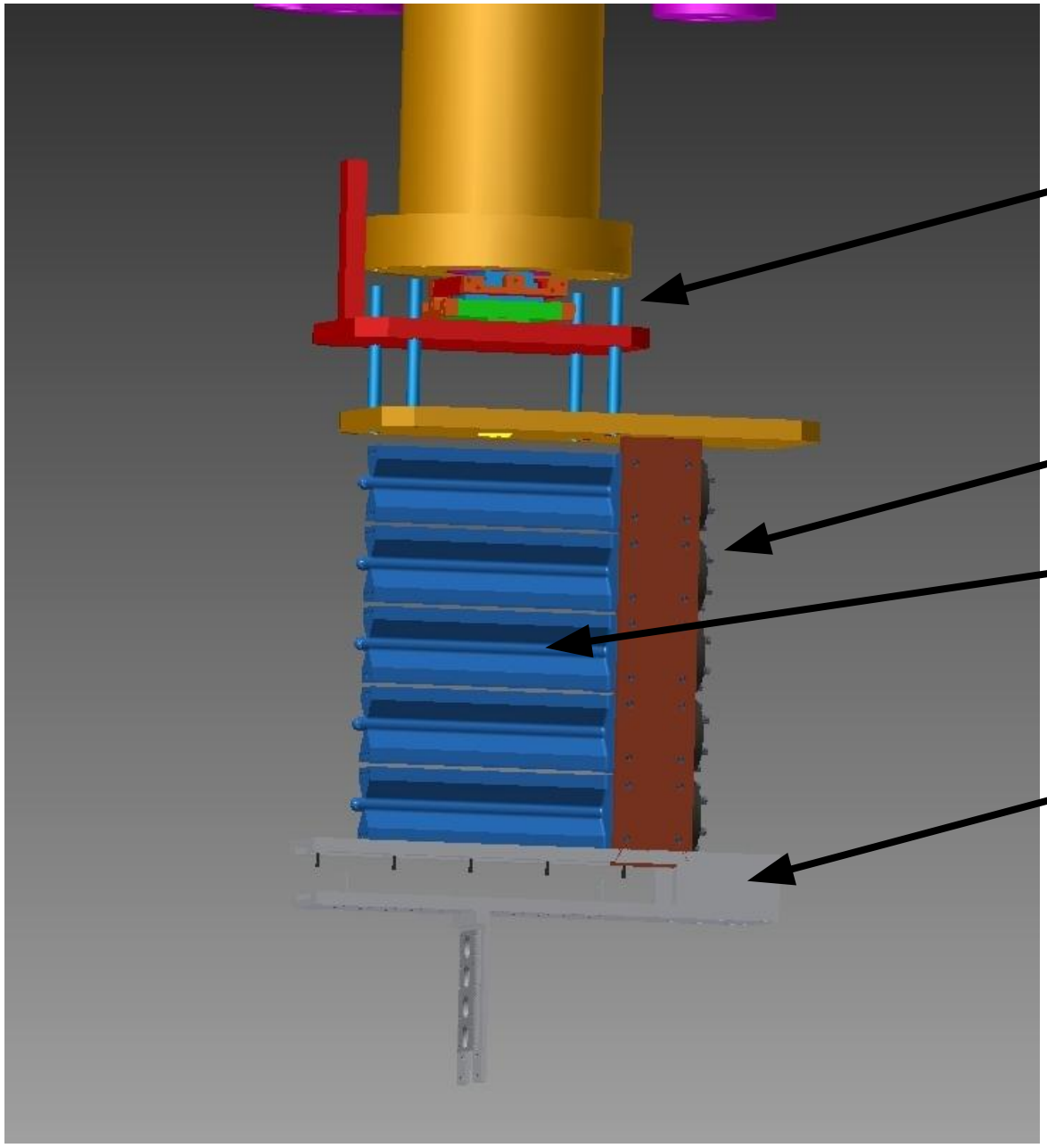
- Use 15K He from ESR to stabilize and cool the cells.
- Use the standard cryotarget cryostat for this

Positioning system

Target Stack

Target Stack

- 5 cells mounted to heat sink
  - T2,D2,H2,He3,MT
- Stack mounted to heat sink
  - Heat sink is cooled with 15K He from ESR
  - Drop lines from HX taps to heat sink
  - Heat sink is temp stabilized at ~35K
  - Other loops can be used as bypass
- Alignment solid and optics targets
- Positioned with cryotarget system
  - Alignment prior to vacuum and cool down ~0.25 mm
  - Target may move ~2 mm
- Total stack height is ~24 inches


Adjuster
Cu Heat sink
Cells
Solid Targets

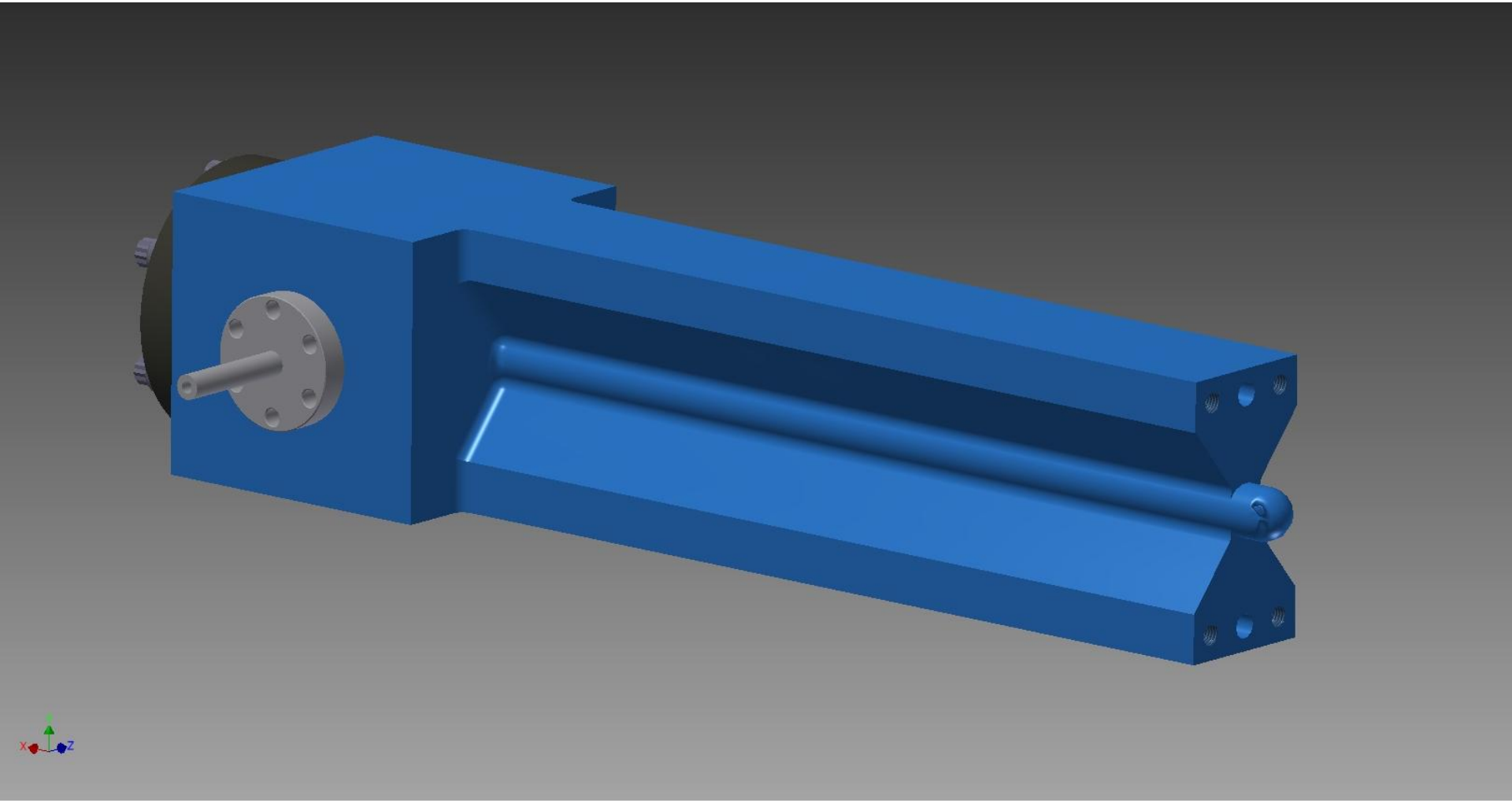
Target Cells

- Challenging machine work: Rutgers/JRP Machine
  - Made from Al 7075-T651
  - Swagelok valves (metal bellows)
  - VCR fill ports
  - Extensive H2 service at JLAB
- Entrance windows attached with CF flange
  - No welding
- Design Pressures
  - T2: 200 psi
  - Others: 375-400 psi
- Contains 1 kCi of T2
- Window thicknesses
  - Entrance: 0.01 inch
  - Exit: 0.011-0.018 inch
  - Wall 0.018 inch
- Latest design is more machinable

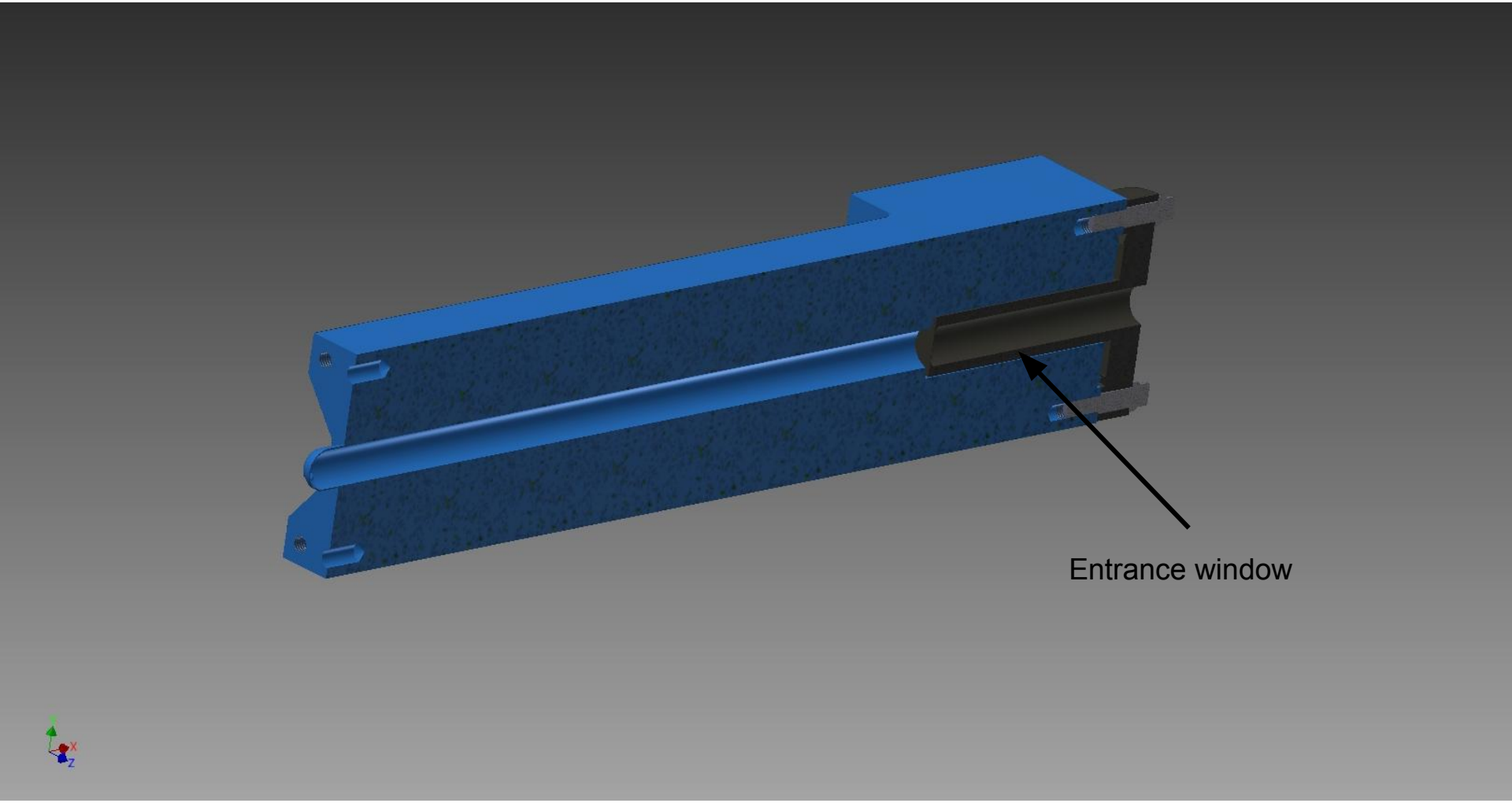
Cell Thicknesses

Cell	Thickness (mg/cm^2)	Pressure (psi)
T2	82	200
H2	55	400
D2	111	400
He3	82	400

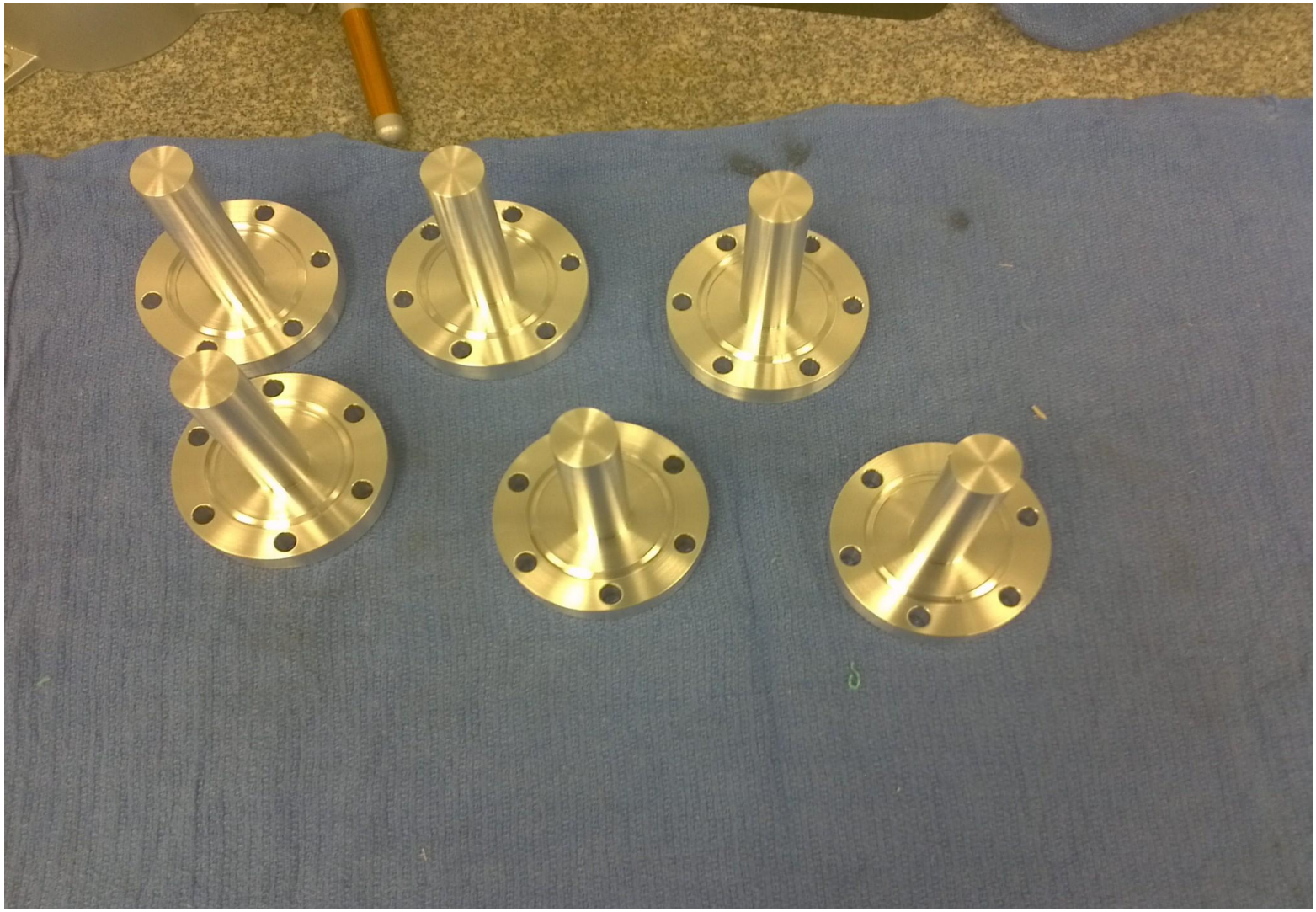
New Cell Design



Section View of Cell

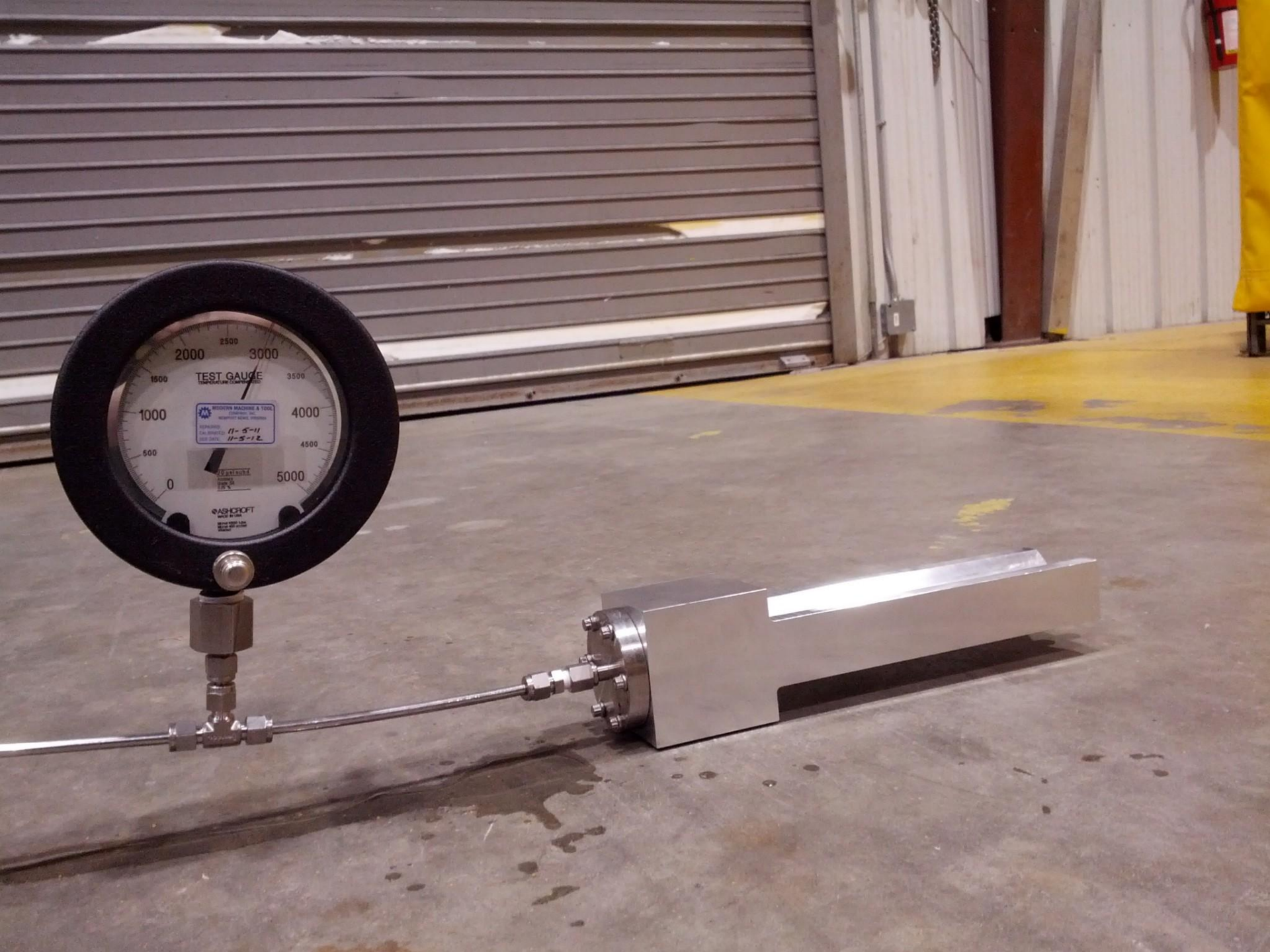


Entrance windows

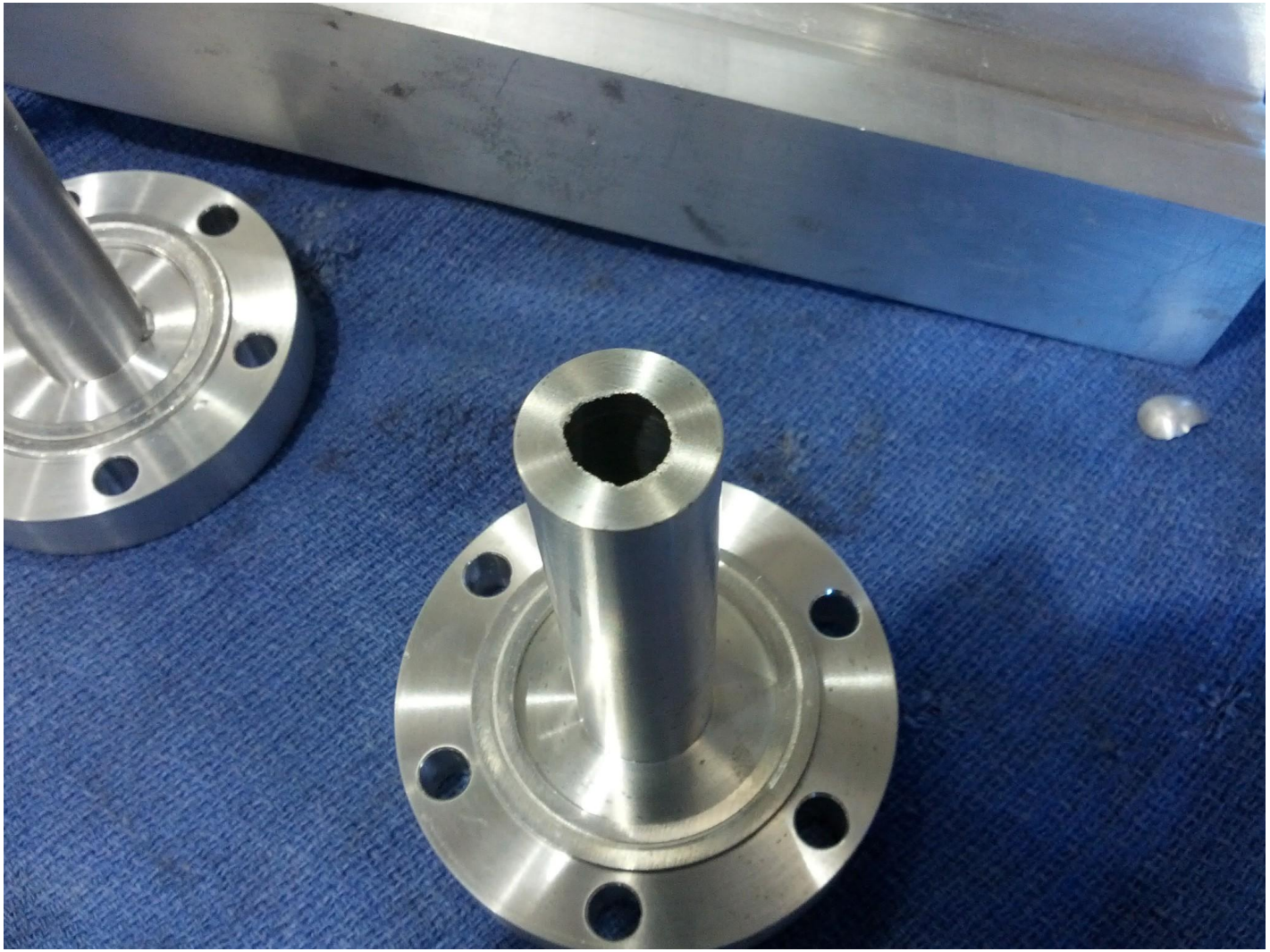


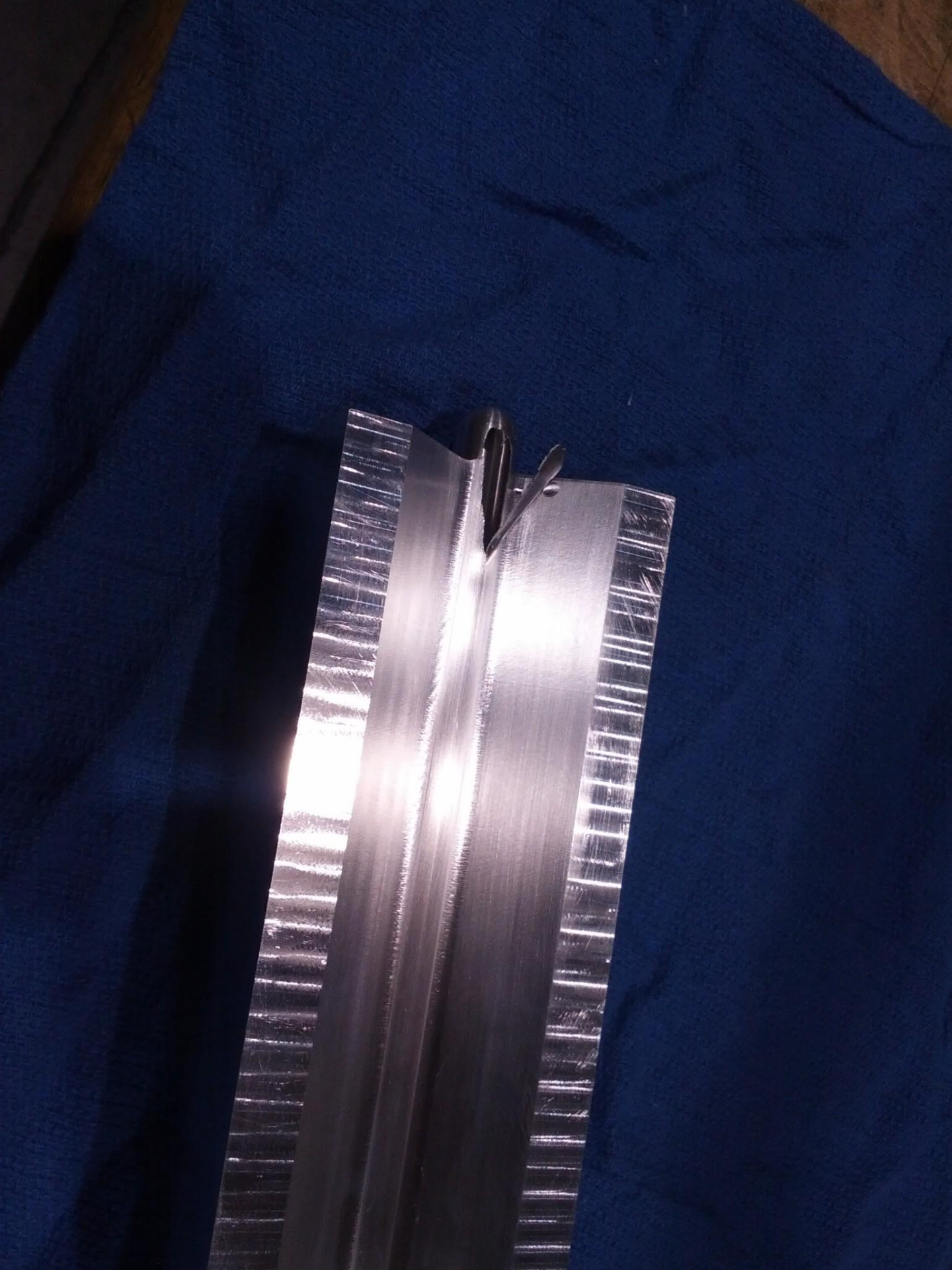
Pressure test of new cell

- Cell wall thickness at thinnest point was 0.014 inch
- Main cell body burst pressure above 3500 psi
  - Factor of ~10 for safety
  - Account for cyclic temperature/pressure loads
- Entrance windows
  - Burst Pressure ~2900 psi


TEST GAUGE
2000
3000
1000
4000
0
5000
ASHCROFT

Cell Entrance Window

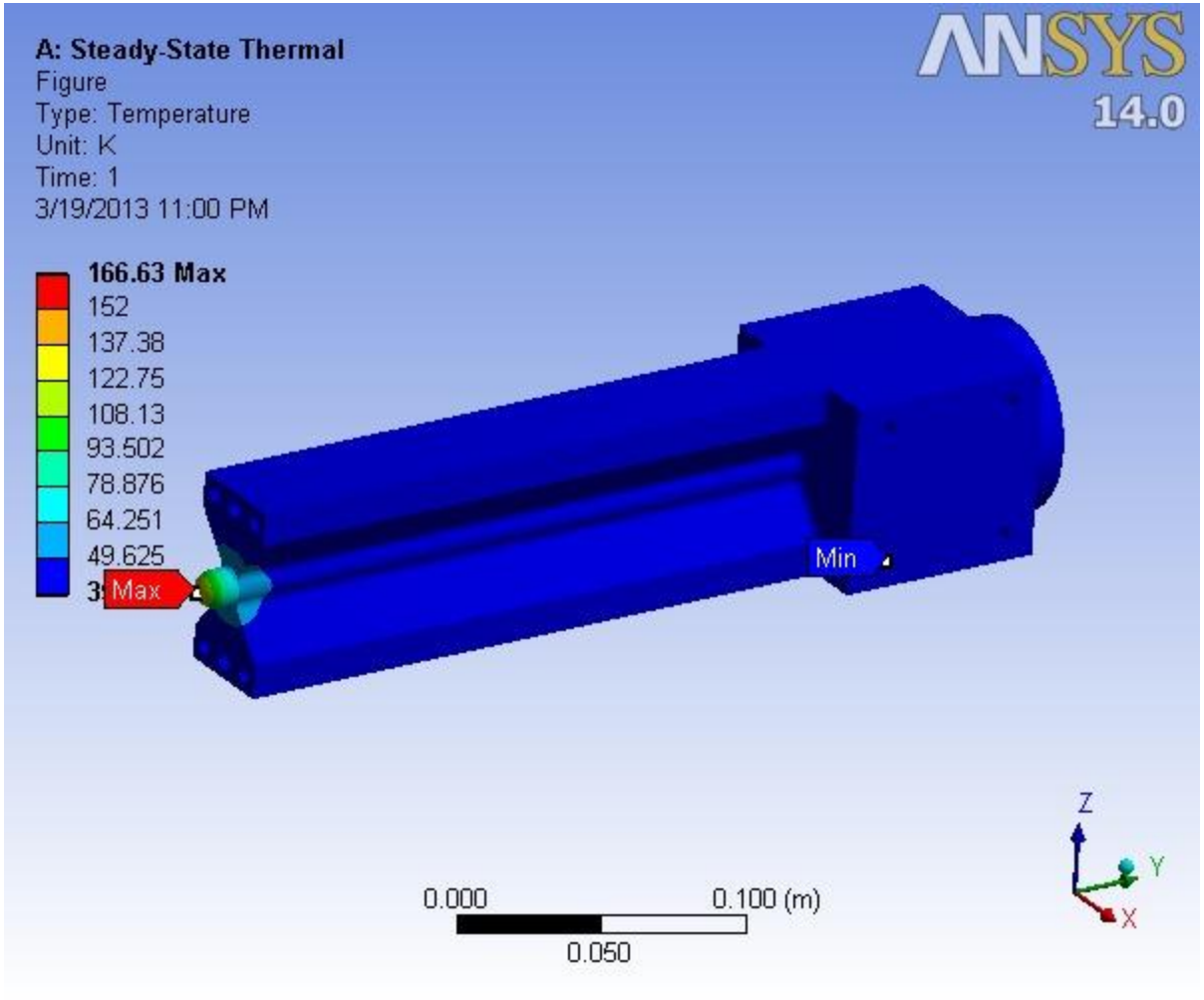




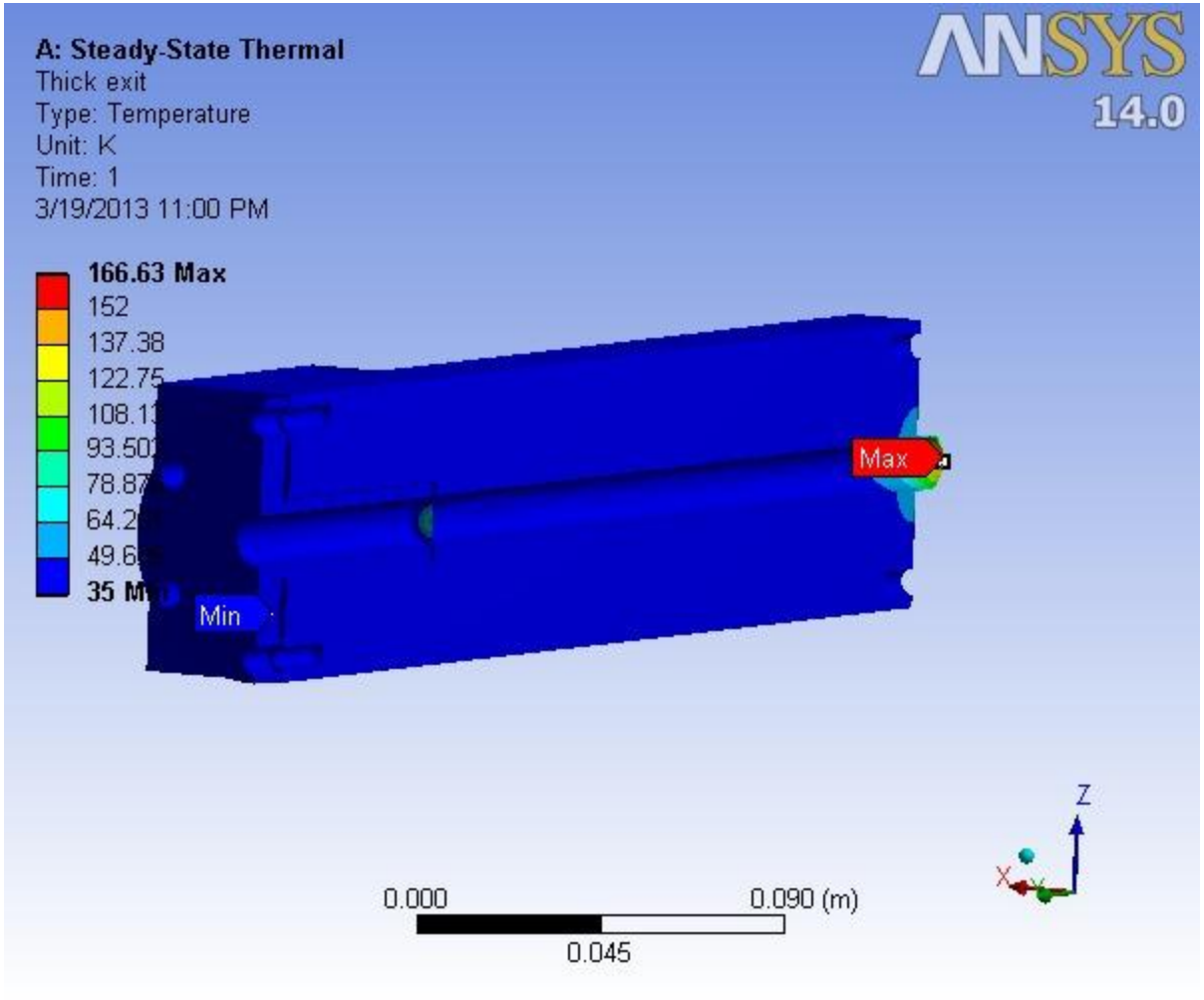
Thermal and Mechanical Analysis

- Mechanical analysis:
  - ASME VIII D2 Part 5 analysis
  - Elastic plastic model
  - Shows safe design
- Thermal Design
  - Not as effective for the newer cell
  - Max temp exceeds 160K for 35K heat sink
  - Older design ~90K
- Propose to thin exit window
  - Thin by hand work
  - should reduce heat at exit
  - no real impact on mechanical properties

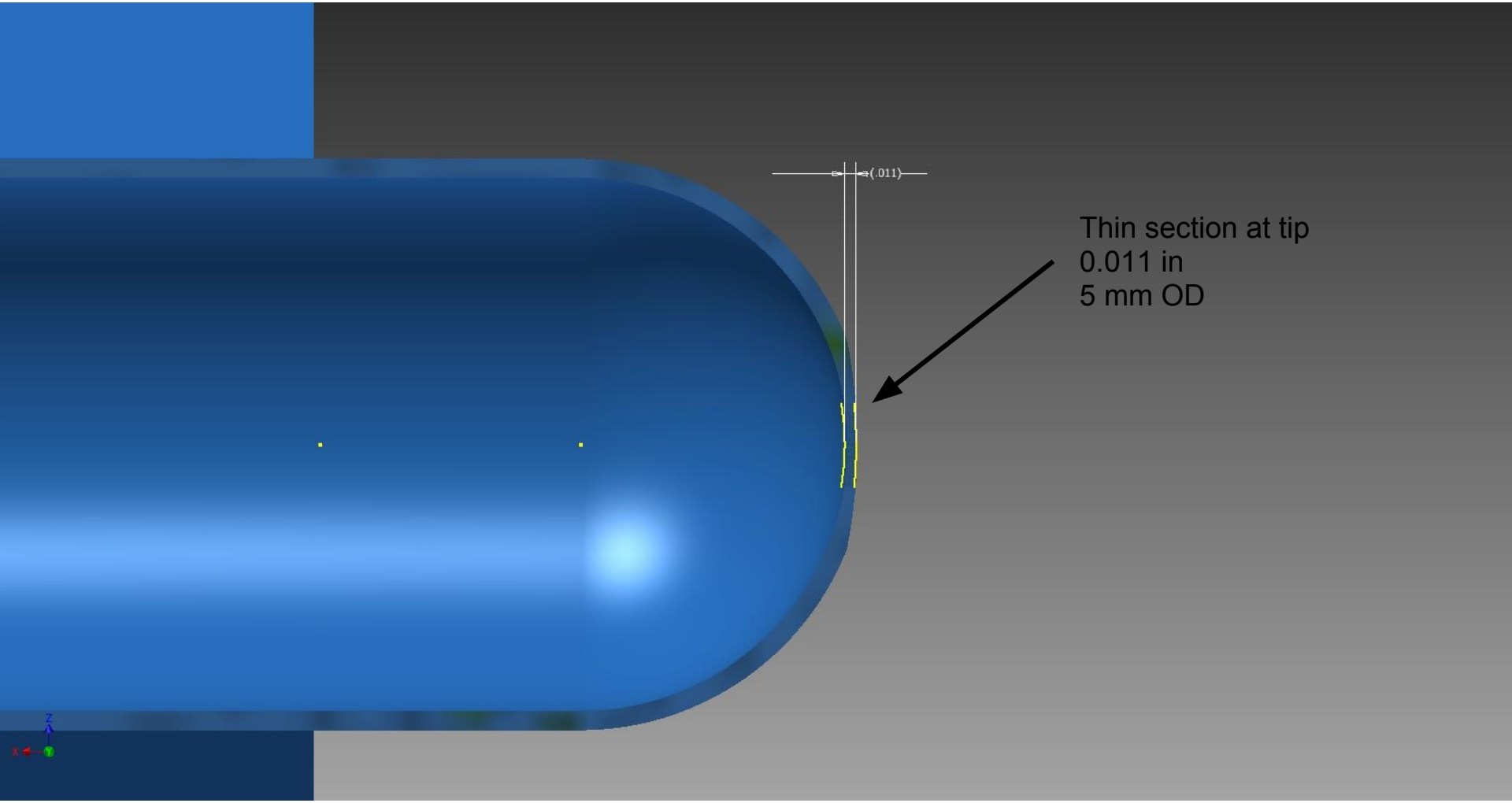
Thermal analysis of thick style cell



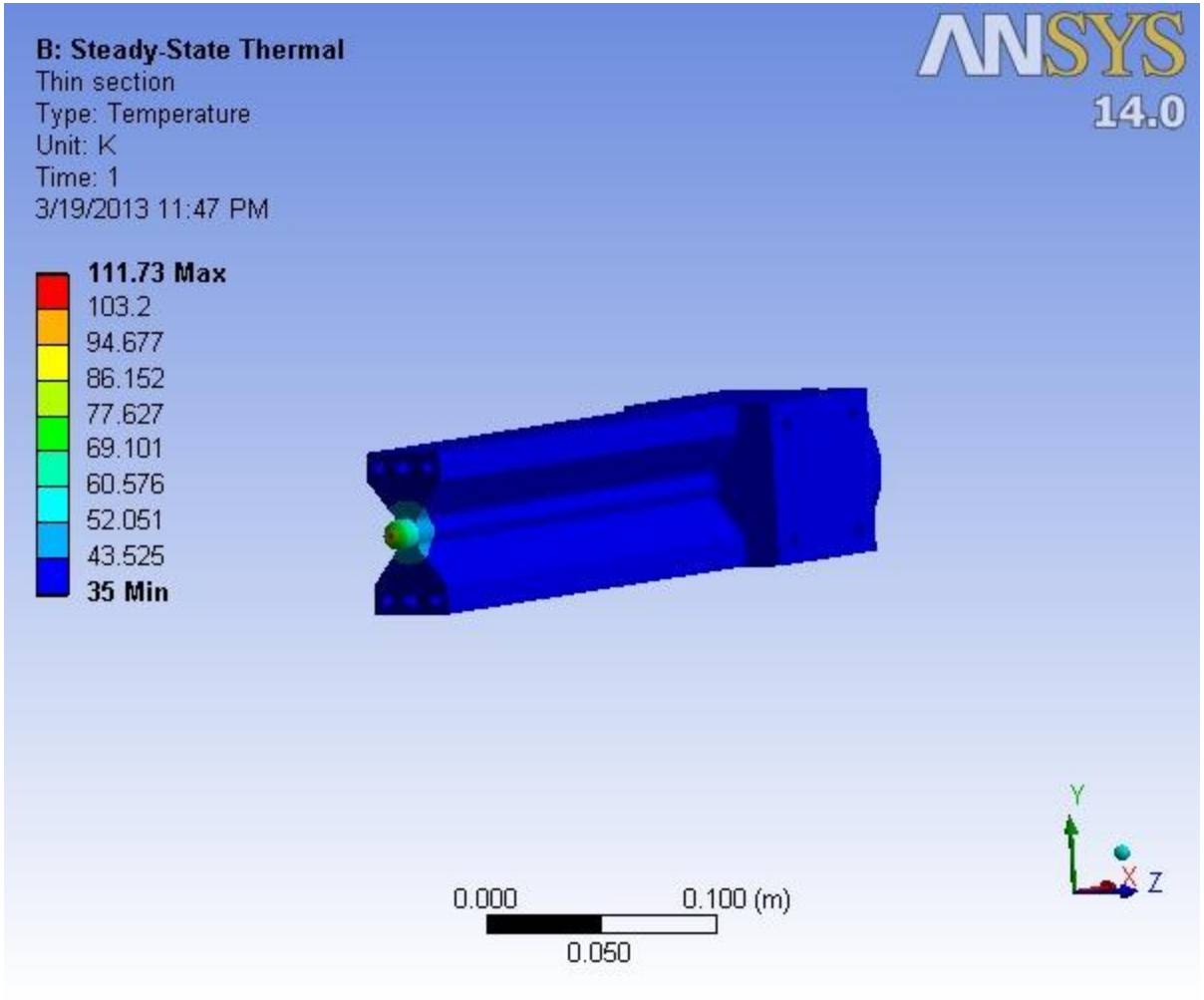
Section view of thick cell



Thin Section



Thermal model for thinned cell



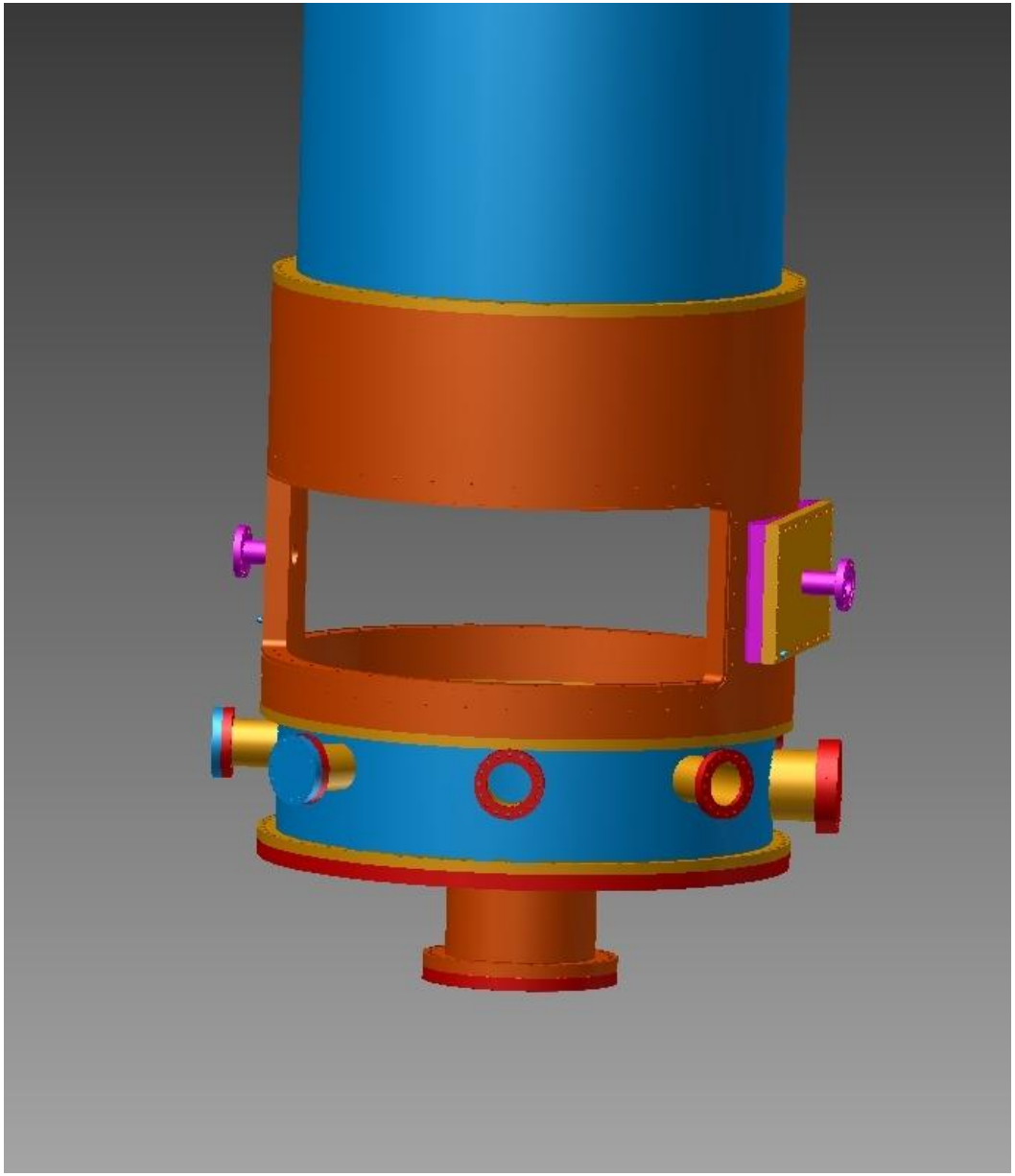
Filling Cells

- Tritium cell
  - Fill at SRS
  - They have agreed to look into filling the cell
    - Design must be reviewed and tested by SRS
    - Their engineering safety plan must include this operation
  - Hung up on shipping
    - BTSP (Bulk Tritium Shipping Package)
    - Can we be a receiver of T2
  - Are we approved to receive T2 or can someone else do this
- Other cells can be filled at JLAB

Scattering Chamber

- Pumps vented to outside stack
- T2 detection in scattering chamber
  - RGA with remote head for low P
  - High pressure ???
- Reuse the Hall A Target Chamber
  - Saves considerable money
  - Reuse could contaminate the chamber
    - It is activated already
    - Decon by pumping for ~ 1 month
  - Scattering angle limit of ~12.5 deg
- Require a hood system connected to vent

Scattering Chamber



Vent Stack(s)

- External stack(s) of ~20m
  - Civil/Facilities/Hall A Support needed for design/construction
  - One line for pump/scattering chamber
  - One line for "handling hut"
  - Route to back of Hall and out existing penetrations
- Vent piping system connected to stack
  - Detection in piping for T2
  - Air flow connected to FSD
- Forced air/purged
  - Extraction fan for handling hut
  - Purge for pump line
    - existing for cryotarget

Beamline

- Require FSD on Raster
- Beamline isolation
  - Design by accelerator personnel
  - Fast valve(s) or "window"
- Collimator
  - Prevent miss steer and cell damage
  - Design by accelerator
- Best place for extra components
  - last girder
- Hall A beamline liaison: Yves Roblin
  - feels that these requests are reasonable
- Offered design help

Outstanding Issues

- Tritium source
- Stack and plan for handling tritium cell need to be formalized
- Requirements for beamline and scattering chamber must be formalized
- Detection of T2 in the Hall must be formalized
  - Baseline
  - Low pressure we have
  - High pressure ???
- Prepare for test at ISU
  - Does this test have meaning?

Summary

- Safety review occurred June 2010
  - Most of the issues raised have been addressed
- Outstanding issues include
  - T2 cell filling
  - Vent stacks
  - T2 monitoring
  - beamline protection
- Plan to have new review in FY14