LiH Absorber R&D

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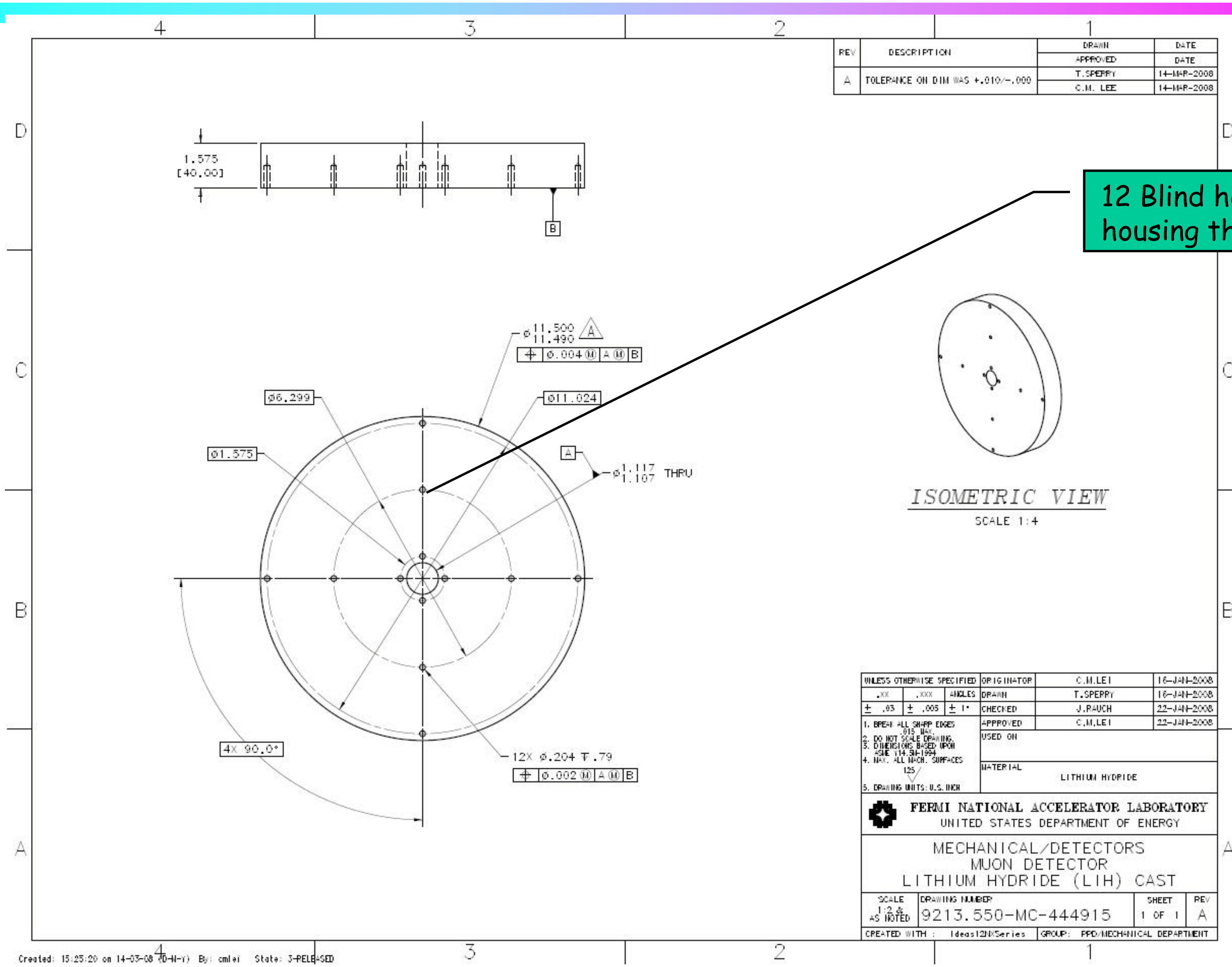
LiH Absorber in Cooling Channel

- LiH absorbers are now the "baseline" for the initial 4D cooling
  - Replaced LH_2
- The issues have to do with the material properties of LiH
  - Thermal characteristics
    - Thermal conductivity
    - Stability
  - Radiation Stability
- Program Goal
  - Test Thermal properties of Hot-Isostatic Pressed LiH
    - Claimed to yield material with 98%+ theoretical density
    - Best thermal conductivity

LiH Disc Fabrication

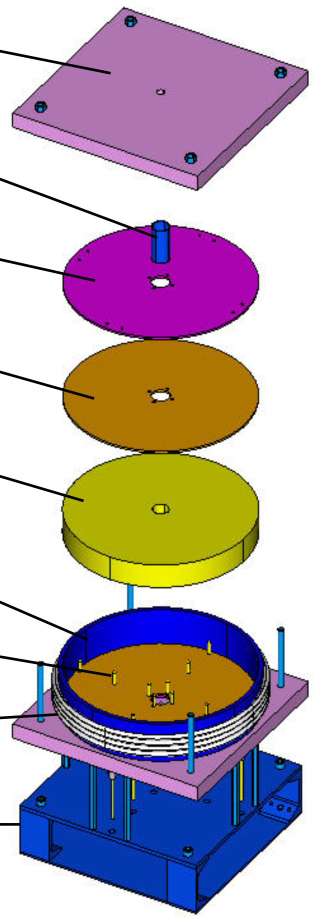
- Subcontracted for production at Y12
  - Produced by Hot Isostatic Pressing
  - Produced using existing mold design
  - Mechanical properties of final parts will be measured
    - Density, hardness, etc
  - Final Parts to be chemically tested
  - X-Rayed by Radiography to ensure no voids
  - Machined to size
  - Dimensional inspection
  - Coated with vapor barrier
    - Process steps STILL under discussion and Need to be finalized
  - Packaged in drum type container
  - Shipped to FermiLab via Fed-X
- Production will consist of
  - 30 and 50 cm diameter disks (+2" disks for destructive testing)

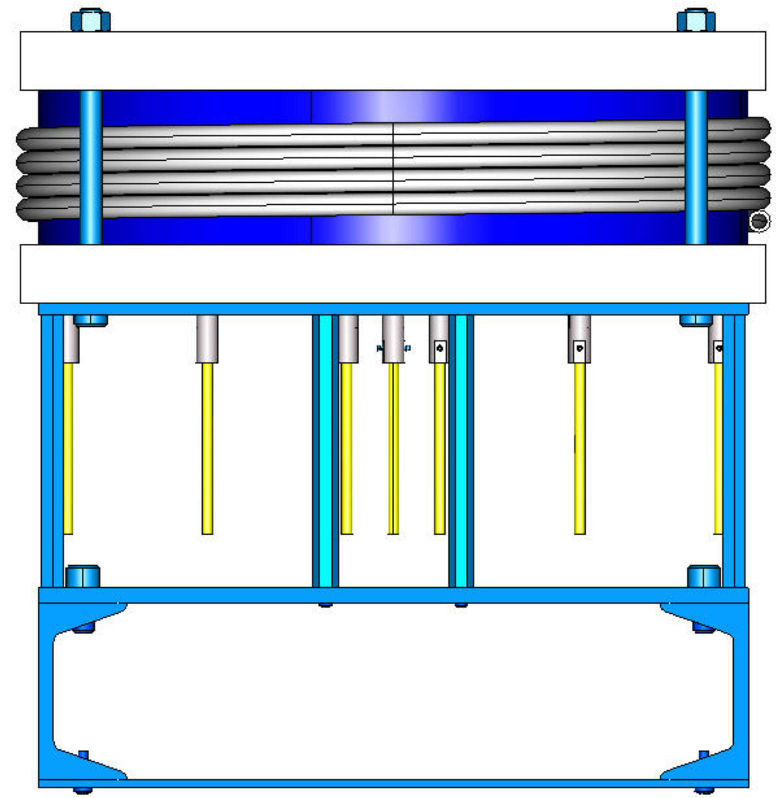
Instrumented 30 ∅ cm Disk



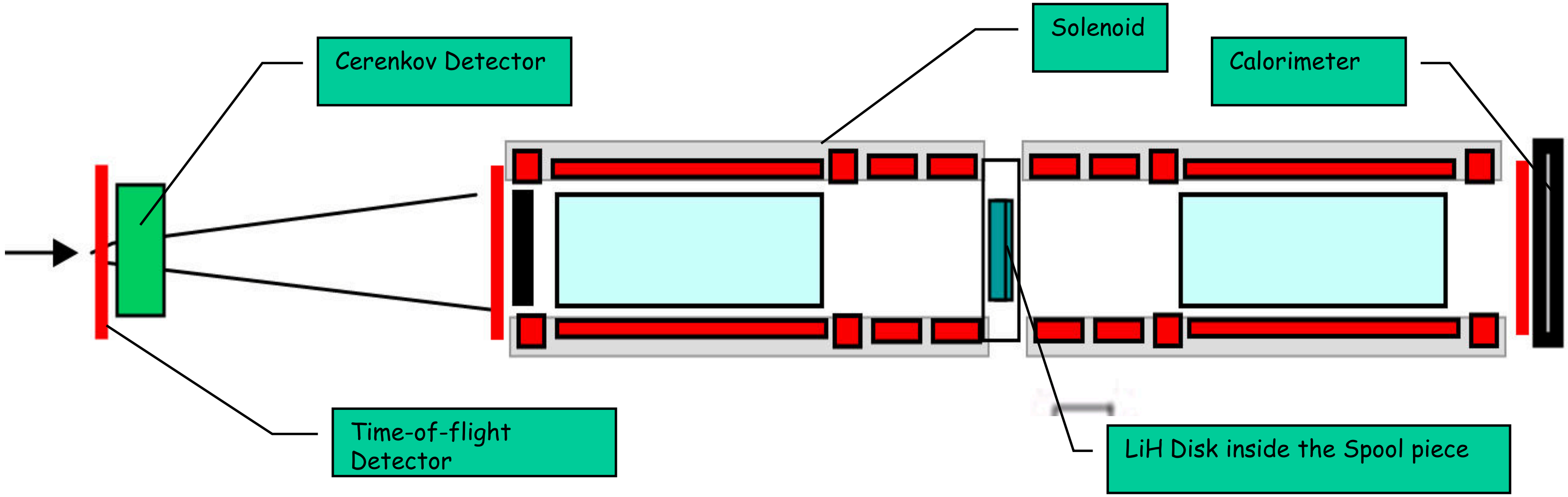
12 Blind holes for housing thermo-couples

Thermal Measurement Test Setup



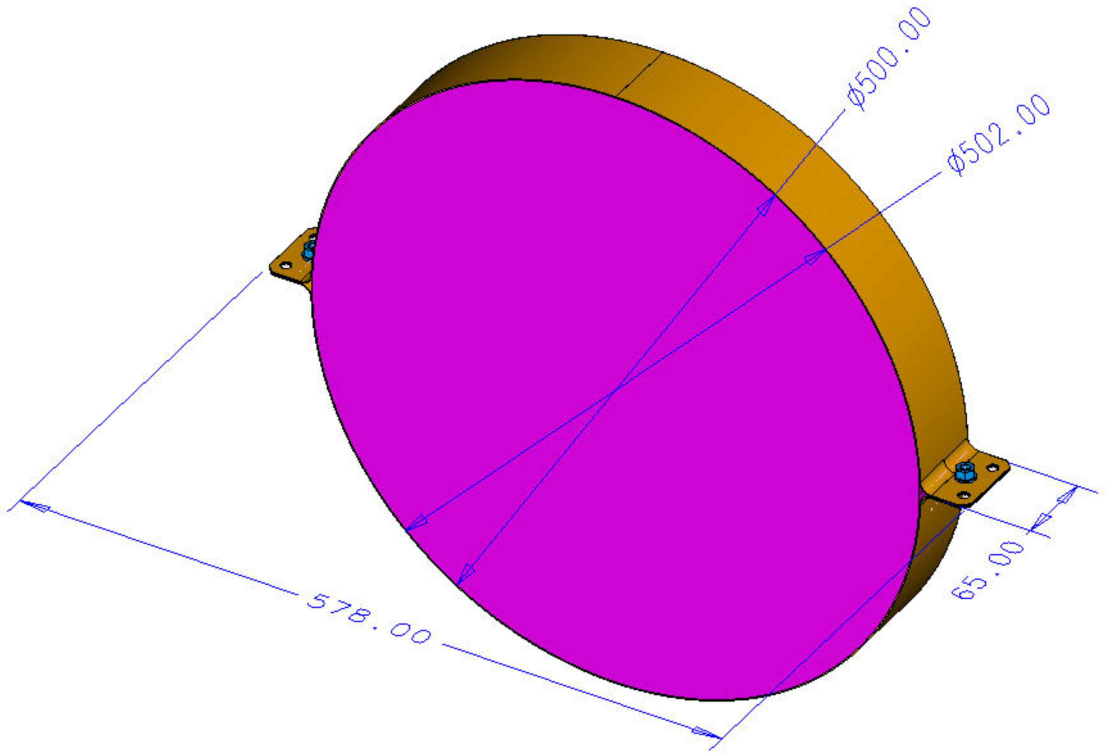


MICE Step III.1



- Produce 50 cm ∅ X 6.5 cm thick disk for MICE for first "cooling" measurment

LiH Absorber for MICE Step III.1



Status of Negotiations with Y12

- All the technical specifications and production issues are resolved
- The only outstanding issue was coating the parts with a water vapor barrier
  - Parylene C (Preferred)
  - Epoxy
- The coating is a safety issue only
  - For both Fermilab and RAL
- But has led to a protracted discussion because of cost

Parylene C

- **Provides 10X better vapor barrier than epoxy**

Table 3. Parylene Barrier Properties

Polymer	Gas Permeability at 25°C, (cc·mm)/(m²·day·atm)[a] N_2	O_2	CO_2	H_2	Water Vapor Transmission Rate (g·mm)/(m²·day)
Parylene N	3.0	15.4	84.3	212.6	0.59[b]
Parylene C	0.4	2.8	3.0	43.3	$\boxed{0.08}$[c]
Parylene D	1.8	12.6	5.1	94.5	0.09[b]
Parylene HT	4.8	23.5	95.4	–	0.22[d]
Acrylic (AR)	–	–	–	–	13.9[e]
Epoxy (ER)	1.6	2.0 – 3.9	3.1	43.3	$\boxed{0.94}$[e]
Polyurethane (UR)	31.5	78.7	1,181	–	0.93 – 3.4[e]
Silicone (SR)	–	19,685	118,110	17,717	1.7 – 47.5[e]

[a]ASTM D 1434
[b]ASTM E 96 (at 90% RH, 37°C)
[c]ASTM F 1249 (at 90% RH, 37°C)
[d]ASTM F 1249 (at 100% RH, 38°C)
[e]*Coating Materials for Electronic Applications*, Licari, J.J., Noyes Publications, New Jersey, 2003.

Procurement

- Although Parylene C is preferred, the system at Y12 needs to be re-commissioned and this is adding a large ($50k) cost to the project
  - Negotiating cost-sharing
- No commercial vendor for coating with Parylene (there are many) would do it on the LiH
- Fermilab Safety prefers we DO NOT do the coating in-house
- Setting up a phone meeting next week with Y12 with all the principals (has been EXTREMELY difficult) to resolve this issue once and for all.
  - Spray epoxy coat @Y12 is fall-back