



MICE Spectrometer Solenoid Design and Assembly



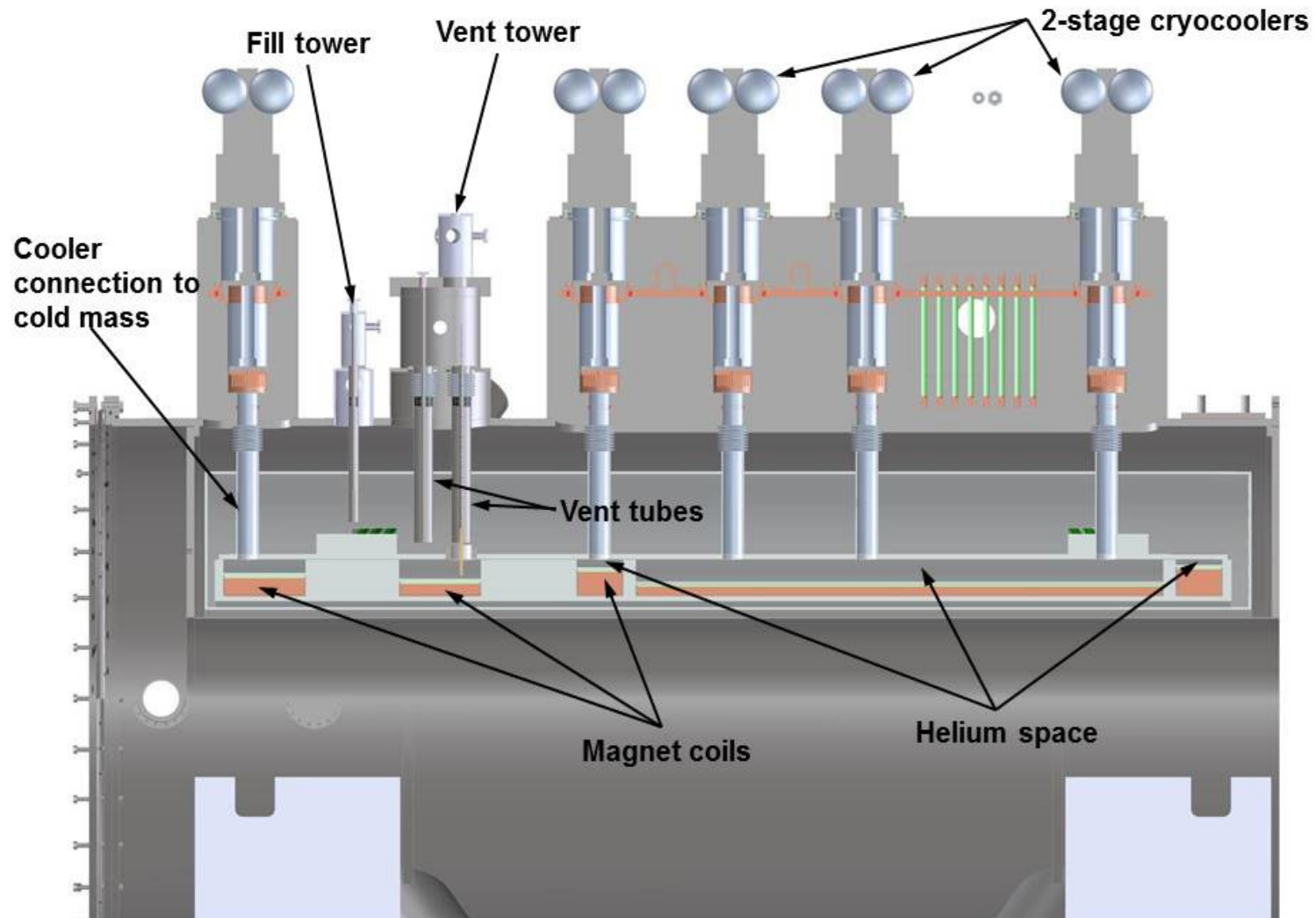


Magnet Design Features

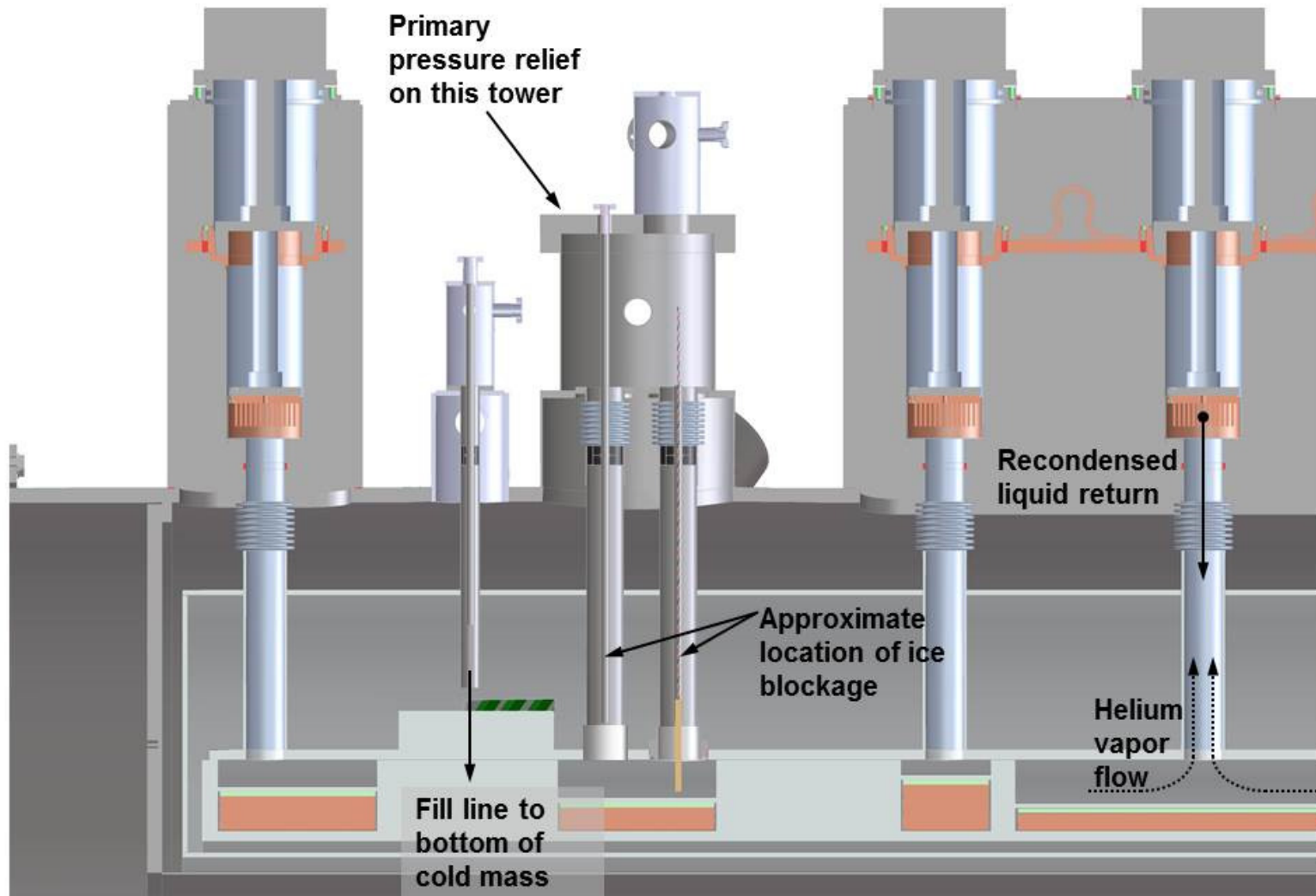


- 5 coils on a single mandrel
- 200L LHe volume in cold mass
- 5 ea 2-stage cryocoolers for recondensing helium vapor and cooling the shield
- Vapor and return LHe pass thru the same cooler tubes at the top of the cold mass
- 8 ea HTS leads feed the 5 coils
- 60K thermal shield made from series 1100 Al

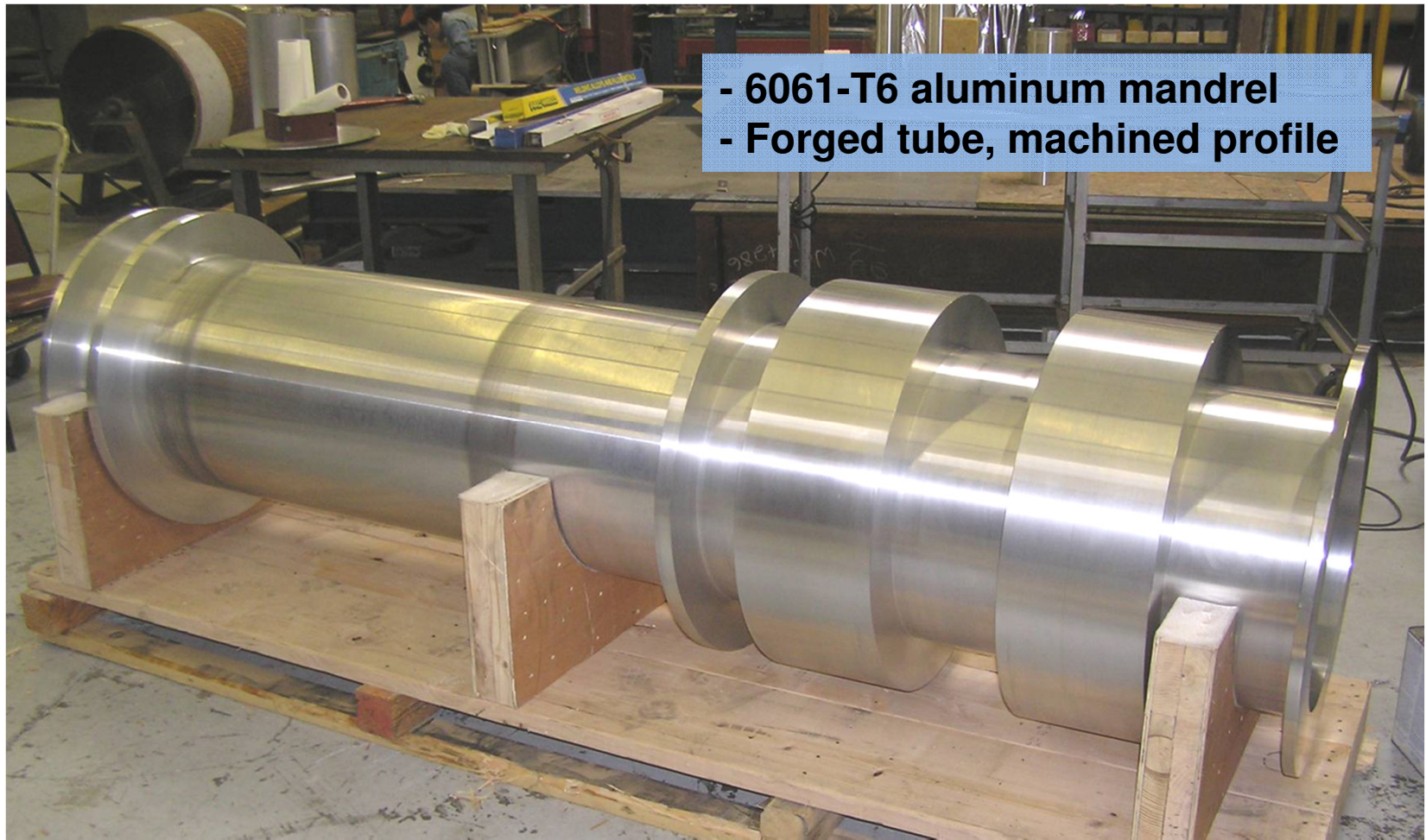
Internal Design Details



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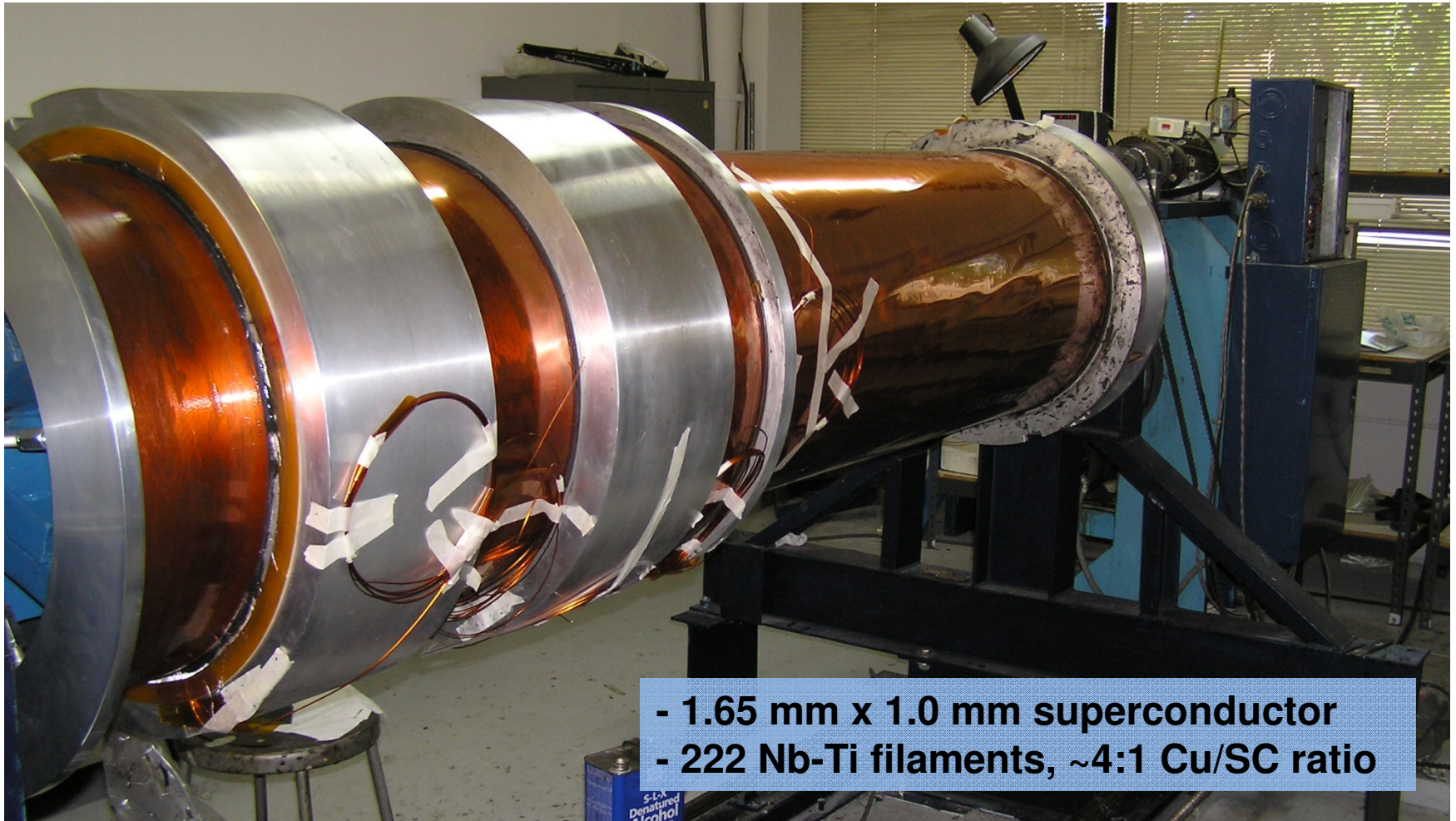
Coil Winding Mandrel



Coil Winding

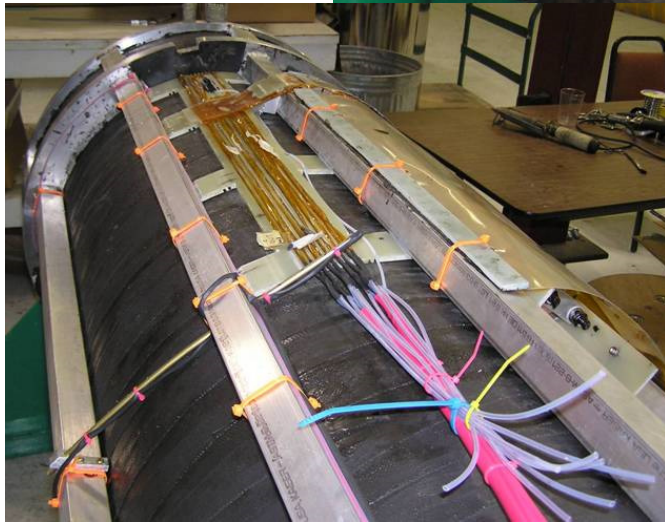


Completed Coil Windings



- 1.65 mm x 1.0 mm superconductor
- 222 Nb-Ti filaments, ~4:1 Cu/SC ratio

Banding and Axial Reinforcement



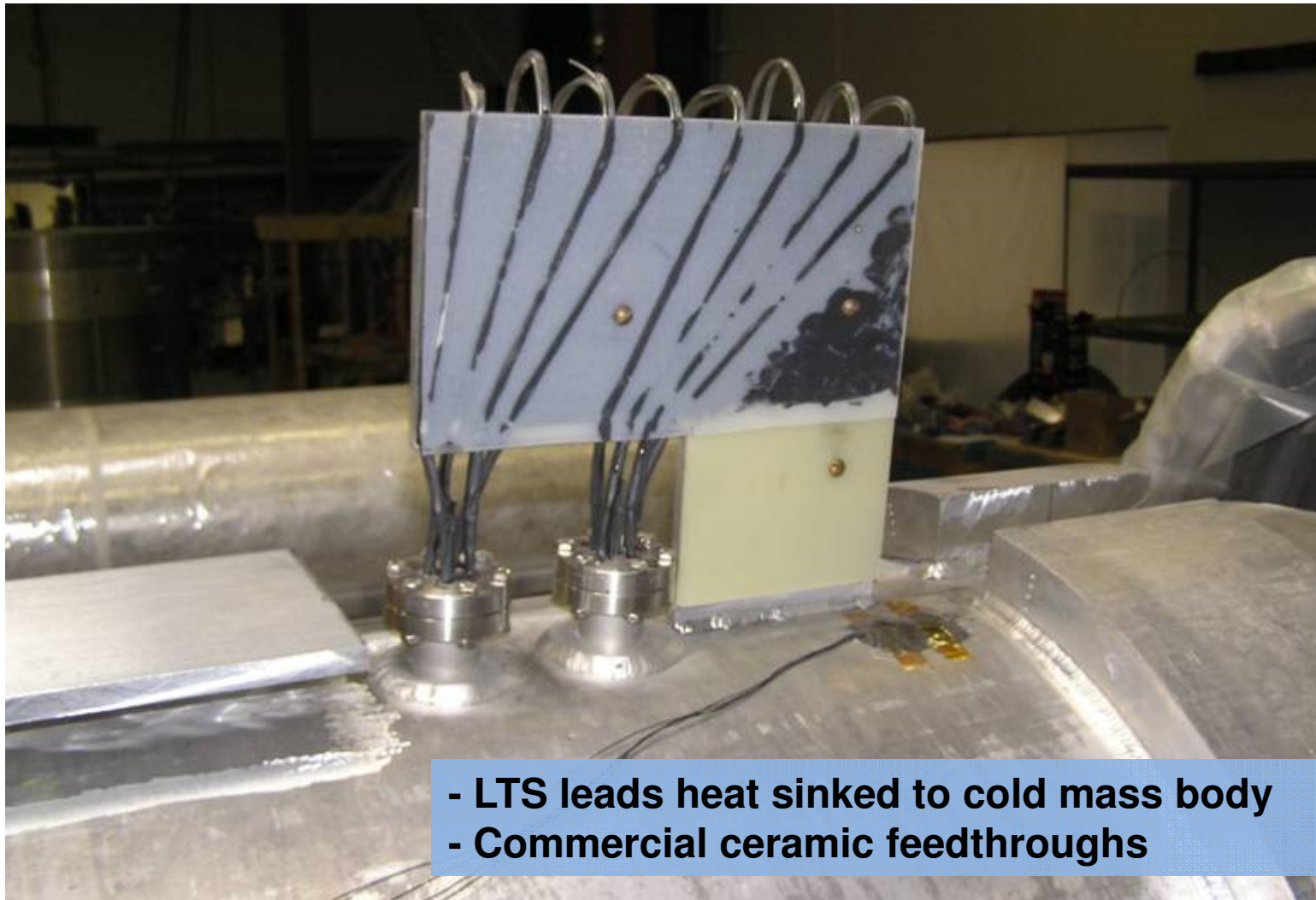
- Wound aluminum banding w/Stycast
- Welded aluminum axial stiffeners

Completed Cold Mass



- Welded aluminum clamshell type cover
- ~200 liter cold mass interior volume

Vacuum Side Coil Leads



- LTS leads heat sunk to cold mass body
- Commercial ceramic feedthroughs



Cold Mass MLI Spacers & Heaters



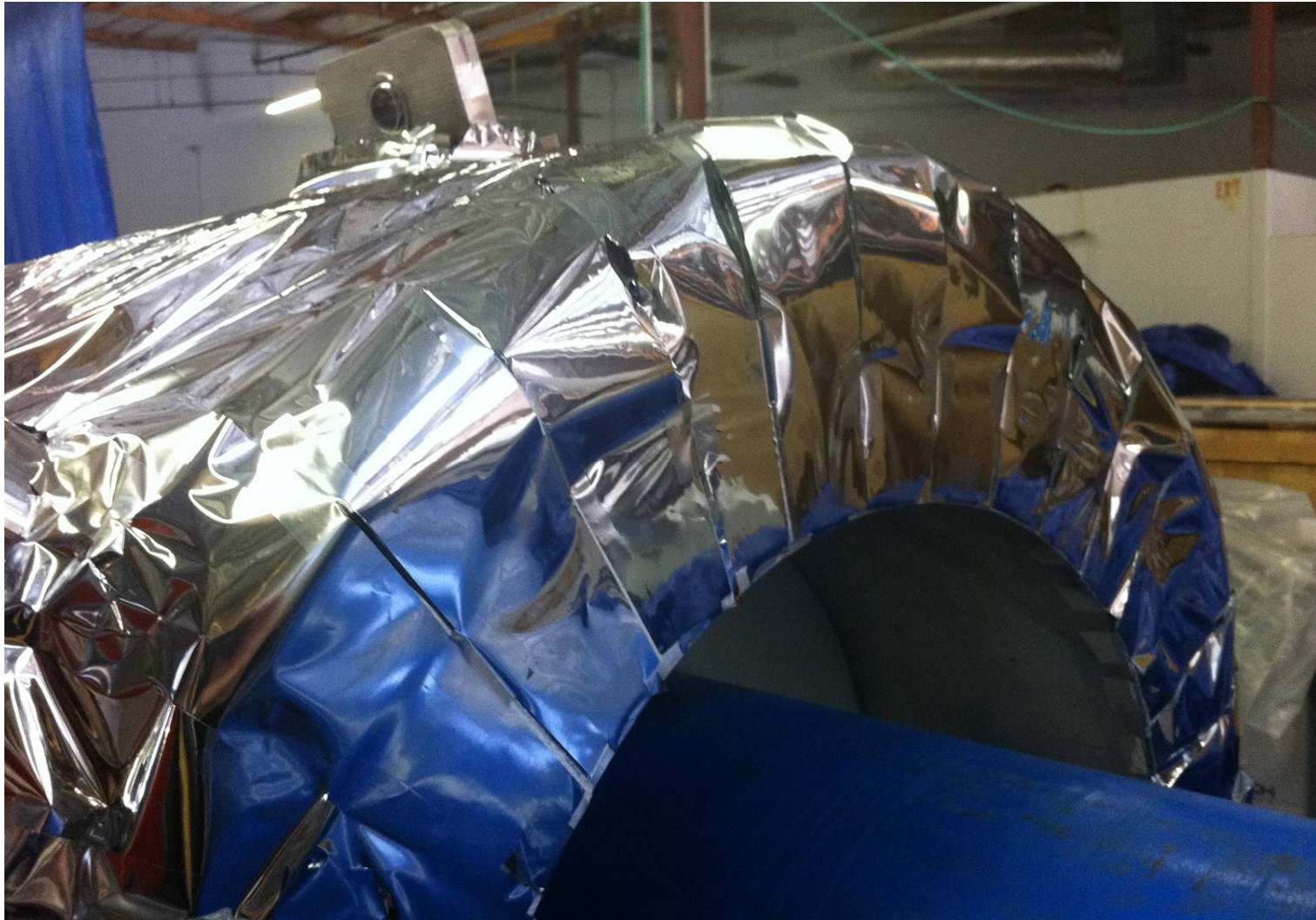
- Spacers help prevent thermal shorts
- Heaters provide pressure regulation

MLI Wrapped Cold Mass



- ~32 layers of aluminized Mylar MLI
- Interleaved joints, Mylar tape

Cold Mass End Wrap Detail

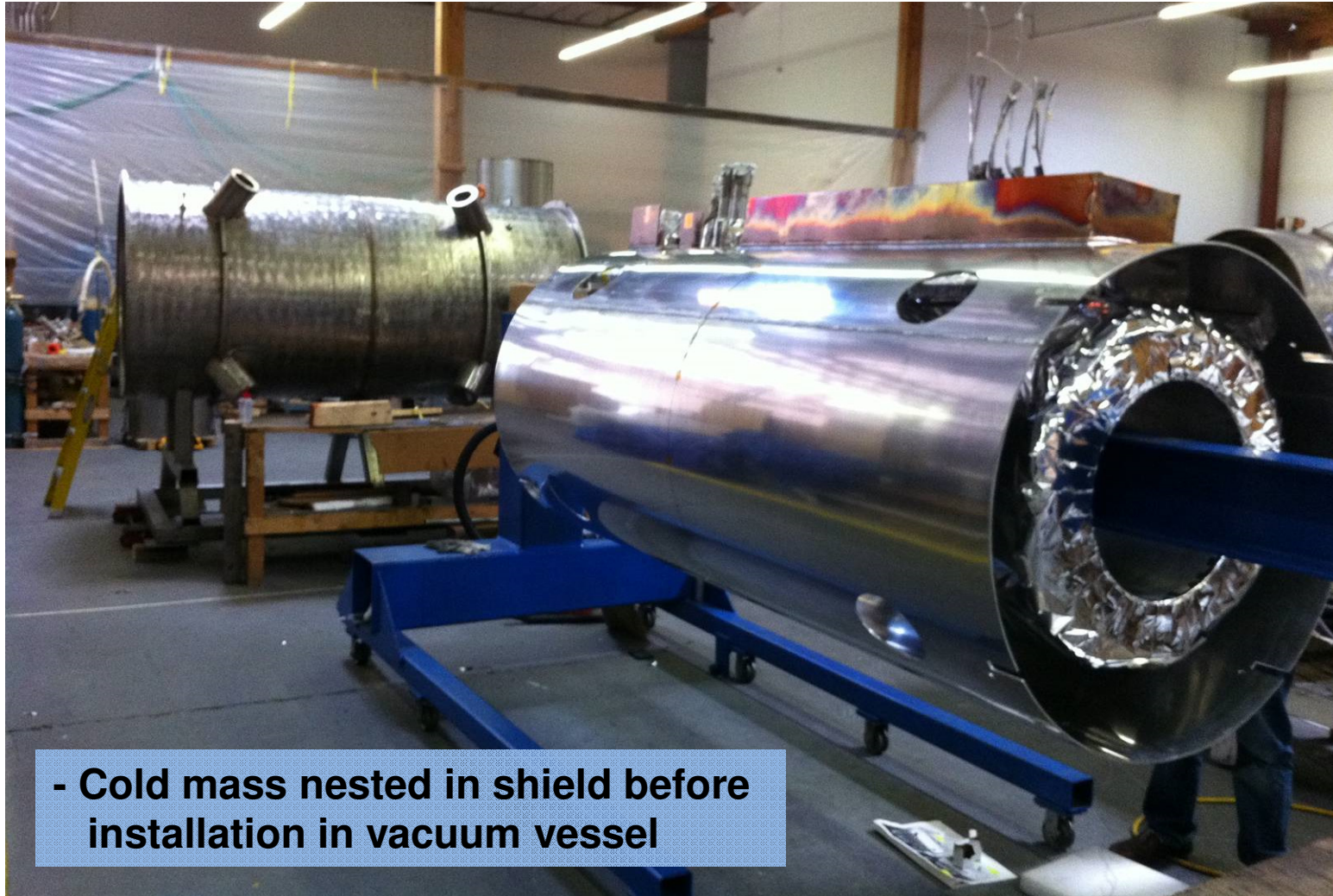


60K Shield Assembly

- Series 1100 aluminum thermal shield
- Copper transition for cooler connection



Nested Cold Mass/Shield



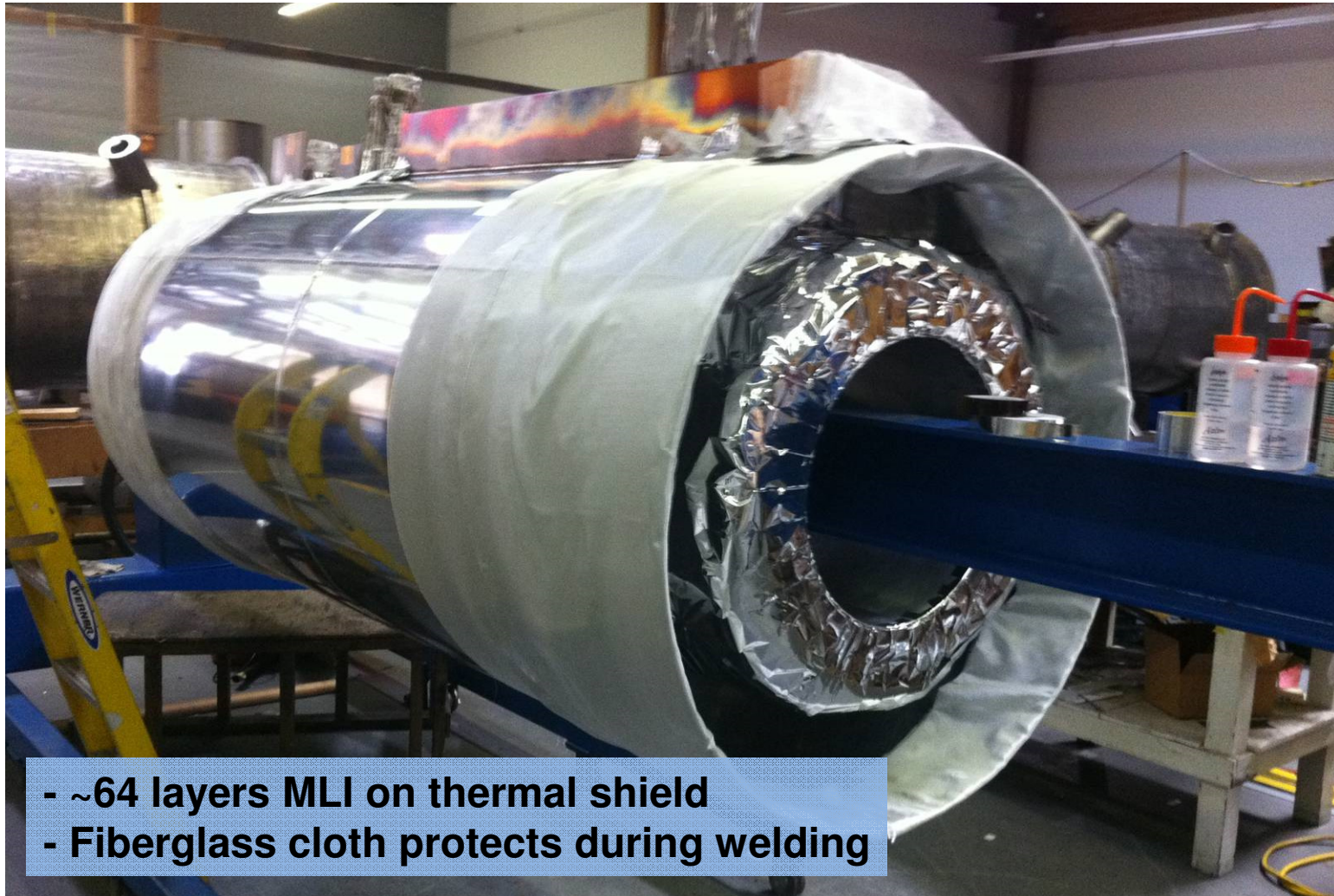
- Cold mass nested in shield before installation in vacuum vessel

Cold Mass Vent and Fill Lines



- Fill and vent lines intercepted at shield
- Thinned out walls limit conduction

Shield Prep for MLI



- ~64 layers MLI on thermal shield
- Fiberglass cloth protects during welding



Shield/Cold Mass Installation



Cold Mass Alignment



- Cold mass alignment using portable CMM

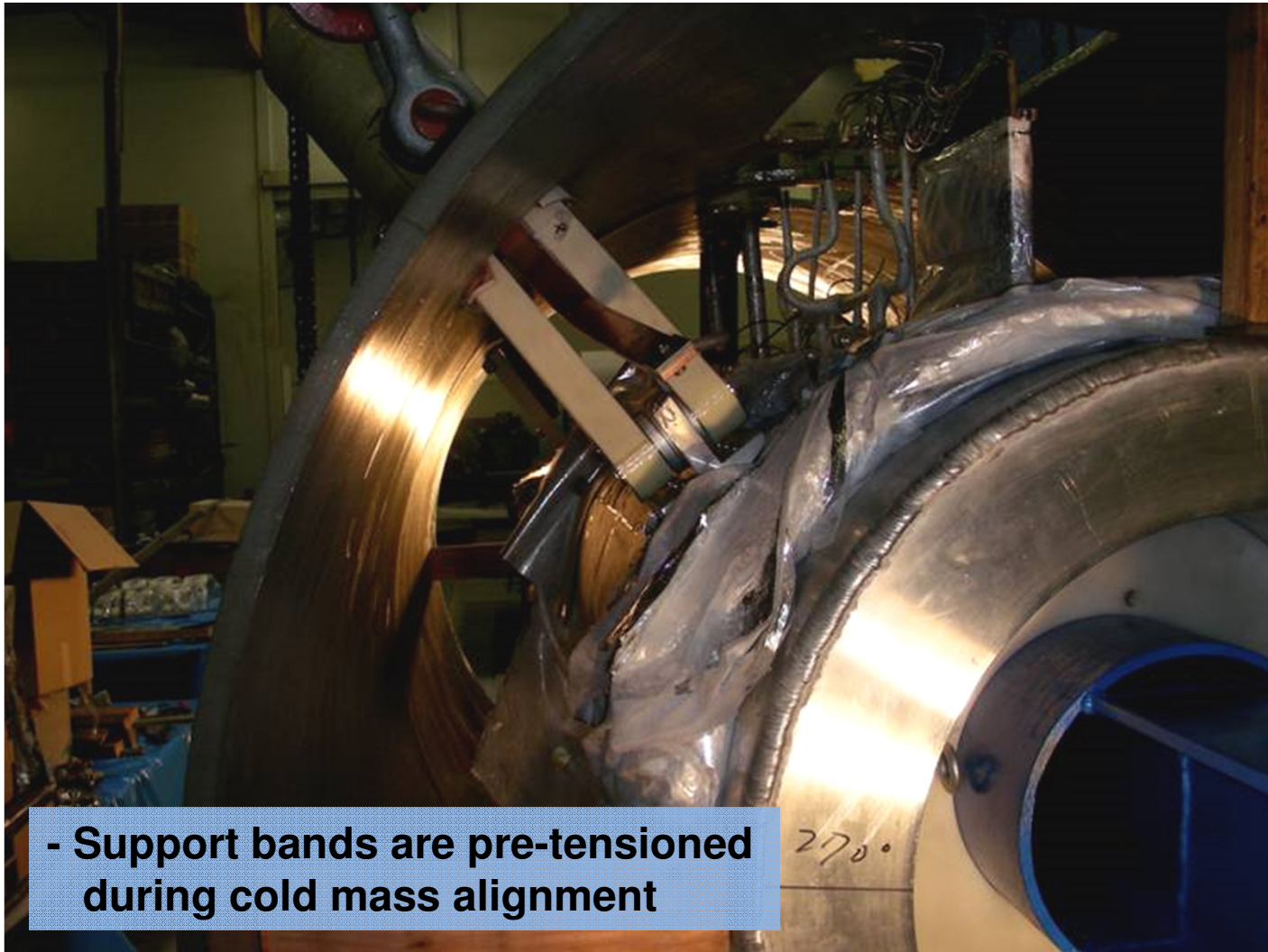
Cold Mass Support Bands



- Fiberglass bands for low heat leak
- Intermediate intercept at 60K shield



Mounting of Cold Mass Suppts



- Support bands are pre-tensioned during cold mass alignment

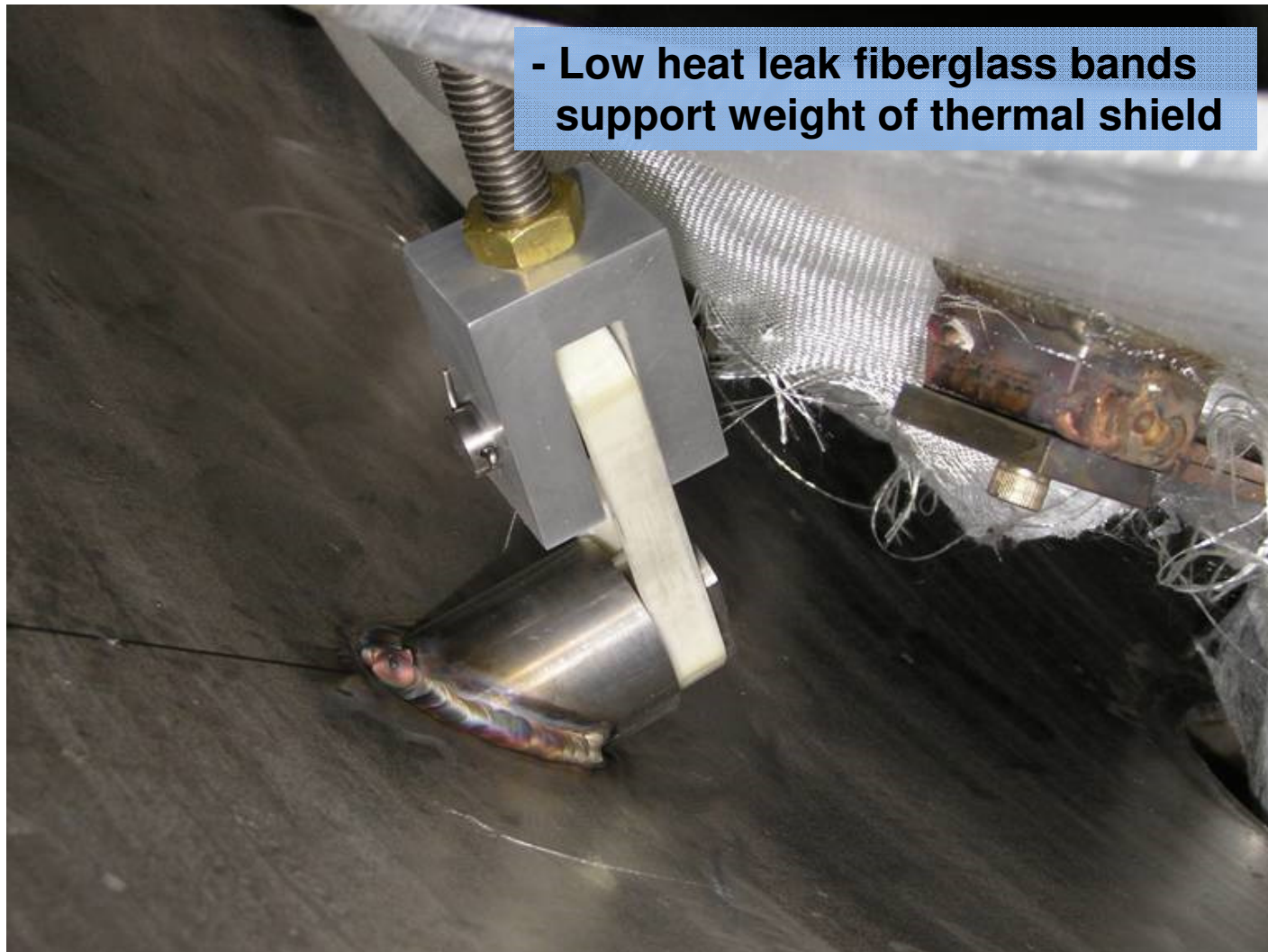
270°



60K Support Band Intercepts



Thermal Shield Support Band

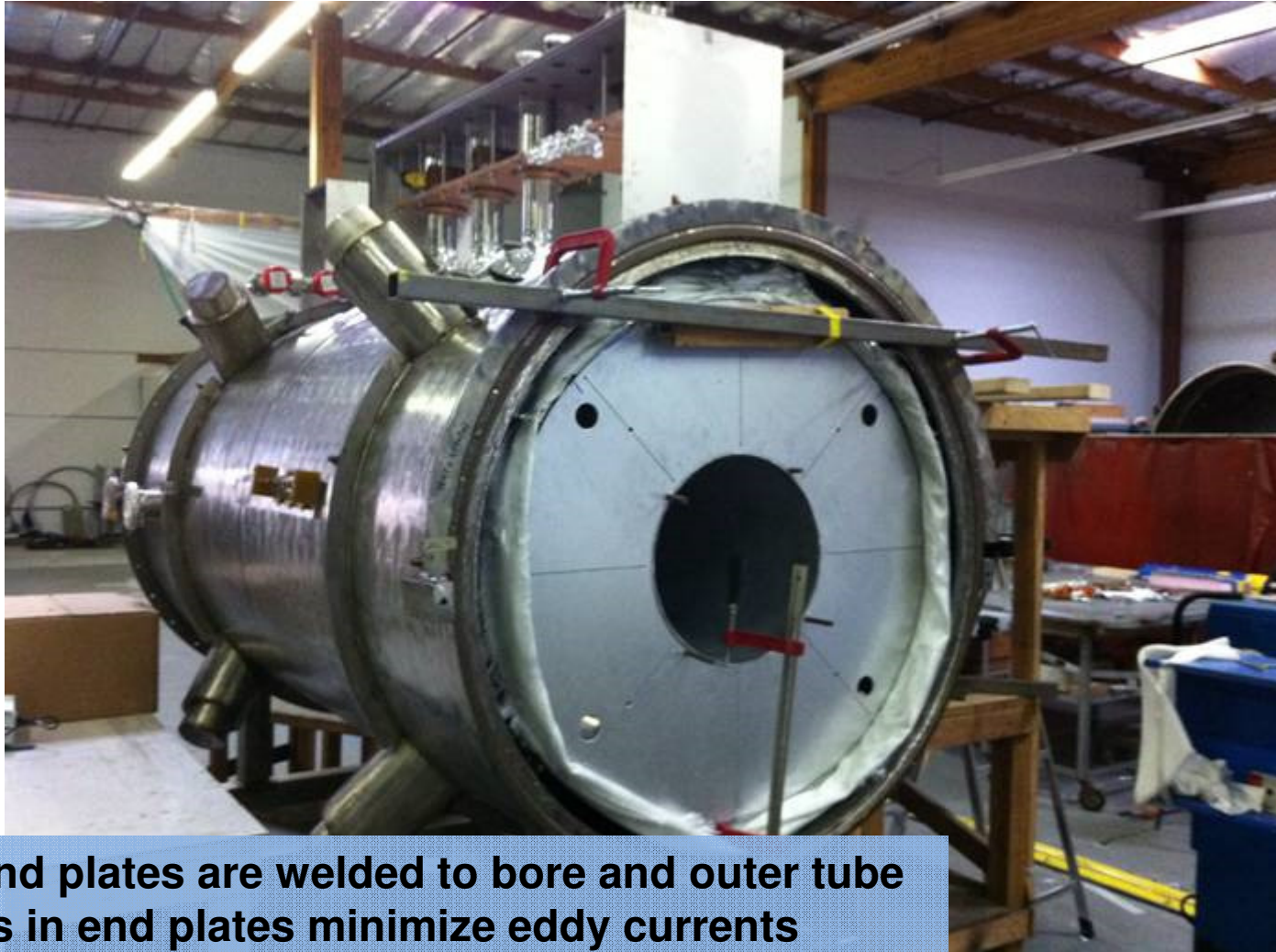




Thermal Shield Bore MLI Wrap



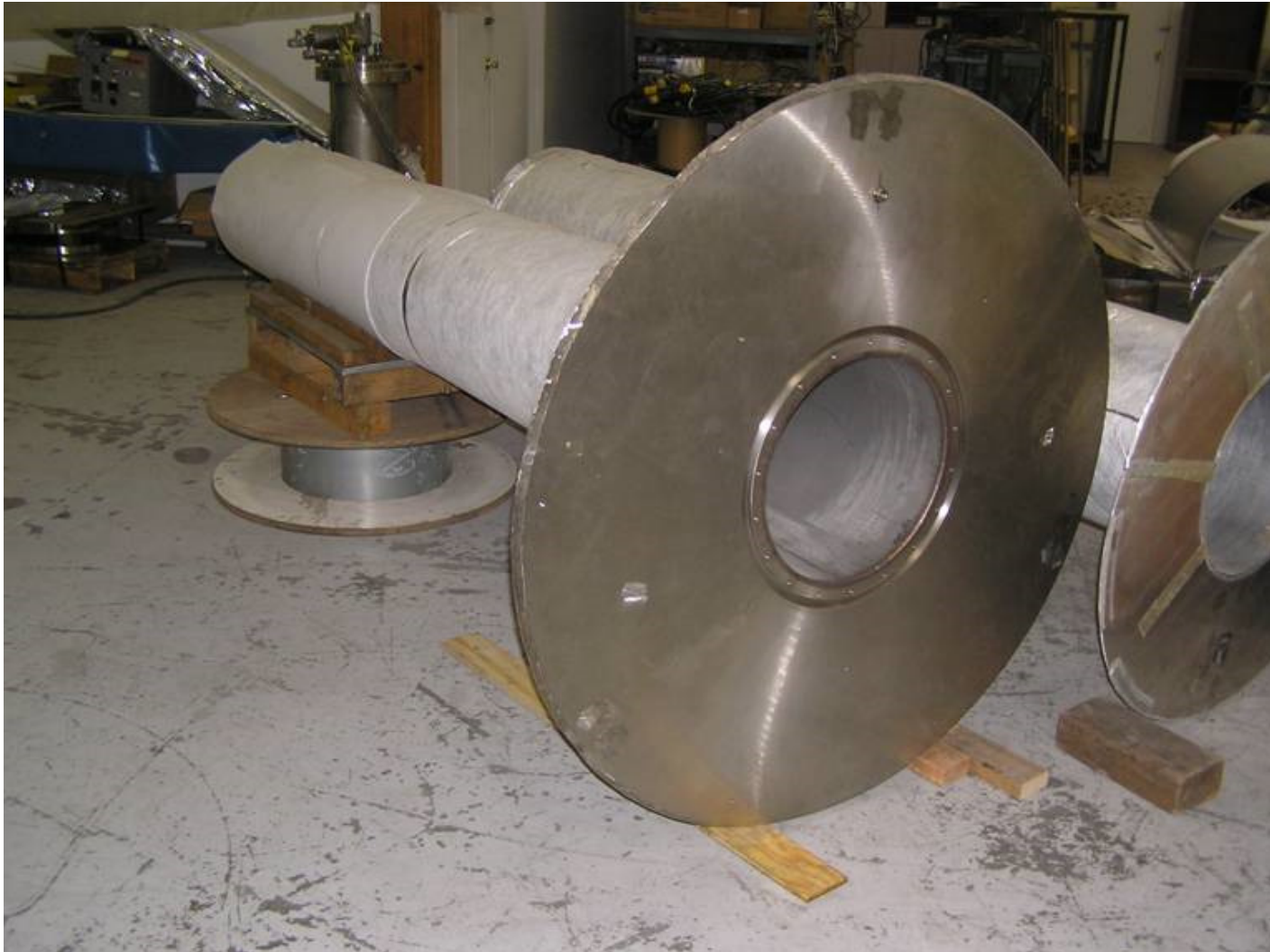
Shield End Plate Installation



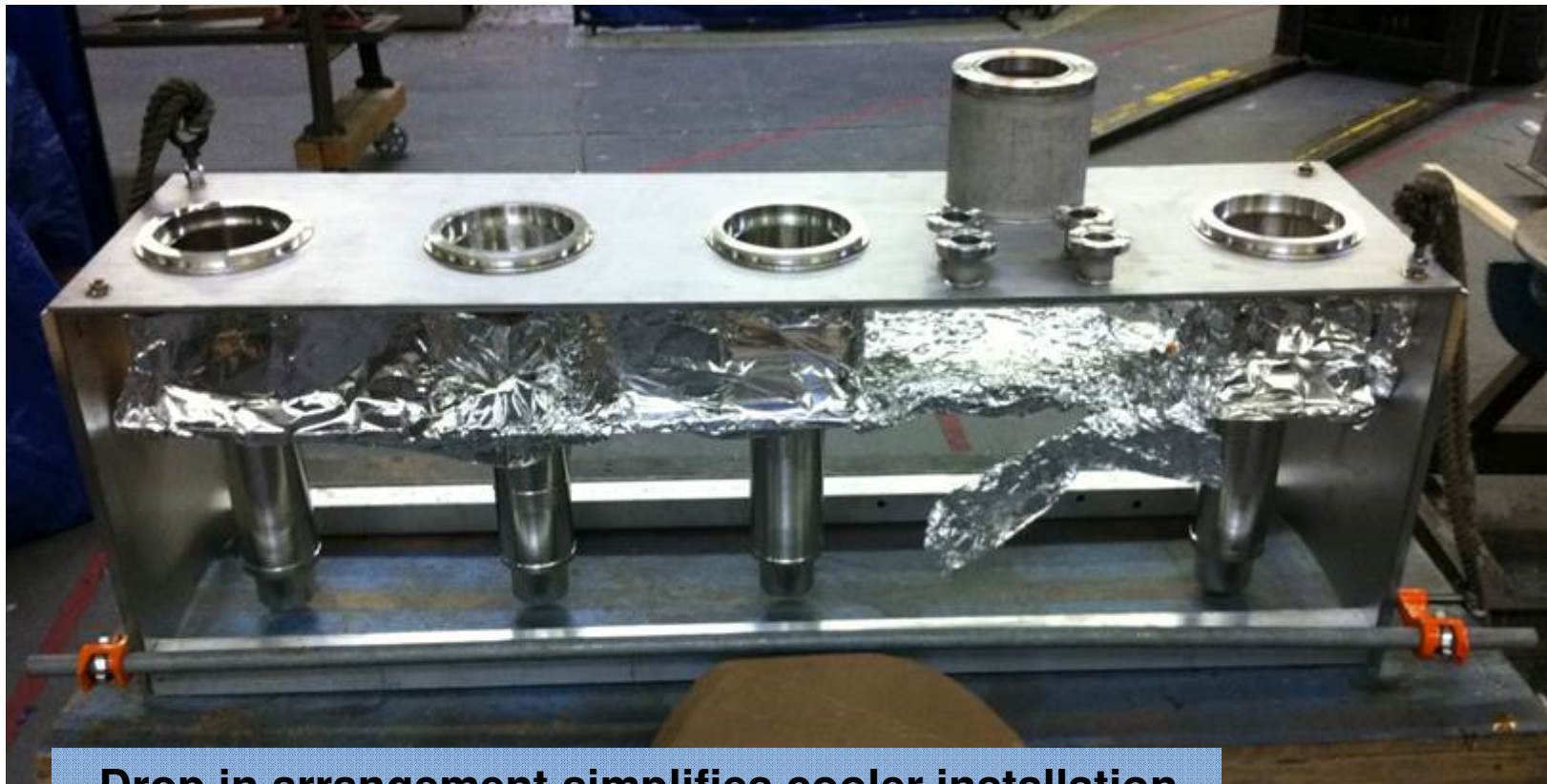
- Shield end plates are welded to bore and outer tube
- Saw cuts in end plates minimize eddy currents



Vacuum Vessel End Wall/Warm Bore



Benchtop Cooler Tower Assembly



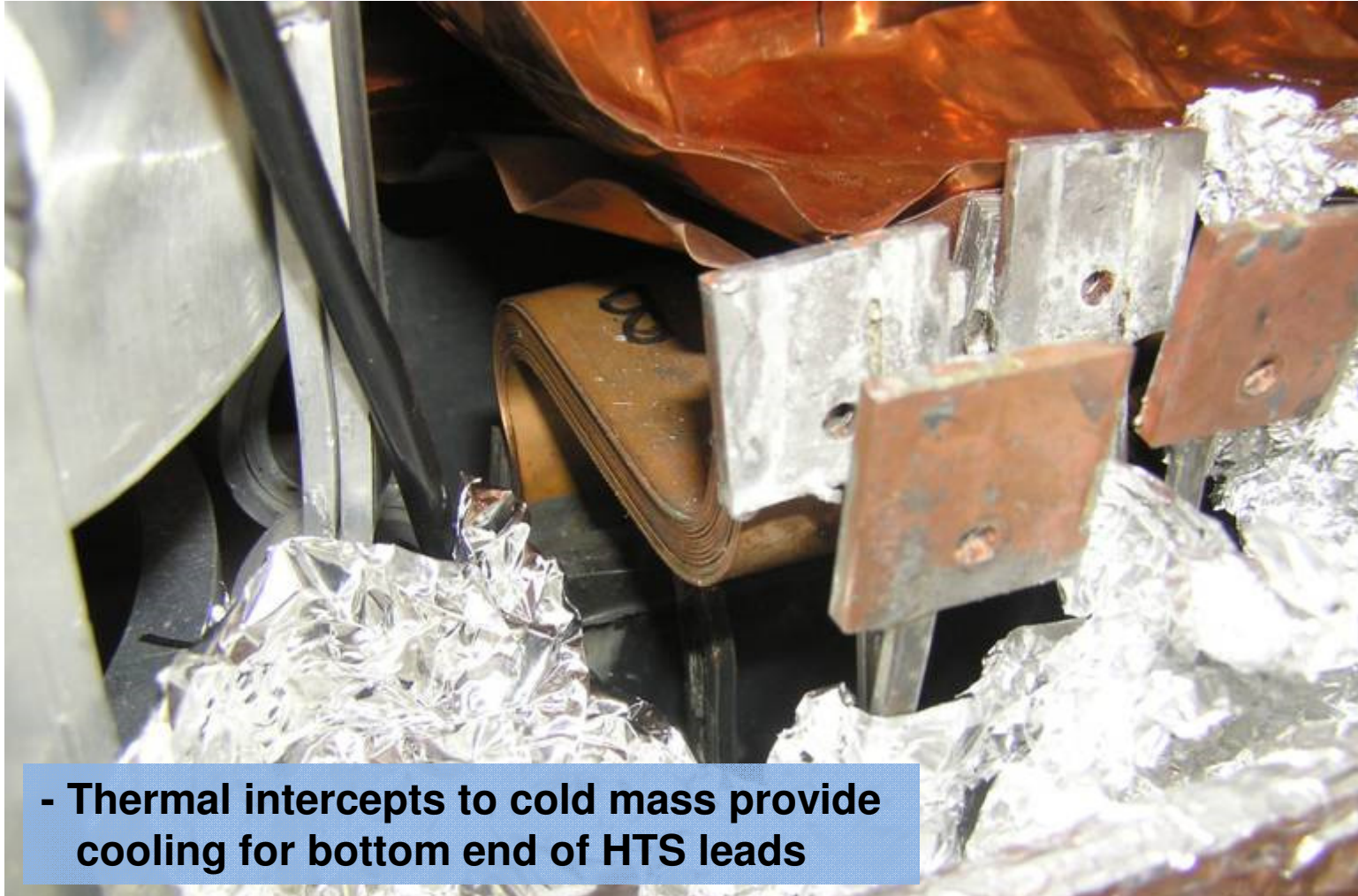
- Drop in arrangement simplifies cooler installation
- Some heat leak in thin walled sleeves



Cooler Tower Install on Vessel

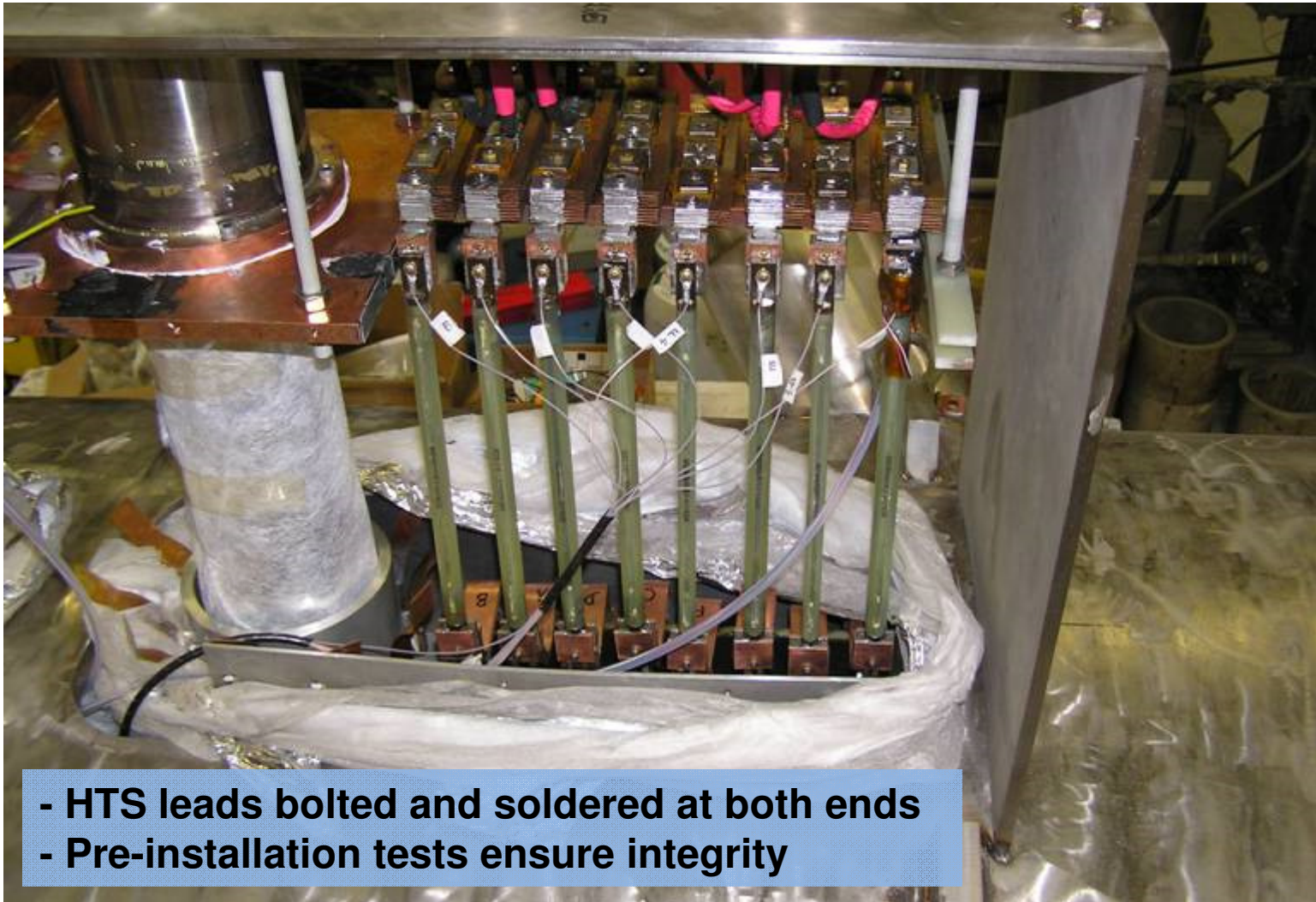


Thermal Intercepts for Lower HTS Leads



- Thermal intercepts to cold mass provide cooling for bottom end of HTS leads

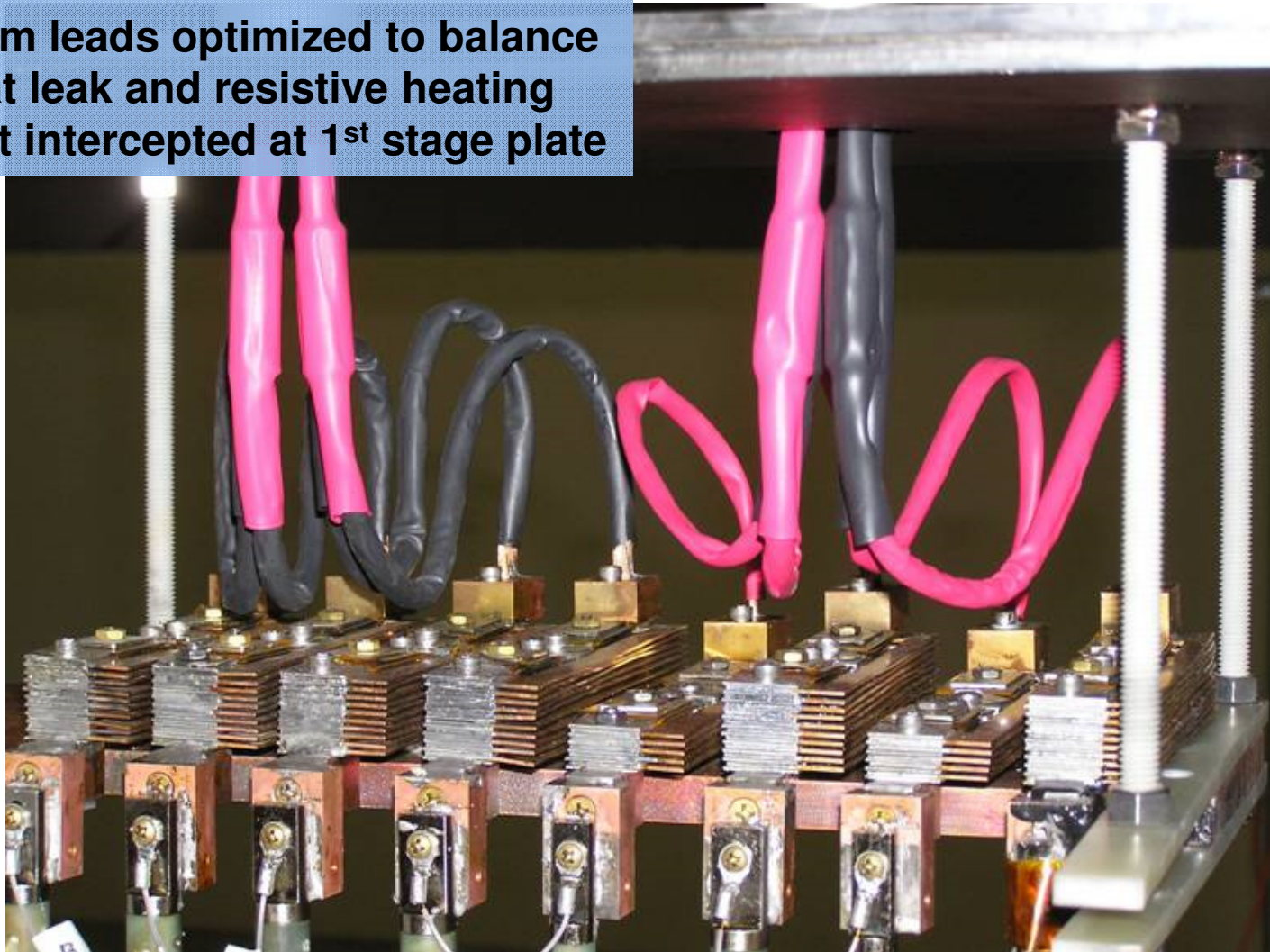
HTS Lead Installation



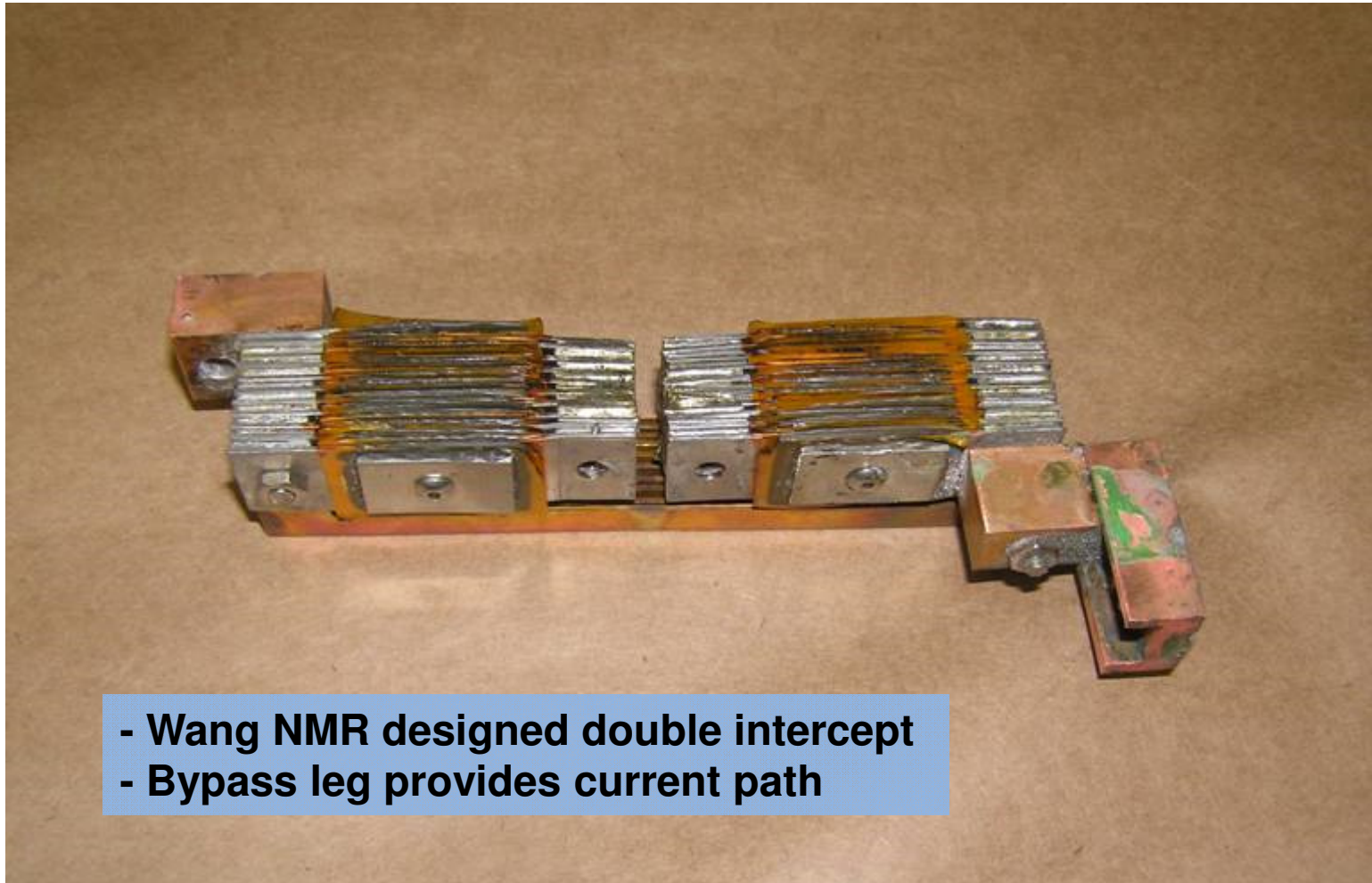
- HTS leads bolted and soldered at both ends
- Pre-installation tests ensure integrity

Warm Lead Configuration

- Warm leads optimized to balance heat leak and resistive heating
- Heat intercepted at 1st stage plate

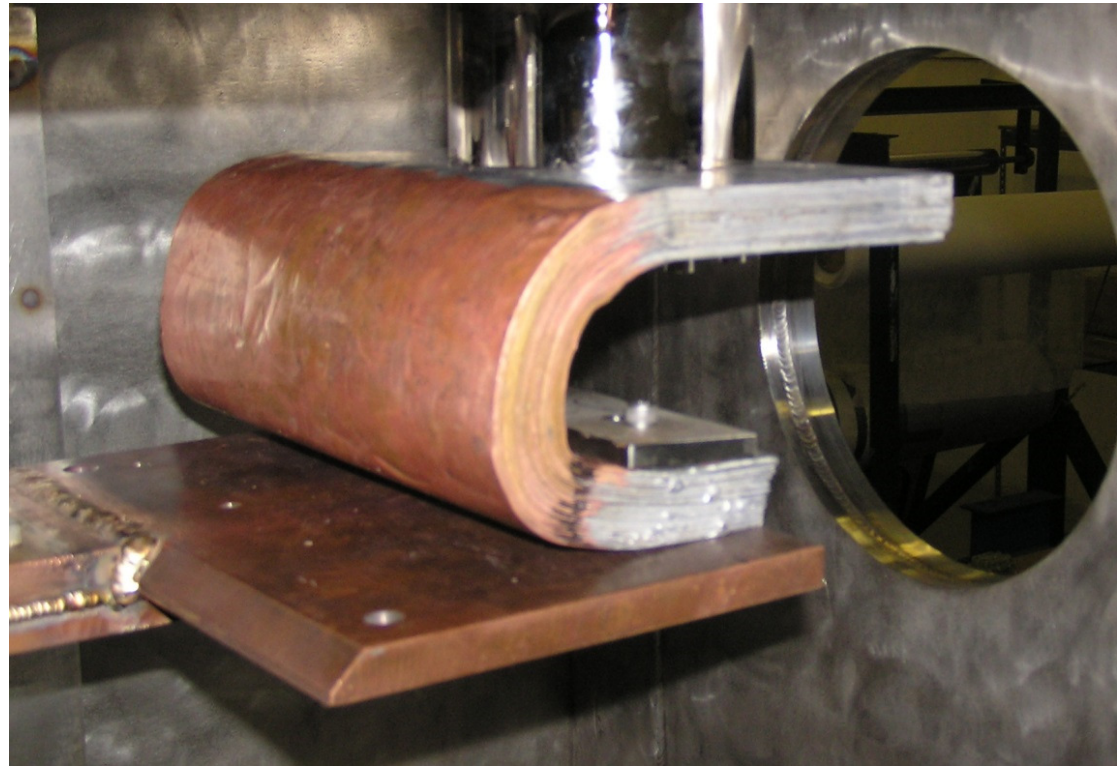


Upper HTS Lead Thermal Intercept



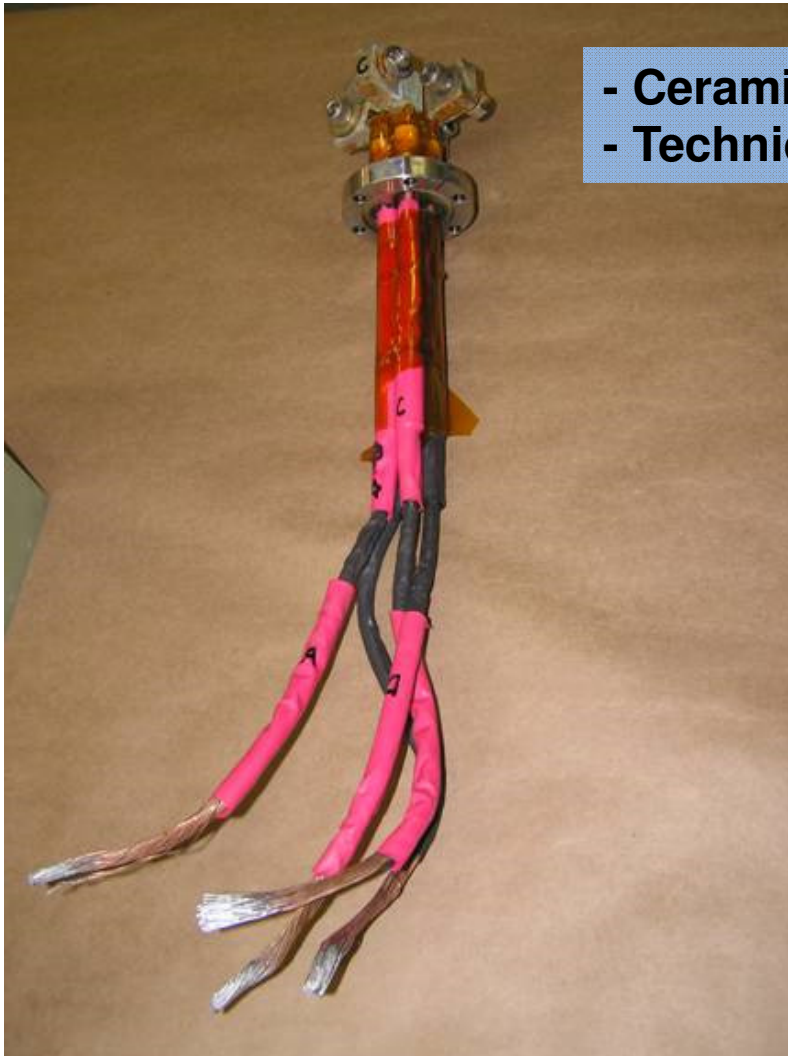
- Wang NMR designed double intercept
- Bypass leg provides current path

Single Stage Cooler for HTS Leads

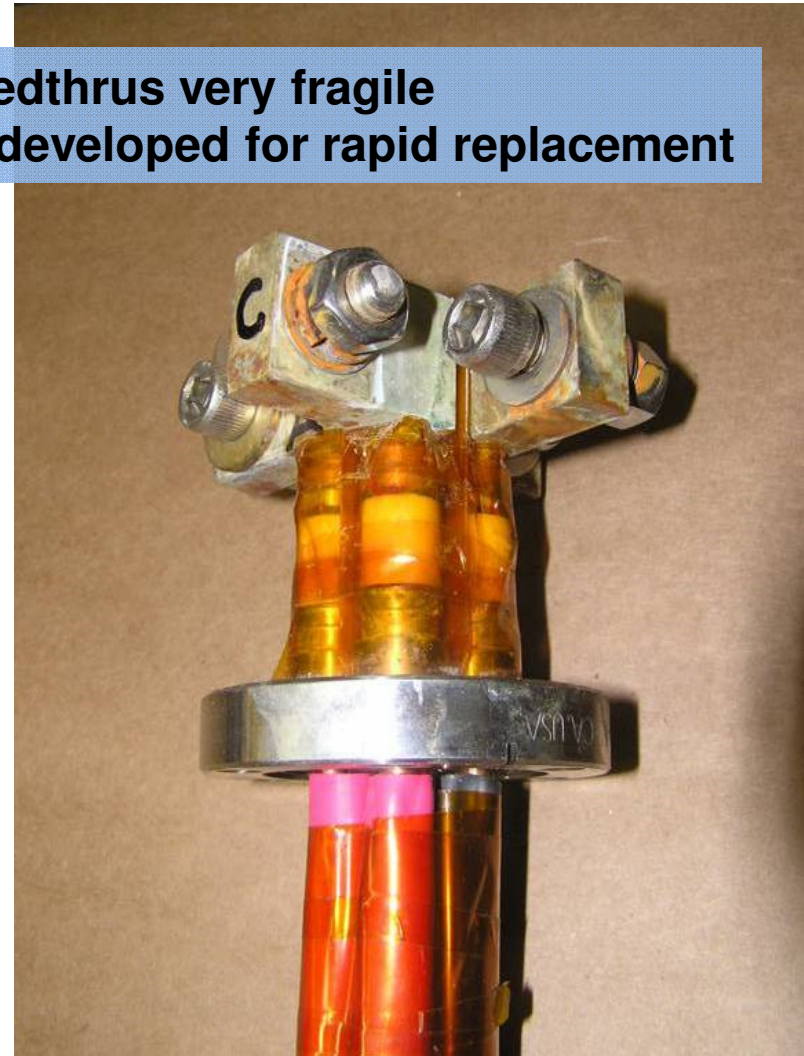


- Single stage cooler directly protects HTS leads
- 175 W of cooling power at 55K

Warm Lead/Feedthru Assembly



- Ceramic feedthrus very fragile
- Technique developed for rapid replacement

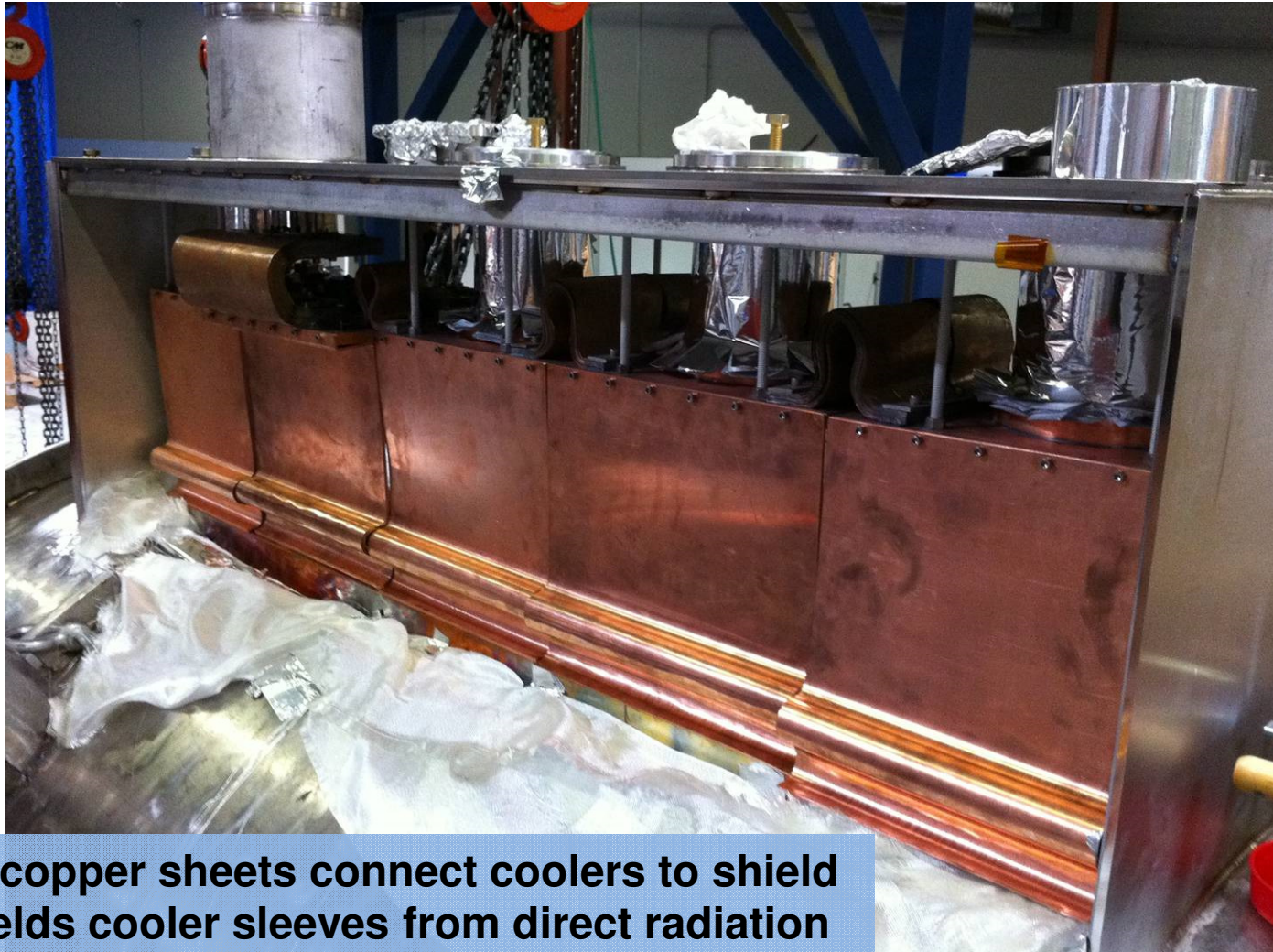




Power Feedthrus w/Copper Flags

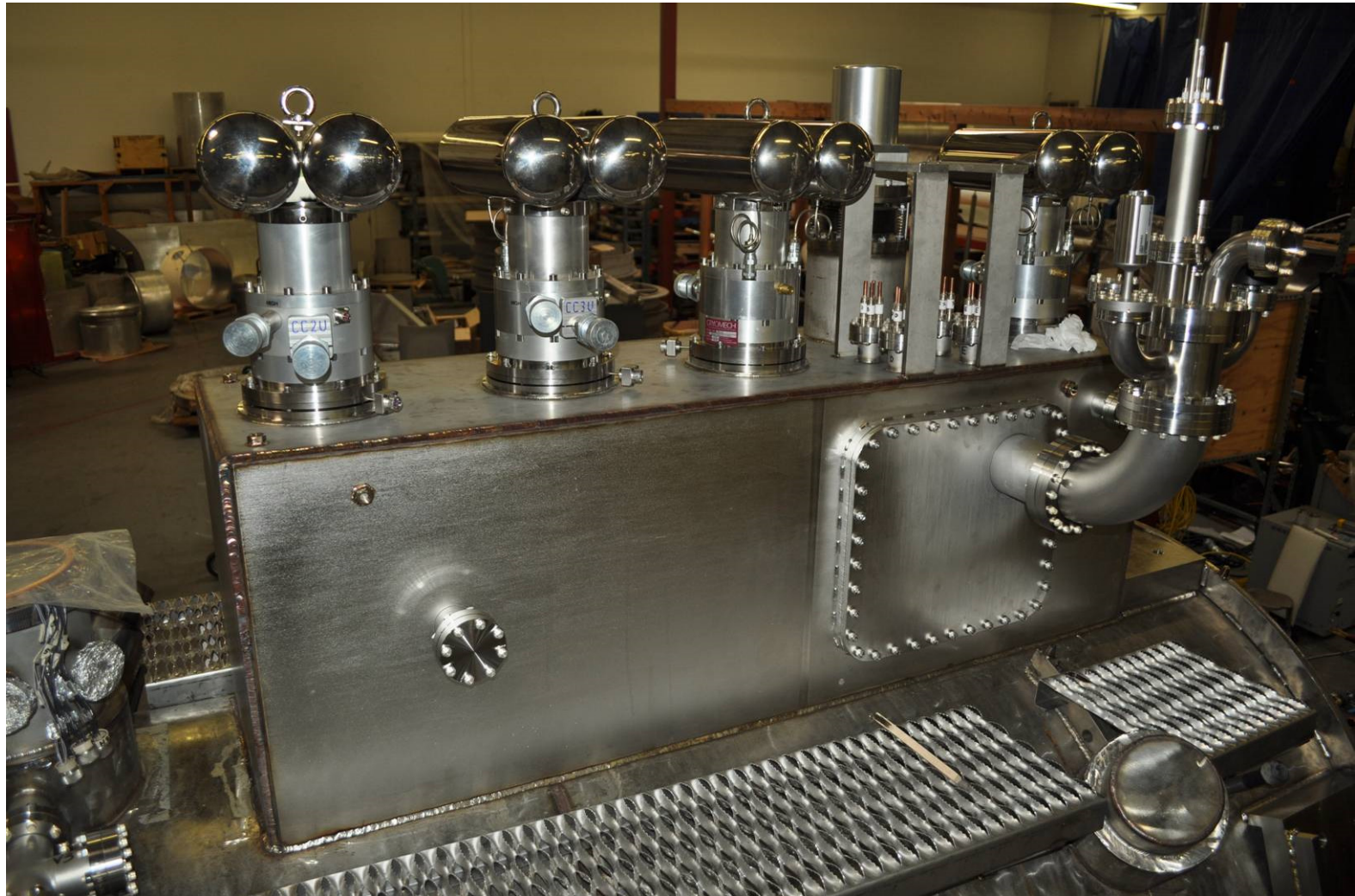


1st Stage Cooler to Shield Connection



- Layered copper sheets connect coolers to shield
- Also shields cooler sleeves from direct radiation

Completed Cooler Tower Assembly





Completed Magnet





Other Information



- The two magnets shipped to RAL are virtually identical in design
- SSU (1st magnet completed) performed better cryogenically than SSD
- Wang NMR went thru several design iterations due to various performance deficiencies
- LBNL and MICE collaborators took a lead role in the final design and assembly of the magnets