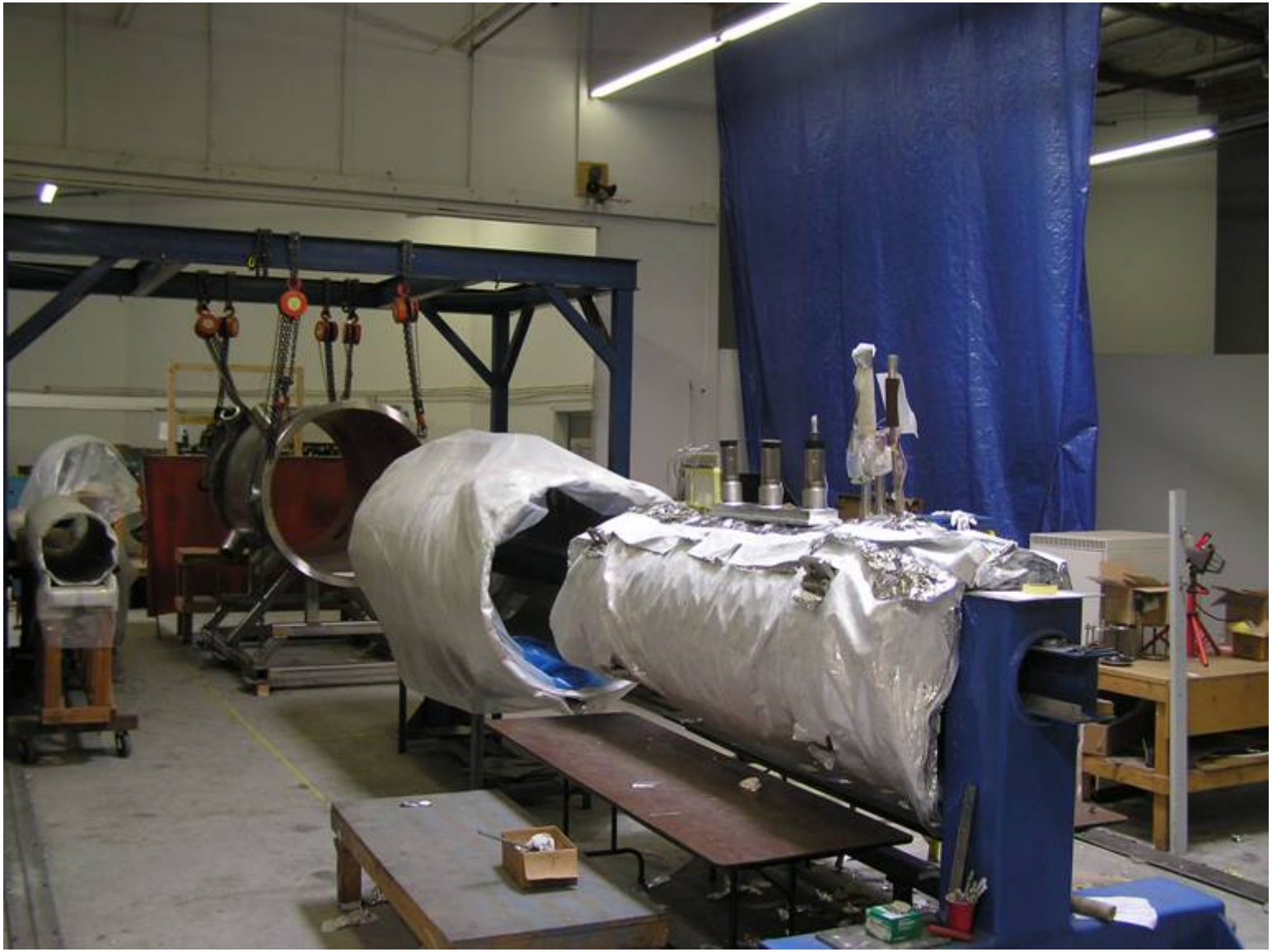
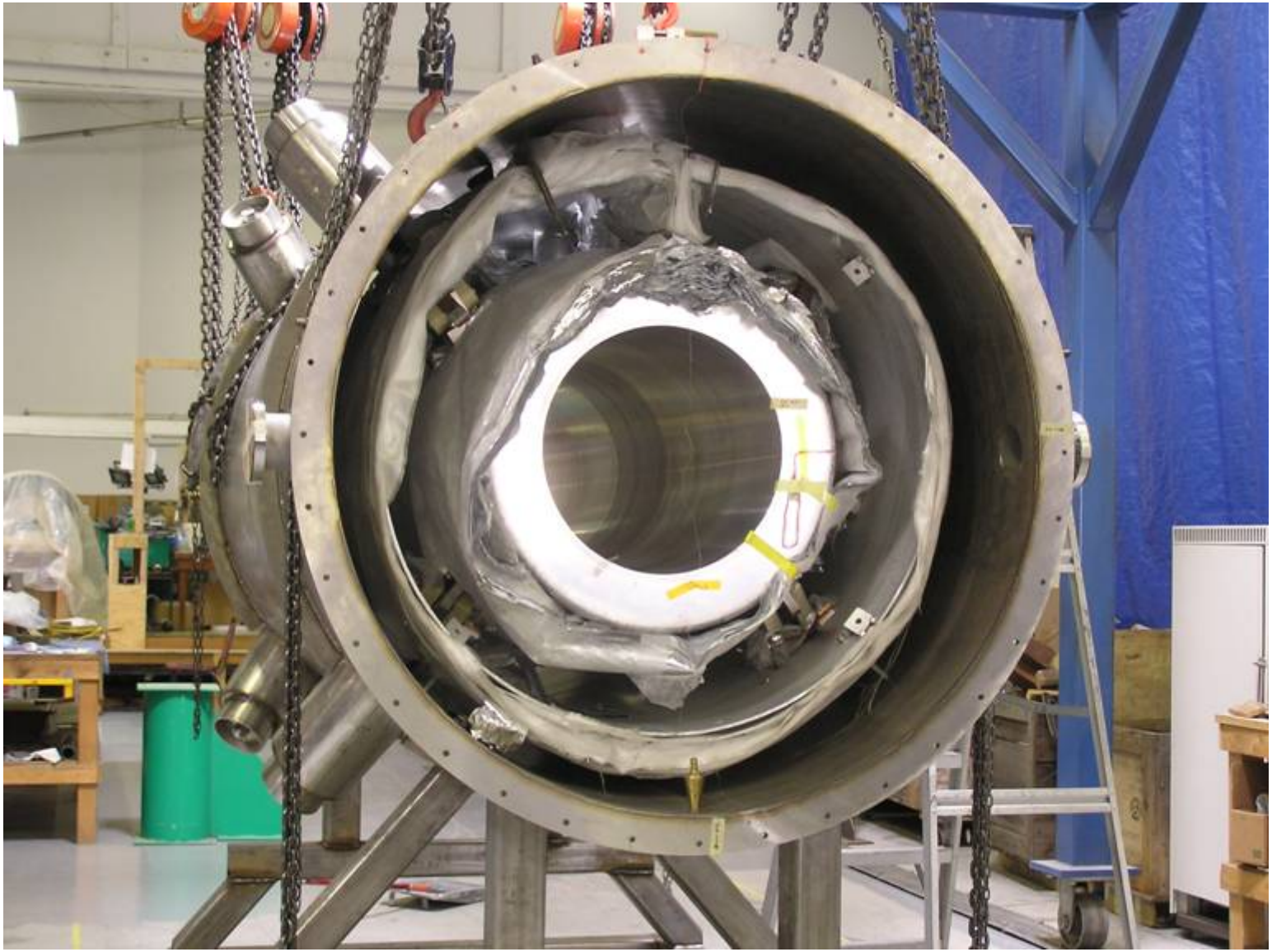
Spectrometer Solenoid Fabrication Photos

The following photos were taken at Wang NMR over the course of the assembly of the two Spectrometer Solenoid magnets. These photos are for background information and were generally selected to show the components and that have a strong influence on the thermal performance of the magnets. 'Magnet 2' refers to the 2nd magnet assembled (now 1st unit), and 'Magnet 1' was the 1st unit assembled (now disassembled).

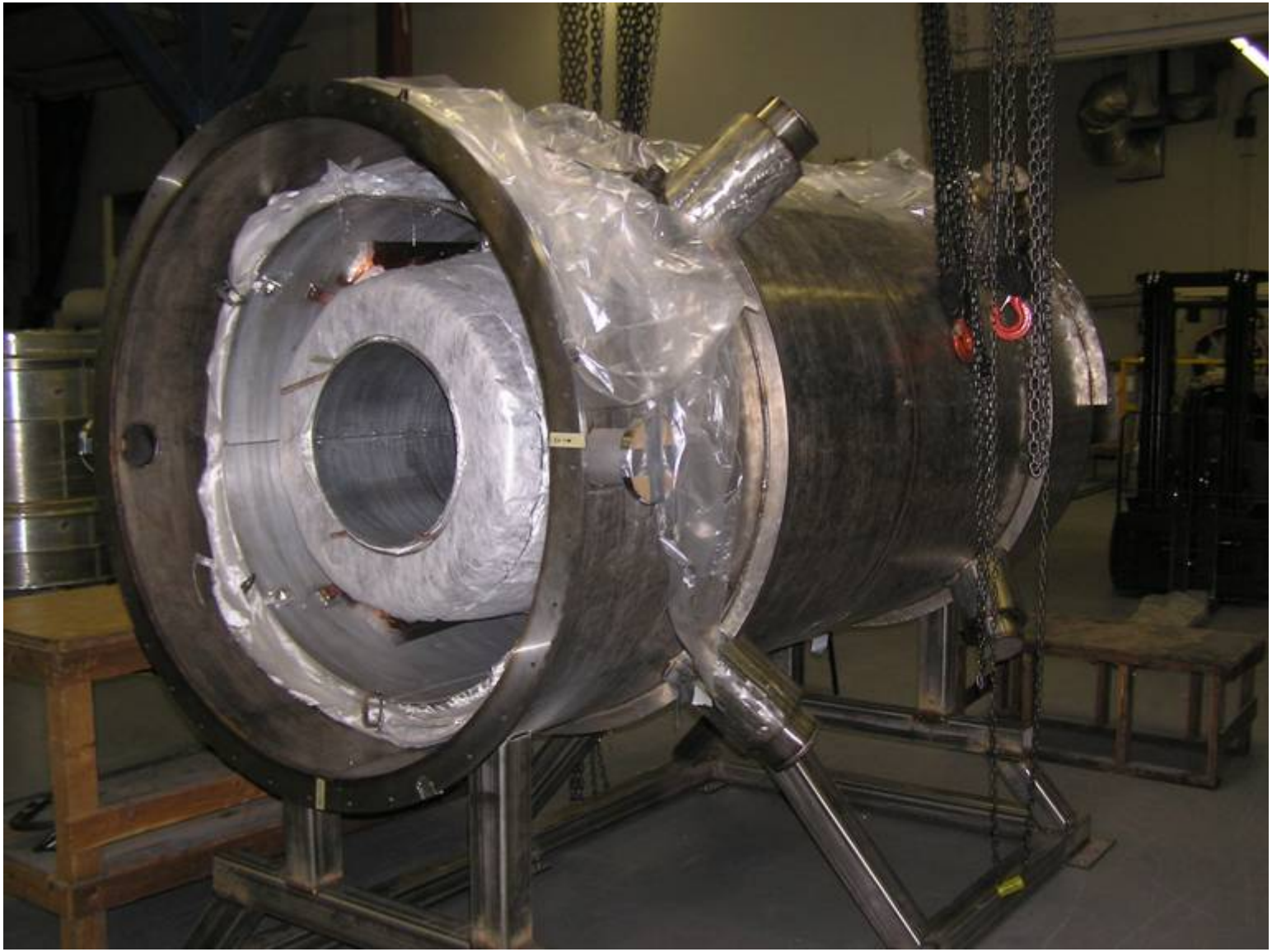
Magnet Assembly



Preparation for assembly of Magnet 2 cold mass into thermal shield and vacuum vessel

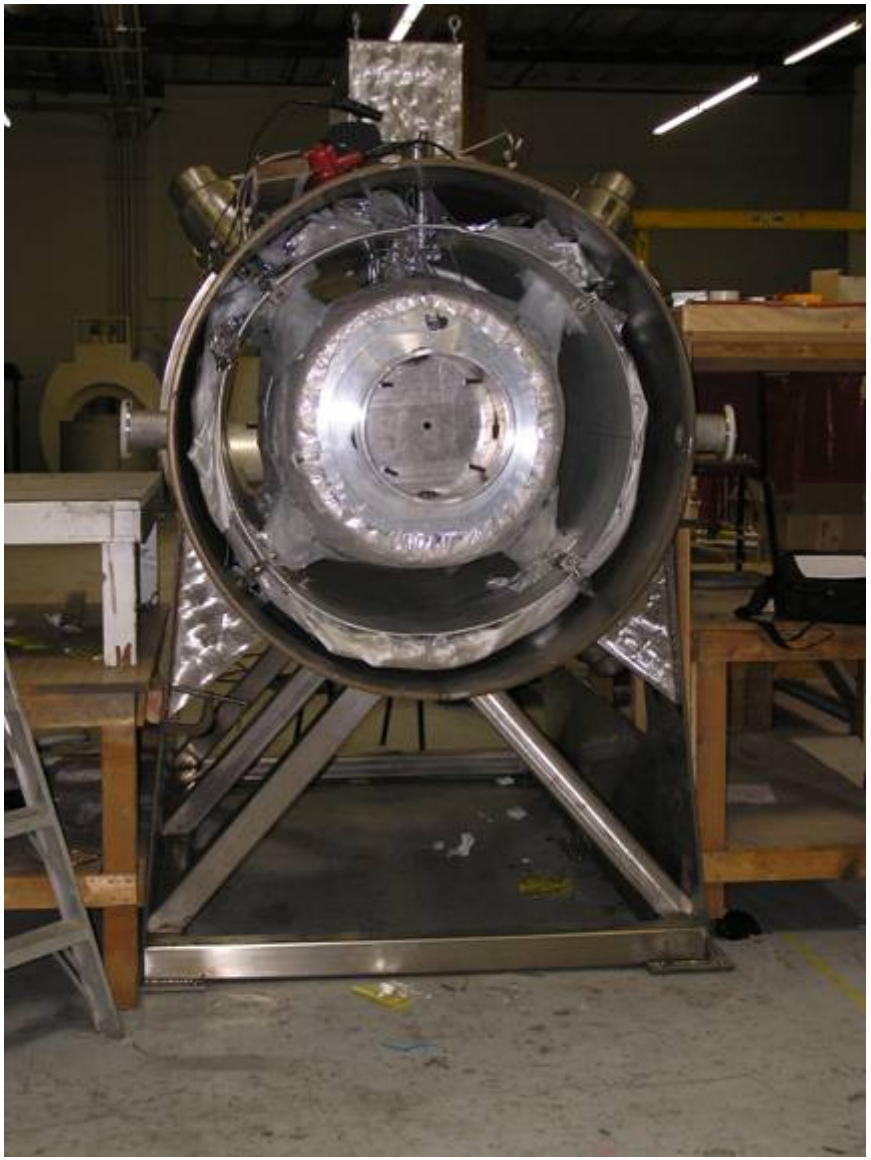


Cold mass and thermal shield installed in vacuum vessel



Inner thermal shield added and ends of cold mass MLI wrapped

Close up of cold mass ends showing wrapped cold mass supports



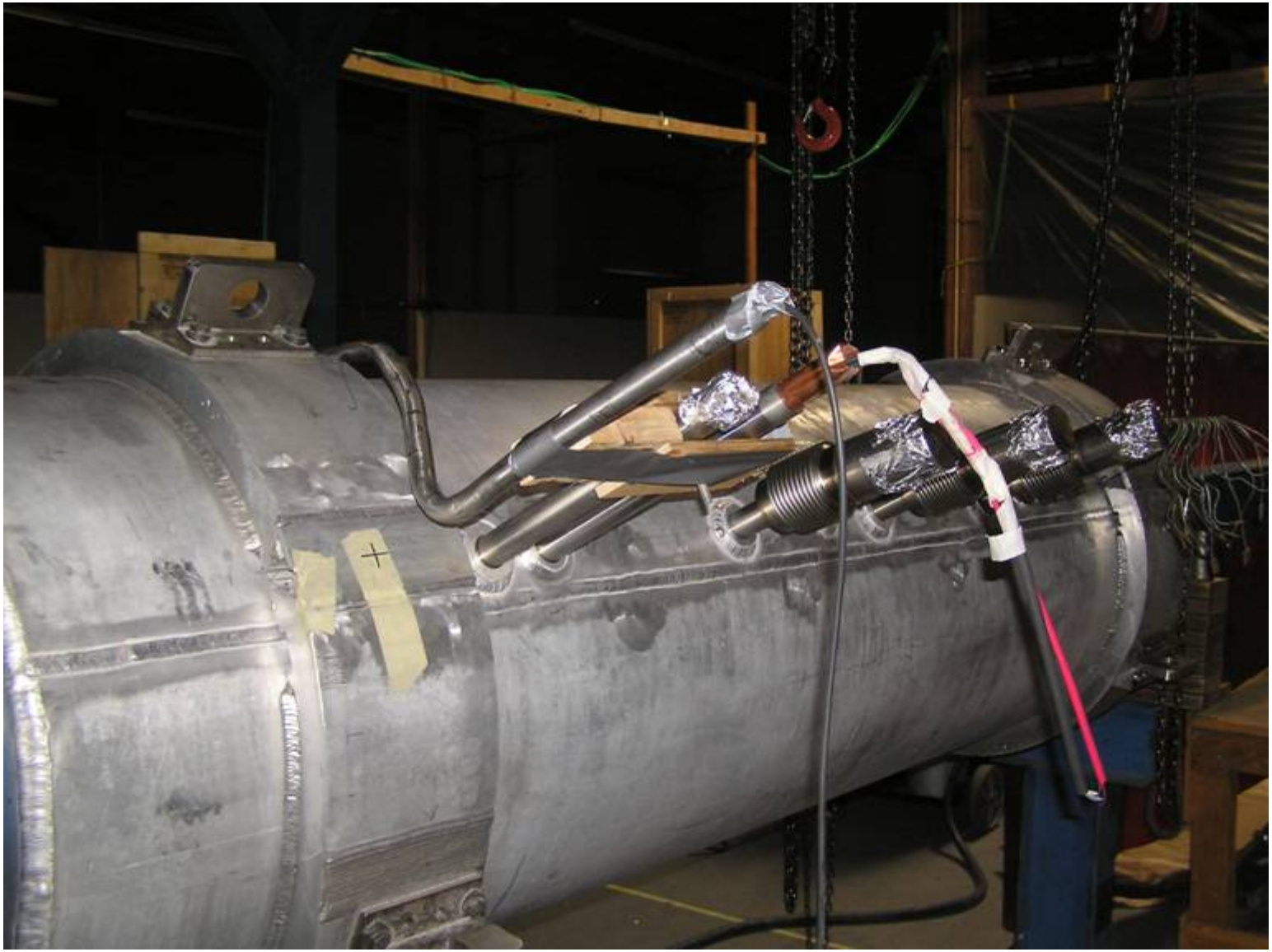
Alignment of cold mass in preparation for end plate installation

Magnet Cold Mass

Final assembly of cold mass feedthroughs (leads and cooler ports, Magnet 2)

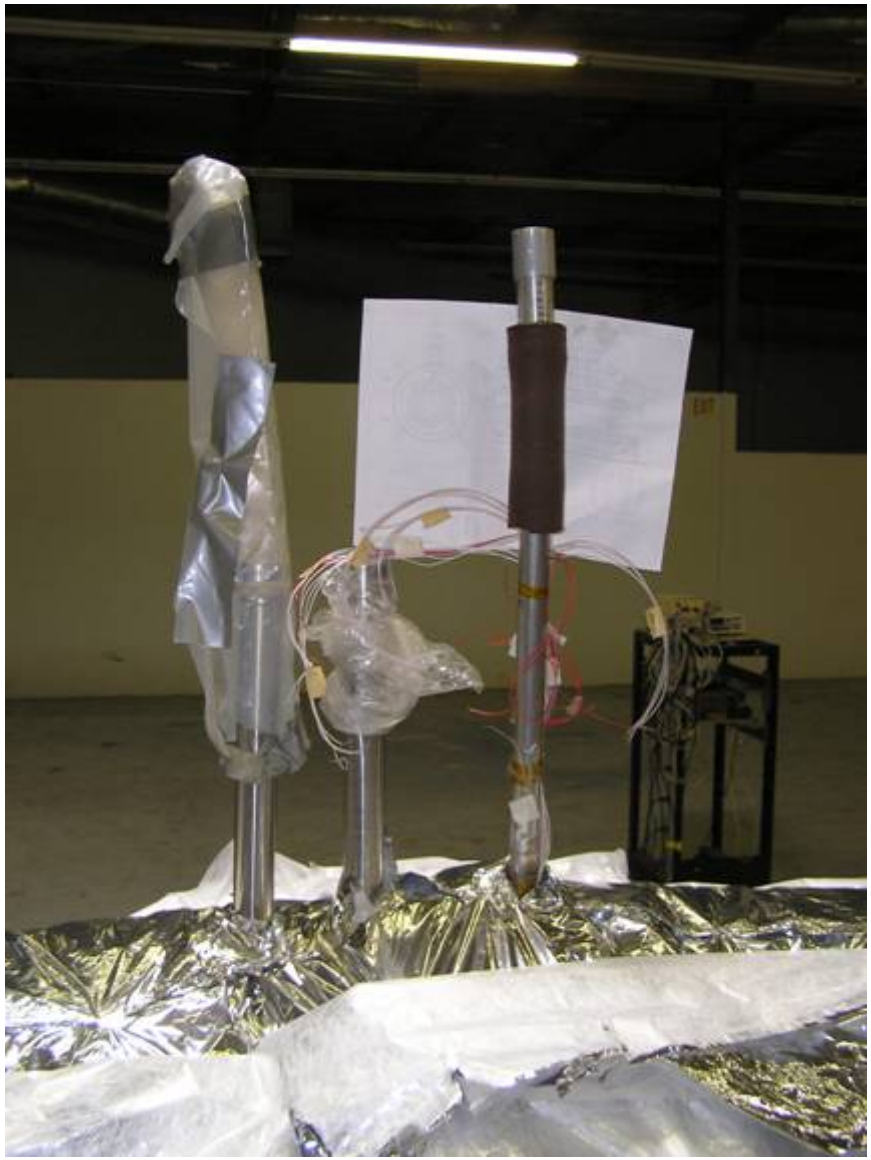
Cryocooler port manifold and connection sleeves/bellows

Final leak check of Magnet 1 cold mass assembly (2nd iteration)



Cold mass feedthroughs for Magnet 1 (2nd iteration)

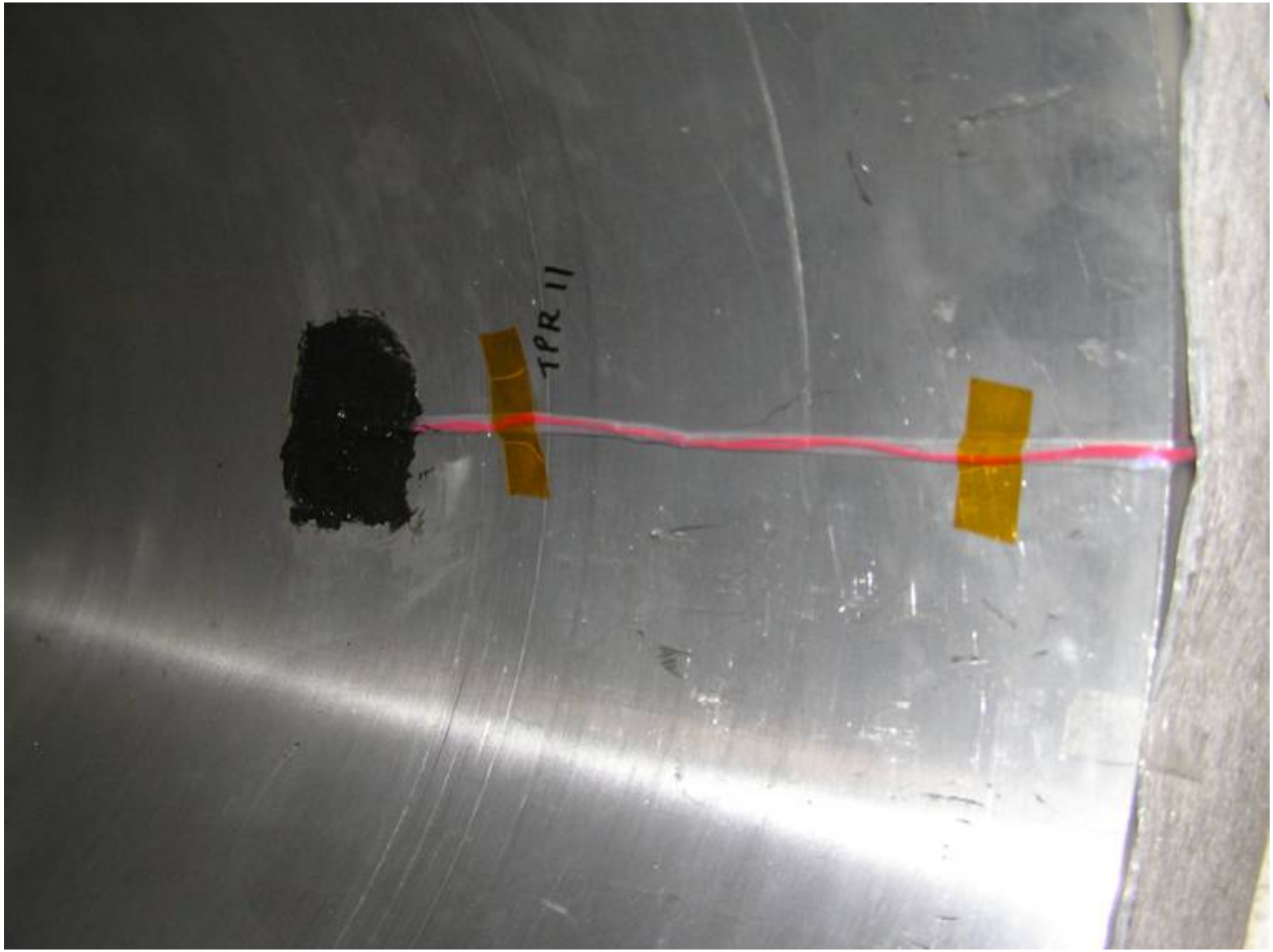
Newly configured cryogen fill tube for Magnet 1 (90º bends eliminated)



Cold mass fill and vent lines (w/instrumentation wires) for Magnet 1 (2nd iteration)

Cold mass connections during assembly into vacuum vessel (Magnet 1, 1st iteration)

Cold mass connections during assembly into vacuum vessel (Magnet 1, 1st iteration)



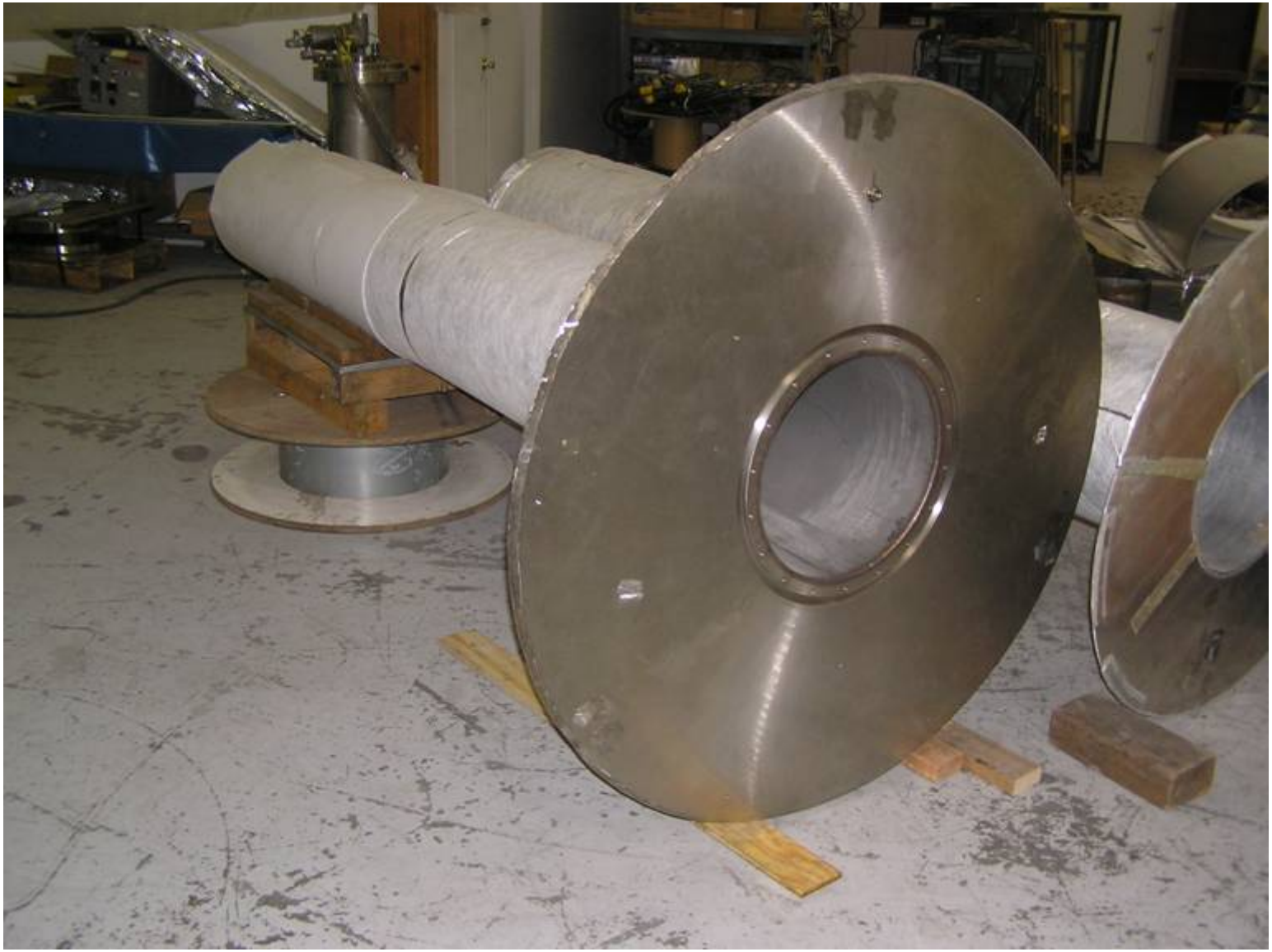
Temperature sensor installation on cold mass inner bore surface

Application of MLI

MLI wrapped cold mass in preparation for assembly into vacuum vessel (w/plastic cover)

MLI wrapping on thermal shield and cold mass

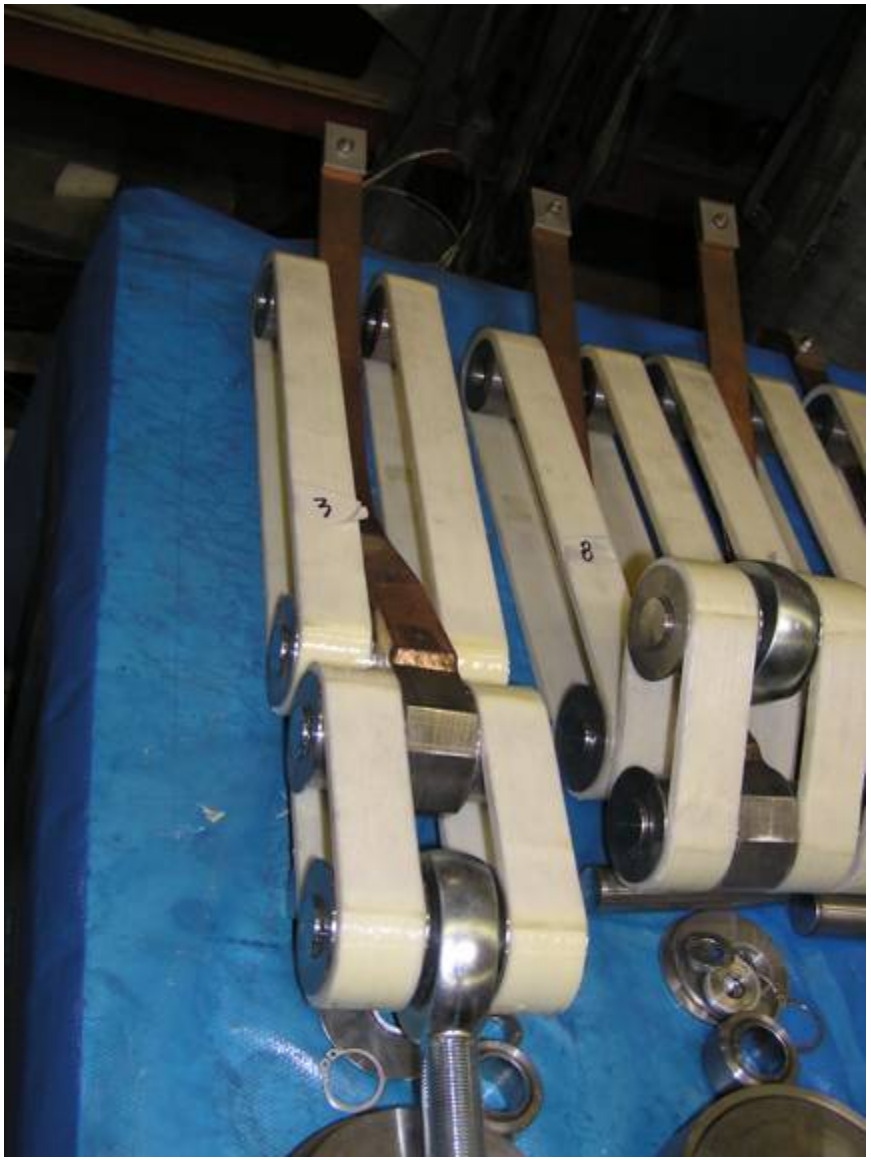
MLI wrapping on OD of thermal shield inner bore (left) and on OD of vacuum vessel inner (warm) bore (right)



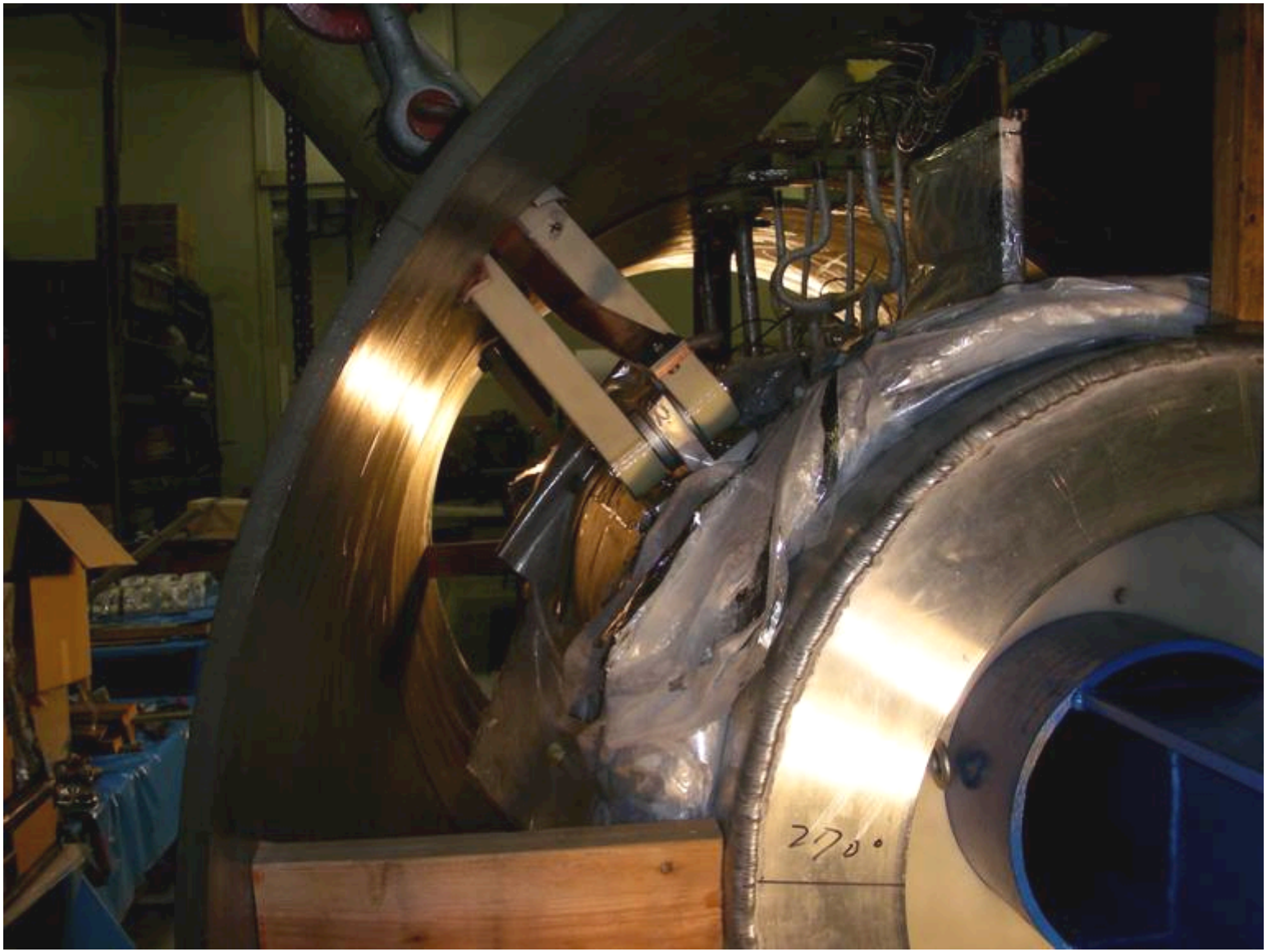
Vacuum vessel end plate/warm bore assembly ready for installation

MLI wrapped cryocooler sleeves and magnet leads in turret area

Cold Mass & Thermal Shield Supports



Cold mass supports with four fiberglass links and copper strap for shield intercept

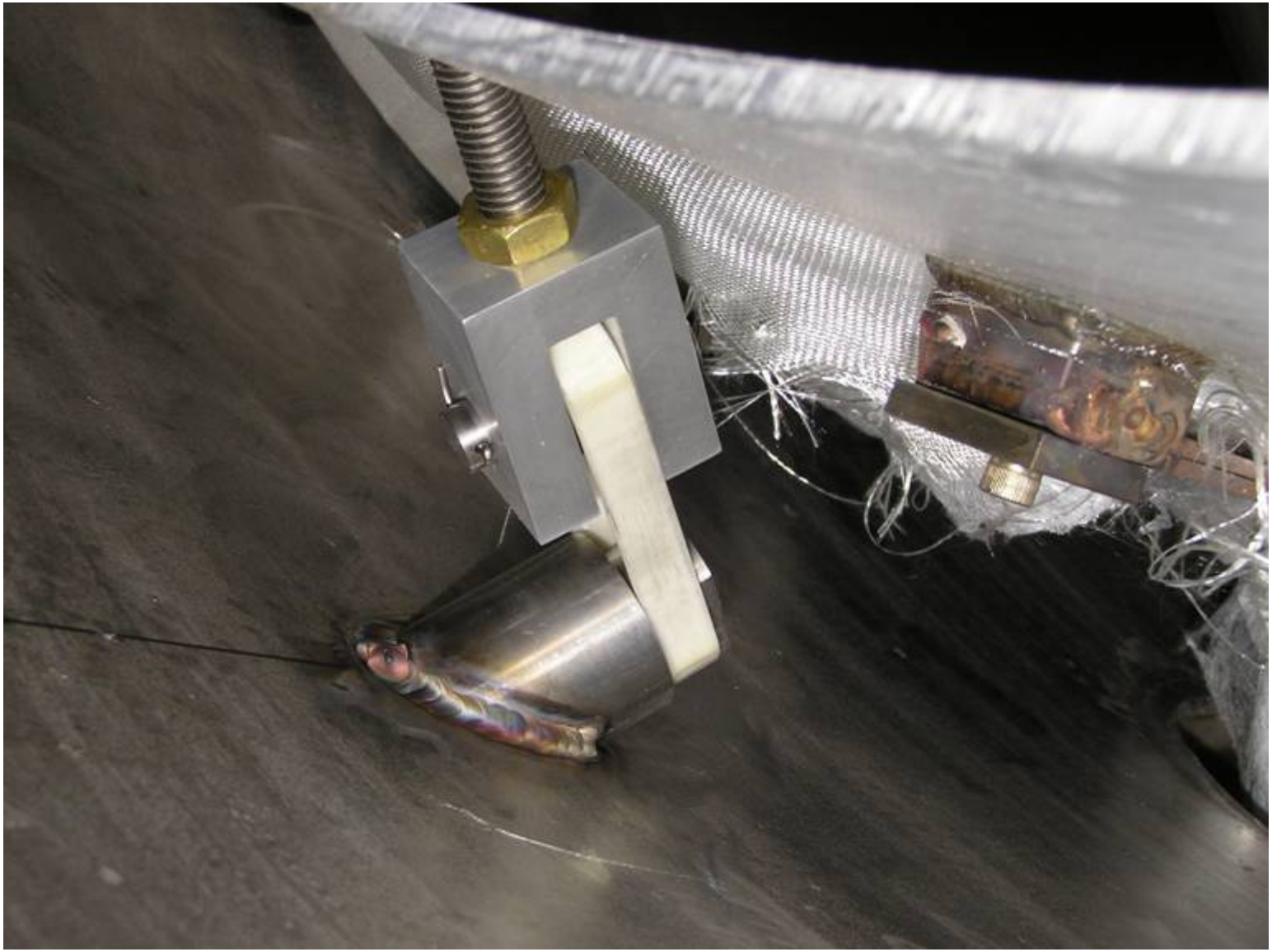


Cold mass support during fit up of cold mass into vacuum vessel (Magnet 1)

Cold mass support copper strap connection to thermal shield

Cold mass support copper strap connection and thermal shield support mount

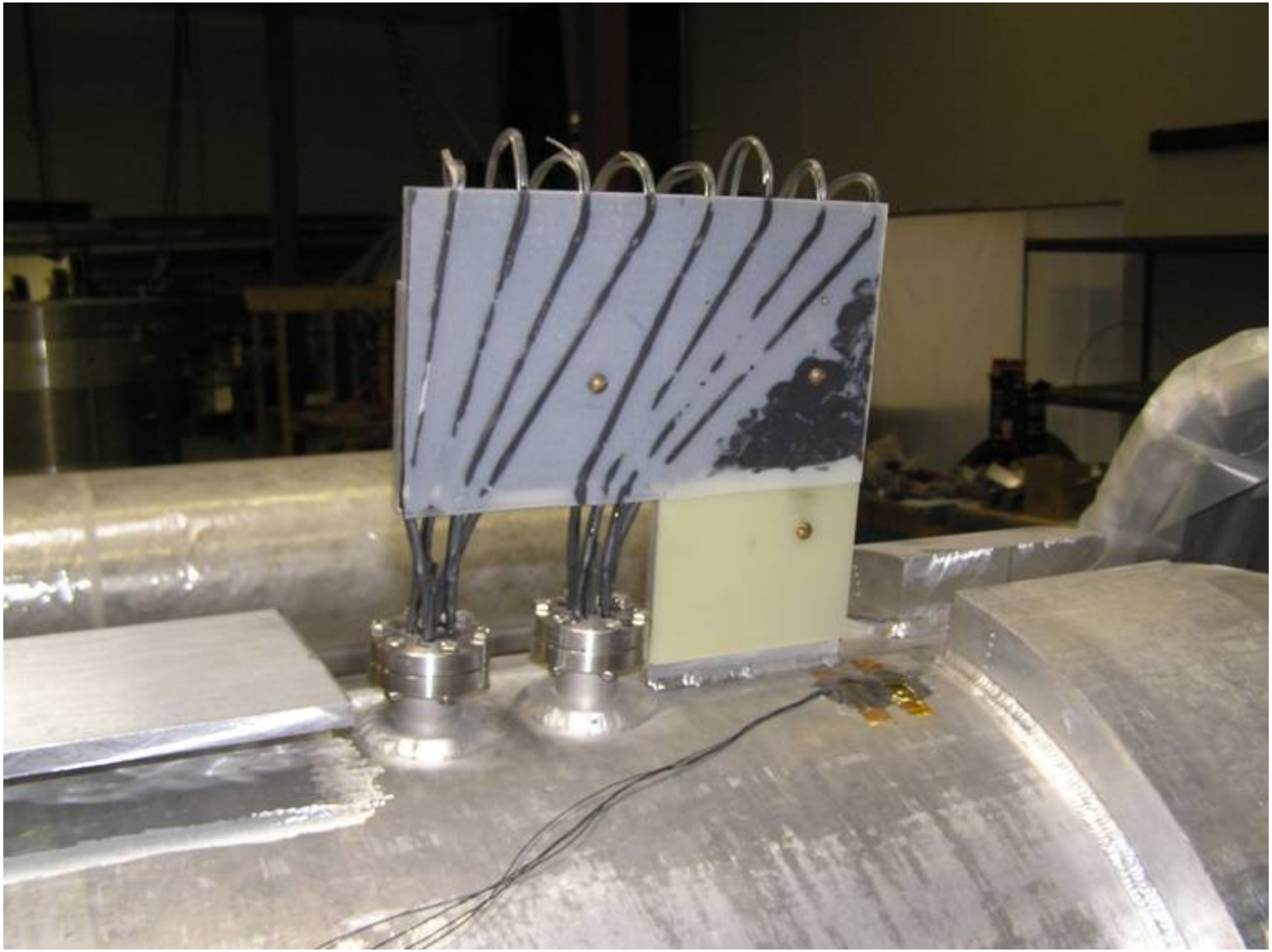
Fiberglass support band and clevis for thermal shield (4 at each end of shield)



Thermal shield support installed in magnet

Overall view of installed thermal shield support

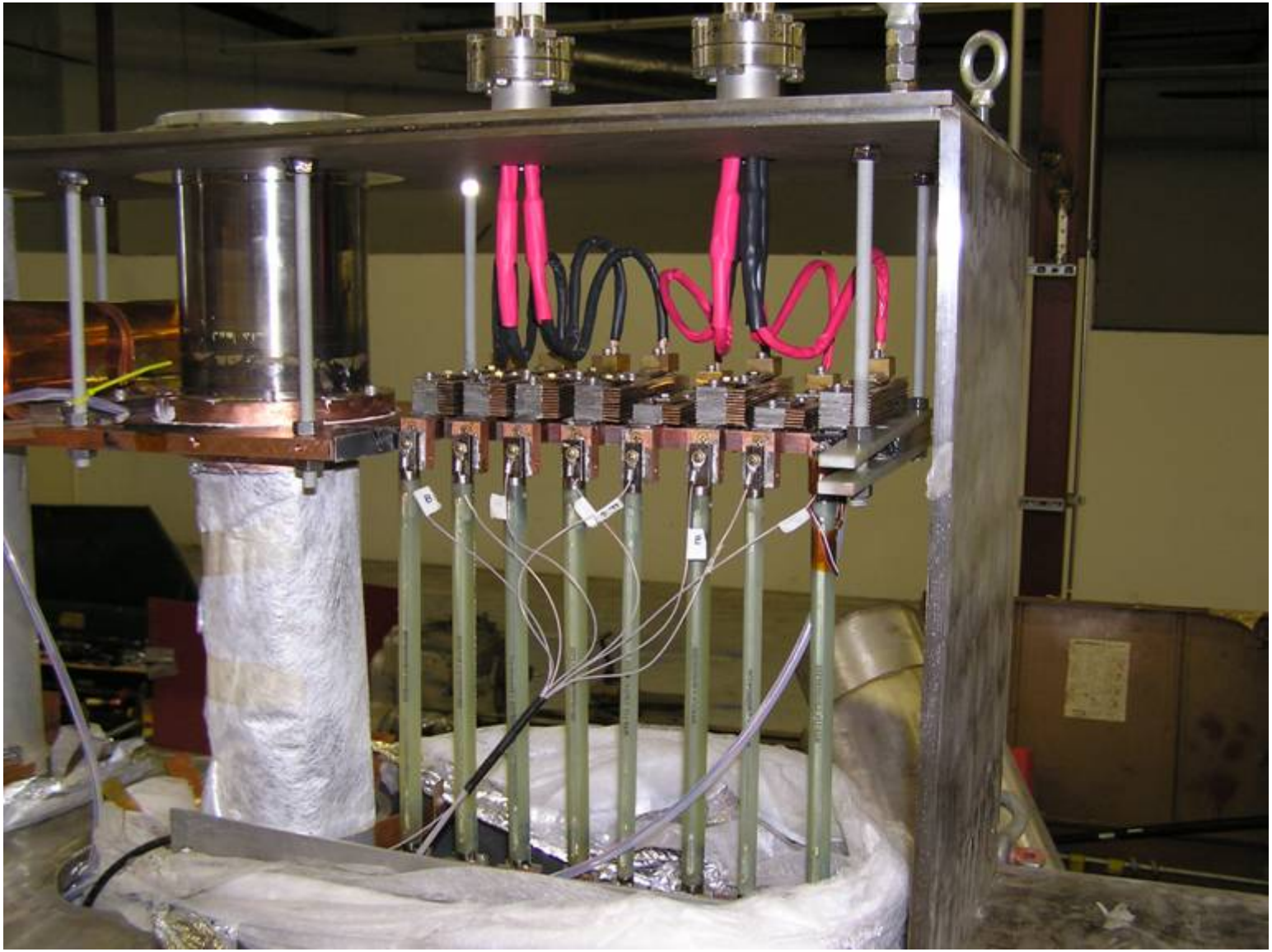
Magnet Coil Leads



Superconducting leads and support plate at cold mass feedthroughs (Magnet 2)

Coil taps and thermal intercepts for connection to lower ends of HTS leads

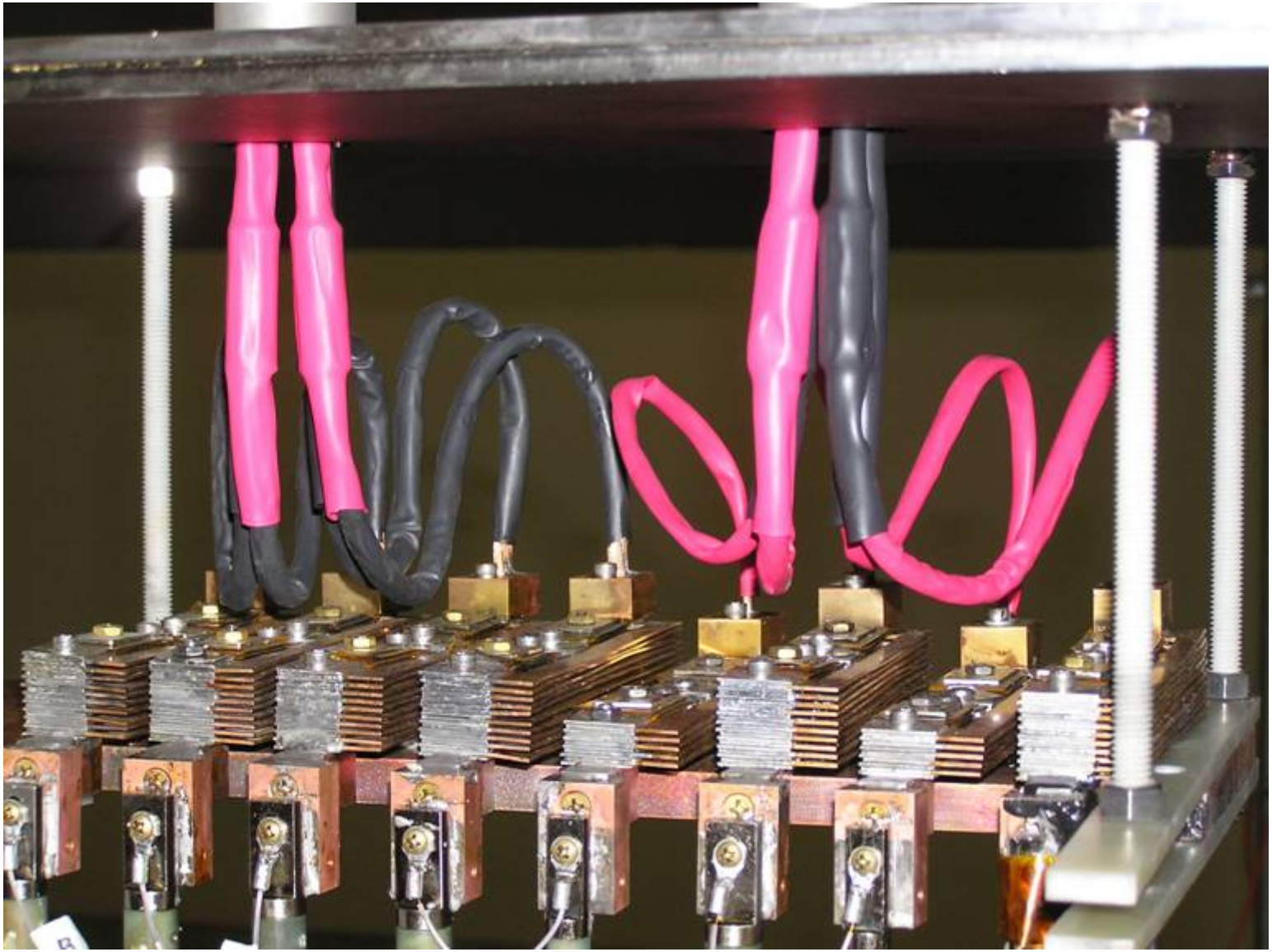
Close up showing coil tap and thermal intercept for lower end of HTS lead



Upper leads and HTS leads assembly in magnet turret

Upper leads and HTS leads assembly in magnet turret

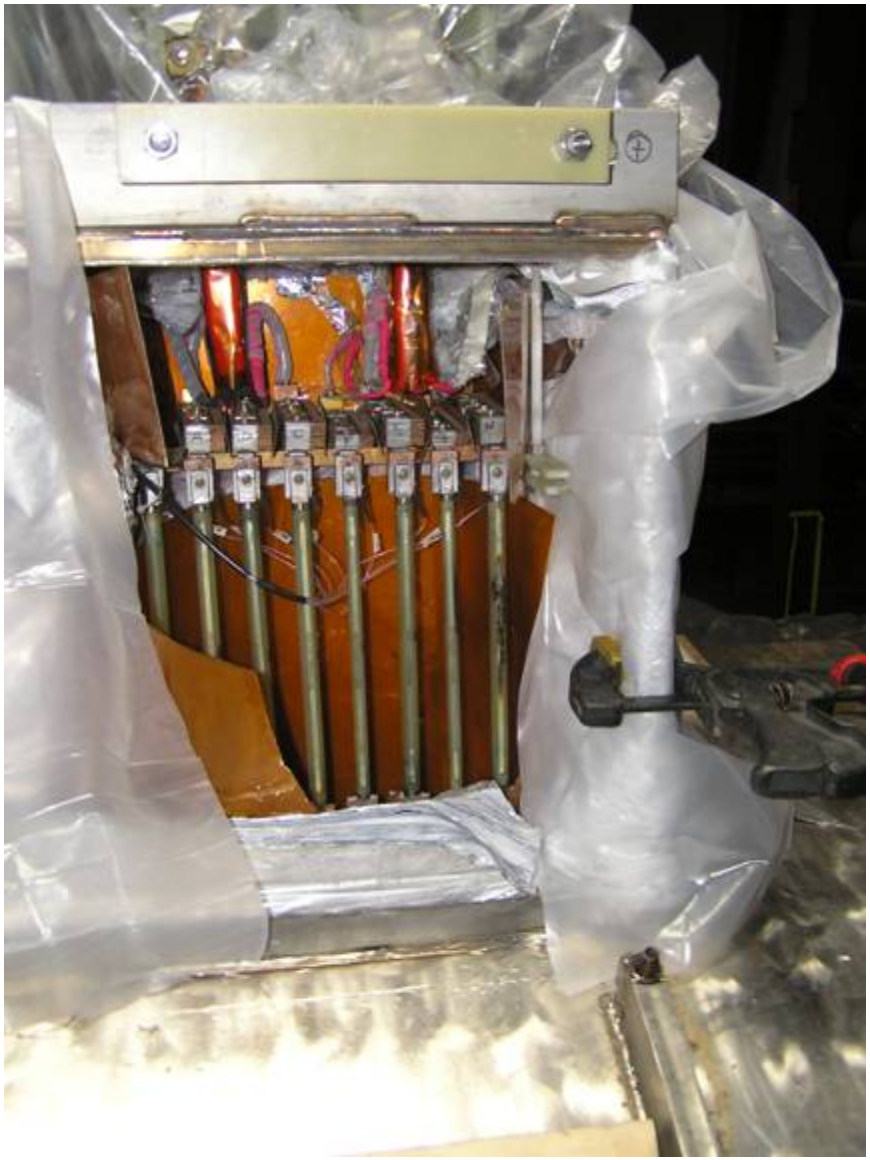
Upper leads detail showing thermal intercepts at 1st stage cryocooler plate



Close up of upper leads and thermal intercepts

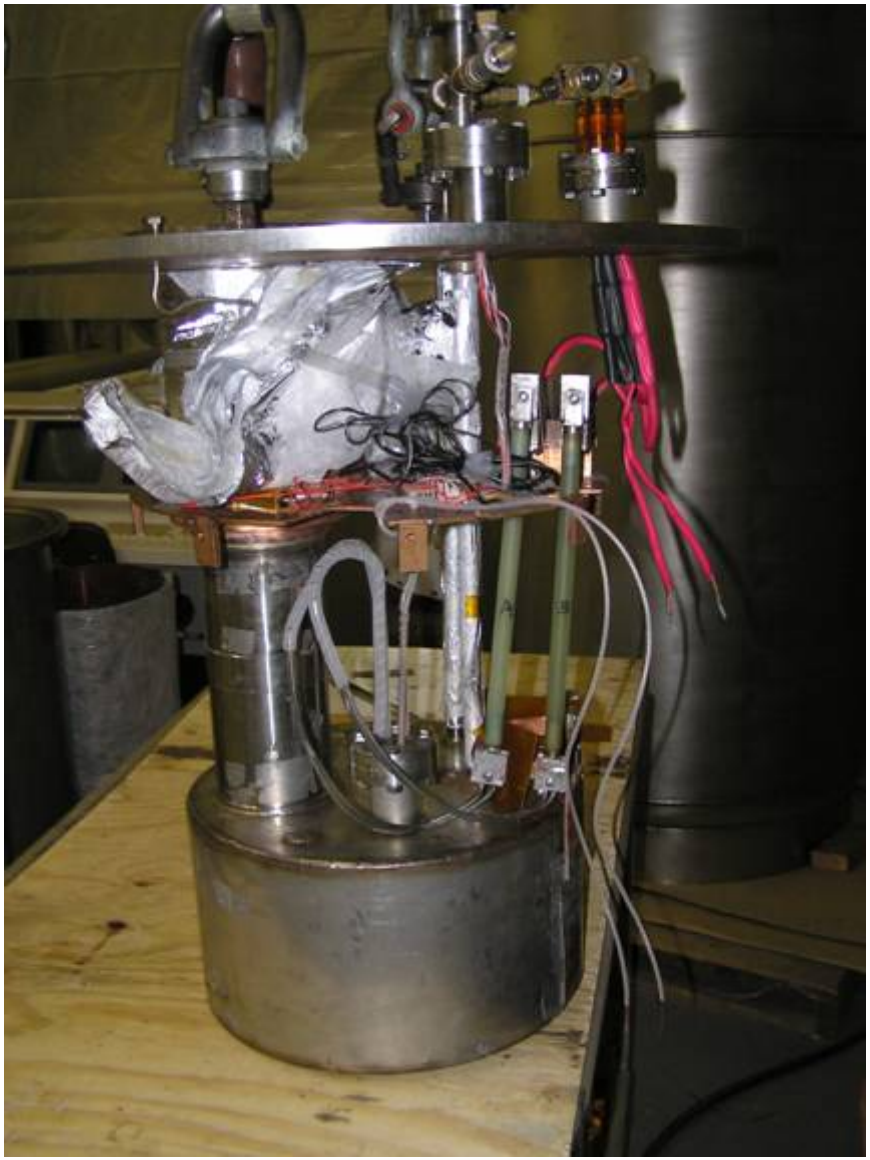
Upper leads and feedthrough for connection between 300K and 70K

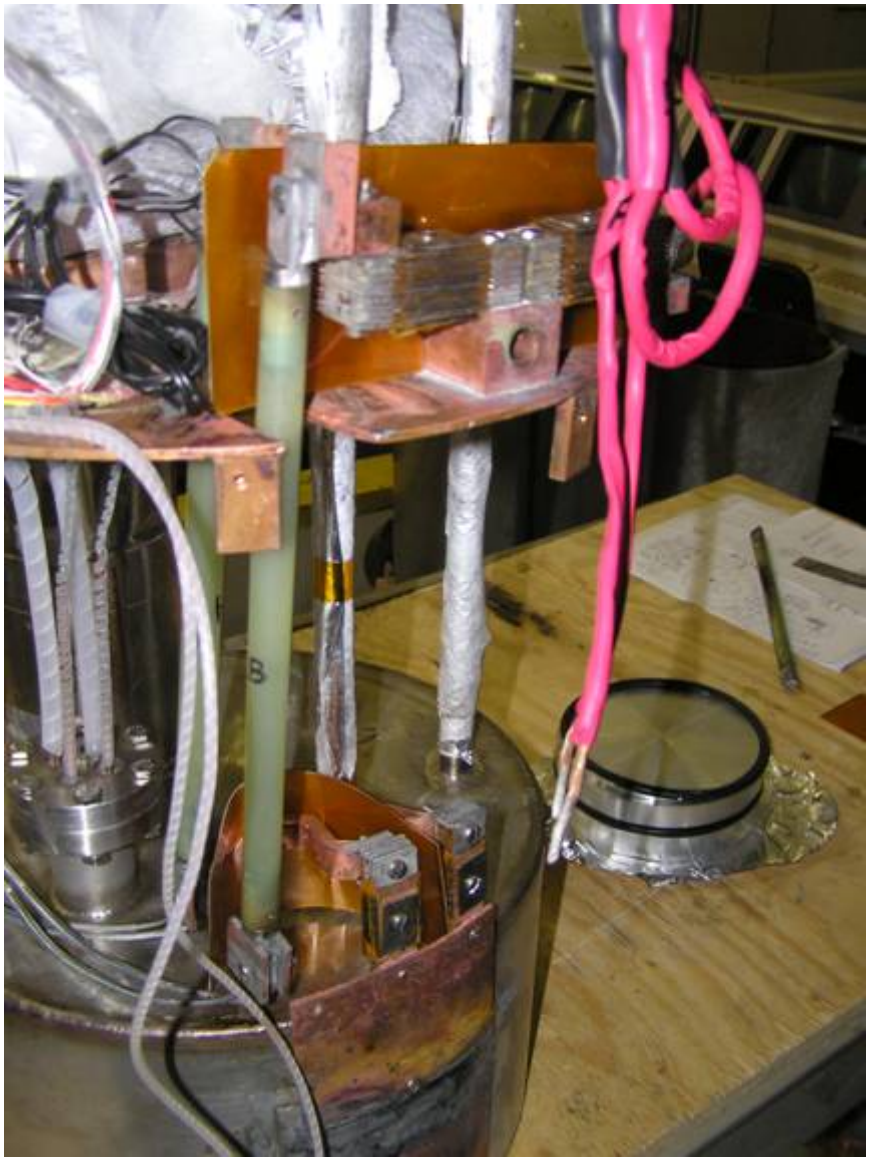
Thermal intercept assembly for connecting upper HTS leads and 1st stage cooler plate



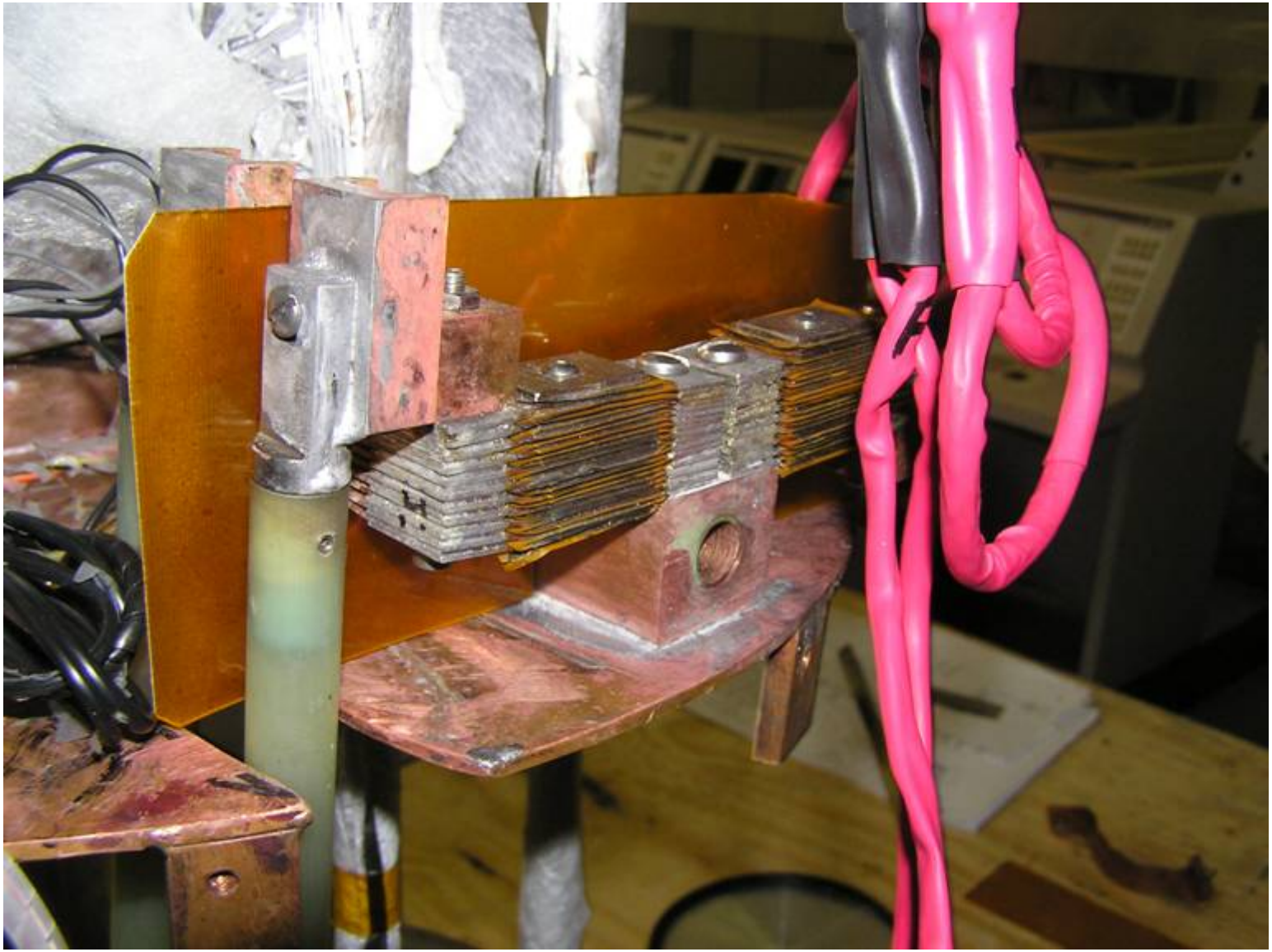
Magnet 2 HTS leads array showing burned out lead at far right

Magnet Lead Test

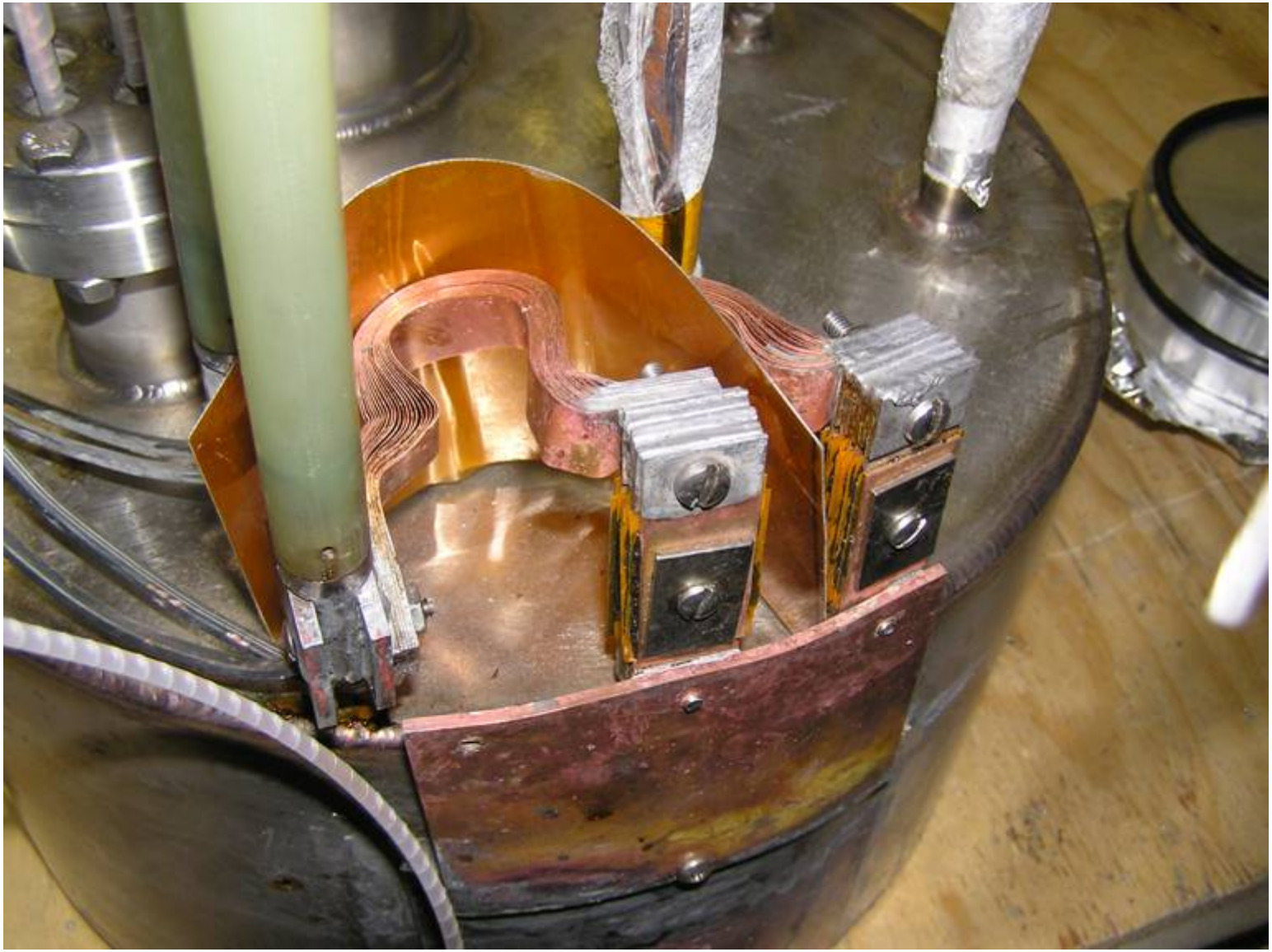




Cryocooler test rig modified to measure lead voltages and temperatures during operation



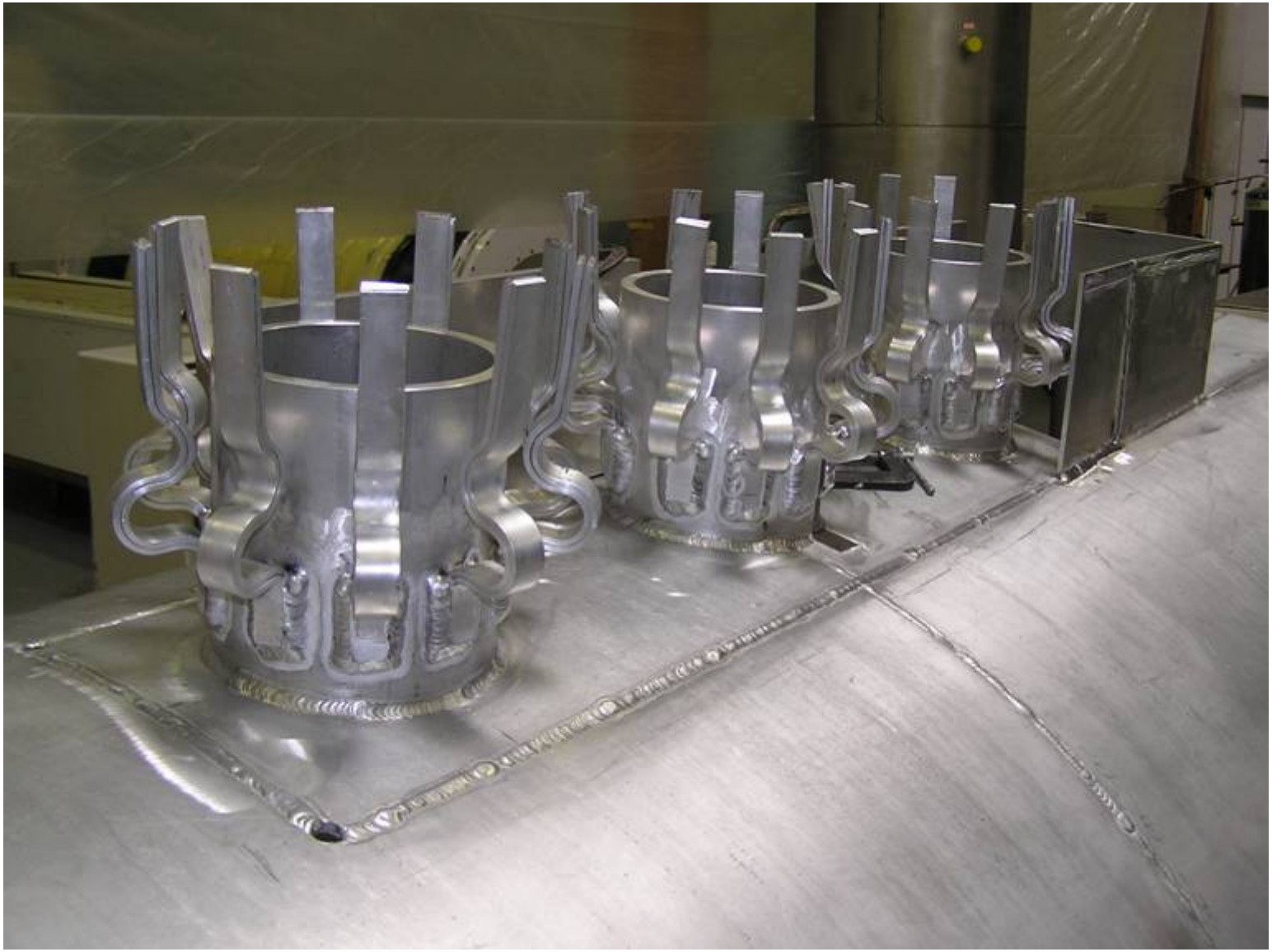
Thermal intercept to cooler 1st stage plate at upper end of HTS leads



Thermal intercept to He vessel (cold mass) at lower end of HTS leads

Thermal Shield Connections

Magnet thermal shield showing connections to cryocooler cooler 1st stage sleeves



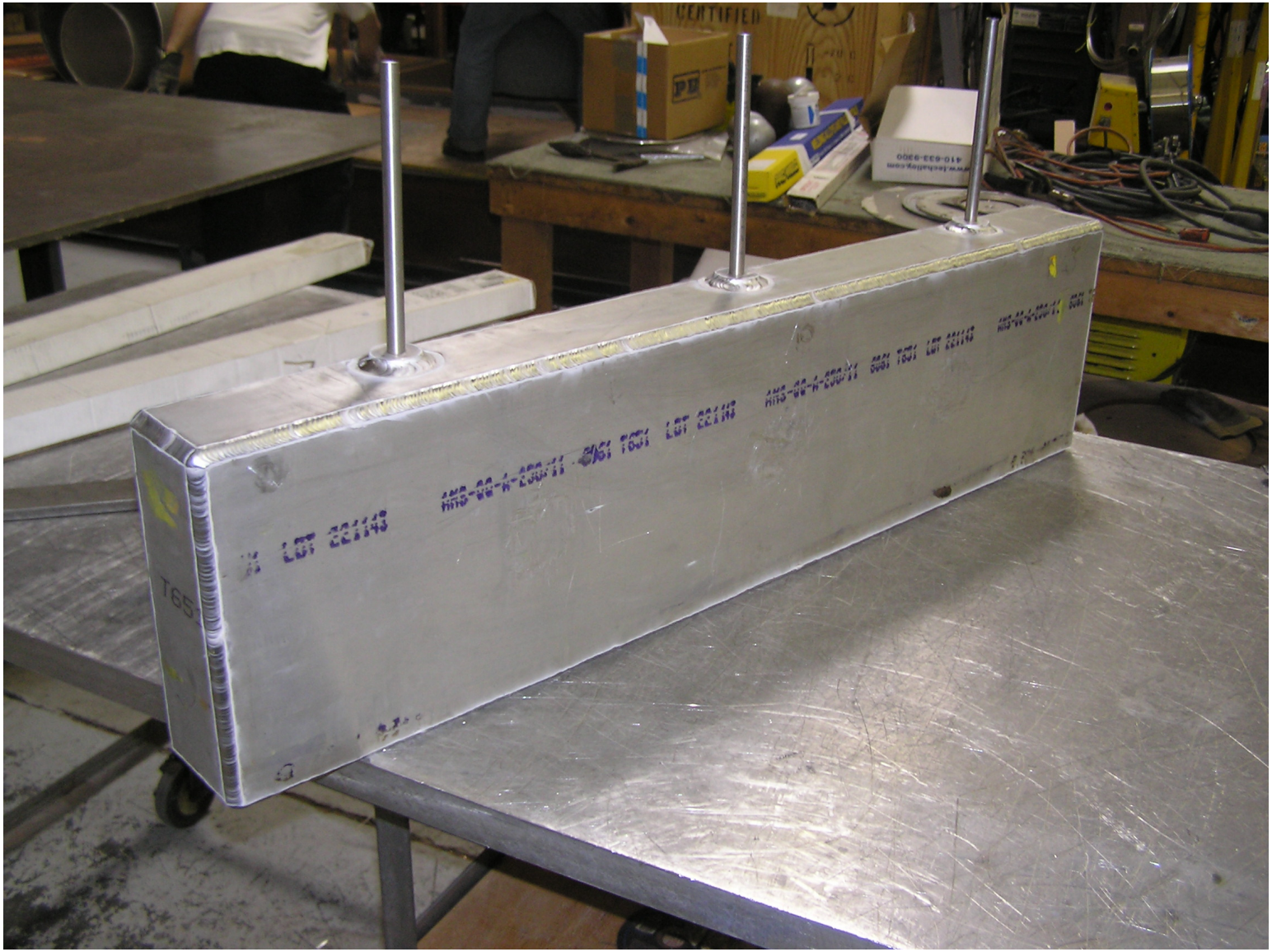
Close up of connections to cryocooler cooler 1st stage sleeves (sleeves not in place)

MLI wrapped shield with cryocooler 1st stage connections and plates welded to shield for LN reservoir attachment (Magnet 2)

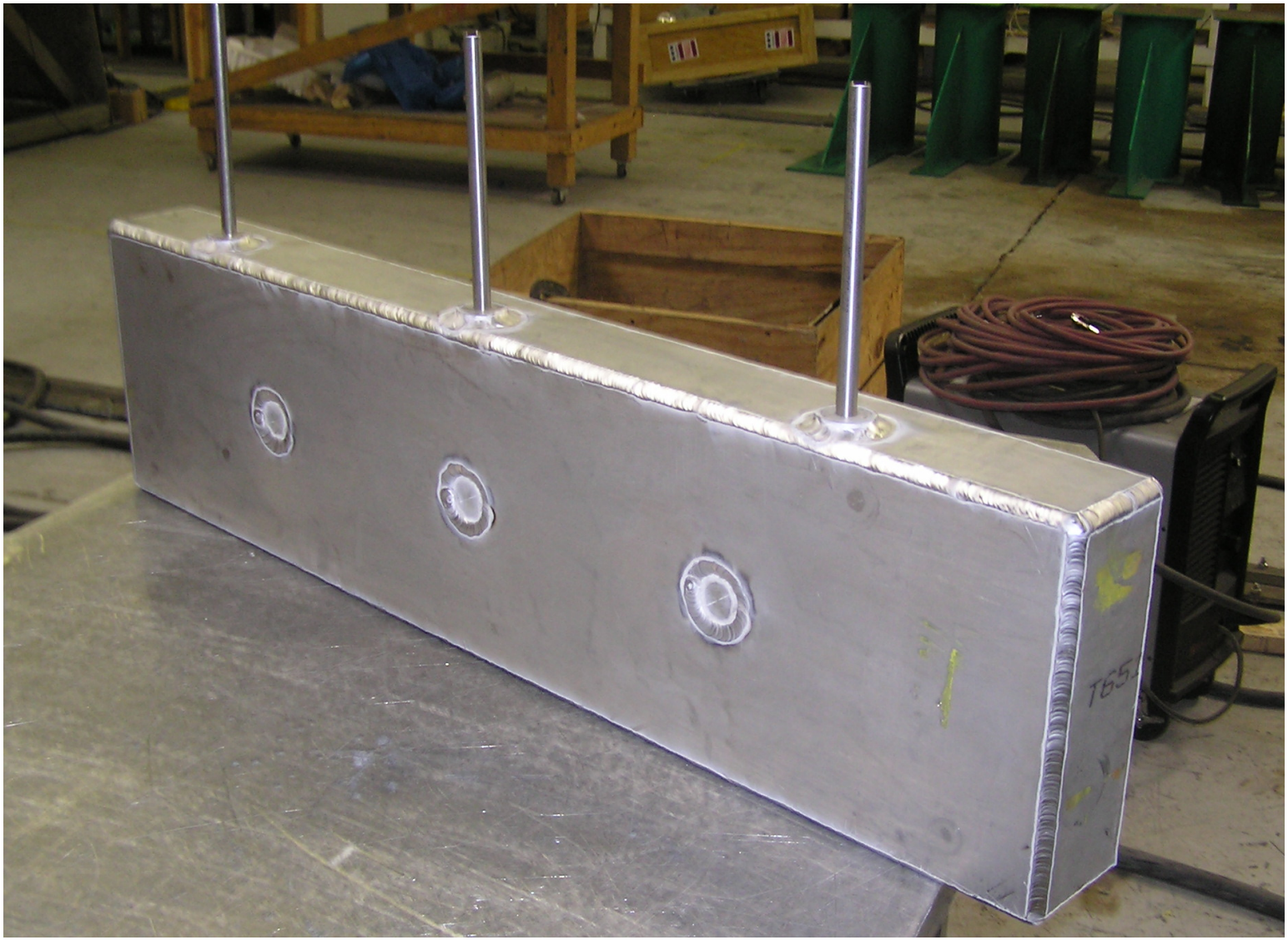
Upper end of cryocooler sleeve attachment to 1st stage copper plate

Cryocooler 1st stage sleeve attachment area (Magnet 1 w/thin Cu instead of thick 1100 Al)

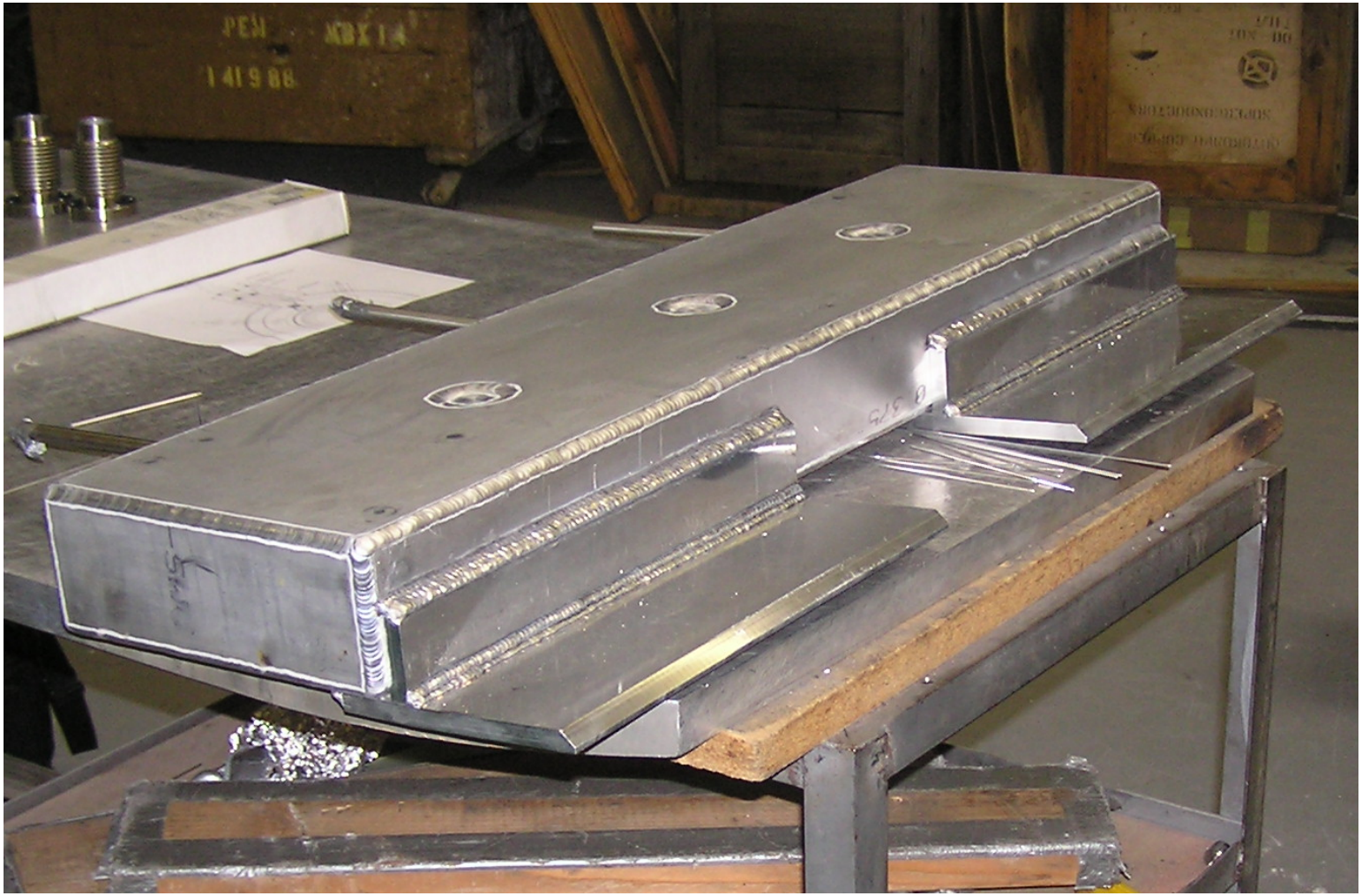
Shield LN Reservoir (Magnet 2)



Welded aluminum LN reservoir with fill/vent/level ports on top

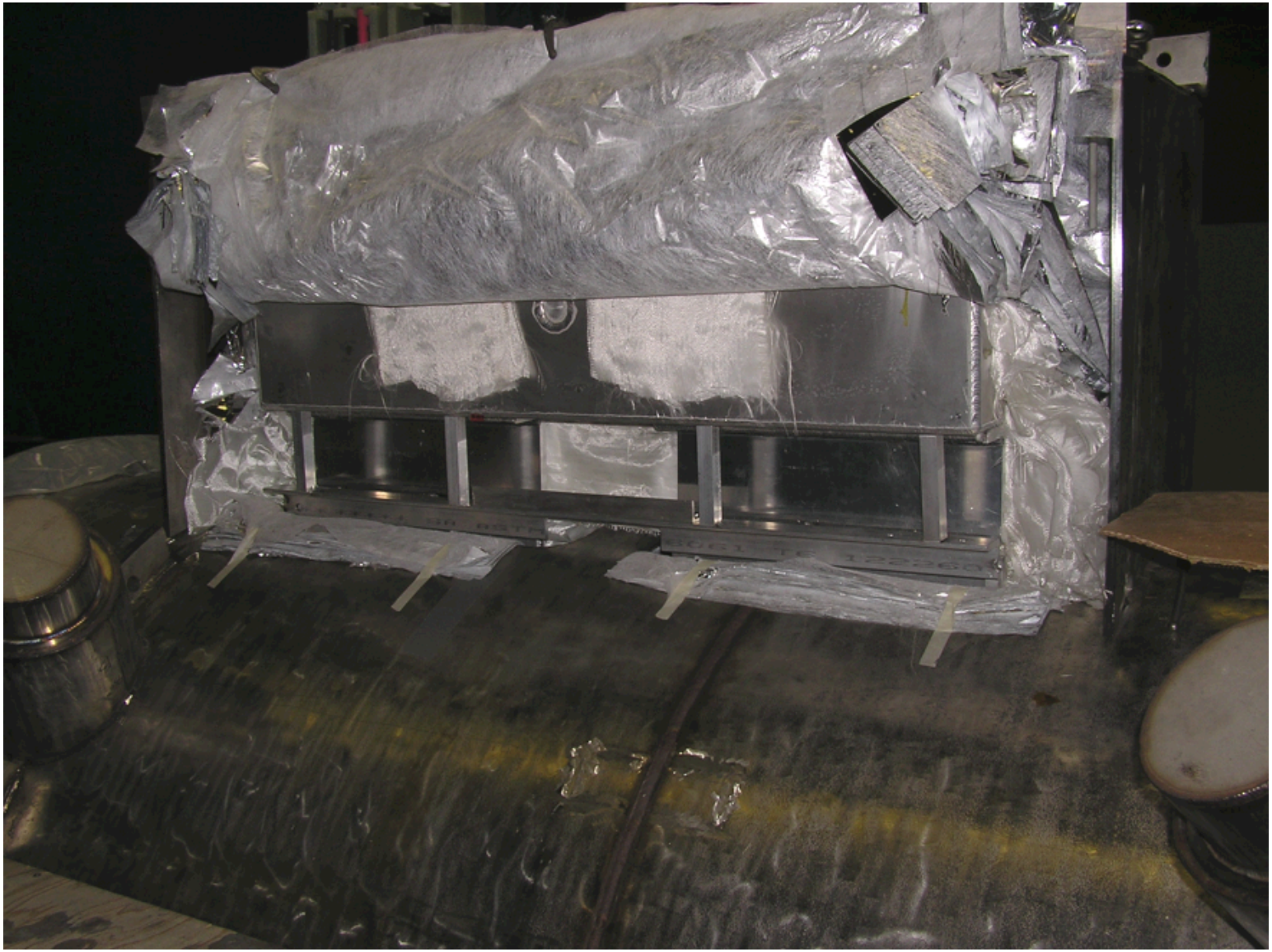


LN reservoir showing reinforcement posts at center



LN reservoir showing connection plates to be welded to thermal shield

Plates (in foreground) welded to thermal shield for LN reservoir attachment



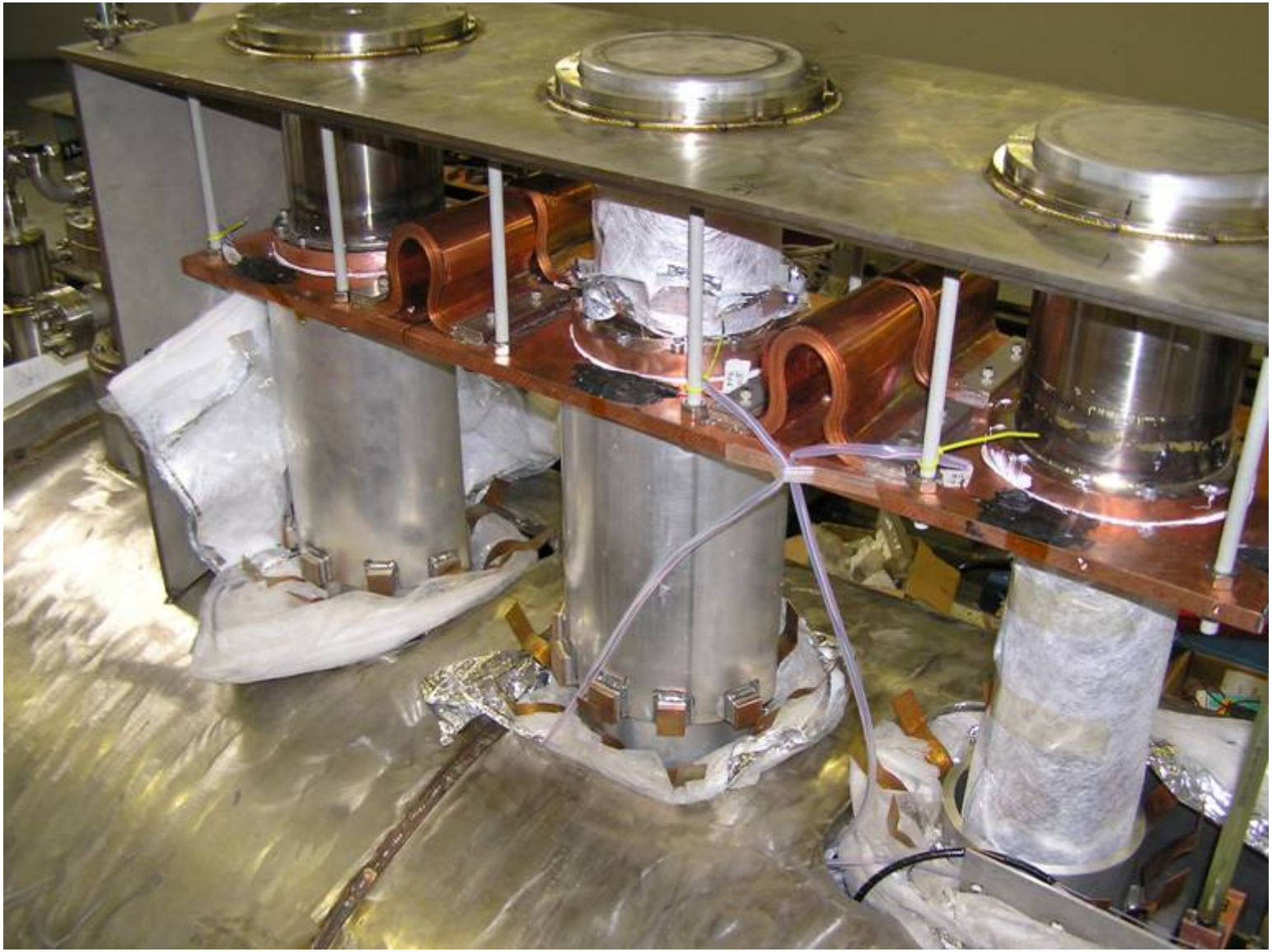
LN reservoir installed in magnet turret area

Drop-in Cryocooler Connections

Cryocooler sleeves and 1st stage copper plate (Magnet 1)

Cryocooler sleeves with MLI wrapping (Magnet 2)

Cryocooler sleeves with 1st stage connection to shield being assembled (Magnet 1)



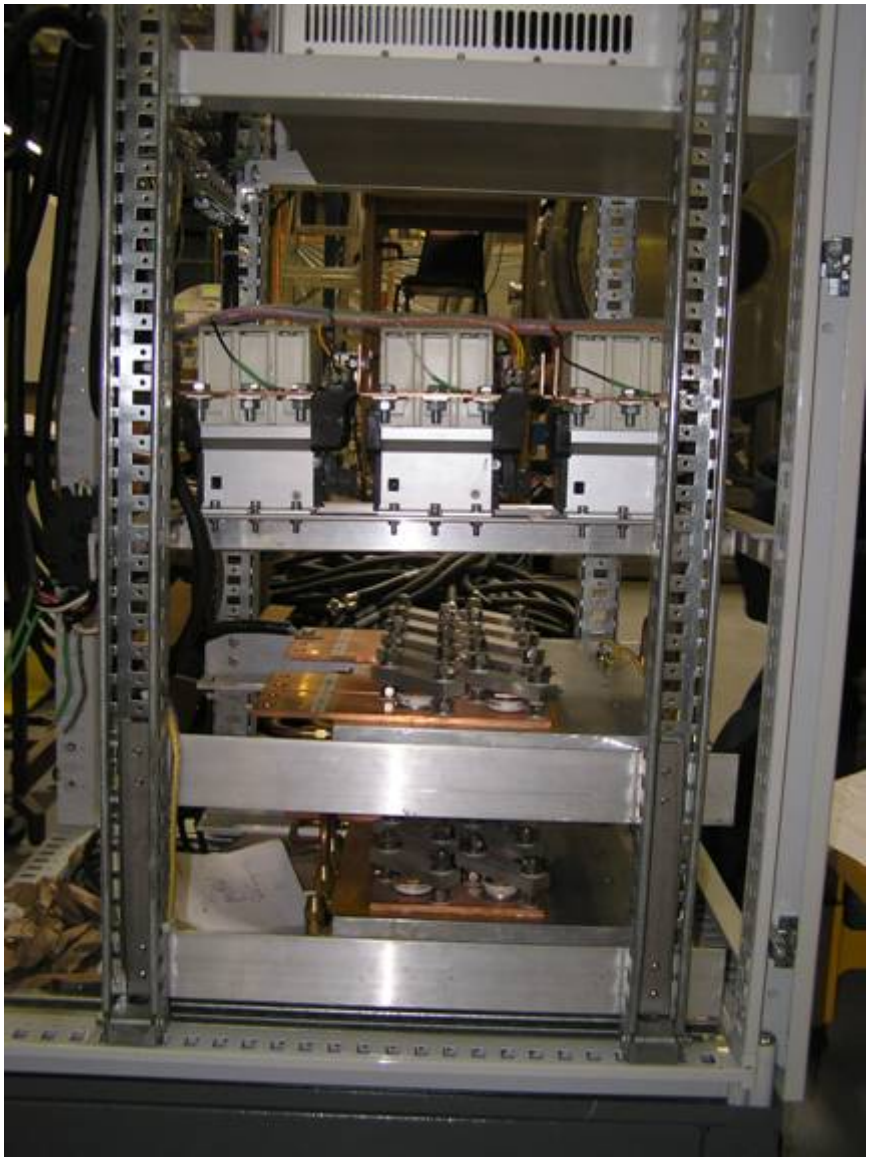
1st stage connection to thermal shield in place (Magnet 1)

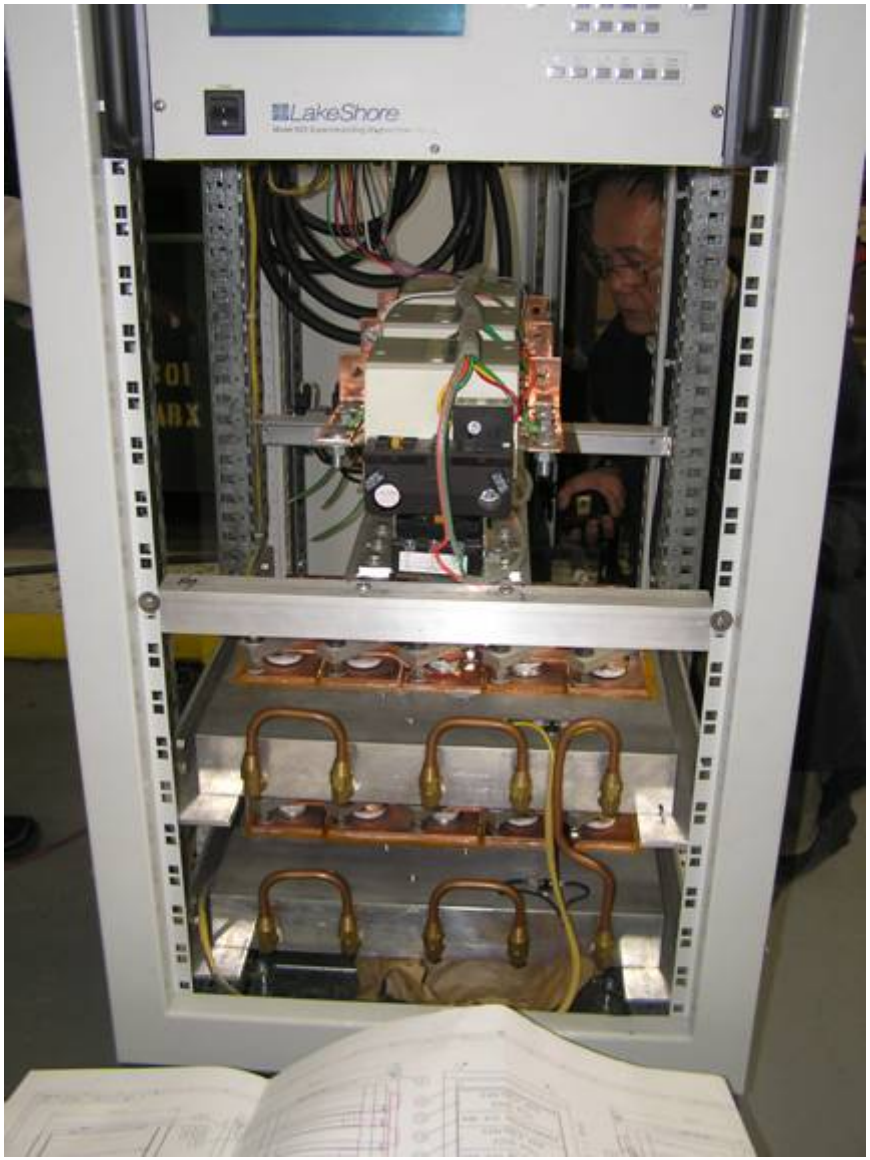
Magnet Cool Down

Magnet cooldown using liquid helium (Magnet 2)

Power Supplies and Racks

Front and rear views of assembled RAL racks for powering a single Spectrometer Solenoid





Front and side views of switches and power absorbing blocks for magnet discharge circuits