# Projects Update

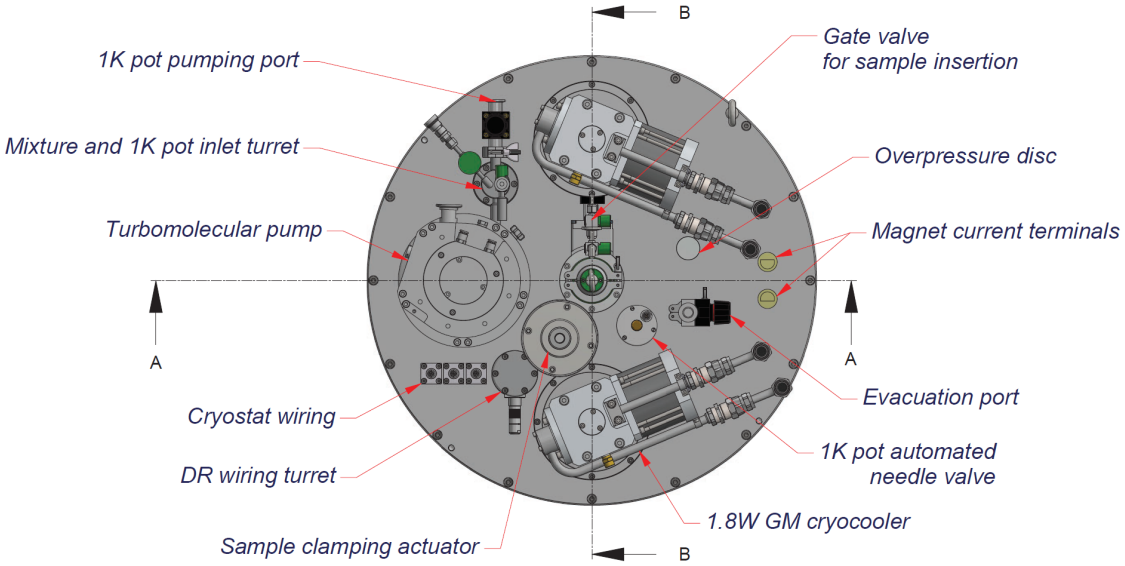
**S. E.:**

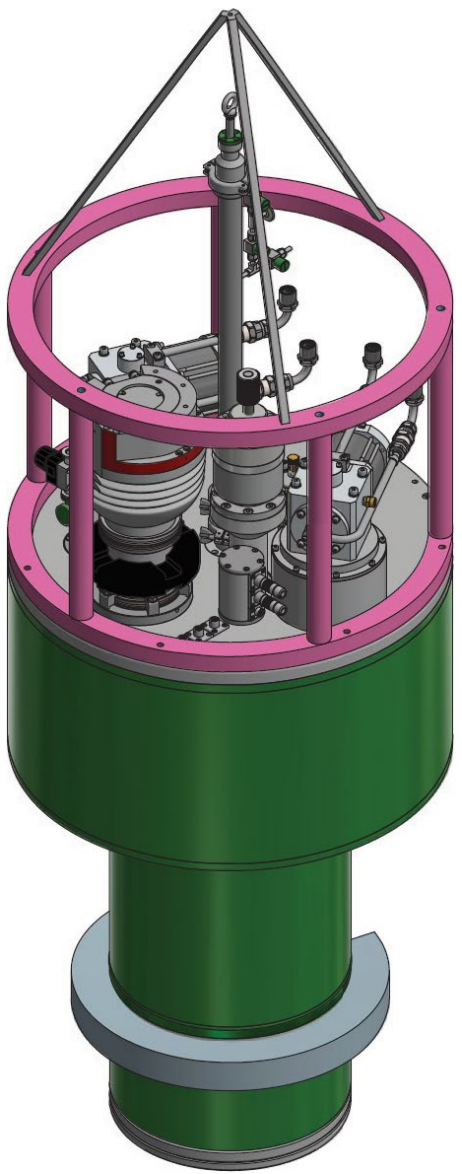
- ✓ 12T Dry Cryomagnet
- ✓ Syringe Pump System
- ✓ Test HT SANS Block Pressure Cells
- ✓ High Pressure Systems
- ✓ 2 kbar $H_2$ Pressure System
- ✓ Empty Vanadium Powder Cans
- ✓ Gas Loading System
- ✓ Reflectometry Furnace
- ✓ Training, and assistance for post-docs

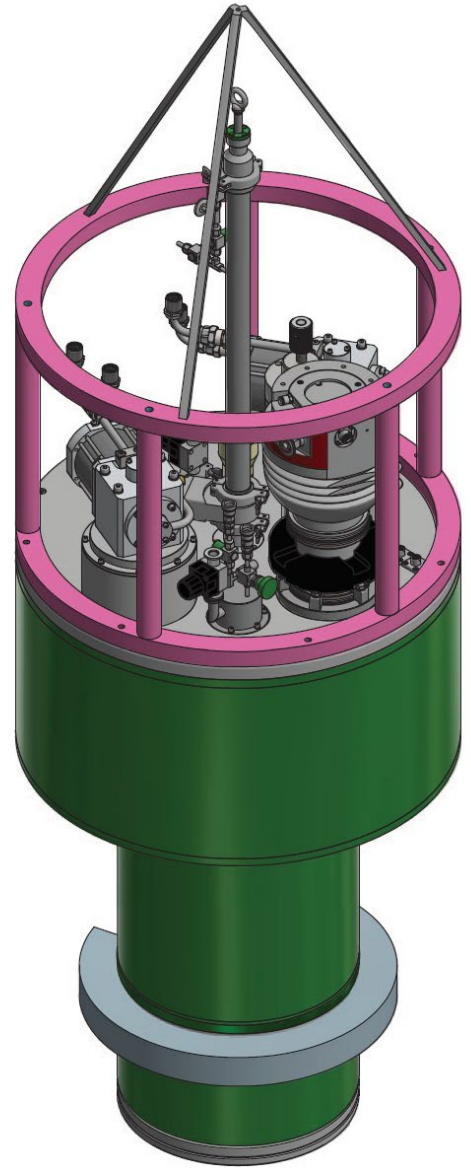
Juscelino Leão

# 12 T Dry Cryomagnet

- Integrated 50 mK Dilution Refrigerator and GHS
- +/- 12 T symmetric vertical field
- 35mm split
- +/- 4-degree beam divergence
- Dark Angle: 40 degrees
- Dil Fridge 60+ microWatt minimum cooling power @100 mK





# 12T Production Plan

CRYOGENIC
CRYOGENIC LIMITED

| | Oct-20 | Nov-20 | Dec-20 | Jan-21 | Feb-21 | Mar-21 | Apr-21 | May-21 | Jun-21 | Jul-21 | Aug-21 | Sep-21 | Oct-21 | Nov-21 | Dec-21 | Jan-22 | Feb-22 | Mar-22 | Apr-22 | May-22 | Jun-22 | Jul-22 | Aug-22 | Sep-22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| Order placed | ● | | | | | | | | | | | | | | | | | | | | | | | |
| Design of magnet and cryostat | ●●● | ●●●● | ●●●● | | | | | | | | | | | | | | | | | | | | | |
| Design of DR system | | | | ●●●● | ●●●● | ●●●● | | | | | | | | | | | | | | | | | | |
| Finalisation of neutron shielding | | | ●● | ●●●● | ●●●● | ●● | | | | | | | | | | | | | | | | | | |
| Frame and integration design | | | | ●● | ●●●● | ●●●● | | | | | | | | | | | | | | | | | | |
| Compile full design and structural report | | | | | | ●● | ●● | | | | | | | | | | | | | | | | | |
| Nist Design review | | | | | | | ●● | | | | | | | | | | | | | | | | | |
| Post review discussion and modification | | | | | | | | ●● | | | | | | | | | | | | | | | | |
| Preparation of component drawings and BOM | | | | | | ●●●● | ●●●● | ●●●● | | | | | | | | | | | | | | | | |
| Sign off design | | | | | | | | | ●● | | | | | | | | | | | | | | | |
| Machining of cryostat parts | | | | | | | | | ●● | ●●●● | ●●●● | ●●●● | | | | | | | | | | | | |
| Cryostat welding | | | | | | | | | | | | | ●● | | | | | | | | | | | |
| Outer painting | | | | | | | | | | | | | | ●● | | | | | | | | | | |
| Manufacture radiation shield | | | | | | | | | | | | | | ●● | | | | | | | | | | |
| Coil winding | | | | | | | | | | | | | ●● | ●●● | | | | | | | | | | |
| Coil reaction | | | | | | | | | | | | | | ●● | | | | | | | | | | |
| Casting and finishing | | | | | | | | | | | | | | | ●●● | | | | | | | | | |
| Split-pair assembly | | | | | | | | | | | | | | | ●● | ●● | | | | | | | | |
| Assembly of Cryomagnet system including integral DR | | | | | | | | | | | | | ●● | ●●●● | ●●●● | ●●●● | ●● | | | | | | | |
| He-3 Required from NIST | | | | | | | | | | | | | | ●● | | | | | | | | | | |
| Main system test | | | | | | | | | | | | | | | | | ●● | ●● | | | | | | |
| He-3 and DR test | | | | | | | | | | | | | | | | | | ●●●● | | | | | | |
| Test contingency | | | | | | | | | | | | | | | | | | | ●●●● | | | | | |
| FAT | | | | | | | | | | | | | | | | | | | | ●● | | | | |
| Pack and Ship | | | | | | | | | | | | | | | | | | | | | ●● | | | |
| On-site comissioning | | | | | | | | | | | | | | | | | | | | | ●●●● | | | |
| Final Sign-off and payment | | | | | | | | | | | | | | | | | | | | | | ● | | |

# 12T Production Plan

CRYOGENIC
CRYOGENIC LIMITED

NOW — NCNR DEMO — NCNR INSTALL

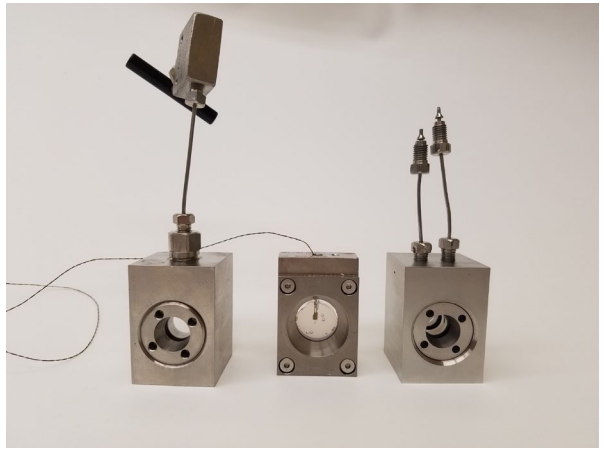
| Operation | 8/1<br>31 | 8/8<br>32 | 8/15<br>33 | 8/22<br>34 | 8/29<br>35 | 9/5<br>36 | 9/12<br>37 | 9/19<br>38 | 9/26<br>39 | 10/3<br>40 | 10/10<br>41 | 10/17<br>42 | 10/24<br>43 | 10/31<br>44 | 11/7<br>45 | 11/14<br>46 | 11/21<br>47 | 11/28<br>48 | 12/5<br>49 | 12/12<br>50 | 12/19<br>51 | 12/26<br>52 | 1/2<br>1 | 1/9<br>2 | 1/16<br>3 | 1/23<br>4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Prepare magnet for test operation | ● | ● | ● | ● | ● | ● | | | | | | | | | | | | | | | | | | | | |
| Make cooling links to magnet | ● | ● | | | | | | | | | | | | | | | | | | | | | | | | |
| Attach current leads to magnet | | | ● | | | | | | | | | | | | | | | | | | | | | | | |
| Connect protection circuit | | | ● | | | | | | | | | | | | | | | | | | | | | | | |
| Wire thermometry | | | | ● | | | | | | | | | | | | | | | | | | | | | | |
| Fit shield and outer (plus tie rods) | | | | ● | | | | | | | | | | | | | | | | | | | | | | |
| Test of cryomagnet | | | | | ● | ● | | | | | | | | | | | | | | | | | | | | |
| Preparation of DR Components | | ● | ● | ● | ● | ● | | | | | | | | | | | | | | | | | | | | |
| Remaining DR parts to machine | | ● | ● | ● | | | | | | | | | | | | | | | | | | | | | | |
| Prepare Still | | | ● | ● | | | | | | | | | | | | | | | | | | | | | | |
| Prepare 1K pot | | | ● | ● | | | | | | | | | | | | | | | | | | | | | | |
| Prepare mixing chamber | | | ● | ● | ● | | | | | | | | | | | | | | | | | | | | | |
| Prepare ULT coupler | | | ● | ● | ● | ● | | | | | | | | | | | | | | | | | | | | |
| Prepare heat exchangers | | | | ● | ● | | | | | | | | | | | | | | | | | | | | | |
| Assembly of DR without magnet for test | | | | | | | ● | ● | ● | ● | ● | | | | | | | | | | | | | | | |
| Disconnect and remove magnet | | | | | | | ● | | | | | | | | | | | | | | | | | | | |
| Install 2nd stage plate with still, 1kpot lines | | | | | | | ● | ● | | | | | | | | | | | | | | | | | | |
| Make all integral joints, mixing pot, etc | | | | | | | | ● | ● | | | | | | | | | | | | | | | | | |
| Top plate configuration (pump, probe line, needle valve) | | | | | | | | | ● | | | | | | | | | | | | | | | | | |
| Test of DR | | | | | | | | | | ● | ● | | | | | | | | | | | | | | | |
| Control system and cart | | | | | | ● | ← | | | | | | ● | | | | | | | | | | | | | |
| Assembly of Carts | | | | | | ● | ← | | | | | ● | | | | | | | | | | | | | | |
| Integrate electronics, gas circuits | | | | | | ● | ← | | | | | ● | | | | | | | | | | | | | | |
| Lift test on cart | | | | | | | | | | | | | ● | | | | | | | | | | | | | |
| Final assembly and test | | | | | | | | | | | | ● | ● | ● | ● | ● | | | | | | | | | | |
| Final assembly of full system | | | | | | | | | | | | ● | ● | | | | | | | | | | | | | |
| Full system test - CL | | | | | | | | | | | | | | ● | ● | | | | | | | | | | | |
| Full system demonstration - NIST | | | | | | | | | | | | | | | | ● | | | | | | | | | | |
| Delivery and sign-off | | | | | | | | | | | | | | | | | ● | ● | ● | ● | ● | ● | ● | ● | | |
| Disassemble & Pack for Shipment | | | | | | | | | | | | | | | | | ● | ● | | | | | | | | |
| Shipment (Cargo to IAD) | | | | | | | | | | | | | | | | | | | ● | ● | | | | | | |
| HOLIDAY BREAK | | | | | | | | | | | | | | | | | | | | | | | | | | |
| On-site comissioning | | | | | | | | | | | | | | | | | | | | | | | ● | ● | | |
| Final Sign-off and payment | | | | | | | | | | | | | | | | | | | | | | | | | ● | |

09/08/22 Update:

- Magnet Status:
  - The magnet wiring has been completed, and the installation of the radiation shield and outer chamber is being completed
  - These are the final steps of closing the cryostat for the preliminary test
  - System cooldown is expected for week of Sept 12th

- DR status:
  - Machining: 95% complete (ULT parts only remain)
  - Still : completed
  - 1K pot : 85% assembled
  - Mixing chamber : 50% complete
  - ULT : Sub-assemblies started
  - Heat exchangers : 80% complete

# Syringe Pump System

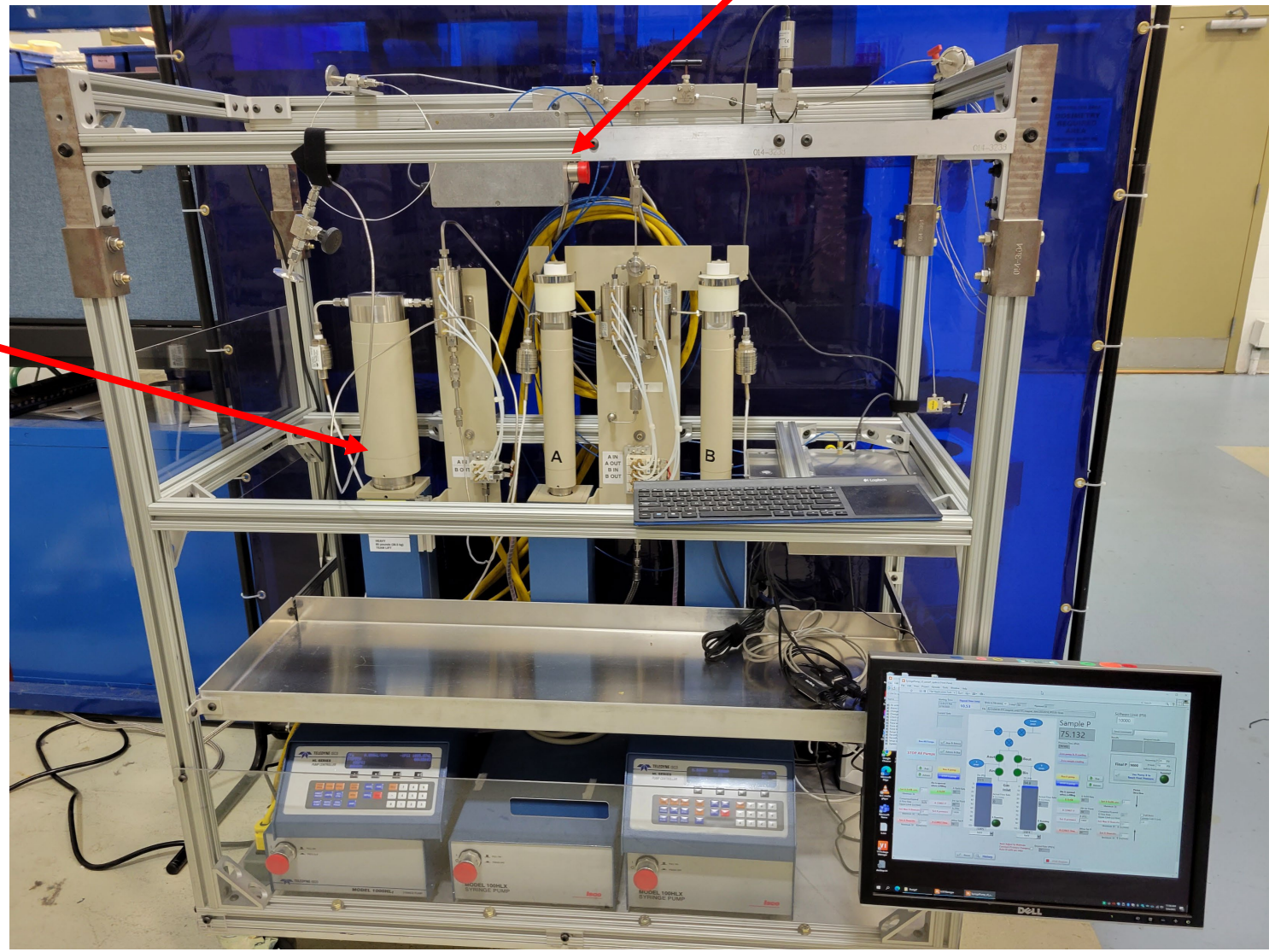


- TO BE DONE:
  - Finish software upgrade
  - Test HT seals for block cells

Many Thanks to:
- Doug Johnson
- Donna Kaltyre
- Sean Mullendore
- Colin Wrenn
- Alan Ye

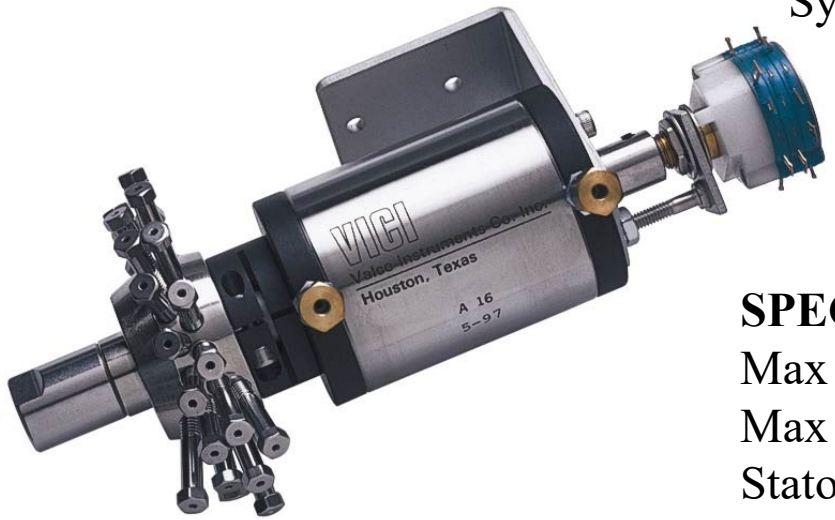
Pneumatic Actuated High-Pressure Selector

1000 cc Pump
"Booster"



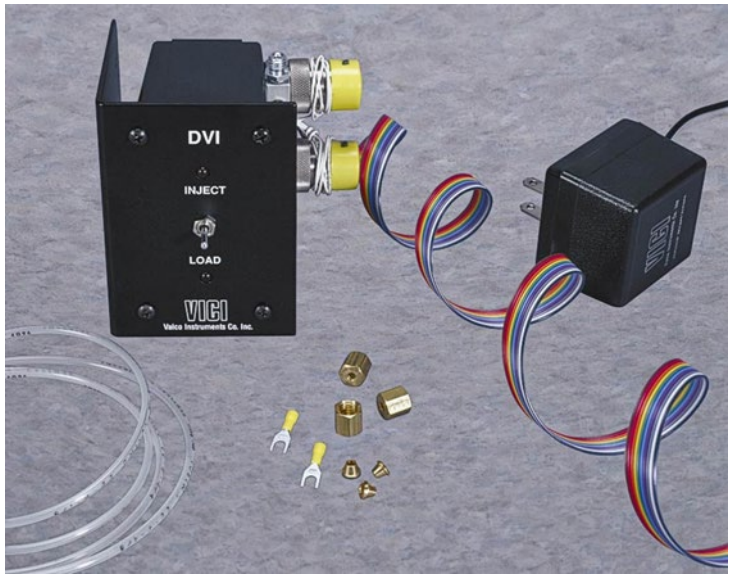

Three syringes system

Syringe Pump System




Cheminert UHPLC selectors valve with Air Actuator

**SPECIFICATIONS**
Max press: 15,000 psi
Max temp: 50°C
Stator: SS w/inert coating
Rotor: Valcon E5
Bore: 250 micrometers
Line OD: 1/16” (NOTE: 150 microm

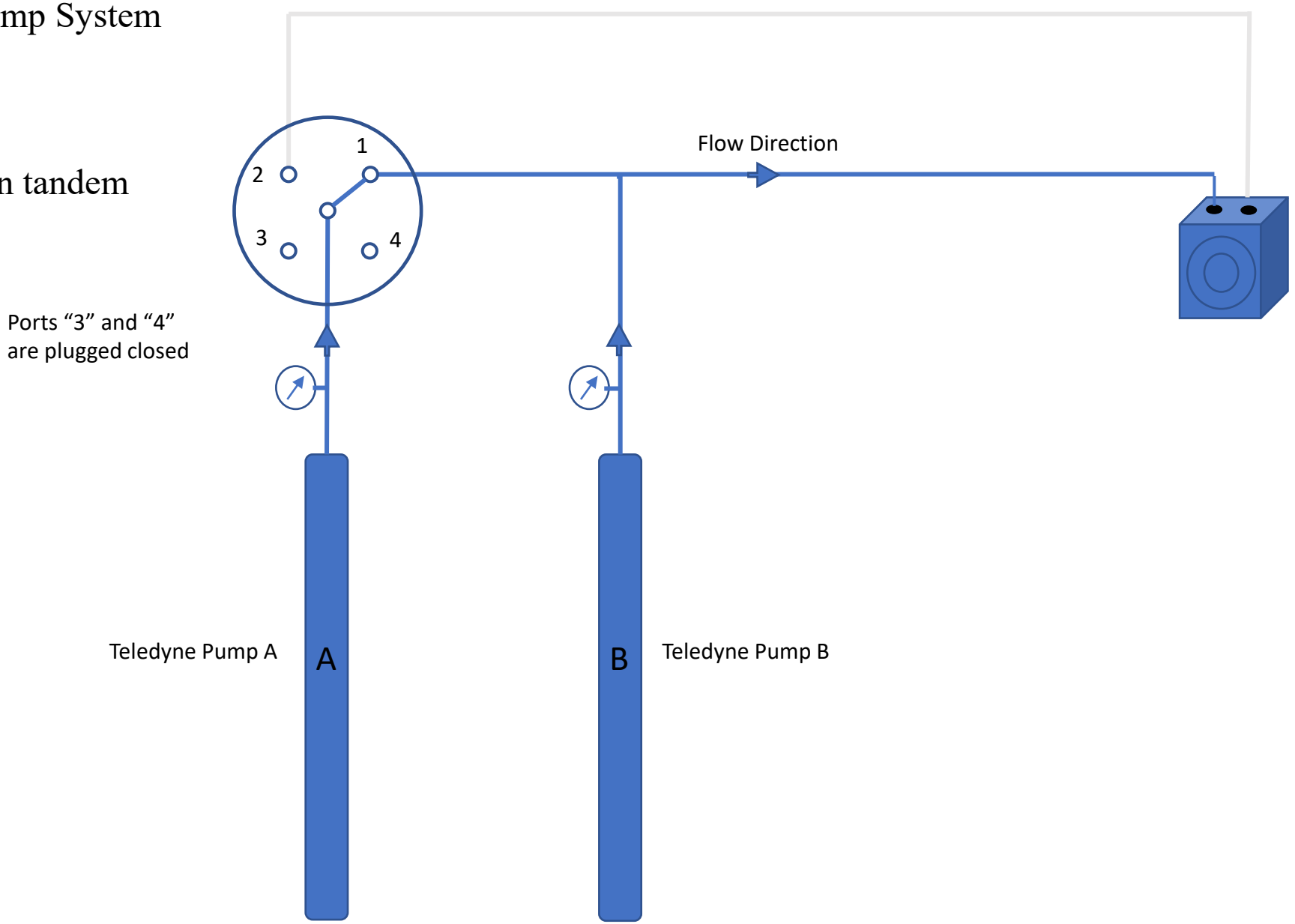



Digital Valve Interface


Serial Valve Interface

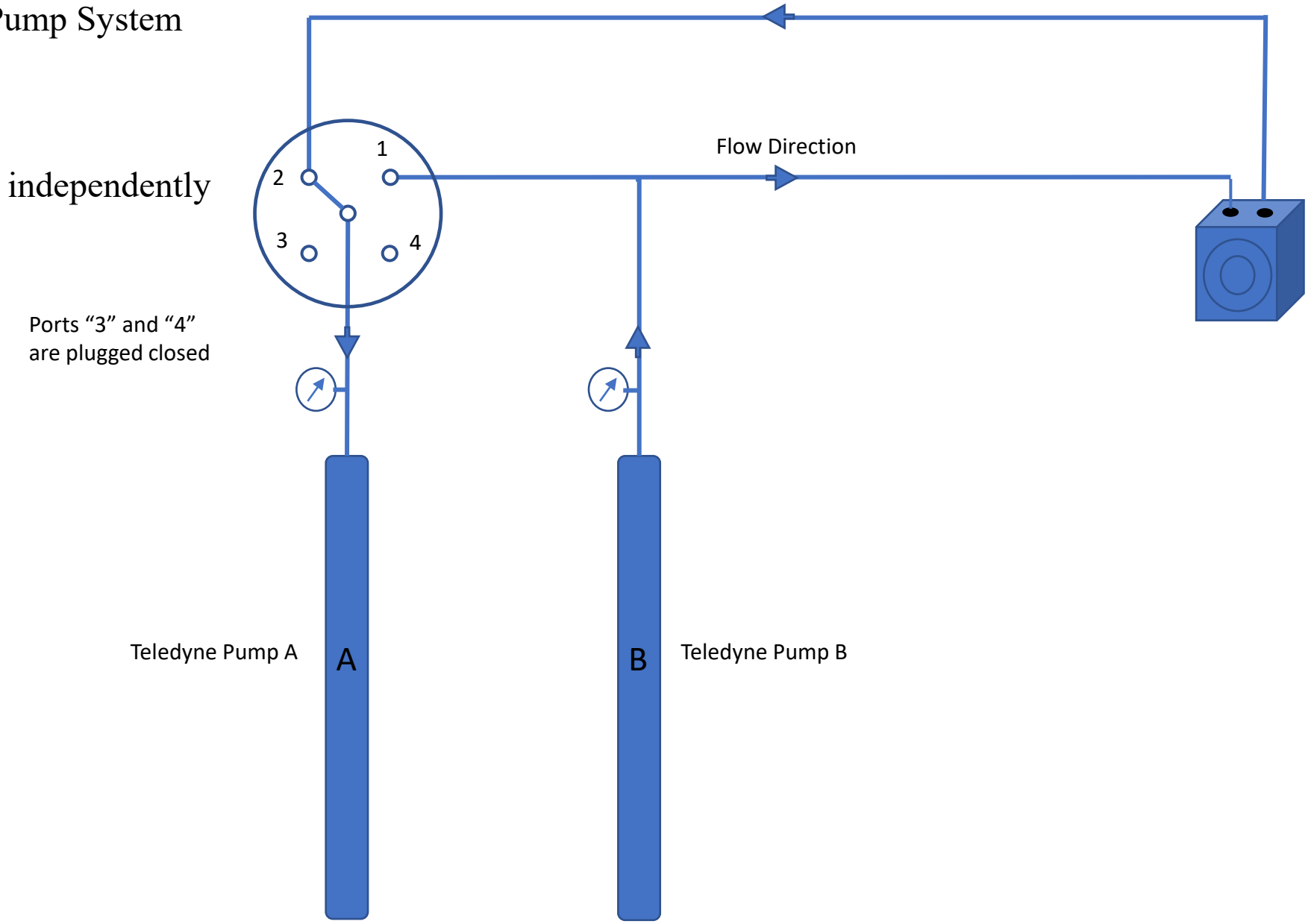
# Syringe Pump System

Pumps “A” and “B” work in tandem

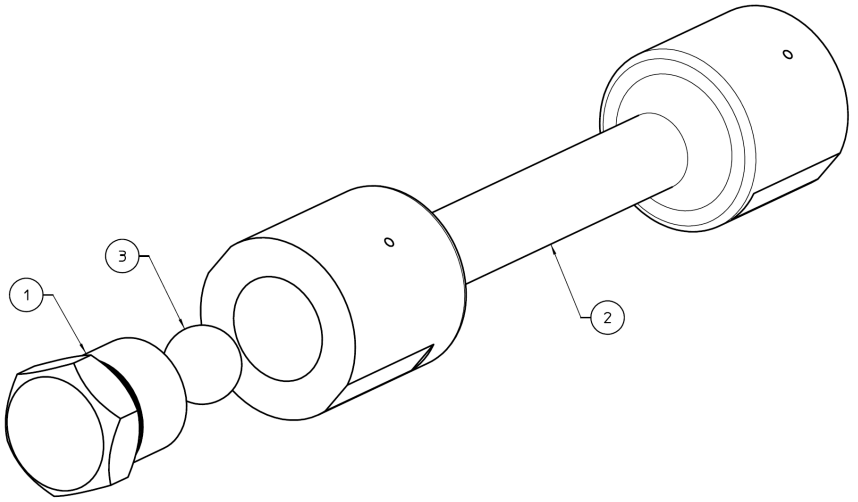


# Syringe Pump System

Pumps “A” and “B” work independently



# 2 kbar $H_2$ Pressure System




## 2 kbar $H_2$-Pressure Vessel

- Double ended hollow cylinder autofretage design
- The design employs a “leak before burst” failure mode

To Be Done:

- Test Lil’Critter H2-Intensifier
- Autofretage pressure vessels
- Test pressure vessels

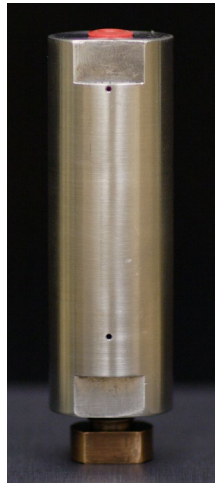
Lil’Critter $H_2$-Intensifier

| $H_2$ Pressure Vessel Calculation | | | | | | |
|---|---|---|---|---|---|---|
| INCONEL Alloy 625, UNS N06625/ | | | | | | |
| **Tensile Strength (psi)** | ID (inches) | OD (inches) | Autofretage Pressure (bar) | Autofretage Design Safety Factor | Working Pressure (bar) | Working Pressure Safety Factor |
| **128,000** | 0.25 | 0.5 | 3,000 | 2 | 2,000 | 3.5 |

# High Pressure Systems

Maintenance

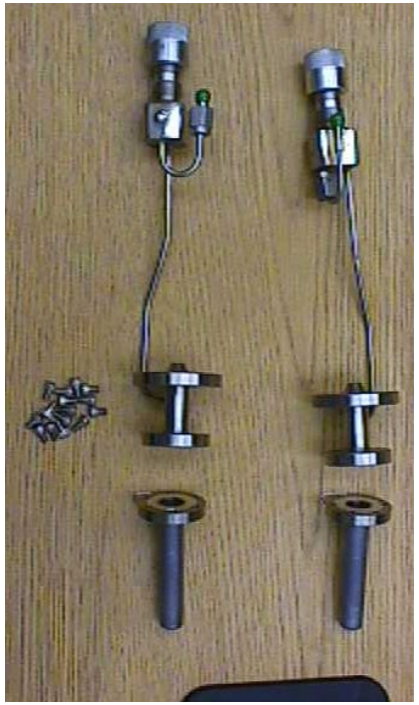
- ✓ Pressure Rig #1
- ✓ Empty and decon pressure cells
- ✓ Training: Full pressure experiment
- ✓ Updated and tested manual
- ✓ Updated Safety paperwork
- ✓ Maintenance Pressure Rig #2
- ✓ Maintenance pressure sticks
- ✓ Inventory pressure cells and ancillary equipment



Many Thanks to:

- Sergiy Gladchenko
- Doug Johnson
- Sean Mullendore

# Gas Loading Systems

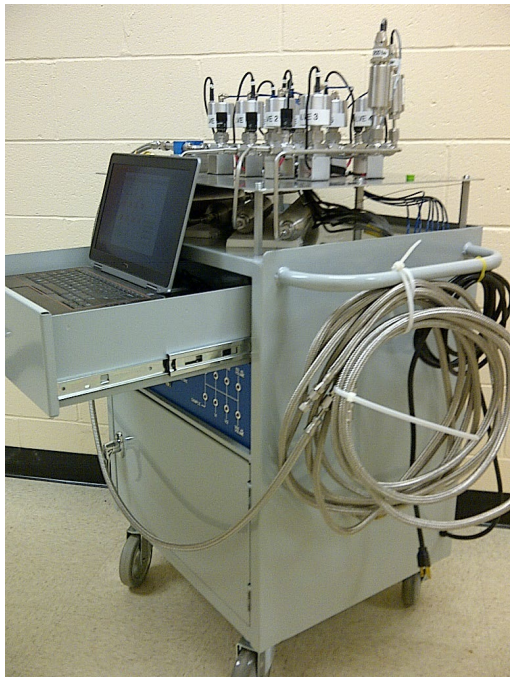


Maintenance and Recalibration

- ✓ Manual Gas Loading Cart 2, 35bar
- ✓ Automated Gas Loading Cart 3, 200bar
- ✓ Manual Gas Loading Cart 1, 200bar

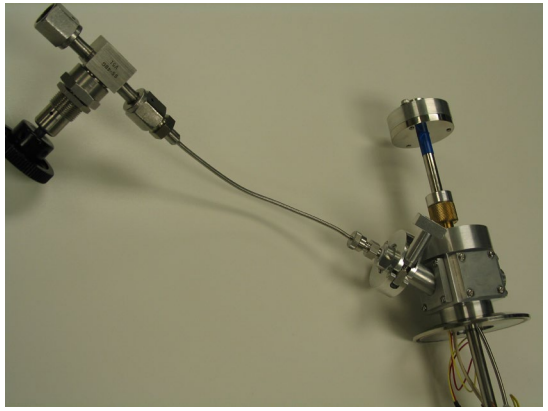
Inventory of sample can lid interfaces

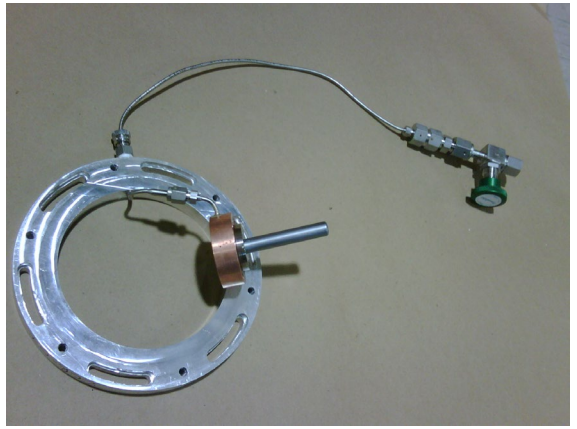
- ✓ 20 BLCCR Rings
- ✓ 10 TLCCR lids
- ✓ 2 HT TLCCR Sticks
- ✓ 2 LT TLCCR Sticks



To Be Done:

- ➢ Test Computer Controlled cart at BT1, DCS, and HFBS for full communication

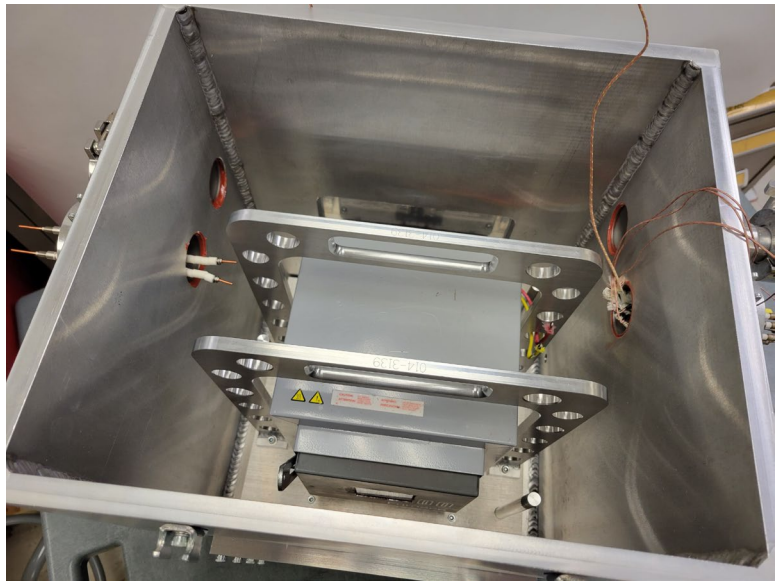




Many Thanks to:

- Donna Kaltyre
- Doug Johnson
- Sean Mullendore

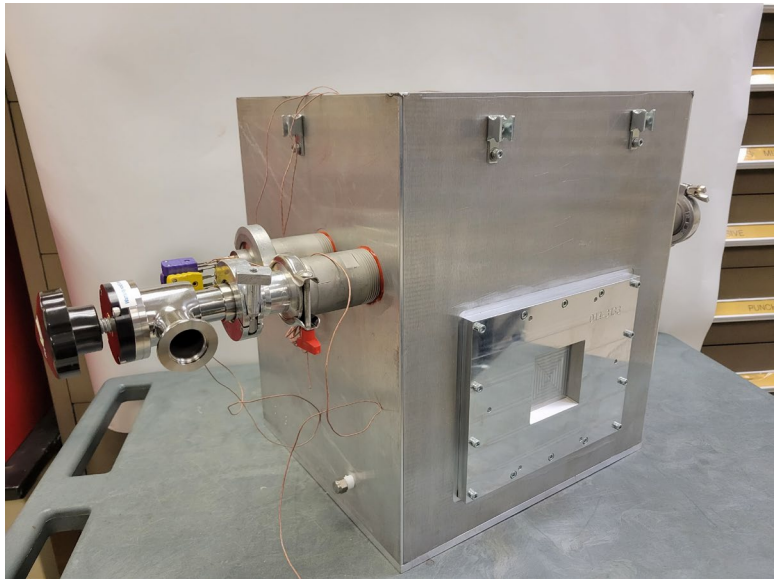
# Reflectometry Furnace



Renewed interested motivated by users

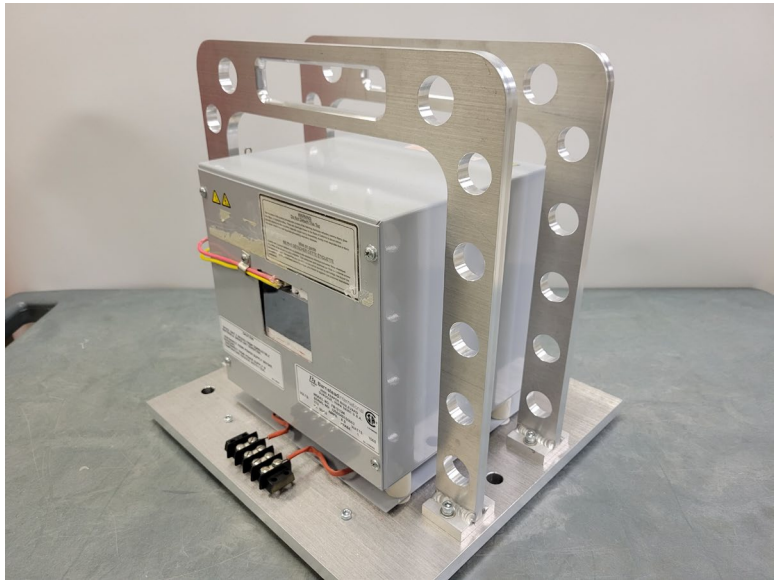
J Feng, et.al. Surface and Coatings Technology 405, 126545 https://doi.org/10.1016/j.surfcoat.2020.126545

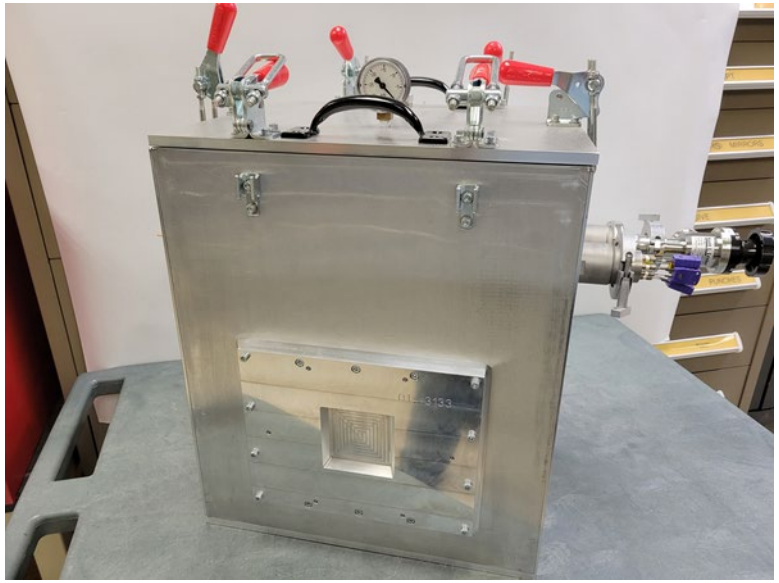
Vacuum/ inert gas environment
Outer aluminum window
Inner silicon window



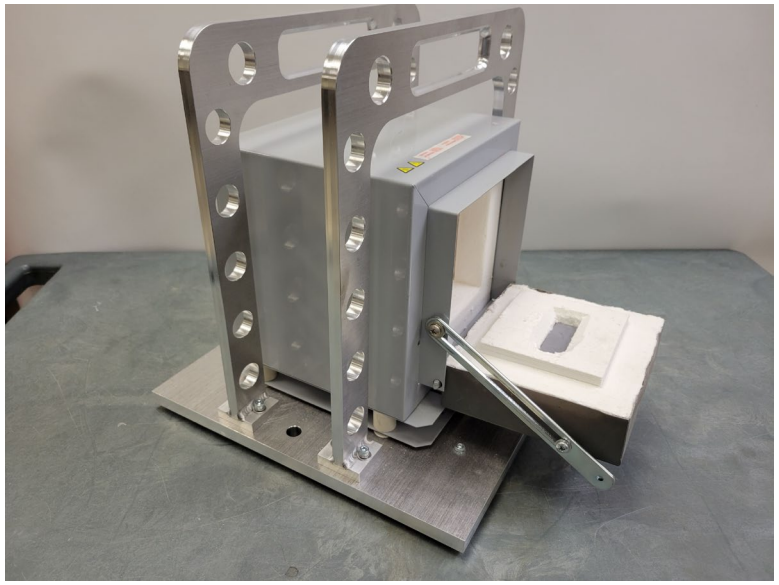
Inner alumina shielded tabletop furnace capable of reaching 1300° C

# Reflectometry Furnace

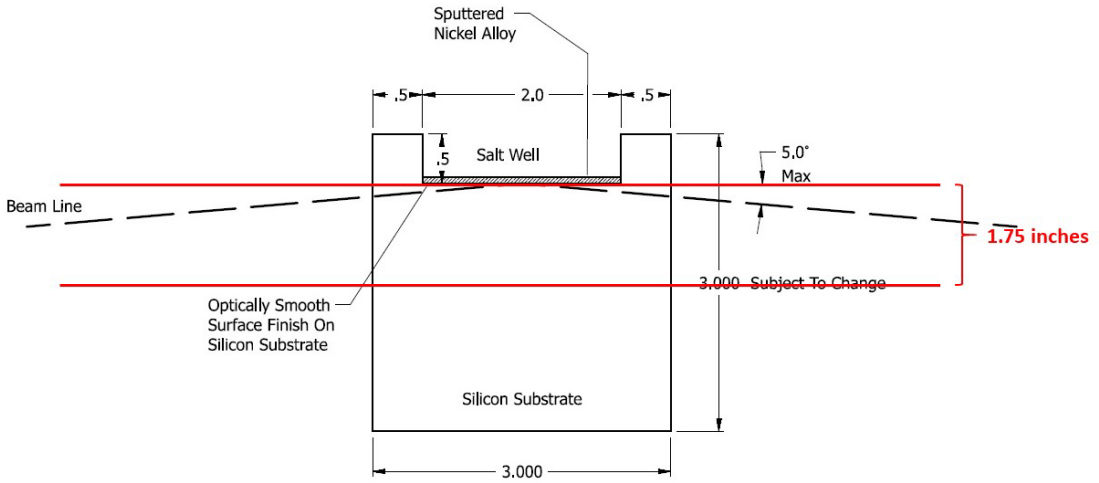




Outer aluminum window
Inner silicon window



Alumina Sample Holder and well




To Be Done:

- Finish wiring
- Test maximum temperature under argon and vacuum
- Ship to SNS for neutron testing

# LIPSS/MUZAC System

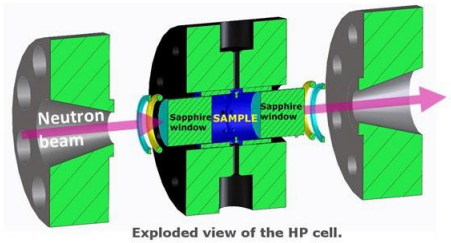
Maintenance

- ✓ Replaced power supply
- ✓ Acquired extra power supply
- ✓ Training: Full pressure experiment
- ✓ Updated manual
- ✓ Updated Safety paperwork
- ✓ Separate LIPSS control
- ✓ Engineer new cells
- ✓ Upgrade cell holder
- ✓ Procure recirculating bath to replace LH45

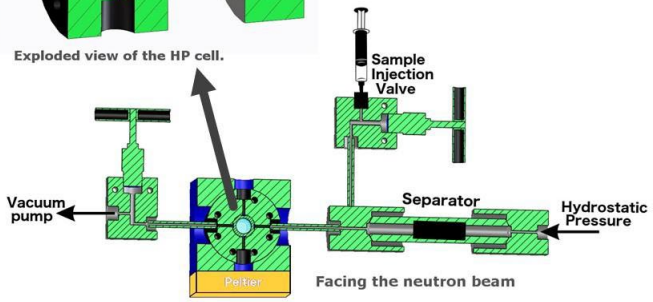
➢ TO BE DONE:

Receive new W55 recirculating baths (Expected Nov 2022)

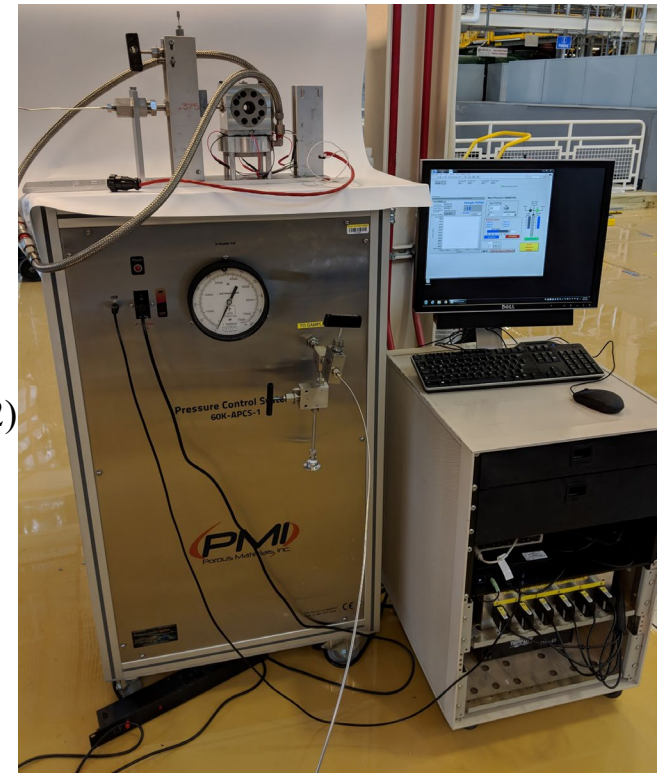
Supply of SANS LIPSS Pressure Vessels

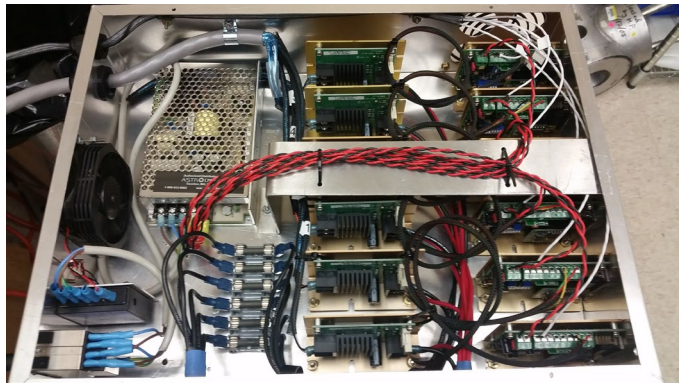



Exploded view of the HP cell.




Facing the neutron beam



Many Thanks to:

- Cedric Gagnon
- Doug Johnson
- Susana Teixeira
- Colin Wrenn
- Alan Ye

Beam Line/ Lab Equip. SOPs, User/Technical Manuals

| Equipment | SOP | User Manual | Technical Manual | STATUS |
|---|---|---|---|---|
| Syringe Pump | ✓ | ✓ | ✓ | Submitted |
| Gas-loading | ✓ | ✓ | ✓ | Submitted |
| High Pressure | ✓ | ✓ | ✓ | Submitted |
| H2 Pressure | ✓ | ✓ | ✓ | Submitted |
| Furnaces | ✓ | ✓ | ✓ | Submitted |
| Torch | ✓ | ✓ | ✓ | Submitted |
| Spin Coater | ✓ | ✓ | ✓ | Submitted |
| 2GPa Clamp Cell | ✓ | ✓ | ✓ | Approved |
| Cryogenics Training | ✓ | ✓ | ✓ | Approved |

# Current Projects Description

| | Estimated Timeline |
|---|---|
| **S. E.:** | |
| ➢ 12T Dry Cryomagnet | On-going to 1st quarter of 2023 |
| ➢ Upgrade Syringe Pump Cart for flow under pressure experiments | Done |
| ➢ Update Software for Three Syringe Pump | November 2022 |
| ➢ Commission 2 kbar $H_2$ Pressure System | Awaiting HR |
| ➢ Test 2 kbar $H_2$ Pressure Vessels | Awaiting HR |
| ➢ Empty and Inventory Irradiated Powder Cans (S.E Group) | On-going |
| ➢ Test HT SANS Block Pressure Cells | October 2022 |
| ➢ Test Computer controlled cart with ICPs | November 2022 |
| ➢ Test General Purpose 1600º C Furnace | December 2022 |
| ➢ Finish Reflectometry Furnace for user experiment at SNS | December 2022 |
| ➢ Receive new W55 recirculating baths (SANS/NSE) | November 2022 |
| ➢ SANS LIPSS Pressure Vessels | March 2023 |
| **Labs:** | |
| ➢ Installation and Implementation of Glove Boxes Remote Manifold | Facility shutdown |
| ➢ Training, and assistance for post-docs | On-going |

# Thank you!

Questions and/or
Suggestions for R&D for 2023

# 2023/2024 Shutdown Period

**S. E.:**

- Installation and Implementation of Glove Boxes Remote Manifold
- SANS High Temperature Furnace
- BT1 Cryo Sample Changer