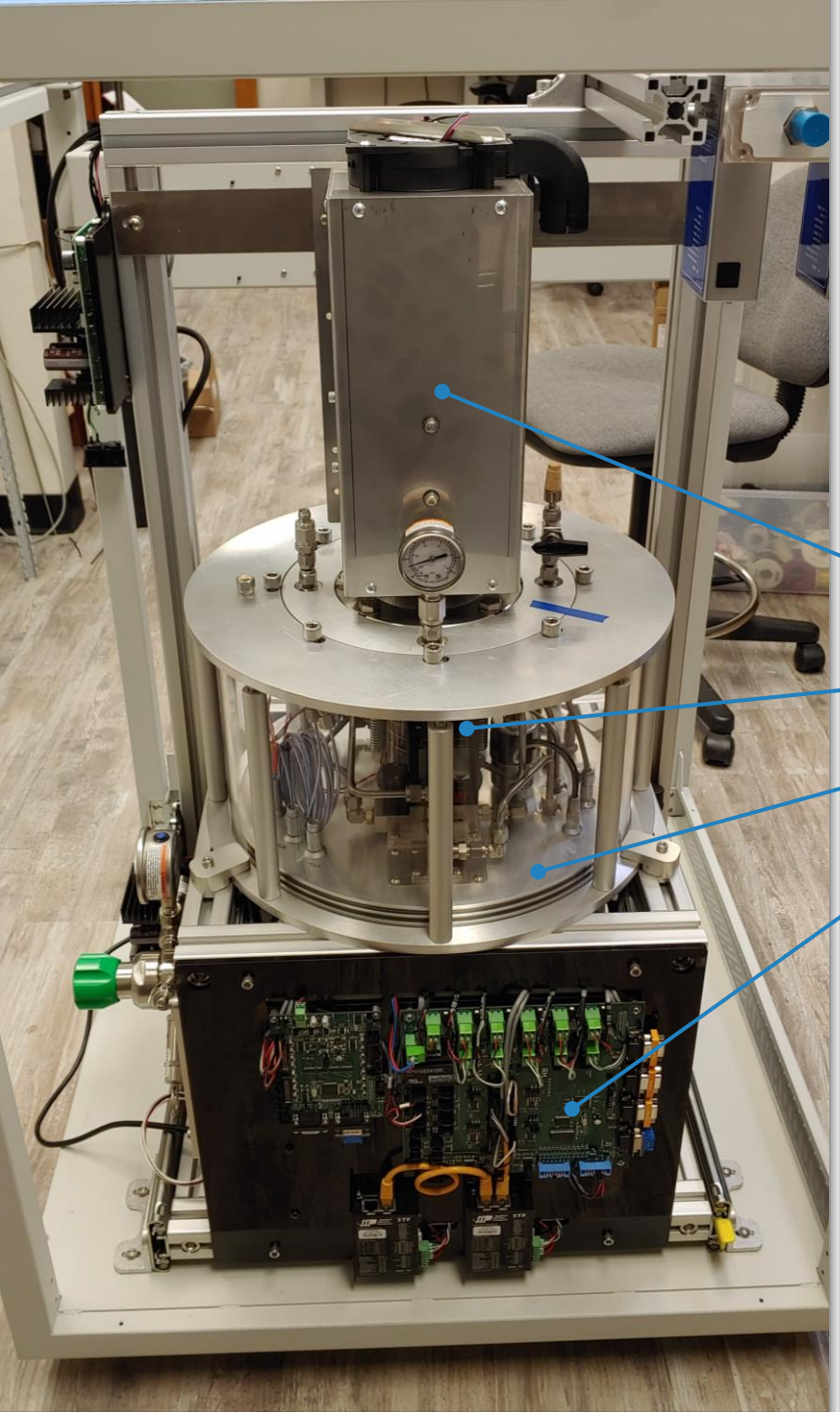
LOW FROST POINT HUMIDITY GENERATION

RH SYSTEMS

MODEL G3

ABOUT THE G3

- HOW IT WORKS
- OPERATING RANGE
- COOLING/HEATING RATE



HOW THE G3 WORKS

INTRODUCTION TO THE MAIN CRITICAL COMPONENTS

- STIRLING COOLERS
- WATER/ICE SATURATOR
- VACUUM CHAMBER
- MICROCONTROLLER SYSTEM
  - TEMPERATURE CONTROL
  - PRESSURE CONTROL
  - DATA COLLECTION/STORAGE
- GAS PATH

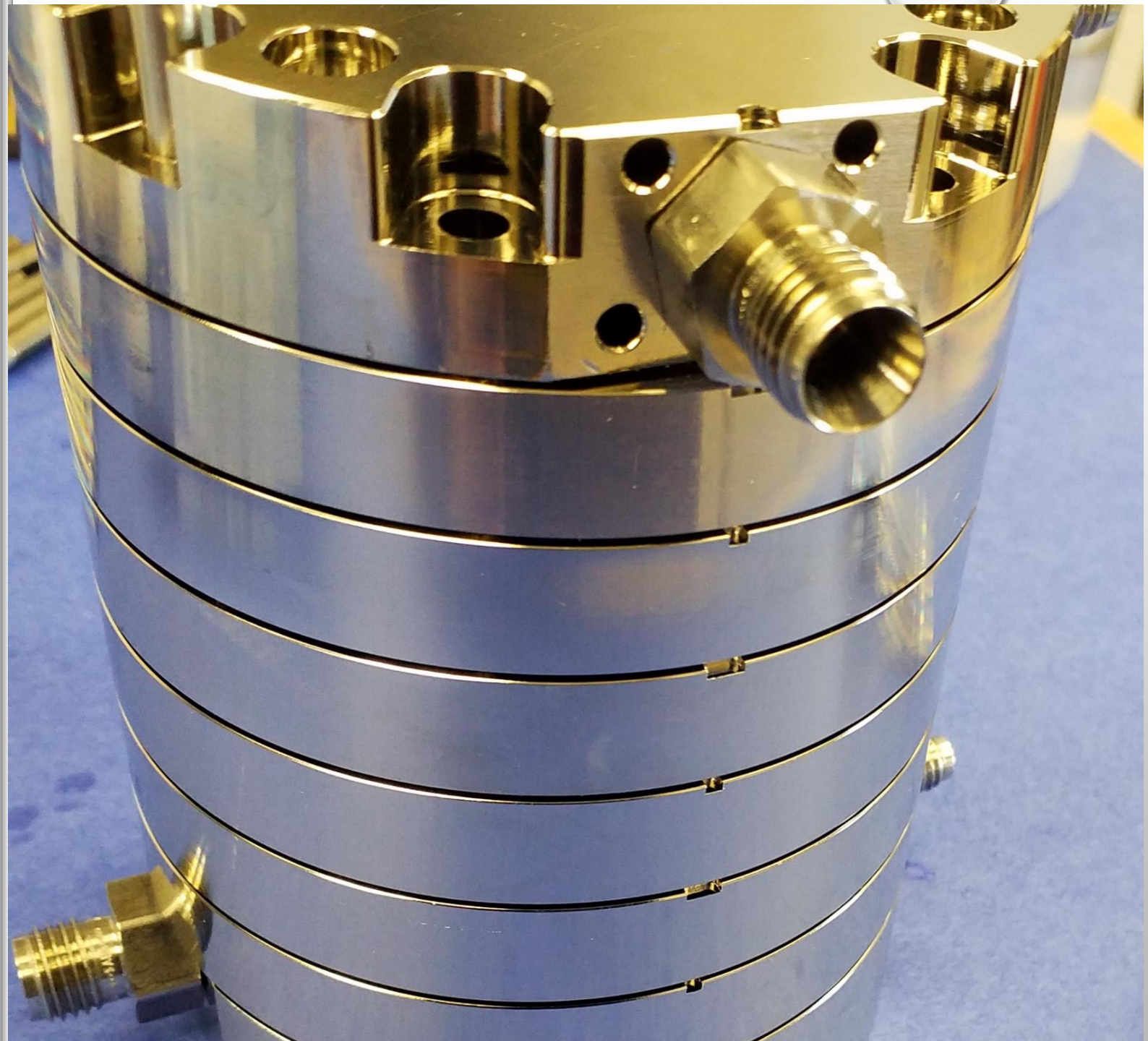
STIRLING COOLERS

FREE-PISTON STIRLING COOLERS ARE USED TO COOL THE SATURATOR

- CAN COOL TO AS LOW AS -120 °C
- FAST AND POWERFUL
- ONE STIRLING COOLER CONNECTS TO TOP OF SATURATOR
- ONE STIRLING COOLER CONNECTS TO BOTTOM OF SATURATOR
- MAGNETICALLY DRIVEN PISTON
- HERMETICALLY-SEALED

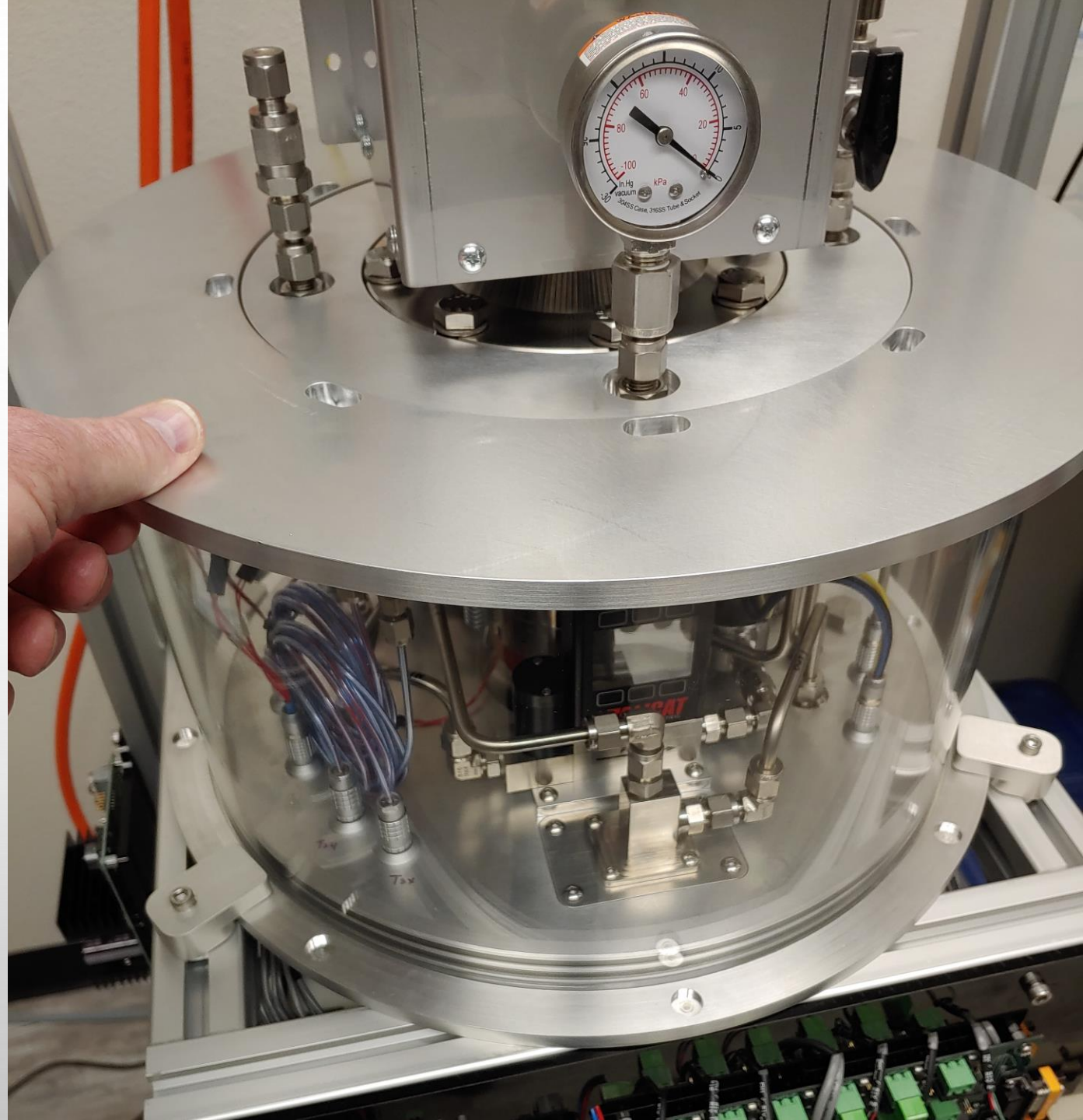
SATURATOR

- STACKED PLATE DESIGN
- EACH PLATE HOLDS WATER/ICE
- MACHINED FROM SOLID COPPER
- NICKEL PLATED AGAINST CORROSION
- GAS ENTERS BOTTOM PLATE AND EXITS THROUGH TOP PLATE
- SATURATOR IS THE HEART OF THE SYSTEM



VACUUM CHAMBER

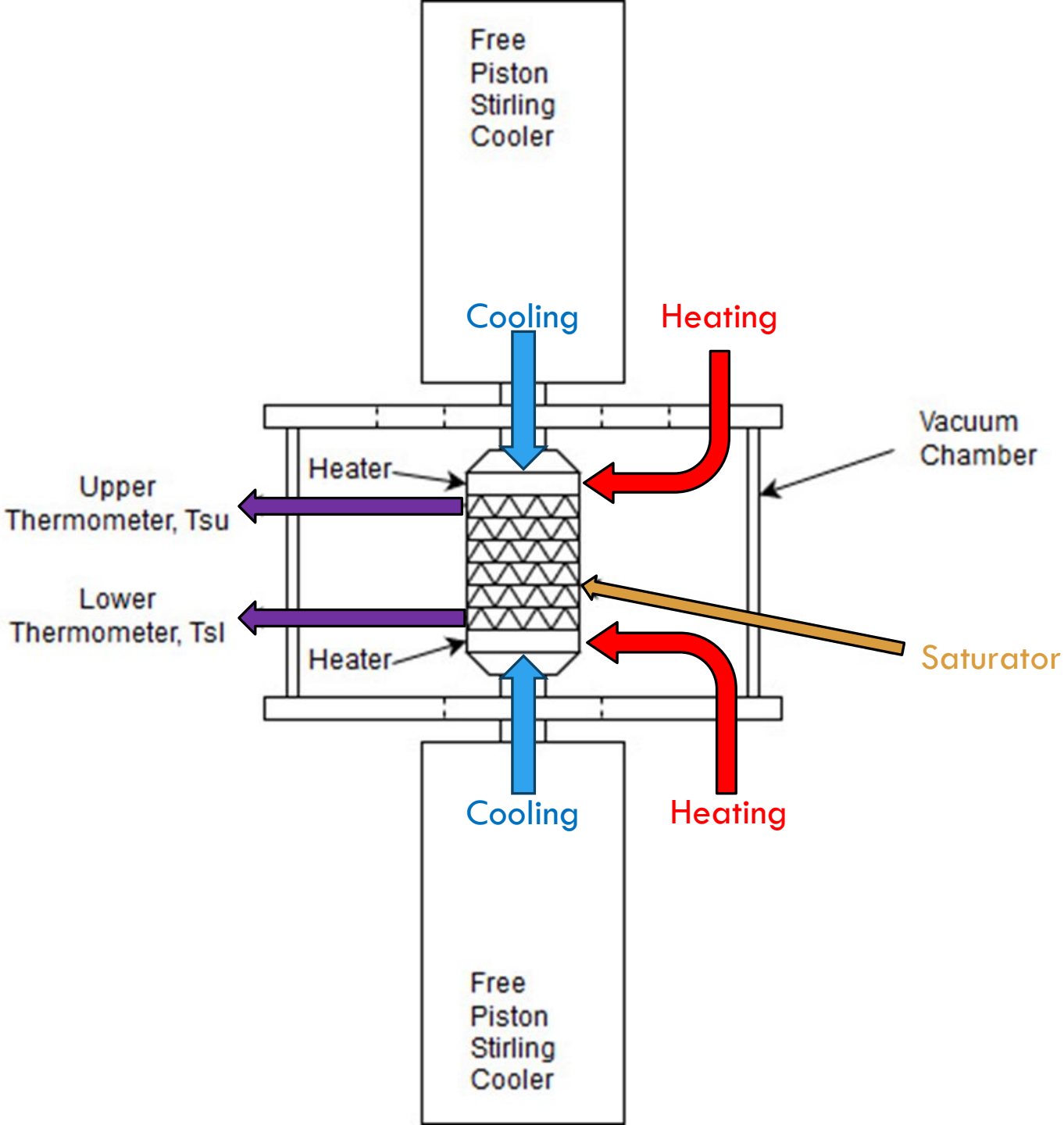
- PROVIDES THERMAL INSULATION FOR SATURATOR
- REMOVES WATER VAPOR AROUND VALVES, FITTINGS, ELASTOMERIC SEALS TO PREVENT UNWANTED WATER VAPOR FROM PERMEATING INTO GAS PATH
- ALLOWS FOR EASY RE-ENTRY FOR CALIBRATION & REPAIR OF TEMPERATURE PROBES, PRESSURE & FLOW CONTROLLERS, VALVES, AND FITTINGS



FULL ASSEMBLY

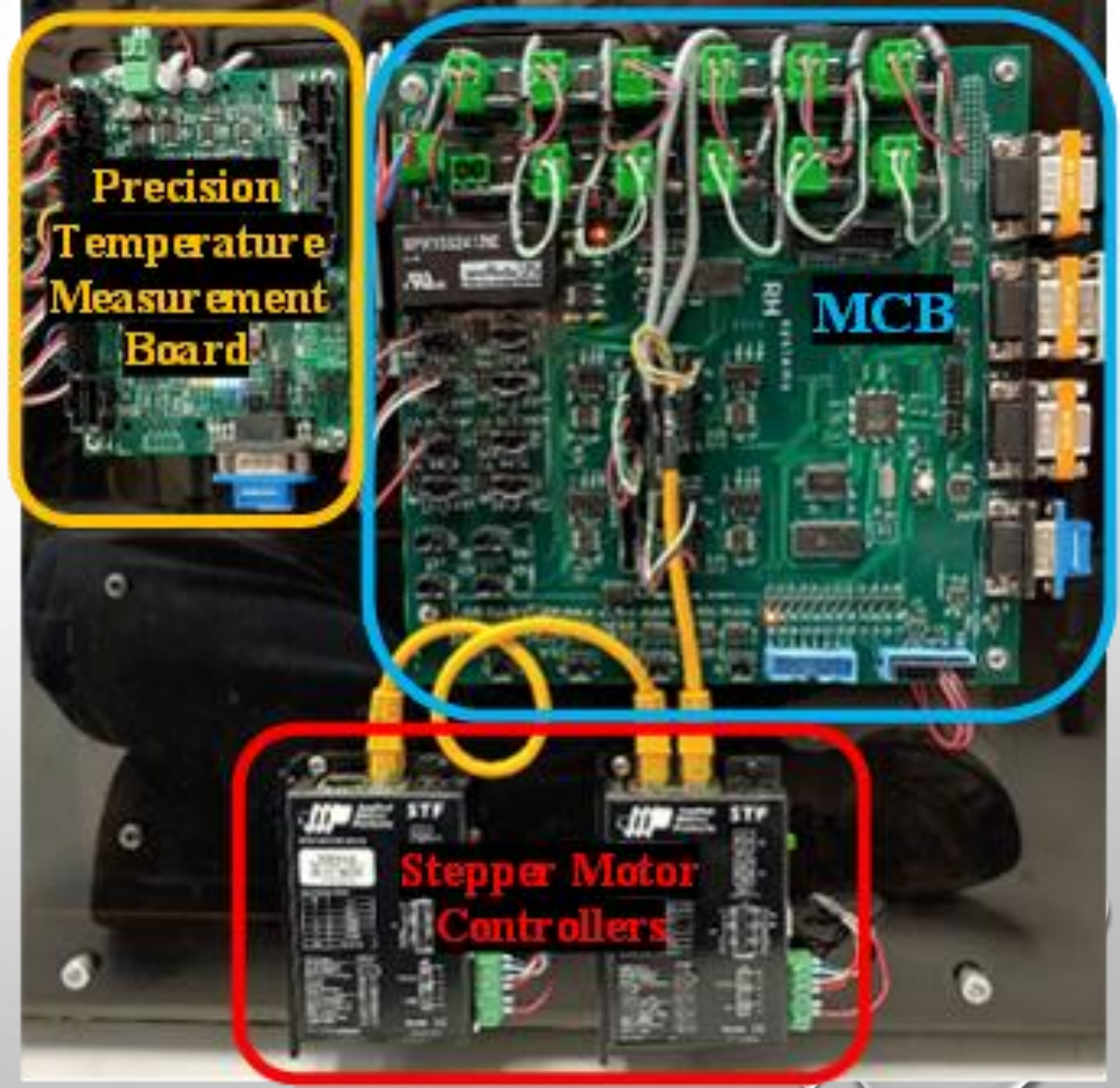
The diagram shows the configuration of the SATURATOR, STIRLING COOLERS, and VACUUM CHAMBER.

- Saturator is cooled by the Stirling Coolers.
- Saturator is heated by direct contact heaters.
- Temperature is measured by upper and lower thermometers [Tsu and Tsl]
- Saturator is inside the VACUUM CHAMBER



MICROCONTROLLER SYSTEM

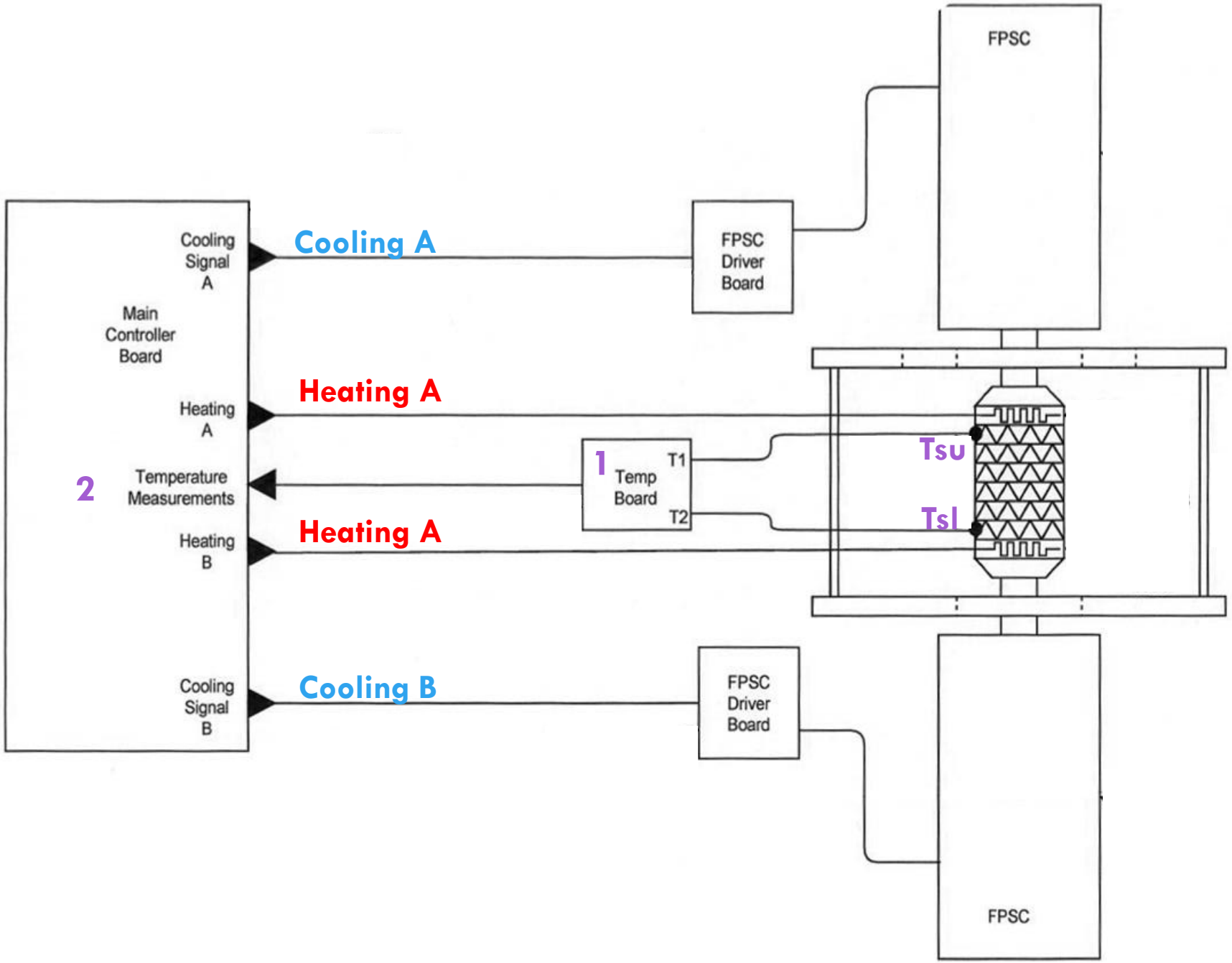
- MEASURES AND CONTROLS
  - TEMPERATURES
  - PRESSURE
  - FLOW RATES
- SETS AND CONTROLS
  - DEW POINT
  - FROST POINT
  - PPM
  - %RH



SAT TEMP CONTROL

Temp board 1 measures Upper Tsu and Lower Tsl saturator temperatures, then sends temperature readings to Main Controller Board 2.

Main Controller Board 2 controls Cooling A and Cooling B, and controls Heating A and Heating B. With these signals, it precisely controls saturator temperature.



GAS PATH PRESSURE AND FLOW CONTROL

A. Pressurized Gas Inlet is applied to the Pressure Controller.

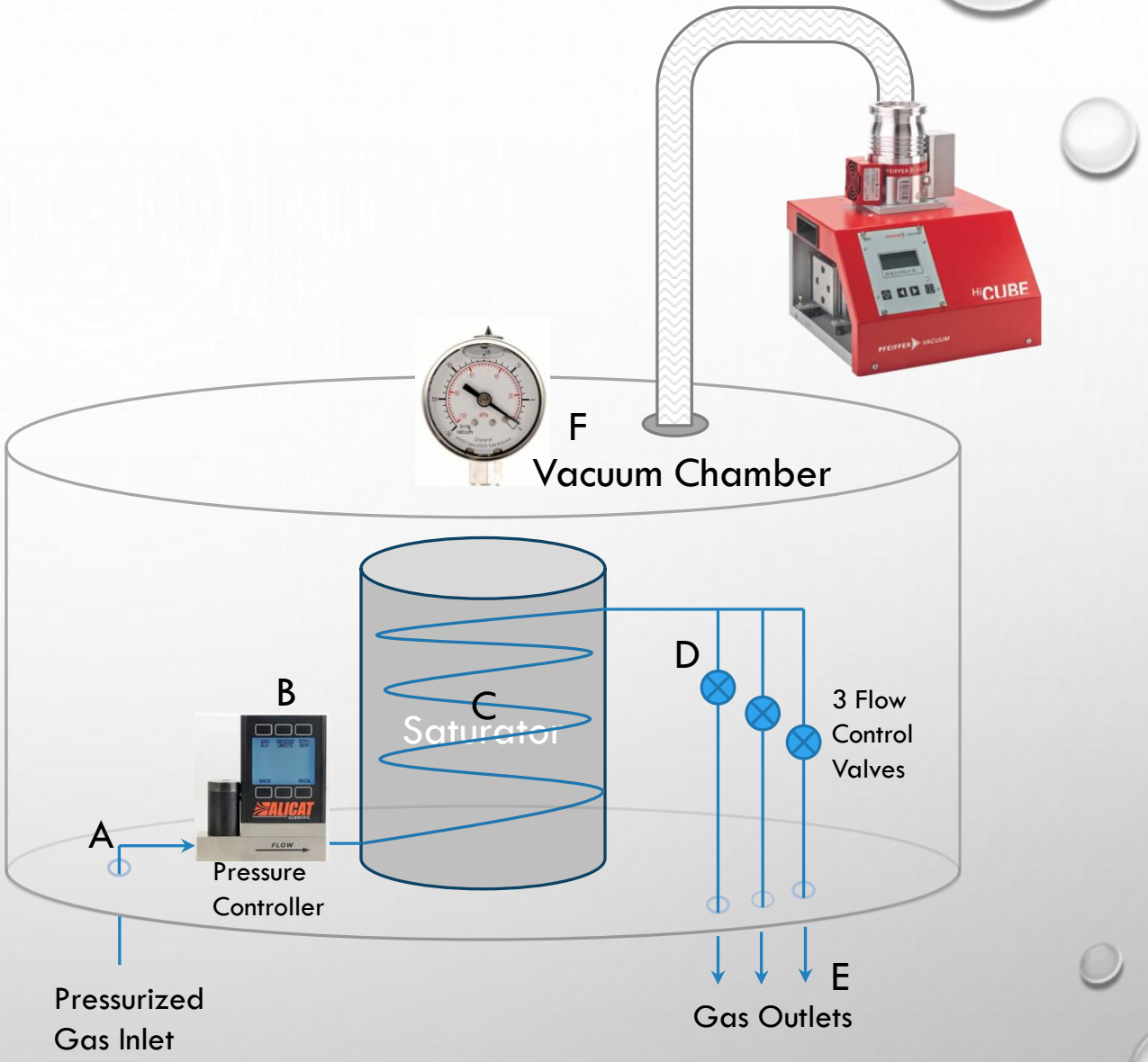
B. The Pressure Controller controls Saturation Pressure.

C. Gas flows through the temperature controlled saturator, mixes with water vapor, and comes to the proper humidity (Dew/Frost Point, PPM, etc.)

D. Three independent flow valves control the Flow rates.

E. Humidity controlled gas flows to 3 separate outputs while dropping the gas to the pressure of the Device Under Test (DUT)

F. The gas path is maintained inside the Vacuum Chamber. The Vacuum Chamber acts as a thermal insulator, and also prevents water vapor permeation into the gas path.



G3 OPERATING RANGE

HUMIDITY RANGE

-120 °C FROST POINT TO +10 °C DEW POINT

1 PPBV … 12000 PPMV

FLOW RATE

3 OUTPUTS

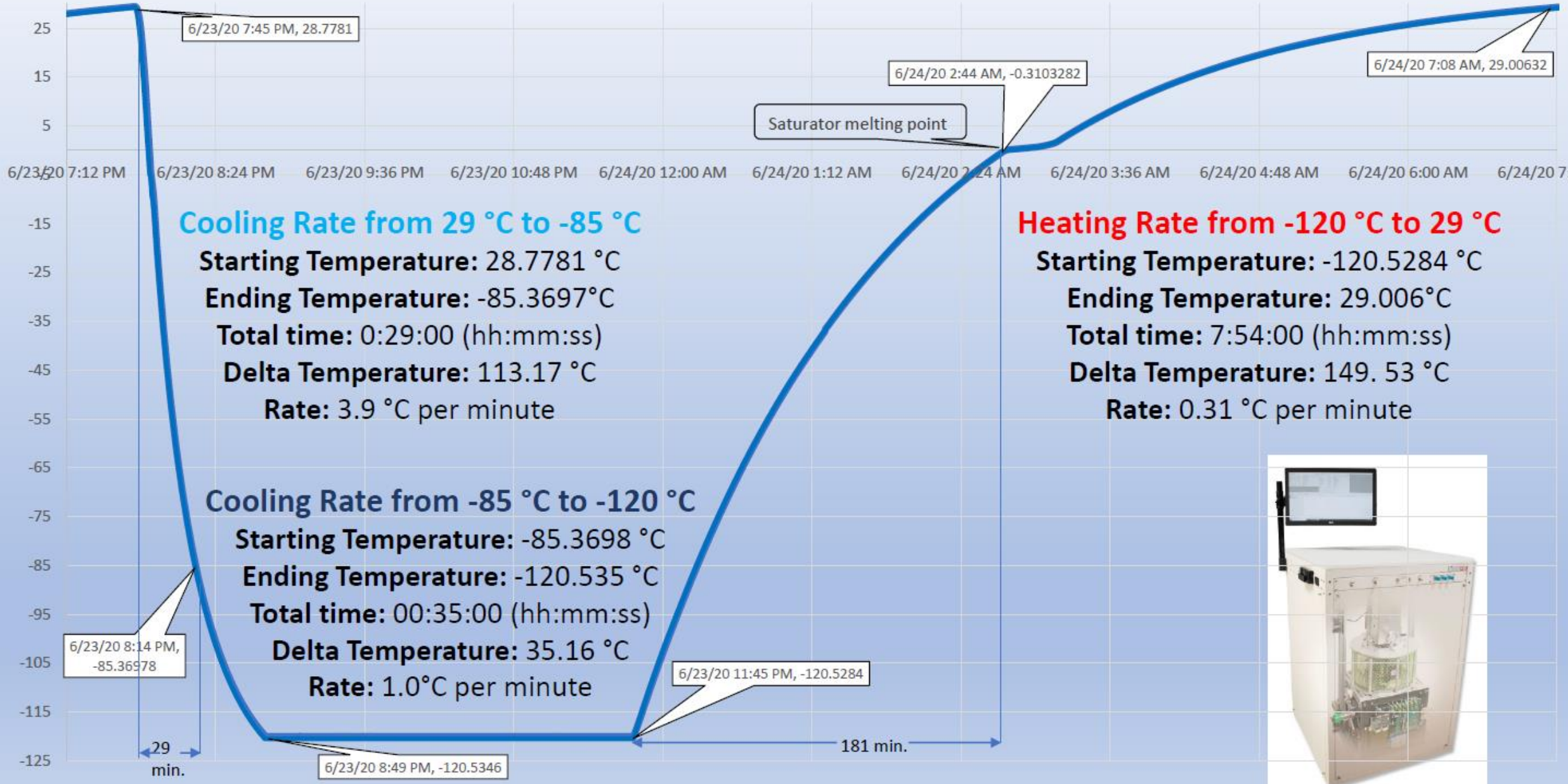
0-5 L/MIN PER OUTPUT

TOTAL MAXIMUM 10 L/MIN

REQUIRES

3 TO 7 BAR COMPRESSED DRY N2 OR AIR, UP TO 10 L/MIN

G3 Cooling and Heating Rate



Cooling Rate from 29 °C to -85 °C

Starting Temperature: 28.7781 °C
Ending Temperature: -85.3697°C
Total time: 0:29:00 (hh:mm:ss)
Delta Temperature: 113.17 °C
Rate: 3.9 °C per minute

Cooling Rate from -85 °C to -120 °C

Starting Temperature: -85.3698 °C
Ending Temperature: -120.535 °C
Total time: 00:35:00 (hh:mm:ss)
Delta Temperature: 35.16 °C
Rate: 1.0°C per minute

Heating Rate from -120 °C to 29 °C

Starting Temperature: -120.5284 °C
Ending Temperature: 29.006°C
Total time: 7:54:00 (hh:mm:ss)
Delta Temperature: 149. 53 °C
Rate: 0.31 °C per minute