Few notes before the construction begins

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Procedures

- construction can start after releasing to UT the final drawings of flanges in CNC format
- drawing for supporting structure will be needed next
- both vessels will be produced about at the same time.
- Air leak test at UT $\lesssim 50\ psi$ (several days per vessel).
  Leak test system ready (Shaun's slide)
- Transport to UKY one-by-one (in boxes with foam pads)
- Wire winding, resistance and power test, wrapping with μ-shield at UKY
- Transport to UT one-by-one (in boxes with foam pads)

Procedures (continued)

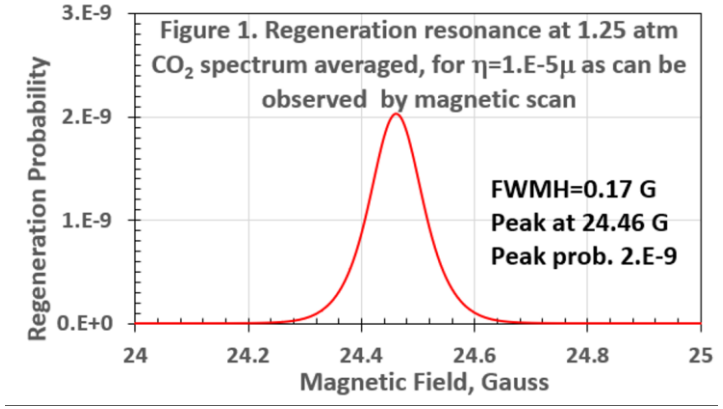
- Purging with CO2 gas 20-30 volumes (two volumes in parallel) with common p-gauge
- Setting final CO2 pressure ~ 1.27703 atm (~ 18.7672 psia) in both vessels and leak test
- Check reproducibility of the pressure after connection/disconnection from filling system
- Painting the shield with black paint. Installation of temperature sensors
- Study of pressure variation after turning current ON
- Assembly of supporting structure, transportation to ORNL
- System test at HFIR site (with ORNL power supply). Serial connection of two magnets?
- Installation to GP-SANS guide vessel
- Connection to GP-SANS feedthroughs (?)
- DAQ test for Power supply and thermal sensors (?)

Again, on the temperature effects

measurement in nTMM experiment is based on the accuracy of compensation of the gas optical potential (depends on the gas number density) by magnetic field

$pV = \frac{m}{\mu} RT$ equation of state for gas

number density $n \sim \frac{m}{V}$

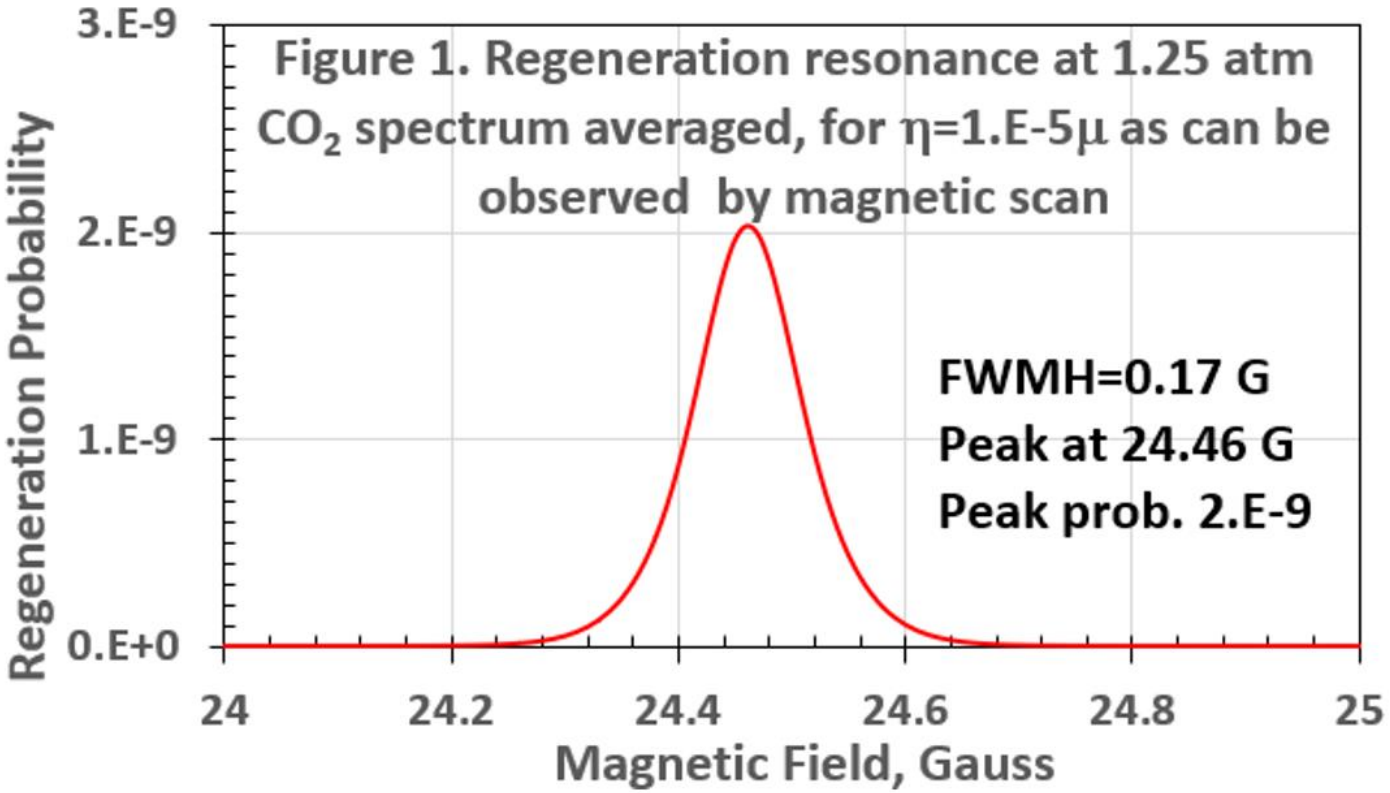


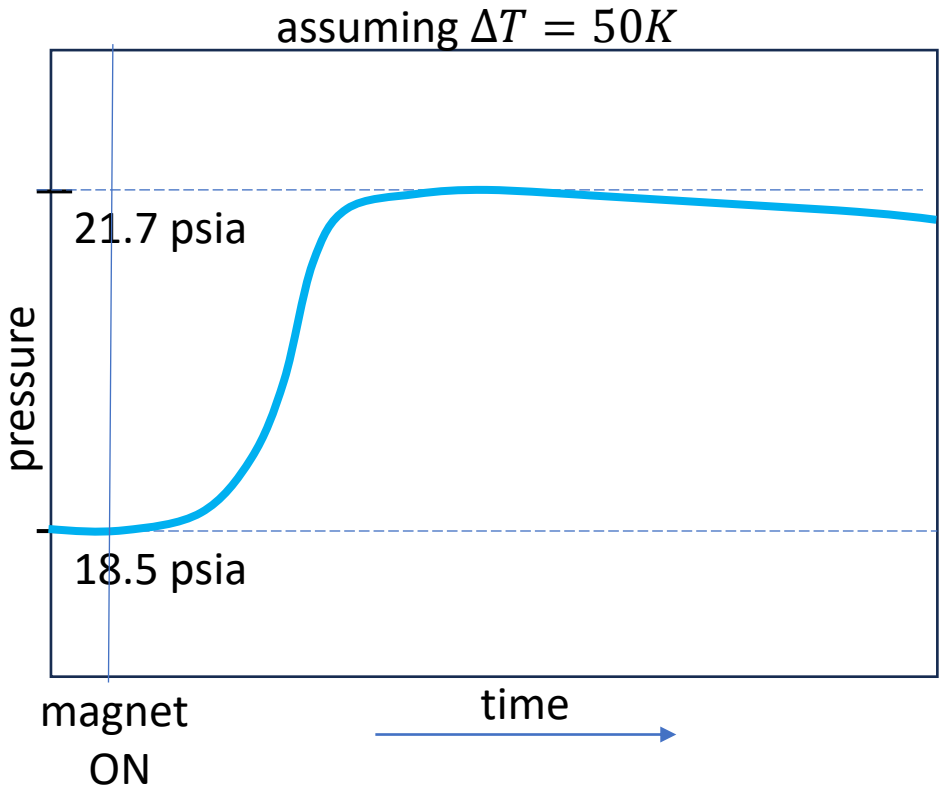
- Main effect of the temperature increase max by $\Delta T = +50\ K$ is pressure increase from 18.5 psia by factor 1.17 to 21.7 psia (not essential since number density do not change if V=cons.)

- Thermal expansion of Al vessel V(+50)/V(0)=$(1+3\alpha \cdot 50) = 1 + 3.45\times 10^{-3}$
  $\alpha(Al\ 6061) < 23 \times 10^{-6}\ /K$

  $\frac{\Delta V}{V} = -\frac{\Delta n}{n} = -3.45\times 10^{-3} = -\frac{\Delta B}{B} \rightarrow \Delta B = -25G * 3.45\times 10^{-3} = -86.25\ mG$

  that is half of the FWHM of the expected resonance





- Thermal measurements are needed.
- Since our modus operandi is magnet on/off the question is how long it takes for gas to change the temperature
- It might be possible to measure this effect in the magnet test by observing pressure variation with time after turning current on

Fluke 700GA5 Pressure Gauge, 30 PSIA

☆☆☆☆☆ 0 reviews | Catalog: 4353550 | UPC: 095969674133 | Model: Fluke 700GA5

- **Range 0 to 30 psia, 0 to 2 bar (Absolute)**
- Accuracy to 0.05 % of full scale
- Easy to use, rugged construction for reliable performance
- Reference class gauge accuracies to 0.04 % of reading
- Log up to 8,493 pressure measurements to memory (requires 700G/TRACK software)

- Battery operated
- NPT ¼” Male connection
- Calibration certificate available (+$300)

Specifications

Model	Range	Resolution	Accuracy	Burst pressure
Fluke-700GA4	0 to 15 psia 0 to 1 bar absolute	0.001 psi 0.0001 bar	± 0.05 % of range	60 psi 4 bar
Fluke-700GA5	0 to 30 psia 0 to 2 bar absolute	0.001 psi 0.0001 bar		120 psi 8 bar
Fluke-700GA6	0 to 100 psia 0 to 6.9 bar absolute	0.01 psi 0.0001 bar		400 psi 27 bar
Fluke-700GA27	0 to 300 psia 0 to 20 bar absolute	0.01 psi 0.001 bar		1200 psi 80 bar

Shaun Vavra slide: no leaks seen in a test system for a week at 42.8 psig

10/25/2023	PSI
7:39	42.8
8:18	42.8
8:49	42.8
14:09	42.8
10/30/2023	
15:27	42.8
10/31/2023	
7:30	42.8
11/1/2023	
9:15	42.8

Table Shows that over the course of a week the pressure in the container is held with no loss. Using the Loctite 567 was able to hold pressure.

Airgas
an Air Liquide company

Carbon Dioxide (CO_2)

A colorless, odorless nonflammable, liquefied gas.

Grade	% Purity	H_2O	THC	Ar	CO	N_2	O_2
SFE[1]	99.9995[3]	1	0.5[4]	1	1	5	1
SFC[2]	99.999[3]	3	1[4]	1	1	5	1
Research Plus	99.999[3]	2	0.5			4	1
Research	99.999[3]	3	1	1	1	5	1
Semiconductor [6]	99.995	5	5[4]				
Laser*Plus*™ - Ultra	99.996[5]	5	1				10
Laser*Plus*™	99.995[5]	5	5				
Laser™	99.99[5]	10	10			70	20
Pure Clean	99.995	5	5 [4]				
Instrument/Coleman	99.99	10	10			70	20
Refrigerant (R744)	99.99	10					
Anaerobic	99.9			10			10
Bone Dry	99.9	10					

$549.0

$112.41

Concentrations given are ppm by volume unless otherwise specified.

Notes

[1] SFE grade also carries a Halocarbon spec of ≤ 1 ppb. THC spec is <0.5ppm for C1-C6 hydrocarbons and <10ppb for C7-C26 hydrocarbons.
[2] SFC grade also carries a Halocarbon spec of ≤ 10 ppb.
[3] Total indicated components must be less than stated impurity.
[4] C1 through C6
[5] Details of Laser grades can be found in the Special Applications section.
[6] Semiconductor grade valve material is brass for standard CGA connection. Cylinders can be provided with SS or DISS valves and additional proper regulator options upon request.

PRODUCT	Ordering Information					Equipment Recommendations		
	Cylinder Size	Contents lbs	Standard Valve Outlet (CGA)	Product Number	Cylinder Pressure at 70°F (psig)	Description Product Number	Delivery Pressure Range (psig)	Page Number
SFE	150A	39	320	CD SFE15AS	835	**Cylinder Connection Kit** Y99-TP18C320K	**N/A**	**E148**
	Certificate of Analysis included. Equipped with siphon tube. Up to 2000 psig Helium head option available.							
SFC	150A	39	320	CD SFC15AS	835	**Cylinder Connection Kit** Y99-TP18C320K	**N/A**	**E148**
	Certificate of Analysis included.							
Research $549.0	200 150A	60 39	320 320	CD R200 CD R15A	835 835	**Two-Stage Regulators** Y12-N245 * 320 Y12-244 * 320 **Single-Stage Regulators** Y11-N245 * 320 Y11-244 * 320	**A = 0-25** **B = 0-50** **D = 0-100** **E = 0-150** **F = 0-250** **G = 0-500****	**E21** **E12** **E20** **E11**
	Certificate of Analysis included.							
Semiconductor	200 150A	60 39	320 320	CD SM200 CD SM15A	835 835			
	Individual or Batch Certificate of Analysis available upon request.							
Pure Clean $112.41	200	60	320	CD PC200S	835			
	Individual or Batch Certificate of Analysis available upon request.							
Instrument/Coleman	200 80	60 26	320 320	CD I200S CD I80S	835 835			
	Individual or Batch Certificate of Analysis available upon request. For cooling applications order this product with a siphon tube for liquid withdrawal. Add "S" to the end of the product number.					* Insert Delivery Pressure Range Code ** Single Stage Only		

Airgas Flowmeter
Regulator Single stage
For CO2 gas
max 6 scfh

https://www.airgas.com/airgascatalog/

Specialty Gas Equipment

Airgas
an Air Liquide company

FLOWMETER REGULATORS | Single-Stage

Airgas FM244 Series

Description: This Airgas® FM244 series of high-purity, single-stage flowmeter regulators are recommended for non-corrosive analytical and process applications.

This regulator is part of our analytical series, machined from brass bar stock which affords minimum internal volume and eliminates large cavities and pockets associated with forged-body regulators. The flowmeter has a 65mm direct reading scale (based on air) etched into the tube. Accuracy is ±5% full scale with ±.25% repeatability. You must specify flow rate and gas service at time of ordering.

Design Features

Filtered Seat
for added gas stream purity and extended service life.
Convoluted Stainless Steel Diaphragms
eliminate outgassing associated with elastomeric diaphragms.
Bar Stock Body
affords low internal volume.
Encapsulated Filter Seat Assy
protect valve seat, extend service life.
Nickel-Plated Brass Body
provides enhanced overall aesthetics, will not tarnish.
Superior Leak Integrity
provides superior leak integrity without contamination from non-metallic liner or seal.
Direct Reading Scale
allows the operator to read the flow directly on the tube.
Safety Relief Valve
protects flowmeter and any equipment down stream.

Regulator Materials	
Body	Nickel-Plated Brass
Bonnet	Nickel-Plated Brass
Seat	PTFE
Diaphragm	316 Stainless Steel
Gauges	2½" Nickel-Plated Brass
Filter	316 Stainless Steel and Bronze
Valve Stem	316 Stainless Steel
Valve Spring	316 Stainless Steel
Outlet Valve	Nickel-Plated Brass
Trim	Nickel-Plated Brass

Specifications for Regulator	
Max Rated Inlet Pressure	3,500 psig
Outlet Pressure Ranges	0-25, 0-50, 0-100 psig
Flow Ranges	0.28, 2.2, 6.0, 20 & 150 scfh of air
Ambient Operating Temperature	-40° F to +165° F
Designed Leak Rate	Bubble-Tight (helium)
Weight	3 lbs.
Ports (4)	¼" FNPT regulator; ⅛" FNPT flowmeter
Inlet	CGA connection
Outlet	¼" MNPT Instrument Valve
Decay Inlet Characteristic	0.35/100 psi

Flowmeter Materials	
Frame	Brass
Available Float Material	Glass Stainless Steel Carboloy

Ordering Information

Product Number	Material	Max Inlet Pressure (psig)	Max Outlet Pressure (psig)	Capacity (scfh @ Max Del. Pressure)	Relief Valve Setting (psig)	Inlet Gauge Range (psig)	Delivery Gauge Range (psig)
Y11-FM244A(CGA)	Brass	3,500	25	*	85	0-4,000	30" Hg-0-30
Y11-FM244B(CGA)	Brass	3,500	50	*	150	0-4,000	0-60
Y11-FM244D(CGA)	Brass	3,500	100	*	150	0-4,000	0-200

*Determined by flowmeter must be specified at time of ordering. See 65 mm Flowmeter section to specify the required flow rate.

Available Options

Product Number	Description
Y15-QMB1	Quick Mounting Option for 1 Cylinder
Y15-QMB2	Quick Mounting Option for 2 Cylinders

Specialty Gas Equipment

Airgas
an Air Liquide company

FLOWMETERS | Standard Valve

65 mm Gas Flowmeters

Description: Airgas® flowmeters feature a direct reading scale, permanently etched onto a heavy glass flow tube.

The brass and stainless steel units feature a 1.5 focal power magnifying front cover that allows for more accurate tube reading.

Each flowmeter is equipped with two panel-mount retaining nuts to simplify industrial panel mounting, or you may purchase an optional tripod base for easy bench setup in laboratory applications. Pipe-to-tubing or pipe-to-hose adapters are also available.

65 mm Details: Preferred for industrial panel mounting, the 65 mm flowmeter tube is recommended for monitoring and control of flow from a central control panel in the facility. These models also serve as an excellent backup for electronic flow systems.

The 65 mm flow tube has a direct-reading scale air etched directly onto the tube. Accuracy is ±5% full scale with ±.25% repeatability.

Ordering Information

Product Number	Max Pressure (psig)	Inlet/Outlet	Float Material	Frame Material	Max Flow Rate * Air ccm	Air scfh
Y21-B651	200	⅛" FNPT	Glass	Brass	100	0.21
Y21-B652	200	⅛" FNPT	Glass	Brass	1,000	2.2
Y21-B653	200	⅛" FNPT	Glass	Brass	2,832	6.0
Y21-B654	200	⅛" FNPT	Stainless Steel	Brass	9,440	20
Y21-B655	200	⅛" FNPT	Carboloy®	Brass	70,800	150
Y21-4651	200	⅛" FNPT	Glass	316 SS	130	0.28
Y21-4652	200	⅛" FNPT	Glass	316 SS	1,000	2.2
Y21-4653	200	⅛" FNPT	Glass	316 SS	2,832	6.0
Y21-4654	200	⅛" FNPT	Stainless Steel	316 SS	9,440	20
Y21-4655	200	⅛" FNPT	Carboloy®	316 SS	70,800	150
Y21-T651	100	⅛" FNPT	Glass	PTFE®	100	0.21
Y21-T652	100	⅛" FNPT	Glass	PTFE®	1,000	2.2
Y21-T653	100	⅛" FNPT	Glass	PTFE®	2,832	6.0
Y21-T654	100	⅛" FNPT	Stainless Steel	PTFE®	9,440	20
Y21-T655	100	⅛" FNPT	Carboloy®	PTFE®	70,800	150

* Minimum flow rate is approximately 10% of maximum figure.
Bold type depicts actual scale reading.

Available Options

Product Number	Description
Y29-TP1	Tripod base (Brass and SS models)
Y99-26190	Brass Adapter – ⅛" MNPT x ¼" Hose
Y99-26110	Brass Adapter – ⅛" MNPT x ¼" Compression
Y99-26490	Stainless Steel Adapter – ⅛" MNPT x ¼" Hose
Y99-26410	Stainless Steel Adapter – ⅛" MNPT x ¼" Compression

Equipment