CIA
CRYO Industries of America, Inc.

HELIUM-3 (TL) 'Top Loader'

The 'TL' is designed for fast sample exchange; the sample can be removed and inserted directly into the He-3 while operating 'cold'.

Easy to use - The sample holder is easy to load and unload, it can be handled by one person. The sample holder is rigid and resistant to bending. The lowest part (He3 end) is designed to be highly thermally isolated and rigid. It doesn't bend!

The thermal anchors slide easily while maintaining excellent thermal contact. And, they do not get stuck when loading and unloading the probe.

Easy to use and resistant to ('*student*') damage!

Easy and fast sample exchange - Sample access is quick and easy:
1. Attach the sample assembly to the top of the cryostat using the quick connect clamp.
2. Pump out the air around the sample.
3. Cool the charcoal to adsorb the He-3 gas.
4. Open the gate valve and slide the sample in.

That's all there is to it!
The sample can be removed and inserted directly into the He-3 while the sample is cold.

Fast cooldown (when needed)- After inserting the sample, the gas is released from the charcoal. The pot cools and the sample temperature drops to less than to 1.5 K in less than an hour from room temperature. Then, closing the full pot and pumping hard on the charcoal brings down the sample to base temperature within less than 30 min.

Advanced sorption pump technology - Advances in synthetic sorption pump technology have been incorporated into the 'He3-TL' to reduce the base temperature and increase the cooling power. The advanced sorption pump technology combined with 'performance by design' CIA technology offer unrivaled performance. The advanced design sorb provides increased pumping speed, lower base temperature and enhanced cooling power.

Independent control of charcoal and He-3
The charcoal has no connection with sample or pot, so regardless of sample temperature the gas can be kept in the charcoal or the gas pressure changed by adjusting the charcoal temperature. At higher temperatures, a very good high vacuum can be maintained, which is important for some applications.

Independent charcoal cooling, controlled through a separate needle valve, provides for easy sub cooling of the charcoal to 2 K - resulting in the highest level of performance available.

Subcooling the charcoal makes quite a difference for 'top loading systems, more so than for sample in vacuum type. To reach the lowest temperatures, charcoal at 1.7-1.8 K is best.

Fine efficient temperature control is another benefit of isolated and independent cooling. Fine adjust the charcoal temperature to vary the temperature at the low end without adding heat.

Independent cooling means cold charcoal independent of the height of the liquid helium in the research or transport (storage dewar).

Cooling of the charcoal is by direct contact with flowing LHe-4. Thermal contact is highly efficient because no thermal interfaces such as cooling coils are used. Thermal contact area between the flowing LHe-4 is large and near absolute, not small as is with a circular coil on a container wall.
Dynamic flow for lowest sub cooled sorb temperatures, highest charcoal pumping speed and use with low helium levels or temperature stratified dewars.

Precooling of warm desorbed gas -
The warm gas from the degassed sorb is sent through a built-in 4K heat exchanger and cooled to 4.2 K before reaching the 1 K POT. The results are higher condensing efficiency with minimum temperature increases during recondensing. Fast sample evaluation with long hold times on the first cycle.

Magnetic field compatibility -
Manufactured from non magnetic stainless steel and other magnetic field compatible materials. Low magneto-error temperature sensors are used throughout. If not now, be ready to add a magnetic field when needed.

Flex circuits for quick & easy wire installation/removal
Automatic thermal anchoring
Printed Circuit (PC) breakout -
Wiring and thermal anchoring is now "oh, so easy". Flexible printed circuit sheets are bonded to the sample probe. Wires soldered to the printed circuits are automatically thermally anchored. Changing, modifying or removing wires is now a simple task and heat sinking wires is quick, easy, automatic and neat.

A break out rectangle section allows bringing better larger experimental wires down from room temperature. Change over to small diameter low thermal conduction wires at the break out rectangle. Large diameter sample tubes (select 1" (25 mm) or 1.5 inch (40 mm) with large quantity wire handling capability provides for experimental versatility without the limitations imposed by other systems.

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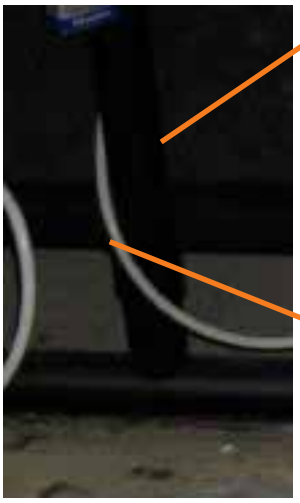
External Gas Handling system with cryopump (std) or active sealed rotary pump
- easy moving of He-3 gas between storage and insert.
In the 'top loader' inserts the sample is located directly in the Helium-3. A gas handling system is supplied with the TL He-3 cryostat. Our sealed rotary pump or external cryopump easily move the gas from the insert to the supplied storage reservoir.

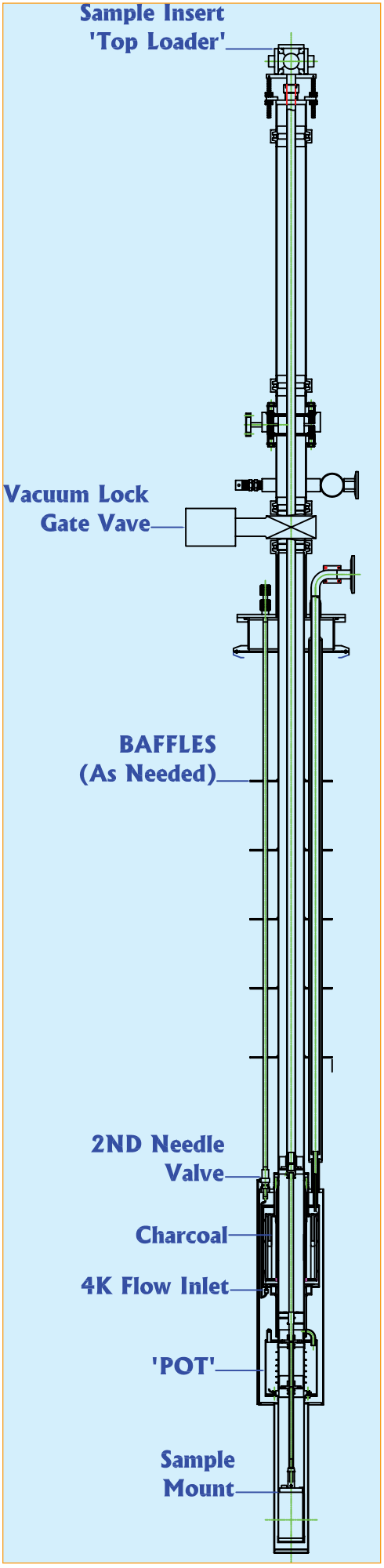
Level Probe for 1K POT [optional]!
To cool the Helium-3 gas below its condensing temperature, a small reservoir containing helium-4, called a 'POT', is pumped on using an external rotary pump. The temperature of the liquid helium-4 in the POT is typically between 1 and 1.5 K. The main function of the POT, commonly called a '1K POT', is to condense the He3 gas. Afterwards, the pot will reduce the heat conducted to the sample space. A needle valve controls the flow from the main liquid helium bath into the pot. The flow can be set to keep the pot continuously 'COLD'.

The CIA top loading helium-3 system works nicely having improved handling capability with separate sub lambda control over charcoal and pot temperatures, long hold times, rigid sample holder, high efficiency thermal anchors on sample stick and efficient radiation baffles - truly 'performance by design and performance and features not available anywhere else!

Comments:

1. The sample holder is easy to load and unload; it can be handled by one person, has more rigidity, doesn't get stuck when loading and the lowest part doesn't bend.
2. *Independent control He-3:* The charcoal has no connection with sample or pot, so regardless of sample temperature the gas can be kept in the charcoal or the gas pressure adjusted by adjusting the charcoal temperature. When working at higher temperatures, I can have very good vacuum, which is important for some of my applications.
3. Releasing the gas from the charcoal and then cooling with the pot brings down the sample in less than an hour to 1.5 K from room temperature, if I wish to. Then, closing the full pot and pumping hard on the charcoal brings down the sample to base temperature within less than 30 min.
4. The closed pot lasts for around 24 hours. The He-3 liquid lasts longer than that, and the pot can be refilled with only a short, temporary increase in sample temperature. I can for instance warm up the sample to 0.6 K for a couple of minutes without boiling off all LHe-3, and then cool down the sample again just by not heating the sample any more.
5. The system behavior is predictable, it cools, warms, etc. just as expected. When heating the charcoal, I can close the charcoal needle valve and don't need to use any LHe etc.
6. I installed many copper wires down to the PC break out. Transitioned to manganin and phosphor bronze down to the He-3 sample mount. All works well!
7. Subcooling the charcoal makes quite a difference, more so than I would have thought. If I want to go to 0.4 K, then it doesn't matter. But to reach the lowest temperatures, I need to cool the charcoal to 1.7-1.8 K.
8. All the sample wires and the large sample space enables measurements without such limitations.
9. I have the large 38 mm sample tube and have installed 34 wires. The sample, which is located 63 mm above the bottom of the sample tube, goes down to 0.30 K on the Ru02 sample mount sensor just by cooling the charcoal without any special tricks.





HELIUM-3 (TL) 'Top Loader'

Helium-3	Sample in Liquid/Gas
Base Temperature	300 mK - 25 mm dia. sample
	300 mK - 340 mK - 38 mm dia. sample
Hold Time at Base Temperature	> 24 hours
Operating Range	0.3 K to 300 K
Closed POT hold time (no inlet flow)	24 hours (approx)
POT refill time	"POT can be refilled in a few minutes with only a short, temporary increase in sample temperature."
Open POT hold time (inlet flow on)	Continuous (Inlet flow replenishes consumption)
Fast Cooldown mode (note: fast cooling can shorten cycle hold time)	1.5 hours from room temperature to base temperature (typical)
Thermometers [All temperature sensors compatible with use in high magnetic fields]	Cernox - Charcoal & POT RuO2 - Sample Si diode or platinum RTD -to monitor sample cooldown
Sample Environment	Liquid/Vapor 'Easy-to-Load' top loading sample holder Size (diameter): - 25 mm or 38 mm Rigidized sample holder CIA 'performance by design' sliding thermal contact
Experimental Access Vacuum Seal	ISO-KF 40 (NW25) Gate Valve Vac Lock
POT digital level monitor	Yes, optional
Wire Anchors	Kapton flex circuits Breakout box
Charcoal Cooling Method	Dynamic flow with direct thermal contact
	Subcooling
	Independent Control - high temperature operation with sample in Xgas or 'very good' vacuum
Experimental Wiring	10 twisted pairs (20 wires) for User

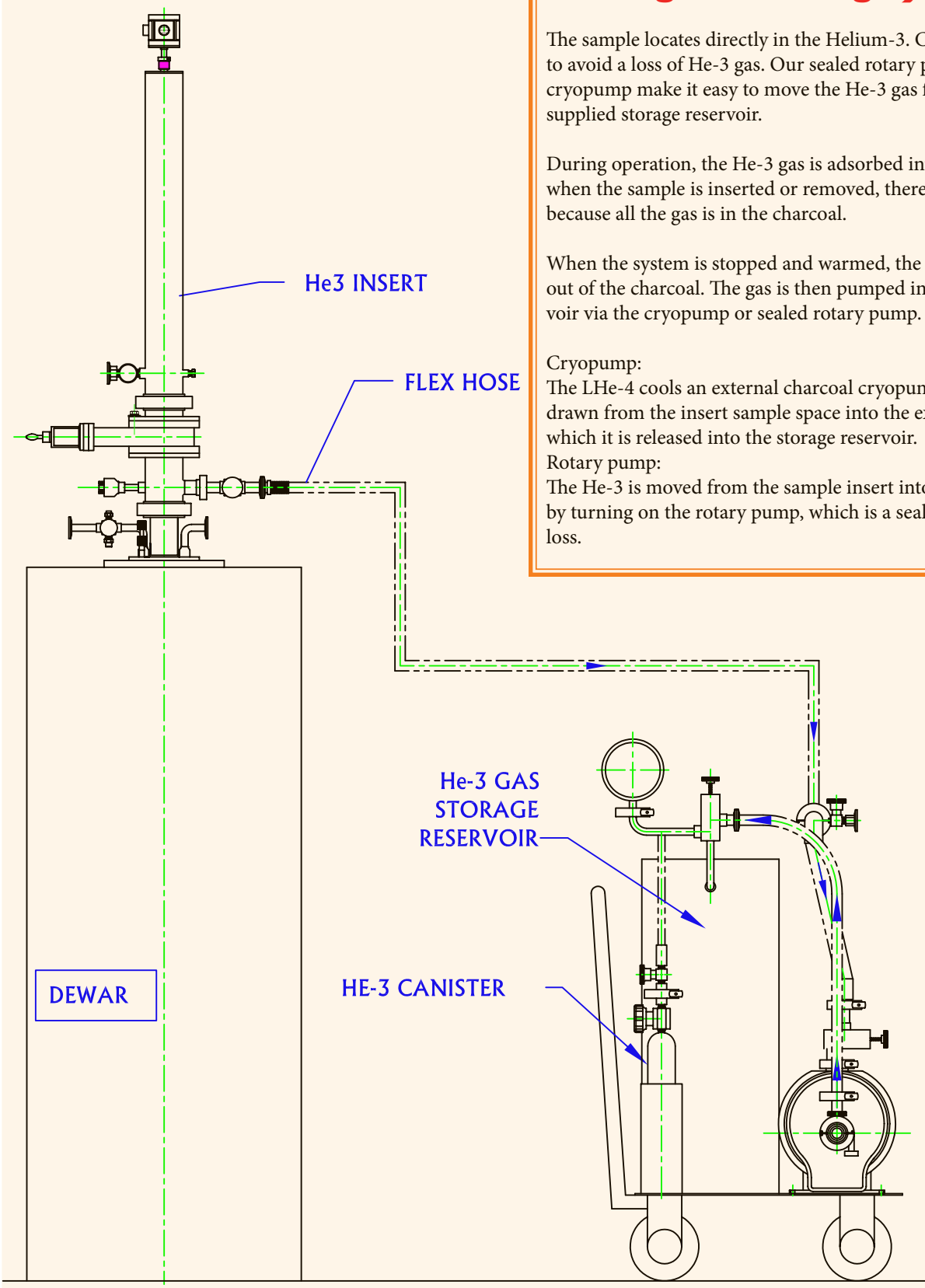
HELIUM-3 (TL) 'Top Loader' gas handling system

The sample locates directly in the Helium-3. Care must be taken to avoid a loss of He-3 gas. Our sealed rotary pump or external cryopump make it easy to move the He-3 gas from the insert to the supplied storage reservoir.

During operation, the He-3 gas is adsorbed into charcoal. Hence, when the sample is inserted or removed, there is no escape of gas because all the gas is in the charcoal.

When the system is stopped and warmed, the He-3 gas will desorb out of the charcoal. The gas is then pumped into the storage reservoir via the cryopump or sealed rotary pump.

Cryopump:
The LHe-4 cools an external charcoal cryopump. The He-3 gas is drawn from the insert sample space into the external charcoal, after which it is released into the storage reservoir.
Rotary pump:
The He-3 is moved from the sample insert into the storage reservoir by turning on the rotary pump, which is a sealed to avoid He-3 gas loss.



HELIUM 3 'TL' INSERT CRYOSTAT
AND GAS HANDLING SYSTEM
CRYO INDUSTRIES OF AMERICA, INC.