

CRYOCOOL-CF

Cryogen Free Cryogenic Gas Stream Cooler for X-ray Crystallography
with *Never-ice* Technology



**CF means no liquid
nitrogen used
(Cryogen Free).
Never-ice means no
shield gas needed -
ever!**

***Never-ice* Technology - No shield gas needed - ever - Ice free (inside and out)**

The Nozzle

The *never-ice* warm tip maintains an ice-free environment at low temperatures - ad infinitum. No signs of frost or ice formed during 6,000 hours of **continuous** operation at 90K (-183°C). **The transfer line and nozzle remained clean of frost and contaminants; none of the many samples analyzed collected ice!**



Save money - Eliminate the need for shield gas and liquid nitrogen!

In the liquid nitrogen old-fashioned shield gas system, liquid nitrogen is converted to gas for both the cold flow and the shield flow. The flows must be balanced at matched velocity at the nozzle exit. Hence, the liquid nitrogen consumption is usually 2 to 2.5 times more than that specified for the cooling flow. For example, using a 0.5 l/hr of liquid nitrogen for cold flow also requires converting an additional 0.5 - 0.75 l/hr for shield gas, resulting in a continuous consumption of 1 to 1.25 liters/hour of liquid nitrogen. Liquid nitrogen requires continuous ordering, handling, storage, transfer and containers. The CRYOCOOL-CF eliminates the need for liquid nitrogen and shield gas!

The Nitrogen Gas Extractor

Nitrogen gas is extracted from the air and cooled by the CRYO Refrigerator.

Only an air compressor is needed.

The nitrogen extractor takes in pressurized air and liberates nitrogen gas from the air. The nitrogen gas flows into the refrigerator where it is cooled. This eliminates the need to buy nitrogen gas or liquid from an outside vendor and there is not need for gas storage cylinders.

The Operating Temperature Range

The CRYOCOOL-CF offers the lowest operating temperature range!

These systems were designed to be able to cool different flowing gases - not just nitrogen. This benefit means lower temperatures are available by simply switching from nitrogen to helium gas. The limitation to the base temperature is the cooling power of the refrigerator - not the system design. By changing to a larger refrigerator (**CF4**), lower temperatures - not previously available - are obtained! This multi-gas capability is a feature unique to the **CRYOCOOL-CF**. We are unaware of any other system that provides this versatility and extra low base temperature. The standard operating base temperature using nitrogen gas is down to 78K (-195°C). With no modifications, switch over to helium gas to go down to 25 K (-248 °C) [28 K at the crystal located 5 mm from the nozzle]. **Heat or Cool** - with an extended operating range to 500 K, crystals can be heated or cooled. A heat exchanger is built in the nozzle to allow variable temperature operation. Accurate 4-wire silicon diode temperature sensors monitor the refrigerator and nozzle temperatures.

Operating Temperature Range

78 K (-195 °C) to 500 K (227 °C) - CF3

25 K (-248 °C) to 500K (227 °C) - CF4

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CRYO

Performance by Design

The Refrigerator

The GM refrigerator cools the nitrogen gas stream.

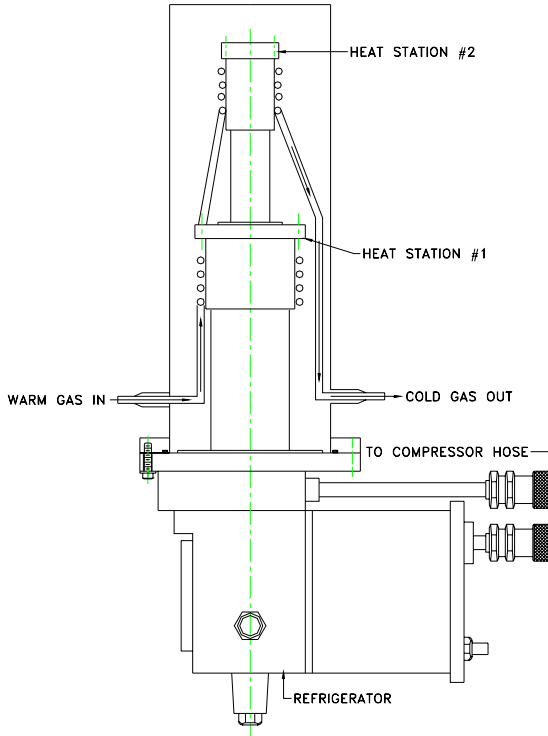
Technology Transfer

Developed for NASA to test gas sensors, this proven technology has now been transferred for use in crystallography. Continuous cryogen free operation, unmatched performance and push-and-play operation are just some of the features.

Warm gas is cooled by the two refrigerator heat stations. No liquid nitrogen or liquid helium is used! Works with nitrogen or helium gas.

The refrigerator operates on the Gifford-McMahon (GM) gas expansion cycle.

A compressor circulates helium gas in a closed loop to and from the refrigerator. This compressed gas is cooled by expansion, providing heat removal at the two refrigeration stations. Similar to a standard room air conditioner, the refrigerant gas is used over and over (closed cycle). Heat exchangers attached to the refrigerator stations cool down the gas 'stream' used to cool the samples (crystals).



PUSH BUTTON START OPERATION

1. Start the gas flowing (nitrogen or helium)
2. Turn-on the never-ice system
3. Push the compressor 'ON' button
4. Watch the system automatically cool and hold the preset gas stream temperature.



**DO NOT USE
LIQUID
NITROGEN**

FREE YOURSELF FROM LIQUID NITROGEN COSTS!

No more liquid nitrogen deliveries, refills, transfers, surprise run outs, bad nitrogen, icing and so on. With never-ice technology there is no need to waste liquid nitrogen or gaseous nitrogen to create shield gas.

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Specifications

CRYOCOOL CF3/CF4 - The Best - Cryocools are Cool - *'Performance by Design'*

| | |
|--|---|
| Temperature Range N2 Gas | 78 K to 500 K (-195 °C to 227 °C) |
| Temperature Range He Gas | 52 K to 500 K [CF3] (55K @ 5 mm from nozzle) [CF3] 25 K to 500 K [CF4] (28 K @ 5 mm from nozzle) [CF4] |
| Temperature Stability | Better than +/- 0.1K |
| Gas Flow Range | 0 to 10 l/min |
| Runtime | Unlimited |
| Icing | Never |
| Liquid nitrogen usage | ZERO (0) |
| Shield gas consumption: | ZERO (0) |
| Cooldown time to 100K from warm start | 120 minutes |
| Transfer line flexible length | 78 in (2.0 m) |

| | |
|-------------------|---|
| Compressor | |
| Power Requirement | 208/240v, single phase, 2.0 kw [CF3] 208/240 v, three phase, 5.0 kw [CF4] |
| Water | 0.5 GPM @ 15 - 25°C [CF3] 2.0 GPM @ 15 - 25°C [CF4] |
| Dimensions | 19.5 in x 19.0 in x 16.25 in 49.5 cm x 48.2 cm x 41.2 cm (length x depth x height) [CF3] 19.5 in x 21.5 in x 23.4 in 49.5 cm x 54.6 cm x 59.3 cm (length x depth x height) [CF4] |

| | |
|--------------------|---|
| Maintenance | <p>Minimal Replace absorber yearly. There are no diaphragm pumps or line driers to service. For optimal efficiency, it is recommended that the insulating vacuum be evacuated as needed, typically once per month.</p> |
|--------------------|---|

CRYO

Performance by Design

System Components - Model XRC-1598-350 X-ray Crystallography CRYOCOOL CF3/CF4 Cryogenic System

High Efficiency Nitrogen Transfer System

- Large nozzle diameter of 0.312 inch (~8 mm), inside diameter 0.272 inch (~ 7 mm)
- Nozzle heater for variable temperature and high temperature stability
- Accurate 4-wire silicon diode temperature sensor installed in nozzle
- Vacuum and superinsulated transfer line for highest efficiency
- All welded stainless steel construction for long term reliability
- Long flexible length for easy handling and manipulation
- Never-ice* warm-tip eliminates ice and shield gas forever
- Charcoal vacuum maintenance cryopump installed
- Control heater installed in nozzle
- Safety Pressure relief installed

Closed Cycle Refrigerator

LOW MAINTENANCE - LOW-VIBRATION - QUIET OPERATIONS

- Accurate 4-wire platinum temperature sensor installed on second stage
- First-stage heat exchanger with sensor and heater controller
- Two-stage Gifford-McMahon (GM) direct drive coldhead
- Integrated first-stage cold trap prevents plugging
- Second stage ultra stable temperature control
- Direct drive design for Lab Quiet operation
- Choice of water or air cooled compressor
- 10 feet interconnecting compressor hoses
- First-stage integrated charcoal cryopump

Nitrogen Gas Extractor

- On-site generation of nitrogen from compressed air
- Lab Quiet air compressor with filters (optional)
- Dual chamber regenerative air dryer (optional)
- Flow control needle valve with flow indicator
- 99.5% pure nitrogen gas generated

Autotune Temperature Controller

- Standard versatile interchangeable design - can be used with most cryogenic systems
- 50 watts PID control heater output, P = gain, I = Integral, D = derivative
- Silicon diode 4-wire temperature sensor input for maximum accuracy
- Independent refrigerator second stage temperature control
- Digital readout of temperature sensor and heater power
- Independent nozzle temperature control
- RS-232 and IEEE (GPIB) computer interfaces
- Tip temperature indicator

Nozzle Support Stand

- Sturdy lightweight corrosion-resistant anodized aluminum alloy construction
- Nozzle X-Y-Z precision micrometer for perfect nozzle alignment
- Tilt and rotational adjustments

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CRYOCOOL-CF3/CF4 (CRYOGEN FREE)

Nitrogen Gas Extractor

The nitrogen 'cold' gas is generated on-site from dry compressed air.

Refrigerator

The GM (Gifford-McMahon) refrigerator cools the nitrogen gas.

Temperature Controllers

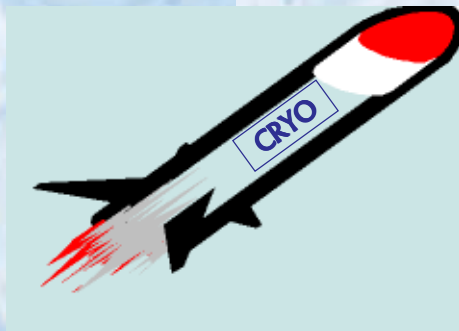
The controllers automatically control the gas stream and the refrigerator temperatures.

Stand

The stand allows precise adjustment of the gas stream.

Nozzle

The unique *never-ice* nozzle maintains ice free operation without the need for shield gas.



"If other systems are 'Jets' or 'Streams', this is the 'CRYORocket'!"