



CryoRad-III

User Manual

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1 Overview

L-1's CryoRad series of radiometers are electrical substitution radiometers (ESR) designed for highly repeatable and accurate measurements of optical radiation. They are optimized for convenient characterization and calibration of detectors such as photodiodes, pyroelectrics, thermopiles, and photomultipliers, using a monochromator or laser as an illumination source.

With precautions against scattered light, calibration of such detectors can be carried out with the radiometer to an absolute accuracy and long term repeatability at the rated accuracy level.

Measuring optical beam power with the radiometer is inherently a difference measurement; each data point is the difference between the servo heater power without radiation and the servo heater power with radiation. Collecting data in this manner is essential to the radiometer operation because of unavoidable low-level radiation background present in the scene viewed by the cryogenic radiometer.

2 Terminology and Acronyms

Terminology:

Backing Pump: A dry scroll pump such as Varian model IDP-3

Convection Gauge: MKS 317 Convection-Enhanced Pirani Pressure Vacuum Sensor

I-Mag Gauge: MKS Cold Cathode Vacuum Sensor

Turbo Pump: A turbo molecular pump such as Varian model V-81

Acronyms:

CF	Conflat
L-1	L-1 Standards and Technology, Inc.
OD	Outer Diameter
PC	Personal Computer
PS	Power Supply
SHCS	Socket Head Cap Screw(s)

NOTE

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3 Inspection and Unpacking

Inspection of Crate

If there is any visible damage to the crates, contact L-1 immediately and do not proceed with opening or unpacking the crates. Be sure to note on the shipping documents any visible damage to the crates, including tip indicators that have been activated.

Unpacking

The system is securely packaged in two shipping crates marked "Crate 1 of 2" and "Crate 2 of 2". A packing list is included with each crate.

Crate #1 contains the CryoRad-III, TC-04 power supply, PC and other electronics, hardware kit, tool kit, lab supplies kit, plumbing kit and any associated cables. Use extreme caution when removing the CryoRad-III from the crate. Large mechanical shocks could cause misalignment problems or other damage. The instructions for unpacking Crate #1 are as follows:

1. Remove all plastic wrapping covering crate and visually inspect crate for any damage. If the crate appears to have been damaged during shipment, stop unpacking and contact L-1 Standards and Technology within one business day.
2. Cut, remove and discard black metal banding around crate exterior.
3. Remove the black Philips drive screws securing the lid, labeled "Top", to the crate.
4. Lift the lid straight up and set aside.
5. Inspect the two (2) "Tip-N-Tilt" shipping indicators inside the crate. If either of the shipping indicators has been activated, stop unpacking and contact L-1 immediately. Please see "Tip-N-Tilt" indicators for explanation of activation.
6. Remove the Philips drive screws securing the panel labeled "FRONT" from the crate.
7. Lift the front panel straight back and set aside. The CryoRad-III (with pre-installed Cryomech cold head, Brewster window assembly, kinematic window mount and TC-04 electronics) will now be accessible.
8. Remove the two (2) yellow ratcheting tie down straps.
9. Remove the black plastic sheeting covering the radiometer.
10. Ensure a proper location for the CryoRad-III and associated equipment has been prepared.
11. The CryoRad-III is secured to two (2) aluminum shipping rails with four (4) ¼"-20 SHCS through a black anodized base plate. Remove the four (4) ¼"-20 SHCS.

12. With at least two people holding the CryoRad-III from at least two acceptable lift points (see Appendix Drawing 2), lift the CryoRad-III out of the crate and place it in its predetermined location (optimally an optics table).
13. Remove the Philips drive screws securing the panel labeled "BACK" from the crate.
14. Lift the back panel straight back and set aside.
15. The remaining equipment is packed in boxes and can now be removed and unpacked.
16. Keep all crates and packing materials at least until final approval after installation and training.

Crate #2 contains the Cryomech compressor and associated cables and parts. Please refer to the Cryomech PT405 CP2850 Installation Operation and Routine Maintenance manual page 4-1, section 4.2 for instructions on unpacking this crate. Please note that the cold head is shipped preinstalled on the radiometer in Crate #1 and will not be present in Crate #2.

Inspection of Equipment

A packing list is included with the shipment and should be checked to see that all parts listed on the packing list are included in the crates. If missing equipment or damage to equipment is suspected, contact L-1 immediately and do not proceed with setup or operation.

Crate #1:

CryoRad-III:

Inspect the CryoRad-III system for any signs of damage. If damage is suspected, immediately contact L-1 with the details and do not setup or operate the system.

Radiometer Power Supply:

The TC-04 Cryogenic Radiometer Power Supply is packed in a separate box along with its power cord and the TC-04 Power Supply Cables for the heat sink and receiver channels of the TC-04 electronics.

Vacuum Gauge Controller:

The vacuum gauge controller is packed in its original packaging along with the power cord, convection gauge cable and I-Mag gauge cable. Manufacturer supplied instructions are included in the documentation wallet provided with the CryoRad-III system.

Computer:

The supplied computer, which has been tested at L-1 with the CryoRad-III system, is

packed in its original packaging along with keyboard, mouse and power cable. LabVIEW runtime engine 2012 64-bit has been preinstalled on the computer. Manufacturer supplied instructions are included in the documentation wallet provided with the CryoRad-III. Check the computer for any signs of damage. Once set up, check that the computer turns on and that the operating system comes up with no errors.

Computer Monitor:

The supplied computer monitor, which has been tested at L-1 with the CryoRad-III system, is packed in its original packaging along with its power cable. Manufacturer supplied instruction are included in the documentation wallet provided with the CryoRad-III system.

GPIB-USB-HS+:

A GPIB controller for hi-speed USB is supplied in its original packaging from National Instruments. The software for the GPIB-USB-HS+ has been installed on the supplied computer and the GPIB controller has been tested at L-1 with the supplied computer. Manufacturer supplied instruction are included in the documentation wallet provided with the CryoRad-III system.

Ethernet Switch:

A NETGEAR Ethernet switch, model GS108, is supplied in its original manufacturer's packaging. The Ethernet switch has been installed and tested at L-1 with the supplied computer. Manufacturer supplied instruction are included in the documentation wallet provided with the CryoRad-III system.

Hardware Kit/Tool Kit/Lab Supplies Kit/Plumbing Kit:

These kits contain parts needed to setup the system and/or replacement parts that may be needed in the future with continued use of the system. A packing slip is included inside each kit that details the parts within each kit.

Crate #2:

Please refer to Cryomech PT405 CP2850 Installation Operation and Routine Maintenance manual page 4-2, section 4.3 for instructions on inspecting the equipment in this crate. Please note that the cold head is preinstalled on the radiometer shipped in Crate #1 and therefore the sections on inspecting the cold head (section 4.3.3) do not apply.

4 Setup

CryoRad-III Placement

Optimally, the CryoRad-III should be mounted on a level optics table (either English or metric) that is grounded to earth ground. The baseplate of the CryoRad-III should be secured to the optics table using the appropriate hardware ($\frac{1}{4}$ "-20 or M6 SHCS) through the appropriate hole pattern of four counterbored holes on the baseplate for either the English or metric based optics table.

The CryoRad-III is shipped with a flip plate and rods installed at the top of the radiometer to protect it during shipping (see Appendix Drawing 2). After the CryoRad-III is mounted to an optics table and prior to operation, the flip plate, rods and associated hardware should be removed and stored for future use as they are necessary for any future servicing and/or shipping.

Instructions for removal and storage of flip plate, rods and associated hardware (see Appendix Drawing 2):

1. Remove the four (4) $\frac{1}{4}$ "-20 SHCS attaching the flip plate to the flip rods.
2. Remove the flip plate from atop the flip rods.
3. Unscrew the four (4) flip rods counter clockwise from the top of the CryoRad-III radiometer (the bottom of the flip rods have 8-32 set screws used to secure the rods to the radiometer).
4. Store the flip plate, flip rods (with set screws) and SHCS for future use.

The TC-04 power supply and the user supplied voltmeter that will be used for calibration are best mounted in a 19" electronics rack located no more than 15 feet (or 5 meters) away from the CryoRad-III.

CryoRad-III Component Grounding

The optics table must be grounded to earth ground. The CryoRad-III radiometer and TC-04 electronics should be grounded to the optics table using the supplied 18 AWG grounding wire, ring and/or spade terminals and SHCS.

1. Ground the CryoRad-III radiometer to the TC-04 electronics enclosures: The CryoRad-III radiometer has four (4) 8-32 tapped holes in the top flange that are used for mounting the flip rods. Using one of these flip plate holes close to the TC-04 electronics, attached one ring or spade terminal with grounding wire crimped and soldered into it using an 8-32 x $\frac{7}{16}$ " SHCS.

This grounding wire then attaches to one of the ¼"-20 tapped holes on the side of the TC-04 electronics enclosures using a ring terminal and a ¼"-20 x ⅜" SHCS.

2. Ground the TC-04 electronics enclosures to the optics table: Using more grounding wire, ring terminals and SHCS, ground the TC-04 electronics (using another of the ¼"-20 tapped holes on the side) to the optics table.

CryoRad-III Component Connections

It is strongly suggested that an UPS (uninterruptable power supply) unit be used to provide a power source with surge protection and battery backup to the following supplied equipment: TC-04 power supply, computer, monitor and vacuum gauge controller.

1. Verify that the TC-04 power supply is turned off before making connections.
2. Connect the TC-04 power supply to the TC-04 electronics mounted on the CryoRad-III using the TC-04 Power Supply Cable-Heat Sink and TC-04 Power Supply Cable-Receiver supplied.
 - The power supply cable labeled Receiver should be connected to the back of the TC-04 power supply at the connector labeled Receiver DC Power Output and also to the TC-04 Radiometer Control Receiver electronics enclosure at the connector labeled Power Supply.
 - The power supply cable labeled Heat Sink should be connected to the back of the TC-04 power supply at the connector labeled Heat Sink DC Power Output and also to the TC-04 Radiometer Control Heat Sink electronics enclosure at the connector labeled Power Supply.
3. Connect the supplied AC power cable to the back of the TC-04 power supply and plug the other end into a power source. Do not turn the TC-04 power supply on yet.
4. Verify connection of the two TC-04 Radiometer Control Cables between the CryoRad-III radiometer and the TC-04 electronics (these cables are shipped pre-installed on the CryoRad-III).
 - The TC-04 Radiometer Control Cable-Receiver has a right angle, 26-pin circular connector on one end labeled "1" and three Lemo connectors on the other end labeled: REC SENSOR #1, REC HEATER #1, REC HEATER #2.
 - The TC-04 Radiometer Control Cable-Heat Sink has a right angle, 26-pin circular connector on one end labeled "2" and three Lemo connectors on the other end labeled: H/S SENSOR #1, H/S HEATER #1, H/S HEATER #2 and a DB-9 male connector labeled TEMP SENSORS.
5. Connect the two TC-04 Radiometer Control electronics enclosures (Heat Sink and Receiver) to the Ethernet switch using two (2) supplied Ethernet cables.

6. Setup the computer, mouse, keyboard, and monitor and connect the computer to the Ethernet switch using a provided Ethernet cable. The computer has a second Ethernet port that can be used along with another Ethernet cable to connect to another network.
7. A GPIB controller for hi-speed USB (GPIB-USB-HS+) from National Instruments is supplied to connect a user supplied voltmeter requiring a GPIB cable to the supplied computer.
8. Using the provided convection and I-Mag gauge cables connect the vacuum gauge controller to the CryoRad-III system (see Appendix Drawing 1) and plug the vacuum gauge into a power source.

Compressor Installation

Please refer to the Cryomech PT405 CP2850 Installation Operation and Routine Maintenance manual: page 6-4, section 6.2 for instructions on installing compressor and connecting to cold head. Please also refer to the Cryomech PT405 CP2850 Installation Operation and Routine Maintenance manual page 5-2, figure 5-1: Cooling water requirement prior to connecting the water lines to the compressor.

5 Operation

Laser and beam setup and radiometer alignment are critical to the optimal functioning of the CryoRad-III system and must be complete prior to operation. These topics will be covered by L-1 staff during on-site installation and training.

Cool Down

1. Review section 6 of this manual and check that the system is setup properly.
2. Review the Cryomech PT405 CP2850 Installation Operation and Routine Maintenance manual: section 7 on operation of the cryogenic refrigeration system.
3. Turn on the TC-04 power supply, vacuum gauge controller, computer and monitor.
4. Verify that the turbo pump vent valve is closed (if manually operated).
5. Turn on the backing pump.
6. Turn on the turbo pump.
7. Slowly open each of the following valves on the CryoRad-III:
 - 2- $\frac{3}{4}$ " OD CF (NW35CF) right angle valve
 - 1- $\frac{1}{3}$ " OD CF (NW16CF) right angle valve
 - 2- $\frac{3}{4}$ " OD CF (NW35CF) 1- $\frac{1}{2}$ " gate valve
8. When the pressure is 1×10^{-5} Torr or less (A1 on vacuum gauge controller), start the Cryomech compressor (see Cryomech PT405 CP2850 Installation Operation and Routine Maintenance manual page 7-2).

NOTE

Be sure the cooling water is turned on and is set to the appropriate flow rate for the compressor (see Cryomech PT405 CP2850 Installation Operation and Routine Maintenance manual page 5-2, figure 5-1: Cooling water requirement for water flow rate specifications in graph form).

9. Start the TC-04 LabVIEW software where pressures and temperatures can be monitored and recorded.
10. When the pressure is 5×10^{-7} Torr or less (A1 on vacuum gauge controller), close the 2- $\frac{3}{4}$ " OD CF (NW35CF) and 1- $\frac{1}{3}$ " OD CF (NW16CF) right angle valves.
11. Turn off the turbo pump.
12. If the turbo pump has a manual vent, slowly open its vent valve.
13. Turn off the backing pump.
14. After the turbo pump has stopped and vented, close its vent valve (if manually operated).

15. Check temperatures of the CryoRad-III via the TC-04 LabVIEW software (cool down to liquid helium temperatures takes about 8 – 11 hours).
16. When liquid helium temperatures have been reached, use the TC-04 LabVIEW software to conduct the experiment.
17. Allow the Cryomech to run uninterrupted until the experiment is concluded.

Shut Down

1. Verify that the following valves are closed:
 - 2- $\frac{3}{4}$ " OD CF (NW35CF) right angle valve
 - 1- $\frac{1}{3}$ " OD CF(NW16CF) right angle valve
 - 2- $\frac{3}{4}$ " OD CF (NW35CF) 1- $\frac{1}{2}$ " gate valve
2. If turbo and backing pumps are running:
 - Turn off the turbo pump.
 - If the turbo pump has a manual vent, slowly open its vent valve.
 - Turn off the backing pump.
 - When the turbo pump has stopped and vented, close its vent valve (if manually operated).
3. Turn off the Cryomech compressor (see Cryomech PT405 CP2850 Installation Operation and Routine Maintenance manual: page 7-3, section 7.4).
4. The radiometer should be left under vacuum (leave all valves closed). A return to room temperature will require approximately 48 hours. The system is then ready to use for the next cold cycle.
5. The TC-04 power supply, vacuum gauge controller, computer and monitor can be turned off.

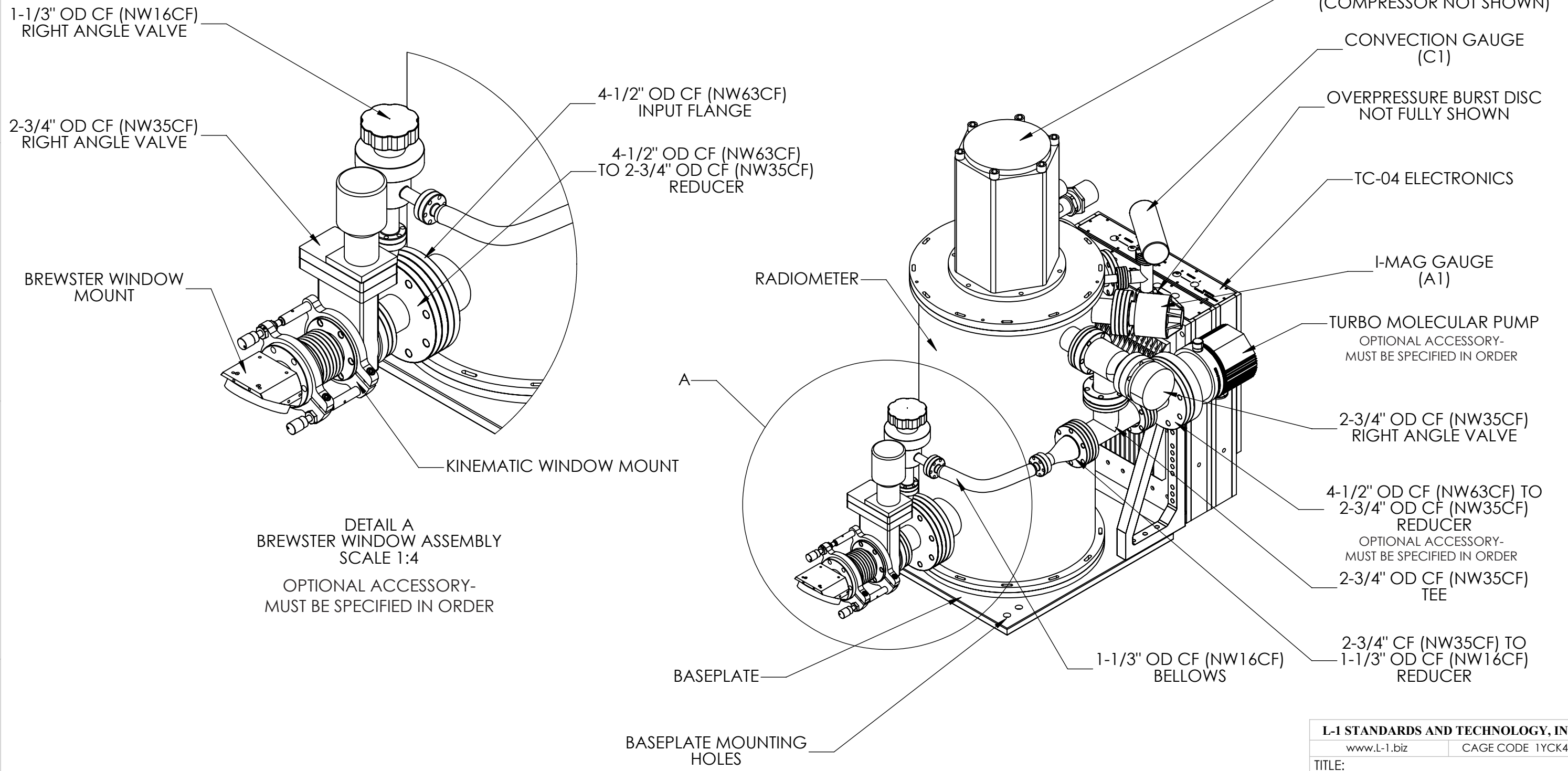
A Appendix

- Drawing 1: CryoRad-III System
- Drawing 2: CryoRad-III FLIP PLATE/RODS & LIFT POINTS

8 7 6 5 4 3 2 1

D
C
B
A

D
C
B
A



L-1 STANDARDS AND TECHNOLOGY, INC.		
www.L-1.biz	CAGE CODE 1YCK4	
TITLE:		
CryoRad-III System		
SIZE	DWG. NO.	REV
B	DRAWING 1	A
SCALE: 1:6	SHEET 1 OF 1	

8 7 6 5 4 3 2 1

8

7

6

5

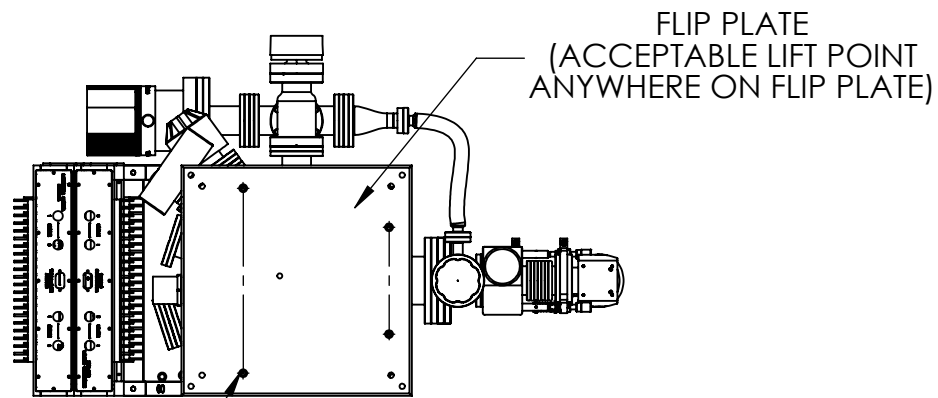
4

3

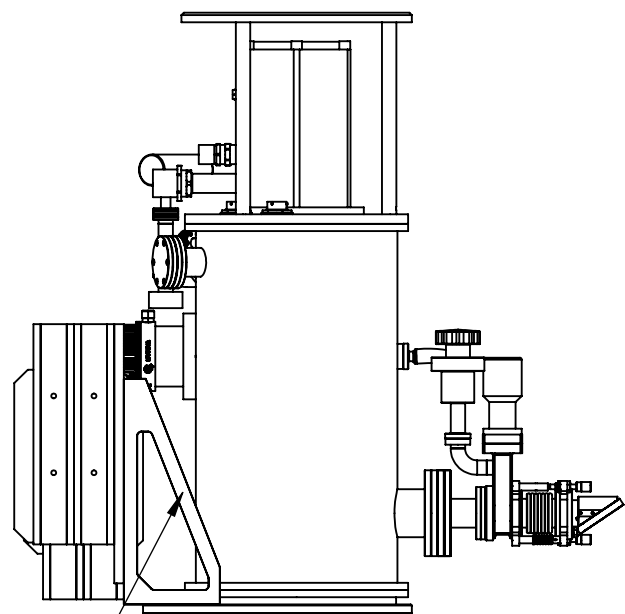
2

1

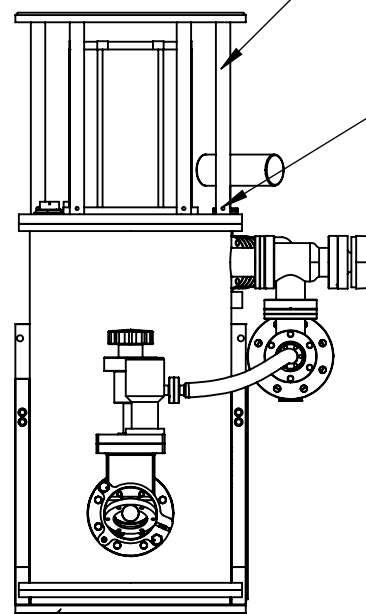
LIFT CryoRad-III FROM LABELED LIFT POINTS ONLY
 LIFTING THE CryoRad-III REQUIRES AT LEAST 2 PEOPLE



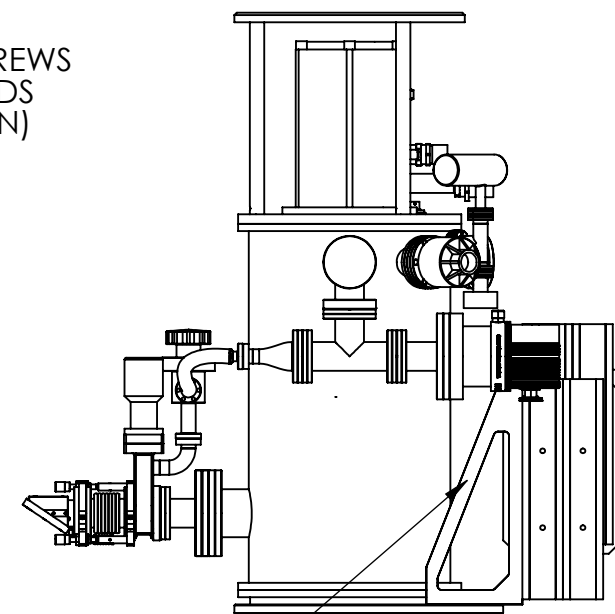
4X 1/4"-20 SOCKET HEAD CAP SCREWS



BASE PLATE
 (ACCEPTABLE LIFT POINT)



90° BRACKET
 (ACCEPTABLE LIFT POINT)



L-1 STANDARDS AND TECHNOLOGY, INC.		
www.L-1.biz	CAGE CODE 1YCK4	
TITLE:		
CryoRad-III FLIP PLATE/RODS & LIFT POINTS		
SIZE	DWG. NO.	REV
B	DRAWING 2	A
SCALE: 1:10		SHEET 1 OF 1

8

7

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4

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2

1