

HIGH VACUUM CRYOGENIC CART



Operation Manual

YOU MUST READ THIS MANUAL BEFORE USE

April 2024

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SECTION 1: Overview

The purpose of this document is to describe the purpose, installation, maintenance, upkeep, and use of the **High Vacuum Cryogenic Cart**.

This High Vacuum Cryogenic pump down system is designed to work with existing roughing systems (such as Stokes or similar). It is meant to evacuate the cryogenic vessel jacket to high vacuum after it has been roughed to a pressure that is less than 10 millitorr. This system includes a remote ruggedized high vacuum gauge (hereon referred to as the **remote gauge**) that is used to measure and monitor the opposite end of the tank. In addition to the remote gauge, there is a built-in Fyra vacuum controller used to monitor the vacuum levels of the Turbo and roughing pumps. Light indicators are used in combination with the Fyra vacuum controller to indicate when certain levels have been reached within the chamber. Finally, there is also a Turbo control panel that can be used to power on or off the Turbo pump on the cart.

System Specifications

Operating Temperature: +5°C to +35°C

Power: 110V with Nema 5-15p plug

Current: 12.1 Amps

Wheel Size: 10" Diameter

Physical Dimensions: 30"W, 46"L, 56"H

System Connection Type: KF50 for High Vacuum

¼ turn Ball Valves: Directs systems flow path to rough or high vacuum

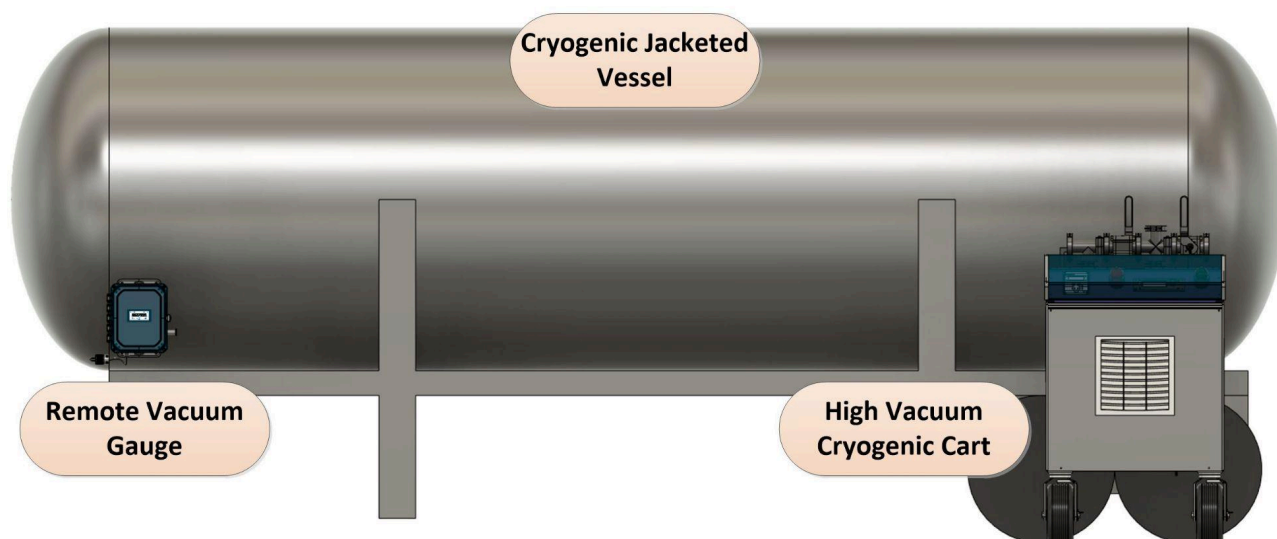
Fyra Vacuum Controller: Vacuum gauge to monitor Roughing and High vacuum pumps

Remote Gauge: Reads the pressure of the cryogenic jacket vessel

Turbo Pump: $<1 \times 10^{-10}$ mbar

System Features

- **Valve #1** - connects to the stokes roughing pump; opens or closes the passage from the stokes roughing pump to the cryogenic vessel
- **Valve #2** - connects to the turbo pump; opens or closes the passage from the turbo pump to the cryogenic vessel jacket
- **Sensor 1** - reads the vacuum pressure of the turbo pump
- **Sensor 2** - reads the cross connection point for the cryogenic vessel jacket
- Light illumination indication:
 - **Red light** - indicates the vacuum pressure of the cryogenic vessel is >25 millitorr/microns (not safe to activate turbo)
 - **Green light** - indicates the vacuum pressure is <25 millitorr/microns (safe to activate turbo)



SECTION 2: Quick Start Guide

1. Install the remote vacuum gauge (vacuum meter)
2. Make sure that the outlet you are using is rated to supply enough power to the cart - a 15 amp circuit.
3. Make sure the cart is close enough to the outlet so the power cable can comfortably rest without risk of being pulled out.

SECTION 3: Operation

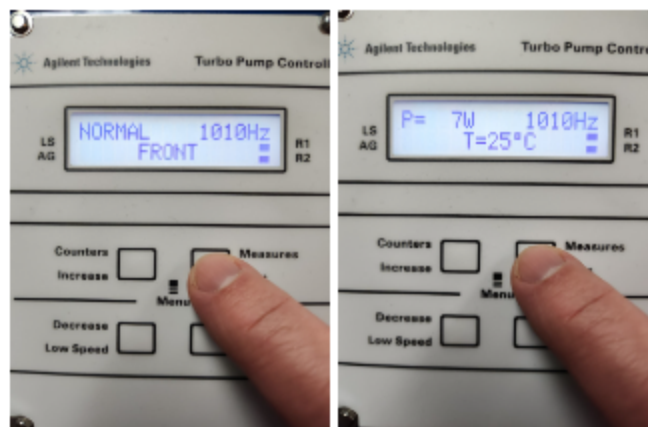
This section describes in more detail about the installation and operation of the cart. The cart was designed to work in an industrial environment. Care should be taken to monitor the temperature.

If the temperature indication on the Turbo **exceeds 35°C or 95°F**, the **Turbo should be turned off**.

How to Check Temperature:

1. Press the **"Measure"** button
2. Note the temperature. If the Temperature is greater than **35°C**, shut down the machine.

Do not move or bang the Turbo cart when the Turbo is running. If you need to move the cart, shut down the turbo pump first.

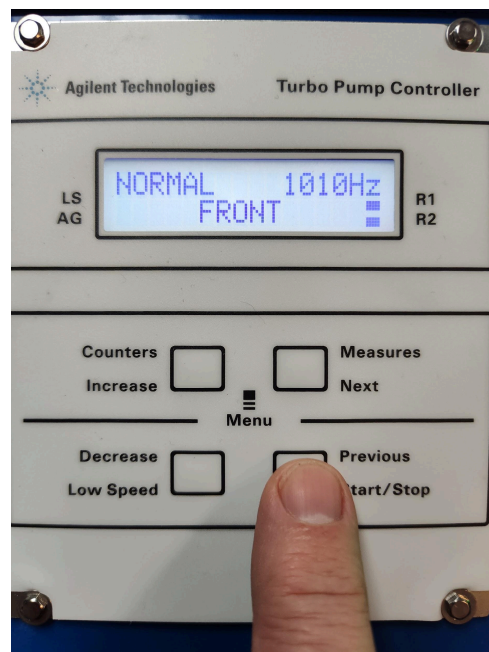


Installation & Operation Guide

Below is a detailed, step by step instruction guide on how to install and operate the cart:

1. Make sure all fittings that will be used for high vacuum are clean. No dust, oil, salt, etc.
 - a. *To Clean:* Wipe clean fittings with ethanol or other mild solvent. Ensure all KF centering rings are clean and the Viton rubber on the rings are in good shape.
 - b. *Note:* If in doubt, replace. If using vacuum grease, less is better.
2. Connect the remote gauge (vacuum meter) to the cryogenic vessel jacket fitting on the one end of the vessel.
3. **Powering the remote gauge:** Plug the remote gauge into a 110V outlet. The display will read **"Range"** or a number between 200 and 1000 Torr.
4. Open the valve on the cryogenic vessel to allow the remote gauge to measure.
5. Roll Cart to the other end of the cryogenic vessel jacket to connect the pumping system to the vessel.
6. Attach the roughing/Stokes pump to the right side of the cart near roughing **Valve #1**.
7. Attach the cryogenic vessel jacket to the **center top KF50 port** on the cart with the bellows hose.
8. Ensure both valves (**#1** and **#2**) are closed. The valves are closed when the handles are perpendicular \perp to the pipe (or in an upright position).
9. Plug the cart into an outlet capable of delivering 15 amps through the NEMA 5-15P plug.
10. Turn the cart on with the black rocker switch underneath the plexiglass panel. The **red light** indicator will be illuminated once the system is powered to signify the system's pressure is above 25 millitorr.
11. Turn on the roughing/Stokes pump.
12. Open roughing **Valve #1**. Valves are open when the valve handle is parallel \parallel to the pipe. The Stokes rough pump will start pumping down the Cryogenic Vessel.
13. Open the evacuation valve on the cryogenic jacket near the pumps.

14. When the vacuum reading of **Sensor 2** reads between 5 and 10 millitorr, the **green light** will be illuminated to signal that the Turbo pump is safe to be activated.
15. When the **green light** is illuminated, turn the turbo pump on by pressing “**Start/Stop**” on the Turbo control panel underneath the plexiglass.
16. Wait 1 minute (you will see RPM in Hz increase).
17. Close roughing **Valve 1**.
18. Open high vacuum **Valve 2**. The Turbo pump will start pumping down the Cryogenic Vessel to a lower pressure.
19. Monitor the **remote gauge** until it reads the desired vacuum level.
 - a. *Note:* A good high vacuum level to achieve for an application like this may be 5×10^{-4} Torr on the remote vacuum gauge, but consult management for the actual target pressure.
20. Determine the proper vacuum level has been reached.
21. Once reached, close the evacuation valve on the cryogenic vessel jacket by the high vacuum cryogenic cart.
22. Close the valve on the cryogenic vessel jacket connected to the **remote gauge** (vacuum meter).
23. Close high vacuum **Valve #2**
24. Stop the Turbo pump by pressing the “**Start/Stop**” button on the Turbo controller. Wait 5 minutes.
25. Disconnect the remote vacuum gauge/vacuum meter from the cryogenic vessel. Install plastic cap on exposed joint.
26. Turn off the High Vacuum Cryogenic Cart with the black rocker switch underneath the plexiglass panel
27. Disconnect the cart from the cryogenic vessel jacket (you will hear a “hiss” as air rushes in to fill the pipe) and Stokes pump connections. Install plastic caps on all exposed joints. This will help keep the systems clean, last longer, and improve pump down times.
28. Unplug the cart, and store the vacuum systems in a safe place.



FYRA Vacuum Controller Information

The FYRA is a color LCD vacuum controller mounted to the console of the cart.



Fyra Features Specific to Cart

- High Vacuum Gauge Card
- FRG700 Inverted Magnetron + Pirani High Vacuum Gauge
- Additional vacuum gauge driver card + Agilent 536 Vacuum Gauge
- 24 volt driver card
 - Illuminates Red Light when pressure is >25 millitorr/microns.
 - Illuminated Green Light when pressure is <25 millitorr/microns.

Displays 2 Readings

- The inlet of the Turbo pump (Sensor 1 on the left)
- The cross connection point for the cryogenic vessel jacket (Sensor 2 on the right)

In this setup, the **green light** means it is **safe to turn the roughing valve off**, and to engage the turbo.

Remote Vacuum Meter/Vacuum Gauge Information

The purpose of the remote gauge is to show what the system pressure is at the opposite side of the cryogenic vessel jacket. The actual reading in the tank will be at a pressure between the gauge at the inlet of the tank and the pressure at the far end of the tank indicated by the remote gauge.

Please note that the remote gauge in the weatherproof box will likely read **RANGE** when the system is exposed to atmospheric pressure.

This is normal and not a cause for concern. The Agilent FRG700 is most accurate at pressures sub-100 mBar. The accuracy of the reading at atmosphere does not affect the accuracy of the reading at deep vacuum. Tests in March of 2023 with the same type FRG700 sensor resulted in a remote vacuum gauge pressure of 3.5×10^{-4} and an inlet vacuum pressure of 5.3×10^{-5} (which would be viewed from the Fyra). This 1-2 decade pressure variation is typical of most systems. The pressure near the vacuum pump will always be lowest, and the pressure furthest away from the vacuum pump will be somewhat higher.



Reminder: The internal volume of this gauge has been evacuated and backfilled with nitrogen several times to avoid moisture or humidity concerns. If the enclosure is opened up, this process needs to be repeated again to mitigate any moisture concerns.

SECTION 4: Maintenance

This following section describes the various ways to maintain and upkeep the High Vacuum Cryogenic Cart.

How to Replace Filters

Check the filters before every run. Replace every 3-6 months or more often if required. It is good practice to monitor how dirty these filters get as individual cases and processes may differ from the manufacturer's specifications.

1. Locate the fan that needs a filter replaced.
2. You will notice a notch in the front face of the fan cover towards the top.
3. Insert a (preferably) flat head screwdriver and insert it into the notch gently. (See Figure **F1**)
4. Gently tilt the handle side of the screwdriver down to release the latch.
5. Now the fan cover is free and can be folded down to reveal the old filter. (See Figure **F2**)
6. Make sure to grab the appropriately sized filter replacement.
7. Replacement filters have been included. (G3 Coarse) These filters are able to be reused by washing with mild soap or vacuum.
8. Simply grab the old filter and swap in the fresh one.
9. Fold the Fan Cover back up until it clicks into place

Other filters such as G4 are able to be used as well if finer filtration is necessary.



Turbo Maintenance

No general maintenance necessary. If there is excessive noise, call Agilent to troubleshoot. If used less than once every 6 months, or for other details, consult the following instruction manual: [TwisTorr 305 FS Remote Controller](#) (See Page 173).

The Turbo is an especially delicate piece of equipment, so sudden movements or direct hits to the device can cause violent failure. So can particles that get in the inlet side of the Turbo. It is recommended to not tamper with the TwisTorr 305FSQ Turbo Pump as well as keep the Cryogenic Cart enclosed in order to protect the device.

IDP 15 Scroll Pump Maintenance

When inlet pressure gets above 500 millitorr, replace tip seals. For any excessive noise, contact Agilent for troubleshooting. For further maintenance details, refer to the following instruction manual: [Dry Scroll Vacuum Pump Instruction Manual](#) (See Page 40).

Calibration

The remote unit is installed at the opposite end of the vessel from the turbo system. To ensure gauge accuracy, send the remote unit for [calibration](#) to DigiVac once yearly. For cart gauges, we recommend an onsite calibration of the TC and a validation of the high vacuum gauge (against recently calibrated remote gauge) once every 2 years, or when readings are suspect. Note the internal components of this sealed gauge are in a nitrogen bath to mitigate any moisture concerns and maximize life time. Calibration for this gauge must include evacuation and backfilling of Nitrogen of the enclosure.

For any other maintenance concerns please [contact us](#) at DigiVac.

Troubleshooting

High pump down times are optimized with clean smooth surfaces and the largest flow paths possible. To improve high vacuum pump down times, a hard piping solution would yield a better result than the KF50 Bellows hose supplied.

In initial March 2023 testing, the pressure at which the roughing vacuum system was valved off and the turbo was valved in was between 3 and 5 millitorr.

For any additional high vacuum cryogenic cart or remote vacuum gauge related troubleshooting, please contact sales@digivac.com or [732-765-0900](tel:732-765-0900). Please reference high vacuum cryogenic cart sales order 19528.

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