Product Manual

ADF105™
Automatic Dewar Filling Station

Designed and Built by:

Chart Inc.

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Part Number 15929 Rev. E

Contents

Revision Log

Revision Level	Date	Description
B	07/18/2014	Reformat with new layout
C	07/30/2014	Update cover photo; add wording to Preface ‘not intended for oxygen use’
D	11/09/2015	Update address to Fremont, CA
E	06/09/2017	Change max pressure to 125 psi; add information throughout based on customer feedback.

Preface

General

Chart's ADF105™ Automatic Dewar Filling Station is a manual start, automatic shut off liquid nitrogen dewar filling station for standard, 160 liter - 240 liter and smaller size dewars (liquid cylinders). The station uses cryogenic sensors to detect a "full" condition. Once full, dual cryogenic valves shut off the fill cycle maintaining the fill pressure inside the liquid cylinder. The liquid cylinder is ready for immediate use.

The ADF105 station is suitable for indoor and outdoor (covered) installations. It is designed to fill portable pressurized liquid nitrogen cylinders from a piping system or bulk tank. The station is not intended for oxygen use.

Highlights

- Small footprint - no large, bulky scale required to fill liquid cylinders
- Robust, cryogenic sensing - faster, safer, and more reliable fill sensing technology to automatically shut off the fill cycle
- High pressure feed - 125 psi (8.6 bar) inlet pressure
- Easy, single button operation - no multi-step process or re-calibration required to activate a fill. Push the button, walk away, and come back to a full liquid cylinder
- Vent safety interlock - vent lines must be properly installed on the liquid cylinder before the system will initiate a fill
- Indoor or covered outdoor installation - fill liquid cylinders where it is most convenient
- Two year warranty - rigorously tested and proven components ensure reliable service

Key Benefits

- Eliminate Waste - no more overfilling or loss of product with other filling methods
- Increase Employee Safety - create a safer work environment with max fill shut off timer, vent safety interlock, and security key switch features
- Create Labor Efficiencies - unattended filling eliminates wasted labor and downtime
- Exponential Cost Savings - control your costs with onsite, facility resources

Product Manual

This manual is designed to be used in conjunction with the ADF105 Automatic Dewar Filling Station provided by Chart. Chart makes no warranties, express or implied, regarding the content in this manual. Chart assumes no responsibility for any outcomes as a result of using this manual. If after reading this manual you are not confident in carrying out any task, please contact Chart's service team at 1-408-371-4932.

Additional copies of this manual are available by contacting Chart at 1-800-371-3303.

The safety requirements for operating the ADF105 station and handling or transporting extremely cold liquid products are shown in the Safety section. Use this safety section as a "Safety Checklist" each time the equipment is being used.

In the Installation section there are illustrations for proper connections.

The Operations section contains set-up and operation information along with system features and service and maintenance.

The remaining sections provide information on Troubleshooting, Schematics and the Warranty provided by Chart.

Terms

Throughout this manual safety precautions will be designated as follows:

Warning! Description of a condition that can result in personal injury or death.

Caution! Description of a condition that can result in equipment or component damage.

Note: *A statement that contains information that is important enough to emphasize or repeat.*

Acronyms / Abbreviations

The following acronyms / abbreviations are used throughout this manual:

BAR	Pressure (Metric)
GN_2	Gaseous Nitrogen
ID	Inner Diameter
Kg	Kilogram
LN_2	Liquid Nitrogen
MPT	Male Pipe Thread
PLC	Siemens PLC/Display
PN	Part Number
PSI	Pounds per Square Inch

Safety

General

Thank you for your purchase of Chart Inc.'s ADF105™ Automatic Dewar Filling Station. Chart has designed and fabricated your system with attention to detail and utilizing the leading cryogenic technologies to ensure a highly efficient and reliable system.

DO NOT use this product in a manner not consistent with the instruction outlined in this manual.

NEVER alter the design, or perform service that is not consistent with the instructions outlined in this manual without prior written approval from Chart.

Warning! If you are at all unsure of how to safely work on this station, STOP and contact Chart immediately at 1-408-371-4932.

Caution! As with any cryogenic system, it should be observed that any non-insulated piping can get extremely cold and should not be touched by exposed skin. If the system requires maintenance, it should be shutdown and allowed to warm up.

The ADF105 station is designed to fill DOT-4L coded liquid nitrogen cylinders with a main safety relief less than 25.3 psig. This requirement can be found in the Code of Federal Regulations (CFR) 49, section 173.320a.

Caution! The maximum operating pressure for the ADF unit and the hoses is 125 psi. Operation at higher pressures implies a safety risk and will cause damage to the unit.

Caution! If the ADF105 system is to be used in a small enclosed area, it is very important that the vent is piped and directed outside the building. Even for larger areas it is recommended to pipe the vent outside.

Safety Bulletin

Portions of the following information is extracted from Safety Bulletin SB-2 from the Compressed Gas Association, Inc. Additional information on oxygen, nitrogen, and cryogenics is available from the CGA.

Cryogenic containers, stationary or portable, are from time to time subjected to assorted environmental conditions of an unforeseen nature. This safety bulletin is intended to call attention to the fact that whenever a cryogenic container is involved in any incident whereby the container or its safety devices are damaged, good safety practices must be followed. The same holds true whenever the integrity or function of a container is suspected of abnormal operation.

Good safety practices dictate the contents of a damaged or suspect container be carefully emptied as soon as possible. Under no circumstances should a damaged container be left with product in it for an extended period of time. Further, a damaged or suspect container should not be refilled unless the unit has been repaired and re-certified.

Incidents which require that such practices be followed include: highway accidents, immersion of a container in water, exposure to extreme heat or fire, and exposure to most adverse weather conditions (earthquake, tornadoes, etc.) As a rule of thumb, whenever a container is suspected of abnormal operation, or has sustained actual damage, good safety practices must be followed.

In the event of known or suspected container vacuum problems (even if an extraordinary circumstances such as those noted above has not occurred), do not continue to use the unit. Continued use of a cryogenic container that has a vacuum problem can lead to embrittlement and cracking. Further, the carbon steel jacket could possibly rupture if the unit is exposed to inordinate stress conditions caused by an internal liquid leak.

Prior to reusing a damaged container, the unit must be tested, evaluated, and repaired as necessary. It is highly recommended that any damaged container be returned to Chart for repair and re-certification.

The remainder of this safety bulletin addresses those adverse environments that may be encountered when a cryogenic container has been severely damaged. These are oxygen deficient atmospheres, oxygen enriched atmospheres, and exposure to inert gases.

Oxygen Deficient Atmospheres

Warning! Nitrogen vapors in air may dilute the concentration of oxygen necessary to support or sustain life. Exposure to such an oxygen deficient atmosphere can lead to unconsciousness and serious injury, including death.

The normal oxygen content of air is approximately 21%. Depletion of oxygen content in air, either by combustion or by displacement with inert gas, is a potential hazard and users should exercise suitable precautions.

One aspect of this possible hazard is the response of humans when exposed to an atmosphere containing only 8 to 12% oxygen. In this environment, unconsciousness can be immediate with virtually no warning.

When the oxygen content of air is reduced to approximately 15 to 16%, the flame of ordinary combustible materials, including those commonly used as fuel for heat or light, may be extinguished. Somewhat below this concentration, an individual breathing the air is mentally incapable of diagnosing the situation because the onset of symptoms such as sleepiness, fatigue, lassitude, loss of coordination, errors in judgment and confusion can be masked by a state of "euphoria," leaving the victim with a false sense of security and well being.

Most individuals working in or around oxygen deficient atmospheres rely on the "buddy system" for protection - obviously the "buddy" is equally susceptible to asphyxiation if he or she enters the area to assist the unconscious partner unless equipped with a portable air supply. Best protection is obtainable by equipping all individuals with a portable supply of respirable air. Life lines are acceptable only if the area is essentially free of obstructions and individuals can assist one another without constraint.

If an oxygen deficient atmosphere is suspected or known to exist:

1. Use the "buddy system." Use more than one "buddy" if necessary to move a fellow worker in an emergency.
2. Both the worker and "buddy" should be equipped with self-contained or airline breathing equipment.

Nitrogen

Nitrogen (an inert gas) is a simple asphyxiate. It will not support or sustain life and can produce immediate hazardous conditions through the displacement of oxygen. Under high pressure this gas may produce narcosis even though an adequate oxygen supply sufficient for life is present.

Nitrogen vapors in air dilute the concentration of oxygen necessary to support or sustain life. Inhalation of high concentrations of this gas can cause anoxia, resulting in dizziness, nausea, vomiting, or unconsciousness and possibly death. Individuals should be prohibited from entering areas where the oxygen content is below 19% unless equipped with a self-contained breathing apparatus. Unconsciousness and death may occur with virtually no warning if the oxygen concentration is below approximately 8%. Contact with cold nitrogen gas or liquid can cause cryogenic (extreme low temperature) burns and freeze body tissue.

Persons suffering from lack of oxygen should be immediately moved to areas with normal atmospheres. SELF-CONTAINED BREATHING APPARATUS MAY BE REQUIRED TO PREVENT ASPHYXIATION OF RESCUE WORKERS. Assisted respiration and supplemental oxygen should be given if the victim is not breathing. If cryogenic liquid or cold boil-off gas contacts worker's skin or eyes, the affected tissue should be flooded or soaked with tepid water (105-115ºF or 41-46ºC). DO NOT USE HOT WATER. Cryogenic burns that result in blistering or deeper tissue freezing should be examined promptly by a physician.

Personal Protective Equipment (PPE)

The following personal protective equipment is recommended when working around cryogenic liquid:

- Safety glasses with side shields to prevent cryogenic liquid from splashing into the eyes
- Chemical / Liquid resistant gloves to prevent cryogenic burns on exposed hands
- Long sleeve shirts to protect the arms
- Cuffless trousers worn over closed shoes

Receiving and Installation

Receiving

The ADF105™ Automatic Dewar Filling Station is a manual start, auto shut off device designed to fill standard low pressure, 160 liter - 240 liter and smaller size dewars.

Upon arrival of the ADF105 station, it is advised to immediately inspect for any signs of damage. If any damage occurred in shipping, claims must be filed with the shipping carrier immediately prior to unpacking.

All contents should be carefully inspected while unpacking the ADF105 station. Things to check for upon arrival include:

- Dents in the ADF105 station valve enclosure or electrical control panel
- The brass check valve is to be installed on the exhaust port (shipping loose)

Caution! This valve must be installed with the arrow pointing upwards.

- Any other components that were defined to ship loose

If there are any pieces listed on the packing slip and/or materials list not in the shipping crate, please contact Chart immediately at 1-800-371-3303.

If not installed immediately, the ADF105 station should be stored in a location that will prevent dirt, water, or other debris from getting inside the system.

Note: *Designate a suitable mounting surface and location prior to removing the unit from the packaging.*

Installation

A qualified and trained facility person, familiar with liquid nitrogen installations, should perform the installation of the ADF105 station and the connection to the liquid nitrogen (LN_2) source. The connection to the LN_2 source should adhere to the appropriate facility specifications and local fire/safety codes. Chart is available to assist with those specifications and procedures. Contact Chart Technical Service at 1-408-371-4932 if you have any questions regarding installation or operation.

The ADF105 station is constructed out of austenitic 304 stainless steel with the electronics sealed in a NEMA 4 enclosure for the installation of the device outdoors.

Items to note prior to installation:

- Ensure all local codes and ordinances are consulted for electrical, mechanical and pneumatic connections if locating the unit outside of a building.
- If the ADF105 station is located in an enclosed area or room, an oxygen monitor and alarm system is highly recommended. Contact Chart at 1-800-371-3303 for information about oxygen monitors.
- Outdoor locations require a covered area for the station.
- The ADF105 station must be securely attached in the desired location. For example:
  - A metal channel, free standing rack, bolted to the floor
  - Metal channel securely attached to a wall
  - Directly bolted to a concrete wall with adequate anchors

Instructions

1. The ADF105 station liquid source (supply) connection is a 1/2” MPT located at the top-right of the unit. It is highly recommended that a shut-off valve and safety relief valve be installed before the inlet. The maximum inlet pressure to the station is 125 psi (8.6 bar). Chart recommends using Chart Vacuum Insulated Piping for the connection of the LN_2 source to the station inlet.

Note: *Prior to the first fill, ensure inlet line is free of debris or similar contaminant.*

2. The ADF105 station exhaust connection is located to the left of the inlet and is also a 1/2” MPT. Before the exhaust of the station is piped away from the operator, the supplied brass check valve must be installed on the exhaust port. The flow arrow on the check valve must point away from the station. There are several methods to “pipe away” exhaust gas. A 1” ID copper pipe with the end pointing down (to keep rain or condensed water out if outside) is a simple option.

   Alternatively, a vacuum jacketed pipe system may be used. Contact Chart at 1-800-371-3303 if this is the option that is considered. Assistance in determining the most efficient solution can then be provided by Chart personnel.

Note: *The vent line should be no longer than 15 feet (4.5 meters) to minimize the possibility of gas build up which could cause back pressure on the vent and affect the cryogenic sensor and automatic shut off.*

3. Attach the supplied flex hoses to the ADF105 station fill port and to the vent port. The 90° elbow on the flex hose attaches to the station and the straight end attaches to the dewar.

4. Attach the power cord to the bottom of the controller box and plug into a 110 volt AC outlet.

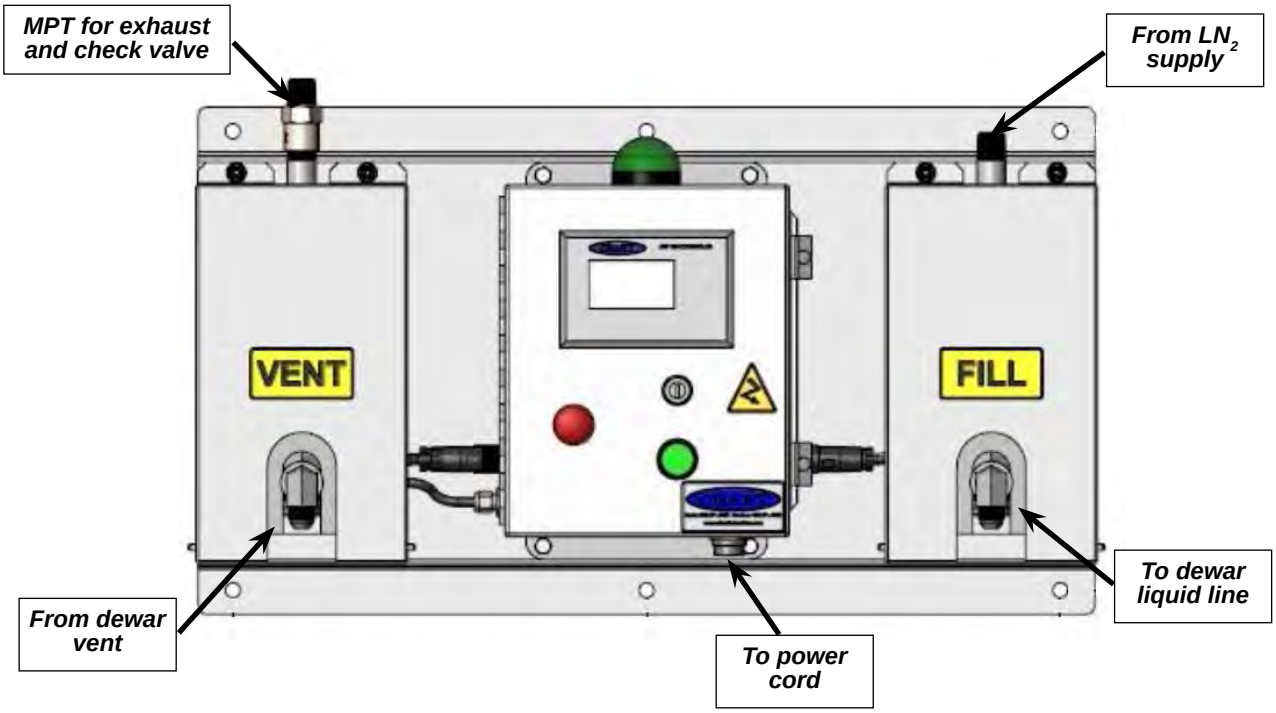


Figure 1 - ADF 105 connections

ADF105 Station Controller

The ADF105 station controller includes a Siemens PLC/ display and light tower. The display will track the amount of time the dewar is filling. The light tower will identify when the filling cycle has begun and in process (green) and when idle, or completed filling (yellow).

Note! *Should the fill time reach 60 minutes the internal clock will time-out and stop the filling cycle.*

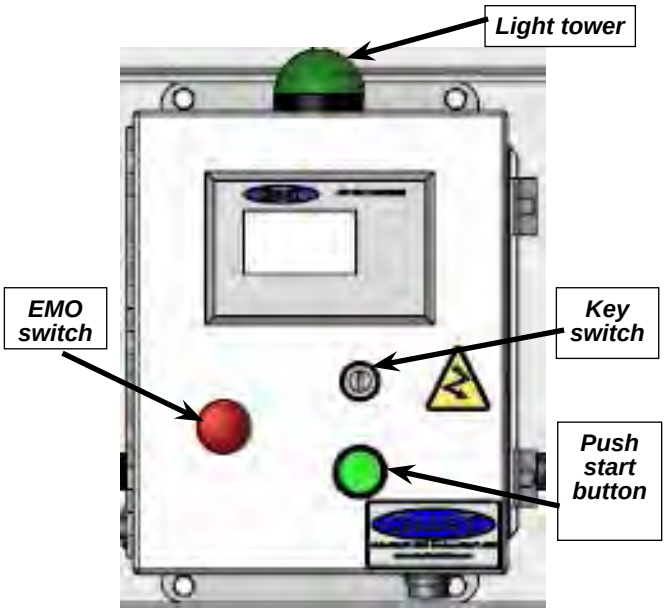


Figure 2 - ADF105 Controller

Operation

1. Open the “VENT” valve of the dewar to exhaust all/any remaining pressure.
2. Connect the right side flexible hose (Fill) to the “LIQUID” valve on the dewar to be filled.
3. Connect the left side flexible hose (Vent) to the “VENT” valve on the dewar.
4. Open both the “LIQUID” and “VENT” valves on the dewar to be filled.
5. Insert the key and turn to the “1” position.

Note: *Make sure the red EMO button is pulled out.*

6. Press the green “START” button to begin the filling process. The filling process is automatic. The unit will shut off when the dewar is full or when the maximum fill timer shuts off after 60 minutes.
7. After the unit has shut off, close both the “LIQUID” and “VENT” valves on the dewar.
8. Disconnect the flexible hoses from the dewar. Do this slowly to relieve residual pressure. Chart recommends immediate insertion of plugs on both hose ends. This will prevent moisture intrusion and ice formation in the hoses.
9. Remove the dewar from the station.

Caution! Ice formation on the top of the dewar when filling or in use is normal. While this is not at cryogenic temperatures gloves should be worn when working around these devices to protect your hands.

ADF105 Station Features

Safety

1. The keyed power button is the first level of safety by limiting the access to the ADF105 station. Only authorized personnel with key access can fill a dewar.
2. The second level of safety is the vent pressure interlock combined with the timing function of the PLC. The vent interlock senses the pressure present at the start of the filling process. If at least two psi of pressure is not present within four seconds, a relay shuts down the filling process. This safeguards against an incomplete hook-up of a dewar.
3. The third level of safety is a time-out relay. If the dewar is not filled within 60 minutes, the ADF105 station shuts down. This safeguards against supply problems and dewar overflow.
4. The fourth level of safety is the thermal detection circuit. This circuit uses a special cryogenically rated device that senses when there is liquid in the vent side of the ADF105 station. The sensitivity of the device allows it to not trip unless it senses pure LN_2 and will do so in a fraction of a second thereby stopping any significant amount of LN_2 from exiting out of the vent.
5. The fifth level of safety is the EMO switch. In case of a liquid leak or any other emergency, pushing this switch will completely stop the filling cycle and turn the unit off.

Max Fill Timer

The Max Fill Timer is a feature designed to minimize the amount of liquid overflow in the unlikely case of a failure in the cryogenic sensor. It uses the internal PLC code to time-out and close both the fill and vent solenoid valves. When the start switch button is pressed, the 60 minute timer begins to countdown. If the cryogenic switch does not close the solenoid valves within 60 minutes, then the timer deactivates the solenoid valves. The timer resets every time the fill start button is pressed.

Vent Interlock

The vent interlock feature uses a low-pressure switch (to sense pressure in the vent circuit of the ADF105 station) in conjunction with the timing circuitry of the PLC that controls power output to both the fill and vent solenoid valves. When the start button is depressed, the ADF105 station will open the solenoid valves for four seconds to allow exhaust pressure to pass through the vent circuit. If after four seconds the pressure switch does not detect at least two psi, the station will cease supplying power to the solenoid valves and they will close. This feature is designed to ensure that the vent side of the dewar to be filled is attached to the station.

Troubleshooting

Refer to the table below for troubleshooting procedures. The table is arranged in a Symptom/Possible Cause/Solution format. Note that possible causes for specific symptoms are listed in descending order of significance. That is, check out the first cause listed before proceeding to the next. If you need further assistance please contact Chart's service team at 1-408-371-4932.

Symptom	Possible Cause	Solution
Station starts for a few seconds and then shuts off.	Vent is not connected to the dewar or not connected properly. Vent interlock mechanism is malfunctioning.	Make sure the vent valve on the dewar is open and connected to the station. Contact Chart at 1-408-371-4932 for diagnosis.
Station fails to start or shows signs of not getting power	Station is not connected to the AC supply.	Make sure the EMO switch is pulled out (if the switch is pushed in there is no power) Ensure station is plugged in correctly. Check fuse in AC plug cavity.
LN_2 leaks through the fill solenoid.	Debris or ice in seat.	Purge with GN_2 to dry out moisture. See the Service and Maintenance section for additional information.
Station shuts off before dewar is filled.	Exceeded max fill timer.	Check for adequate liquid delivery. Ensure dewar valves are fully opened.

Specifications

Product Specifications

Weight: 54 lbs (24.5 kg)

Dimensions: 26.0” L x 14.7” W x 9.7” D
(660 mm x 373 mm x 246 mm)

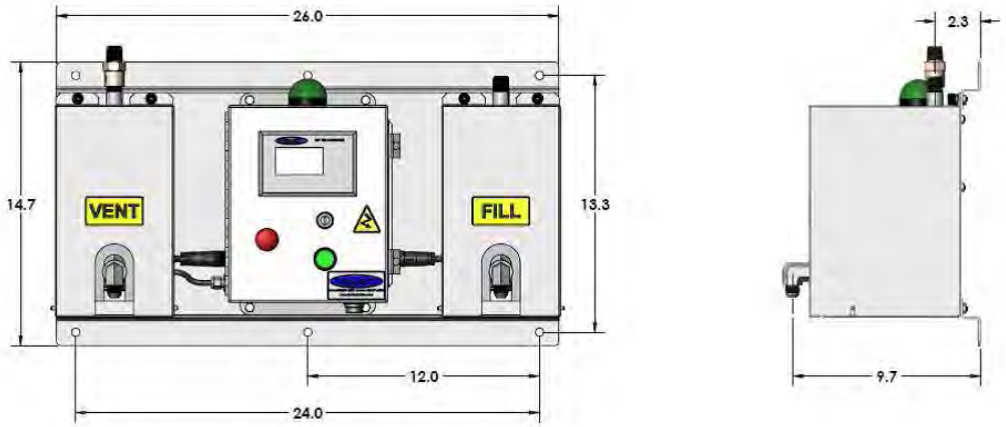
Exterior Case: Stainless Steel

Utility Requirements

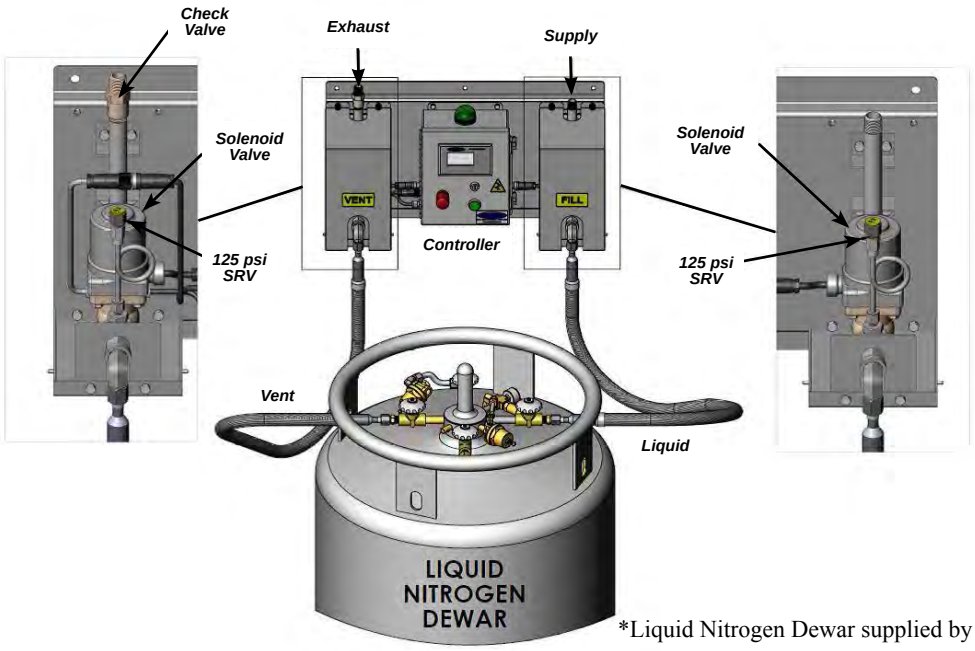
Liquid Nitrogen: 22 psi-125 psi (1.5 bar-8.6 bar)

Electrical Supply: 100-240 Volt AC 50-60 Hz 110 W

ADF105 Station Dimensions

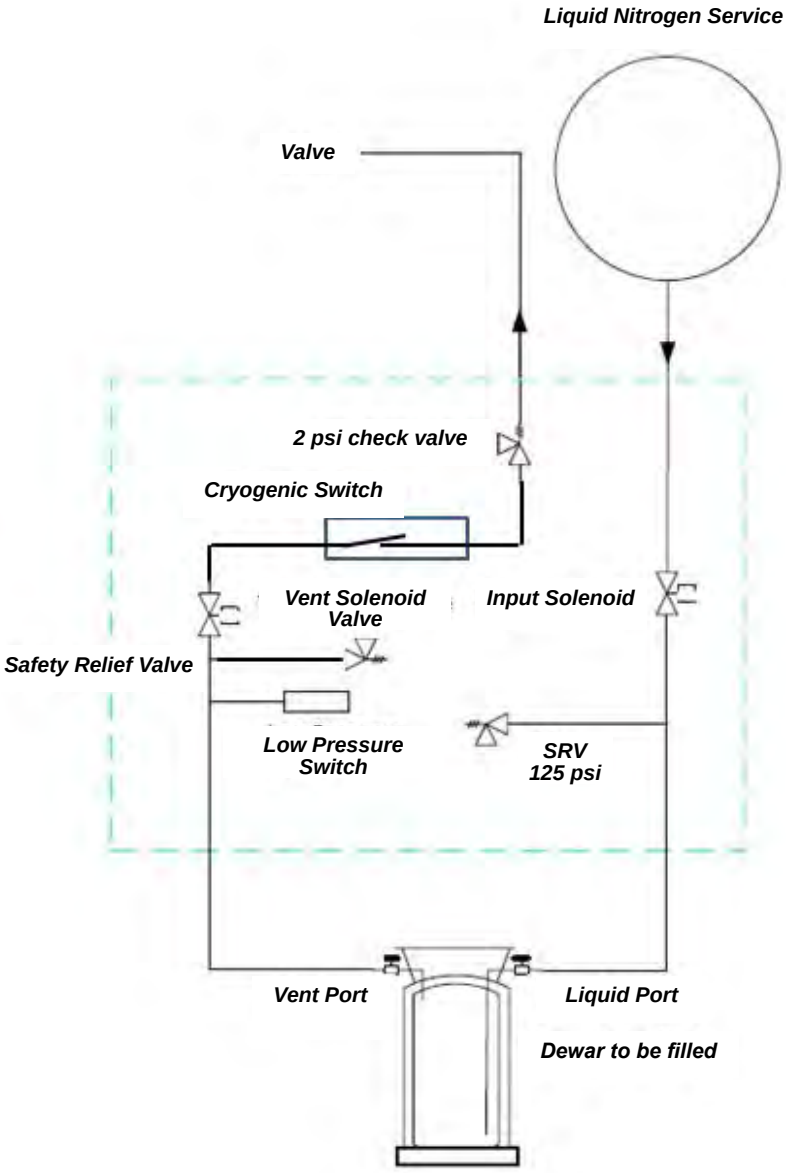


ADF105 Station Components

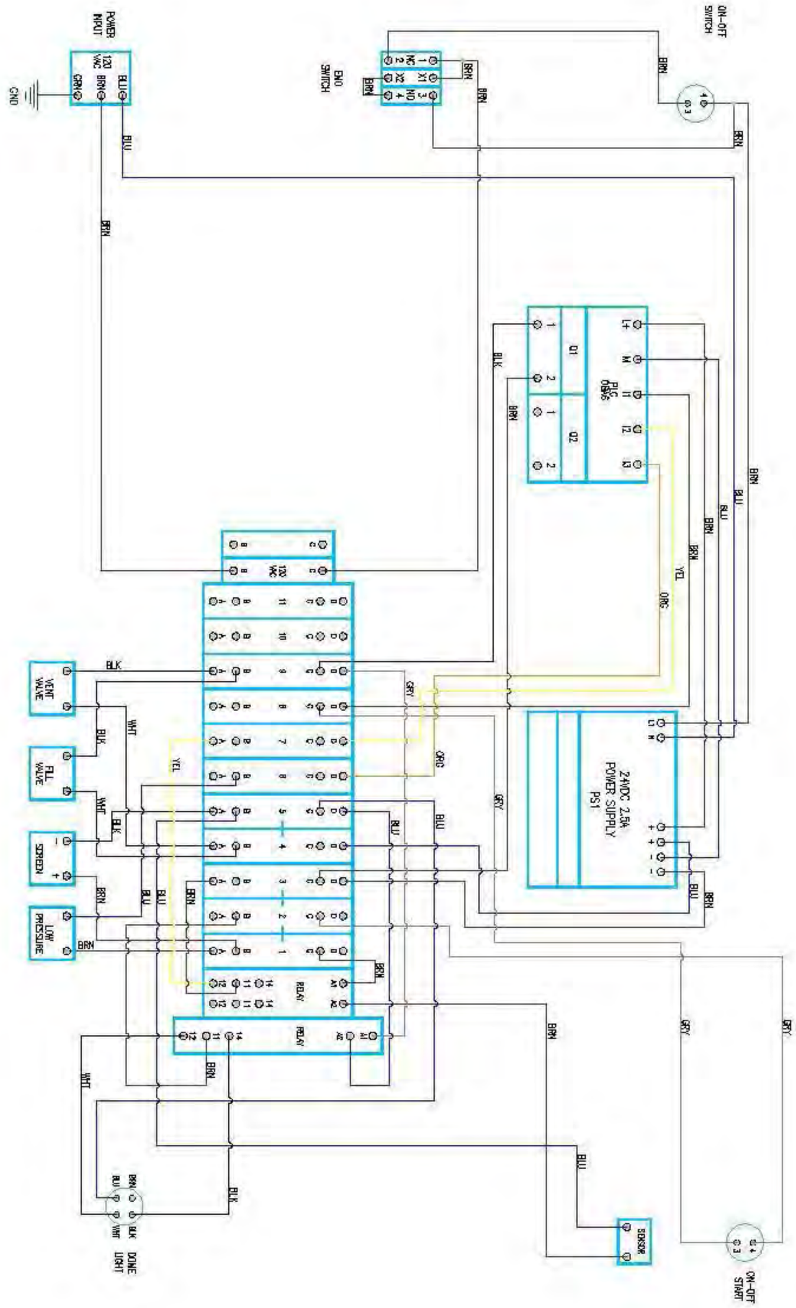


*Liquid Nitrogen Dewar supplied by other

Mechanical Schematic

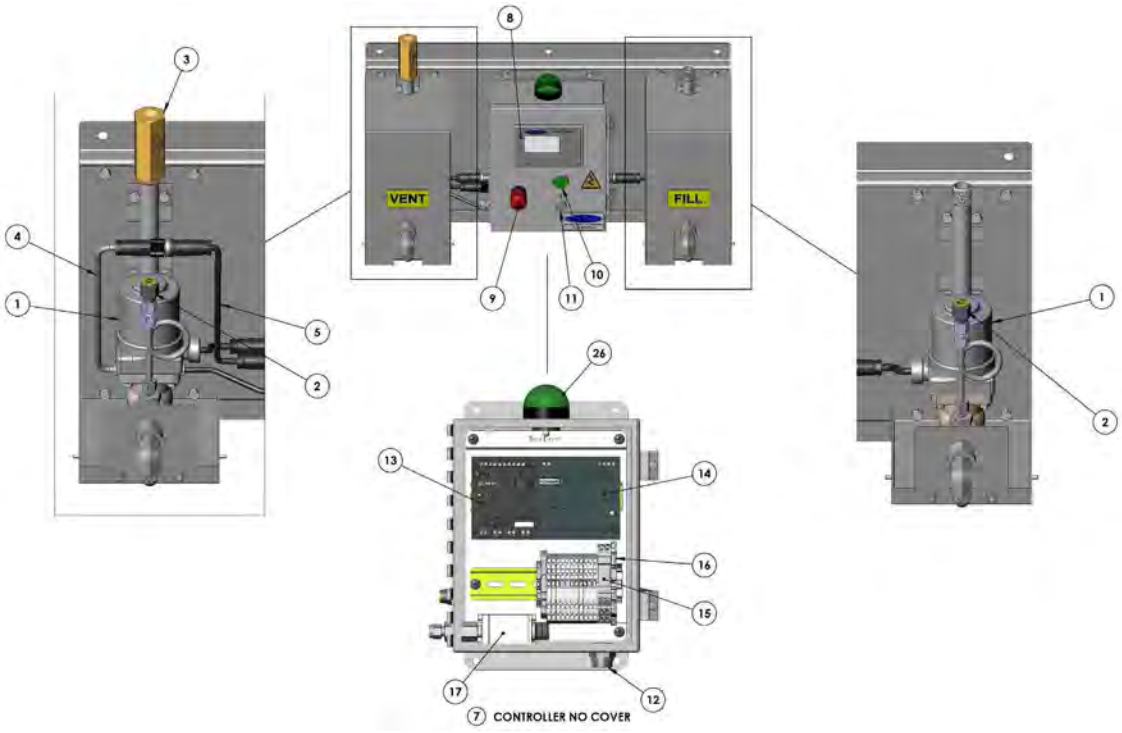


Controller Wiring Schematic



Replacement Parts

Item Number	Part Description	Part Number
	ADF105 Station Parts	
1	Fill/Vent Solenoid Valve Assembly	CR_8000.07
2	SRV, 125 psi	C6010.4
3	Check Valve, 1 psi	C6127
4	Thermistor Sensor Assembly	CR_8000.19
5	Thermistor Cable Assembly	8000.31
6	Low Pressure Switch Tubing	CR_2273
	ADF105 Station Controller Parts	
7	Controller Assembly	8000.30
8	Display	5560.14
9	EMO Switch	8000.34
10	Start Button (green)	8000.33
11	Key Switch	8000.22
12	AC Power Receptable	2199
13	PLC	5560.13
14	Power Supply	2820.05
15	Switching Relay	8000.21
16	Power Relay	8000.20
17	Low Pressure Switch	7046
NOT SHOWN	Controller Power Cord Assembly - 4m	410
	Misc Parts	
NOT SHOWN	4’ Flex Hose	7188
NOT SHOWN	User Manual, ADF105	15929



Warranty

All sales of ADF105 Automatic Dewar Filling Stations ("ADF105") from Chart Inc. ("Chart") to the purchaser are subject to all applicable Chart standard terms and conditions in effect at the time of sale, unless otherwise agreed in writing by an authorized representative of Chart. In addition to the warranty stated in Chart's Standard Terms and Conditions of Sale, Chart warrants to the original purchaser of Chart manufactured ADF105 station that for two (2) years after the date of shipment to the original purchaser said Chart manufactured ADF105 station will maintain all performance standards for said ADF105 station as published by Chart on the date of invoice.

Purchaser agrees that as a pre-condition to any Chart warranty obligation hereunder, purchaser shall fully inspect the ADF105 station immediately upon delivery to purchaser and shall give Chart written notice of any claim or purported defect within ten (10) days after receipt of the ADF105 station. As a further pre-condition to any Chart warranty obligation hereunder, purchaser shall return said purportedly defective ADF105 station, freight prepaid, to the plant of the manufacturer within thirty (30) days after receipt of the ADF105 station. Chart shall inspect the returned ADF105, and, if said ADF105 station is found defective, shall, at Chart's option as purchaser's sole and exclusive remedy, either (i) repair or replace such ADF105 station or any defective component or part thereof which proves to be defective, or (ii) refund the net purchase price paid by the original purchaser. Alterations or repairs by others or operation of such ADF105 station in a manner inconsistent with Chart accepted practices and all operating instructions, unless preauthorized in writing by Chart, shall void this warranty. This warranty does not extend to defects caused by the effects of normal wear and tear, erosion, corrosion, fire, or explosion.

Chart's sole and exclusive liability under this Warranty is to the original purchaser and shall not exceed the lesser of the cost of repair, cost of replacement, or refund of the net purchase price paid of the ADF105 station by the original purchaser. Chart is not liable for any other losses, damages, or costs of delays, including incidental or consequential damages. CHART SPECIFICALLY MAKES NO WARRANTIES OR GUARANTEES, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE, OTHER THAN OR WHICH EXTEND THOSE WARRANTIES EXPRESSED HEREIN. The original purchaser shall indemnify, defend and hold Chart harmless from any third party claims as a result of the use, sale, or lease of the ADF105 station.