TW-372

Taylor-Wharton

MicroBulk

1000/1500/2000/3000

Instruction and Operation Manual

Do not attempt to use or maintain these units until you read and understand these instructions. Refer to the Taylor Wharton's "Safety First" booklet (TW - 202) for handling cryogenic material. Do not permit untrained persons to use or maintain this equipment. If you do not understand these instructions, contact your supplier for additional information.

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INTRODUCTION

This manual provides information for the operation and maintenance of Taylor-Wharton's new line of MICRO BULK cryogenic gas supply systems. These products store cryogenic liquid and dispense it as a warm pressurized gas. The MICRO BULK is designed for applications requiring nitrogen, argon, oxygen or CO_2 gas.

Additional product specifications, flow diagram, views, and important dimensions are shown on the general arrangement drawing provided in the appendix of this manual.

SYSTEM DESCRIPTION

The MICRO BULK consists of a cryogenic liquid vessel, piping, external vaporizer, and external pressure builder.

The vessel consists of a pressure vessel suspended inside a jacket. The space between the pressure vessel and the jacket is evacuated and insulated with a micro-fiberglass / aluminum foil radiation shield. Both the inner pressure vessel and vacuum jacket are constructed of type-304 stainless steel. All models are designed and constructed in accordance with ASME.

Piping circuits allow the vessel to vent, fill, pressurize, and provide pressurized gas. Piping is type-304 stainless steel. Valves are brass. Fittings are machined from forged brass and type-316 stainless steel.

Instrumentation options consist of a pressure gauge, a differential pressure gauge, and a digital liquid level gauge. The pressure gauge allows the vessel pressure to be monitored. Accurate measurement of the vessel contents is provided by the differential pressure gauge and/or the digital liquid level gauge.

The MICRO BULK automatically maintains pressure by vaporizing cryogenic liquid in a controlled fashion. All energy for building pressure and vaporizing liquid is provided by heat from ambient air. The pressure building coil is attached to the outer jacket. The free standing vaporizer is attached to the pallet.

SPECIFICATION

MODEL		MB-1000HP	MB-1000VHP	MB-1500HP	MB-1500VHP
Dimension					
Foot Print	in(mm)	54 x 54(1372x 1372)	54 x 54(1372x1372)	62 x 60(1575x 1524)	62 x 60(1575x 1524)
Cylinder Diameter	in(mm)	42(1067)	42(1067)	48(1219)	48(1219)
Height	in(mm)	90.5(2299)	90.5(2299)	96.5(2451)	96.5(2451)
Empty weight	lb(Kg)	2,000 (907)	2,200 (997)	2,500(1,133)	3,000 (1,360)
Capacity, Gross	gal(L)	284 (1,074)	284 (1,074)	410 (1,552)	410 (1,552)
Capacity, Net	gal(L)	255 (965)	255 (965)	385 (1,457)	385 (1,457)
MAWP	psig (BAR)	350 (24.1)	500 (34.4)	350 (24.1)	500 (34.4)
DESIGN SPECIFICATION					
CODE		ASME SECTION VIII, DIVISION I			
Safety Devices					
Pressure Relief Valve	psig	350	500	350	500
Inner Container Bursting Disc	psig	525	750	525	750
Pressure Control Devices					
Economizer Regulator Setting	psig	325	425	325	425
Pressure Building Regulator	psig	300	400	300	400
Gaseous Capacity[3]					
Nitrogen	SCF(M^3)	26,420 (623)	26,420 (623)	35,842 (941)	35,842 (941)
Oxygen	SCF(M^3)	32,628 (770)	32,628 (770)	44,263 (1,163)	44,263 (1,163)
Argon	SCF(M^3)	31,908 (753)	31,908 (753)	43,287 (1,138)	43,287 (1,138)
Carbon Dioxide	SCF(M^3)	21,009 (495)	21,009 (495)	28,501 (748)	28,501 (748)
Weight of Contents[4]					
Nitrogen	lb (Kg)	3,913 (1,775)	4,113 (1,866)	5,096 (2,310)	5,596 (2,537)
Oxygen	lb (Kg)	4,703 (2,133)	4,903 (2,224)	6,167 (2,796)	6,667 (3,023)
Argon	lb (Kg)	5,299 (2,403)	5,499(2,494)	6,975 (3,163)	7,475 (3,390)
Carbon Dioxide	lb (Kg)	4,403 (1,997)	4,360 (2,088)	5,760 (2,612)	6,260 (2,839)
Gas Delivery Rate(LIN,LOX,LAR)	SCH	960	960	1,350	1,350
Gas Delivery Rate (CO_2)	SCH	410	410	580	580
NER % capacity per day N_2		1.0%			

(1) Height includes standard pallet
(2) Empty weight includes pallet
(3) Based on gaseous @ at 1 atmosphere and 0˚C
(4) Based on liquid at full trycock saturated @ 20.7 barg (CO2)
(5) Based on liquid at full trycock saturated @ 0 bar

SPECIFICATION

MODEL		MB-2000HP	MB-2000VHP	MB-3000HP	MB3000VHP
Dimension					
Foot Print	in(mm)	62 x 60(1575x 1524)	62 x 60(1575x 1524)	71 x 71(1803x 1803)	71 x 71(1803x 1803)
Cylinder Diameter	in(mm)	48(1219)	48(1219)	59(1499)	59(1499)
Height	in(mm)	117.5(2985)	117.5(2985)	115(2921)	115(2921)
Empty weight	lb(Kg)	3,000 (1,360)	3,250 (1,474)	3,900 (1,769)	4,500(2,041)
Capacity, Gross	gal(L)	540 (2,043)	540 (2,043)	775 (2,933)	775 (2,933)
Capacity, Net	gal(L)	513 (1,942)	513 (1,942)	720 (2,725)	720 (2,725)
MAWP	psig(BAR)	350 (24.1)	500 (34.4)	350 (24.1)	500 (34.4)
DESIGN SPECIFICATION					
CODE		ASME SECTION VIII, DIVISION I			
Safety Devices					
Pressure Relief Valve	psig	350	500	350	500
Inner Container Bursting Disc	psig	525	750	525	750
Pressure Control Devices					
Economizer Regulator Setting	psig	325	425	325	425
Pressure Building Regulator	psig	300	400	300	400
Gaseous Capacity[3]					
Nitrogen	SCF(M^3)	47,847 (1,257)	47,847 (1,257)	67,035(1,895)	67,035(1,895)
Oxygen	SCF(M^3)	59,089 (1,553)	59,089 (1,553)	82,785 (2,341)	82,785 (2,341)
Argon	SCF(M^3)	57,786 (1,519)	57,786 (1,519)	80,959 (2,291)	80,959 (2,291)
Carbon Dioxide	SCF(M^3)	38,048 (1,000)	38,048 (1,000)	53,306(1,505)	53,306(1,505)
Weight of Contents[4]					
Nitrogen	lb(Kg)	6,461 (2,930)	6,710 (3,043)	8,755 (3,971)	9,356 (4,243)
Oxygen	lb(Kg)	7,888 (3,577)	8,138 (3,691)	10,758(4,880)	11,358 (5,151)
Argon	lb(Kg)	8,965 (4,066)	9,215 (4,179)	12,271 (5,566)	12,871 (5,838)
Carbon Dioxide	lb(Kg)	7,346 (3,332)	7,596 (3,445)	9,998 (4,535)	10,598 (4,807)
Gas Delivery Rate(LIN,LOX,LAR)	**SCH**	1,400	1,400	1,550	1,550
Gas Delivery Rate (CO_2)	**SCH**	860	860	860	860
NER % capacity per day N_2		1.0%			

(1) Height includes standard pallet
(2) Empty weight includes pallet
(3) Based on gaseous @ at 1 atmosphere and 0˚C
(4) Based on liquid at full trycock saturated @ 20.7 barg (CO2)
(5) Based on liquid at full trycock saturated @ 0 bar

WARNINGS

The following safety precautions are for your protection. Before installing, operating, or maintaining this unit read and follow all safety precautions in this section and in the reference publications. Failure to observe all safety precautions can result in property damage, personal injury, or possibly death. It is the responsibility of the purchaser of this equipment to adequately warn the user of the precautions and safe practices for the use of this equipment and the cryogenic fluid stored in it.

CAUTION: When installing field-fabricated piping, it is recommended to make certain a suitable safety valve is installed in each section of piping between shut-off valves.

For more detailed information concerning safety precautions and safe practices to be observed when handling cryogenic liquids consult CGA pamphlet P-12 "Handling Cryogenic Liquids" available from the Compressed Gas Association, 1235 Jefferson Davis Highway, Arlington, VA 22202.

Safety Precautions for Liquid Oxygen

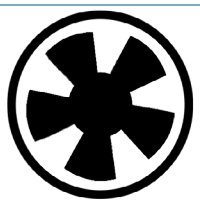
Oxygen is a colorless, odorless, and tasteless gas that can be condensed into a liquid at the low temperature of 297 degrees below zero Fahrenheit (-183°C) under normal atmospheric pressure. Approximately one-fifth of normal air is oxygen. As a liquid, oxygen is pale blue in color. Oxygen is non-flammable; however it vigorously accelerates the burning of combustible materials.

Keep Combustibles Away from oxygen and eliminate ignition sources. Many substances that do not normally burn in air require only a slight spark or moderate heat to set them aflame in the presence of concentrated oxygen. Other sub stances, which are only moderately combustible in air, can burn violently when a high percentage of oxygen is present.

Do not permit smoking or open flame in any area where liquid oxygen is stored, handled, or used. Keep all organic materials and other flammable substances away from possible contact with liquid oxygen. Some of the materials that can react violently with oxygen are oil, grease, kerosene, cloth, wood, paint, tar, and dirt that contains oil or grease. Under certain conditions flammable materials that have become permeated with liquid oxygen are impact sensitive and can detonate if subjected to shock.

Keep Area and Exterior Surfaces Clean to Prevent Ignition
As normal industrial soot and dirt can constitute a combustion hazard, all equipment surfaces must be kept very clean. Do not place oxygen equipment on asphalt surfaces, or allow grease or oil deposits to remain on benches or concrete surfaces in the vicinity of the oxygen equipment. Use cleaning agents, which will not leave organic deposits, on the cleaned surfaces. Equipment to be used in contact with liquid oxygen should be handled only with clean gloves or hands washed clean of oil.

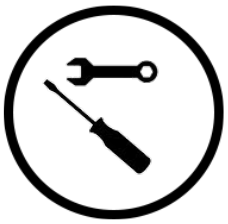
Maintain Adequate Ventilation
Enclosed areas containing oxygen equipment should be ventilated to prevent accumulations of oxygen and thereby minimize combustion hazards.



WARNINGS

Extreme Cold - Cover Eyes and Exposed Skin

Accidental contact of liquid oxygen or cold issuing gas with the skin or eyes may cause a freezing injury similar to frostbite. Handle the liquid so that it won't splash or spill. Protect your eyes and cover the skin where the possibility of contact with the liquid, cold pipes and equipment, or the cold gas exists. Safety goggles or a face shield should be worn if liquid ejection or splashing may occur or cold gas may issue forcefully from equipment. Clean, insulated gloves that can be easily removed and long sleeves are recommended for arm protection. Cuff-less trousers should be worn outside boots or over the shoes to shed spilled liquid. If clothing should be splashed with liquid oxygen or otherwise saturated with the gas, air out the clothing immediately, removing it if possible. Such clothing will be highly flammable and easily ignited while the concentrated oxygen remains, and should not be considered safe for at least 30 minutes.

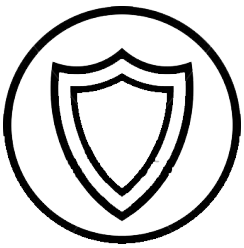


Replacement Parts Must be Suitable for Oxygen Service

Many materials, especially some non-metallic gaskets and seals, constitute a combustion hazard when in oxygen service, although they may be acceptable for use with other cryogenic liquids. Make no substitutions for recommended spare parts. Also, be sure all replacement parts are thoroughly "Cleaned For Oxygen Service" in accordance with Compressed Gas Association (CGA) Pamphlet G-4.1 "Cleaning for Oxygen Service" or equivalent industrial cleaning specifications.

Observe Safety Codes When Locating Oxygen Equipment

Before locating oxygen equipment, become thoroughly familiar with National Fire Protection Association (NFPA) Standard No. 50, "Bulk Oxygen Systems", and with all federal, state and local safety codes. The NFPA Standard covers the general principles recommended for the installation of bulk oxygen systems on industrial and institutional consumer premises.



Safety Precautions for Liquid Nitrogen and Liquid Argon

Nitrogen is an inert, colorless, odorless, and tasteless gas making up four-fifths of the air you breathe. Liquid nitrogen is obtained by cooling air until it becomes a liquid and then removing the oxygen. Air is roughly one-fifth oxygen. Liquid nitrogen is at a temperature of -320°F (-196°C) under normal atmospheric pressure.

NOTE: Argon is an inert gas whose physical properties are very similar to those of Nitrogen. For handling of liquid Argon, follow the safe practices described for the handling and use of liquid Nitrogen.

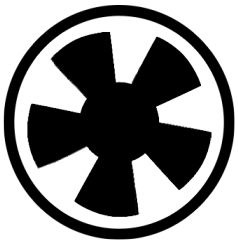
Extreme Cold - Cover Eyes and Exposed Skin

Accidental contact of liquid nitrogen or cold issuing gas with the skin or eyes may cause a freezing injury similar to frostbite. Handle the liquid so that it won't splash or spill. Protect your eyes and cover the skin where the possibility of contact with the liquid, cold pipes and equipment, or the cold gas exists. Safety goggles or a face shield should be worn if liquid ejection or splashing can occur or cold gas can issue forcefully from equipment. Insulated gloves that can be easily removed and long sleeves are recommended for arm protection. Trousers without cuffs should be worn outside boots or over the shoes to shed spilled liquid.

WARNINGS

Keep Equipment Area Well Ventilated

Although nitrogen is non-toxic and non-flammable, it can cause asphyxiation in a confined area without adequate ventilation. Any atmosphere not containing enough oxygen for breathing can cause dizziness, unconsciousness, or even death. Nitrogen, a colorless, odorless, and tasteless gas, cannot be detected by the human senses and will be inhaled normally. Without adequate ventilation, the expanding nitrogen will displace the normal air resulting in a non-life-supporting atmosphere.



Dispose of Waste Liquid Nitrogen Safely

Dispose of waste liquid nitrogen out-of-doors where its cold temperature cannot damage floors or driveways and where it will evaporate rapidly. An outdoor pit filled with clean sand or gravel will evaporate liquid nitrogen safely and quickly.

NOTE: Argon is an inert gas whose physical properties are very similar to those of nitrogen. For handling of liquid argon, follow the safe practices described for the handling and use of liquid nitrogen.

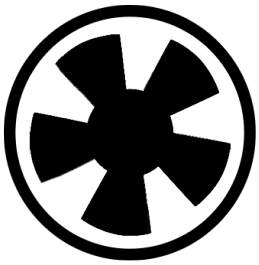
Safety Precautions for Liquid Carbon Dioxide

WARNING: CARBON DIOXIDE CAN CAUSE ASPHYXIATION AND DEATH IN CONFINED, POORLY VENTILATED AREAS.
COLD GAS CARBON DIOXIDE CAN CAUSE SEVERE FROSTBITE TO THE EYES OR SKIN. DO NOT TOUCH FROSTED PIPES OR VALVES. IF ACCIDENTAL EXPOSURE TO THESE GASES OCCURS, CONSULT A PHYSICIAN AT ONCE. IF A PHYSICIAN IS NOT READILY AVAILABLE, WARM THE AREAS AFFECTED BY FROSTBITE WITH WATER THAT IS NEAR BODY TEMPERATURE

Keep Equipment Area Well Ventilated.

Carbon dioxide affects the important acid-base balance in the body. Carbon dioxide is formed in normal functioning within the body, but the body can tolerate increased amounts of carbon dioxide only in limited concentration. This is recognized in OSHA standards where a Threshold Limit Value of 5,000 parts per million by volume (0.5 percent concentration) has been adopted. For safety, concentrations above this level should not be permitted; increased concentrations can cause bodily harm or death. Additionally, carbon dioxide can cause asphyxiation by displacing oxygen resulting in dizziness, unconsciousness or death.

Ten percent carbon dioxide in air can be endured for only a few minutes; twelve to fifteen percent soon cause unconsciousness; twenty five percent may cause death if exposure lasts for several hours. Carbon dioxide cannot be detected by the human senses and will be inhaled normally. Carbon dioxide is heavier than air and will accumulate in low lying areas. Carbon dioxide concentrations will be greater in these areas. If adequate ventilation is not provided, carbon dioxide may displace normal air without warning that a life-depriving atmosphere is developing.



WARNINGS

Cover Eyes and Skin

If released to atmosphere, liquid carbon dioxide will turn to carbon dioxide snow. Accidental contact of carbon dioxide snow or cold gas with the eyes or skin may cause severe frostbite. Handle liquid so that it will not vent or spill. Protect your eyes with safety goggles or a face shield, and cover the skin to prevent contact with snow or cold gas, or with cold pipes and equipment. Protective gloves can be quickly and easily removed and long sleeves are recommended for protection.

Ground All Piping

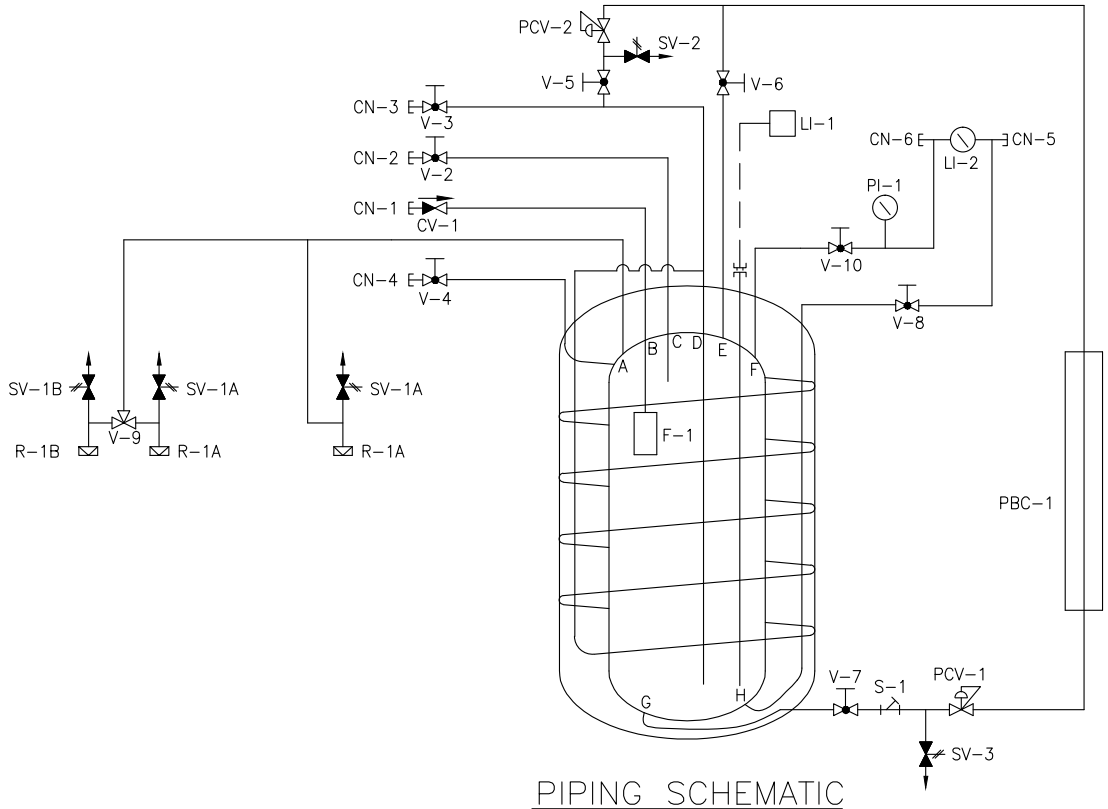
The rapid discharge of liquid carbon dioxide through a line which is not electrically grounded will result in a buildup of static electricity. Contact with this electrical charge could be startling and potentially dangerous to operating personnel. Such lines should, therefore, be grounded before use.

NOTE: For additional information on properties of carbon dioxide and proper handling refer to CGA pamphlets G-6, "Carbon Dioxide" and G-6.1, "Standard for Low Pressure Carbon Dioxide Systems at Consumer Sites". These publications are available from the Compressed Gas Association, 1235 Jefferson Davis Highway, Arlington, VA, 22202

PIPING CIRCUITS

The following information describes the operation of the piping circuits of the system. The descriptions refer to the main components of each circuit and are grouped by function. Reference the piping schematic below and in the general arrangement drawing for the component designations. These component and circuit descriptions should be understood before attempting operation.

P&ID: MB-1000 – MB-3000 Standard Configuration



PIPING SCHEMATIC

LEGEND

A	SAFETY	CN–1	CONNECTION, FILL	LI–1	LIQUID LEVEL GAUGE (OPTIONAL)
B	TOP FILL	CN–2	CONNECTION, FULL TRYCOCK AND VENT	LI–2	LIQUID LEVEL DP GAUGE
C	FULL TRYCOCK/VENT	CN–3	CONNECTION, LIQUID WITHDRAWAL	PI–1	PRESSURE GAUGE
D	LIQUID WITHDRAWAL	CN–4	CONNECTION, VAPORIZER OUTLET (INTERNAL)	PBC–1	PRESSURE BUILDING COIL
E	PRESSURE BUILDER RETURN	CN–5	CONNECTION, AUXILIARY LIQUID INSTRUMENT	PCV–1	PRESSURE BUILDING REGULATOR
F	VAPOR INSTRUMENT	CN–6	CONNECTION, AUXILIARY GAS INSTRUMENT	PCV–2	ECONOMIZER REGULATOR
G	PRESSURE BUILDER INLET	CV–1	CHECK VALVE, PUMP/TOP FILL	S–1	STRAINER
H	LIQUID INSTRUMENT	V–2	VALVE, FULL TRYCOCK/VENT	SV–1A	SAFETY VALVE
		V–3	VALVE, LIQUID WITHDRAWAL	SV–1B	SAFETY VALVE
		V–4	VALVE, GAS USE	SV–2	RELIEF VALVE
		V–5	VALVE, ECONOMIZER ISOLATION	SV–3	RELIEF VALVE
		V–6	VALVE, PRESSURE BUILDING OUTLET	R–1A	INNER CONTAINER BURST DISC
		V–7	VALVE, PRESSURE BUILDING INLET	R–1B	INNER CONTAINER BURST DISC
		V–8	VALVE, LIQUID INSTRUMENT	F–1	FLOAT
		V–9	VALVE, DIVERTER		
		V–10	VALVE, GAS INSTRUMENT		

Figure 1-MB-1000-MB-3000 Standard System Piping Schematic

Note: Information and related materials are subject to change without notice. All information and related materials are provided "as is".

Liquid & Vent Circuits

The liquid valve (V-3) communicates with the bottom of the vessel. Liquid is removed from the vessel through this connection and valve.

The vent / trycock valve (V-2) is attached to a vertical tube in the upper portion of the vessel. Opening the vent valve reduces pressure in the vessel during filling. It also serves as a "full trycock", venting liquid from the vessel when the liquid level exceeds 100%.

Liquid & Vent Circuits

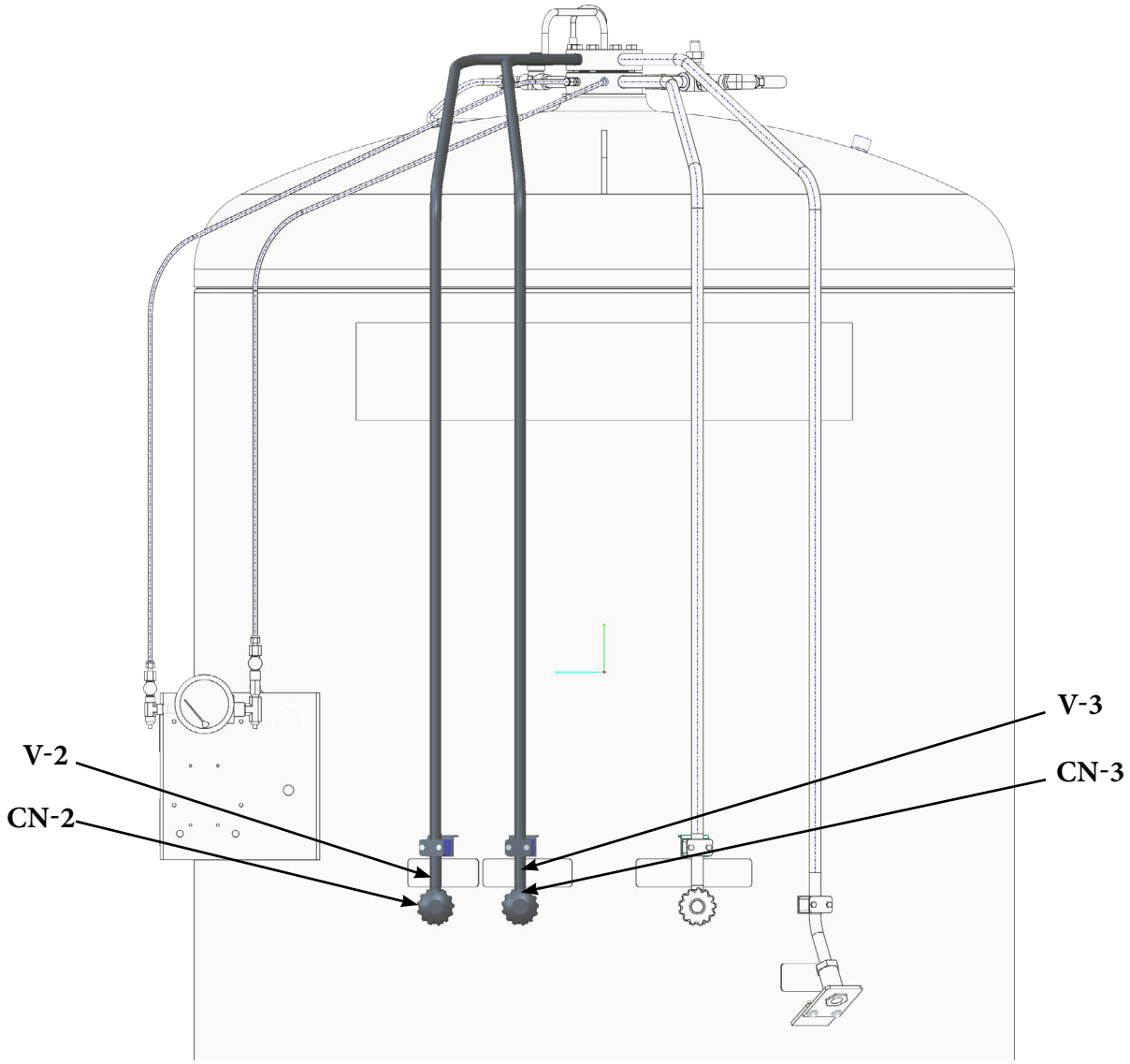


Figure 2: Liquid and vent circuits highlighted

Fill Circuits

The Fill circuit may be used for filling from the Taylor-Wharton MICRO BULK Cryogenic Delivery System or for filling by a cryogenic pump. A check valve (CV-1) will prevent product from escaping the vessel.

Fill Circuits

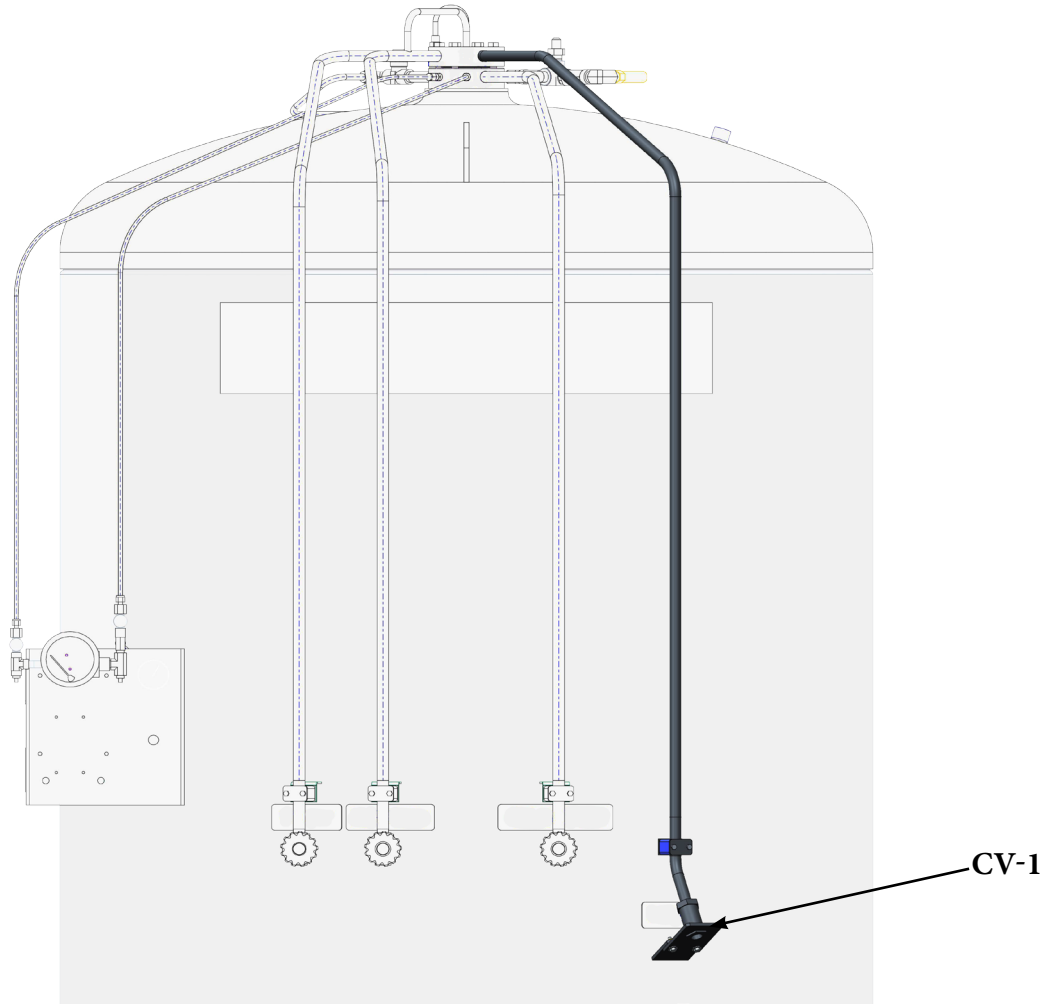


Figure 3: Fill circuit highlighted

Pressure Building Circuit

The pressure building circuit serves to build pressure after filling the vessel. The circuit is also used to ensure sufficient driving pressure during high product withdrawal periods. Opening the pressure building outlet valve (V-6) and pressure building inlet valve (V-7) permits the circuit to function. When the pressure inside the vessel drops below the pressure builder setting, the pressure building regulator (PCV-1) opens. This creates a path from the liquid in the bottom of the container to the gas space in the top. This path contains an external pressure building coil (PBC-1) to vaporize product as it flows from the bottom to the top of the vessel. Liquid is expanded to a vapor and pressure is increased in the vessel.

Pressure Building Circuit

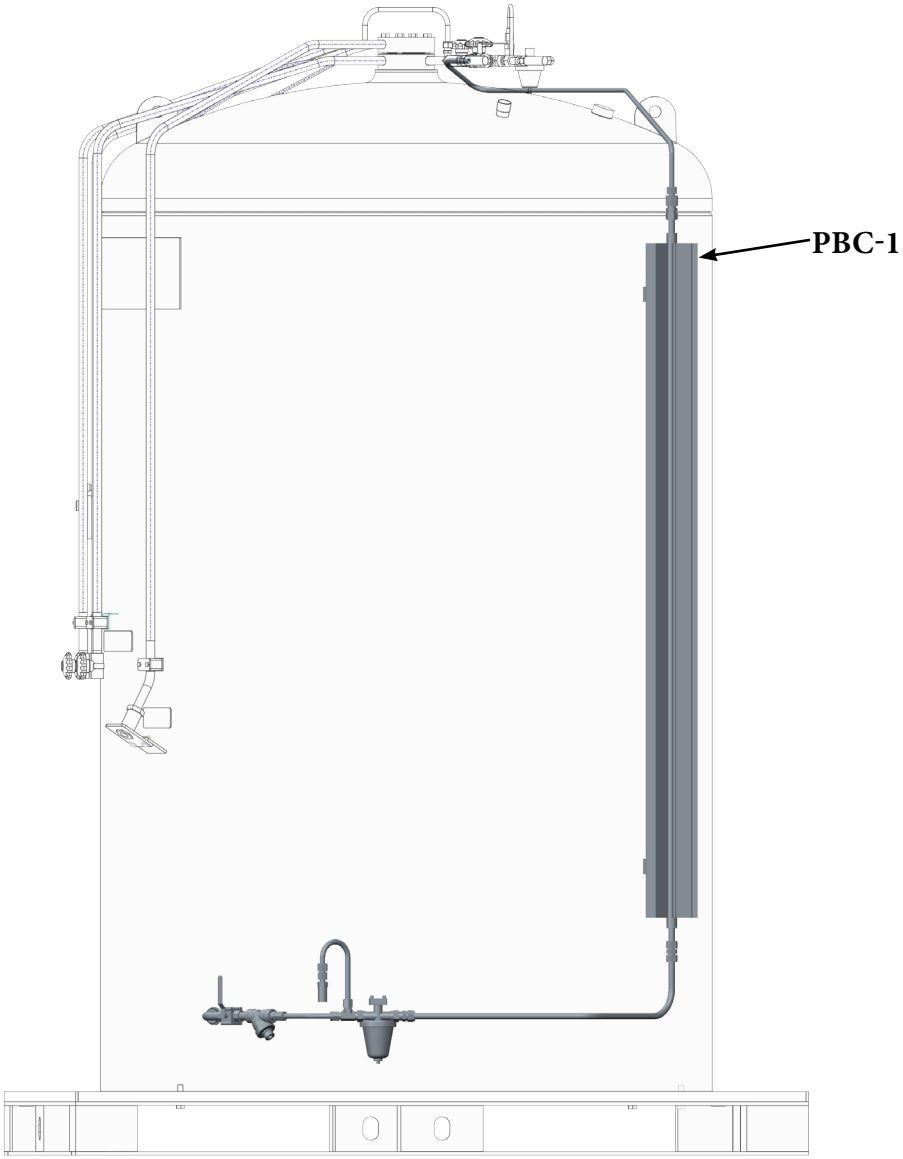


Figure 4: Pressure building circuit highlighted

External Pressure builder, and Economizer Circuit

The pressure builder(PB) inlet circuit provides pressurized cryogenic liquid to an external pressure builder. Opening the PB Inlet Valve (V-7) allows liquid, driven by the pressure within the vessel, to flow into the external pressure builder. The pressure builder uses heat from the ambient air to convert the liquid into a gas and warm it.
The economizer circuit reduces product loss due to normal evaporation of the liquid within the vessel. The pressure builder outlet valve (V-6) and the economizer circuit isolation valve (V-5) must be open for the circuit to function. The economizer regulator (PCV-2) opens when the pressure within the vessel exceeds the economizer set point. This allows gas from the top of the vessel to flow into the vaporizer circuit/ liquid withdrawal. Provided that gas from the vaporizer is being withdrawn for use, the vessel pressure will be reduced. The primary safety valve (SV-2) will be prevented from opening, avoiding product loss.

The economizer circuit may be isolated for maintenance without emptying or depressurizing the vessel. Closing the pressure builder outlet valve (V-6) and the economizer circuit isolation valve (V-5) isolates the circuit.

External Pressure builder, and Economizer Circuit

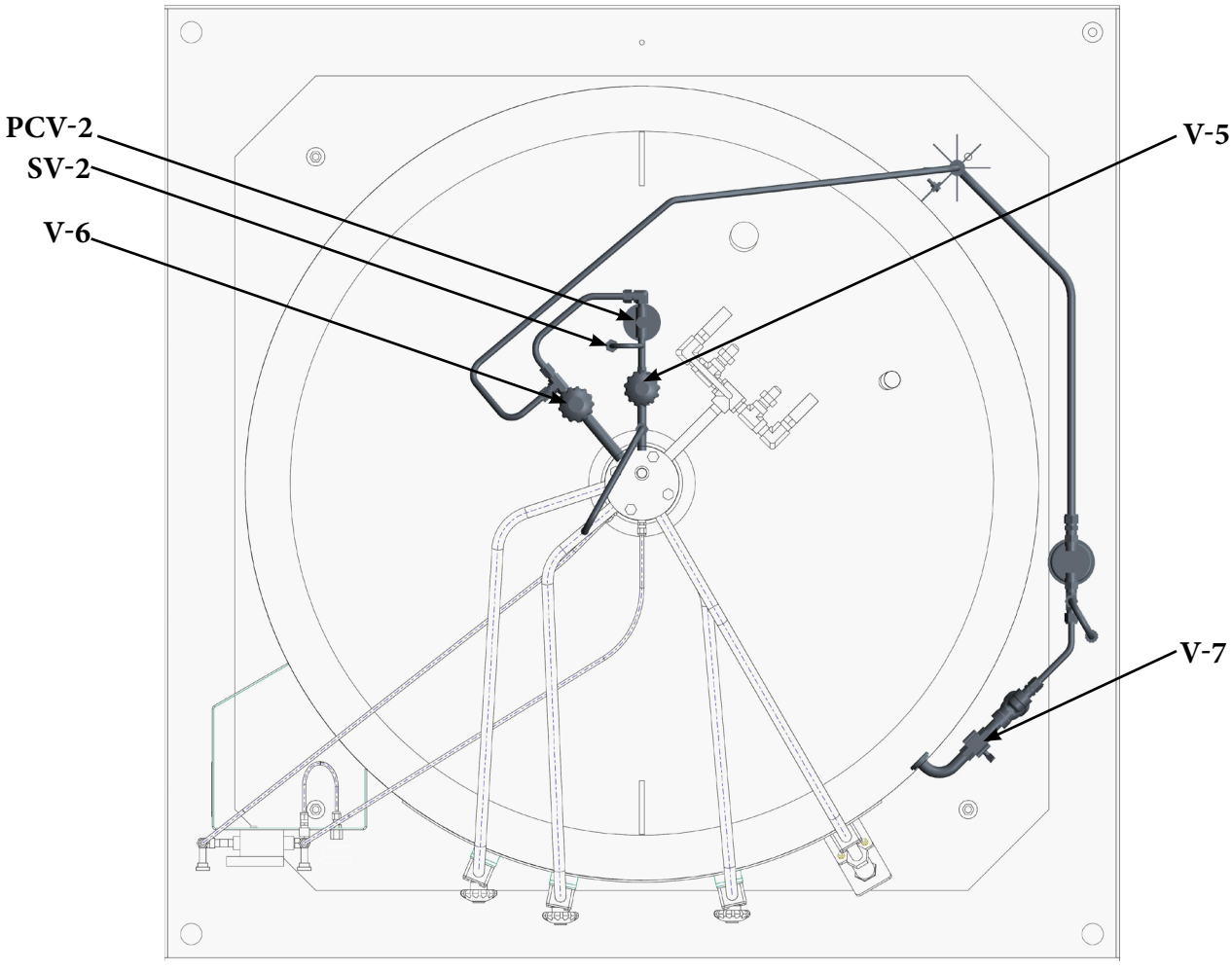


Figure 5: External Pressure builder, and Economizer circuit highlighted

Safety Devices

The MICRO BULK features safety valves to prevent over-pressurization of the vessel. The safety valves (SV-1A and SV-1B) relieve pressure when it exceeds the maximum operating pressure of the vessel. The valve resets when pressure drops below this point. In addition, the primary safety valve is supported by a secondary relief device consisting of a rupture discs (R-1A and R-1B). The rupture disc requires replacement in the event a safety valve malfunctions and allows vessel pressure to reach the burst pressure rating of the disc. A Dual Safety Divert valve (V-9) permits the operation of one set of protection devices while the other set is isolated at the same time and permits maintenance of the device with out the need to vent tank pressure. To activate one set of devices while isolating the other move the selector valve handle all the way to the end of its travel toward the devices to be activated.

Safety Devices

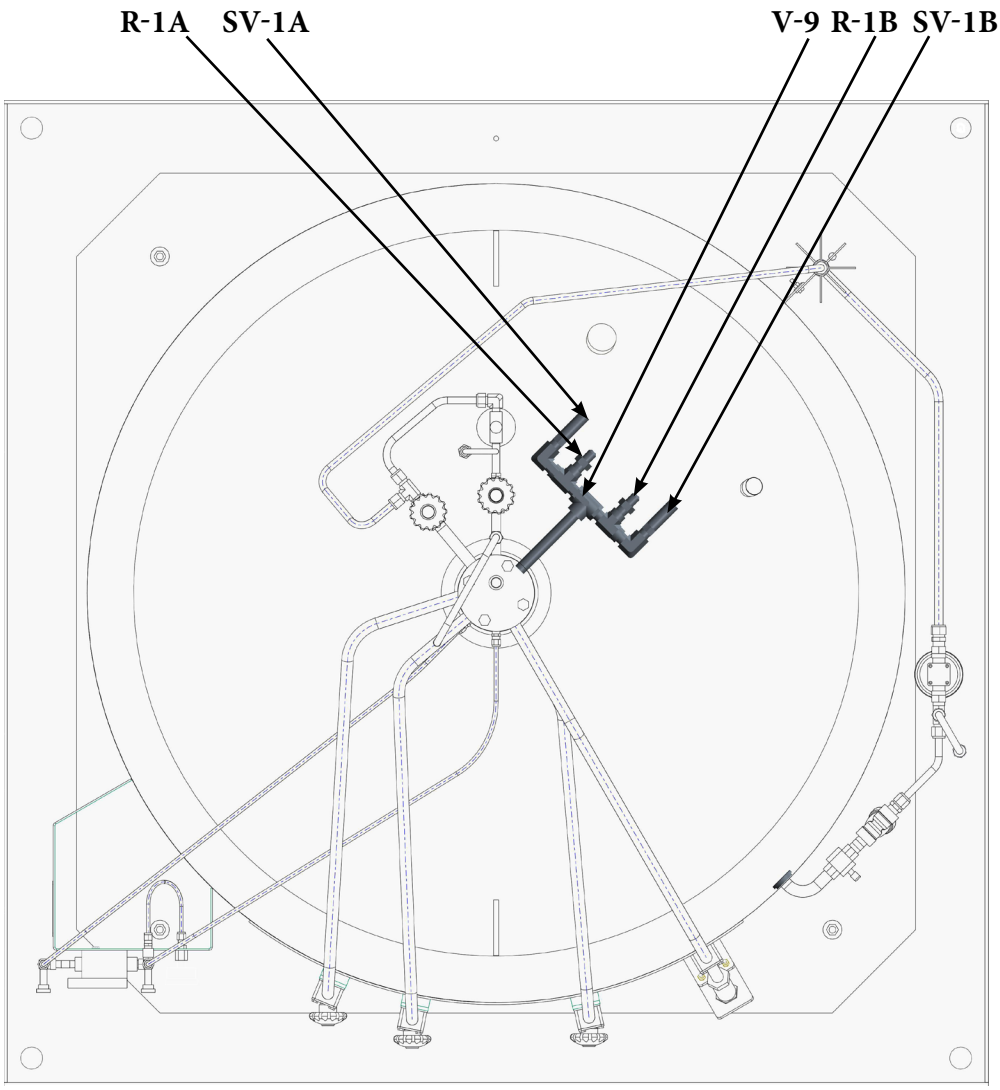


Figure 6: Safety circuit highlighted

Instrumentation Circuits

The instrumentation consists of a pressure gauge and liquid level gauge or differential pressure gauge. The pressure gauge (PI-1) displays the inner vessel pressure in pounds-per-square-inch and kilo pascals. The liquid level gauge (LI-1) measures the difference in pressure between the top and bottom of the vessel. Product within the vessel creates a higher pressure at the bottom of the vessel than at the top. Readings on the liquid level gauge are in inches of water. This reading, when compared to the contents chart attached to the front of the vessel, allows accurate monitoring of the amount of product within the vessel.

Isolation valves (V-8 and V-10) allow maintenance of the circuit without emptying and depressurizing the vessel. The equalization valve (V-9) must be opened before the isolation valves are closed. Two ¼" female pipe thread connections (CN-5 and CN-6) are provided to allow easy connection of telemetry devices or other differential pressure measurement instruments. The connections are provided plugged.

Instrumentation Circuits

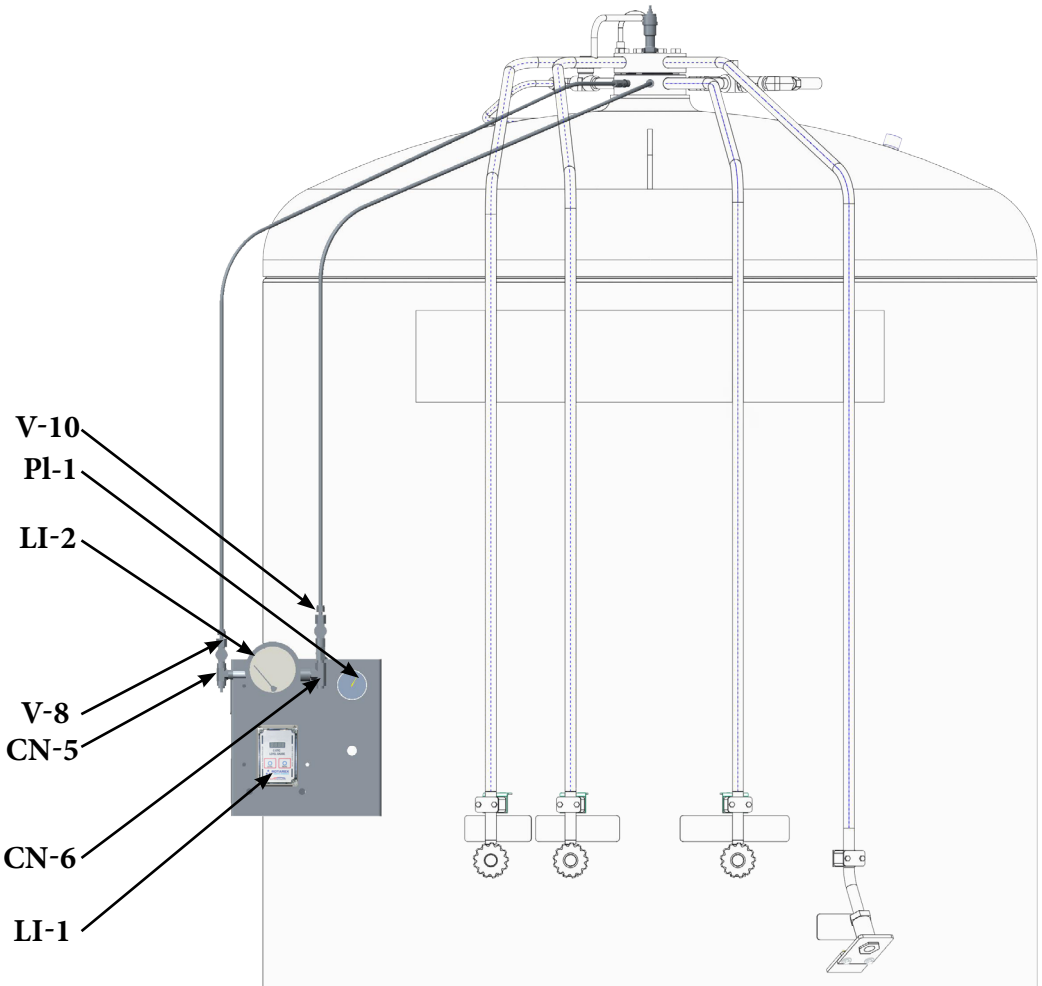


Figure 7: Instrumentation circuits highlighted

INSTALLATION

Handling

The MICRO BULK should be handled only by a forklift or crane. Ensure that handling equipment has adequate rated capacity for the system weight listed on the general arrangement drawing in the appendix. The MICRO BULK is a rugged product intended for years of industrial use. However, take care when moving the unit. Abuse (dropping or careless handling by forklift) may affect the integrity of the insulation system or damage piping. Always transport, operate, and store the unit in the vertical position. Never place the unit on its side.

Important: When lifting by crane, use the lift-eyes provided on the top of the jacket. Never lift the unit overhead.

OPERATIONS

These instructions are for operators experienced with cryogenic equipment. Before operating this product, become familiar with the safety precautions in this manual and in reference publications. Study this manual and the general arrangement drawing located in the back of this manual thoroughly. Know the location and function of all components.

Filling by Pressure Transfer

Filling by pressure transfer is accomplished by lowering the pressure in the MICRO BULK below that of the source vessel. Typically the source vessel is a truck-mounted vessel. The pressure is reduced in the MICRO BULK by venting gas through the vent valve (V-2). Liquid is pushed by pressure from the truck-mounted vessel and into the MICRO BULK.

CAUTION: Follow the safety precautions at the beginning of this manual. Accidental contact with liquid or cold gas can occur during filling.

A cryogenic transfer hose equipped with a relief valve and dump valve should be used to connect the MICRO BULK to the fill connection. Follow the instructions below to fill by pressure transfer:

When liquid issues from the vent valve, the vessel is full. The designed gas head space will remain above the liquid.

Once liquid stops issuing from the vent valve (V-2), close the vent valve.

Close the liquid source supply valve.

Disconnect the transfer hose from the Fill connection (CN-1).

Filling by Pump Transfer

When a pump is used to fill the container, the pump / top fill connection (CN-1) should be used. Closely monitor the vessel pressure during the fill. If the vessel pressure approaches the relief valve setting or the pump pressure rating, shut down the pump. Open the vent valve (V-2) to reduce pressure as needed.

When using a traditional pumping system, the vent valve (V-2) should remain open during the fill. Monitor the product exiting the vent valve closely. When liquid issues from the vent valve (V-2) immediately stop the pump. Once liquid stops issuing from the vent valve close the vent valve.

OPERATIONS

Before disconnecting fill hose from fill connection (CN-1) open fill purge valve to discharge product from fill hose. After this operation is complete close fill purge valve then disconnect hose from (CN-1).

Withdrawing Product

External Vaporizer

To withdraw product from the MICRO BULK, connect a suitable vaporizer to the vaporizer inlet connection (CN-4). Equip the vaporizer with a relief valve sized in accordance with the vaporizer manufacturer's recommendations. Install a line regulator downstream of the vaporizer. Connect the outlet of the regulator to the application. Follow these steps:

1. Open the pressure building valve (V-6). Monitor the pressure gauge (PI-1). When the pressure exceeds the desired delivery pressure, continue.

2. Open the vaporizer inlet valve (V-4).

3. Adjust the line regulator to desired delivery pressure.

Withdrawing Liquid

Attach a transfer hose from the receiver vessel to the MICRO BULK liquid connection (CN-3) and open the adjacent liquid valve (V-3). The pressure in the container will drive liquid product out through the valve as long as the container pressure exceeds that of the receiver.

Changing Gas Service

The MICRO BULK changed for the following gas only; argon, oxygen, or nitrogen service. A tank that has been used for CO_2 **cannot be switched to another service**. Follow these steps to properly change gas service:

1. Safely empty all liquid from the container.

2. Open the pressure building inlet and outlet valves (V-6 and V-7) and the vent valve (V-2) to vaporize any residual liquid that may remain in the bottom of the vessel. It may require an hour or longer to vaporize all the residual liquid.

3. To ensure purity, it is recommended that the MICRO BULK be evacuated with a suitable vacuum pump. The ultimate vacuum reading should be at least 20 inches of mercury.

4. Replace the fittings for the liquid, top fill, and use connections with the appropriate fittings shown in the chart below. Use Teflon tape or another suitable thread sealant when threading the fittings into the connections.

5. Remove any decals identifying the previous gas service. Attach new gas service identification decals.

MAINTENANCE

Routine inspections of the system are recommended. The need for maintenance usually becomes apparent from inspection and indications of improper operation. Typical trouble indications include leakage from valves or piping connections and excessive venting through relief valves. Keep a permanent log of all inspections and repairs performed. Such a log can be valuable in evaluating performance and scheduling maintenance.

Date	Nature of Work (Describe in Full)	Remarks	Service men's Signature

Table 1.1 : Inspection and Repair Log (Sample Form)

Always observe the safety precautions at the front of this manual and follow the instructions given in this section. Before working on the system, properly empty the vessel of liquid and relieve pressure on the vessel and piping. Do not allow unqualified persons to attempt repairs on this equipment. Refer to the Trouble-Remedy Guide in this manual (page 23) for assistance in troubleshooting.

Suggested Leak Test

After making repairs requiring disassembly or replacement of components, leak test all valves or piping joints that were taken apart and reconnected. Apply leak detector fluid to the test surface. Large leaks instantly form large bubble clusters, while fine leaks produce white foam that builds up more slowly. All leaks must be repaired and retested before the system is returned to service.

MAINTENANCE

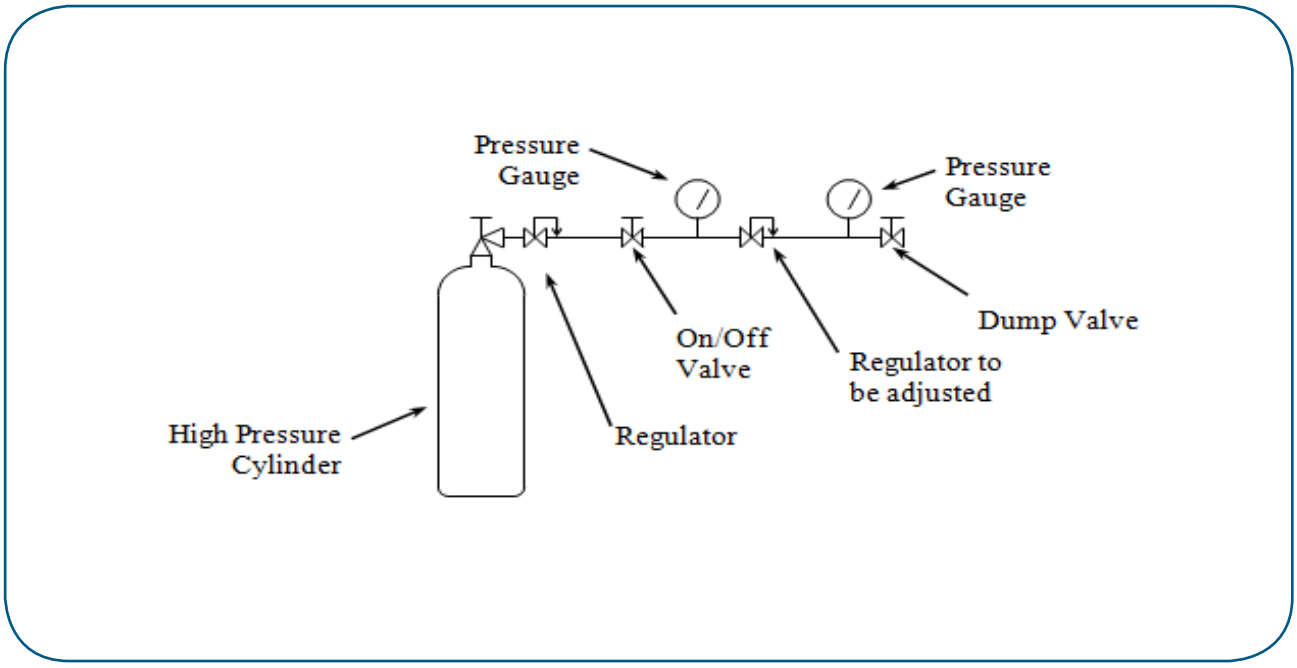
Regulators

The pressure-building regulator may be adjusted without removal from the system. The following procedure describes the process:

1. Fill the container with liquid product.

2. Open the pressure-building valve and allow the container pressure to stabilize for about an hour. Note the pressure.

3. Loosen the lock nut on the adjusting screw on the top of the regulator. Raise the set point by turning the adjusting screw clockwise; lower the set point by turning the screw counterclockwise. When decreasing the setting, the pressure building valve must be closed and the container vented to a lower pressure. Repeat step two and observe the change.



1. Leak test joints between the high pressure cylinder regulator and the dump valve. Joints must be leak free before proceeding.

2. Close the on/off valve and the dump valve.

3. Open the high pressure cylinder valve.

4. Set the high pressure regulator above the desired set point for the pressure builder.

5. Slowly open the on/off valve and observe the downstream pressure gauge.

6. When the regulator under adjustment closes, the pressure-building. Set point is indicated on the downstream pressure gauge.

7. Close the on/off valve and open the dump valve.

MAINTENANCE

8. To reset the regulator, loosen the lock nut on the adjusting screw. Raise the set point by turning the adjusting screw clockwise; lower the set point by turning the screw counterclockwise. After adjustment, repeat steps 5 and 6 to check the setting before reinstalling the regulator on the liquid container.

9. When reinstalling the pressure-building regulators on the system, orient the regulator so the flow arrow points away from the pressure-building valve.

Adjustment of the economizer regulator should be accomplished with the regulator removed from the system. The regulator bench adjustment fixture should be used.

1. Leak test joints between the high pressure cylinder regulator and the dump valve. Joints must be leak free before proceeding.

2. Close the on/off valve. Open the dump valve.

3. Open the high-pressure cylinder valve.

4. Set the high-pressure regulator above the desired set point for the economizer.

5. Slowly open the on/off valve for a few seconds and then close it.

6. When the regulator has been adjusted, the economizer set point is indicated on the upstream pressure gauge.

7. To reset the regulator, loosen the lock nut on the adjusting screw. Raise the set point by turning the adjusting screw clockwise; lower the set point by turning the screw counterclockwise. After adjustment, repeat steps 5 and 6 to check the setting before reinstalling the regulator on the liquid container.

8. The economizer regulator should be reinstalled oriented horizontally with the tube compression fitting threaded into the side port.

Instruments

User adjustment of the pressure gauge or liquid-level gauge is not possible. If the gauges are malfunctioning, they must be replaced. Close both isolation valves (V-8 and V-10) and immediately open the equalization valve (V-9). Loosen one of the tube compression fitting nuts to reduce pressure. When the pressure gauge (PI-1) indicates zero it is safe to work on the circuit.

Vacuum

Cryogenic containers are two containers, one within the other. The space between the containers acts as a highly efficient thermal barrier including high technology insulation, a vacuum, and a vacuum-maintenance system. Each serves a very important part in the useful life of the container. The high technology insulation is very effective in preventing radiated heat from entering the inner container. Unfortunately, the perfect vacuum cannot be achieved since trace gas molecules begin to enter the vacuum space from the moment of manufacture. The vacuum-maintenance system consists of materials that gather trace gas molecules from the vacuum space. The maintenance system can perform its function for years; however it has a limited capacity. When the vacuum-maintenance system becomes saturated it can no longer maintain the vacuum integrity of the container. The change will be very gradual and may go unnoticed for several years. When the vacuum in the insulation space is no longer effective, the following symptoms may appear:

OPERATIONS

1. With liquid in the container, the outer casing will be much colder than comparative containers.

2. Frost, indicating the liquid level, may be visible on the outer casing of the container.

3. Condensation may form on the container. Note that some icing or condensation is normal around the piping connections of the vessel. Condensation may also occur on the vessel outer surface as a result of high humidity.

4. The relief valve will open continuously until the container is empty.

If it has been determined that the vessel has a vacuum problem it will be necessary to repair and re-evacuate the vessel. A skilled service technician should perform vessel repair. Contact Taylor-Wharton customer service at **1-800-898-2657** for assistance in locating the closest service center.

TROUBLE-REMEDY GUIDE

Trouble	Possible Cause	Remedy
Low operating pressure.	**a.** Safety valve leaking or frozen open. **b.** Safety disc ruptured. **c.** Piping leaks to atmosphere. **d.** Pressure building / economizer regulator malfunction. **e.** Excessive product withdrawal. **f.** Pressure building valve closed. **g.** Malfunctioning pressure gauge. **h.** Excessive frost on pressure building coils.	**a.** Thaw out valve or replace if necessary. **b.** Replace disc. **c.** Leak test and repair piping. **d.** Adjust regulators. Replace if necessary. **e.** Check for leaks downstream. Reduce product use. **f.** Open pressure building valve. **g.** Replace pressure gauge. **h.** Thaw pressure-building coils.
Excessive system pressure.	**a.** Extensive shutdown time. **b.** Low withdrawal rate. **c.** Malfunction of pressure-building circuit. **d.** Malfunction of pressure gauge. **e.** Bad vessel vacuum.	**a.** No remedy. **b.** No remedy. **c.** Adjust pressure-building regulators. Replace if necessary. **d.** Replace gauge. **e.** Perform NER test. Have vessel repaired and re-evacuated if necessary.
Leaking relief valve.	**a.** Dirt or ice in valve. **b.** Damaged valve seat.	**a.** Thaw out valve. Replace if necessary. **b.** Replace valve.
Ruptured pressure vessel rupture disc.	**a.** Excessive vessel pressure. **b.** Defective rupture disc. **c.** Atmosphere corrosion and/or disc fatigue. **d.** Interior disc corrosion. **e.** Relief device failed.	**a.** Excessive system pressure trouble section. Replace rupture disc. **b.** Replace rupture disc. **c.** Replace rupture disc. **d.** Blow out safety device line. Replace rupture disc. **e.** Replace relief device and rupture disc.

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