INSTRUCTIONS MANUAL
FOR
MTU MODEL TANKS
(ADM PRESSURE CODE)

Do not attempt to use or maintain these units until you read and understand these instructions. Refer to the Taylor-Wharton 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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WARNING

Following safety precautions are for your protection. Before performing installation, operating or maintenance procedures read and follow all safety precautions in this section and in 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.

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°F (-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 but vigorously accelerates the burning of combustible materials.

Keep Combustibles Away from Oxygen and Eliminate Ignition Sources

Many substances, which 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 substances, 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, which contains oil or grease. Under certain conditions flammable materials, which 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.

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 cold 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. Cuffless 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 Coded 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.

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

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 NITROGEN

Nitrogen is an inert, colorless and tasteless gas, which makes 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, which makes up the other fifth of the air. Liquid nitrogen is at a temperature of -320°F (-196°C) under normal atmospheric pressure.

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 cold 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. Cuffless trousers should be worn outsides booths or over the shoes to shed spilled liquid.

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, which does not contain enough oxygen for breathing, can cause dizziness, unconsciousness, or even death. Nitrogen being colorless, odorless and tasteless cannot be detected by the human senses and will be inhaled normally as if it were air. Without adequate ventilation, the expanding nitrogen will displace the normal air without warning that a non-life-supporting atmosphere is present. Store liquid containers outdoors or in other well-ventilated areas.

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.

CAUTION: ***When installing field fabricated piping, 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.

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.*

LIMITED WARRANTY AND LIABILITY

Taylor-Wharton Malaysia warrants to the initial user of each cryogenic storage tank that such equipment will be free from defects in materials and workmanship and will perform in accordance with Taylor-Wharton Malaysia standard specifications under normal use during a period of eighteen (18) months from delivery or twelve (12) months from the date of initial operation of the equipment (whichever is first) if used, operated and maintained according to Taylor-Wharton Malaysia's written instructions. Taylor-Wharton Malaysia's warranty as to components manufactured by third parties and used in any equipment described herein will be limited to extending to the initial user such warranty as may be offered by such original manufacturer.

The remedies set forth herein are exclusive. Taylor-Wharton Malaysia shall not be liable for any consequential, special, or incidental damages resulting from the delivery, use of failure of the product (including loss of any materials stored in product), or from any other cause whatsoever. By accepting delivery of this product sold hereunder, the Buyer accepts this limitation of remedies as reasonable and enforceable. In no event shall Taylor-Wharton Malaysia's liability exceed the purchase price for the product.

To make a claim under these warranties, the Buyer must: 1) give Taylor-Wharton Malaysia written notice within ten (10) days after discovery of a claimed defect; and 2) immediately discontinue use of the product.

This warranty is voided by alterations or repairs of others. Taylor-Wharton Malaysia shall not be liable under this warranty, or otherwise, for defects caused by negligence, abuse or misuse of this product, corrosion, fire, heat, or the effects of normal tear. Any related components or other equipment manufactured by others, which may be sold with Taylor-Wharton Malaysia's product, are not covered by this warranty.

Taylor-Wharton Malaysia's sole liability under these warranties shall be limited to the repair, or at its option, replacement or refund of the purchase price, of such equipment which proves to be defective.

THE ABOVE EXPRESS WARRANTY IS IN LIEU OF ANY WARRANTY OF MERCHANTABILITY AND ALL OTHER EXPRESS OR IMPLIED WARRANTIES WITH RESPECT TO THIS PRODUCT.

INTRODUCTION

This manual provides information for the user to operate and maintain Taylor-Wharton's MTU-1600 and MTU-2800. This Mobile Transport Unit Cryogenic Tank is designed to transport liquid oxygen, nitrogen, or argon.

The MTU tanks are designed to transport and store liquid nitrogen, oxygen, or argon at a maximum working pressure of 275 psig (19 bar/ 19.3 kg/ cm^2). A simple mounting arrangement makes these tanks easily installed on a truck, chassis, trailer, or stationary foundation.

The MTU tank is of a double wall construction with an inner container suspended inside a carbon steel outer casing constructed in accordance with ADM2000 Pressure Vessel Code. An internal baffle is provided to prevent sloshing of liquid while in motion.

The insulation space between the pressure vessel and the vacuum jacket is filled with perlite powder insulation and evacuated to a high vacuum through the EVACUATION VALVE (4) which is permanently factory sealed. Molecular sieve adsorbent traps are installed in the evacuation space to help maintain the vacuum. Valves, piping and gauges are enclosed in the metal control cabinet which covers the rear head of the tank. The high capacity atmospheric vaporizer is mounted on the right side of the tank, while a storage tube for the liquid transfer hose is mounted on the left side.

Rapid transfer of liquid to another system may be achieved up to 20 gal./min (75 liter/min.) at approximately 50 psig (3.4 bar/3.5 kg/cm^2) pressure differential. This pressure transfer allows virtually no-loss filling of customer units without any need for power sources or pumps.

THESE INSTRUCTIONS ARE FOR EXPERIENCED OPERATORS

IF YOU ARE NOT FULLY FAMILIAR WITH THE PRONCIPLES AND SAFE PRACTICES FOR CRYOGENIC EQUIPMENT AND SUPPLY SYSTEMS, WE URGE YOU TO READ AND FULLY UNDERSTAND THE SAFETY PRECAUTIONS AND REFERENCE PUBLICATIONS LISTED IN THIS MANUAL BEFORE ATTEMPTING OPERATION AND / OR MAINTENANCE.

TANK SPECIFICATIONS

Description	Unit	MTU 1600	MTU 2800
Dimension – Length (A) *please refer figure 1 for tank dimension detail	Millimeter	4013	5994
Design Code		ADM	ADM
Inner Material		X2CrNiN 18-10 (1.4311) DIN 17440	X2CrNiN 18-10 (1.4311) DIN 17440
Maximum Allowable Working Pressure	Bar	19	19
	PSI	275	275
Capacity (Gross)	Liters	6,300	11,300
(Net)	Liters	5,670	10,600
Weight			
Empty	Kg	4,173	5,443
Loaded: Oxygen	Kg	10,646	17,554
Nitrogen	Kg	8,756	14,016
Argon	kg	12,071	20,230

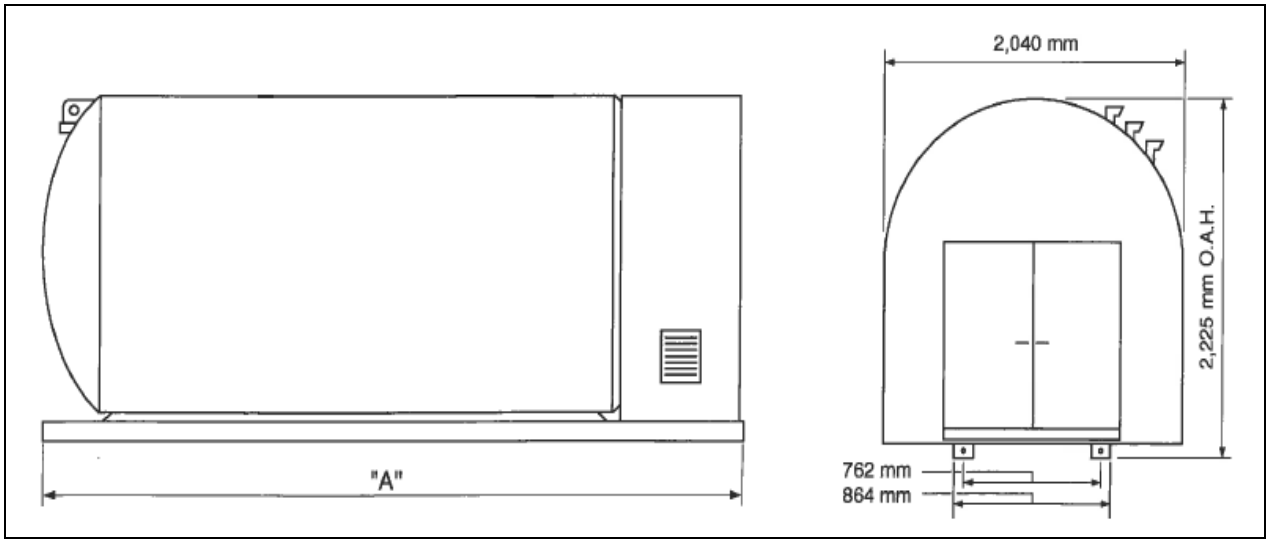


Figure 1: MTU Tanks Dimensions

FUNCTIONAL DESCRIPTION

Piping

A total of eight lines run from the inner container through the rear head of the casing to the valves and other components mounted inside the control cabinet. These lines and their function are identified in the Flow Diagram.

Liquid enters the tank through a transfer hose connected to a FILL CONNECTION (25). The tank is filled through a LIQUIED FILL VALVE (21) or a GASS FILL VALVE (22). The TRYCOCK (5) is used to determine fill termination. The HOSE DRAIN VALVE (24) is used to vent pressure from the transfer hose after filling or withdrawal of liquid. Gas can be vented from the tank through the BLOWDOWN VALVE (6).

Liquid product leaves the tank through the LIQUID WITHDRAWAL VALVE (21), gas product can be withdrawn through the GAS WITHDRAWAL VALVE (22).

Instrumentation

Container pressure is indicated by a PRESSURE GAUGE (15). The CONTENTS GAUGE (14), which is calibrated in “inches of water”, indicates the amount of liquid in the tank. The Contents Gauge Conversion Chart in this manual is used to convert the gauge readings to gallons, pounds, and cubic feet of product. Both the PRESSURE GAUGE (15) and the CONTENT GAUGE (14) are connected to the container through two ISOLATION VALVES (13) and a CONTENTS GAUGE BYPASS VALVE (16).

Pressure Controls

Tank Pressure is increase to the level required for liquid transfer by the pressure building system, designed for a 20 gal./ min. (75 liters/min.) withdrawal rate of 50 psig (3.4 bar/3.5 kg/cm^2).

The Pressure Building System consists of VAPORIZER (19) and its associated controls. When the VAPORIZER ISOLATION VALVE (20) is open, pressure building can be manually controlled by opening the MANUAL REGULATING VALVE (17).

Safety Devices

Both the inner container and the outer casing are protected by variety of safety devices, which are designed to limit the possibility of dangerous pressure build up anywhere in the system.

The CASING SAFETY DEVICE (1), a bursting disc rated at 10 psig (0.6 bar / 0.7 kg/cm^2), provides overpressure protection for the outer casing. This device will release any internal casing pressure in the event of a leak into the insulation space from the inner vessel or piping.

Primary overpressure protection for the inner vessel is provided by a SAFETY RELIEF VALVE (11) set at 275 psig (19 bar / 19.3 kg/cm^2). A RUPTURE DISC (12) set at 350 psig (24 bar / 24.6 kg/cm^2) provides a secondary protection.

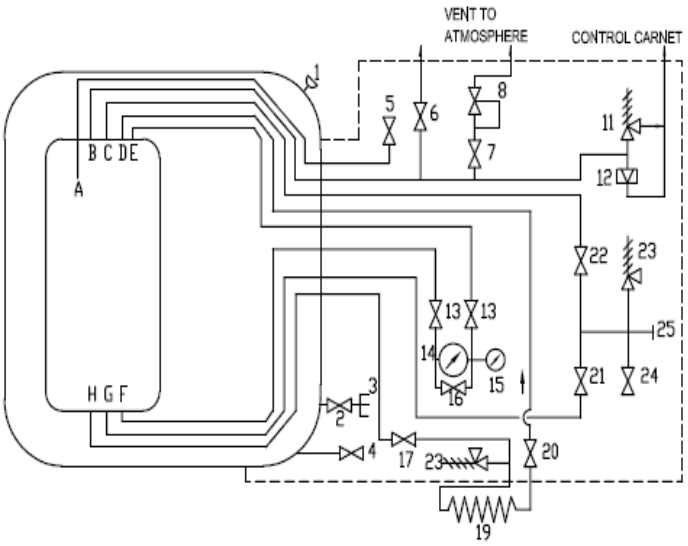
All piping sections where liquid could be trapped between closed valves are protected by PRESSURE RELIEF VALVES set at 400 psig (27.6 bar / 18 kg/cm^2) or 280 psig (19.3 bar / 19.7 kg/cm^2).

The ROAD-RELIEF VALVE (8) is not strictly a safety device. The major function is to control pressure in the inner vessel while the tank is in transit. A high-pressure ROAD RELIEF

VALVE (8) is set at 250 psig (17.2 bar / 17.4 kg/cm^2) operates when SHUT OFF VALVE (7) is open.

NOTE: For a detailed discussion of the proper operation of the road relief valves, including charts of the maximum allowable product weights for each pressure range, refer to "Road Relief Operation" in the "Operation" section of manual.

PIPING SCHEMATIC



LEGEND

Tag No.	Description
1	CASING SAFTY DEVICE
2	VACUUM GAUGE TUBE ISOLATION VALVE
3	VACUUM GAUGE TUBE
4	VACUUM EVACUATION VALVE
5	FULL TRYCOCK VALVE
6	BLOWDOWN VALVE
7	ROAD RELIEF SHUT OFF VALVE
8	ROAD RELIF VALVE
11	CONTAINER SAFETY VALVE
12	CONTAINER BURSTING DISC
13	CONTENTS GAUGE ISOLATION VALVE
14	CONTENTS GAUGE
15	PRESSURE GAUGE
16	CONTENTS GAUGE BYPASS VALVE
17	PRESSURE BUILDING VALVE (MANUAL)
19	PRESSURE BUILDING COIL
20	COIL ISOLATION VALVE
21	LIQUID PHASE FILL / WITHDRAWAL VALVE
22	GAS PHASE FILL / WITHDRAWAL VALVE
23	BLOCK LINE RELIEF VALVE
24	HOSE DRAIN VALVE
25	FILL CONNECTION

Item	Description
A	FULL TRYCORK LINE
B	SAFETY LINE
C	TOP FILL LINE
D	P.B OUTLET LINE
E	GAS INSTRUMENT LINE
F	LIQUID INSTRUMENT LINE
G	BOTTOM FILL LINE
H	P.B INLET LINE

Figure 2: Flow Diagram

INSTALLATION

The MTU tanks' mounting arrangement makes installation easy on almost any suitable truck chassis or trailer. They can also be placed on temporary foundations for use at construction sites and similar applications.

Tank dimensions are shown in Figure 1. For additional details refer to the installation drawing which are available on request.

Note: Read the instructions in this section carefully before attempting to handle the tank or connect auxiliary equipment to it.

Pre-Installation Inspection

Before installing the tank, inspect it carefully for any shipping damage. Report any such damage to the carrier and to the factory. In addition, check tank pressure and vacuum as follows:

1. Tanks are shipped pressurize with nitrogen gas at 20 psig (1.3 bar / 1.4 kg / cm^2). Open BYPASS VALVE (16) and GAUGE ISOLATION VALVE (13) on the gas-phase side: Read tank pressure indicated on PRESSURE GAUGE (15), record "as received" pressure. If recorded pressure is less than 3 psig (0.2 bar / 0.2 kg/cm^2) stop and proceed to step 3.

2. Connect a Hastings-Raydist VT-6 or TV-4 VACUUM GAUGE to the VACUUM GAUGE TUBE (3). Open ISOLATION VALVE (2). Leave ISOLATION VALVE (2) open for 30 minutes before reading VACUUM GAUGE (3). Record "as received" vacuum. Close ISOLATION VALVE (2). If recorded vacuum is greater than 200 microns (0.20 mm Hg), stop and proceed to step 3.

3. If the recorded pressure obtained in step 1 is less than 3 psig (0.2 bar / 0.2 kg/cm^2), or the recorded vacuum obtained in step 2 is greater than 200 microns (20 mm Hg). Absolute, contact the factory.

4. If pressure and vacuum readings both are satisfactory, proceed with installation.

Handling

Because of the size and weight of the MTU tanks should be handled by qualified personnel. Ensure that rigging equipment has adequate rated capacity to handle the tank weight. Tank weights are listed on the "Specification Table" in the front of this manual.

The tank should be lifted by the two lifting lugs shown in Figure 1. Never handle the MTU tank that contains any amount of liquid product: lifting filled tank could overstress and damage tank and rigging equipment, resulting in a risk of serious accident. Refer to the "Operation' section for information on emptying the MTU tank.

Customer Installed Equipment

Standard designs are available for adding many capabilities to these tanks. Where such standard designs apply, the benefits of standardization will be passed along to the customer without special design costs.

CAUTION: Designing safe and effective cryogenic systems require extensive knowledge and experience. Persons lacking the necessary skills are urged to seek competent advice before attempting to design cryogenic systems. Design and consultation services are available from the factory at the location given in the front of this manual.

The MTU tank is provide with a 1-1/2" CGA or a 1-1/4" 4 bolt brazed block assembly connection at the product FILL / WITHDRAWAL BLOCK and on both ends of the transfer hose.

OPERATION

These instructions are for experienced operators. Before operating the MTU tanks, become thoroughly familiar with the safety precautions in this manual and the reference publications. Make certain that installation has properly completed before placing a tank in operation. Study the Flow Diagram, Tank Controls, and the Functional Description. Know the location and function of all tank components. Observe all safety precautions including the wearing of protection equipment before transferring liquid product.

NOTE: For operator convenience, a Flow Diagram, and Contents Gauge Conversion Chart Are mounted inside the MTU tank Control Cabinet.

TRANSPORTATION

When used for transporting liquid nitrogen, oxygen or argon, the MTU tank may be used as cargo tanks which are permanently mounted on a motor vehicle or as portable tanks which are temporarily mounted on a vehicle such as a semi-trailer. In either case, the transportation of these liquefied atmospheric gases is usually regulated by various governmental authorities. It is the user's responsibility to be aware of such regulations and to comply with their requirements.

CONTENTS GAUGE CHART MTU2800

INCHES OF WATER	GALLONS (U.S.)			POUNDS		
	NITROGEN	OXYGEN	ARGON	NITROGEN	OXYGEN	ARGON
3	157	93	69	1056	887	801
6	287	171	127	1937	1632	1477
9	439	264	196	2965	2511	2275
12	609	367	273	4106	3497	3175
15	791	480	358	5336	4574	4163
18	983	601	449	6632	5726	5225
21	1182	729	546	7974	6941	6352
24	1385	861	648	9343	8208	7535
27	1590	999	754	10723	9516	8767
30	1793	1139	863	12096	10856	10038
33	1993	1282	976	13444	12218	11344
36	2186	1427	1090	14749	13594	12677
39	2370	1575	1207	15991	14974	14030
42	2542	1716	1324	17149	16351	15399
45	2698	1859	1442	18198	17714	16776
48	2750*	1999	1561	18540*	19056	18157
51		2138	1680		20367	19534
54		2271	1787		21637	20903
57		2399	1914		22856	22258
60		2520	2029		24014	23591
63		2634	2141		25097	24898
66		2738	2250		26091	26171
69		2755*	2357		26250*	27404
72			2459			28590
75			2556			29719
78			2647			30785
81			2733			31776
84			2775*			32250*
87						

46 — ACTUAL INCHES OF WATER READING

67 — ACTUAL INCHES OF WATER READING

83 — ACTUAL INCHES OF WATER READING

*DOT FULL CONDITION

1 pound of Nitrogen = 13.8 cu. Ft. of gas (NTP)
1 pound of Oxygen = 12.1 cu. Ft. of gas (NTP)
1 pound of Argon = 9.7 cu. Ft. of gas (NTP)

Figure 3 : Contents Chart

CONTENTS GAUGE CHART MTU-1600

INCHES OF WATER	GALLONS (U.S.)			POUNDS		
	NITROGEN	OXYGEN	ARGON	NITROGEN	OXYGEN	ARGON
3	73	43	32	490	411	372
6	133	79	59	899	757	685
9	204	122	91	1375	1165	1055
12	283	170	127	1905	1622	1473
15	367	223	166	2475	2122	1931
18	456	279	208	3077	2656	2424
21	548	338	253	3699	3220	2947
24	643	339	301	4334	3808	3495
27	738	463	350	4974	4414	4067
30	832	528	400	5611	4911	4657
33	925	595	453	6237	5668	5216
36	1014	662	506	6842	6306	5881
39	1099	729	560	7418	6946	6509
42	1179	796	614	7955	7585	7144
45	1252	862	669	8442	8218	7782
46	1276*	927	724	8601*	8840	8423
51		992	779		9448	9062
54		1054	834		10037	9697
57		1113	888		10603	10325
60		1169	941		15779	10944
63		1222	993		11642	11550
66		1270	1044		12104	12141
67		1278*	1093		12177*	12713
72			1141			13263
75			1186			13787
78			1229			14281
81			1268			14741
83			1287*			14961*
84						
87						

*DOT FULL CONDITION ACTUAL INCHES OF WATER READING

1 pound of Nitrogen = 13.8 cu. Ft. of gas (NTP)
1 pound of Oxygen = 12.1 cu. Ft. of gas (NTP)
1 pound of Argon = 9.7 cu. Ft. of gas (NTP)

Figure 4 : Contents Chart

FILLING PROCEDURES

Filling a Warm Tank

Perform following steps to fill a tank for the first time or when returning a tank to service after it has been emptied and allowed to warm:

1. Close all valves except the GAUGE ISOLATION VALVE (13) and the ROAD RELIEF SHUTOFF VALVE (7).

2. Check name of contents on supply source against product name on tank to ensure that the proper product is being transferred into the MTU tank.

3. Remove the transfer hose from its storage tube and connect it to the FILL CONNECTION (25) and the supply tank liquid supply line.

NOTE: New tanks are factory pressurized with nitrogen gas. If the tank is to be filled with any other product, it must be purged using the gas it will contain.

4. Open BLOWOWN VALVE (6), blowdown tank pressure to 5 psig (0.3 bar / 0.3 kg/cm^2). Close valve.

5. Fully open product supply valve. Partially open GAS FILL VALVE (22). Open FULL TRYCORK (5).

CAUTION: Fill a warm tank SLOWLY. Rapid cooling can cause distortion which may damage the inner vessel.

6. Fill tank to approximately ¼ full as the initial charge (refer to Table 2 for Contents Gauge Chart information). Close GAS FILL VALVE (22) and product supply valve. Allow the tank to cool for at least 12 hours to cool down gradually before completing the fill procedure.

7. Open GAS FILL VALVE (22) and the product supply valve to resume filling.

8. Monitor tank PRESSURE GAUGE (15). If pressure approaches 250 psig (17.2 bar / 17.4 kg/cm^2), close GAS FILL VALVE (22) and stop fill immediately. Open BLOWDOWN VALVE (6) and blowdown tank pressure to 175 psig (12.1 bar / 12.3 kg/cm^2). Close BLOWDOWN VALVE (6). Open GAS FILL VALVE (22) and resume filling.

9. Allow the fill to continue up to when liquid spurts from the FULL TRYCOCK (5). Close FILL VALVE (22) to stop fill. Close FULL TRYCOCK (5) when liquid stops flowing through it. Close product supply valve on the bulk supply tank.

10. Open HOSE DRAIN VALVE (24) to relieve pressure and drain liquid product from hose.

WARNING: Handle hose carefully. It will be extremely cold and may contain residual liquid product.

11. Carefully loosen the connections and disconnect the fill hose. Install dust caps on both ends and return hose to storage tube.

12. Replace the pressure cap on the tank FILL CONNECTION (25) and close HOSE DRAIN VALVE (24).

Filling a Cold Tank

Perform the following steps to fill a tank containing liquid product or one that has been recently emptied:

1. Close all valves except GAUGE ISOLATION VALVES (13).

2. Check name of contents on supply against product name on thank to be sure that proper product is being transferred into tank.

3. Remove the transfer hose and connect it to the FILL CONNECTION (25) and the supply tanks liquid supply line.

4. Fully open product supply valve. Fully open tank LIQUID FILL VALVE (21) to start tank fill. Adjust LIQUID FILL VALVE (21) to maintain tank pressure below 275 psig (19 bar / 19.3 kg/cm^2).

NOTE: Filling through LIQUID FILL VALVE (21) will increase tank pressure whereas, filling through GAS FILL VALVE (22) will decrease tank pressure.

5. Open FULL TRYCORK (5) when tank is about ¾ full (Refer to Contents Gauge Conversion Chart).

6. Allow the fill to continue up to when liquid spurts from the FULL TRYCORK (5). Close FILL VALVE (21). Close FULL TRYCOCK (5) when liquid stops flowing through it. Close product supply valve on the bulk supply tank and open HOSE DRAIN VALVE (7) to relieve pressure and drain liquid product from hose.

WARNING: Handle hose carefully. It will be extremely cold and may contain Residual liquid product.

7. Carefully loosen the connections and disconnect the fill hose. Install dust caps on both ends and return hose to storage tube.

8. Replace the pressure cap on thank FILL CONNECTION (25) and close HOSE DRAIN VALVE (24).

ROAD-RELIEF VALVE OPERATION

The MTU tank is equipped with a ROAD RELIEF VALVE set at operating pressures. ROAD RELIEF VALVE (8) is factory set at 250 psig (17.2 bar / 17.5 kg/cm^2).

NOTE: The FULL TRYCOCK level in the inner vessel normally corresponds to the allowable product weight. However, the FULL TRYCOCK may give a false indication when the tank is not perfectly level and is only good for one product.

The PRESSURE ROAD RELIEF VALVE (8) is factory set at 250 psig (17.2 bar / 17.5 kg/cm^2) to permit operation at higher pressure for liquid transfer and for over-the-road operation when the weight of the liquid product in the tank is below the maximum value listed in the table below. VALVE (8) is placed in operation by opening the PRESSURE ROAD RELIEF SHUT-OFF VALVE (7).

MAXIMUM PRODUCT WEIGHT FOR OPERATION

Product		MTU-1600	MTU-2800
Nitrogen	kg (lb)	4,583 (10,104)	8,568 (18,900)
Oxygen	kg (lb)	6,473 (14,271)	12,100 (26,676)
Argon	kg (lb)	7,898 (17,412)	14,766 (32,553)

When the MTU tank has been filled to maximum density for transportation of the liquid and the first delivery is too small to reduce the product weight below the limit for 250 psig (17.2 bar / 17.4 kg/cm^2) operation, it will be necessary to open the BLOWDOWN VALVE (5) long enough to drop tank pressure back to below 250 psig (17.2 bar / 17.4 kg/cm^2). The SHUT-OFF VALVE (7) should be opened to permit the ROAD RELIEF VALVE (8) to operate. This procedure will have to be repeated after each delivery until the weight of remaining product is less than the maximum permitted for 250 psig (17.2 bar / 17.4 kg/cm^2) operation.

PRESSURE TRANSFER OF LIQUID

Liquid product can be transferred from an MTU tank to other cryogenic liquid storage tanks. For efficient pressure transfer, the pressure in the MTU tanks should be approximately 50 psig (3.4 bar / 3.5 kg/cm^2) greater than the pressure in the receiving tank. If the pressure in the receiving tank is too great to permit pressure transfer, it will be necessary to blow the pressure sown to an acceptable value or use a ground-mounted transfer pump.

Use the following procedure when transferring liquid product from the MTU unit to another cryogenic tank:

1. Compare the product label on the MTU unit against the receiving tank to ensure that the proper product is being transferred.

2. Remove pressure cap from the FILL / WITHDRAWAL CONNECTION (25).

3. Remove the transfer hose from the storage tube. Remove dust caps from hose. Connect hose to MTU LIQUID WITHDRAWAL CONNECTION (25) and to the storage tank fill connection. Tighten connections firmly to prevent leakage.

4. Close ROAD RELIEF SHUT-OFF VALVE (8).

5. Read pressure gauge on storage tank.

6. Read PRESSURE GAUGE (15) on the MTU unit. If the pressure in the MTU is at least 50 psig (3.4 bar / 3.5 kg/cm^2) above that in the storage tank, proceed to Step 8.

7. Increase the pressure in the MTU to at least 50 psig (3.4 bar / 3.5 kg/cm^2) above that in the storage tank.

For manual control, open ISOLATION VALVE (20); then slowly open MANUAL PRESSURE BUILDING VALVE (17) while observing the PRESSURE GAUGE (15). During the transfer, throttle MANUAL PRESSURE BUILDING VALVE (17) as necessary to maintain the required pressure on PRESSURE GAUGE (15).

8. Open fill valve (gas or liquid phase as required) on the storage tank.

9. Open the LIQUID WITHDRAWAL VALVE (21) to supply liquid to the storage tank.

10. Monitor pressure gauges on storage tanks and on MTU unit and use pressure building system to maintain pressure at least 50 psig (3.4 bar / 3.5 kg/cm^2) above storage tank pressure.

11. When liquid transfer is completed, close the fill valve on storage tank and LIQUID WITHDRAWAL VALVE (21) on the MTU unit. Open HOSE DRAIN VALVE (24) to vent the transfer hose.

WARNING: Handle the hose carefully. It will be extremely cold and may contain residual liquid.

12. Carefully loosen connections and disconnect the fill hose. Install dust caps on both ends and return hose to storage tube.

13. Replace pressure cap on the FILL / WITHDRAWAL CONNECTION (25) and close HOSE DRAIN VALVE (24).

14. Depending on the product weight in the tank, ROAD-RELIEF VALVE (8) must operate during transit. Open SHUT-OFF VALVE (7) to place ROAD RELIEF VALVE (8) in operation.

OPERATION AS CUSTOMER STATION

The MTU tank can be used to supply liquid as gaseous product at the user's site. It can be set up as a portable unit or as a fixed installation. In either arrangement, including auxiliary equipment, the tank must conform to safety codes and local regulations. For supplying gaseous product, Taylor-Wharton has available a variety of vaporizer units and control equipment that will meet nearly every requirement.

To minimize evaporation loss in customer station applications, the minimum recommended product withdrawal rates (standard cubic feet per day) are as follows:

Product	MTU-1600	MTU-2800
Nitrogen	2700 (71)	
Oxygen	2100 (55.2)	
Argon	2250 (59)	

Note: Values in parenthesis () are cubic meter per day at STP.

Connect the user's system to the WITHDRAWAL CONNECTION (25) to provide the desired operating pressure. Be sure that ROAD RELIEF SHUTOFF VALVE (8) is closed. Open WITHDRAWAL VALVE (21) to supply product to the vaporizer or other user equipment.

When the MTU customer station is to be shut down for an extend period, close WITHDRAWAL VALVE (21 & 22) and PRESSURE BUILDING ISOLATION VALVES (17 & 20).

CHANGING PRODUCT SERVICE

MTU tanks are suitable for transportation and storage of liquid nitrogen, oxygen, and argon. They can be easily converted from one product service to another when requirements change. To change product service the following steps required:

1. Empty the tank by transferring any remaining liquid to another tank or by vaporizing the liquid and venting the gas to a safe location. Refer to “Taking the Tank Out of Service”.

2. Change the transfer hose and Fill / Withdrawal block connection fittings to the proper CGA connector for the new product service.

3. Purge the tank as necessary to achieve the required purity and moisture specifications for the new product. Refer to “Purging Procedures”.

4. Apply the appropriate placards and labels required to properly identify the product that the tanks is contain.

5. Fill the unit according to the “warm tank” procedure.

PURGING PROCEDURES

MTU tanks are shipped from the factory pressurized with nitrogen gas, regardless of the product service for which they are intended. To prevent contamination of the product, when the tank is filled with a product other than nitrogen, the inner vessel and all piping on the tank must be purge with the gas in which the tank will be filled. Purging is also required whenever the tank is converted from one product service to another. There are differences in the recommended purge procedures depending on the gasses involved.

NOTE: the purge procedures described below are intended to remove unwanted gas from the tank so that the purity of the product with which the tank is filled will not be degraded. Purity specifications, along with the analytical equipment / methods used to determine the effectiveness of the purging operation, are the responsibility of the user.

Purging for Oxygen Service. – Before filling a tank with oxygen after it has contained nitrogen or argon, purge with oxygen as follows:

1. Check to be sure that the tank is empty. For best results, purge when tank is warm.

2. Blow tank pressure down to approximately 5 psig (0.3 bar / 0.4 kg/cm^2).

3. Introduce a small amount of liquid oxygen into the MTU unit through the LIQUID PHASE FILL VALVE (21). Stop filling when tank pressure reaches 250 psig (17.2 bar / 17.5 kg/cm^2).

4. Open all valves on the MTU unit, including the PRESSURE BUILDING and VALVES (17 & 20), to blow tank pressure down to about 5 psig (0.3 bar / 0.4 kg/cm^2). Close all valves on the MTU unit.

5. Analyze the product in the tank to determine its purity. If purity is below specifications, vent gas from the tank and retest until purity is acceptable.

6. Fill the MTU tank with liquid oxygen. Refer to “Filling Procedures”.

Purging for Nitrogen Service – Before filling a tank with nitrogen after it has contained oxygen or argon, purge with nitrogen as follows:

1. Check to be sure that the tank is empty. For best results, purge when tank is warm.

2. Below tank pressure down to approximately 5 psig (0.3 bar / 0.4kg/cm^2).

3. Introduce a small amount of liquid nitrogen into the MTU unit through the LIQUID-PHASE FILL VALVE (21). Stop filling when pressure reaches 250 psig (17.2 bar / 17.5 kg/c^2).

4. Open all valves on the MTU unit, including the PRESSURE BUILDING VALVES (17 & 20), to blow tank pressure down to about 5 psig (0.3 bar / 0.4 kg/cm^2). Close valves.

5. Analyze the product in the tank to determine its purity and moisture content.

6. If purity and moisture content are acceptable, fill the tank liquid nitrogen. If not, repeat Step 3, 4, and 5 until acceptable results are achieved.

Purging for Argon Service – Before filling the tank with argon, after it has contained nitrogen or oxygen, purge with argon gas as follows:

1. Check to be sure that tank is empty. For best results, purge while tank is warm.

2. Blow tank pressure down to about 5 psig (0.3 bar / 0.4 kg/cm^2).

3. Close ROAD RELIEF SHUTOFF VALVE (7) and open the PRESSURE BULDING VALVES (17 & 20).

4. Pressurize the tank to approximately 50 psig (0.3 bar / 0.4 kg/cm^2) with argon gas.

5. Wait one hour to assure thorough diffusion of the argon throughout the tank. Then, blow tank pressure down to approximately 5 psig (0.3 bar / 0.4 kg/cm^2) with all valves open.

6. Re-pressurize the tank with argon gas to about 50 psig (3.4 bar / 3.5 kg/cm^2). Wait 20 minutes then blow down to 5 psig (0.3 bar / 0.4 kg / cm^2) with all valves open.

7. Repeat step 6 until analysis indicates acceptable product purity. At least 8 to 10 pressurizing / venting cycles are required.

8. When purity testing indicates that the tanks has been effectively purged, fill the tank with liquid argon. Refer to “Filling Procedures”.

TAKING A TANK OUT OF SERVICE

When possible, schedule shutdown operation to coincide with low liquid level in the MTU Tank. If a large quantity of liquid is in the tank, drain it into another tank for use elsewhere or for disposal at a safe location. Small quantities of liquid can be vaporized by the PRESSURE BUILDING COIL (19) and vented through the BLOWDOWN VALVE (6) provided appropriate safety precautions are taken.

For shutdowns of short duration, retain residual liquid in tank. Close all valves except the GAUGE ISOLATION VALVES (13) and ROAD RELIEF SHITOFF VALVE (7).

For shutdowns of a prolonged duration, drain liquid product from tank. Open BLOWDOWN VALVE (6) and reduce tank pressure to 20 psig (1.3 bar / 1.4 kg/cm^2). Close the BLOWDOWN VALVE (6).

MAINTENANCE

Maintenance required usually becomes apparent from inspection of the system during operation. If equipment does not operate properly, stop work immediately and investigate cause of malfunction. Prompt action to correct any damage or malfunction is recommended. Keep a permanent log of all inspections, vacuum readings, and repairs performed. A sample form is shown below.

DATE	NATURE OF WORK (DESCRIPE IN FULL)	REMARKS	SERVICE MAN'S SIGNATURE

SAMPLE PAGE OF INSPECTION AND REPAIR LOG

Under no circumstances should any person attempt repairs for which they are not fully qualified. Field repairs to instruments and controls must be made by a qualified instrument specialist. Refer to Trouble-Remedy Guide section for troubleshooting assistance. Use only approved replacement parts which are cleaned for oxygen service. Obtain a copy of Cleaning Specification GS-38 from Customer Service Department, TAYLOR-WHARTON.

A list or replacement parts is supplied in the Replacement Parts List section of this manual. Provide complete ordering information such as Part Number, Description, and Quantity. Order parts directly from supplier indicated. When ordering parts that will be in contact with cryogenic fluids, specify that the parts must be cleaned for oxygen service and suitably packaged to prevent contamination. Minimum order from TAYLOR-WHARTON is $100.00. refer to Tools, Equipment, and Materials section for items required to perform maintenance. Supplier locations are specified in the Address List section. Maintenance instructions for specifications components follow.

Hand Valves

If packing leakage cannot be stopped by tightening packing nut, repack valve. Use either preformed or twisted Teflon filament packing, untwist Teflon and use only a single strand. Pack Teflon tightly, otherwise moisture will get into valve and freeze when valve is cold, making it impossible to operate the valve.

Control Valves

The following control valve disassembly and assembly procedures are for the ROAD RELIEF VALVE (8). Use these instructions in conjunction with Figure 5 when servicing these valves. The item numbers relate to Figure 5, part numbers shown are available from the A. W. Cash Valve Mfg. Corp.

Disassembly Instructions:

1. Loosen LOCKNUT (2) and turn PRESSURE SCREW (1) counterclockwise until there is no tension on the pressure spring.

2. Remove SPRING CHAMBER (4).

3. Remove SPRING BUTTON (3), PRESSURE SPRONG (5), and DIAPHARAGM STOP (10).

4. Lift diaphragm assembly from valve body.

5. Use soft-jaw pliers on the hex portion of the Seat Disc (14) and unscrew the PRESSURE PLATE NUT (8).

6. Remove LOCKWASHER (13), PRESSURE PLATE (9), DIAPHRAGMS (11), and DIAPHARAGM GASKET (12).

7. Remove Seat Ring (15).

Assembly Instructions:

When Control Valves are disassembled, replace the gaskets with new ones. Inspect diaphragms for cracks or other imperfections. Replace as required.

1. Thoroughly clean and dry all parts. Parts used in oxygen service must be cleaned to rigid specifications for that service.

2. Assemble diaphragm assembly as follows:

    a. If SEAT DISC (14) and SEAT RING (15) are replaced, use light lapping compound and lap ball end of seat disc to the beveled side of seat ring. Reclean and dry both parts after lapping.

    b. Place flat side of seat ring into body recess.

    c. Holding SEAT DISC (14) in one hand, place GASKET (18) over threaded end so that it rests on the flat side of disc.

    d. Place 4 DIAPHRAGMS (12) on top of gasket installed in step “c”. Arrange grain of metal in each diaphragm at right angle to the grain on adjacent diaphragm.

    e. Place PRESSURE PLATE (9), flat side against the DIAPHRAGMS (12) and LOCKWASHER (13) on top of PRESSURE PLATE (9).

    f. Thread PRESSURE PLATE NUT (8) onto Seat Disc. Using soft-jawed pliers on the hex portion of the seated disc, tighten the pressure plate nut until the lock-washer is completely compressed.

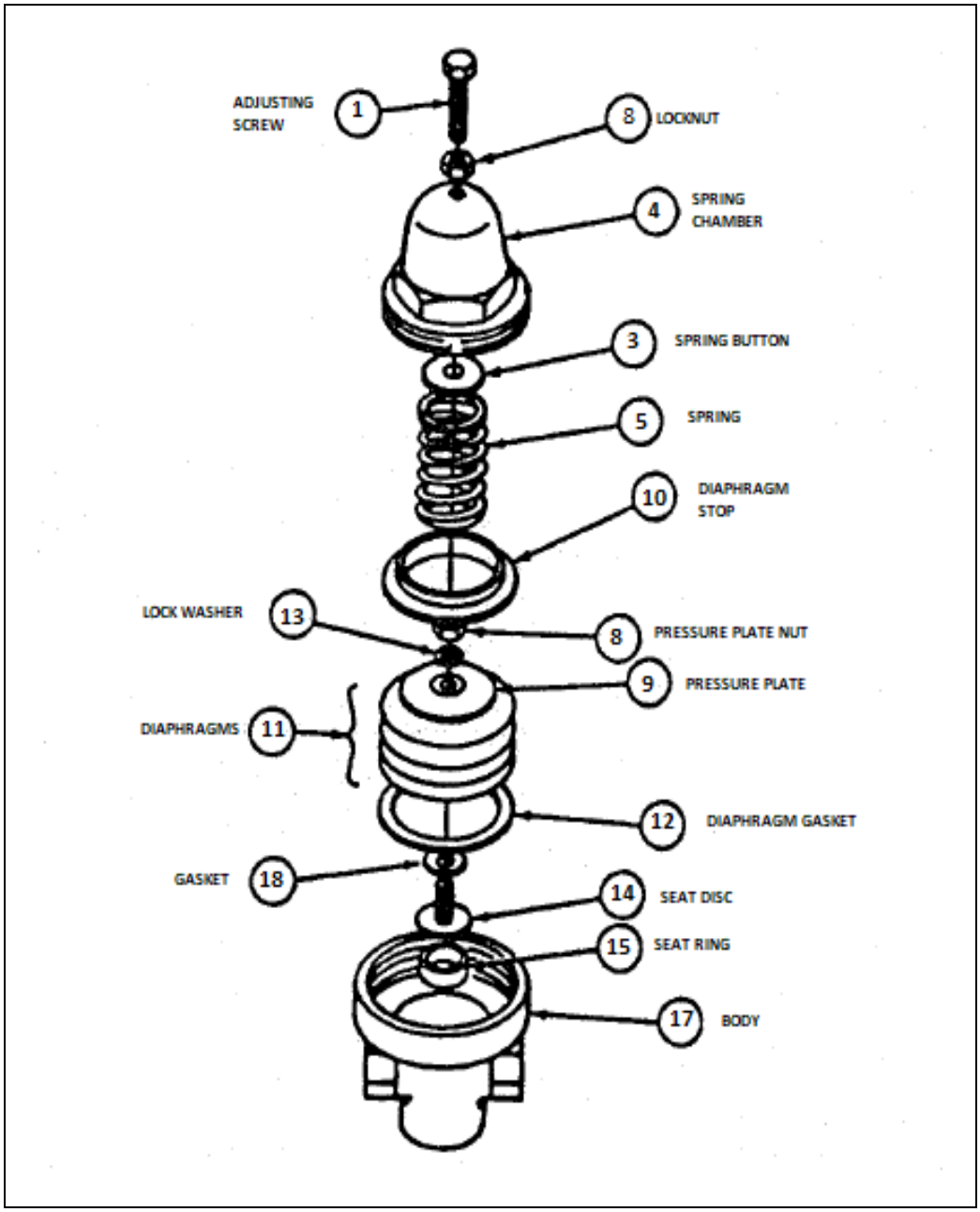
    g. Install DIAPHRAGM GASKET (12) into Body (17).

3. Install diaphragm assembly into body assembly making sure that diaphragms are seated against the flat face in the body below the threads.

4. Place the DIAPHRAGM STOP (10) on top of the diaphragm assembly. Install PRESSURE SPRING (5) and SPRING BUTTON (3).

5. Install SPRING CHAMBER (4) to BODY ASSEMBY (17).

6. Adjust valve for correct operating pressure by turning PRESSURE SCREW (1). Tighten LOCKNUT (2) to fix the adjustment.



Control Valve Assembly / Disassembly

Container Safety Devices

Replace INNER VESEL ORUPTURE DISC (12) annually. Observe standard practices to repair and reseat SAFETY RELIEF VALVE (11) and ROAD RELIEF VALVE (8).

Pressure and Contents Gauges

the major cause of a malfunctioning tank PRESSURE GAUGE (15) or CONTENTS GAUGE (16) is leakage in the gauge lines. Refer to the Trouble-Remedy Guide for maintenance procedures. If the problem persists, replace gauge with a spare. Field repair or recalibration is not recommended. Return the defective gauge to the manufacturer for repair. Include a description of the difficulty encountered.

Leak Testing

After making repairs requiring disassembly or part replacement, leak test all valves and piping joints that were taken apart and reconnected. Apply leak detector as recommended by manufacture to the test surface. Larger leaks instantly form large bubble clusters with very fine leaks forming white foam that builds up for 30 seconds or more.

Field Repainting

If repainting of tank is required, be sure to use material compatible with factory applied finish. The tank was originally painted with the following material:

PRIMER: High Solid Epoxy Coating

FINISH COAT: High Solids Urethane Coating

VACUUM MAINTENANCE

Checking Vacuum

Some vacuum deterioration may occur over an extended period of time due to outgassing of materials within the vacuum space or from leakage. A history of vacuum readings taken over a period of time can be valuable when evaluating tank performance and scheduling maintenance work.

To detect vacuum deterioration, periodic measurement of the tank vacuum is recommended. A thermocouple-type VACUUM GAUGE TUBE (3), is located on the rear head of the tank, is provided for this purpose.

To check tank vacuum, perform the following steps:

1. Remove the protective plastic cap from the gauge tube connector.

2. Connect a Hastings-Raydist Model TV-4A or VT-6 Vacuum Gauge to the GAUGE TUBE (3).

3. Open the VACUUM GAUGE VALVE (2) and wait at least 30 minutes before taking the vacuum reading.

4. After vacuum reading is recorded, close the VACUUM GAUGE VALVE (2), disconnect the Vacuum Gauge, and replace the protective cover on the GAUGE TUBE (3) connector.

The vacuum reading obtained on a cold tank is initially less than 50 microns (0.05 mm HG) absolute; however, gradual deterioration over an extended period of time is normal. A complete log of vacuum readings, along with dates when they were taken, can be very helpful in evaluating vacuum performance and scheduling maintenance work.

NOTE: If the tank is empty and warm, vacuum space pressure will tend to be high because of the release of adsorbed gases from the adsorbent material inside the vacuum space.

Because re-evacuation is time consuming and usually requires taking the tank out of service, it is not normally attempted until tank performance becomes unacceptable. Even a relatively high degree of deterioration can be tolerated in a tank from which high withdrawal is being made. However, if vacuum deterioration seriously affects tank operation by producing excessive pressure buildup and high loss rates, contact the factory for information about how to determine and correct the cause of the trouble.

Vacuum Gauge Tube

If the GAUGE TUBE (3) is damaged or is suspected of giving inaccurate readings, replace it as follows:

1. Make certain that the VACUUM GAUGE VALVE (2) is closed.

2. Unscrew the GAUGE TUBE (3) from the VALVE (2). Use 2 wrenches, one on the TUBE, one on the VALVE.

3. Clean the threads and opening of the VALVE (2)

NOTE: Do not use Teflon tape as a sealant on vacuum system fittings.

4. Thread the new TUBE (3) into the VALVE (2) by engaging one thread. Apply a suitable high vacuum sealant to the remaining exposed threads. Tighten the TUBE (3) into the VALVE (2), using 2 wrenches. Do not over tighten.

5. Install a new vinyl cover over the GAUGE TUBE (3) connector.

NOTE: If corrosion of the gauge tube is a problem at a particular location, spray the tube housing with "Krylon Crystal Clear Coating 1301" or equivalent acrylic spray. Do not spray the contact pins of the electrical connector; this could cause erroneous vacuum readings.

6. Check vacuum following the above described procedure. The waiting period to obtain a stable reading with a new gauge tube may exceed the specified 30 minutes. This is due to outgassing of the new gauge tube and the thread sealant.

Analyzing Vacuum Deterioration

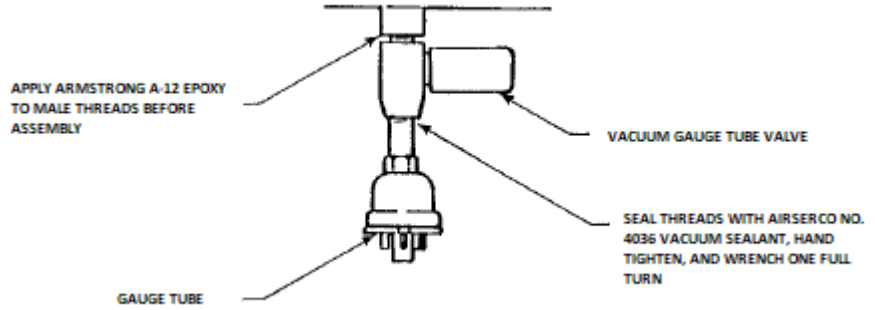
If you decide to re-evacuate because of slow deterioration over a long period of time, contact the factory for re-evacuation procedures. If vacuum deterioration occurs over a relatively short period of time and pressure is greater than 1,000micron (1mm Hg) absolute, suspect that a leak has developed in the external vacuum jacket of the tank. If deterioration is rapid and cause the OUTER VESSEL RELIEF DEVICE to function, suspect leakage from the pressure vessel or internal piping.

NOTE: An abnormally high vacuum reading without other evidence of vacuum loss (excessive pressure, rapid venting etc.) may be caused by a fault in the gauging equipment or by improper operation of the equipment. Be sure that the Vacuum Gauge and the GAUGE TUBE are in good condition and follow operating instructions carefully. Always be sure that the VACUUM GAUGE VALVE has been open for at least 30 minutes before taking a reading.

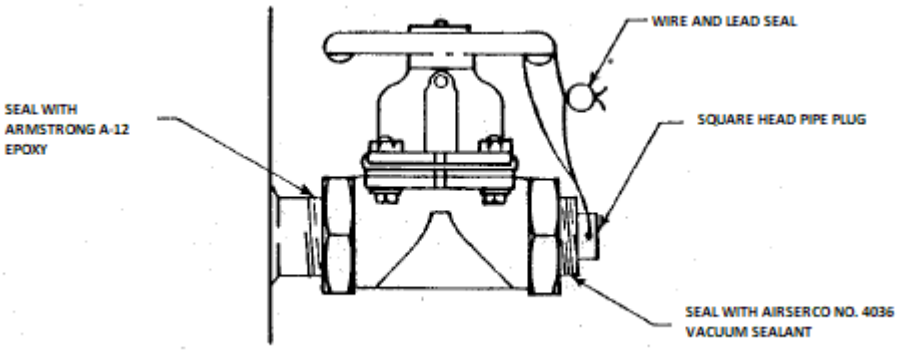
To try to determine the source of leakage in cases where the OUTER VESSEL RELIEF DEVICE has not functioned, visually inspect the following area in the order in which they are listed:

a. VACUUM GAUGE TUBE (3),
b. VACUUM GAUGE VALVE (2),
c. EVACUATION VALVE (4),
d. Sealed insulation ports (on top of the tank),
e. OUTER VESSEL RELIEF DEVICE (1),
f. All liquid and gas phase lines at exit point from outer vessel,
g. Any area of the vacuum jacket that might have been exposed to cryogenic spray or contact.

Look for sign of damage, corrosion, or operated valves, and other abnormal conditions. Contact the factory for repair and r
e-evacuation procedures.

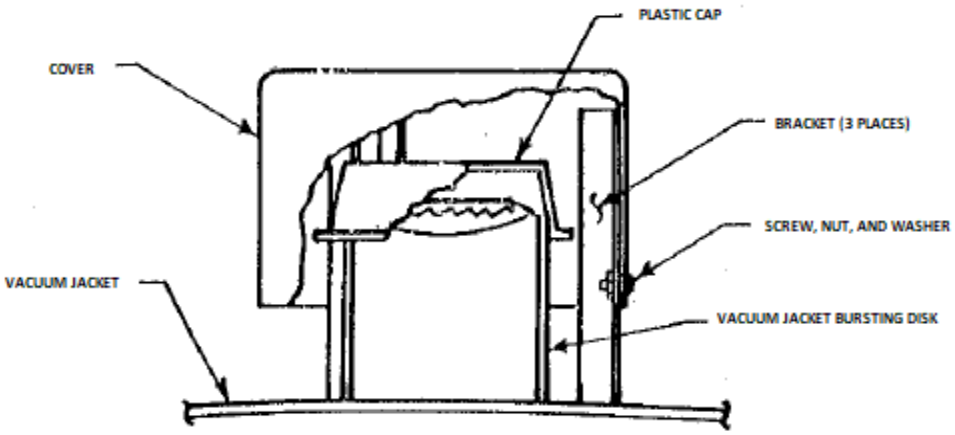


VACUUM GAUGE TUBE



EVACUATION VALVE

CAUTON: WHEN INSPECTION BURSTING DISK, REMOVE PLASTIC CAP SLOWLY AND CAREFULLY TO PREVENT DAMAGE TO DISK. SUCTION COULD PULL DISK UP AGAINST KNIFE POINTS AND RUPTURE IT.



VACUUM JACKET BURSTING DISK

Vacuum Systems Components

TROUBLE REMEDY GUIDE

Use the following guide for troubleshooting a tank. Refer to Flow Diagram for item identification and the Functional Description and Maintenance Section of this manual. Observe all safety precautions in this manual and the reference publication.

Trouble Remedy Guide				
Symptom	**Possible Causes**		**Suggested Remedy**	
Failure to maintain tank at desired pressure	a	Road relief valve (8) or container safety relief valve leaking or frozen open.	a	Thaw out valve or replace if necessary. Refer to Step 4, this section.
	b	Container bursting disk (12) ruptured.	b	Replace container bursting disk.
	c	Piping leaks to atmosphere.	c	Soap test repair leaks.
	d	Excessive product withdrawal.	d	Install higher capacity pressure building coil.
	e	Improper filling procedure	e	Refer to filling instructions in Operation section
	f	Low liquid level	f	Refill tank
Excessive Tank Pressure	a	Extensive shutdown time.	a	No remedy.
	b	Low withdrawal rate.	b	No remedy.
	c	Low insulation space vacuum.	c	Refer to Step 6, this section.
	d	Improper filling procedure.	d	Refer to filling instructions in Operation section.
	e	Malfunction of tank pressure gauge (15).	e	Replace pressure Gauge.
	f	Lack of refrigeration caused by low liquid level.	f	Refill tank.
	g	Leaking valve(s) in P.B. circuit	g	Repair or replace leaking valve(s).
Erratic or Erroneous Contents Gauge Reading	a	Leaking Gauge lines.	a	Soap test and repair leaks.
	b	Gauge needle stuck.	b	Tap contents gauge slightly. Inspect needle and bend if necessary.
	c	Gauge not zeroed.	c	Refer to Pressure and Contents Gauge section.
	d	Gauge damaged or faulty.	d	Replace contents gauge.
Leaking Safety Valve	a	Dirt or ice under valve disk	a	Thaw valve or replace if necessary.
	b	Improper valve setpoint.	b	Replace valve.
	c	Damaged valve seat or disk.	c	Replace valve.
Ruptured container bursting disk (12)	a	Excessive tank pressure.	a	Refer to Step 2, this section. Replace container bursting disk.
	b	Defective container bursting disk.	b	Replace container bursting disk.
	c	Atmospheric corrosion and / disk failure.	c	Replace container bursting disk.
	d	Interior disk corrosion.	d	Blow out safety device line. Replace container bursting disk.
	e	Improper rupture disk installed.	e	Install correct container bursting disk.
Tank Vacuum Leak	a	Ruptured casing bursting disk.	a	Refer to Analyzing Vacuum Deterioration section. Replace bursting disk.
	b	Evacuation valve (4) leak.	b	Replace evacuation diaphragm. Re-evacuate insulation space per Re-Evacuation Procedures section.
	c	Vacuum gauge tube (3) or vacuum gauge tube valve (2) leak.	c	Replace faulty component. Re-evacuate insulation space per Re-evacuation procedures section.
	d	Tank casing leak.	d	Refer to Analyzing Vacuum Deterioration section.
	e	Positive pressure space in insulation caused by container or internal piping leak; but not enough to rupture casing bursting disk.	e	Refer to Analyzing Vacuum Deterioration section.
Inability to obtain desired vacuum when Re-evacuating	a	Defective vacuum pump.	a	Repair or replace.
	b	Incorrect vacuum reading.	b	Repeat vacuum measurement. Refer to Casing Vacuum Maintenance Section.
	c	Defective vacuum probe (3).	c	Replace vacuum gauge probe (3).
	d	Leak in connections between pump and vacuum jacket.	d	Repair leaks.
	e	Excessive moisture in insulation.	e	Evacuate insulation space with cold trap on pump suction line.
	f	Moisture in pump	f	Replace lubricant. If condition persists, use cold trap on pump section.

TOOLS, EQUIPMENT, AND MATERIAL LIST

A list of tools, equipment, and materials recommended for tank maintenance is shown below.

REFERENCE	DESCRIPTION	PART NUMBER	SOURCE
All Hand Valves	Twisted Teflon Filament Packing	4936-9000	Taylor-Wharton Cryogenics
All Piping	Snoop Liquid Leak Detector	-	Nupro Company
Vacuum Gauge Tube	Krylon Crystal Clear Coating	1301	Borden
	Vacuum Gauge	TV-4A, VT-6	Teledyne Hastings-Raydist
	Lilquid High Vacuum Sealant 4oz.	4036	Airserco Mfg. Co.
	Epoxy	A-12	Armstrong Prod.
Vacuum Jacket Relief Device	Celevacene Grease	-	Consolidated Vacuum Corp.
	Chlorothen VG	-	Dow Chemical Co.

REPLACEMENT PART LIST

Order replacement parts from TAYLOR-WHARTON. Follow ordering procedure describe in the Maintenance section of this manual.

REPLACEMENT PARTS LIST		
Flow Diagram Number	**Part Number**	**Description**
1	9902-7330	Casing Bursting Disk
2	612921	Globe Valve 1/8” x 1/8” W / Filter
3	5740-8470	Thermocouple Gauge Tube, 0-1000 microns
4	8545-0151	Vacuum Valve 1-1/2”
5, 24	610738	Globe Valve 3/8” ODT 400 psi WOG
6, 20	8544-2686	Gate Valve 1-½”
7	8544-2280	Gate Valve ½”
8	2100013	Back Pressure Valve, ½”
11	2100011	Safety Valve ¾” MNPT x 1” FNPT 275 psig
12	8516-3795	Safety Head 1.0” 3000 psi
13,16	2100014	Rupture Disk 350 psig
14	223301	Globe Valve .25” MPT
15	909688	Contents Gauge 0-100”
17	5714-3750	Pressure Gauge 4.5” Dial 0-400#
21, 22	8544-4700	Gate Valve ¾” 400 psi WOG
23	8544-4577	Glove Valve 1-1/2”
	611253	Relief Valve .25” 400 psi
	2206052	Flow Diagram
	2100511	Contents Chart