INSTRUCTIONS MANUAL

FOR
SCS 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.

TABLE OF CONTENT

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.*

SAFETY PRECAUTIONS FOR CARBON DIOXIDE

WARNING

Carbon Dioxide can cause asphyxiation and death in confined, poorly ventilated areas. Cold Carbon Dioxide gas can cause severe frostbite to the eyes or skin. Do not touch frosted pipes or valves. If accidental exposure 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 WORK AREA WELL VENTILATED

Carbon dioxide affects the important acid-base balance in the body. Carbon dioxide is formed from normal functioning of 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 causes unconsciousness; twenty five percent may cause death if exposure lasts for several hours. Carbon dioxide cannot be detected by human senses and will be inhaled like air. 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.

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. 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.

GROUP ALL PIPING

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

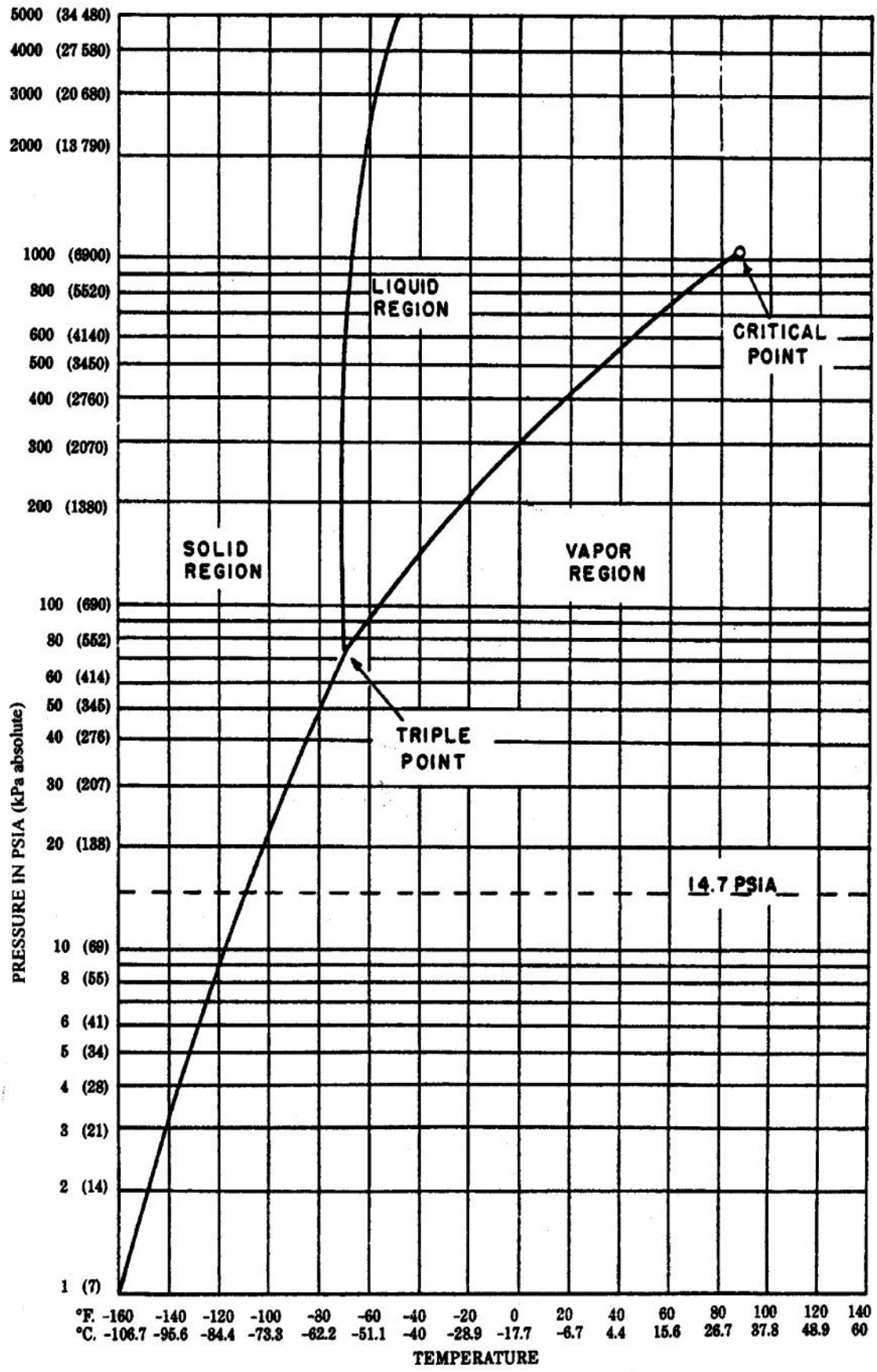
NOTE: *For additional information of properties of carbon dioxide and proper handling refer to CGA pamphlets G-6, "Carbon Dioxide" and G-6.1, "Standard for Low Pressure Carbon Dioxide Systems at Consumer Sites". These publications are available from the Compressed Gas Association, 1235 Jefferson Davis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

PROPERTIES OF CARBON DIOXIDE

Under normal atmospheric conditions, Carbon Dioxide exists as a colourless, odourless gas, which is about 1.5 times heavier than air.

When confined to a storage tank, carbon dioxide can exist in any three states of matter; SOLID, LIQUID and GAS; depending on pressure. The point at which all three states may exist is 75 psia [60.4 psig (4 bar)]. This is the triple point. At temperatures and pressure below these values, carbon dioxide may either be a solid or a gas, depending on the conditions.

At temperatures and pressures above the triple point, carbon dioxide liquid with overlaying gas may exist in equilibrium within a closed vessel.


5000 (34 480)
4000 (27 580)
3000 (20 680)
2000 (13 790)
1000 (6900)
800 (5520)
600 (4140)
500 (3450)
400 (2760)
300 (2070)
200 (1380)
100 (690)
80 (552)
60 (414)
50 (345)
40 (276)
30 (207)
20 (138)
10 (69)
8 (55)
6 (41)
5 (34)
4 (28)
3 (21)
2 (14)
1 (7)
PRESSURE IN PSIA (kPa absolute)
LIQUID REGION
SOLID REGION
VAPOR REGION
CRITICAL POINT
TRIPLE POINT
14.7 PSIA
°F. -160 -140 -120 -100 -80 -60 -40 -20 0 20 40 60 80 100 120 140
°C. -106.7 -95.6 -84.4 -73.3 -62.2 -51.1 -40 -28.9 -17.7 -6.7 4.4 15.6 26.7 37.8 48.9 60
TEMPERATURE

SAFETY PRECAUTIONS FOR NITROUS OXIDE

Nitrous oxide is a gas, which has no colour, taste, and practically no odour. It is obtained by the thermal decomposition of ammonium nitrate, which yields nitrous oxide and water. Due to the toxic impurities produced in this process, the water is condensed out and the gas is passed through scrubbing towers to remove impurities.

EXTREME COLD - COVER EYES AND EXPOSED SKIN -

Accidental exposure or contact with skin or eyes can cause severe frostbite. Avoid contact with cold piping and equipment. Protect eyes with goggles or shield, especially if there is a possibility of liquid ejection or if cold gas may issue forcefully from equipment. Keep skin covered at all times.

KEEP WORK AREA WELL VENTILATED.

Due to the difficulty of detecting nitrous oxide's presence, there is eminent danger of loss of consciousness and physical inability to function if exposed to low levels of this gas, and death by asphyxiation if exposed to medium or high levels. Since nitrous oxide is a non-toxic gas, these hazards are created when life-supporting oxygen is displaced. The American Conference of Governmental Industrial Hygienist (ACGIH) in it's "Threshold Limit Valves & Biological Exposure Indices for 1989-1990" recommends a 50 ppm threshold limit value - Time Weighted Exposure Limit (TLV-TWA). It is imperative to maintain a well-ventilated work environment to minimize the danger from a leaking system or activated safety relief device.

DANGER OF EXPLOSION

Nitrous oxide is non-flammable but, as with oxygen, ignition of combustible materials may occur more readily in a nitrous oxide-enriched atmosphere. Nitrous Oxide decomposes exothermically under conditions of high temperature and pressure. If sufficient heat is added, the decomposition can be self-sustaining and, with high temperature and pressure, nitrous oxide can explode. Open flame and smoking are strictly prohibited.

Note: *For more detailed information concerning safety precautions and safe handling of nitrous oxide, consult CGA pamphlet G-8.1, "Standard for Nitrous Oxide at Consumer Sites", and CGA pamphlet G-8.2 "Commodity specification for Nitrous Oxide". These publications are available from the Compressed Gas Association, 1235 Jefferson Davis Highway, Arlington, VA 22202.*

LIMITED WARRANTY AND LIABILITY

Taylor Wharton Malaysia Sdn Bhd 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 Sdn Bhd** 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 Sdn Bhd 's** written instructions. Taylor-Wharton **Malaysia Sdn Bhd** 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 Sdn Bhd** 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 Sdn Bhd**'s liability exceed the purchase price for the product.

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

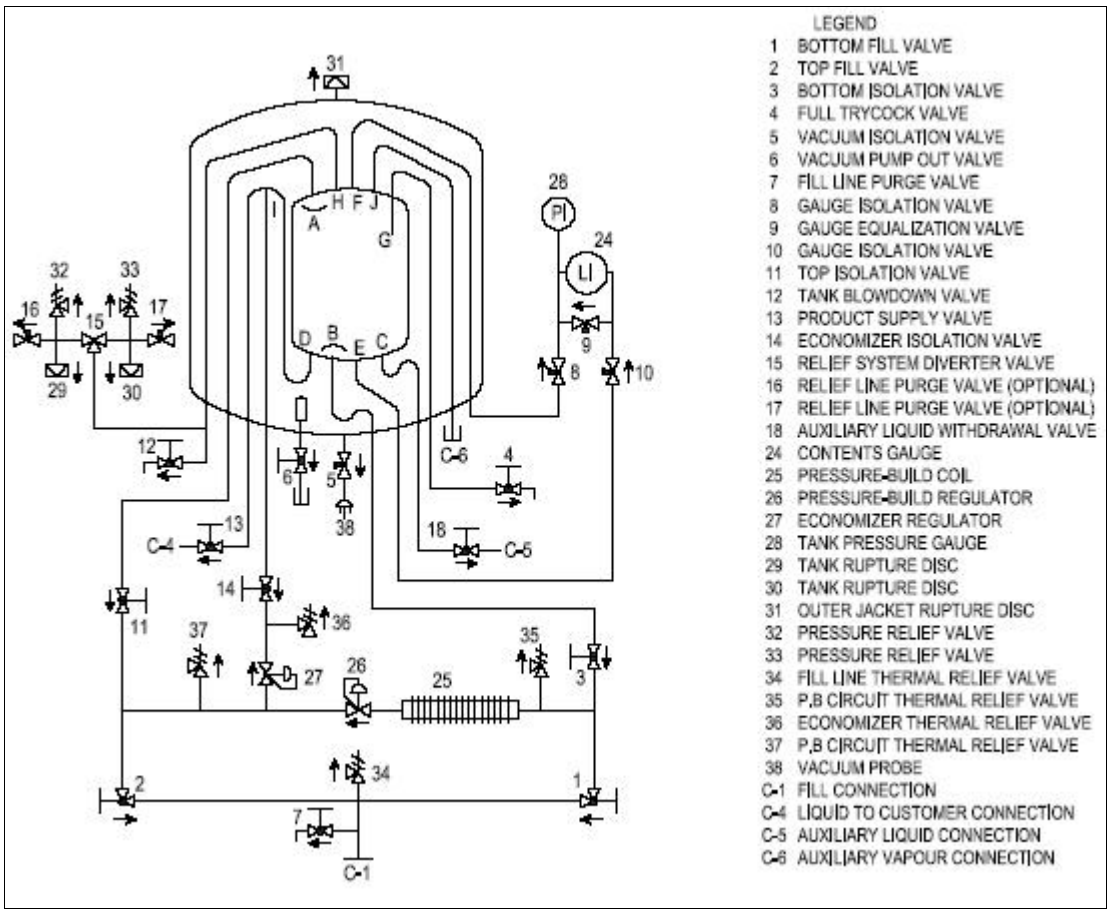
This warranty is voided by alterations or repairs of others. Taylor-Wharton **Malaysia Sdn Bhd** shall not be liable under this warranty, or otherwise, for defects caused by negligence, abuse or misuse of this product, corrosion, fire, heat, or the effects of normal tear. Any related components or other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

Taylor-Wharton **Malaysia Sdn Bhd**'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

These instructions are for experienced operators only. If you are not fully familiar with the principles of operations 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.



General Reference - Piping Schematic Diagram for Standard Tank
(Detail P&ID shall be referred to General Arrangement Drawing)

FUNCTIONAL DESCRIPTION

Tank Construction

SCS Series tanks are vertical tank with a maximum allowable working pressure range from 10 bar to 37 bar. The pressure vessel is suspended inside a vacuum jacket and insulated with perlite powder under high vacuum. The liquid and gas phase lines to the pressure vessel pass through the lower head of the vacuum jacket. All piping is designed to withstand the stresses caused by expansion and contraction of the pressure vessel, its supports system and piping itself.

The pressure vessel is designed and constructed in accordance with the AD-Merkblatter Code. The inner vessel is constructed of stainless steel 1.4301 (DIN 17440), and the piping is stainless steel. The vacuum jackets and leg supports are made of structural steel.

The insulation space between the pressure vessel and the vacuum jacket is filled with perlite powder insulation and evacuated to a high vacuum through an VACUUM PUMP OUT VALVE (6), which is permanently sealed at a factory. Insulation space vacuum is measured in the field by connecting a vacuum gauge to the VACUUM PROBE (38) that is located on the lower head of head of the tank. The VACUUM PROBE (38) is isolated from the vacuum jacket by a VACUUM ISOLATION VALVE (5).

Refer Piping Schematic Diagram for valve reference numbers and location.

Piping

The tank is filled with product through the FILL CONNECTION (C-1) and two extended stem FILL VALVES (1 AND 2). One FILL VALVE is connected to the top of the pressure vessel and the other to the bottom of the pressure vessel. Filling through the TOP FILL VALVE (2) tends to reduce tank pressure, while filling through the BOTTOM FILL VALVE (1) tends to increase tank pressure. The TANK BLOWDOWN VALVE (12) is opened for venting and throttled to maintain desired tank pressure during filling. The FULL TRYCOCK VALVE (4) is used to determine fill termination.

Product is normally withdrawn through the siphon withdrawal line as a liquid, which flows through the PRODUCT SUPPLY VALVE (13). During operation when the TOP ISOLATION VALVE (11) is open and tank pressure exceeds the set-point of the PRESSURE REDUCING REGULATOR (ECONOMIZER), gas will flow from the top of the tank through the PRESSURE BUILD COIL (25) and the PRESSURE REDUCING REGULATOR (ECONOMIZER) and back into the tank where it connects with the VAPORIZER INLET LINE. When tank pressure falls below the PRESSURE REDUCING REGULATOR (ECONOMIZER) set-point, withdrawal from the tank is automatically switched from the liquid phase to the gas thereby supplying the pipeline with gas that would otherwise be vented to the atmosphere.

AUXILARY LIQUID WITHDRAWAL CONNECTION (C-5) is also provided on the tank.

Instrumentation

Tank pressure is indicated by a PRESSURE GAUGE (28). Product level is indicated on the CONTENT GAUGE (24). Tubing with THREE VALVE MANIFOLD connects the gauges to the storage tank. The CONTENT GAUGE is calibrated.

Pressure Controls

The pressure building system provides a mean of maintaining tank pressure at a constant preset value during product withdrawal. This system operates when the BOTTOM ISOLATION VALVE (3) and TOP ISOLATION VALVE (11) are open. Withdrawing product from the tank reduces the tank pressure and when the tank pressure decreases to the PRESSURE BUILD REGULATOR (26) set-point, the REGULATOR opens and liquid flows through the BOTTOM ISOLATION VALVE (3) to the PRESSURE BUILD VAPORIZER (25). The coil vaporizes the liquid product and tank pressure is then increased by allowing this gas product to return to the top of the tank. When tank pressure increases above the REGULATOR set-point, the PRESSURE BUILD REGULATOR closes and the pressure building process stops. Normal REGULATOR set-point is 5 psig (0.34 bar / 34 kPa) above the desire tank delivery pressure.

Safety Devices

INNER VESSEL

Two safety valves are connected with change over (Diverter) valve containing two interchangeable pressure chambers. The bursting head/Rupture disc is a secondary safety device.

Section Relief Valves

Are installed at the tank final piping assembly at all parts where liquid may be trapped especially between two isolation valves.

OUTER VESSEL

The outer vessel is protected against internal overpressure by vacuum safety rupture disc or lifting plate.

Optional Equipment

A FILL CONNECTION (C-1) may be ordered from the factory. Gas service must be specified.

A factory installed tank mounted 2000 SCFH CAPACITY VAPORIZER may be order with the SCS3400, SCS6000 or SCS8600.

A factory installed tank mounted LEVEL GAUGE with electrical switched is available for installations requiring low and high liquid level protection. Gauge switches can be wired to sound an alarm, or light indicator lamps on either low or high liquid levels.

INSTALLATION

Handling

Dimension and connection data for each SCS-Tank can be found on the General Arrangement Drawing supplied with the tank and included in this manual. Additional copies of the drawing may be requested from the factory. Please include information on the tank model number and part number in making requests for these drawing. The drawing part number is listed in Specification chart in this manual.

Tank installation is the customer's responsibility. The tank is shipped in the horizontal position on wooden cradles, which must be removed prior to erection of the tank. Make certain the foundation used for the tank is designed for the conditions at the installations site, and that it is suitable for the tank weight. Refer to local codes for recommended foundation specifications. Employ experienced personnel to move and install the tank. Ensure the rigging equipment has adequate rated capacity to handle the tank weight listed in the specifications. This tank must be shipped and lifted empty, and with a warm inner vessel.

CAUTION: ***To prevent possible tip over, do not leave the tank standing upright unless it is on a specified foundation or other surface capable of supporting its weight. Loading on the tank legs is great enough to cause them to sink into most surfaces other than reinforced concrete.***

Installation Checks

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

1. Tanks are shipped pressurized with nitrogen gas at 20 psig (1.38 bar / 138 kPa). Open the gauge TOP ISOLATION VALVE and read tank pressure indicated on the PRESSURE GAUGE. Record the "as received" tank pressure. Close the TOP ISOLATION VALVE.

   Tank pressure may change due to temperature variations, accidental opening of valves, packing leaks, or minor leaks at the FILL CONNECTION. If a positive pressure is not indicated on the PRESSURE GAUGE and no repairable leaks are found, contact the factory in accordance with conditions specified in the tank warranty.

2. Check insulation space vacuum by connecting a Hasting-Raydist Model TV-4A or VT-6 vacuum gauge to the tank VACUUM PROBE. Open the tank VACUUM ISOLATION VALVE, wait 30 minutes before taking a reading for accurate result.

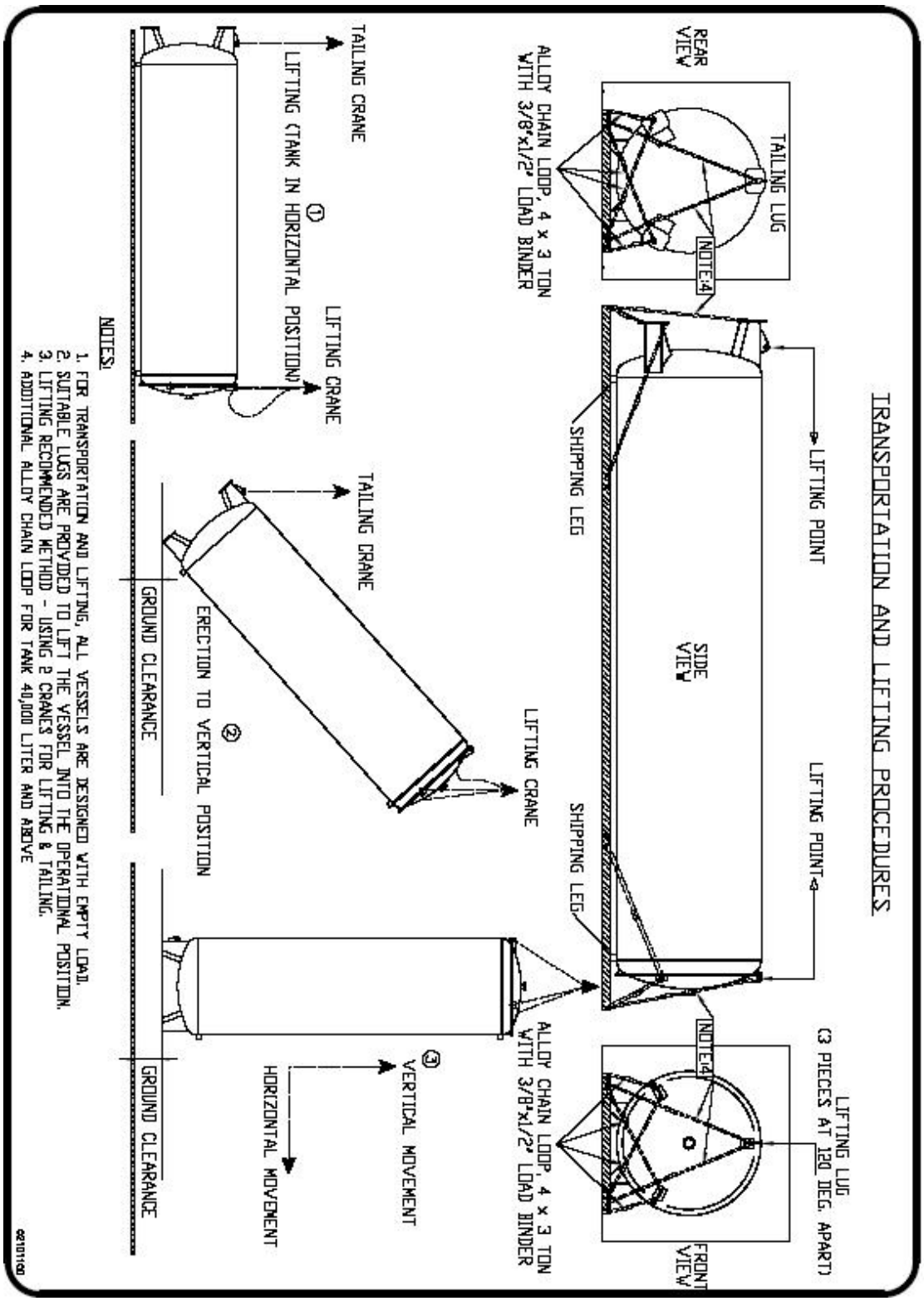
3. Attach a tag to the tank PRESSURE GAUGE indicating the normal operating pressure range of the tank. This information enables an operator to monitor tank pressure during tank filling, and to prevent pressure oversets caused by improper fill procedures.

Customer Installed Equipment / Piping

When installing vaporizing and control equipment, be sure to follow accepted design practices for cryogenic equipment. All equipment must be cleaned for oxygen service. Be sure to include pressure relief valves in all piping where liquid product could be trapped between closed valves, regulators, etc.

Designing safe and effective cryogenic system requires extensive knowledge and experience. Persons lacking the necessary skills are urged to seek competent advice before attempting to design cryogenic systems.

TRANSPORTATION, LIFTING AND ERECTION OF TANK



OPERATION

These instructions are for experience operators. Before operating a storage tank become thoroughly familiar with the safety precautions in this manual and in reference publications. Make certain all applicable provisions set forth in the Installation section have been followed before placing a tank in operation. Study the Flow Diagram, Tank Elevation and Bottom View on the applicable General Arrangement Drawing in the Appendix section of this manual and the Functional Description section of this manual. Know the location and function of all tank components.

Purge Procedure

Before placing a tank in service, determine the level of purity in the pressure vessel. If pressure vessel contents purity is unacceptable, perform a product purge to reduce the contaminants. The following procedure is recommended for most application:

1. Attach the liquid purge product source to tank FILL CONNECTION (C-1). Product delivery pressure should be approximately 100 psig (6.9 bar / 690 kPa).

   CAUTION: ***A positive pressure must always be maintained in the tank during the purge procedure to prevent drawing atmospheric contaminants back into the tank.***

2. Close all valves except THREE VALVE MANIFOLD (8,9,10), BOTTOM ISOLATION VALVE (3) AND TOP ISOLATION VALVE (11).

3. Open TANK BLOWDOWN VALVE (12) and vent inner vessel to 5 psig (0.34 bar/34 kPa) as indicated on the tank PRESSURE GAUGE (28). Close TANK BLOWDOWN VALVE (12).

4. Open BOTTOM FILL VALVE (1) slightly to allow liquid to flow slowly into bottom of tank. Flow must be gradual enough to allow the liquid to vaporize in the bottom fill line and PRESSURE BUILD COIL (25) so the pressure builds up in the inner vessel. Momentarily open TOP FILL VALVE (2) to flood the exposed section of line, then close valve.

5. When tank PRESSURE GAUGE indicates maximum desired purge pressure, close the liquid supply source. Close BOTTOM ISOLATION VALVE.

6. Cautiously open the LIQUID WITHDRAWAL VALVE to drain all liquid from the tank. The valve should be opened slowly to avoid splashing of liquid. When vapour appears from the valve, all liquid has been drained from the tank.

7. Close the LIQUID WITHDRAWAL VALVE.

8. After liquid has drained from the tank, close THREE VALVE MANIFOLD (8, 9, 10). The EQUALIZATION VALVE (9) should be opened just before closing THREE VALVE MANIFOLD to prevent damage to the LEVEL GAUGE.

9. Loosen the adapters on both sides of the LEVEL GAUGE. Fully open THREE VALVE MANIFOLD and visually check the resultant gas streams for signs of moisture. Vent these lines for approximately two minutes. If no moisture is evident, close the THREE VALVE MANIFOLD. If moisture is evident, continue venting until the stream is free of moisture.

NOTE: *Be careful when opening the gauges valves since some residual liquid may have remained in tank or the instrument lines.*

10. Open PRODUCT SUPPLY VALVE (13) to check for moisture as in Step 9.

11. Open TANK BLOWDOWN VALVE (12) and FULL TRYCOCK VALVE (4).

12. Repeat purge procedures 2 through 11 until an acceptable product purity is achieved.

13. Reconnect the LEVEL GAUGE, open THREE VALVE MANIFOLD and close EQUALIZATION VALVE.

14. After completion of tank purge, make sure that all valves are closed except the THREE VALVE MANIFOLD.

Filling a Warm Tank for Liquid Nitrogen, Oxygen and Argon

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

1. Close all valves except the tank THREE VALVE MANIFOLD.

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

3. Connect supply source fill hose to tank FILL CONNECTION. Make certain connection is leak tight.

   NOTE: *The tank was pressurized at the factory with nitrogen gas. If it is to be filled with any product, the nitrogen gas must be purged from the tank. Purge with product gas until analysis indicates an acceptable purity. Use the steps outlined in the Purge Procedure section above as a guide.*

4. Open TANK BLOWDOWN VALVE and FULL TRYCOCK VALVE. Vent tank pressure to about 5 psig (0.34 bar / 34 kPa). Close TANK BLOWDOWN VALVE but leave FULL TRYCOCK VALVE open.

5. Fully open TOP FILL VALVE to fill tank as rapidly as possible.

6. Monitor tank pressure on tank PRESSURE GAUGE. If tank pressure rises to within 90% of tank MAIN SAFETY VALVE setting, close tank TOP FILL VALVE and stop fill immediately. Open tank BLOWDOWN VALVE and vent tank pressure to at least 50 psig (3.45 bar / 345 kPa) below MAIN SAFETY VALVE set-point. Close tank BLOWDOWN VALVE. Open tank TOP FILL VALVE and resume filling.

7. When liquid spurts from tank FULL TRYCOCK VALVE, close supply source valve to stop fills. Close tanks FULL TRYCOCK VALVE.

8. When residual liquid in the fill hose vaporizes, close tank TOP VALVE.

   CAUTION: ***To avoid injury, do not touch fill house or connections with bare hands. During filling, these parts are cooled to extremely low temperatures.***

9. Relieve fill hose pressure.

10. When pressure is released disconnect fill hose.

Filling a Cold Tank for Liquid Nitrogen, Oxygen, and Argon

Perform the following steps to fill a tank containing liquid product or one that has been recently emptied but still cold.

NOTE: Make certain the TOP AND BOTTOM FILL VALVES are closed.

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

2. Connect supply source fill hose to tank FILL CONNECTION. Make certain connection is leak tight.

3. Open supply source liquid delivery valve.

4. Fully open tank BOTTOM FILL VALVE to start tank fill. Open tank TOP FILL VALVE one turn. Adjust the two FILL VALVES as required to maintain normal tank operation pressure as shown on tag attached to tank PRESSURE GAUGE.

   NOTE: Filling through the BOTTOM FILL VALVE will increase tank pressure since gases in the vapor space are compressed, whereas filling through the TOP FILL VALVE decreases tank pressure since gases in the ullage (vapor) space are cooled and re-liquefied.

5. Open tank FULL TRYCOCK VALVE when tank LEVEL GAUGE indicates ¾ full.

6. When liquid spurts from tank FULL TRYCOCK VALVE, close supply source delivery valve to stop fills. Close tank BOTTOM FILL VALVE and FULL TRYCOCK VALVE.

7. When residual liquid in the fill hose vaporizers, close tank TOP FILL VALVE.

   CAUTION: To avoid injury, do not touch fill hose or connections with bare hands. During filling, these parts are cooled to extremely low temperatures.

8. Relieve fill hose pressure. When pressure is released, disconnect fill hose.

Filling a Cold Tank for Liquid Carbon dioxide

Perform the following steps to fill a tank containing liquid product or one that has been recently emptied but still cold.

1. Attach a liquid fill line from the supply trailer to the *FILL CONNECTION*, and a gas phase line from the trailer to the *VENT VALVE* connection on the tank.

2. Open the trailer gas phase valve and the tank *VENT VALVE* and wait until both the tank and the trailer pressure gauges reach the same pressure.

3. Open the *BOTTOM FILL VALVE AND BOTTOM ISOLATION* valve on the tank and the corresponding trailer valve. Start the pump and observe the *CONTENT GAUGE* during transfer for fill termination.

CAUTION ***DO NOT OVER FILL.***

4. When transfer is complete as indicated by the *CONTENT GAUGE,* stop the pump, close *BOTTOM ISOLATION VALVE* and liquid valve at the transfer truck, then close the VENT VALVE and gas phase valve at the transfer truck.

5. Blow down the transfer lines and disconnect from storage tank.

Normal Operation

During normal operation, tank pressure forced liquid through the siphon withdrawal line and the LIQUID WITHDRAWAL VALVE to the user'' pipeline or to external vaporizer and to the user pipeline. To compensate for lowering of tank pressure as product is withdrawn, the PRESSURE BUILDING REGULATOR allows a regulated amount of liquid to flow by gravity to the PRESSURE BUILDING VAPORIZER. Vaporized liquid is returned to the tank to provide the driving force for uninterrupted pipeline withdrawal. During periods when the withdrawal rate is low and tank pressure rises above the PRESSURE REDUCING REGULATOR (ECONOMIZER) set-point, the economizer circuit becomes operational. Liquid withdrawal is interrupted and gas flows through the PRESSURE REDUCING REGULATOR (ECONOMIZER) and its supplying the pipeline with gas that would otherwise be vented to the atmosphere.

To prepare the tank for normal product withdrawal, open the following valves:

LIQUID PHASE VALVE,
THREE VALVE MANIFOLD,
LIQUID WITHDRAWAL VALVE.

All other valves should be closed.

Taking a Tank Out of Service

Schedule the shutdown operation to coincide with low liquid level in the tank. If a large quantity of liquid in the tank, drain it into a trailer for use elsewhere or for disposal at a safe location. For tanks so equipped, small quantities of liquid can be vaporized by the PRESSURE BUILDING VAPORIZER and vented through the VENT VALVE, provided appropriate safety precautions are taken.

For shutdowns of a short duration, retain residual liquid in the tank. Close all valves except the tank THREE VALVE MANIFOLD.

For shutdowns of a prolonged duration, perform the following steps for the appropriate service.

Tanks in Oxygen Service

1. Drain liquid product from tank. Open tank BLOWDOWN VALVE and reduce tank pressure to atmospheric. Close tank BLOWDOWN VALVE.
2. Connect a source of warm nitrogen gas to tank FILL CONNECTION. Admit nitrogen purge gas through tank BOTTOM ISOLATION VALVE. Vent tank through TANK BLOWDOWN VALVE. Two or three times during purge, close tank BLOWDOWN VALVE and build tank pressure to about 10 psig (0.7 bar / 70 kPa). Release pressure and continue purge.
3. Open tank TRYCOCK VALVE and check exit gas with a nitrogen gas analyzer. Allow one hour between samples reading for the gas to adequately mix. Discontinue purge when only nitrogen gas is indicated. Close tank TRYCOCK VALVE.
4. Close tank BLOWDOWN VALVE. Build tank pressure to 20 psig (1.4 bar / 140 kPa). Close tank BOTTOM ISOLATION VALVE. Disconnect nitrogen gas hose from tank FILL CONNECTION.
5. Warm tank inner vessel before shipping to a new location.

Tanks in Nitrogen / Argon Service

1. Drain liquid product from tank. Open tank BLOWDOWN VALVE and reduce tank pressure to 2 psig (0.14 bar / 14 kPa). Close tank BLOWDOWN VALVE.
2. Warm tank inner vessel before shipping to a new location.

MAINTENANCE

General

The need for maintenance usually becomes apparent from inspection of the tank before filling, routine observation during and filling and indications of improper operation. Typical trouble indications would be unusually high or low tank or pipeline pressure, leakage from valves or piping connections and excessive venting through relief valves. Prompt action to correct damage or malfunction is required to assure readings and repairs performed. Keep a permanent log of all inspections, vacuum readings, and repairs performed. Such a log can be valuable in evaluating tank performance and scheduling maintenance.

Inspection and Repair Log (Sample Form)

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

Always observe the safety precautions at the front of this manual and follow the instructions given in this section. Before working on the tank or piping system, isolate the piping section to be repaired from the tank, and relieve pressure on the component or piping.

Do not allow unqualified persons to attempt repairs on this equipment. Field repairs to instruments and controls must be made by a qualified instrument specialist. Refer to Trouble-Remedy Guide in this manual for assistance in troubleshooting.

Make certain all parts that will come in contact with cryogenic liquid or gaseous product have been cleaned for in conformance with CGA Pamphlet G-4.1, "Cleaning Equipment for Oxygen Service," or other equivalent standard. If parts are purchased cleaned for oxygen service, they should be suitably packaged to prevent contamination.

WARNING: ***For O_2 System Users: Residue of leak detectors can be flammable. All surfaces to which the leak detector solution has been applied must be adequately rinsed with potable water to remove all traces of residue. Reference CGA G-4.4 Section 4.9.***

Leak Test

After making repairs requiring disassembly or replacement, leak test all valves or piping joints that were taken apart and reconnected. Apply leak detector to the test surface per the component manufacturer's instructions. Large leaks instantly indicate from large bubble clusters, while fine leaks produce white foam that builds up more slowly. All leaks must be repaired and re-tested before the tank is returned to service.

Hand Valves

The most common trouble with manual valves will be leakage at the stem packing. Packing leaks are usually indicated by ice emerging from the packing gland or retainer threads. If tightening cannot stop packing leakage, replace packing. Use preformed packing, which can be ordered from the valve manufacturer.

Control Valves

This tank has two automatic valves that control operating pressure.

The PRESSURE BUILDING REGULATOR opens on falling tank pressure and closes on rising pressure.

The PRESSURE REDUCING REGULATOR (ECONOMIZER) is a backpressure device that opens on rising tank pressure and closes on falling pressure.

The factory set Pressure Building Regulator for respective tanks maximum allowable working pressures are as follows:

10 bar service pressure	8 bar
17.2 bar service pressure	10 bar
24 bar service pressure	20 bar
37 bar service pressure	32 bar

The factory settings of the control valves may be field adjusted. The PRESSURE REDUCING REGULATOR (ECONOMIZER) should be set to open at a pressure above the shut-off pressure of the pressure building circuit. The standard opening pressure is set 1 bar above the PRESSURE BUILDING REGULATOR.

Before attempting repair of either the control valves, isolate and depressurize the valves by closing the BOTTOM ISOLATION VALVE and the TOP ISOLATION VALVE. Carefully loosen the compression fitting between the ECONOMIZER and the ECONOMIZER CHECK VALVE. Turn the PRESSURE REDUCING REGULATOR (ECONOMIZER) set screw counterclockwise to the end of its adjustment. Loosen the pressure RELIEF VALVE in the line between the PRESSURE BUILDING REGULATOR and the BOTTOM ISOLATION VALVE. This will release any pressure in the line. When repairs are complete, re-tighten the

RELIEF VALVE and COMPRESSION FITTING, pressure test all joints that were disassembled.

Order replacement parts from the valve manufacturer. Be sure to give all information on the valve nameplate, including the factory part number, to ensure receiving the correct parts for these special valves.

Resetting Control Valves

Use the following procedures to change control valve setting or to readjust the valves after completing repairs requiring disassembly of the valves.

The PRESSURE BUILDING REGULATOR should be set so that tank pressure is held about 5 psig (0.34 bar / 34 kPa) above the desired delivery pressure. The PRESSURE REDUCING REGULATOR (ECONOMIZER) should be set at least 15 psig (1.03 bar / 103 kPa) above the setting of the PRESSURE BUILDING REGULATOR, but has always be chosen below the permissible operating pressure (set 2 bar below). If both controls are to be reset, set the PRESSURE BUILDING REGULATOR before setting the PRESSURE REDUCING REGULATOR (ECONOMIZER).

Note: The tank must contain liquid for setting control valves. The PRESSURE REDUCING REGULATOR (ECONOMIZER) must be adjusted while a product is being withdrawn through the product withdrawal line.

Setting PRESSURE BUILDING REGULATOR:

1. If the tank pressure is below desired setting: Loosen pressure screw locknut on REGULATOR. With BOTTOM ISOLATION VALVE and TOP ISOLATION VALVE open, gradually open REGULATOR by turning pressure screw in (clockwise) to build tank pressure to 5 psig (0.34 bar / 34 kPa) above the desired delivery pressure. Note that the pressure screw must be adjusted in small increments, allowing sufficient time for tank pressure to stabilize each time screw is turned. When desired set point is reached, tighten pressure screw locknut.

2. If tank pressure is above desired setting: Loosen pressure screw locknut and turn pressure screw out (counterclockwise) to end of adjustment range. Open TANK BLOWDOWN VALVE and vent until tank pressure is 5 psig (0.34 bar / 34 kPa) above the desired delivery pressure. With BOTTOM ISOLATION VALVE and TOP ISOLATION VALVE open slowly turn pressure screw in (clockwise) until REGULATOR just opens as indicated by cooling of downstream pipe (at REGULATOR outlet). Tighten pressure screw locknut.

Setting PRESSURE REDUCING REGULATOR (ECONOMIZER):

1. Loosen PRESSURE REDUCING REGULATOR (ECONOMIZER) pressure screw locknut and turn pressure screw in (clockwise) to end of adjustment range. Check that the TOP ISOLATION VALVE is open.
2. a. If tank pressure is below desired set point: Build pressure by opening both fill valves. Note that the fill connection must be securely blanked off. As tank pressure increases to desired set-point – at least 15 psig (1.03 bar / 103 kPa) above setting of PRESSURE BUILDING REGULATOR – close the BOTTTOM FILL VALVE. When liquid in line vaporizers, close the TOP FILL VALVE.
   b. If tank pressure is above desired set-point: Open TANK BLOWDOWN VALVE and vent until tank pressure is a desired set-point – at least 15 psig (1.03 bar / 103 kPa) above setting of PRESSURE BUILDING REGULATOR.
3. With tank pressure at desired PRESSURE REDUCING REGULATOR (ECONOMIZER) set-point, slowly turn pressure screw out (counterclockwise) until valve opens as indicated by cooling of pipe between PRESSURE REDUCING REGULATOR (ECONOMIZER)

Inner Vessel and Piping Safety Devices

The inner vessel is protected by a MAIN SAFETY VALVE acting as a primary relief device and a TANK RUPTURE DISC acting as a secondary relief device.

If an TANK RUPTURE DISC ruptures, determine and correct the cause of the rupture before replacing the device. This device should be replaced annually as a preventive maintenance procedure. The TANK RUPTURE DISC on this tank is a sealed assembly of which membrane must be replaced as a unit.

A MAIN SAFETY VALVE that leaks or fails to operate at the set pressure should be replaced immediately. Only experienced personnel with proper equipment should do repair and recalibration of this valve.

Replace RELIEF VALVES when leakage or improper functioning occurs. Do not attempt to repair or test these components since they are meant to be disposable.

Pressure Gauge and Liquid Level Indicator

The major cause of malfunctioning tank PRESSURE GAUGE or CONTENT GAUGE is an open EQUALIZATION VALVE or leakage in the gauge lines. Refer to the Trouble-Remedy Guide in this manual for maintenance procedures. If the problem is not readily corrected, replace the gauge with a spare. Field repair and recalibration of CONTENT GAUGE is not recommended. Return the defective gauge to the manufacturer for repair. Include a description of difficulty encountered.

VACUUM MAINTENANCE

Checking Vacuum

Taylor-Wharton cryogenic tanks are carefully design, manufactured, and tested with every effort made to eliminate vacuum space leakage. An absorbent system is sealed inside the casing to help maintain the vacuum over a long period of time. However, some vacuum deterioration over time can be expected due to out-gassing of materials inside the vacuum space. To detect vacuum deterioration, periodic measurement of casing vacuum is recommended. A thermocouple-type-VACUUM PROBE, located on the bottom head of the tank, is provided for this purpose.

To check vacuum:

1. Remove the protective plastic cap from the gauge tube connector.
2. Connect a Hasting-Raydist Model TV-4A or VT-6 Vacuum Gauge to the gauge tube.
3. Open the gauge tube isolation valve and wait at least 30 minutes before reading the vacuum gauge.
4. After the vacuum reading is recorded, close the isolation valve, disconnect the vacuum gauge and replace the protective cover back on the gauge tube connector.

The vacuum reading obtained on a cold tank is initially less than 100 microns (0.1 mm Hg) absolute; however, gradual deterioration over a period of many years is normal. Complete logs of vacuum readings, along with dates when they were taken, can be very helpful in evaluating vacuum performance and scheduling work.

Note: If the tank is empty and warm, vacuum space pressure will tend to be high because of the release of gases from absorbent package 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 rate, contact the factory for information about how to determine and correct the cause of the trouble.

VACUUM PROBE

If the gauge tube is damaged or is suspected of giving inaccurate reading, replace it as follows:

1. Make certain that gauge tube isolation valve is closed.

2. Unscrew the gauge tube from the valve. Use two wrenches, one on the tube, one on the valve.

3. Clean the threads and opening of the valve.

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

4. Thread the new gauge tube into the valve by engaging one thread. Apply Airserco high vacuum sealant to remaining exposed threads. Tighten tube into valve, using two wrenches. Do not over tighten.

5. Install a new vinyl cover over the gauge tube connector.

NOTE: If corrosion of the gauge tube is a problem, spray the tube housing with "Krylon Crystal Clear Coating 1304" or equivalent acrylic spray. Do not spray the contact pins of the electrical connector; this could cause erroneous vacuum readings.

6. Check vacuum following previously described procedure. The waiting period to obtain a stable reading with a 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 and pressure is greater than 1,000 microns (1 mm Hg) absolute, suspect that a leak has developed in the external vacuum jacket of the tank. If deterioration is rapid and causes the TANK RUPTURE DISC to rupture, it is suspect leakage from the liquid container or internal piping.

NOTE: An abnormally high vacuum reading without other evidence of vacuum loss (excessive pressure, rapid venting, etc), maybe 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 good condition and follow operating instructions carefully. Always be sure that the gauge tube valve has been open for at least 30 minutes before taking a reading.

Try to determine the source of leakage in cases where the OUTER JACKET RUPTURE DISC has not rupture, visually inspect the exterior of the outer vessel. Check the following areas in the order in which they are listed:

a. Vacuum probe,
b. Vacuum isolation valve,
c. Vacuum pump out valve,
d. Vacuum jacket inner tank bursting head,
e. All liquid and gas phase line at exit point from vacuum jacket,
f. Any area of the vacuum jacket that might have been exposed to cryogenic liquid spray or contact.

Look for signs of damage, corrosion operated valves and other abnormal conditions. Make repairs to any suspicious area and proceed with re-evacuation.

PAINTING

If repainting the tank is required, be sure to use materials that are compatible with the factory-applied finish. The tank was painted with the following materials:

Primer: Hempel-Hempadur mastic 45881.
Base no. 45889, Curing Agent no. 95881

Finish Coat: Hempel-Hempathane Enamel 55100
Base no. 55109, Curing Agent no. 95370

Safety Precautions Pertaining To Painting Operations

All paint components contain volatile solvents, mainly petroleum distillates, alcohols, xylene. Normal precautions for flammable materials should be observed including exclusion of heat, sparks and open flame. Containers should be grounded before pouring.

All the ingredients present physiological hazards both from inhalation and absorption through the skin. Breathing of the vapour and spry mist must be avoided. Protective clothing including rubber gloves must be worn. Allergy-prone individuals may be sensitised and should not be exposed to isocyanates.

MOVING THE TANK

Purged and warmed tank prior to removal and shipping. The tank must not be shipped cold because the internal supports are not designed to withstand the shipping loads when the tank is cold. Refer to rigging information in “Installation” section when relocating the tank.

TROUBLE-REMEDY GUIDE

TROUBLE	POSSIBLE CAUSE	REMEDY
1. Tank pressure too low	a. Pressure vessel main safety valve leaking or frozen open.	a. Thaw out valve or replace if necessary. Refer to step 4 of this section.
	b. Inner tank bursting head rupture.	b. Replace inner tank bursting head. Refer to step 5 of this section.
	c. Piping leaks to atmosphere.	c. Test and repair tank.
	d. Low liquid level.	d. Refill tank.
	e. Strainer clogged.	e. Clean or replace strainer screen as required.
	f. Excessive product withdrawal.	f. Install higher capacity pressure building vaporizer.
	g. Improper filling procedure.	g. Refer to filling instruction in operation remedy.
2. Excessive tank pressure	a. Extensive shutdown time.	a. No remedy.
	b. Low withdrawal rate.	b. No remedy.
	c. Malfunction of pressure building regulator.	c. Refer to step 3 of this section.
	d. Malfunction of tank pressure gauge.	d. Replace pressure gauge.
	e. Lack of refrigeration caused by low liquid level.	e. Refill tank.
	f. Malfunction of back pressure valve.	f. Refer to step 3 of this section.

3. Malfunction of back pressure valve	a. Improper valve set point. b. Dirt on valve seat or valve component.	a. Check valve set point reset if required, follow in resetting control valves section. b. Disassemble, inspect, clean and reassemble per instruction of manufacturer.
4. Erratic or erroneous liquid level indicator readings	a. Leaking gauge line. b. By-pass valve open. c. Contents gauge needle stuck. d. Contents gauge needle not zero adjusted. e. Gauge line reversed. f. Contents gauge damaged or faulty. g. Plugged gauge line.	a. Test and repair leaks. b. Close by-pass valve. c. Tap contents gauge slightly. Inspect needle and bend as required. d. Adjust as required. e. Connect properly. f. Replace contents gauge. g. Disconnect lines at contents gauge and test for flow.
5. Leaking main safety valve	a. Dirt or ice under valve or disc. b. Improper valve set point. c. Damaged valve seat or disc.	a. Thaw out valve; replace if necessary. b. Replace valve. c. Replace valve.

6. Rupture inner tank bursting head	a. Excessive tank pressure.	a. Refer to step 2 of this section. Replace inner tank bursting head.
	b. Defective inner tank bursting head.	b. Replace inner tank bursting head.
	c. Atmosphere corrosion and/or disc fatigue.	c. Replace inner tank bursting head.
	d. Interior disc corrosion.	d. Blow out safety device line. Replace inner tank bursting head.
	e. Improper inner tank bursting head.	e. Install correct inner tank bursting head.
7. Tank vacuum leak	a. Leak in vacuum jacket relief device.	a. Refer to analyzing vacuum. Deterioration section. Replace relief valve.
	b. Evacuation connection leak.	b. Replace evacuation connection diaphragm. Re-evacuate insulation space per re-evacuation procedures section.
	c. Vacuum probe or vacuum valve leak.	c. Replace faulty component. Re-evacuate insulation space per re-evacuation procedure section.
	d. Tank vacuum jacket leak.	d. Refer to analyzing vacuum deterioration section.

8. Inability to obtain desired vacuum when re-evacuating	a. Defective vacuum pump.	a. Repair or replace vacuum pump.
	b. Incorrect vacuum reading.	b. Repeat vacuum measurement.
	c. Defective vacuum probe.	c. Replace vacuum probe.
	d. Leak in connections between vacuum pump and vacuum jacket.	d. Repair leaks.
	e. Excessive moisture in insulation.	e. Evacuate insulation space with cold trap on pump suction.
	f. Moisture in pump lubricant.	f. Replace lubricant.

RECOMMENDED TOOLS, EQUIPMENT AND MATERIALS

Components in the "Reference" column are provided to indicate where various tools, equipment and material are used.

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

REPLACEMENT PARTS

Order replacement parts from Taylor-Wharton Malaysia Sdn. Bhd., Shah Alam or the prime manufacturer. All replacement part must be cleaned for oxygen service before installation on the tank. If ordering from the prime manufacturer, provide the Taylor-Wharton part number and all identifying information with part being serviced. Refer to tank Flow Diagram in Illustration section. Please refer to next attachments for the replacement parts list.

Process and instrumentation components

SCS3400 to SCS8600

Pos	Description	Manufacturer	Material	Size	Model	Part no.
1	Main Safety	HEROSE	Bronze	½“ x 1”	06388	40128401
2	Pressure Building regulator	Cash Acme	Bronze	1/2” FNPT	TYPE B	85362675
3	Shut off valve in pressure reducing system	Herose	Stainless steel	3/8”	Globe valve	40240802
4	Pressure reducing system, Economizer	Cash Acme	Bronze	3/8” FNPT	FRM-2	50195101
5	Tank Rupture Disc	OSECO	Nickel	½”	STD	615245
6	Tank Blowdown Valve	Herose	Stainless steel	1“	Globe Valve	40240906
7	Vacuum Isolation valve	HOKE	Brass	1/8” FNPT	Bellows sealed	518697
8	Vacuum probe	Teledyne	Stainless steel	1/8” MNPT	DV-6R	57408470
9	Pressure Building Vaporizer	Cryoquip	Aluminium	1”	Ambient	
10	Product Withdrawal/vaporiser inlet valve	Herose	Stainless steel	1”	Globe valve	40240906
11	Three Valve manifold	WIKA	Stainless steel	¼” FNPT	Needle	-
12	Pressure gauge	WIKA	Stainless steel	¼” FNPT	232.50.100, G1/2B	-
13	Contents Gauge	WIKA	Stainless steel	¼” FNPT	732.51.2170	-
14	Fill relief valve	REGO	Brass	¼” MNPT	PVRT19432T350	587695
15	Fill connection	-	Stainless steel	1”	SORF	401216100
16	Bottom fill valve	Herose	Stainless steel	1 ½“	Angle Globe	61520008
17	Bottom isolation valve	Herose	Stainless steel	1”	Globe	40240906
18	Trycock valve	REGO	Brass	3/8”	9453 DA	01298262
19	Top fill valve	Herose	Stainless steel	1 1/2”	Angle Globe	61520008
20	Top isolation Valve	Herose	Stainless steel	1”	Globe	40240906
21	Vacuum Pump out valve	Diaphragm	Cast Iron	1 ½” FNPT	Diaphragm	85450151
22	Outer Jacket Rupture Disc	TWI	Nickel	4”	Bursting Disc	99027330
23	Relief system diverter valve	Herose	Bronze	1”	Ball valve	40240920
24	Economizer relief valve	REGO	Brass	¼” MNPT	PVRT19432T350	587695
25	Safety line purge valve	Swagelok	Brass	¼” MNPT	B4JN-SC11	85443725
26	Auxiliary Product Withdrawal	Herose	Stainless steel	1”	Globe	40240906
27	Fill line purge valve	REGO	Brass	3/8”	9453 DA	02198262
28	Pressure regulator relief valve	REGO	Brass	¼” MNPT	PVRT19432T350	587695
29	Vapour return connection	TWA	Stainless steel	¾”	Welded cap	-

SCS11000 and above

Pos	Description	Manufacturer	Material	Size	Model	Part no.
1	Main Safety	HEROSE	Bronze	½“ x 1”	06388	40128401
2	Pressure Building regulator	Cash Acme	Bronze	1/2” FNPT	TYPE B	85362675
3	Shut off valve in pressure reducing system	Herose	Stainless steel	3/8”	Globe valve	40240802
4	Pressure reducing system, Economizer	Cash Acme	Bronze	3/8” FNPT	FRM-2	50195101
5	Tank rupture disc	OSECO	Nickel	1”	STD	02200744
6	Tank blowdown valve	Herose	Stainless steel	1“	Globe Valve	40240906
7	Vacuum Isolation valve	HOKE	Brass	1/8” FNPT	Bellows sealed	518697
8	Vacuum probe	Teledyne	Stainless steel	1/8” MNPT	DV-6R	57408470
9	Pressure Building Vaporizer	Cryoquip	Aluminium	1”	Ambient	-
10	Product Withdrawal/vaporiser inlet valve	Herose	Stainless steel	1“	Globe Valve	40240906
11	Three Valve manifold	WIKA	Stainless steel	¼” FNPT	Needle	-
12	Pressure gauge	WIKA	Stainless steel	¼” FNPT	232.50.100, G1/2B	-
13	Contents gauge	WIKA	Stainless steel	¼” FNPT	732.51.2170	-
14	Fill relief valve	REGO	Brass	¼” MNPT	PVRT19432T350	587695
15	Fill connection	-	Stainless steel	1 ½ ”	SORF	4200600
16	Bottom fill valve	Herose	Stainless steel	1 ½ “	Anglr Globe	61520008
17	Bottom isolation valve	Herose	Stainless steel	1 ½ ”	Globe	40240840
18	Over flow valve	REGO	Brass	3/8”	9453 DA	01298262
19	Top fill valve	Herose	Stainless steel	1 ½ ”	Angle Globe	61520008
20	Top Isolation Valve	Herose	Stainless steel	1 ½ ”	Globe	40240840
21	Evacuation connection	Diaphragm	Cast Iron	1 ½” FNPT	Diaphragm	85450151
22	Casing relief device	TWI	Stainless steel	6”	Lifting Plate	2200745
23	Relief System diverter valve	Herose	Bronze	1”	Ball valve	40240920
24	Economizer relief valve	REGO	Brass	¼” MNPT	PVRT19432T350	587695
25	Safety line purge valve	Swagelok	Brass	¼” MNPT	B4JN-SC11	85443725
26	Auxiliary Product Withdrawal	Herose	Stainless steel	1 ½ ”	Globe	40240840
27	Fill line purge valve	REGO	Brass	3/8”	9453 DA	02198262
28	Pressure regulator relief valve	REGO	Brass	¼” MNPT	PVRT19432T350	587695
29	Vapour return connection	TWA	Stainless steel	¾”	Welded cap	-

APPENDICES