TAYLOR-WHARTON

VJ Series

CO_2 / N_20 Bulk Storage Tanks

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

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TAYLOR-WHARTON GAS EQUIPMENT DIVISION harsco corporation

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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 buildup 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.*

SAFETY PRECAUTIONS FOR NITROUS OXIDED

WARNING: ***The following safety precautions are for your protection. Before performing installation, operation, 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 to adequately warn the user of the precautions and safe practices for the use of this equipment and the cryogenic fluid stored in it.***

Nitrous oxide is a gas, which has no color, taste, and practically no odor. 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 AN 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.*

INTRODUCTION

This manual provides information for the user to operate and maintain Taylor-Wharton Cryogenics VJ-Series Carbon Dioxide Storage Vessels. These tanks are primarily intended for liquid withdrawal at a normal operating pressure between 260 psig (18 bar/1793 kPa) and 320 psig (22 bar/2206 kPa), the maximum allowable working pressure is 350 psig (24 bar/2413 kPa). If your application requires the withdrawal of gaseous product, the flow rate must not exceed the ability of the tank to maintain a minimum pressure of 200 psig (14 bar/1379 kPa) at all times. The constant withdrawal of gaseous product at high flow rates will cause a decrease in tank pressure. This effect can be overcome by installing an electric pressure building vaporizer. Supply and return connections are provided on the tank to allow for the addition of this feature if required.

CAUTION: *To avoid irreparable damage to the structure of the tank, an internal pressure of no less than 200 PSIG (14 bar/1379 kPa) must be maintained at all times.*

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.

Tank specifications, flow diagram and an elevation with bottom view of the tank showing controls and piping may be found on the General Arrangement Drawings located in the back of this manual. Additional copies of these drawings may be obtained from the factory. Please include information on the tank model number and part number in making drawing requests. Tank Specifications, Rigging Details and Vacuum System Components are also shown in this manual.

PROPERTIES OF CARBON DIOXIDE

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

When confined to a storage tank, depending upon the pressure carbon dioxide can exist in any three states of matter; SOLID, LIQUID and GAS. 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.

FUNCTIONAL DESCRIPTION

TANK CONSTRUCTION

The pressure vessel is suspended inside the vacuum jacket and insulated with perlite powder. 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 support system, and the piping itself.

The pressure vessel is designed and constructed in accordance with the ASME Boiler and Pressure Vessel Code Section VIII, Division 1. The inner vessel is constructed of SA-612 normalized carbon steel and the piping is stainless steel. The vacuum jacket and support legs are made of structural grade carbon steel.

The insulation space between the pressure vessel and the vacuum jacket is filled with perlite powder and evacuated to a high vacuum through an EVACUATION VALVE (V-4) that is sealed at the factory. Insulation space vacuum is measured in the field by connecting a vacuum gauge to the VACUUM GAUGE TUBE (VR-1) located on the lower head of the tank. The VACUUM GAUGE TUBE (VR-1) is isolated from the vacuum jacket by a VACUUM GAUGE VALVE (V-3).

PIPING AND CONTROLS

The following paragraphs describe the operation of the main circuits of the VJ-CO2 bulk tanks. The descriptions refer to the main components of each circuit and are grouped by function. These component and circuit descriptions are pertinent to any of the tanks and should be read before attempting operation.

Fill

LIQUID FILL CONNECTION (CN-1) is a connector through which the tank is filled with liquid. It is connected to a line that connects to the bottom of the inner vessel.

LIQUID FILL VALVE (V-1) regulates flow of liquid through LIQUID FILL CONNECTION (CN-1) during a filling operation.

VAPOR EQUALIZATION CONNECTION (CN-2) is a connection where a hose is connected to the transport trailer during fill to allow equalization of tank and trailer pressures throughout the pump transfer. Presence of liquid product in this line indicates a full tank.

VAPOR EQUALIZATION VALVE (V-2) isolates VAPOR EQUALIZATION CONNECTION (CN-2) from the transport.

DRAIN VALVES (V-9A, V-9B) are provided to relieve transport hose pressure.

Liquid and Vapor Connections

Two liquid and two vapor connection are provided on the VJ-6, VJ-14, and VJ-26 tanks. Three liquid and two vapor connections are provided on the VJ-35 and VJ-50 tanks.

Instrumentation

LIQUID LEVEL GAUGE (LI-1) is a differential pressure gauge that indicates tank liquid level and is calibrated for lbs/tons of CO2.

PRESSURE GAUGE (PI) is a 0-600 psi gauge with 4-1/2" face. It is mounted beside the liquid level gauge.

INSTRUMENT EQUALIZATION VALVE (V-7) is used to equalize the pressure between the high and low-pressure sides of the contents gauge.

LIQUID PHASE ISOLATION VALVE (V-6) isolates contents and pressure gauges from the tank liquid (bottom) phase.

VAPOR PHASE ISOLATION VALVE (V-5) isolates contents and pressure gauges from the tank gas (top) phase.

Safety Relief

OUTER JACKET LIFT PLATE (R-1) protects the tank vacuum jacket from overpressure.

SAFETY RELIEF VALVES (SV-1A, SV-1B) provide overpressure protection for the pressure vessel. They will relieve excess tank pressure in the event that the maximum allowable working pressure of the tank is exceeded. Once activated, the valve will close when the pressure falls below 350 psig (24 bar/2413 kPa).

SAFETY RELIEF VALVE SELECTOR (V-10) permits the operation of one safety valve while the other is isolated. This arrangement prevents both valves from being isolated from the tank at the same time and permits maintenance of a valve without the need to vent tank pressure. To activate one valve while isolating the other move the selector valve handle all the way to the end of its travel toward the valve to be activated

BACK PRESSURE REGULATOR (PCV) automatically closes on falling tank pressure and opens on rising tank pressure to allow the tank to maintain a set pressure during periods of little or no usage. This valve is factory set at 325 psig (22 bar/2241 kPa).

ISOLATION VALVE (V-8) must be opened to activate the Back Pressure Regulator (PCV-1).

Refrigeration

An internal refrigeration coil is supplied as standard equipment on the VJ-6 ton and VJ-14 ton tanks. It has been sized to condense gaseous product produced by normal heat leakage into the tank. An optional one-half horsepower refrigeration condenser unit is available for these two sizes (see Appendix B).

The VJ-26, VJ-35, and VJ-50 ton tanks may be ordered with an optional internal refrigeration coil. It is suitable for connection to a one horsepower refrigeration condenser unit.

INSTALLATION

HANDLING

Tank installation is the customer's responsibility. The tank is shipped in the horizontal position and secured on wooden cradles. These cradles must be removed prior to erection of the tank. Make certain the foundation used for the tank is designed for the conditions at the installation 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 that 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 hard 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 (1.4 bar/138 kPa). Open the gauge ISOLATION VALVE (V-5) and read tank pressure indicated on the PRESSURE GAUGE (PI). Record the "as received" tank pressure. Close the ISOLATION VALVE (V-5). Tank pressure may change due to temperature variations, accidental opening of valves, packing leaks, or minor leaks at the fill connections. If a positive pressure is not indicated on the PRESSURE GAUGE (PI) 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 GAUGE TUBE. Open the tank VACUUM GAUGE VALVE (V-3), wait 30 minutes, and take a reading. If the "as received" vacuum (tank at ambient temperature) is greater than 100 microns (0.10 mm Hg) absolute, contact the factory

3. Remove shipping screws from all LIQUID LEVEL GAUGES that are equipped with adjustable level switches.

4. Attach a tag to the tank PRESSURE GAUGE (PI) indicating the normal operating pressure range of the tank. This information enables an operator to monitor tank pressure during a tank fill, and to prevent pressure upsets caused by improper fill procedures.

CUSTOMER INSTALLED EQUIPMENT/PIPING

External piping may employ carbon steel or stainless steel pipe. Liquid lines should be insulated with several inches of polyurethane insulation.

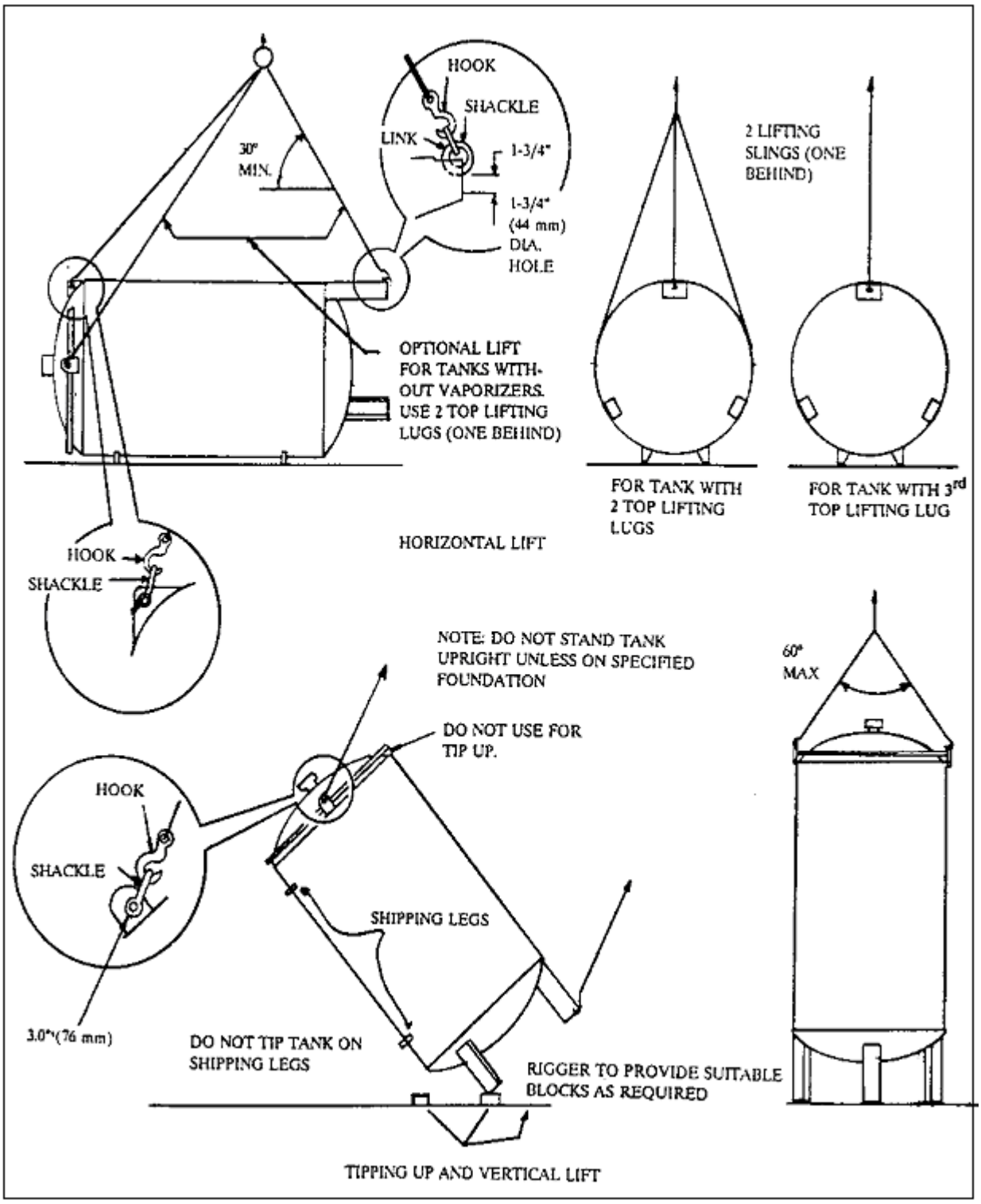
When installing vaporizing and control equipment, be sure to follow accepted design practices for your gas service. Be sure to include pressure relief valves in piping where liquid product could be trapped between closed valves, regulators, etc.

Designing safe and effective systems for handling liquefied gases requires extensive knowledge and experience. Persons lacking the necessary skills are urged to seek help from the manufacturer. Design and consultation services are available from the Customer Service Department.

WARNING: *To protect the purity of the pressure vessel, all tanks are shipped with a charge of nitrogen at 20 PSIG (1.4 bar/138 kPa). Before removing the pipe plugs for attachment of customer piping, the pressure vessel must be relieved to prevent personal injury to installation personnel*.

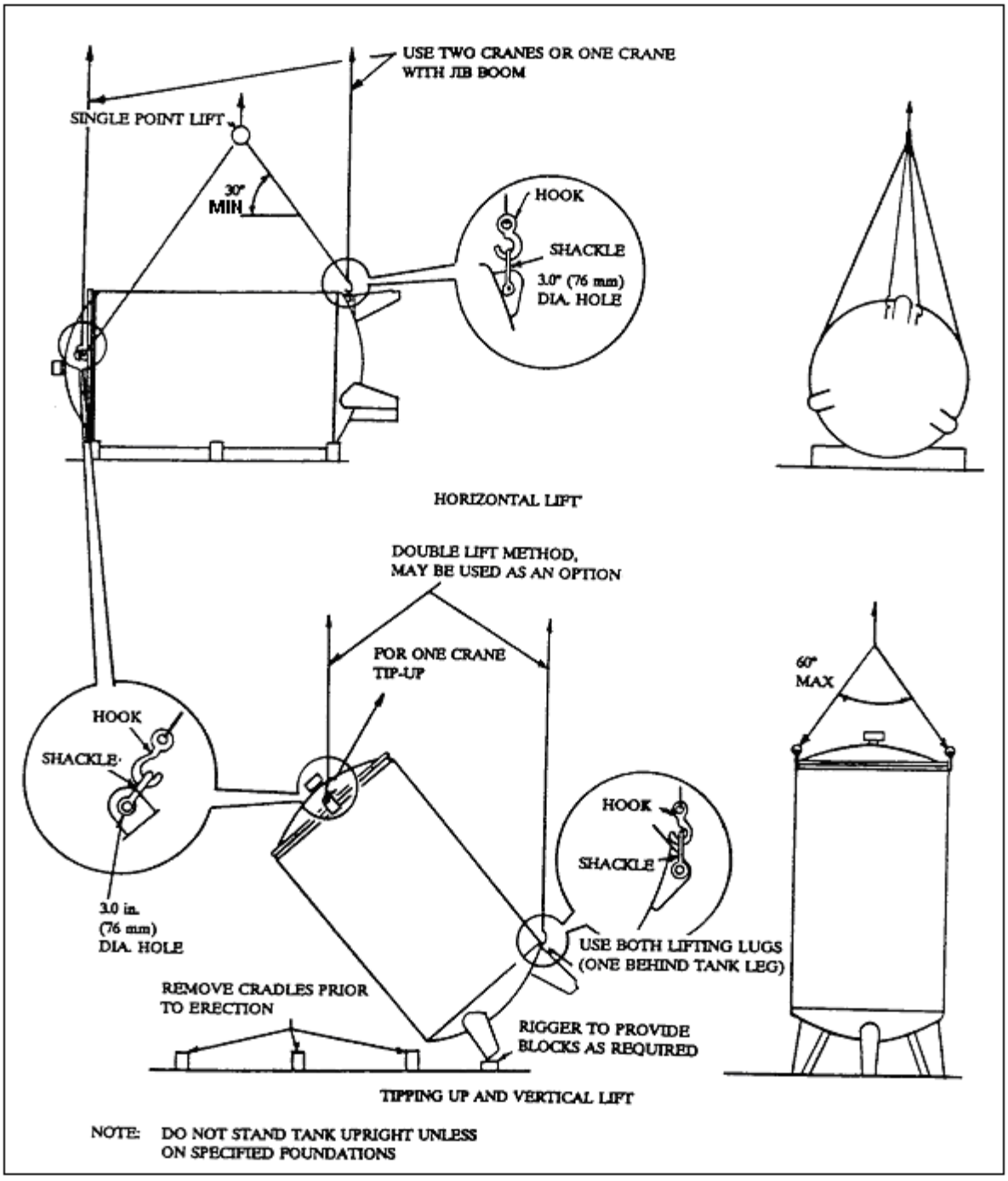
To relieve shipping pressure for piping, open the LIQUID FILL VALVE (V-1) and VAPOR EQUALIZATION VALVE (V-2) until the PRESSURE GAUGE (PI) indicates zero psig. The close (V-1) and (V-2).

RIGGING



Note: Refer to General Arrangement Drawing for Critical Weight and Dimensional Data

Rigging VJ-6 TON & VJ-14 TON



Note: Refer to General Arrangement Drawing for Critical Weight and Dimensional Data

Rigging VJ-26 TON, VJ-35 TON & VJ-50 TON

OPERATION

Normal operation of a properly installed unit requires some operator intervention. Frequent checks should be made to ensure pressure and liquid levels are within normal range. Low pressure could cause damage to the tank due to resulting liquid temperature below the design parameters of the steel in the pressure vessel. A daily inspection that includes checks for frost, leaks, low pressure, low liquid level and physical damage is recommended.

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 contaminants. The following procedure is recommended for most application:

1. Attach the transport vapor equalization line to CN-2. Product delivery pressure should be around 250 psig (17.23 bar/1723 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 ISOLATION VALVES (V-5, V-6).

3. Remove cap from FILL CONNECTION (CN-1), then open LIQUID FILL VALVE (V-1) and vent inner vessel to 5 psig (0.34 bar/34 kPa) as indicated on the tank PRESSURE GAUGE, INNER VESSEL (PI). Close LIQUID FILL VALVE (V-1).

4. Open VAPOR EQUALIZATION VALVE (V-2) slightly to allow vapor to flow slowly from the transport into top of the tank. Flow must be gradual enough to allow the vapor to warm in the tank and to allow the transport pressure building system to keep the transport pressure stable.

5. When tank PRESSURE INDICATOR, INNER VESSEL (PI) indicates maximum desired purge pressure, close the vapor supply source.

6. Close LIQUID AND VAPOR ISOLATION VALVES (V-6, V-5). The EQUALIZATION VALVE (V-7) should be opened just before closing ISOLATION VALVES (V-6, V-5) to prevent damage to the LIQUID LEVEL GAUGE (LI). Carefully loosen the adapters on both sides of the LIQUID LEVEL GAUGE (LI) to relieve pressure. Disconnect the instrument lines and fully open ISOLATION VALVES (V-6, V-5). Visually check the resultant gas streams for signs of moisture. Vent lines for approximately two minutes. If no moisture is evident, close the ISOLATION VALVES (V-6, V-5). If moisture is evident, continue venting until the stream is free of moisture.

   CAUTION: *Do not look directly into the tank lines. Bodily injury could occur. Carefully open gauge valves since some residual liquid may have remained in tank or the instrument lines.*

7. Open DRAIN VALVE (V-9A) to check for moisture as in Step 8.

8. Loosen setscrew lock nut on BACK PRESSURE REGULATOR (PCV) and turn setscrew counterclockwise to the end of its travel counting the number of turns made. Open REGULATOR ISOLATION VALVE (V-8) to purge safety line.

9. Repeat purge procedures 2 through 8 until an acceptable product purity is achieved.

10. Reconnect the LIQUID LEVEL GAUGE (LI), open ISOLATION VALVES (V-6, V-5) and close EQUALIZATION VALVE (V-7). Reset BACK PRESSURE REGULATOR (PCV) by turning the setscrew clockwise the counted number of turns, then tighten lock screw.

11. After completion of tank purge, make sure that all valves are closed except the GAUGE ISOLATION VALVES (V-6, V-5).

FILLING PROCEDURE

1. Attach a liquid fill line from the supply transport to the LIQUID FILL CONNECTION (CN-1), and a gas phase line from the transport to the VAPOR EQUALIZATION CONNECTIONS (CN-2) on the tank.

2. Open the trailer and the tank VAPOR EQUALIZATION VALVE (V-2) and wait until both the tank and the trailer pressure gauges reach the same pressure.

3. Open the LIQUID FILL VALVE (V-1) on the tank and the corresponding transport valve. Start the pump and observe the LIQUID LEVEL GAUGE (LI) during transfer for fill termination.

   CAUTION: Do not over fill.

4. When transfer is complete as indicated by the LIQUID LEVEL GAUGE (LI), stop the pump and close the transport supply valve. When the liquid in the fill hose has vaporized close LIQUID FILL VALVE (V-1). Then close the VAPOR EQUALIZATION VALVE (V-2) and finally the gas valve to the transfer truck.

5. Relieve the pressure in the transfer lines and disconnect from storage tank.

MAINTENANCE

No attempt at maintenance of this equipment should be undertaken without a thorough understanding of the pressures, procedures and specialized skills involved.

WARNING: *Isolate components and slowly depressurize the plumbing to be repaired before attempting repairs.The sudden release of pressure could cause personal injury. Observe safety precautions to prevent a dangerous accumulation of gas.*

Before installing, be sure to properly clean any replacement parts that are not packaged and marked for cleaned for oxygen service. Keep all parts clean during installation to prevent contamination.

CAUTION: *Carbon dioxide may form into solid phase (dry ice) if the pressure over the liquid is allowed to drop below 70 psig (4.8 bar/ 483 kPa). Pressure in the container must be*

maintained above this value to insure solid CO2 will not form inside the container. Before performing maintenance, components must be isolated and depressurized, or the contents must be transferred to another container so that the container pressure can be released. In addition to avoid irreparable damage to the structure of the tank, an internal tank pressure of no less than 200 PSIG (14 bar/1379 kPa) must be maintained at all times.

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 form 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 packing leakage cannot be stopped by tightening, replace packing. Use pre-formed packing that can be ordered from the valve manufacturer.

BACK PRESSURE VALVE

Before attempting repair of the BACK PRESSURE VALVE (PCV), isolate and depressurize the valve and associated piping.

RESETTING BACK PRESSURE VALVE

1. Open BACKPRESSURE REGULATOR ISOLATION VALVE (V-8) and loosen Back Pressure Valve pressure screw lock nut and turn pressure screw in (clockwise) to end of adjustment range.

2. *a. If tank pressure is below desired setpoint*: Build pressure within tank using a pressure building unit. As tank pressure increases to desired setpoint, approx. 10 psi (7 bar/70 kPa) below setting of SAFETY VALVES (SV-1A/B) discontinue pressure building.

   b. If tank pressure is above desired setpoint: Open EQUALIZATION VALVE (V-2) and vent until tank pressure is at desired setpoint, approx. 10 psi (7 bar/70 kPa) below setting of SAFETY VALVES (SV-1A/B).

3. With tank pressure at desired BACK PRESSURE REGULATOR (PCV) setpoint, slowly turn pressure screw out (counterclockwise) until valve just opens. Tighten pressure screw lock nut.

PRESSURE AND LIQUID LEVEL GAUGES

The major cause of a malfunctioning tank PRESSURE GAUGE (PI) or LIQUID LEVEL GAUGE (LI) is an open INSTRUMENT EQUALIZATION VALVE (V-7) 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 the LIQUID LEVEL GAUGE (LI) is not recommended. Return the defective gauge to the manufacturer for repair. Include a description of difficulty encountered.

CASING AND VACUUM MAINTENANCE

CHECKING VACUUM

Taylor-Wharton Cryogenic tanks are carefully designed, 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 gauge tube, located on the bottom head of the tank, is provided for this purpose.

To check casing vacuum:

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

2. Connect a Hastings-Raydist 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 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 months or years 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 work.

NOTE: *If the tank is empty and warm, vacuum space pressure will tend to be high because of the release of gases from adsorbent 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 rates of withdrawal are being made. However, if vacuum deterioration seriously affects tank operation by producing excessive pressure buildup and high loss rates, use the information in this section to determine and correct the cause of the trouble.

Necessary repairs must be made before the casing is re-evacuated and the tank returned to service. Leak detection and repair procedures are often complicated and difficult. Only persons who are trained and experienced in cryogenic equipment, troubleshooting and repair procedures should attempt such work. If difficulties in troubleshooting and repair are either anticipated or encountered, consultation services can be obtained from Taylor-Wharton Cryogenics. Contact the Customer Service Department at the Theodore, Alabama factory.

VACUUM GAUGE TUBE

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

1. Make certain that the 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. Check vacuum following previously 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 out-gassing of the new gauge tube and the thread sealant.

6. After reading has been recorded, close gauge tube valve and disconnect Vacuum Gauge. Install 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 1301" or equivalent acrylic spray. Do not spray the contact pins of the electrical connector; this could cause erroneous vacuum readings.*

ANALYZING VACUUM DETERIORATION

If you decide to re-evacuate because of slow deterioration over a long period of time, go directly to the Re-Evacuation procedure. 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 casing of the tank. If deterioration is rapid and causes the bursting disk to rupture, 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.) 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 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 casing safety device has not ruptured; visually inspect the exterior of the casing. Check the following areas in the order in which they are listed:

a. Vacuum gauge tube,
b. Vacuum gauge tube valve (V-3),
c. Casing evacuation valve (V-4),
d. Casing bursting disk (R-1),
e. All liquid and gas phase lines at exit point from casing,
f. Any area of the casing 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.

If there is complete loss of vacuum and rupture of the casing safety device accompanied by ejection of perlite insulation, the cause is probably leakage from the liquid container or internal piping. Field repair of such internal leakage is beyond the scope of these instructions. Contact the Customer Service Department at the Theodore, Alabama factory for advice or assistance.

TESTING FOR CASING LEAKAGE

If leakage appears to be from atmosphere and there is no evidence of casing safety device failure, check for leaks in the casing and/or casing/piping connection. This involves breaking any remaining partial vacuum, pressurizing the casing, and checking all casing welds, especially those around piping.

BREAKING VACUUM

If it is necessary to break vacuum (allow insulation space to return to atmospheric pressure) of a tank that is still under partial vacuum, it is important to minimize the entry of moisture into the insulation space. Removing such moisture during re-evacuation is difficult and time consuming. This problem can be minimized by breaking vacuum with dry nitrogen gas admitted through the evacuation valve.

1. Remove the pipe plug from the evacuation valve inlet.

2. Connect a cylinder of dry nitrogen gas, equipped with a pressure regulator and an accurate 0-5 psig (35 kPa) pressure gauge, to the evacuation valve inlet.

3. Open the cylinder valve and adjust the regulator to a delivery pressure of about 2 psig (15 kPa).

4. Slowly open the evacuation valve to allow nitrogen gas to enter the insulation space.

5. When the vacuum has been broken, shut off the nitrogen supply and disconnect it from the evacuation valve.

6. Leave evacuation valve open for at least 60 minutes to allow the insulation space pressure to equalize. Then close the evacuation valve.

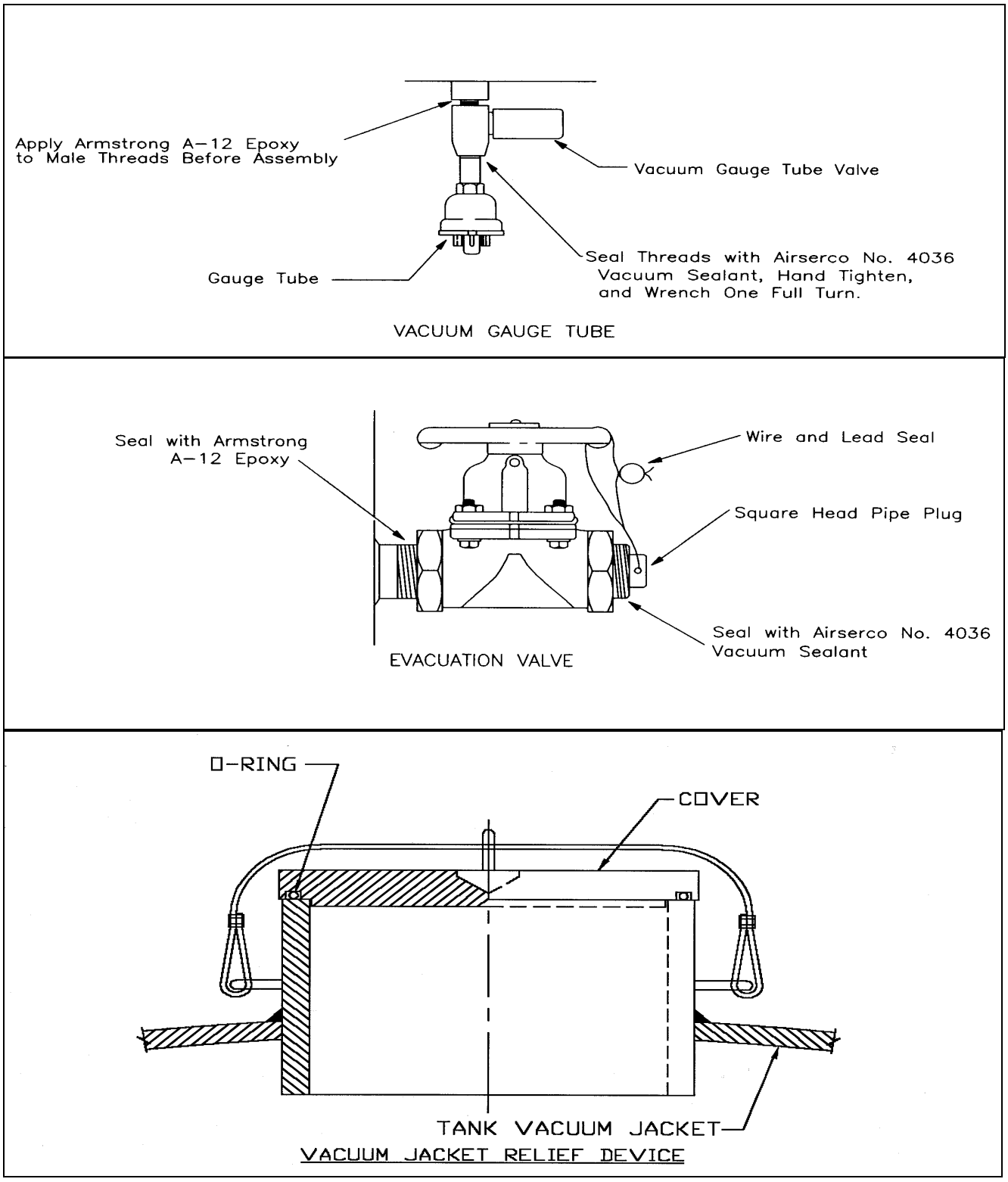


Figure 6. Vacuum System Components

RE-EVACUATION PROCEDURE

After any required vacuum repairs have been completed, re-evacuate the insulation space as follows:

1. Break the seal wire and remove the pipe plug from the evacuation valve. Use two wrenches, one on the valve, the other on the plug.

2. Be sure that there is not positive pressure in the casing. If necessary, crack open the evacuation valve to relieve the pressure.

3. Check that the inner container is empty, warm, and pressurized to at least 10 psig. Refer to "Warming the Tank".

4. Attach vacuum pump to the evacuation valve.

5. With the evacuation valve open, evacuate the insulation space to at least 150 microns (0.15 mm Hg) absolute.

NOTE: *Vacuum level will decrease to an acceptable level when the liquid container is filled with product.*

6. When proper vacuum has been obtained, close the evacuation valve and disconnect the vacuum pump.

7. Thread the pipe plug into the valve port, engaging one thread. Apply Airserco high vacuum sealant to the remaining threads. Tighten plug using two wrenches. Install new seal wire to prevent tampering.

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:	Gavlon 8198 High Build Epoxy Primer 2 – 3 mils thick
Finish Coat:	Gavlon HS350 Polyurethane Enamel, Gloss White 2 – 3 mils thick

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 vapor and spray mist must be avoided. Protective clothing including rubber gloves must be worn. Allergy-prone individuals may be sensitized and should not be exposed to isocyanates.

MOVING THE TANK

Purge and warm 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. Before moving the tank, refer to Taylor-Wharton Cryogenics Customer Service Dept. Refer to rigging information in "Installation" section when relocating the tank.

TROUBLE-REMEDY GUILD

TROUBLE	POSSIBLE CAUSES	REMEDY
1. Tank Pressure too low.	a. Pressure Vessel Safety Valve leaking	a. Thaw out valve or replace if
	b. Piping leaks to atmosphere.	b. Test and repair tank
	c. Low liquid level.	c. Refill tank.
	d. Excessive product withdrawal.	d. Install higher capacity Pressure
	e. Improper filling procedure	e. Refer to filling instruction in
2. Excessive tank pressure.	a. Extensive shutdown time.	a. No Remedy.
	b. Low withdrawal rate.	b. No Remedy.
	c. Malfunction of Pressure Building	c. Refer to Step 3, this section.
	d. Malfunction of tank Pressure Gauge.	d. Replace Pressure Gauge.
	e. Lack of refrigeration caused by low	e. Refill tank.
	f. Malfunction of Back Pressure Valve.	f. Refer to Step 3, this section.
3. Malfunction of Back Pressure Valve.	a. Improper valve set point.	a. Check valve set point reset if required;
	b. Dirt on valve seat or valve	b. Disassemble, inspect, clean, and
4. Erratic or erroneous Liquid Level Gauge readings.	a. Leaking gauge lines.	a. Test and repair leaks.
	b. By-pass valve open.	b. Close by-pass valve.
	c. Contents Gauge needle stuck.	c. Tap Contents Gauge slightly. Inspect
	d. Contents Gauge needle not zero	d. Adjust as required.
	e. Gauge line reversed.	e. Connect properly.
	f. Contents Gauge damaged or faulty.	f. Replace Contents Gauge.
	g. Plugged gauge lines.	g. Disconnect lines at Contents Gauge

5.	Leaking safety valve.	a. b. c.	Dirt or ice under valve or disc. Improper valve set point. Damaged valve seat or disc.	a. b. c.	Thaw out valve. Replace if necessary. Replace valve. Replace valve.
6.	Tank vacuum leak.	a. b. c. d.	Leak in Vacuum Jacket Relief Device. Evacuation Valve leak. Vacuum Probe or Vacuum Valve Tank Vacuum Jacket leak.	a. b. c. d.	Refer to Analyzing Vacuum Replace Evacuation Valve diaphragm. Replace faulty component. Re- Refer to Analyzing Vacuum
7.	Inability to obtain desired vacuum when re-evacuating.	a. b. c. d. e. f.	Defective vacuum pump. Incorrect vacuum reading. Defective Vacuum Gauge Tube. Leak in connections between vacuum Excessive moisture in insulation. Moisture in pump lubricant.	a. b. c. d. e. d.	Repair or replace vacuum pump. Repeat vacuum measurement. Replace Vacuum Gauge Tube. Repair Leaks Evacuate insulation space with cold Replace lubricant.

RECOMMENDED TOOLS, EQUIPMENT AND MATERIALS

Components in the "Reference" column are provided to indicate where various tools, equipment, and material are used. For locations of various suppliers listed, refer to the Address List section.

REFERENCE	DESCRIPTION	PART NUMBER	SOURCE
All Piping	Snoop Liquid Leak Detector	-	Nupro Company
Liquid Level Gauge	Pointer Puller	-	ITT Barton
Vacuum Gauge Tube	Krylon Crystal Clear Coating	1301	Borden
	Vacuum Gauge	TV-4A, VT-6	Teledyne Hastings-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, Cryogenic Equipment Plant, Theodore, Alabama or the prime manufacturer. All replacement parts 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.

VACUUM-JACKETED CO_2 TANKS							
Valve Number	Description	Part Number	VJ-6	VJ-14	VJ-26	VJ-35	VJ-50
V-1	Ball Valve 2.0" FPT	85450371	-	x	x	x	x
V-1	Ball Valve 2.0" FPT	85450367	x	-	-	-	-
V-2	Ball Valve 1-1/2" FPT	85440366	x	x	x	x	x
V-3	Vacuum Gauge Valve	612921	x	x	x	x	x
V-4	Valve, Vacuum, 1.5” MPT	8545-0151	x	x	x	x	x
V-5,V-6	Ball Valve, 1/2" FPT	85450369	x	-	-	-	-
V-5, V-6, V-7	Globe Valve, 1/4” MPT	85443725	V-7	x	x	x	x
V-8	Ball Valve, 1/4" MPT	85450368	x	x	x	x	x
V-9A, -9B	Ball Valve, 1/2” FPT	85450369	x	x	x	x	x
V-10	Diverter Valve 1"	85449389	x	x	x	x	x
PCV	Back Pressure Valve 1/4" Set at 325 psi	8536-8055	x	x	x	x	x
SV-1A,SV-1B	Safety Relief Valve 3/4" Male Inlet x 1.0" Female Outlet 350 psig	8545-1060	x	x	x	x	x
R-1	Casing Relief Device	2200763	x	x	x	x	x
PI	Pressure Gauge 4-1/2" 0-600 psig	5714-3505	x	x	x	x	x
LI	Barton Transmitter Differential Gauge Lbs. of CO2	2208976	x	-	-	-	-
	Barton Transmitter Differential Gauge Lbs. of CO2	2205856	-	x	-	-	-
	Barton Transmitter Differential Gauge Lbs. of CO2	2205857	-	-	x	-	-
	Barton Transmitter Differential Gauge Lbs. of CO2	2205858	-	-	-	x	-
	Barton Transmitter Differential Gauge Lbs. of CO2	2205859	-	-	-	-	x
	Flow Diagram	2208910	x	-	-	-	-
	Flow Diagram	2210862	-	x	x	-	-
	Flow Diagram	2210208	-	-	-	x	-
	Flow Diagram	2210887	-	-	-	-	x

APPENDIX A: CONTENTS GAUGE CHARTS

VJ-6 TON CONTENTS GAUGE CHART 260 PSIG

INCHES OF WATER	GALLONS	TONS	WEIGHT (LBS)
5	0	0	0
10	14	.06	118
15	57	.24	490
20	115	.50	997
25	177	.77	1532
30	239	1.03	2068
35	301	1.30	2603
40	363	1.57	3139
45	425	1.84	3674
50	486	2.10	4210
55	548	2.37	4745
60	610	2.64	5281
65	672	2.91	5816
70	734	3.18	6351
75	796	3.44	6887
80	858	3.71	7422
85	920	3.98	7958
90	982	4.25	8493
95	1043	4.51	9029
100	1105	4.78	9564
105	1167	5.05	10100
110	1229	5.32	10635
115	1291	5.59	11170
120	1353	5.85	11706
125	*1395	*6.03	*12067

*Full Trycock

Based on 260 psig saturation

Actual Inches of Water Reading

VJ-6 TON CONTENTS GAUGE CHART 320 PSIG

INCHES OF WATER	GALLONS	TONS	WEIGHT (LBS)
5	0	0	0
10	15	.06	128
15	62	.26	518
20	124	.52	1040
25	188	.79	1583
30	253	1.06	2126
35	318	1.33	2669
40	382	1.61	3212
45	447	1.88	3754
50	512	2.15	4297
55	576	2.42	4840
60	641	2.69	5353
65	705	2.96	5926
70	770	3.23	6469
75	835	3.51	7011
80	599	3.78	7554
85	964	4.05	8097
90	1028	4.32	8640
95	l093	4.59	9183
100	1158	4.86	9725
105	1222	5.13	10268
110	1287	5.41	10811
115	1352	5.68	11354
120	*1395	*5.86	*11715

*Full Trycock

Based on 320 psig Saturation

Actual Inches of Water Reading

VJ-14 TON CONTENTS GAUGE CHART 260 PSIG

INCHES OF WATER	GALLONS	TONS	WEIGHT (LBS)
5	0	0	0
10	8	.04	71
15	58	.25	498
20	139	.6	1203
25	239	1.03	2065
30	343	1.48	2970
35	448	1.94	3875
40	552	2.39	4780
45	657	2.84	5685
50	762	3.29	6589
55	866	3.75	7494
60	971	4.20	8399
65	1075	4.65	9304
70	1180	5.10	10209
75	1284	5.56	11114
80	1389	6.01	12019
85	1494	6.46	12924
90	1598	6.91	13829
95	1703	7.37	14734
100	1807	7.82	15638
105	1912	8.27	16543
110	2016	8.72	17448
115	2121	9.18	18353
120	2226	9.63	19258
125	2330	10.08	20163
130	2435	10.53	21068
135	2539	10.99	21973
140	2644	11.44	22878
145	2748	11.89	23783
150	2853	12.34	24688
155	2958	12.80	25592
160	3062	13.25	26497
165	3167	13.70	27402
*168.4	*3239	*14.01	*28029

*Full Trycock

Based on 260 psig saturation

Actual Inches of Water Reading

VJ-14 TON CONTENTS GAUGE CHART 320 PSIG

INCHES OF WATER	GALLONS	TONS	WEIGHT (LBS)
5	0	0	0
10	9	.04	77
15	63	.26	528
20	150	.63	1264
25	256	1.07	2150
30	365	1.53	3067
35	474	1.99	3985
40	584	2.45	4902
45	693	2.91	5819
50	802	3.37	6737
55	911	3.83	7654
60	1020	4.29	8571
65	1130	4.74	9489
70	1239	5.20	10406
75	1348	5.66	11323
80	1457	6.12	12241
85	1566	6.58	13158
90	1676	7.04	14075
95	1785	7.50	14993
100	1894	7.96	15910
105	2003	8.41	16827
110	2112	8.87	17745
115	2222	9.33	18662
120	2331	9.79	19850
125	2440	10.25	20497
130	2549	10.71	21414
135	2658	11.17	22332
140	2768	11.62	23249
145	2877	12.08	24166
150	2986	12.54	25084
155	3095	13.00	26001
160	3204	13.46	26918
*161.6	*3239	*13.61	*27210

*Full Trycock

Based on 320 psig Saturation

Actual Inches of Water Reading

VJ-26 TON CONTENTS GAUGE CHART 260 PSIG

INCHES OF WATER	GALLONS	TONS	WEIGHT (LBS)
10	6	.03	51
20	131	.57	1131
30	334	1.44	2888
40	543	2.35	4698
50	752	3.25	6508
60	961	4.16	8318
70	1170	5.06	10127
80	1380	5.97	11937
90	1589	6.87	13747
100	1798	7.78	15557
110	2007	8.68	17367
120	2216	9.59	19176
130	2425	10.49	20986
140	2634	11.40	22796
150	2844	12.30	24606
160	3053	13.21	26416
170	3262	14.11	28226
180	3471	15.02	30035
190	3680	15.92	31845
200	3889	16.83	33655
210	4099	17.73	35465
220	4308	18.64	37275
230	4517	19.54	39084
240	4726	20.45	40894
250	4935	21.35	42704
260	5144	22.26	44514
270	5353	23.16	46324
280	5563	24.07	48133
290	5772	24.97	49943
300	5981	25.88	51753
308.8	6165*	26.67*	53346*

*Full Trycock

Based on 260 psig saturation

Actual Inches of Water Reading

VJ-26 TON CONTENTS GAUGE CHART 320 PSIG

INCHES OF WATER	GALLONS	TONS	WEIGHT (LBS)
10	6	.03	52
20	140	.59	1178
30	354	1.49	2972
40	572	2.40	4807
50	791	3.32	6641
60	1009	4.24	8476
70	1227	5.16	10311
80	1446	6.07	12145
90	1664	6.99	13980
100	1883	7.91	15815
110	2101	8.82	17649
120	2319	9.74	19484
130	2538	10.66	21319
140	2756	11.58	23154
150	2975	12.49	24988
160	3193	13.41	26823
170	3411	14.33	28658
180	3630	15.25	30492
190	3848	16.16	32327
200	4067	17.08	34162
210	4285	18.00	35996
220	4503	18.92	37831
230	4722	19.83	39666
240	4940	20.75	41500
250	5159	21.67	43335
260	5377	22.58	45170
270	5595	23.50	47005
280	5814	24.42	48839
290	6.32	25.34	50674
296.1	6165*	25.89*	51788*

*Full Trycock

Based on 320 psig Saturation

Actual Inches of Water Reading

VJ-35 TON CONTENTS GAUGE CHART 260 PSIG

INCHES OF WATER	GALLONS	TONS	WEIGHT (LBS)
0	0	0	0
10	29	.12	247
20	231	1.0	2003
30	535	2.31	4628
40	852	3.69	7370
50	1169	5.06	10112
60	1485	6.43	12853
70	1802	7.80	15595
80	2119	9.17	18336
90	2436	10.54	21078
100	2753	11.91	23819
110	3070	13028	26561
120	3386	14.65	29302
130	3703	16.02	32044
140	4020	17.39	34785
150	4337	18.75	37527
160	4654	20.13	40268
170	4970	21.50	43010
180	5287	22.88	45751
190	5604	24.25	48493
200	5921	25.62	51234
210	6238	26.99	53976
220	6555	28.36	56717
230	68715	29.73	594595
240	7188	31.10	62200
250	7505	32.47	64942
260	7822	33.84	67683
270	*8112	*35.10	*70194

*Full Trycock

Based on 260 psig saturation

Actual Inches of Water Reading

VJ-35 TON CONTENTS GAUGE CHART 320 PSIG

INCHES OF WATER	GALLONS	TONS	WEIGHT (LBS)
0	0	0	0
10	30	.13	256
20	248	1.04	2085
30	568	2.39	4773
40	899	3.78	7553
50	1230	5.17	10332
60	1561	6.56	13111
70	1692	7.95	15890
80	2222	9.33	18669
90	2553	10.72	21448
100	2884	12.11	24228
110	3215	13.50	27007
120	3546	14.89	29786
130	3877	16.28	32565
140	4207	17.67	35344
150	4538	19.06	38124
160	4869	20.45	40903
170	5200	21.84	43682
180	5531	23.23	46461
190	5862	24.62	49420
200	6192	26.01	52020
210	6523	27.40	54799
220	6854	28.79	57578
230	7185	30.18	60357
240	7516	31.57	63136
250	7847	32.96	65915
260	*8112	*34.07	*68144

*Full Trycock

Based on 320 psig Saturation

Actual Inches of Water Reading

VJ-50 TON CONTENTS GAUGE CHART 260 PSIG

INCHES OF WATER	GALLONS	TONS	WEIGHT (LBS)
10	12	.05	101
20	185	.80	1603
30	479	2.07	4147
40	796	3.44	6889
50	1113	4.82	9630
60	1430	6.19	12372
70	1747	7.56	15113
80	2063	8.93	17855
90	2380	10.30	20596
100	2697	11.67	23338
110	3014	13.04	26079
120	3331	14.41	28821
130	3648	15.78	31562
140	3964	17.15	34304
150	4281	18.52	37045
160	4598	19.89	39787
170	4915	21.26	42528
180	5232	22.63	45270
190	5548	24.01	48011
200	5865	25.38	50753
210	6182	26.75	53494
220	6499	28.12	56236
230	6816	29.49	58977
240	7133	30.86	61719
250	7449	32.23	64460
260	7766	33.60	67202
270	8083	34.97	69943
280	8400	36.34	72685
290	8717	37.71	75426
300	9033	39.08	78168
310	9350	40.45	80909
320	9667	41.83	83651
330	9984	43.20	86392
340	10301	44.57	89134
350	10618	45.94	91875
360	10934	47.31	94617
370	11251	48.68	97358
380	11568	50.05	100100
389.2*	11861*	51.32*	102631*

*Full Trycock

Based on 260 psig saturation

Actual Inches of Water Reading

VJ-50 TON CONTENTS GAUGE CHART 320 PSIG

INCHES OF WATER	GALLONS	TONS	WEIGHT (LBS)
10	12	.05	99
20	197	.83	1653
30	508	2.13	4264
40	838	3.52	7043
50	1169	4.91	9822
60	1500	6.30	12601
70	1831	7.69	15380
80	2162	9.08	18160
90	2493	10.47	20939
100	2823	11.86	23718
110	3154	13.25	26497
120	3485	14.64	29276
130	3816	16.03	32056
140	4147	17.42	34835
150	4478	18.81	37614
160	4808	20.20	40393
170	5139	21.59	43172
180	5470	22.98	45951
190	5801	24.37	48731
200	6132	25.75	51510
210	6463	27.14	54289
220	6793	28.53	57068
230	7124	29.92	59847
240	7455	31.31	62627
250	7786	32.70	65406
260	8117	34.09	68185
270	8448	35.48	70964
280	8778	36.87	73743
290	9109	38.26	76523
300	9440	39.65	79302
310	9771	41.04	82081
320	10102	42.43	84860
330	10433	43.82	87639
340	10764	45.21	90418
350	11094	46.60	93198
360	11425	47.99	95977
370	11756	49.38	98756
373.1*	11861*	49.82*	99634*

*Full Trycock

Based on 320 psig Saturation

Actual Inches of Water Reading

APPENDIX B: OPTIONAL REFRIGERATION SYSTEM KIT (PN99442400)

Introduction

An internal refrigeration coil is supplied as standard equipment on the VJ-6 ton and VJ-14 ton tanks. It has been sized to condense gaseous product produced by normal heat leakage into the tank. An optional one-half horsepower refrigeration condenser unit is available for these two sizes. Figure 1B shows a schematic for the installed system. The kit consists of the following parts:

1) Condensing Unit
2) Condensing Unit Hood
3) Pressure Control
4) Filter/Drier
5) Sight glass
6) Thermostatic Expansion Valve

For installation of the refrigeration system employ only qualified individuals experienced with the installation of low temperature refrigeration systems and electrical wiring. Follow each manufacturer's instructions supplied with the individual refrigeration components. Copies of these instructions have been included in this manual for your convenience. Be sure to follow all regulations, codes, and standards applicable to refrigeration piping and electrical systems.

Condenser Unit

The condenser unit is a 0.5 Horse Power, 115 volt single phase-60 Hz, Copeland Model #M4FL-0040-IAA for use with R-404A refrigerant. It consists of the compressor, evaporator coil, receiver tank, and service valves. With the R-404A refrigerant an Evaporator Coil service temperature of minus 20 degrees F can be obtained.

Refrigeration piping connections: Suction Line – 0.375" flare copper.
Liquid Discharge Line – 0.25" flare copper.

Supplied separately is Copeland's Model # 005-0882-09 weather hood.

Tank Evaporator Coil

The tank evaporator coil provides approximately 4.4 square feet of surface area. The total volume of the coil and connecting piping is about 130 cubic inches.

Pressure Control Switch

The pressure control, Johnson Controls Model # P70AB-2, is a pressure-actuated switch that closes on increasing pressure. Its pressure sensor is to be installed in the condenser suction line. Connection type is 0.25" flare nut. The pressure switch must be installed in a place protected from the weather. Electrically, install the Pressure Control's switch in the line before the Condenser Unit.

With product in the tank, as the tank pressure increases the temperature inside the tank around the Evaporator Coil will rise. This rise in temperature will cause an increase in the refrigerant pressure inside the evaporator coil. When the set point of the Pressure Control is reached the pressure switch closes and activates the Condenser Unit. As the tank contents is refrigerated the temperature in the

tank decreases and the pressure in the suction line will decrease causing the switch to open, shutting off the Condenser Unit.

Setting the Pressure Control Switch: - After the refrigeration system has been installed, is operating properly, and the tank has been filled with product set the Pressure Control Switch. Initially set the "cut in" pressure on the switch at the top of its range. Also set the "cut out" pressure at the bottom of its range. Closely monitor tank pressure. As the tank pressure over time is allowed to rise to point where the refrigeration is necessary (approximately 300 psig) lower the "cut in" pressure until the Condenser Unit just comes on. Continue to monitor tank pressure. When the pressure decreases to the desired point increase the "cut out" pressure until the Condenser Unit cuts off.

Thermostatic Expansion Valve and Bulb

The Thermostatic Expansion Valve and Bulb, Sporlan Model # BFS-AA-ZP, causes a pressure drop in the liquid refrigerant coming from the Condenser Unit. This pressure drop flashes the liquid refrigerant causing a decrease in temperature. As the temperature of the carbon dioxide in the tank is decreased the Bulb senses a cooler refrigerant temperature at the outlet of the Evaporator Coil and it causes the valve to close further. The valve and bulb should be installed in a horizontal position. Insulate the suction line and bulb starting from the tank.

Filter / Drier and Sight-glass

The Filter / Drier, Catch-All Model # C-052, and the Sight-glass, See-All Model # SA-12FM, should be installed between the Condenser Unit and the Expansion Valve.

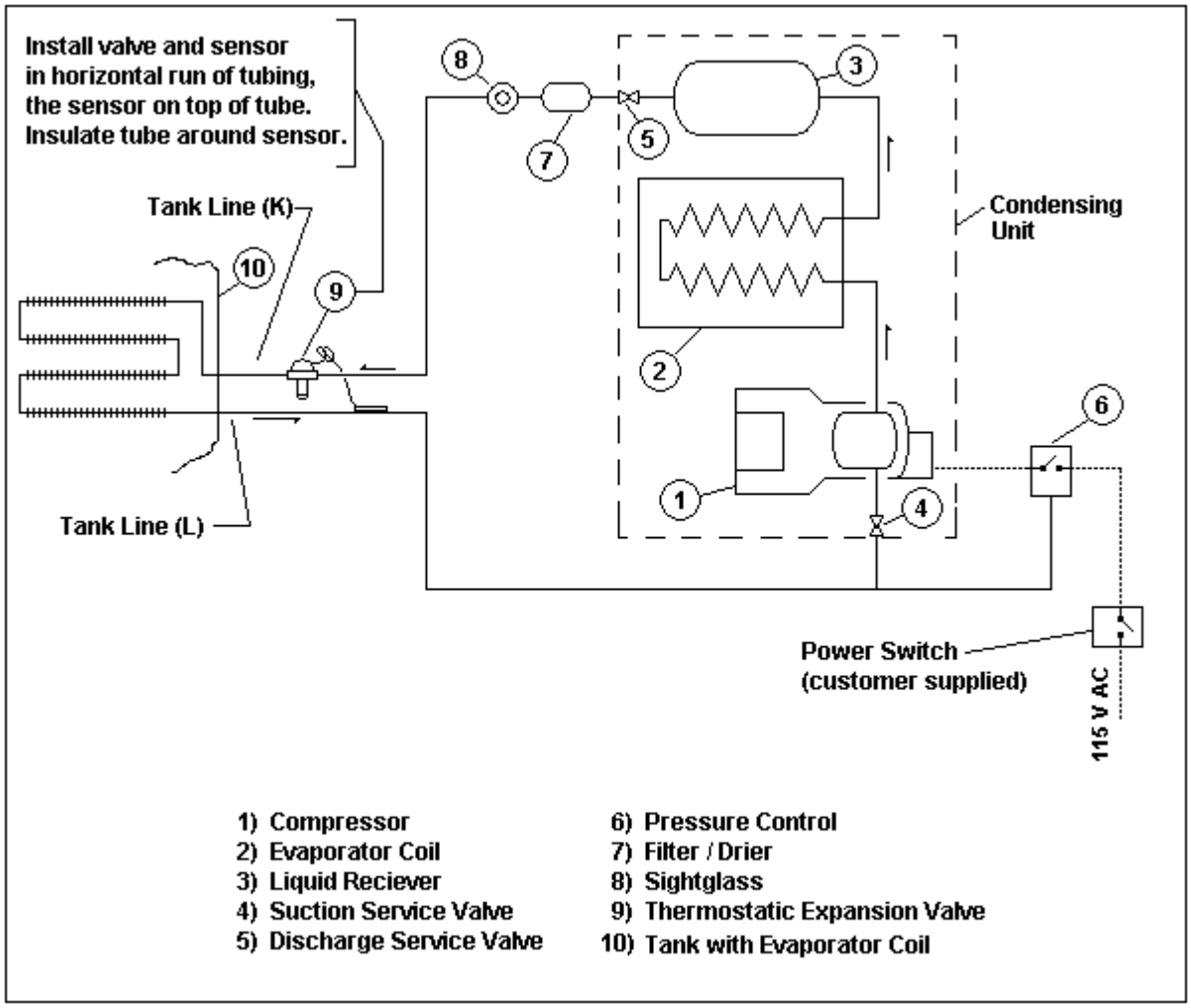


Figure 1B: Schematic for optional refrigeration system

For more information on Taylor Wharton Products

Please contact:

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