Technical Manual
for
Vertical Hospital Reserve
Storage Station

Applies specifically to Chart model (s):

- **VHR-120SS-250-ASME**
  (Part # 11499521)
- **VHR-260SS-250-ASME**
  (Part # 11506550)
- **VHR-400SS-250-ASME**
  (Part # 11517937)

Manual # 11506875
Revision C

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Revision Log	Description
Rev A (03/12/01)	Replace PSE-31A/B, #11374497 with #11509339.
Rev B (05/07/01)	Replace HCV-32/33/34/46 #10975565 with #11368257
Rev C (12/13/01)	Replace PSV-31A/B Herose #11494835 with Rockwood RXSO

Section 1 - SPECIFICATIONS

1-1. VERTICAL HOSPITAL RESERVE STATION

Manufacturer:Chart
Type: Vertical, cylindrical, double wall

TECHNICAL DATA	VHR-120SS-250-ASME	VHR-260SS-250-ASME	VHR-400SS-250-ASME
Liquid Capacity Gross Net (full trycock)	118 gal. (447 L) 112 gal. (424 L)	269 gal. (1,017 L) 256 gal. (969 L)	410 gal. (1,553 L) 391 gal. (1,479 L)
Gaseous Equivalent (Net Volume) Oxygen	12,800 scf	29,500 scf	45,000 scf
Design Temperature	+100°F to –320°F (38°C to –196°C)	+100°F to –320°F (38°C to –196°C)	+100°F to –320°F (38°C to –196°C)
Inner Tank Working Pressure Maximum	250 psig @ -320°F (17.2 BAR @ -196°C)	250 psig @ -320°F (17.2 BAR @ -196°C)	250 psig @ -320°F (17.2 BAR @ -196°C)
Operating Pressure	120 psig @ -320°F (8.3 BAR @ -196°C)	120 psig @ -320°F (8.3 BAR @ -196°C)	120 psig @ -320°F (8.3 BAR @ -196°C)
Normal Evaporation Rate Liquid Oxygen	0.70% per day	0.62% per day	0.62% per day
Shipping Envelope (L x W x H)	40" x 31" x 80" (102 cm x 79 cm x 203 cm)	50" x 43" x 94" (127 cm x 109 cm x 239 cm)	57" x 49" x 100" (145 cm x 124 cm x 254 cm)
Weight– Empty Full (liquid oxygen)	642 lbs. (300 kg) 1,710 lbs. (780 kg)	1,700 lbs. (771 kg) 4,100 lbs. (1,860 kg)	2,100 lbs. (953 kg) 5,800 lbs. (2,631 kg)

1-2. CONSTRUCTION DATA

Inner Vessel Material: Stainless Steel, SA-240, T-304
Inner Vessel Coding: ASME Section VIII, Div. 1
Outer Vessel Material: Stainless Steel, SA-240, T-304
Insulation (Evacuated Annulus): Super Insulation

1-3. FIELD CONNECTIONS

Liquid Fill: 3/8" FPT
Gas Use: 3/8" FPT

Section 2 - SAFETY INFORMATION

2-1. SAFETY SUMMARY

Strict compliance with proper safety and handling practices is necessary when using a Vertical Hospital Reserve System (VHR). We recommend that all our customers re-emphasize safety and safe handling practices to all their employees and customers. While every possible safety feature has been designed into the unit and safe operations are anticipated, it is essential that the user of the VHR carefully read all WARNINGS and CAUTION notes listed in this safety summary and enumerated below. Also read the information provided in the Safety Bulletin for Oxygen and Inert Gases following this Safety Summary. Periodic review of the Safety Summary is recommended.

In an oxygen-enriched atmosphere, flammable items burn vigorously and could explode. Excess accumulation of oxygen creates an oxygen-enriched atmosphere (defined by the Compressed Gas Association as an oxygen concentration above 23%). Certain items considered non-combustible in air may burn rapidly in such an environment. Keep all organic materials and other flammable substances away from possible contact with oxygen; particularly oil, grease, kerosene, cloth, wood, paint, tar, coal, dust, and dirt which may contain oil or grease. Do not permit smoking or open flame in any area where oxygen is stored, handled, or used. Failure to comply with this warning may result in serious personal injury.

Before removing any parts or loosening fittings, empty a cryogenic container of liquid contents and release any vapor pressure in a safe manner. External valves and fittings can become extremely cold and may cause painful burns to personnel unless properly protected. Personnel must wear protective gloves and eye protection whenever removing parts or loosening fittings. Failure to do so may result in personal injury due to the extreme cold and pressure in the tank.

Accidental contact of liquid gases with skin or eyes may cause a freezing injury similar to a burn. Handle liquid so that it will not splash or spill. Protect your eyes and cover skin where the possibility of contact with liquid, cold pipes and cold equipment, or 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 easily be removed and long sleeves are recommended for arm protection. Cuffless trousers should be worn over the shoes to shed spilled liquid.

If clothing should be splashed with liquid oxygen it will become highly flammable and easily ignited while concentrated oxygen remains. Such clothing must be aired out immediately, removing the clothing if possible, and should not be considered safe for at least 30 minutes.

Use only replacement parts that are compatible with liquid oxygen and have been cleaned for oxygen use. Do not use regulators, fittings, hoses, etc., which have been previously used in a compressed air environment. Similarly, do not use oxygen equipment for compressed air. Failure to comply with these instructions may result in serious damage to the container.

Before locating oxygen equipment, become familiar with the National Fire Protection Association (NFPA) standard No. 50, "Bulk Oxygen Systems at Customer Sites", and with all local safety codes. The NFPA standard covers general principles recommended for installing bulk oxygen systems on industrial and institutional consumer premises.

Also review NFPA standard no. 99, "Health Care Facilities", which provides performance, safety, and testing criteria for normal and emergency electrical, gas and vacuum, and environmental systems.

2-2. SAFETY BULLETIN

Portions of the following information have been extracted from Safety Bulletin SB-2, from the Compressed Gas Association, Inc. Additional information on nitrogen and argon and liquid cylinders is available in CGA Pamphlet P-9. Write to the Compressed Gas Association, Inc., 1725 Jefferson Davis Highway, Arlington, VA 22202.

From CGA Safety Bulletin

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

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

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

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

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

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

OXYGEN DEFICIENT ATMOSPHERES

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

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

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

Human exposure to atmosphere containing 12% or less oxygen leads to rapid unconsciousness. Unconsciousness can occur so rapidly that the user is rendered essentially helpless. This can occur if the condition is reached by immediate change of environment, or through the gradual depletion of oxygen.

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

If oxygen deficient atmosphere is suspected or known to exist:

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

OXYGEN ENRICHED ATMOSPHERES

An oxygen-enriched atmosphere occurs whenever the normal oxygen content of air is allowed to rise above 23%. While oxygen is non-flammable, ignition of combustible materials can occur more readily in an oxygen-rich atmosphere than in air; and combustion proceeds at a faster rate although no more total heat is released.

It is important to locate an oxygen system in a well-ventilated location, since oxygen-rich atmospheres may collect temporarily in confined areas during the functioning of a safety relief device or leakage from the system.

Oxygen system components, including but not limited to, containers, valves, valve seats, lubricants, fittings, gaskets and interconnecting equipment including hoses, shall have adequate compatibility with oxygen under the conditions of temperature and pressure to which the components may be exposed in the containment and use of oxygen. Easily ignitable materials shall be avoided unless they are parts of equipment or systems that are approved, listed, or proved suitable by tests or by past experience.

Compatibility involves both combustibility and ease of ignition. Materials that burn in air may burn violently in pure oxygen at normal pressure, and explosively in pressurized oxygen. In addition, many materials that do not burn in air may do so in pure oxygen, particularly when under pressure. Metals for containers and piping must be carefully selected, depending on service conditions. The various steels are acceptable for many applications, but some service conditions may call for other materials (usually copper or its alloys) because of their greater resistance to ignition and lower rate of combustion.

Similarly, materials that can be ignited in air have lower ignition energies in oxygen. Many such materials may be ignited by friction at a valve seat or stem packing, or by adiabatic compression produced when oxygen at high pressure is rapidly introduced into a system initially at low pressure.

NITROGEN AND ARGON

Nitrogen and argon (inert gases) are simple asphyxiants. Neither gas will support or sustain life and can produce immediate hazardous conditions through the displacement of oxygen. Under high pressure these gases may produce narcosis even though an adequate oxygen supply, sufficient for life, is present.

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

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

VHR units are safely designed with the following features:

A vacuum maintenance system specifically designed to provide long life and all possible safety precautions.

Safety relief devices to protect the pressure vessel and vacuum casing, sized and selected in accordance with ASME standards to include a pressure control valve and rupture disc system to protect the pressure vessel, and a reverse buckling rupture disc or lift plate to protect the vacuum casing from overpressure. While Chart equipment is designed and built to the most rigid standards, no piece of mechanical equipment can ever be 100% foolproof.

Section 3 - INSPECTION

3-1. DESCRIPTION

Cryogenic vessels are carefully designed and engineered to insulate a cryogenic liquid with maximum efficiency from ambient conditions by minimizing conduction, convection and radiation. Vessels are not designed to be operated out of position.

A vertical vessel, for example, is most susceptible to damage during shipment, when it is on its side, braced only by auxiliary internal supports. Stationary vessels are not designed to be run over potholes, railroad tracks, etc. Therefore, a receiving inspection is one of the most important operations in the life of the tank. The inspection should be performed thoroughly and conscientiously to identify any possible damage and to minimize problems during start up of the vessel on site.

3-2. RECEIVING CHECKPOINTS

1. Observe the crate which contained the VHR. Damage or deformation would indicate the possibility of mishandling during shipment.

2. Examine welded or brazed joints on plumbing for cracks or deformation. In particular, check areas near valves and fittings.

3. Check for cracks or breaks at points where pipes exit from knuckle.

4. Check relief valves and burst discs for dirt or damage.

5. Check pressure within vessel on (PI-31). If pressure is "0", then extra precautions against contamination and impurities must be taken.

Section 4 - OPERATION

4-1. GENERAL

This section provides purging, initial fill, liquid delivery, gas use, and refilling procedures for the VHR-120/260/400, along with regulator adjustment information. Before performing any of the procedures contained in this section, become familiar with the location and function of VHR controls and indicators as detailed on the schematic.

4-2. INSTALLATION

Determine the best location for the VHR - between the Vertical Station (VS) and the hospital - where the length of the liquid and gas use delivery lines will be kept to a minimum.

1. Install the VHR to the vertical station (VS) by running the Top and Bottom Fill Lines (which include valves HCV-32 and HCV-31) from the VHR and connecting at the VS Liquid Withdrawal Connection (C-3). A Liquid Isolation Valve and a Liquid Withdrawal Check Valve must be installed between the Liquid Withdrawal Connection (C-3) on the vertical station (VS) and Top and Bottom Fill Valves (HCV-32 and HCV-31) on the VHR. Make sure that the body flow orientation arrows on the Liquid Isolation Valve and the Liquid Withdrawal Check Valve are positioned to flow from the vertical station (VS) to the VHR unit.

2. Connect the VHR to the control manifold by running a line from the VHR Gas Use Valve (HCV-43) and the VHR Economizer Outlet Regulator (PCV-32) to the control manifold.

3. A line must also be run to the control manifold from connection *downstream of product withdrawal vaporizer (VAP)* on the Vertical Station (VS).

4-3. PREPARATION FOR INITIAL FILL

The initial fill is usually performed on a warm VHR, one that has not been in use for an extended period of time. (See initial fill procedures). The warm container must be purged to ensure product purity.

When preparing the VHR for filling, the following items should be considered:

1. The vessel should be inspected for possible damage or unsuitability for the intended use. If damage is detected (e.g. serious dents, loose fittings, etc.), remove the unit from service and perform repairs as soon as possible.

2. The VHR may be filled by pumping or pressure transfer. If internal VHR pressure is at least 50 PSI less than the maximum allowable pressure of the supply unit, liquid may be transferred by pressure transfer. If the normal working pressure of the VHR is equal to or greater than the maximum allowable pressure of the supply unit, liquid must either be pumped into the tank, or the VHR may need to be vented before liquid can be transferred.

3. To remove moisture or foreign matter from the VHR or VHR lines, the unit must be purged. Use a small amount of product for purging to ensure purity or remove contaminants.

4-4. VHR PURGING PROCEDURE

CAUTION: *THE MAXIMUM PURGE PRESSURE SHOULD BE EQUAL TO 50 PERCENT OF THE MAXIMUM OPERATING PRESSURE OF THE VHR OR 30 PSIG, WHICHEVER IS LESS. THE MAXIMUM PURGE PRESSURE SHOULD BE DETERMINED BEFORE STARTING THE PURGE OPERATION. TO PREVENT DRAWING ATMOSPHERIC CONTAMINANTS BACK INTO THE TANK, A POSITIVE PRESSURE OF AT LEAST 5 PSIG MUST ALWAYS BE MAINTAINED IN THE TANK.*

1. Attach the source of liquid purge product to the VHR Fill Connection (FC-31).

2. Close all valves except the Pressure Builder Inlet Valve (HCV-33), Pressure Builder Outlet Valve (HCV-41), and Gas Phase (low) and Liquid Phase (high) Valves (HCV-38 and HCV-40).

   NOTE: *The pressure building regulator is set to build pressure to 120 PSIG. When this pressure is used as the purge pressure, DO NOT adjust the regulator adjusting screw.*

3. Open the VHR Bottom Fill Valve (HCV-31) enough to allow liquid to slowly flow into the inner vessel through the bottom fill line. The gradual flow enables the liquid to vaporize in the line and pressure building coil, and slowly builds up pressure in the inner tank.

4. Monitor the pressure gauge (PI-31) and shut off the liquid supply source when the pressure in the tank reaches the maximum purge pressure. Close VHR Bottom Fill Valve (HCV-31) and disconnect liquid source.

5. Once again, open the Bottom Fill Valve (HCV-31) slowly to avoid splashing of the liquid. Drain all liquid from the tank. The appearance of gas (vapor) indicates that all liquid has been drained.

   NOTE: *Leave 10 to 20 PSIG pressure in the VHR.*

6. Close Bottom Fill Valve (HCV-31).

7. When all liquid is drained, open the Equalization Valve (HCV-39) to prevent damage to the gauge before closing the Gas Phase (low) and Liquid Phase (high) Valves (HCV-38 and HCV-40).

8. Loosen the unions on either side of the liquid level gauge (LL-31). Both the gas phase and liquid phase valves should be opened wide and the gas streams visually checked for signs of moisture. Provided no moisture is observed after blowing the lines for approximately two (2) minutes, both valves should be closed. If moisture is observed in the gas stream, the gas should be discharged until it is clear of all moisture.

   NOTE: *Due to their small diameter, gauge lines are easily plugged by ice. A careful check for moisture in the phase lines will ensure trouble-free operation of the liquid level gauge.*

9. Open the Vent/Full Trycock Valve (HCV-34) and the VHR Top Fill Valve (HCV-32).

10. Repeat purge procedures 2 through 6 and 9 at least three times to ensure product purity.

11. Reconnect the liquid level gauge (LL-31), open the Gas Phase (low) and Liquid Phase (high) Valves (HCV-38 and HCV-40), then close the Equalization Valve (HCV-39).

12. After purging the tank, but before filling, verify that the following valves are open or closed as indicated:

VALVE	**POSITION**
Bottom Fill Valve (HCV-31)	Closed
Top Fill Valve (HCV-32)	Closed
Vent/Full Trycock Valve (HCV-34)	Closed
Equalization Valve (HCV-39)	Closed
VHR Gas Use Valve (HCV-43)	Closed
Pressure Building Inlet Valve (HCV-33)	Closed
Gas Phase (low) Valve (HCV-38)	Open
Liquid Phase (high) Valve (HCV-40)	Open

4-5. INITIAL FILLING PROCEDURE (WARM TANK) – WITHOUT VS

NOTE: *The following procedure applies to a VHR which is **not** in operation with a vertical station (VS).*

1. Purge tank to assure product purity (see section 4-4).

2. Verify the contents of the supply unit as **oxygen**.

3. Verify that all valves except gas phase (low) and liquid phase (high) valves (HCV-38 and HCV-40) are closed.

4. Connect the supply unit transfer hose to the tank VHR Fill Connection (FC-31).

5. Slowly open VHR Top Fill Valve (HCV-32).

6. If a pressure transfer is to be made, allow pressure to build up in the liquid supply unit until it is at least 20 PSI higher than pressure in the VHR. Open the discharge valve on the supply unit to begin flow.

   (or)

   If a pump transfer is to be made, make the required connections to the pump. Open the supply unit transport discharge valve slowly. Maintain pump discharge pressure from 50 to 100 PSI higher than pressure in the VHR.

7. Monitor VHR pressure (PI-31) during filling. If VHR pressure rises above supply pressure, or near relief valve pressure (PSV-31A or PSV-31B), the VHR may have to be vented through the Vent/Full Trycock Valve (HCV-34). Should pressure continue to rise, the fill may have to be interrupted to allow pressure to drop.

8. Monitor Differential Pressure Gauge (LL-31) as the vessel is filled. When LL-1 indicates "full" or when liquid spurts from Vent/Full Trycock Valve (HCV-34), stop fill at the supply source and close the Vent/Full Trycock Valve (HCV-34).

9. Close the VHR Top Fill Valve (HCV-32).

10. Drain residual liquid in the fill hose by opening the drain valve on the liquid supply unit.

11. Relieve fill hose pressure by loosening the fill connection, then disconnect the hose.

12. Open valves (HCV-33, HCV-41, HCV-47, and HCV-43) as required to place the VHR in service.

4-6. REFILLING PROCEDURE – WITHOUT VS

> ***NOTE:*** *The following procedure applies to a VHR which is **not** in operation with a vertical station (VS).*

A vessel that is in service must be refilled using Top and Bottom Fill Valves (HCV-32 and HCV-31). No interruption of service should occur when proper filling procedures are conducted. Generally it is not necessary to vent the vessel down prior to filling.

> ***NOTE:*** *Filling a cryogenic vessel through the bottom tends to raise pressure in the vessel, as gases in the vapor space are compressed. Filling through the top tends to lower pressure, as gases in head space are cooled down and re-liquefied.*

1. Verify the contents of the supply unit as **oxygen**.

2. Verify the minimum required operating pressure in VHR.

3. Verify that the Top and Bottom Fill Valves (HCV-32 and HCV-31) are closed and all other valves are in normal operating positions (HCV-33, HCV-41, HCV-43, HCV-38, HCV-40, HCV-47 open).

4. Connect the supply unit transfer hose to VHR Fill Connection (FC-31).

5. Open Top Fill Valve (HCV-32) completely.

6. If a PRESSURE TRANSFER is to be made, allow pressure to build up in the liquid supply unit until it is at least 20 PSI higher than station pressure. Open the discharge valve on the supply unit to begin flow.

(or)

If a PUMP TRANSFER is to be made, make the required connections to the pump. Open the supply unit transport discharge valve slowly. Close pump circulating valve slowly, so as not to lose prime. Maintain pump discharge pressure from 50 to 100 PSI higher than tank pressure.

7. Monitor the pressure in vessel as indicated on (PI-31). If pressure begins to drop to near the minimum operating pressure, open Bottom Fill Valve (HCV-31) and throttle the Top Fill Valve (HCV-32) until pressure stabilizes.

8. Observe the Differential Pressure Gauge (LL-31) as the vessel is filled. When LL-31 indicates

"full" or when liquid spurts from Vent/Full Trycock Valve (HCV-34), stop fill at the supply source and close the Vent/Full Trycock Valve (HCV-34).

9. Close the Top and Bottom Fill Valves (HCV-32 and HCV-31).

10. Drain residual liquid in the fill hose by opening the drain valve on the liquid supply unit.

11. Relieve hose pressure by loosening the hose at fill connection (FC-31), and then disconnect the hose.

4-7. INITIAL FILLING PROCEDURE (WARM TANK) – WITH VS

NOTE: *The following procedure applies to a VHR which is in operation with a bulk storage system (vertical station).*

1. Purge tank to assure product purity (see section 4-4).

2. Verify the contents of the supply unit as **oxygen**.

3. Verify that all valves except Gas Phase (low) and Liquid Phase (high) Valves (HCV-38 and HCV-40) are closed.

4. Open Liquid Isolation Valve (Located between VHR unit and vertical station).

5. Slowly open Top Fill Valve (HCV-32).

6. If a PRESSURE TRANSFER is to be made, allow pressure to buildup in the liquid supply unit until it is at least 20 PSI higher than pressure in the VHR. Open the discharge valve on the supply unit to begin flow. Pump transfer is not recommended.

7. Monitor VHR pressure (PI-31) during filling. If pressure rises above supply pressure, or near relief valve pressure (PSV-31A or PSV-31B), the VHR may have to be vented through Vent/Full Trycock Valve (HCV-34). Should pressure continue to rise, the fill may have to be interrupted to allow pressure to drop.

8. Monitor Differential Pressure Gauge (LL-31) as the vessel is filled. When LL-31 indicates "full" or when liquid spurts from Vent/Full Trycock Valve (HCV-34), stop fill at the supply source and close the Vent/Full Trycock Valve (HCV-34).

9. Close the Top Fill Valve (HCV-32).

10. Close the Liquid Isolation Valve (Located between VHR unit and vertical station).

11. Open valves (HCV-33, HCV-41, HCV-43, and HCV-47) as required to place the VHR in service.

4-8. REFILLING PROCEDURE – WITH VS

> ***NOTE:*** *The following procedure applies to a VHR which is in operation with a vertical station (VS).*

A vessel that is in service must be refilled using both the Top and Bottom Fill Valves (HCV-32 and HCV-31). No interruption of service should occur when proper filling procedures are conducted. Generally it is not necessary to vent the vessel down prior to filling.

> ***NOTE:*** *Filling a cryogenic vessel through the bottom tends to raise pressure in the vessel, as gases in the vapor space are compressed. Filling through the top tends to lower pressure, as gases in head space are cooled down and re-liquefied.*

1. Verify the contents of the supply unit as **oxygen**.

2. Verify the minimum required operating pressure in VHR.

3. Verify that the Top and Bottom Fill Valves (HCV-32 and HCV-31) are closed and all other valves are in normal operating positions (HCV-33, HCV-41, HCV-43, HCV-47, HCV-38, HCV-40 open).

4. Open the Liquid Isolation Valve (Located between VHR unit and vertical station).

5. Open Top Fill Valve (HCV-32) completely.

6. If a PRESSURE TRANSFER is to be made, allow pressure to build up in the liquid supply unit until it is at least 20 PSI higher than station pressure. Open the discharge valve on the supply unit to begin flow. Pump transfer is not recommended.

7. Monitor the pressure in vessel as indicated on (PI-31). If pressure begins to drop to near the minimum operating pressure, open Bottom Fill Valve (HCV-31) and throttle the Top Fill Valve (HCV-32) until pressure stabilizes.

8. Observe the Differential Pressure Gauge (LL-31) as the vessel is filled. When LL-31 indicates "full" or when liquid spurts from Vent/Full Trycock Valve (HCV-34), stop fill at the supply source and close the Vent/Full Trycock Valve (HCV-34).

9. Close the Top and Bottom Fill Valves (HCV-32 and HCV-31).

4-9. GAS WITHDRAWAL PROCEDURE

1. Connect customer line to VHR Gas Use Valve Connection (HCV-43).

2. Verify that all valves except Gas Phase (low) and Liquid Phase (high) Valves (HCV-38 and HCV-40) are closed.

3. Open VHR Gas Use Valve (HCV-43), Pressure Builder Inlet Valve (HCV-33), Pressure Builder Outlet Valve (HCV-41, and Economizer Outlet Valve (HCV-47) to start gas flow.

4. Once the required amount of product has been delivered, stop gas flow by closing the VHR Gas Use Valve (HCV-43). The operation of a Chart unit is completely automatic; valves need to be opened and closed during filling and during major maintenance.

5. Normal valve operating positions for a VHR unit are as follows:

VALVE	**POSITION**
Bottom Fill Valve (HCV-31)	Closed
Top Fill Valve (HCV-32)	Closed
Vent/Full Trycock Valve (HCV-34)	Closed
Equalization Valve (HCV-39)	Closed
Gas Use Valve (HCV-43)	Open
Pressure Builder Inlet Valve (HCV-33)	Open
Pressure Builder Outlet Valve (HCV-41)	Open
Economizer Outlet Valve (HCV-47)	Open
Gas Phase (low) Valve (HCV-38)	Open
Liquid Phase (high) Valve (HCV-40)	Open

4-10. VHR PRESSURE BUILDING REGULATOR ADJUSTMENT

> ***NOTE:*** *To set or adjust regulators in the field, the vessel must contain liquid product; Chart recommends performing this procedure with a full tank.*

Under normal circumstances, components on the VHR system do not require frequent adjustment. However, it may be necessary to change regulator settings to obtain either higher or lower pressure settings. A helpful operating technique is to verify regulator set points during an initial fill.

The steps below describe procedures required to "final set" the regulators after spring replacement, or after completing valve repairs which require disassembly and reassembly.

This procedure should be performed with a full tank, as all adjustments to VHR Pressure Building Regulator (PCV-31) will affect the entire system.

1. Observe reading on VHR Pressure Gauge (PI-31). If pressure is lower than desired set point of Pressure Building Regulator (PCV-31), proceed to step 2; if pressure is higher, proceed to step 3.

2. If tank pressure is below the desired setting, loosen the pressure screw lock nut on the VHR Pressure Building Regulator (PCV-31). With valves (HCV-33) and (HCV-41) open, gradually open the regulator by turning the pressure screw (clockwise) to build tank pressure to the desired setting.

   > ***NOTE:*** *The pressure screw should be adjusted in small increments to allow sufficient time for tank pressure to stabilize each time the screw is turned.*

   The tank can be considered stabilized when no frost is found on the pressure building circuit (HCV-33, HCV-41 TSV-31, TSV-32, and PCV-31). This reduces the possibility of over-shooting the desired pressure which would, in turn, require partial tank blowdown via the VHR Vent/Full Trycock Valve (HCV-34). Tighten the lock nut on the regulator and return vessel to normal service.

3. If the tank pressure is above the desired setting, open the VHR Vent/Full Trycock Valve (HCV-34) to vent excess gas. Should pressure continue to rise above the desired level, proceed to step 4.

4. Again, vent excess gas by opening VHR Vent/Full Trycock Valve (HCV-34). Reduce pressure until tank pressure gauge indicates a reading of 10 PSI below the desired setting. Loosen set screw on (PCV-31), and go back to Step 2.

4-11. LIQUID LEVEL GAUGE ADJUSTMENT

The Differential Pressure Gauge (LL-31) indicates the amount of liquid in the vessel. This gauge may occasionally require adjustment. To check and/or adjust the zero setting of this gauge, close the Gas Phase (low) Valve and Liquid Phase (high) Valves (HCV-38 and HCV-40), and open the Equalization Valve (HCV-39). The gauge pointer should indicate zero. If the gauge pointer indicates a value other than zero, adjust the unit until the zero setting is reached.

Since some gauges have a set screw for adjustment, while other gauges require movement of the pointer, make a note of the method used to adjust zero point on this gauge. Check the adjustment several times by closing and opening the Equalization Valve (HCV-39). Normally the glass face must be removed for adjustment. Use an oxygen compatible grease or sealant to wet the protective O-ring prior to reassembly. Entry of water into the gauge caused by improper sealing of the glass face will distort the gauge components and readings. After adjusting, close the Equalization Valve (HCV-39) and open the Gas Phase (low) and Liquid Phase (high) Valves (HCV-38 and HCV-40).

Section 5 - MAJOR COMPONENTS

5-1. REPLACEMENT PARTS LIST

TAG	NOMENCLATURE	P/N	MANUFACTURER	MODEL	SIZE	COMMENTS
HCV-31	BOTTOM FILL VALVE	10975565	REGO	ES9473-D MSS-SP80	½" NOM x 3/8" FPT	GLOBE VALVE, EXT STEM
HCV-32	TOP FILL VALVE	11368257	REGO	BK9453FAB	½" NOM x 3/8" FPT	GLOBE VALVE, EXT STEM
HCV-33	PRESSURE BUILDER INLET VALVE	11368257	REGO	BK9453FAB	½" NOM x 3/8" FPT	GLOBE VALVE, EXT STEM
HCV-34	VENT/FULL TRYCOCK VALVE	11368257	REGO	BK9453FAB	½" NOM x 3/8" FPT	GLOBE VALVE, EXT STEM
HCV-38	GAS PHASE (LOW) VALVE	10907239	REGO	CMM250A	¼" MPT x ¼" MPT	NEEDLE VALVE (ANGLE)
HCV-39	EQUALIZATION VALVE	10907239	REGO	CMM250A	¼" MPT x ¼" MPT	NEEDLE VALVE (ANGLE)
HCV-40	LIQUID PHASE (HIGH) VALVE	10907239	REGO	CMM250A	¼" MPT x ¼" MPT	NEEDLE VALVE (ANGLE)
HCV-41	PRESSURE BUILDER OUTLET VALVE	1710022	REGO	9464ADAG	3/8" NPS x 3/8" FPT	GREEN HANDLE
HCV-43	GAS USE VALVE	11368257	REGO	BK9453FAB	½" NOM x 3/8" FPT	GLOBE VALVE, EXT STEM
HCV-45	SAFETY RELIEF SELECTOR	11501901	HEROSE	06510-2050-9998	¾" NPS STUB	3-WAY DIVERTOR BALL VALVE
HCV-47	ECONOMIZER OUTLET VALVE	1713912	REGO	9464CA	3/8" NPS x 3/8" FPT	PLAIN HANDLE
LL-31	LEVEL INDICATOR	2012819	BARTON	#288	6" DIAL	0-75" H_2O
PCV-31	PRESSURE CONTROL VALVE	2110032	A.W. CASH	A-32, #19077-0125	¼" FPT	SET @ 125 PSI
PCV-32	ECONOMIZER REGULATOR	11501177	A.W. CASH	FRM-2, 12790	¼" FPT	SET @ 140 PSI
PI-31	PRESSURE INDICATOR	10700596	NOSHOK	40.100.400	¼" MPT	0-400 PSI
PSE-31A/B	PRESSURE SAFETY ELEMENT	11509339	Chart **UD Coded**	A-11509339	¾" MPT x FREE	375 PSI
PSE-31A/B	PRESSURE SAFETY ELEMENT	11519668 **VHR-400**	Chart **UD Coded**	A-11519688	¾" MPT x ¾" MPT	375 PSI
PSV-31A	PRESSURE SAFETY VALVE	1810402	Rockwood	RXSO	½"MPT x ¾"FPT	250 PSI
PSV-31B	PRESSURE SAFETY VALVE	1810402	Rockwood	A-11494835	¾" MPT x 1" FPT	250 PSI
TSV-31	LINE RELIEF VALVE	1810462	REGO	PRV9432T350	¼" MPT	350 PSI
TSV-32	LINE RELIEF VALVE	1810462	REGO	PRV9432T350	¼" MPT	350 PSI

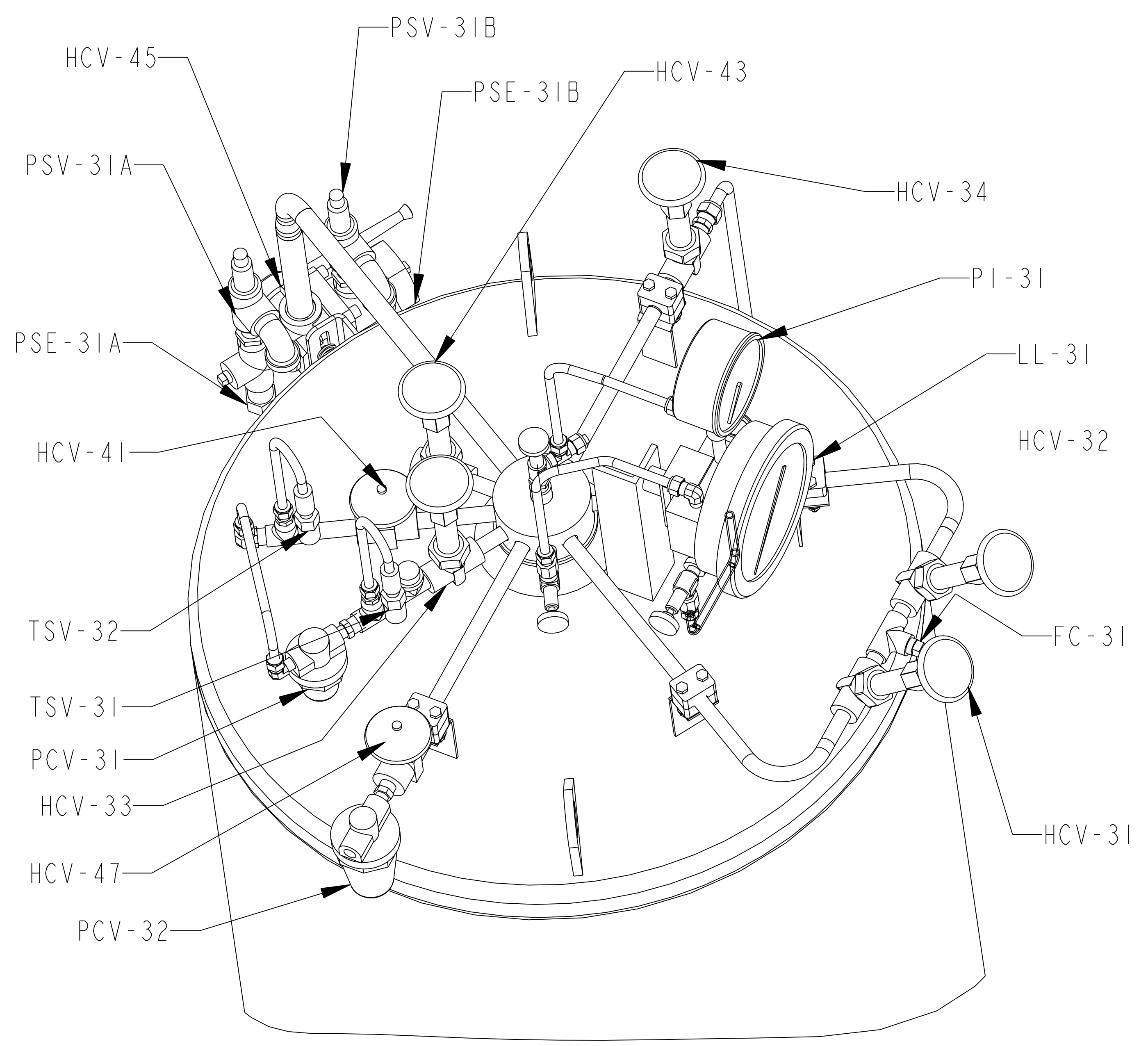
Section 6 – ILLUSTRATIONS

PROCESS & INSTRUMENT DRAWING VHR-120 C-11516011

PROCESS & INSTRUMENT DRAWING VHR-260 C-11516029

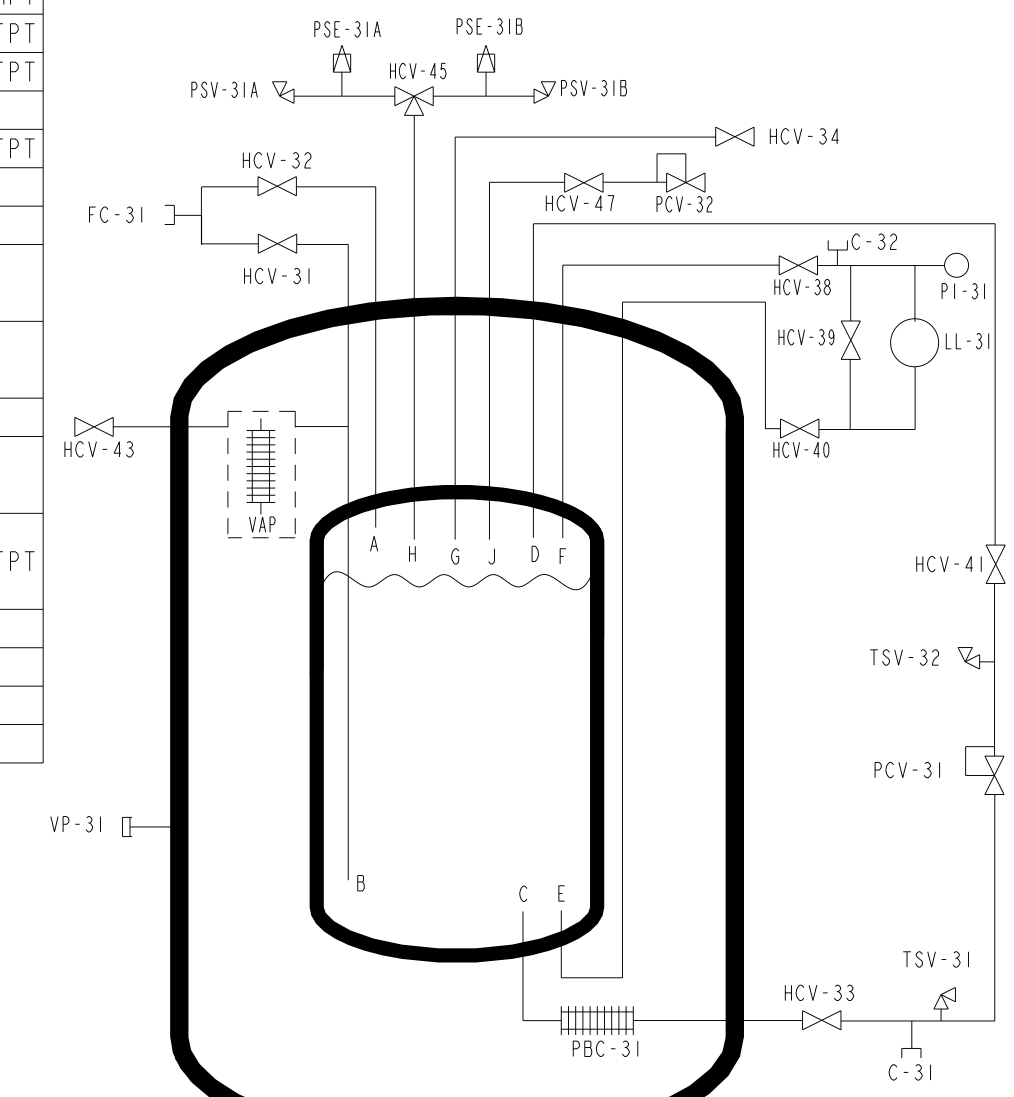
PROCESS & INSTRUMENT DRAWING VHR-400 C-11516045

DRAWING NO. C-11516011



TAG	DEFINITION	VENDOR INFORMATION	SIZE
C-31	INNER VESSEL PURGE CONNECTION	- -	3/8" MPT
C-32	PRESS SWITCH CONNECTION - OPTIONAL	- -	3/8" ODT
FC-31	FILL CONNECTION	- -	3/8" FPT
HCV-31	BOTTOM FILL VALVE	REGO ##BK9453FAB	1/2" NOM X 3/8" FPT
HCV-32	TOP FILL VALVE	REGO ##BK9453FAB	1/2" NOM X 3/8" FPT
HCV-33	PB INLET VALVE	REGO ##BK9453FAB	1/2" NOM X 3/8" FPT
HCV-34	VENT/FULL TRYCOCK VALVE	REGO ##BK9453FAB	1/2" NOM X 3/8" FPT
HCV-38	LL-31 VAPOR PHASE VALVE	REGO #CMM250A	1/4" MPT X 1/4" MPT
HCV-39	LL-31 EQUALIZATION VALVE	REGO #CMM250A	1/4" MPT X 1/4" MPT
HCV-40	LL-31 LIQUID PHASE VALVE	REGO #CMM250A	1/4" MPT X 1/4" MPT
HCV-41	PB OUTLET VALVE	REGO #9464ADAG	3/8" NPS X 3/8" FPT
HCV-43	GAS USE VALVE	REGO ##BK9453FAB	1/2" NOM X 3/8" FPT
HCV-45	SAFETY RELIEF SELECTOR	HEROSE #06510-2050-9998	3/4" NPS STUB
HCV-47	ECONOMIZER OUTLET VALVE	REGO #9464CA	3/8" NPS X 3/8" FPT
LL-31	LEVEL INDICATOR	BARTON GAUGE MODEL 288	
PBC-31	PRESSURE BUILD COIL	CHART SUPPLIED	
PCV-31	PRESSURE CONTROL VALVE	AW CASH TYPE A-32 VALVE #19077-0125 SPRING #07337	1/4" FPT
PCV-32	ECONOMIZER REGULATOR	AW CASH TYPE FRM-2 VALVE #12790 SPRING #8241	1/4" FPT
PI-31	PRESSURE INDICATOR	NOSHOK #40.100.400	1/4" MPT
PSE-31A PSE-31B	PRESSURE SAFETY ELEMENT	CONTINENTAL OR BS & B SET AT 375 PSI	3/4" MPT * FREE
PSV-31A PSV-31B	PRESSURE RELIEF VALVE	ROCKWOOD SET AT 250PSI	1/2" MPT * 3/4" FPT
TSV-31	PB CIRCUIT THERMAL RELIEF VALVE	REGO #PRV9432T350	1/4" MPT
TSV-32	PB CIRCUIT THERMAL RELIEF VALVE	REGO #PRV9432T350	1/4" MPT
VAP	GAS USE VAPORIZER	CHART SUPPLIED	
VP-31	VACUUM PORT		

A	5/8" OD	TOP FILL
B	5/8" OD	BOTTOM FILL
C	1/2" NOM	PB INLET
D	1/2" NOM	PB OUTLET
E	1/4" OD	LIQUID PHASE
F	3/8" OD	VAPOR PHASE
G	5/8" OD	FULL TRYCOCK/VENT
H	1/2" PS	DUAL RELIEF
J	5/8" OD	ECONOMIZER



INNER VESSEL DESIGN DATA

MAWP	PSIG	250
	barg	17.24
DESIGN PRESSURE	PSIG	267.3
	barg	18.43
CODE COMPLIANCE:	ASME SECTION VIII DIVISION 1- PART UHA	
DESIGN TEMPERATURE	°F	-320 TO 100
	°C	-196 TO 37
MATERIAL OF CONSTRUCTION	SA240 T304 STAINLESS STEEL	

OUTER VESSEL DESIGN DATA

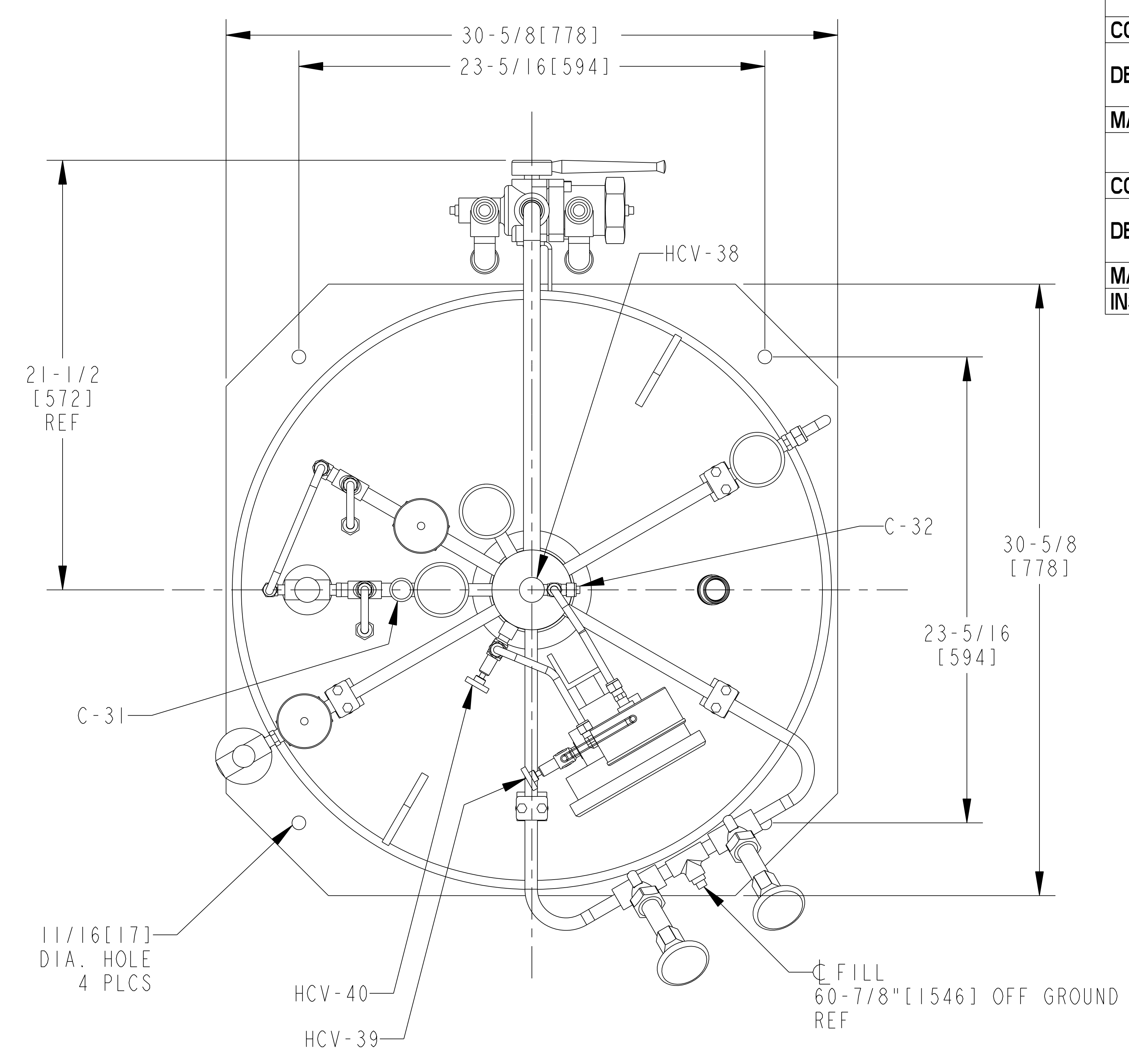
CODE COMPLIANCE	FULL VACUUM PER CGA-341	
DESIGN TEMPERATURE	°F	-20 TO 300
	°C	-29 TO 149
MATERIAL OF CONSTRUCTION	SA240 T304 STAINLESS STEEL	
INSULATION TYPE	VACUUM AND MULTILAYER INSULATION	

CAPACITIES

CAPACITY	GROSS (COLD)	GALLONS	118
		LITERS	447
	NET (COLD)	GALLONS	112
		LITERS	424
GAS EQUIVALENT AT 1atm AND 70°F	OXYGEN	SCF	12,800
		NM3	300
	NITROGEN	SCF	10,400
		NM3	300
	ARGON	SCF	12,600
		NM3	300

WEIGHTS AND SHIPPING DATA

WEIGHT EMPTY		POUNDS	700
		KILOGRAMS	300
WEIGHT FULL	OXYGEN	POUNDS	1,710
		KILOGRAMS	780
	NITROGEN	POUNDS	1,400
		KILOGRAMS	640
	ARGON	POUNDS	1,950
		KILOGRAMS	890
SHIPPING DIMENSIONS		IN'S	40 X 30-5/8 X 80
		mm'S	1016 X 778 X 2032
OUTER OD			30[762] OD
INNER ID			27-5/8[701] ID
HEIGHT OF PIPING			80 [2032] REF



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REV	ECR NO	REVISION DESCRIPTION	BY	DATE
E	11896	CHG RV'S	JJC	12-11-01
D	11776	ADDED C-32 CONNECTION	MDS	6/12/01
C	-	BK9453FAB WAS ES9473	JEN	5/3/01
B	-	ADDED C-31 CONNECTION	MDS	4/3/01
A	-	CHGD RPD TYPE, LABELS	MDS	3/12/01

	APPROVED	DATE
DRAWN BY	JJS	1/23/01
CHK'D BY	MMK	2/1/01
MFG. SERV.	-	-
PROJ. ENGR.	MDS	2/5/01
MFG. ENGR.	-	-
QUAL. CONT.	-	-

NEXT ASS'Y	USED ON	NEXT ASS'Y	FINAL ASS'Y
APPLICATION		QUANTITY REQ'D	

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MAT'L

PART NUMBER 11516011

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.
TOLERANCES:
FRACTIONS ± 1/4
ANGLES ± 1°
2 PLACE DECIMALS ± NA
3 PLACE DECIMALS ± NA

CHART Storage Systems Division New Prague Operations

TITLE PROCESS AND INSTRUMENT OUTLINE & DIMENSION VHR-120

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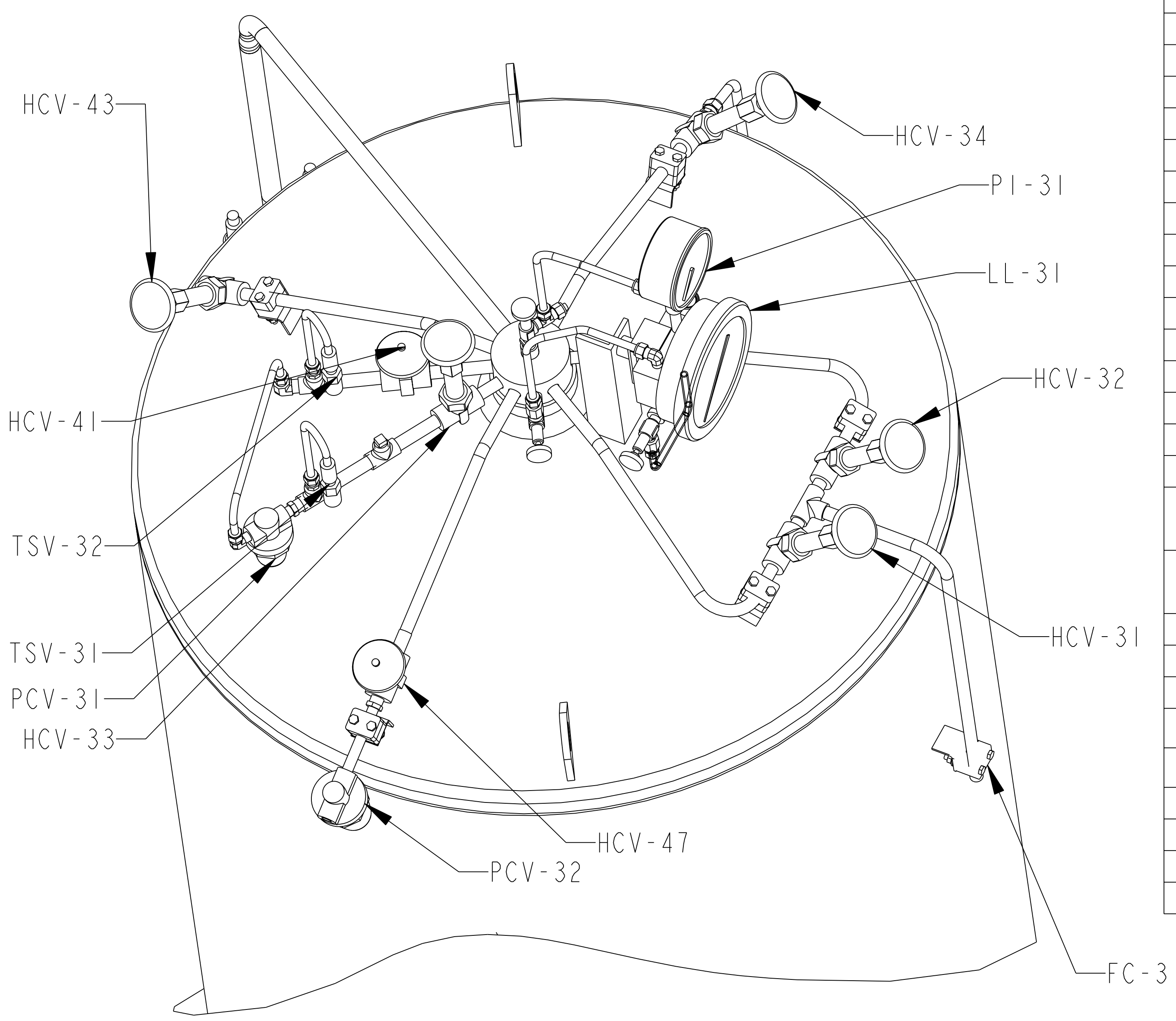
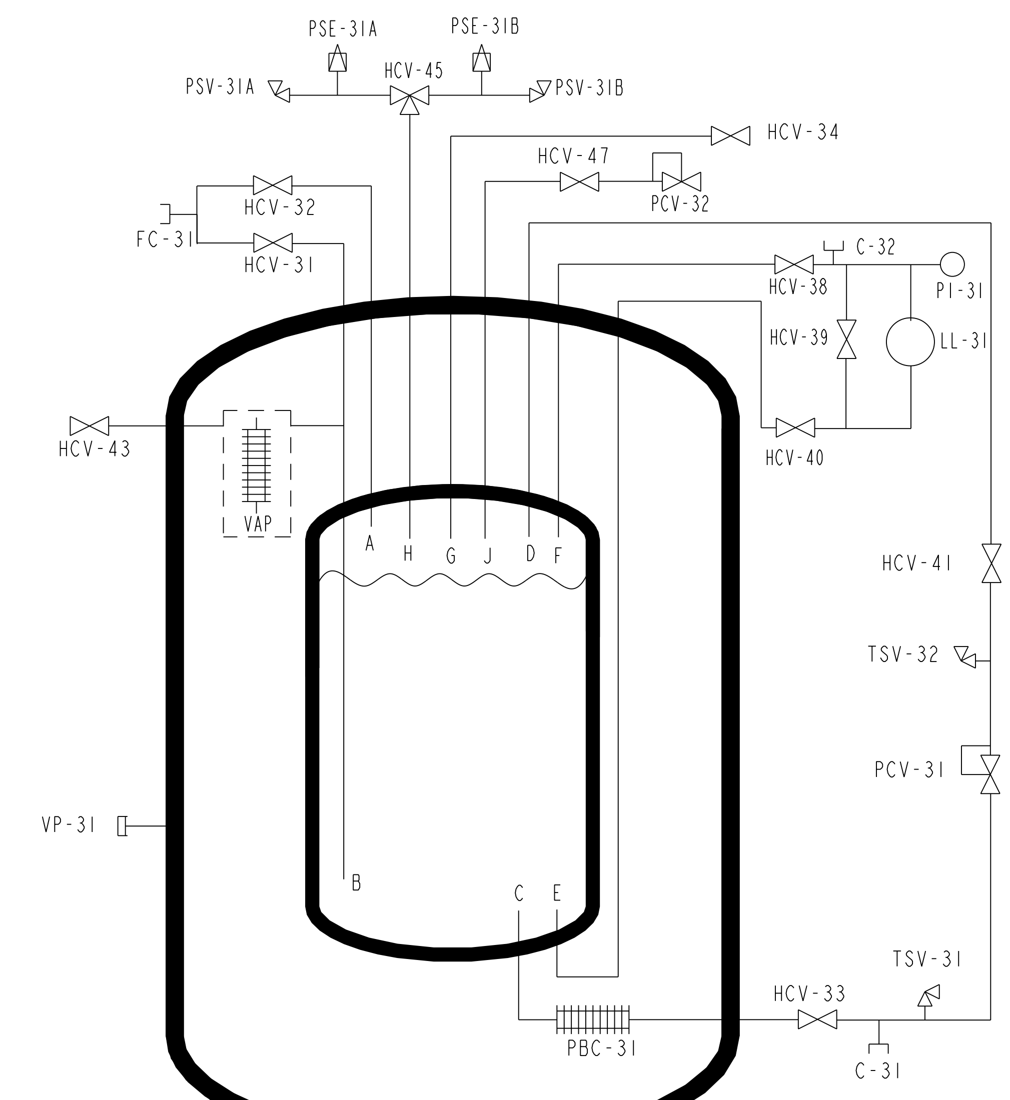
SCALE 3/64"=1" | DO NOT SCALE DRAWING | SHEET 1 OF 1

DRAWING NO. C-11516029



TAG	DEFINITION	VENDOR INFORMATION	SIZE
C-31	INNER VESSEL PURGE CONNECTION	- -	3/8" FPT
C-32	PRESS SWITCH CONNECTION - OPTIONAL	- -	3/8" ODT
FC-31	FILL CONNECTION	- -	3/8" MPT
HCV-31	BOTTOM FILL VALVE	REGO #BK9453FAB	1/2" NOM X 3/8" FPT
HCV-32	TOP FILL VALVE	REGO #BK9453FAB	1/2" NOM X 3/8" FPT
HCV-33	PB INLET VALVE	REGO #BK9453FAB	1/2" NOM X 3/8" FPT
HCV-34	VENT/FULL TRYCOCK VALVE	REGO #BK9453FAB	1/2" NOM X 3/8" FPT
HCV-38	LL-31 VAPOR PHASE VALVE	REGO #CMM250A	1/4" MPT X 1/4" MPT
HCV-39	LL-31 EQUALIZATION VALVE	REGO #CMM250A	1/4" MPT X 1/4" MPT
HCV-40	LL-31 LIQUID PHASE VALVE	REGO #CMM250A	1/4" MPT X 1/4" MPT
HCV-41	PB OUTLET VALVE	REGO #9464ADAG	3/8" NPS X 3/8" FPT
HCV-43	GAS USE VALVE	REGO #BK9453FAB	1/2" NOM X 3/8" FPT
HCV-45	SAFETY RELIEF SELECTOR	HEROSE #06510-2050-9998	3/4" NPS STUB
HCV-47	ECONOMIZER OUTLET VALVE	REGO #9464CA	3/8" NPS X 3/8" FPT
LL-31	LEVEL INDICATOR	BARTON GAUGE MODEL 288	
PBC-31	PRESSURE BUILD COIL	CHART SUPPLIED	
PCV-31	PRESSURE CONTROL VALVE	AW CASH TYPE A-32 VALVE #19077-0125 SPRING #07337	1/4" FPT
PCV-32	ECONOMIZER REGULATOR	AW CASH TYPE FRM-2 VALVE #12790 SPRING #8241	1/4" FPT
PI-31	PRESSURE INDICATOR	NOSHOK #40.100.400	1/4" MPT
PSE-31A PSE-31B	PRESSURE SAFETY ELEMENT	CONTINENTAL OR BS & B SET AT 375 PSI	3/4" MPT * FREE
PSV-31A PSV-31B	PRESSURE RELIEF VALVE	ROCKWOOD SET AT 250PSI	1/2" MPT * 3/4" FPT
TSV-31	PB CIRCUIT THERMAL RELIEF VALVE	REGO #PRV9432T350	1/4" MPT
TSV-32	PB CIRCUIT THERMAL RELIEF VALVE	REGO #PRV9432T350	1/4" MPT
VAP	GAS USE VAPORIZER	CHART SUPPLIED	
VP-31	VACUUM PORT		

A	5/8" OD	TOP FILL
B	5/8" OD	BOTTOM FILL
C	1/2" NOM	PB INLET
D	1/2" NOM	PB OUTLET
E	1/4" OD	LIQUID PHASE
F	1/4" OD	VAPOR PHASE
G	5/8" OD	FULL TRYCOCK/VENT
H	1/2" PS	DUAL RELIEF
J	5/8" OD	ECONOMIZER

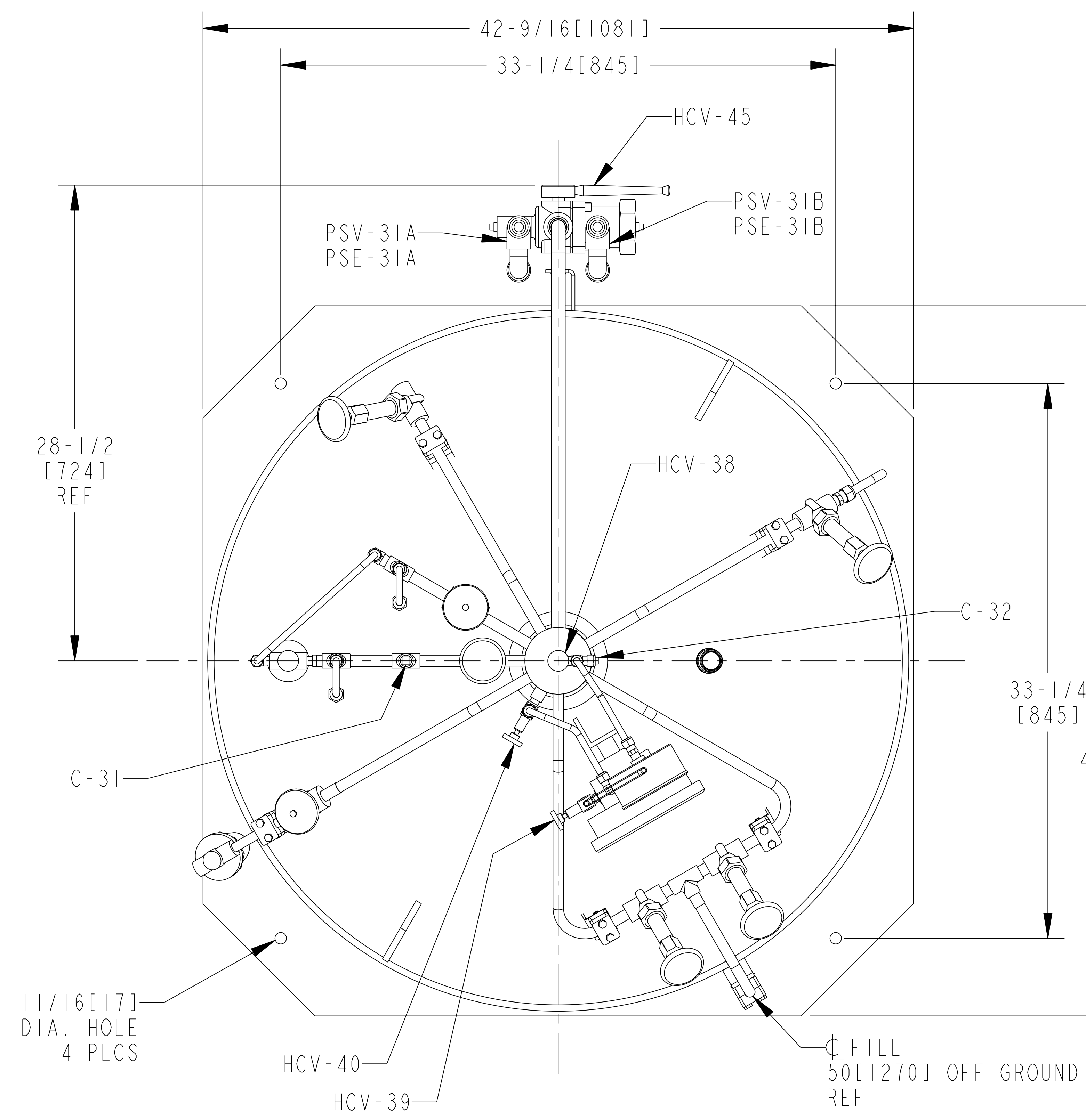


INNER VESSEL DESIGN DATA

MAWP	PSIG	250
	barg	17.24
DESIGN PRESSURE	PSIG	268
	barg	18.48
CODE COMPLIANCE:	ASME SECTION VIII DIVISION 1- PART UHA	
DESIGN TEMPERATURE	°F	-320 TO 100
	°C	-196 TO 37
MATERIAL OF CONSTRUCTION	SA240 T304 STAINLESS STEEL	

OUTER VESSEL DESIGN DATA

CODE COMPLIANCE	FULL VACUUM PER CGA-341	
DESIGN TEMPERATURE	°F	-20 TO 300
	°C	-29 TO 149
MATERIAL OF CONSTRUCTION	SA240 T304 STAINLESS STEEL	
INSULATION TYPE	VACUUM AND MULTILAYER INSULATION	



CAPACITIES

CAPACITY	GROSS (COLD)	GALLONS	269
		LITERS	1,017
	NET (COLD)	GALLONS	256
		LITERS	969
GAS EQUIVALENT AT 1atm AND 70°F	OXYGEN	SCF	29,500
		NM3	780
	NITROGEN	SCF	23,900
		NM3	630
	ARGON	SCF	28,800
		NM3	760

WEIGHTS AND SHIPPING DATA

WEIGHT EMPTY		POUNDS	1,700
		KILOGRAMS	770
WEIGHT FULL	OXYGEN	POUNDS	4,100
		KILOGRAMS	1,860
	NITROGEN	POUNDS	3,400
		KILOGRAMS	1,540
	ARGON	POUNDS	4,700
		KILOGRAMS	2,130
SHIPPING DIMENSIONS		IN'S	50 X 43 X 94
		mm'S	1,270 X 1,092 X 2,388
OUTER OD			42 [1067] OD
INNER ID			37-1/4 [946] ID
HEIGHT OF PIPING			94 [2388] REF

REV	ECR NO	REVISION DESCRIPTION	BY	DATE
D	11896	CHG RV'S	JJC	12-11-01
C	11776	ADDED C-32 CONNECTION	MDS	6/12/01
B	-	BK9453FAB WAS ES9473	JEN	5/3/01
A	-	ADDED C-31 CONNECTION	MDS	4/4/01

APPROVED		DATE
DRAWN BY	JJS	1/23/01
CHK'D BY	MMK	2/1/01
MFG. SERV.	-	-
PROJ. ENGR.	MDS	2/5/01
MFG. ENGR.	-	-
QUAL. CONT.	-	-

NEXT ASS'Y	USED ON	NEXT ASS'Y	FINAL ASS'Y
APPLICATION		QUANTITY REQ'D	

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IN[mm]

MAT'L

PART NUMBER 11516029

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.
TOLERANCES:
FRACTIONS ± 1/2
ANGLES ± 1°
2 PLACE DECIMALS ± NA
3 PLACE DECIMALS ± NA

CHART Storage Systems Division New Prague Operations

TITLE PROCESS AND INSTRUMENT OUTLINE & DIMENSION VHR-260

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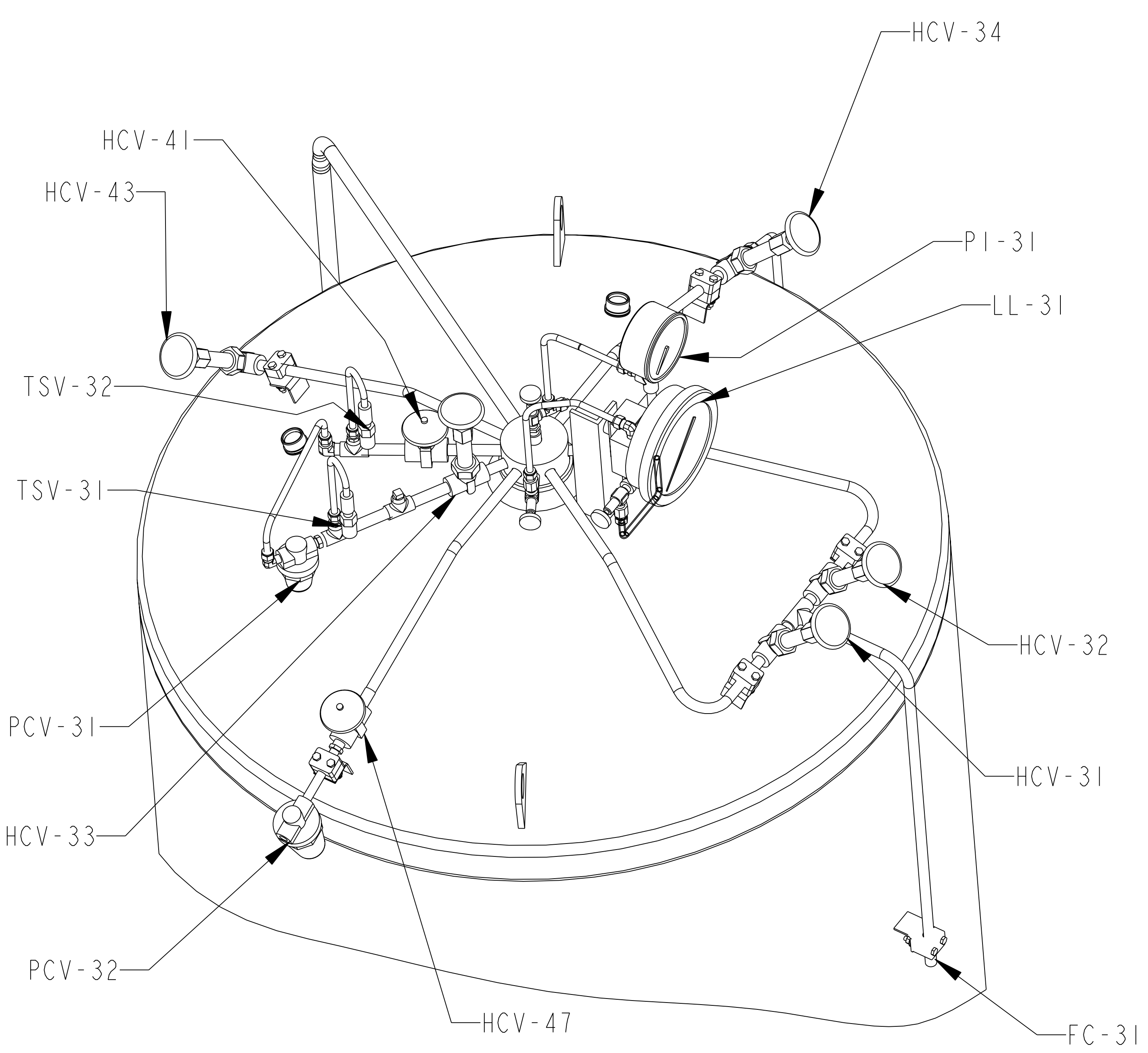
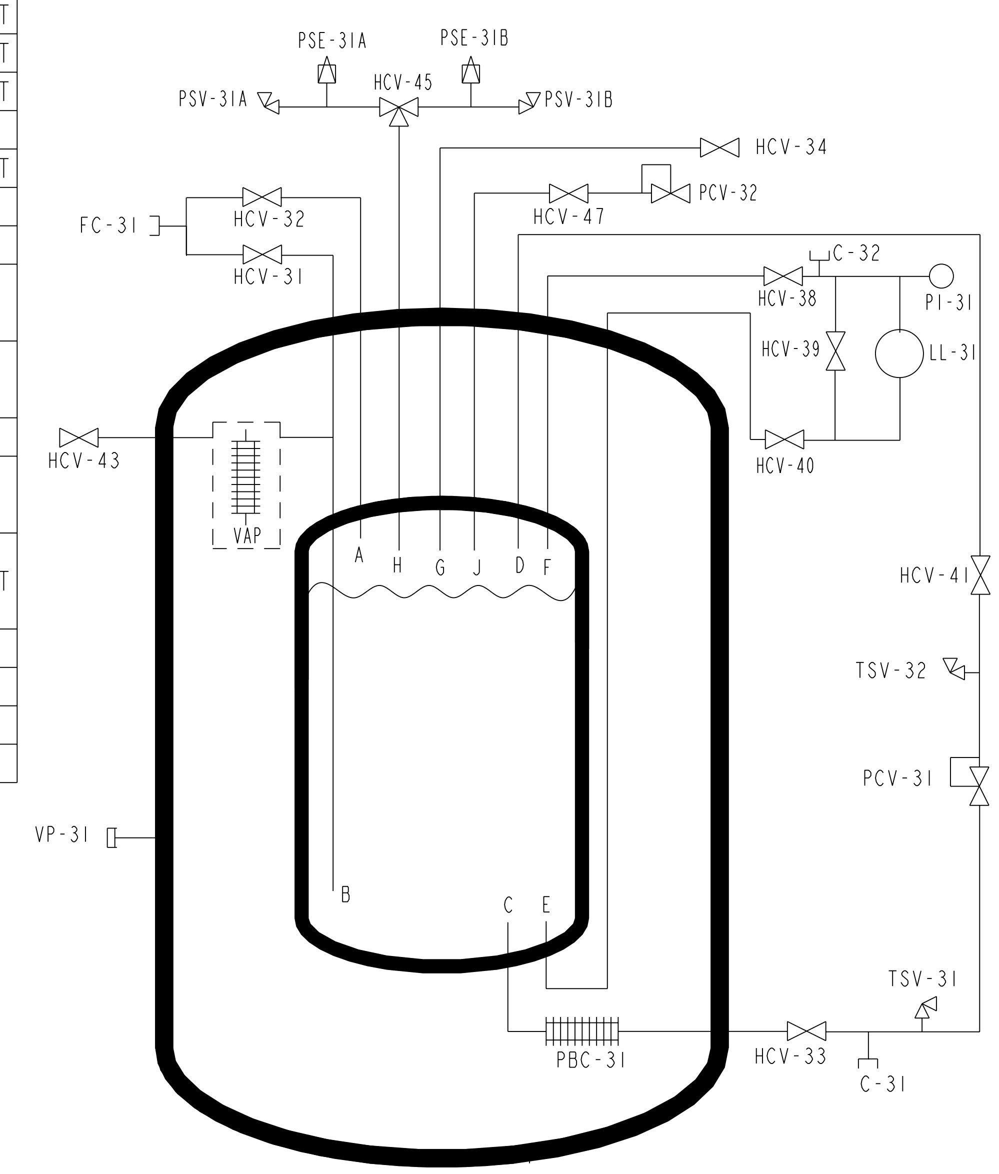


TAG	DEFINITION	VENDOR INFORMATION	SIZE
C-31	INNER VESSEL PURGE CONNECTION	- -	3/8" FPT
C-32	PRESS SWITCH CONNECTION - OPTIONAL	- -	3/8" ODT
FC-31	FILL CONNECTION	- -	3/8" MPT
HCV-31	BOTTOM FILL VALVE	REGO #BK9453FAB	1/2" NOM X 3/8" FPT
HCV-32	TOP FILL VALVE	REGO #BK9453FAB	1/2" NOM X 3/8" FPT
HCV-33	PB INLET VALVE	REGO #BK9453FAB	1/2" NOM X 3/8" FPT
HCV-34	VENT/FULL TRYCOCK VALVE	REGO #BK9453FAB	1/2" NOM X 3/8" FPT
HCV-38	LL-31 VAPOR PHASE VALVE	REGO #CMM250A	1/4" MPT X 1/4" MPT
HCV-39	LL-31 EQUALIZATION VALVE	REGO #CMM250A	1/4" MPT X 1/4" MPT
HCV-40	LL-31 LIQUID PHASE VALVE	REGO #CMM250A	1/4" MPT X 1/4" MPT
HCV-41	PB OUTLET VALVE	REGO #9464ADAG	3/8" NPS X 3/8" FPT
HCV-43	GAS USE VALVE	REGO #BK9453FAB	1/2" NOM X 3/8" FPT
HCV-45	SAFETY RELIEF SELECTOR	HEROSE #06510-2050-9998	3/4" NPS STUB
HCV-47	ECONOMIZER OUTLET VALVE	REGO #9464CA	3/8" NPS X 3/8" FPT
LL-31	LEVEL INDICATOR	BARTON GAUGE MODEL 288	
PBC-31	PRESSURE BUILD COIL	CHART SUPPLIED	
PCV-31	PRESSURE CONTROL VALVE	AW CASH TYPE A-32 VALVE #19077-0125 SPRING #07337	1/4" FPT
PCV-32	ECONOMIZER REGULATOR	AW CASH TYPE FRM-2 VALVE #12790 SPRING #8241	1/4" FPT
PI-31	PRESSURE INDICATOR	NOSHOK #40.100.400	1/4" MPT
PSE-31A PSE-31B	PRESSURE SAFETY ELEMENT	CONTINENTAL OR BS & B SET AT 375 PSI	3/4" MPT * FREE
PSV-31A PSV-31B	PRESSURE RELIEF VALVE	ROCKWOOD SET AT 250PSI	1/2" MPT * 3/4" FPT
TSV-31	PB CIRCUIT THERMAL RELIEF VALVE	REGO #PRV9432T350	1/4" MPT
TSV-32	PB CIRCUIT THERMAL RELIEF VALVE	REGO #PRV9432T350	1/4" MPT
VAP	GAS USE VAPORIZER	CHART SUPPLIED	
VP-31	VACUUM PORT		

A	5/8" OD	TOP FILL
B	5/8" OD	BOTTOM FILL
C	1/2" NOM	PB INLET
D	1/2" NOM	PB OUTLET
E	1/4" OD	LIQUID PHASE
F	1/4" OD	VAPOR PHASE
G	5/8" OD	VENT/FULL TRYCOCK
H	1/2" PS	DUAL RELIEF
J	5/8" OD	ECONOMIZER

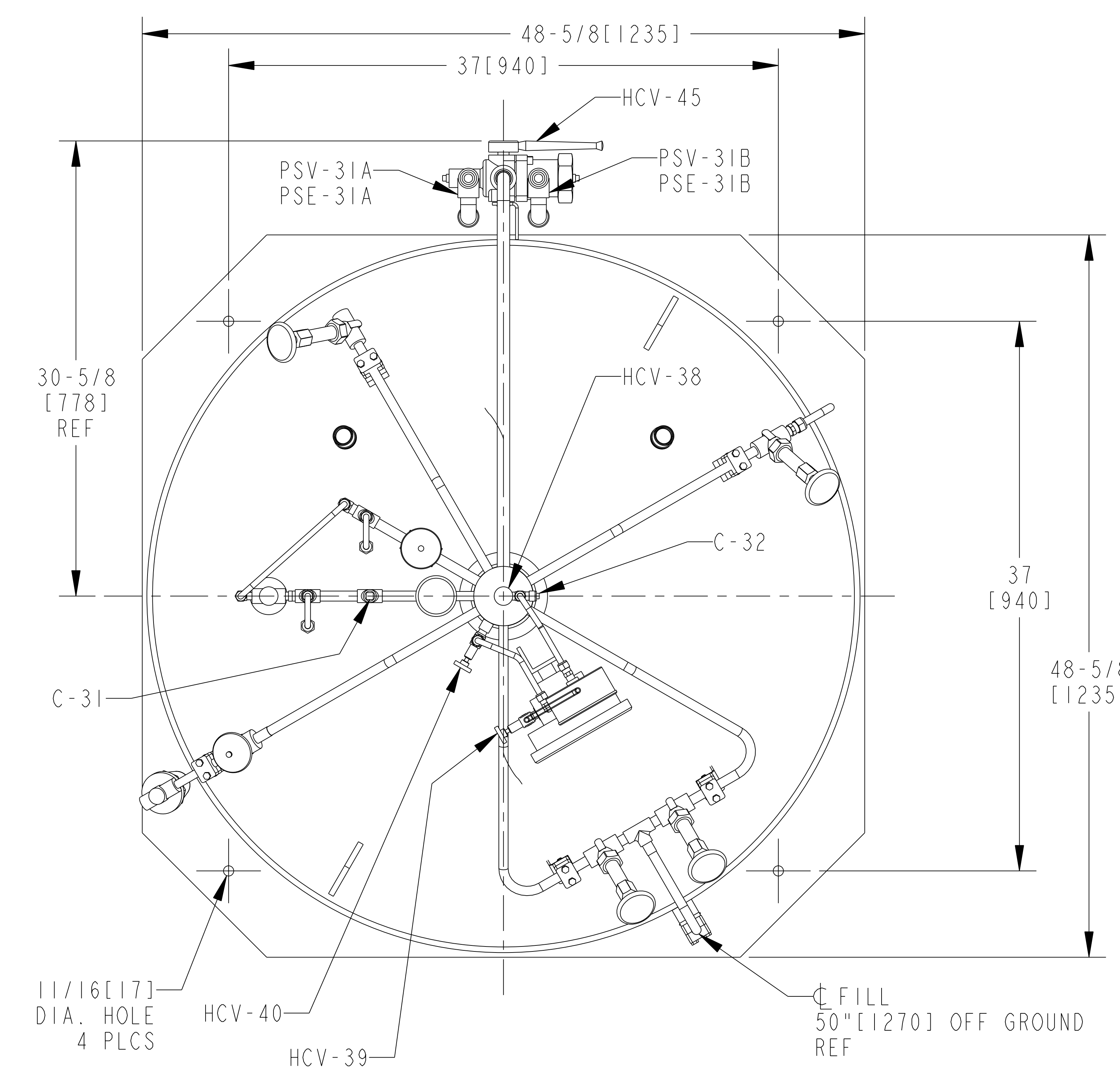


INNER VESSEL DESIGN DATA

MAWP	PSIG	250
	barg	17.24
DESIGN PRESSURE	PSIG	268
	barg	18.48
CODE COMPLIANCE:	ASME SECTION VIII DIVISION 1- PART UHA	
DESIGN TEMPERATURE	°F	-320 TO 100
	°C	-196 TO 37
MATERIAL OF CONSTRUCTION	SA240 T304 STAINLESS STEEL	

OUTER VESSEL DESIGN DATA

CODE COMPLIANCE	FULL VACUUM PER CGA-341	
DESIGN TEMPERATURE	°F	-20 TO 300
	°C	-29 TO 149
MATERIAL OF CONSTRUCTION	SA240 T304 STAINLESS STEEL	
INSULATION TYPE	VACUUM AND MULTILAYER INSULATION	



CAPACITIES

CAPACITY	GROSS (COLD)	GALLONS	410
		LITERS	1,553
	NET (COLD)	GALLONS	391
		LITERS	1,479
GAS EQUIVALENT AT 1atm AND 70°F	OXYGEN	SCF	45,100
		NM3	1,190
	NITROGEN	SCF	36,500
		NM3	960
	ARGON	SCF	44,000
		NM3	1,160

WEIGHTS AND SHIPPING DATA

WEIGHT EMPTY		POUNDS	2,100
		KILOGRAMS	950
WEIGHT FULL	OXYGEN	POUNDS	5,800
		KILOGRAMS	2,630
	NITROGEN	POUNDS	4,800
		KILOGRAMS	2,180
	ARGON	POUNDS	6,700
		KILOGRAMS	3,040
SHIPPING DIMENSIONS	IN'S	57 X 49 X 100	
	mm'S	1,448 X 1,245 X 2,540	
OUTER OD		48 [1219] OD	
INNER ID		44 [1118] ID	
HEIGHT OF PIPING		100 [2540] REF	

IN[mm]

REV	ECR NO	REVISION DESCRIPTION	BY	DATE
C	11896	CHG RV'S	JJC	12-11-01
B	11776	ADDED C-32 CONNECTION	MDS	6/12/01
A	-	BK9453FAB WAS ES9473	JEN	5/3/01

	APPROVED	DATE
DRAWN BY	JJS	1/23/01
CHK'D BY	MMK	2/1/01
MFG. SERV.	-	-
PROJ. ENGR.	MDS	2/5/01
MFG. ENGR.	-	-
QUAL. CONT.	-	-

NEXT ASS'Y	USED ON	NEXT ASS'Y	FINAL ASS'Y
APPLICATION		QUANTITY REQ'D	

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MAT'L

PART NUMBER 11516045

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.
TOLERANCES:
FRACTIONS ± 1/2
ANGLES ± 1°
2 PLACE DECIMALS ± NA
3 PLACE DECIMALS ± NA

CHART Storage Systems Division New Prague Operations

TITLE PROCESS AND INSTRUMENT OUTLINE & DIMENSION VHR-400

DRAWING NO. C-11516045 REV C

SCALE 7/64"=1" | DO NOT SCALE DRAWING | SHEET 1 OF 1