OPERATING INSTRUCTIONS

CH SERIES STANDARD VESSELS

LIQUID HELIUM

OP-75

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Contents

General Instructions and Warranty

Thank you for purchasing this product from Wessington Cryogenics.

The CH series vessel is designed only for the storage of liquid helium. Liquefied gas is filled into the vessel, stored there until it is required and then withdrawn either as liquefied or gaseous gas. Any other use of the vessel is not intended.

The vertical storage vessel shall only be operated, used and employed in accordance with the information contained in these operating instructions or any other information cross-referenced in this document. In particular, only the activities described in this document shall be carried out and only by authorized personnel.

The vertical storage vessel must not be used for any other purpose other than that defined in this document. If the vessel is used for any other purpose other than described herein, there is a risk of accident, (fatal) injury and (extensive) damage. Therefore any use that it is not intended for is forbidden.

Neither the manufacturer nor their assistants are liable for any damage caused as a result of using the vessel other than intended.

We trust that your CH Series Vessel will give you many years of trouble free service. However, to help ensure this please take note of the following:

- Always follow the operating instructions.
- Follow the safety guidelines.
- Keep the vessel upright at all times.
- Handle with care at all times - Rough handling can cause serious damage to the vessel.
- Do not 'walk' roll or drag vessels.
- Protect the vessel from severe jolting and impact.
- Do not allow the vessel to come into contact with chemicals or other substances which could promote corrosion.
- Do not attempt to lift or move large, heavy vessels without assistance.

This vessel has been constructed from materials suitable for cryogenic service to ensure a high performance specification. Every care has been taken in its design, construction and testing to ensure it is safe and fit for the purpose for which it is sold.

Full terms and conditions are available on request.

General Information

The ***CH series*** of vessels are specially designed for the storage, transportation and dispensing of liquid helium in both industrial and laboratory applications.

Constructed entirely from stainless steel, the CH series vessels combine high strength with an attractive polished finish. The CH 250 and larger vessels are also made of the same high strength material and are painted white rather than polished. A robust valve protection ring offers both security to the operation valves and safety valves fitted to the vessel. This ring also helps with the handling of the vessel. All vessels are mounted on heavy duty stainless steel swivel castors as standard. Two are fitted with a brake arrangement.

The vessel has been designed, constructed and tested in accordance with relevant international pressure vessel codes and is TPED approved. Provided the unit is operated in accordance with the following procedures, the vessel should provide you with years of trouble free operation. Careless use of this vessel may cause damage to the vessel, user and/or nearby property. Do not allow unauthorised use of this vessel.

Standard Models in the CH series	Accessories available for the CH series
CH-30 : 30 litre capacity	Superconducting contents Meter/Probe
CH-60 : 60 litre capacity	Safety equipment
CH-100 : 100 litre capacity	Oxygen deficiency monitors
CH-120 : 120 litre capacity	Bladder
CH-250 : 250 litre capacity	Dipstick
CH-500 : 500 litre capacity	Transfer Siphon
CH-1000 : 1000 litre capacity	

Photographs of Typical Vessel

Safe Use of Liquefied Gases

Ensure the vessel is operated in an area which has adequate ventilation. This is essential when filling and decanting the vessel. Liquid helium is an inert gas which does not support life. Small volumes of liquid can evaporate into large quantities of gas - nominally 750:1 ratio and consequently can easily deplete the oxygen content of the air in enclosed spaces, thus causing asphyxiation.

Liquid Oxygen can liquefy from the air onto cold components, it constitutes a further major hazard in that it supports combustion and this can be explosive in its intensity.

Avoid all possible sources of fire

NO SMOKING - NO NAKED FLAMES OR SPARKS - NO ELECTRIC METERS OR WELDING EQUIPMENT IN THE VACINITY - NO COMBUSTIBLE MATERIALS EITHER NEARBY OR IN THE EQUIPMENT ITSELF. DO NOT USE OIL OR GREASE ON ANY SCREW THREADS OR FITTINGS - ANY EQUIPMENT MUST BE THOROUGHLY DEGREASED FOR OXYGEN SERVICE.

Use only containers specifically designed for cryogenic service. Use proper transfer equipment such as a stainless steel flexible hose, phase separator or special filling adaptor / funnel to prevent splashing / spillage.

Cryogenic liquefied gases can cause severe cold burns if the liquid is allowed to come into contact with bare skin or delicate tissues such as your eyes.

WEAR PROTECTIVE CLOTHING - WEAR WARM DRY NON-ABSORBENT GLOVES (SUCH AS LEATHER). WEAR EYE PROTECTION - GLASSES, GOGGLES OR FACE SCREEN. HANDLE WITH CARE AND POUR OR TRANSFER SLOWLY TO AVOID SPILLING.

First Aid Treatment of Cold Burns

Flush the affected areas of skin with copious quantities of tepid water, but do not apply any form of direct heat, e.g. Hot water, room heaters etc. Move casualty to a warm place (about 22C). If medical attention is not immediately available, arrange for the casualty to be transported to hospital without delay.

While waiting for transport:

1) Loosen any restrictive clothing.

2) Continue to flush the affected areas of skin with copious quantities of tepid water.

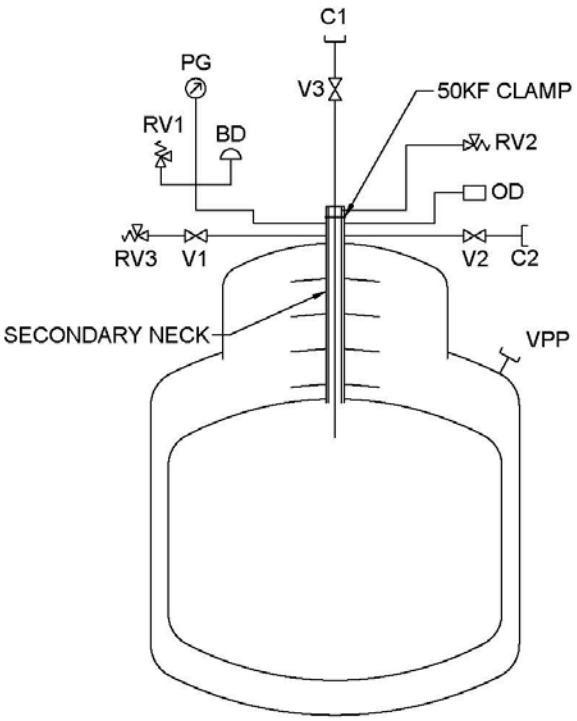
3) Protect frozen parts with bulky, dry, sterile dressings. Do not apply too tightly so as to cause restriction of blood circulation.

4) Keep the patient warm and at rest.

Ensure ambulance crew or hospital is advised of details of accident and first aid treatment already administered.

Smoking & alcoholic beverages reduce the blood supply to the affected part and should be avoided.

Schematic Arrangement



CH Series - Standard Arrangement

Item	Description
V1	Travelling Valve
V2	Helium Recovery Valve
V3	Isolation Valve (Optional)
RV1	Primary Relief Valve
RV2	Secondary Relief Valve (Optional)
RV3	Travelling Relief Valve
BD	Burst Disc
OD	Oscillation Damper
PG	Pressure Gauge
VPP	Vacuum Pumping Port
C1	Siphon Gland(s)
C2	NW 25 KF Connector

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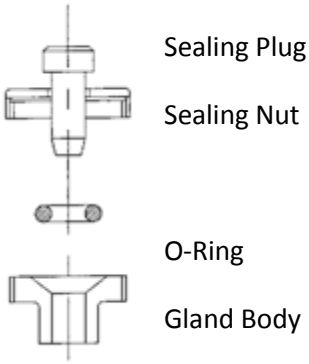
This schematic is for the standard vessel, for schematics of factory fitted variations see applicable section of operating instructions.

Description of Valves and Components

V1	Travelling Valve	This ball valve is installed in the primary vent path. Opening this valve enables the pressure in the vessel to be relieved by the Travelling Relief Valve RV3. When the full vessel is being transported, it is recommended that the Travelling Valve is in the open position.
V2	Helium Recovery Valve / Primary Vent Valve	This ball valve is installed in the primary vent path to ensure that under normal operation, the natural evaporation rate of Helium gas is through the narrow annulus, close to the wall of the vessel neck tube, to give the best thermal efficiency to the insulation and floating radiation shields. This is the valve which should be connected to a Helium recovery system during normal operation.
V3	Isolation Ball Valve (optional)	This valve is installed in the secondary (inner) vent path to allow insertion of the helium siphon with minimum loss of pressure / ingress of air.
RV1	Primary Relief Valve	This is a low pressure safety relief valve installed in the primary vent path to relieve excess pressure during normal operation.
RV2	Secondary Relief Valve (optional)	This is a low pressure safety relief valve connected to the inner neck of the safety head to provide a second relief in the event of overload of the primary relief valve or primary vent path blockage.
RV3	Travelling Relief Valve	This relief valve is in the primary vent path, set at a lower pressure than the other safety relief devices, for use when the full vessel is begin transported. To use this relief valve the Travelling Valve V1 must be open.
BD	Burst Disc	This is a rupture device which is installed in the primary vent path gives overall protection in the event of gross failure in the vessel. Its set pressure is higher than that of the Relief Valves.
OD	Oscillation Damper	Very severe and rapid thermal oscillation can occur in small bore tubes which connect between the cold Liquid Helium and the warm atmospheric head of Helium Dewars. The narrow annulus created by the twin neck can behave very similarly to a small bore tube and the oscillation damper is installed to prevent this.
PG	Pressure Gauge	This indicates the pressure in the inner vessel.

C1 Siphon Entry Port(s) Siphon entry ports are provided. These will be bored out to suit the size of siphon the customer intends to use. We can supply from 10mm to 16mm diameter or NW25KF flange



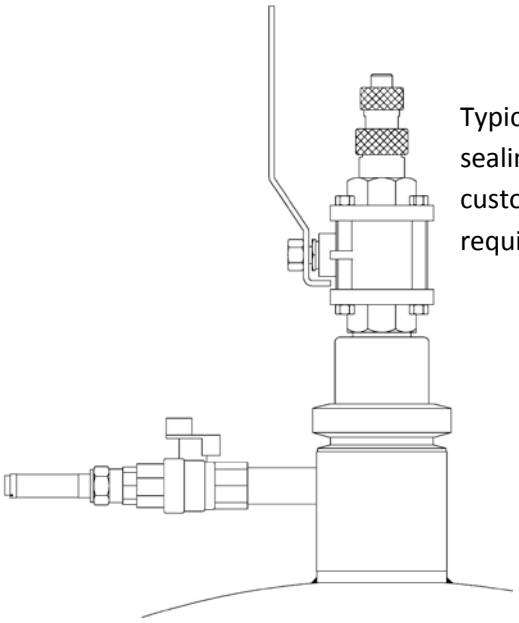


Fig.2

In some instances more than one is provided, and also reducing glands which cater for two size are installed depending on the application.

Whatever the size or configuration, they all conform generally to the typical arrangement shown in fig. 2.

Secondary Neck — The secondary neck tube is manufactured from a non-metallic material which has low thermal conductivity properties. The function of the secondary neck, detailed previously, is to improve the safety of the vessel by having two, separate safety relief paths.

Castors — Castors are fitted as standard on the CH Range of helium dewars. Two castors are fitted with a footbrake to prevent the vessel from moving when required.

Tubular Ring Handle — The tubular ring handle is used for both manoeuvrability of the vessel, and to provide protection of the valves and safeties.

Putting a New Dewar into Service

Note!

Because of the low latent heat of vaporisation of Liquid Helium it would be grossly wasteful to attempt to fill a warm dewar without pre-cooling it.

a) Pre-Cooling with Liquid Nitrogen

Part fill with Liquid Nitrogen (approximately 20% to 30% of rated contents) and allow the vessel to cool down to -196oC. Note! This can take several days on the first cool down of a new, warm dewar.

Pump out the remaining Liquid Nitrogen by pressure dispensing until the vessel is virtually empty.

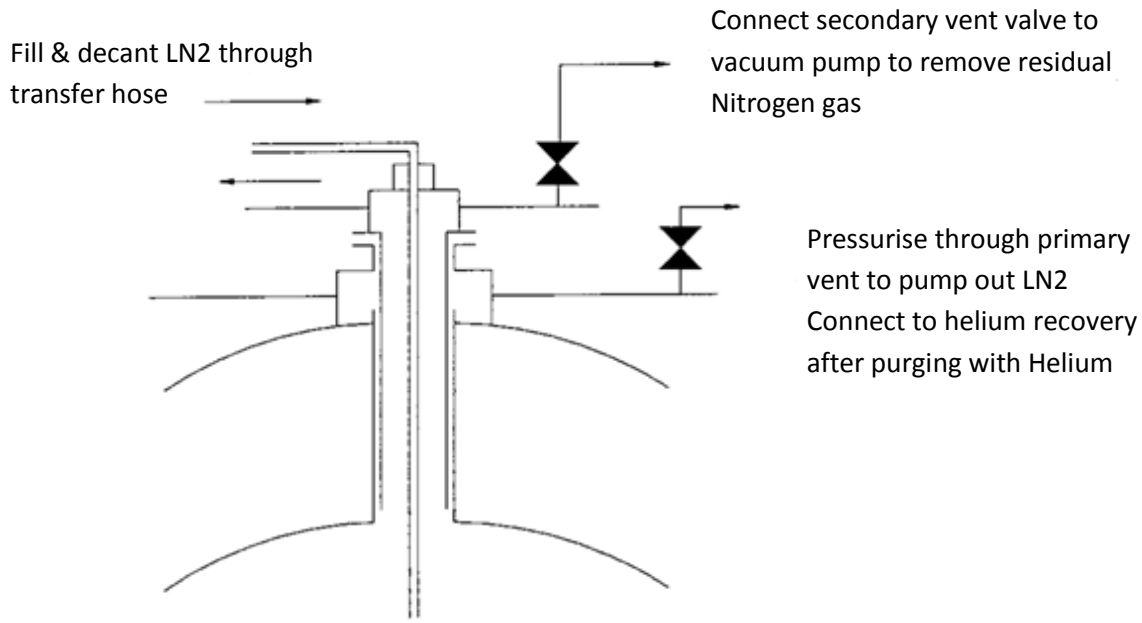


Fig.3 Pre-cooling with Liquid Nitrogen

Remove all final traces of Nitrogen from the vessel by connecting to a vacuum pump as shown in fig.3.

b) Purging with Cold Helium Gas

After removing all Nitrogen gas from the dewar, purge the interior with cold Helium gas from the supply tank. The use of cold gas will help to lower the temperature of the dewar further and help in reducing liquid transfer losses when it is eventually filled.

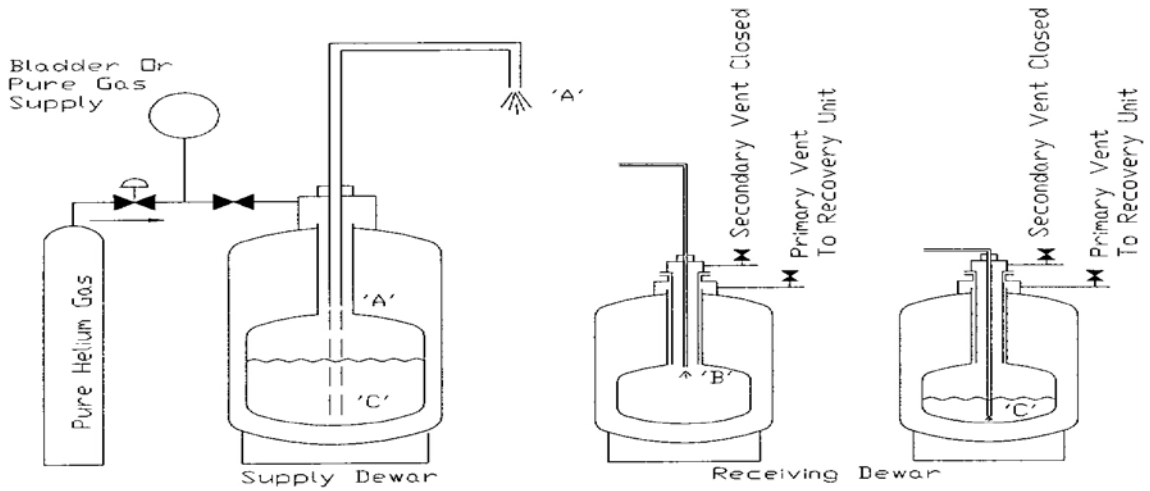


Fig.4 Purging with Cold Helium Gas

Arrange the supply tank, receiving dewar, and vacuum insulated tube as shown in fig. 4.

Provide a means of pressurising the supply tank (either a low pressure helium gas supply or a bladder as shown).

Remove the siphon gland seal from the supply tank and insert the longer leg of the transfer tube - Helium gas will flow through and purge the transfer tube (Position 'A').

Remove the siphon gland seal from the receiving dewar and slowly lower the transfer tube into both supply tank and receiving dewar (Position 'B'). Cold gas from the supply tank will help to further pre-cool the receiving dewar.

Lower the transfer tube slowly to Position 'C' - in some instances it may be easier to raise the receiving dewar on a trolley jack to attain this final position.

At this final Position 'C', the intense cold concentrated at the base of the dewar will cool it sufficiently to allow liquid to begin to collect in the receiving dewar.

Visual indication of the state of the inside of the receiving dewar is evident during cooling down and filling.

Whilst the dewar is still cooling down there will be a heavy discharge of gas through the vent valve to the recovery system together with quite high pressure fluctuations in the system due to the rapid expansion of evaporating liquid and cold gas.

If persistent pressure fluctuations continue, gradually raising or lowering the position of the transfer tube in the receiving dewar can help to solve the problem.

Contents Charts and Flutter Tube Diagram

Contents Charts and Flutter Tube Diagrams are available for all small CH vessels, please contact Wessington for the Charts/Diagram applicable to your vessel.

Dispensing Liquid Helium

This process is exactly the same as the arrangement for filling except that the dewar now becomes the supply tank and the transfer tube is routed from the dewar to the cryostat or experimental apparatus which is to receive the helium.

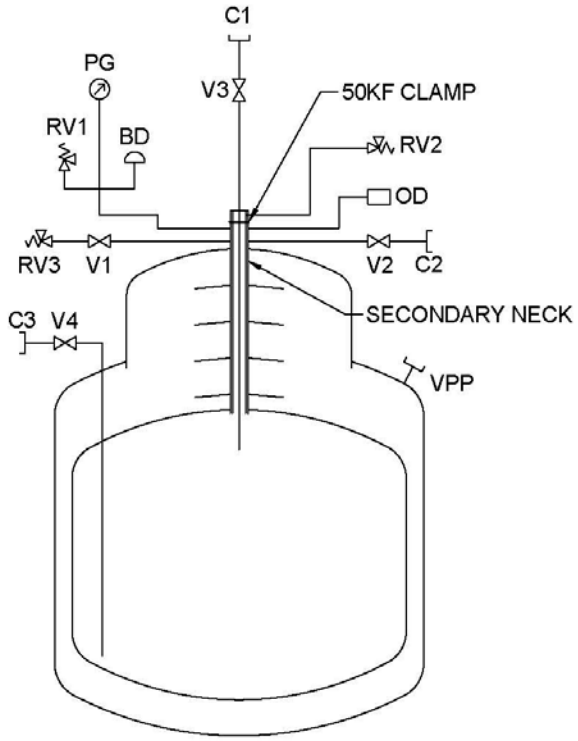
Operation with (Optional) Stinger

This section of the operating instructions should be read in conjunction with the schematic below.

Use of the Stinger allows:

- Effective liquid transfer, often in conjunction with an insulated transfer hose.

Schematic with Stinger



CH Series - Stinger Arrangement

Item	Description
V1	Travelling Valve
V2	Helium Recovery Valve
V3	Isolation Valve (Optional)
V4	Stinger Valve
RV1	Primary Relief Valve
RV2	Secondary Relief Valve (Optional)
RV3	Travelling Relief Valve
BD	Burst Disc
OD	Oscillation Damper
PG	Pressure Gauge
VPP	Vacuum Pumping Port
C1	Siphon Gland(s)
C2	NW 25 KF Connector
C3	Stinger Bayonet

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Operating Procedure

All safety and operational information, including operating of valves, for this option remains the same as for the Standard Vessel with the following exception.

Transfer can be performed using the bayonet C3 by opening valve V4.

The "Health and Safety at Work etc. Act" (HSWA 1974), places duties on organisations and employers to protect the health and safety of employees and/or members of the public. The duties include the provision and maintenance of plant and systems of work that are, so far as is reasonably practicable, safe and without risks to health. This includes the use of pressure equipment.

All equipment, including gas pressure equipment, is subject to "The Provision and Use of Work Equipment Regulations" (PUWER 1998) which requires that work equipment should not result in health and safety risks, regardless of its age, condition or origin. The PUWER 1998 requires that the employer selects suitable equipment and carries out appropriate maintenance, inspection, identifies any specific risks and provides suitable information, instructions and training.

"Safe use of work equipment: Provision and Use of Work Equipment Regulations 1998 Approved Code of Practice and guidance" (HSE L22) provides further guidance on the PUWER 1998.

Gas pressure equipment operating above 0.5 bar is regulated by "The Pressure Systems Safety Regulations" (PSSR 2000). The PSSR 2000 requires such equipment to be examined, maintained and inspected. It should be noted that the overall intention of the PSSR 2000 is to prevent serious injury from the hazard of stored energy, as a result of the failure of a pressure system or one of its component parts.

The primary responsibility for compliance with these regulations lies with the user of the pressure equipment and it is his responsibility to enlist the assistance he requires to comply with the regulations.

The Health and Safety Executive provide guidance on the PSSR 2000 in document "Safety of pressure systems: Pressure Systems Safety Regulations 2000 Approved Code of Practice" (HSE L122), and provide additional guidance on the safety of pressure systems in document "Pressure systems: A brief guide to safety" (INDG261).

For gas pressure equipment which is outside of the scope of PSSR 2000 the requirements of PUWER 1998 will still apply and therefore the other relevant requirements of these instructions and maintenance / inspections shall be applied.

Gas pressure equipment which is covered by the "Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations" (CDGUTPER 2009), for example, road tankers, gas cylinders, cargo transportable unit, and transportable pressure equipment, are not included within the scope of the PSSR 2000.

However, if it is required to retain any transport approvals for the purchased vessel which may be being used in a stationary / mobile application, or there is an intention to subsequently use the pressure equipment for the transportation of products, the inspection and test regime required under the CDGUTPER 2009, shall be implemented prior to its first use in this mode. These requirements should be included in an enhanced Written Scheme of Examination in accordance with the PSSR 2000 plus all appropriate transport inspections.

Routine inspections should include:

- Pressure equipment and systems should be properly maintained. There should be a maintenance programme for the system and its equipment as a whole. It should take into account the system and equipments age, its uses and the environment.
- Look for tell-tale signs of problems with the system and the equipment, e.g. if a safety relief valve repeatedly discharges, this could be an indication that either the system is over pressurising or the safety valve is not working.
- Look for signs of wear and corrosion.
- System must be depressurised before maintenance work is carried out. Pressure in the vessel may cause cold liquid or gas (or parts) to be ejected from the dewar which may cause injury.
- Ensure there is a safe system of work, so maintenance work is carried out and under suitable supervision.

References

Health and Safety at Work etc. Act 1974 – UK Public General Acts, 1974 c. 37 (HSWA 1974)

The Provision and Use of Work Equipment Regulations 1998 – Statutory Instrument, 1998 No. 2306 Health and Safety (PUWER 1998)

Safe use of work equipment: Provision and Use of Work Equipment Regulations 1998 Approved Code of Practice and guidance – Health and Safety Executive, L22 (HSE L22)

The Pressure Systems Safety Regulations 2000 – Statutory Instruments, 2000 No. 128 Health and Safety (PSSR 2000)

Safety of pressure systems: Pressure Systems Safety Regulations 2000 Approved Code of Practice – Health and Safety Executive, L122 (HSE L122)

Pressure systems: A brief guide to safety – Health and Safety Executive, INDG261(rev2) (INDG261)

The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 – Statutory Instruments, 2009 No. 1348 Health and Safety (CDGUTPER 2009)

Routine Check List

Check visually and manually the following key features where applicable:

a. Check outer vessel to ensure no signs of excessive moisture or frosting which may indicate deterioration in vessel vacuum (isolated frost spots which are due to the pressure building coil are normal).

b. No signs of dents or other damage which may give indication of potential failure or hazard.

c. Pressure Gauge - responds properly to rise and fall in vessel pressure.

d. Ball Valves (Liquid, Gas Vent, Pressure Build) open and close properly.

e. Safety Relief Valves - ensure they do not leak at low pressure (lower than the pressure rating stamped on the valve body). Those valves which are fitted with a 'pull to test' device - lift the test device and release - ensure the valve re-seats properly.

f. Burst Discs - check for signs of disc failure / contamination / corrosion.

g. No signs of pipe work leakage.

h. Wheels and castors move freely and footbrakes operate correctly.

Maintenance

If any of the key checks are not satisfactory proceed as follows where applicable:

CHECK RESULT	1ST ACTION	2ND ACTION
Excessive moisture or frost on sides and bottom of outer vessel	Suspect deterioration of vacuum—check vessel evaporation rate	Re-pump vessel
Mechanical damage to vessel	Consult qualified pressure vessel engineer	Return vessel to repair
Pressure gauge does not respond properly	Replace pressure gauge	
Valves do not operate-handle to stiff or broken	Replace valve	Replace valve
Stem seal leaks	Tighten stem seal	
Safety relief valve does not operate properly	Replace safety valve	
Burst disc failed/contaminated/corroded	Replace burst disc assembly	
leakage on pipes in joint work	tighten nuts, seal rings, pipe joints (do not over tighten)	Replace any faulty joint seals which may continue to leak
Wheels/castors/brakes do not operate properly	Clean and grease ball bearings, adjust brakes and remove any tangled obstructions	Replace wheels/castors/brakes

Evaporation Rate Test

If the outer vessel exhibits excessive moisture or frosting, or if excessive heat leak is suspected causing quicker than normal liquid use, the vessel should be subjected to the following evaporation rate test.

1. Fill the vessel to 75% - 100% of rated capacity.

2. Keep the gas vent valve open and allow the vessel to remain at atmospheric pressure for a minimum of 24 hours.

3. Either a) Accurately weigh and record weight, date and time.

   b) Connect suitable gas flow meter to gas vent valve and record flow rate, date and time.

4. After 24 and 48 hours, repeat (3).

5. Determine average daily evaporation rate by either a) converting weight loss to liquid loss per 24 hours, or b) converting gas flow rate to liquid loss per 24 hours. Only when loss/24hr has stabilised has vessel cooled down.

6. Compare evaporation rate with that quoted in original specification. If rate is excessive, contact Wessington Sales Department to arrange for vessel repair. If rate is within acceptable limits, return vessel to service.

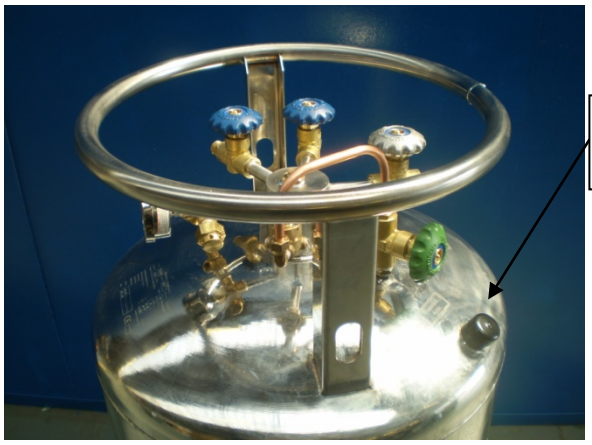
Vacuum Seal

The vessel is fitted with a vacuum port. This device is designed to allow the vacuum in the vessel to be pumped during manufacture, and during any periodic maintenance when vacuum deterioration is suspected. A separate vacuum pump out adaptor is available to allow users to connect to a suitable vacuum pump system. Please contact the Sales Department for details on this accessory and procedure.

In normal operation of the vessel, this boss is not required to be operated. Any tampering of this item may affect vessel vacuum / performance / warranty.

The boss is fitted with a black rubber dust cover.

The unit also doubles as an outer vessel over-pressure relief device. Any pressure build up in the vacuum space (generally caused by damage / rupture of the inner vessel whilst filled with liquid) will be prompt the plug to be ejected from the boss. The boss / plug / dust cover should not be blocked / prevented from normal operation at any time.



Wessington Safety Equipment and Courses

Warning Sign

Oxygen Monitors

Face shield

Leather hide gloves

Cryo-gloves and aprons

For more information regarding safety equipment please contact our sales department or alternately see our spares and accessories brochure.

Wessington cryogenics are able to offer various training courses to suit a variety of end applications and needs. The workshops are constructed, with experience in mind, to be solution based, the delegates constructing their efforts in finding solutions to working safely with gases.

Our expanded range of training workshops available and an e-learning facility is available on our website. *Please see:* www.wessingtonsafetytraining.com *where you can also find all necessary contact details.*

Reference information

British Compressed gases Association: WWW.BCGA.CO.UK

European Industrial Gases Association: WWW.EIGA.ORG

Cryogenic Safety Manual - A Guide to Good Practice (4th Edition); published by British Cryogenics Council; ISBN 0 8543 2605 7

Inspection and Repair Log

It is recommended that routine inspections of the vessel are carried out. Through routine inspections the need for maintenance becomes apparent. The inspection and any repairs performed on the vessel should be carried out only by authorized personnel.

DATE	NATURE OF WORK COMPLETE	SIGNATURE