PERMA-CYL 230/450/1000/1500

Installation Manual

Part Number 11630833 - Revision C

PERMA-CYL®

CHART

TABLE OF CONTENTS

Any comments or suggestions about this manual should be mailed in writing to:

CHART Industries
407 Seventh Street NW
New Prague, MN 56071

FOR ORDERING OR TECHNICAL ASSISTANCE ON ANY CHART PRODUCT PLEASE CALL

1-800-400-4MVE

SAFETY

This manual is a documentation of the Perma-Cyl cryogenic liquid cylinders manufactured by Chart Industries. Its purpose is to provide the users with the necessary information for the installation of the following tanks; Perma-Cyl 230C MP, HP DOT, Perma-Cyl 450MP, Perma-Cyl 450HP, Perma-Cyl 450VHP, Perma-Cyl 1000MP, Perma-Cyl 1000HP, Perma-Cyl 1000VHP, Perma-Cyl 1500HP and Perma-Cyl and 1500VHP.

CAUTION

Only use replacement equipment, which is compatible with liquid oxygen and has been cleaned for oxygen use. Do not use regulators, fittings, hoses, etc., which have been previously used in compressed air service. Similarly, do not use oxygen equipment for compressed air. Failure to comply with these instructions may result in serious damage to the liquid cylinder and personal injury.

CAUTION

If liquid can be trapped in the transfer system, a suitable relief valve must be installed to prevent over pressurization.

Before making a liquid transfer be sure that protective eyeglasses and gloves are being worn. If the transfer is being made to an open top vessel, the transfer pressure should be as low as possible and a phase separator should be used to eliminate splashing and hose whip.

CAUTION

All valves on an empty Perma-Cyl should always be kept closed to protect the inner vessel and plumbing from being contaminated.

CAUTION

Pressure should be allowed to escape from the transfer hose before it is completely removed. A hose drain and relief valve should be installed in all transfer lines.

THE PERMA-CYL FAMILY

The Perma-Cyl family consists of four sizes: 230L, 450L, 1000L, and 1500L. Each size has different size and applications. Consult the Perma-Cyl cut sheet for sizes and service pressures. Tanks that are sized appropriately for the application operate more efficiently.

PERMA-CYL 230L and 450L models

PERMA-CYL 1000L and 1500L models

CONDUCTING A SITE EVALUATION

Before a PERMA-CYL is installed a site evaluation should be conducted. This trip to the customer's site will help identify any special needs that each site invariably has. While on site note what application the PERMA-CYL will be used for and what service it will be in. Decide whether the installation will be inside or outside. Proximity to the ORCA fill point and the user's equipment should be taken into account in making this decision. When the placement has been set, take measurements of how much and where the piping will be run.

INDOOR INSTALLATIONS
(Inert: Any Size | Oxygen: 230-450 L)

Required:
- Room Size – Air volume must allow oxygen level to stay between 18% to 25%
- Increased ventilation
- Valves vented outside (including mobile tanks)
- CO_2 monitors required for all CO_2 installations

Preferred:
- Sealed off away from other work areas
- Ground level next to outside wall
- Oxygen monitors recommended for LAR and LIN

OUTDOOR INSTALLATIONS
(Any Size)

Required:
- Open
- Well Ventilated
- At or above ground level

CONDUCTING A SITE EVALUATION

While conducting the site evaluation, note any unique tools or supplies that will be needed for the installation. The following is a list of common tools and supplies for standard installations.

COMMON INSTALLATION TOOLS AND SUPPLIES

INSTALLATION SUPPLIES:

- Silicone sealant (clear and white) – used to seal holes in walls or joints
- Plumber's putty – used to seal holes in walls
- ¼" Plastic screw anchors – used to mount pipe brackets or straps to drywall
- Self-tapping screws – used to mount pipe brackets or straps
- 9" cable ties
- Duct tape
- Teflon tape
- Chalk or marker
- Leak check solution

INSTALLATION TOOLS:

- Electric Hammer Drill – used for drilling holes and chiseling brick. Some accessories include:
  - ¾" x 21" Scaling Chisel
  - 2 ½" Core Bit
  - 1"x 21" Masonry Bit
  - ½" Masonry Bit
- 7 ¼" Builder's Circular Saw – Used for scoring brick and cutting wood exteriors. Some common accessories include:
  - Masonry Cutoff Wheel
  - Combination Blade
- Reciprocating Saw – Used for cutting through wood walls. Accessories include:
  - Masonry Blades
  - Wood Blades
  - Steel Blades
- Oxy-Acetylene Torch – Used for cutting rebar in poured concrete walls and floors

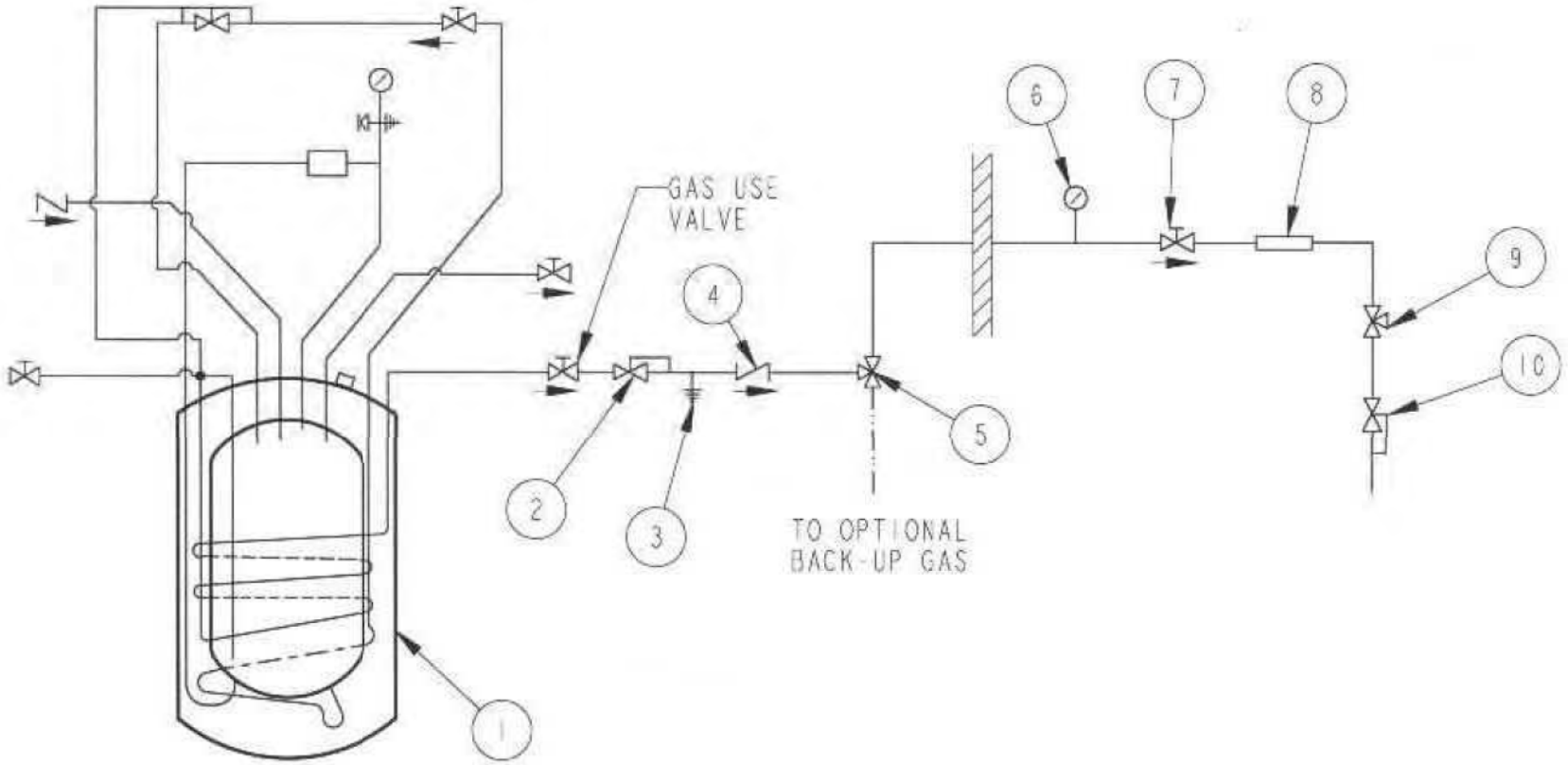
OUTDOOR INSTALLATIONS

Externally Sited/Gas Use Indoors

Outdoor installations can offer better accessibility for the ORCA for filling purposes. Also, lines do not need to be run except from the tank to the user's equipment. Outdoor installations should be made on a concrete pad. In most areas, the pad can be made of standard 4" thick concrete and should be large enough to accommodate the PERMA-CYL. The PERMA-CYL should be bolted to the concrete pad using ½" anchor bolts. Also in outdoor installations, a fence can provide added protection for the PERMA-CYL and work to eliminate tampering with any plumbing component. An example of a PERMA-CYL installed outdoors is shown below. Schematic drawings and parts listings are included on the following pages.

OUTDOOR INSTALLATIONS

Externally Sited/Gas Use Indoors



EXTERNALLY SITED/GAS USE INSIDE INSTALLATION

DRAWING COMPONENT LIST					
DRAWING TITLE: Externally Sited/Gas Use Inside Installation					
Item No.	**Component Description**	**Manufacturer**	**CHART Part Number**	**Maintenance/ Examination Interval**	**Pressure Setting**
1	Cryogenic Pressure Vessel (PERMA-CYL)	CHART	Various		
2	Pressure Reducing Regulator	Cash/Acme	Various	3 years	Maximum 90% of Item 3 set pressure
3	Pressure Relief Valve	Rego	Various	3 years	Set pressure not to exceed MAWP of pipe work system
4	Check Valve	Generant	11051090	3 years	
5	Supply Diverter Valve	SMC	10924039	3 years	
6	Pressure Gauge	Noshok	2010064	3 years	
7	Gas Use Isolation Valve	Rego	11554519	3 years	
8	Line Filter	Parker	11628611	3 years	
9	Back-up system Purge Valve	SMC	10924039	3 years	
10	Pressure Reducing Regulator			3 years	To suit connected equipment requirements

INDOOR INSTALLATIONS

General Information

For all indoor installations, certain regulations and codes must be adhered to. The installer will need to find out what local city ordinances and which rules they are mandated to follow. One of the following standards may apply: Uniform Fire Code (UFC), Compressed Gas Association (CGA), and the National Fire Protection Association (NFPA, for oxygen only).

- Uniform Fire Code standards
  - Article 75
    - Flammable Cryogenic fluids
    - Inert Cryogenic fluids
    - Oxidizer Cryogenic fluids
- Compressed Gas Association
  - Pamphlet P-9 Inert Gases
    - Section 9 & 10 storage liquid cylinders capacity indoors
    - Must be well ventilated
    - Section 12 Storage Bulk capacity indoors
    - See Pamphlet P-18
  - Pamphlet P-18 Bulk Inert Gases
    - Section 5.2 Indoor storage
    - No capacity given
    - Must be well ventilated
    - Fill, full try cock, vent, and relieves must be piped outside
    - Warning signs are required
  - Pamphlet G-4 Oxygen Gases
    - Section 6 Oxygen storage and handling safety
    - Section 7 Oxygen storage
    - Area must be well ventilated preferable outside
    - Keep away from flammable materials
    - Section 9 Bulk Oxygen Systems
    - No capacity listed
    - Refers to NFPA 50 for direction

- National Fire Protections Association
  - NFPA 50 Bulk Oxygen Systems
    - Section 1-3 Bulk Oxygen Systems are 658 liters (which includes all tanks in system) and larger
    - Chapter 2 locations for bulk oxygen tanks
    - Section 2-1.1 Storage can be outside above ground or inside a non-flammable or limited combustible building (see NFPA 220 for description of building requirements)
    - Area must be adequately vented and used exclusively for that purpose
    - Section 2-2 list distances for special items
    - Section 3-5.8 area must be marked with permanently marked placards

Note: Items listed above are only paraphrased and are only to be used as a reference to find sections of the listed codes that apply to the storage of cryogenic tanks. All items listed in the codes must be followed and adhered to in order to comply. There maybe other codes which apply to your installation. Check with your local authorities. Hard copies of these codes are available for purchase from the respective regulatory authority.

Installers are obligated to be knowledgeable of these publications.

Fill Station

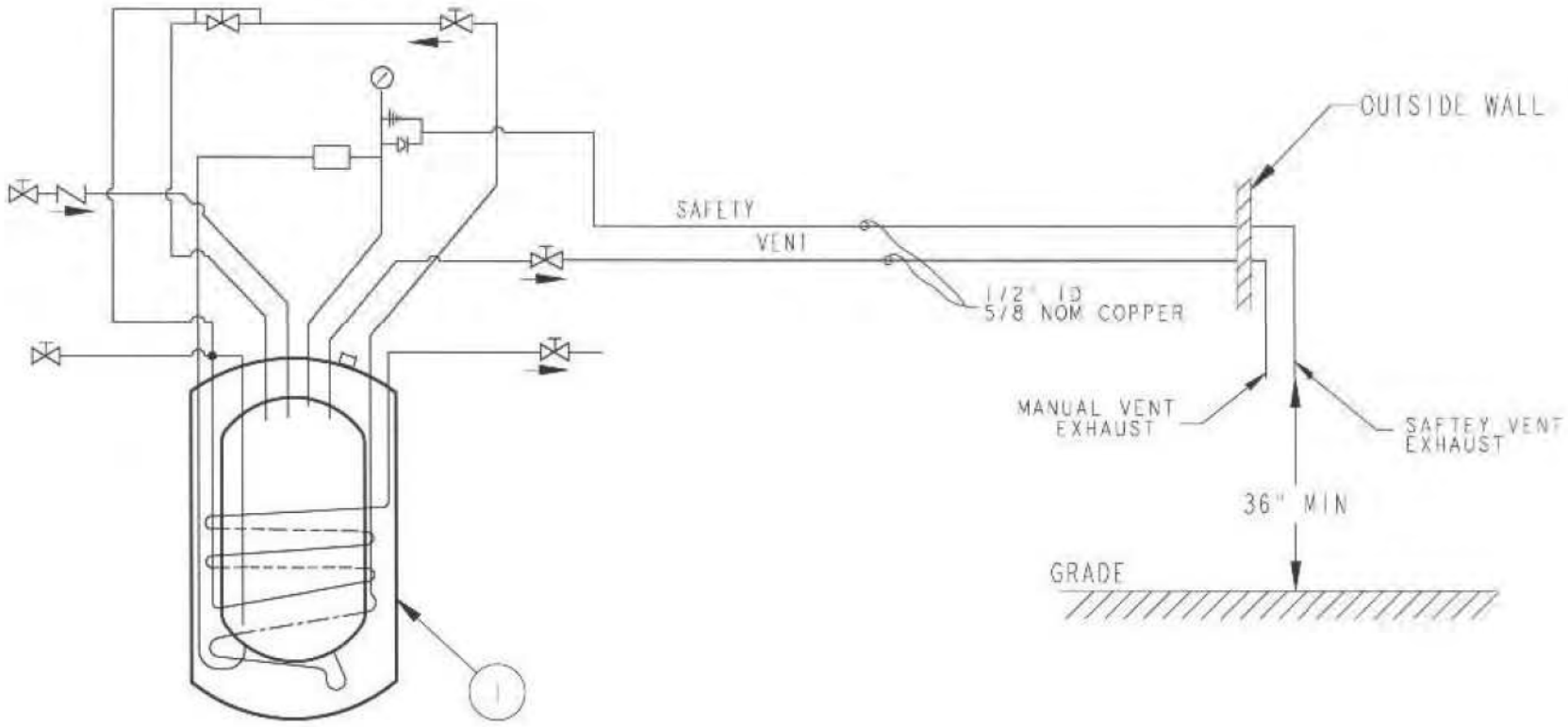
The dust caps fitted to the pipe end connections should not be pressure retaining.

1. Connection to the Top-Fill Line.
2. Vent Line.
3. Exhaust pipe work from the Relief Valve and Burst Disk on the Perma-Cyl.
4. Pressure gauge.

INDOOR INSTALLATIONS

Internally Sited/Filled Indoors/Pipe Out Safeties

Some indoor installations allow for direct filling of the cylinder because of a close proximity to a doorway. These installations do not require the use of a wall box but still need to have safeties vented outside. A drain valve should be included in the safety line. This valve should be operated periodically to prevent moisture build-up in the line causing blockage. ½" nominal copper should be used for both lines. Once through the wall, both lines should be directed downward and kept a minimum of 36" above the grade.



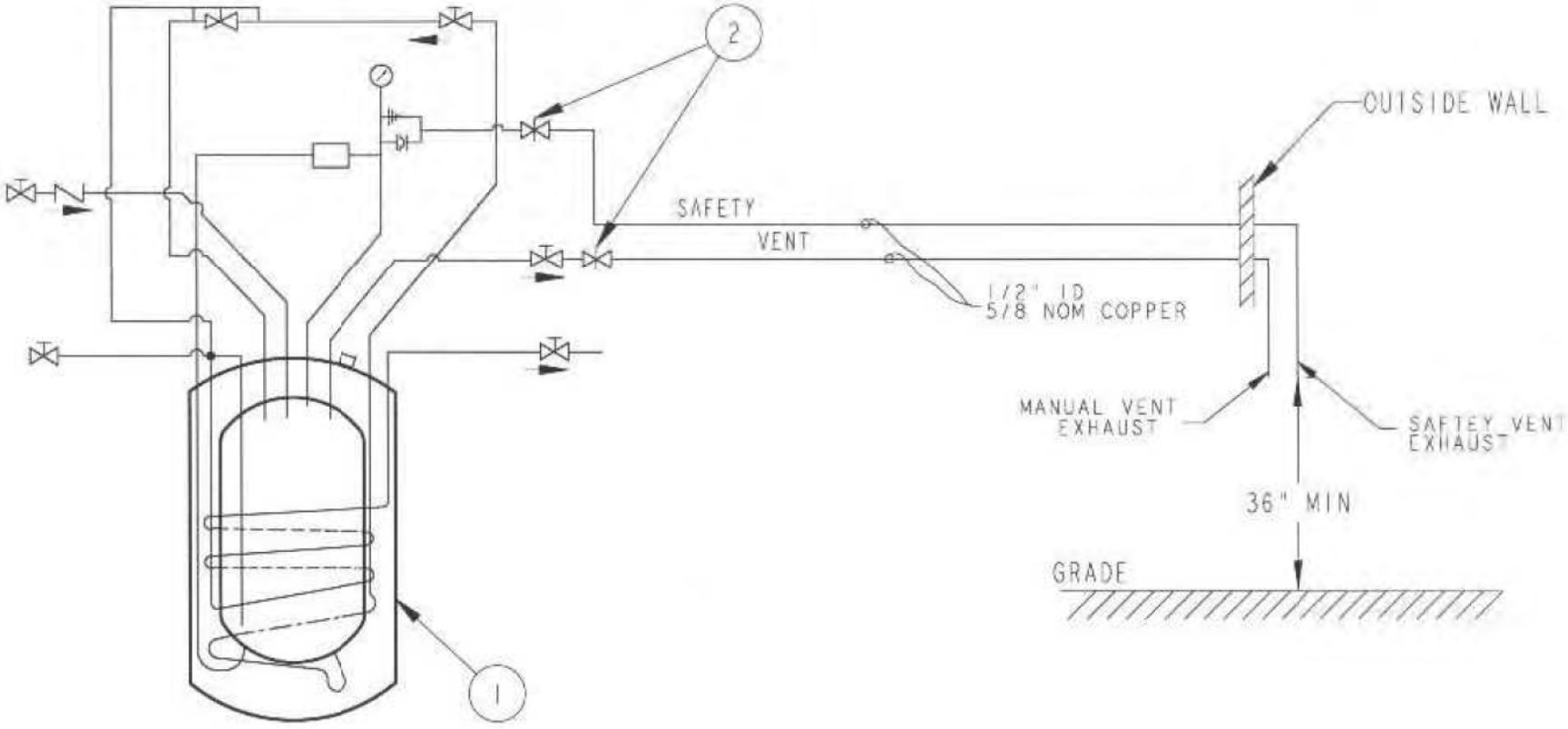
INTERNALLY SITED/FILLED INDOORS/PIPE OUT SAFETIES

DRAWING COMPONENT LIST					
DRAWING TITLE: Internally Sited/Filled Indoors/Pipe Out Safeties					
Item No.	**Component Description**	**Manufacturer**	**CHART Part Number**	**Maintenance/ Examination Interval**	**Pressure Setting**
1	Cryogenic Pressure Vessel (PERMA-CYL)	CHART	Various		

INDOOR INSTALLATIONS

Internally Sited/Mobile Base/Pipe Out Safeties with Quick Disconnect

Installations on of a 230L PERMA-CYL on casters can be made so that the tank can be moved to be filled but still can be piped outside. This type of installation is very similar to the previous example but includes quick disconnects on the lines piped outside. The quick disconnects allow the tank to be moved for filling but still keeps line integrity while connected.



INTERNALLY SITED/MOBILE BASE/PIPE OUT SAFETIES W/QD

INDOOR INSTALLATIONS

Internally Sited/Mobile Base/Pipe Out Safeties with Quick Disconnect

DRAWING COMPONENT LIST					
DRAWING TITLE: Internally Sited/Mobile Base/Pipe Out Safeties with QD					
Item No.	**Component Description**	**Manufacturer**	**CHART Part Number**	**Maintenance/Examination Interval**	**Pressure Setting**
1	Cryogenic Pressure Vessel (PERMA-CYL)	CHART	Various		
2	Quick Disconnect	Parker	Nipple – 10904193 Receptacle - 10904100	3 years	

INDOOR INSTALLATIONS

Internally Sited/Typical Wall Box

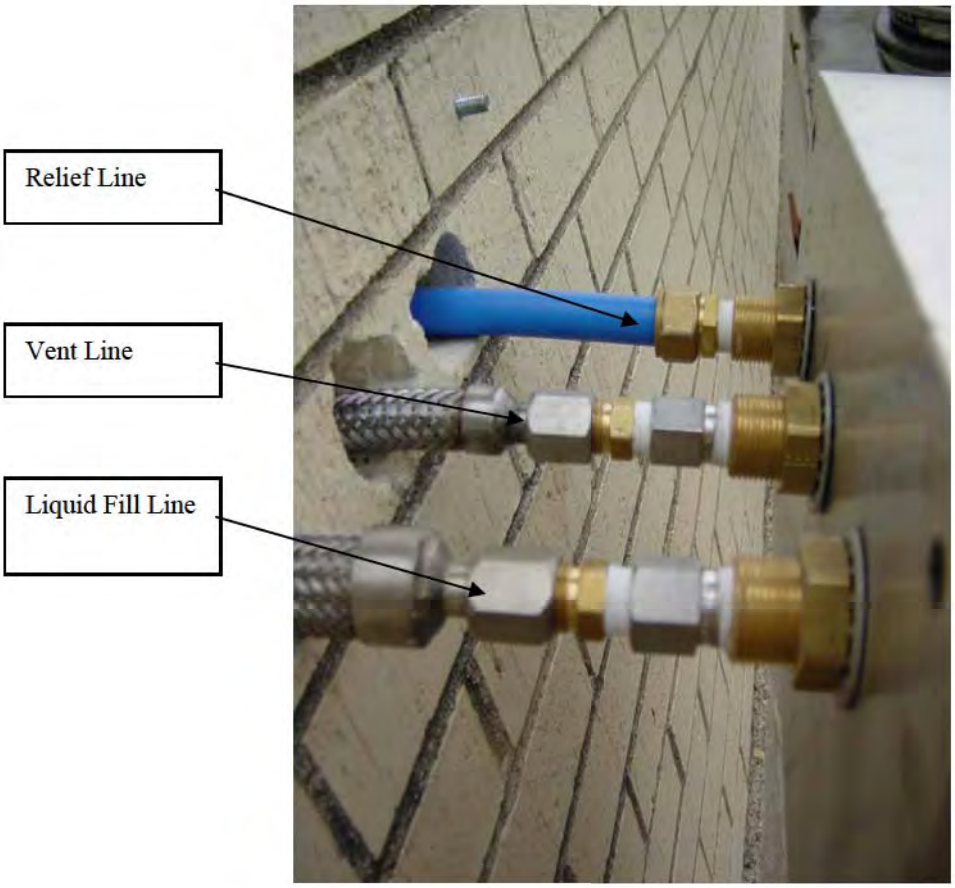
Indoor installations allow the tank to be positioned in very close proximity to the end user's equipment. This can be accomplished very easily using a PERMA-CYL Wall Box. The Wall Box contains a Vent valve, Fill line, Pressure Gauge and Safety pipe out. All connections on the Wall Box are ½" FPT.

Hardware	MVE P/N
PERMA-CYL Wall-Box	11045036
PERMA-CYL Wall-Box AR QD	11074494
PERMA-CYL Wall-Box Inert Flare	11074486
PERMA-CYL Wall-Box N2 QD	11074478
PERMA-CYL Wall-Box O2 Flare	11074523
PERMA-CYL Wall-Box O2 QD	11074515

Connections on the Wall Box are provided for the vent line, liquid fill line and relief line.

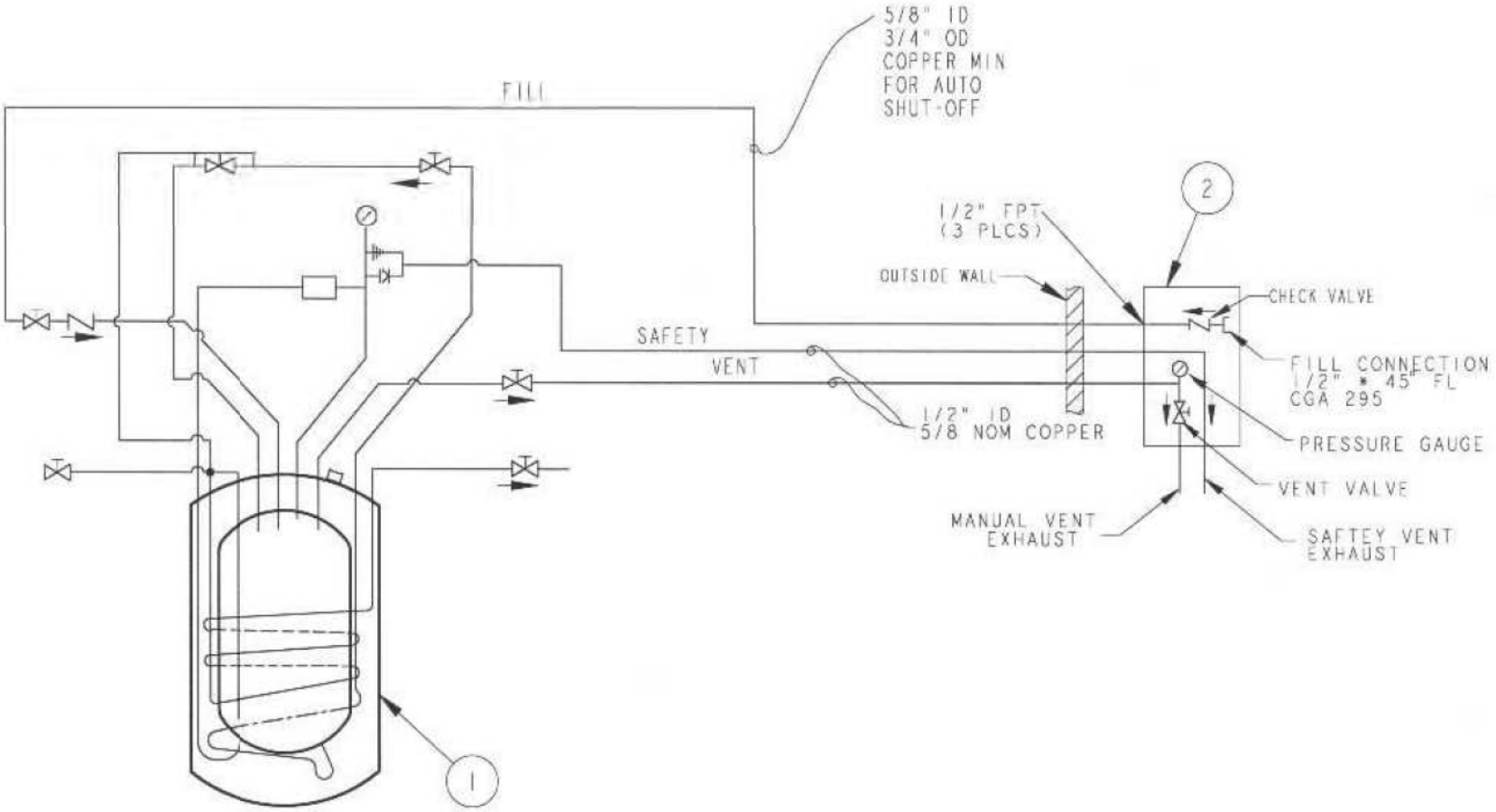
- **Liquid Fill line** – The liquid fill should be piped using a minimum diameter of ¾" Nominal Copper. The equivalent size stainless steel braided hose can also be used. The line should be connected from the fill connection in the Wall Box to the liquid fill check valve on the PERMA-CYL. When piping this line there are a few guidelines that should be followed.
  - Bends and elbows should be kept at a minimum. When needed they should be made with a wide bend radius. A minimum bend radius of 6" should be observed.
  - The length of the line from the tank to the box should be kept to a minimum. Bare copper line can be used for lines less than 15'. For lines longer than 15', CHART PYTHON or VJ pipe should be used. If bare copper is used, it should be insulated using air conditioning foam.
  - Line size should be a minimum 5/8" ID.
- **Vent line** – The vent line should be run using ½" Nominal Copper or the equivalent size stainless steel braided hose. This line should connect the vent valve in the Wall Box to the vent valve on the PERMA-CYL.
- **Relief line** – The relief line should be run using ½" Nominal Copper. Kitec tubing or braided stainless steel hose can also be used.

INDOOR INSTALLATIONS
Internally Sited/Typical Wall Box



INDOOR INSTALLATIONS

Internally Sited/Typical Wall Box



INTERNALLY SITED/TYPICAL EXTERNAL WALLBOX

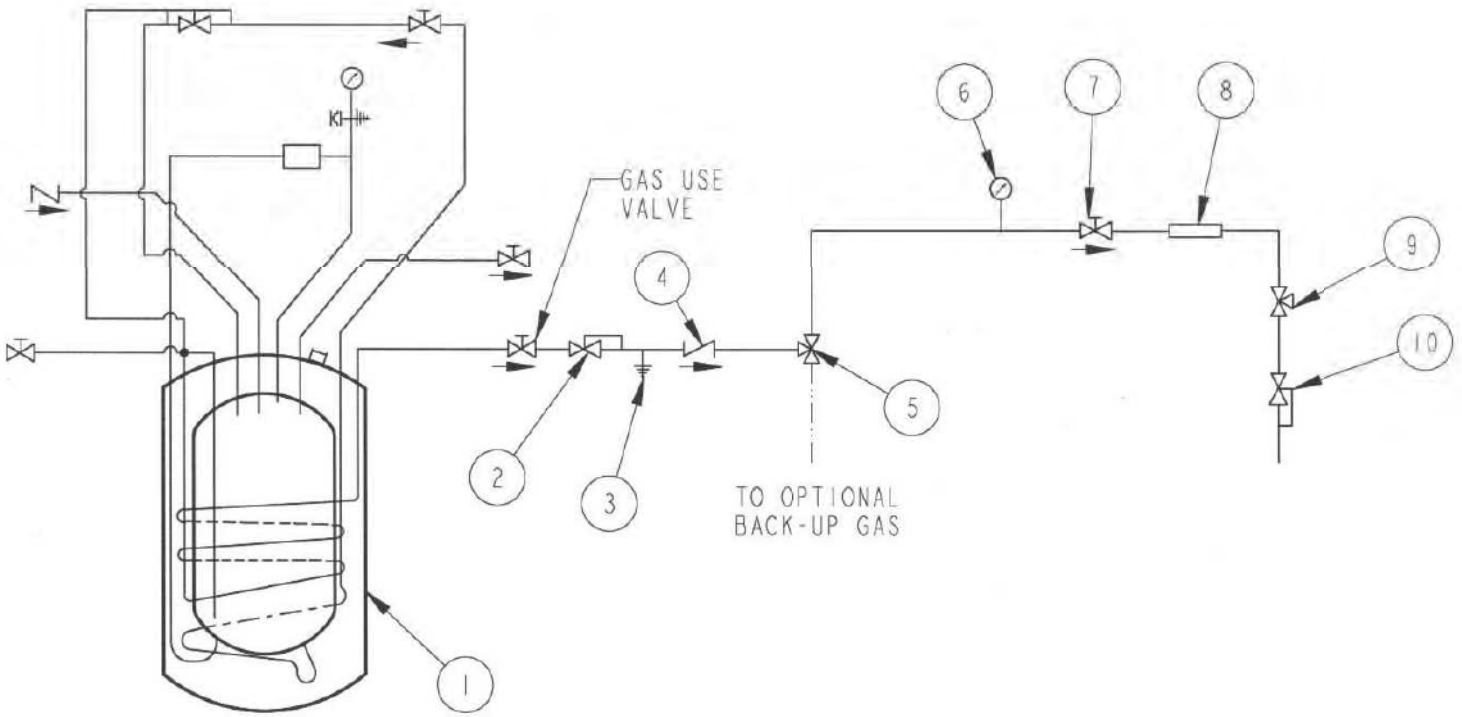
INDOOR INSTALLATIONS

Internally Sited/Typical Wall Box

DRAWING COMPONENT LIST					
DRAWING TITLE: Internally Sited/Typical External Wall Box					
Item No.	**Component Description**	**Manufacturer**	**CHART Part Number**	**Maintenance/ Examination Interval**	**Pressure Setting**
1	Cryogenic Pressure Vessel (PERMA-CYL)	CHART	Various		
2	PERMA-CYL Wall-Box	CHART	Various	3 years	

TYPICAL GAS USE PIPING

To provide an end use application with gas, the internal vaporizer inside the PERMA-CYL can be utilized by opening the Gas Use Valve on the tank. This will pull liquid through the internal vaporizer and create gas to supply the customer. A typical piping configuration is shown.

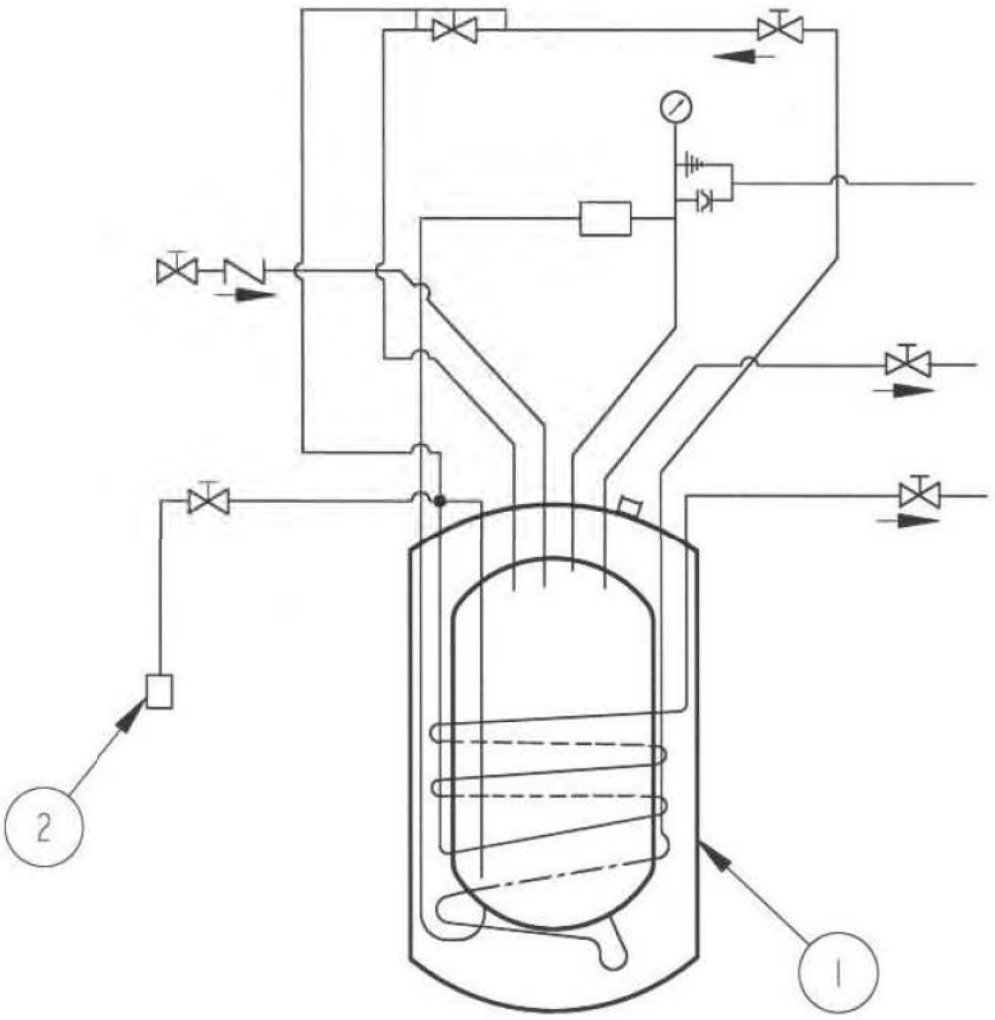


TYPICAL GAS USE INSTALLATION

TYPICAL GAS USE PIPING

DRAWING COMPONENT LIST					
DRAWING TITLE: Typical Gas Use Piping					
Item No.	**Component Description**	**Manufacturer**	**CHART Part Number**	**Maintenance/ Examination Interval**	**Pressure Setting**
1	Cryogenic Pressure Vessel (PERMA-CYL)	CHART	Various		
2	Pressure Reducing Regulator	Cash/Acme	Various	3 years	Maximum 90% of Item 3 set pressure
3	Pressure Relief Valve	Rego	Various	3 years	Set pressure not to exceed MAWP of pipe work system
4	Check Valve	Generant	11051090	3 years	
5	Supply Diverter Valve	SMC	10924039	3 years	
6	Pressure Gauge	Noshok	2010064	3 years	
7	Gas Use Isolation Valve	Cash	11554519	3 years	
8	Line Filter	Parker	11628611	3 years	
9	Back-up system Purge Valve	SMC	10924039	3 years	
10	Pressure Reducing Regulator			3 years	To suit connected equipment requirements

TYPICAL LIQUID USE PIPING



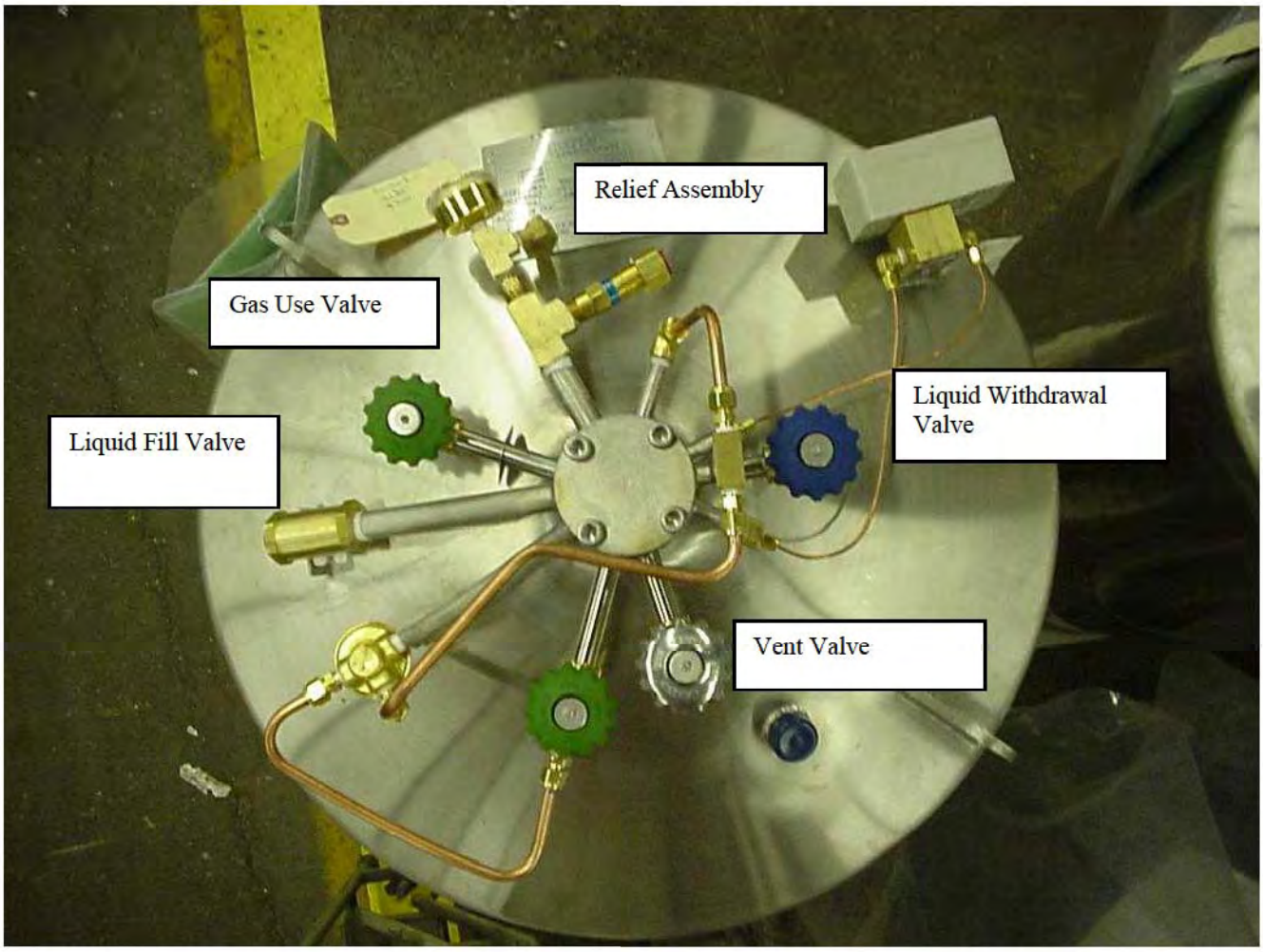
TYPICAL LIQUID USE

TYPICAL LIQUID USE PIPING

DRAWING COMPONENT LIST					
DRAWING TITLE: Typical Liquid Use					
Item No.	**Component Description**	**Manufacturer**	**CHART Part Number**	**Maintenance/ Examination Interval**	**Pressure Setting**
1	Cryogenic Pressure Vessel (PERMA-CYL)	CHART	Various		
2	Phase Separator	CHART	10615869	1 year	

PERMA-CYL CONNECTIONS 6

Although PERMA-CYL valve connections may differ in their location on the cylinder, the type of valve, function of the valve and the line sizes used are the same on every tank in the family. The general overview of the PERMA-CYL can be seen below as it appears on a PERMA-CYL 450.



PERMA-CYL CONNECTIONS 6

The PERMA-CYL has five points of connection that may be used in any installation.

- **Liquid Fill Valve** – The liquid fill valve is used to top fill the PERMA-CYL using the patented PERMA float device. The fill line has a check valve that serves as the sole pressure connection. The check valve can be equipped with either a CGA flare fitting or a Quick Disconnect. For indoor installations, the guidelines given for the liquid fill line should be followed.

PERMA-CYL Liquid Fill Connection

- **Liquid Use Valve** – The liquid use valve is used for connection to a liquid withdrawal application. On the PERMA-CYL line, the liquid use valve is a blue handled globe valve. For connection to a liquid application, CHART PYTHON or VJ line should be used. Copper pipe or stainless steel braided hose can be used for short runs of less than 5 ft.

PERMA-CYL Liquid Withdrawal Connection

- **Gas Use Valve** – The gas use valve leverages the internal vaporizer on the PERMA-CYL to supply gaseous product to the end user. The internal vaporizer can support certain flow rates. Consult the PERMA-CYL cut sheet for specific flow capacities of each cylinder. The gas use valve used is a green handled globe valve. In inert service, the gas use connection can be made using Kitec tubing. Kitec tubing allows for a quick and easy installation. Kitec tubing should be used at pressures below 200 psi

and for gas at temperatures above 10°F. At conditions other than those outlined previously, the Kitec tubing can burst. For applications other than those outlined above, copper tubing or stainless steel braided hose should be used. The line size for the gas use should be sized properly for the pressure and flow rate that is desired.

PERMA-CYL Gas Use Connection

- **Vent Valve** – The vent valve is used to relieve excess pressure in the cylinder. On PERMA-CYL s, the vent valve is a gray handled globe valve. When installed indoors, the vent line should be piped outdoors using ½" Nominal copper or the equivalent stainless steel hose.

PERMA-CYL Vent Connection

- **Safety device connections** – Every PERMA-CYL is equipped with both a spring operated relief valve and a burst disk. These devices are used to automatically relieve excess pressure in the cylinder. For indoor applications, the relief assemblies should be piped outdoors using ½" Nominal copper or the equivalent stainless steel tubing.

PERMA-CYL Relief Assembly

APPENDIX A
Typical Tank Siting Form

CHART SERVICE DIVISION – INSTALLATION CHECK LIST

CUSTOMER NAME:_____

CONTACT
NAME:_____PH._____FAX._____CELL_____

DATE INSTALL IS REQUIRED:_____PO#_____

INSTALLATION ADDRESS:_____

DIRECTIONS TO SITE:_____
_____

NUMBER AND SIZE OF PERMA'S:_____
APPROXIMATE DISTANCE FROM FILL TO FIRST CYLINDER:_____
REQUIRES FORKLIFT: YES NO (circle one)
REQUIRES CRANE: YES NO (circle one)
INSTALL IS: OUTDOOR INDOOR (circle one) INDOOR REQUIRES PIPE AWAY RELIEF VALVES.
WALL MATERIALS OR CONSTRUCTION:_____
IS THIS A NEW INSTALL: YES NO (circle one)
IS THIS AN ADDITION TO AN EXISTING SYSTEM: YES NO (circle one)
WILL THIS INSTALL INCLUDE A USE POINT CONNECTION: YES NO
SIZE OF USE POINT CONNECTION:_____
INSTALL REQUIRES WALL BOX: YES NO (circle one)
REQUIRES REMOTE LIQUID LEVEL GAUGES: YES NO (circle one)
ANCHORING OF PERMA'S REQUIRED: YES NO (circle one)
PERMIT REQUIRED: YES NO (circle one)
WILL ADDITIONAL PIPING BE REQUIRED: YES NO (circle one)
IF ABOVE YES HOW MUCH:_____

DETAILS OF ANY SPECIAL
REQUIREMENTS:_____
_____
_____

CUSTOMER SIGNATURE:_____DATE:_____

CHART REPRESENTATIVE SIGNATURE:_____DATE:_____

APPENDIX B
PERMA-CYL Pad Layout Drawings

DWG NO. C-11604475

SCHEDULE 1: FOOTING/PADS FOR VESSEL SUPPORT

EQUIPMENT UNIT	PRODUCT	PAD/FOOTING				
		CONCRETE (2500 PSI NORMAL WEIGHT)			REINFORCEMENT (1) LAYER, B.W., 3" BELOW T.O.C.	REF. DETAIL
		LENGTH "L" FT	WIDTH "B" FT	THICKNESS IN		
450 MP/HP/VHP	O2, N2, AR	4'	4'	12"	#5@12" MAX	1/S1
1000 MP/HP	O2, N2, AR	4'-6"	4'-6"	12"	#5@12" MAX	
1000 VHP	O2, N2	4'-6"	4'-6"	12"	#5@12" MAX	
1000 VHP	AR	5'	4'-8"	12"	#5@12" MAX	
1500 HP/VHP	O2, N2	5'-8"	5'	12"	#5@12" MAX	
1500 HP	AR	5'-8"	5'-8"	12"	#5@12" MAX	
1500 VHP	AR	6'	5'-8"	12"	#5@12" MAX	
2000 VHP	O2, N2	6'-8"	6'	12"	#5@12" MAX	
2000 VHP	AR	7'	6'-6"	12"	#5@12" MAX	

SCHEDULE 2: SLABS-ON-GRADE FOR VESSEL SUPPORT

EQUIPMENT UNIT	PRODUCT	SLAB-ON-GRADE 10'x10' MINIMUM OVERALL DIMENSIONS				
		UNIT TO BE CENTERED ON SECTION OF THE SLAB WITH FOLLOWING DIM'S			REINFORCEMENT (1) LAYER, B.W., 2" CLR. BELOW T.O.C.	REF. DETAIL
		LENGTH "L" FT	WIDTH "B" FT	THICKNESS IN		
450 MP/HP/VHP	O2, N2, AR	4'-6"	4'	8"	#4@12" MAX	2/S1
1000 MP/HP	O2, N2, AR	5'	4'-6"	8"	#4@12" MAX	
1000 VHP	O2, N2	5'	4'-6"	8"	#4@12" MAX	
1000 VHP	AR	5'	5'	8"	#4@12" MAX	
1500 HP/VHP	O2, N2	5'-8"	5'	8"	#4@12" MAX	
1500 HP	AR	5'-8"	5'-8"	8"	#4@12" MAX	
1500 VHP	AR	6'	5'-8"	8"	#4@12" MAX	
2000 VHP	O2, N2	6'-6"	6'	8"	#4@12" MAX	
2000 VHP	AR	7'	6'-6"	8"	#4@12" MAX	

SCHEDULE 3: VESSEL CONNECTION - EPOXY ANCHORS

EQUIPMENT UNIT	PRODUCT	ANCHORAGE: HILTI HVA FOR ICBO ER5368 GALVANIZED SCHEDULES & NOTES					SPECIAL INSPECTION REQUIRED
		DIAMETER	MIN. EMB.	MIN. EDGE DIST	STEEL	MIN. ANT. PER UNIT	
450 MP/HP/VHP	O2, N2, AR	#1/2"	4-1/4"	9"	A36	4	YES
1000 MP/HP/VHP	O2, N2, AR	#1/2"	4-1/4"	10"	A36	4	YES
1500 HP/VHP	O2, N2, AR	#1/2"	4-1/4"	11"	A36	4	YES
2000 VHP	O2, N2, AR	1/2"	4-1/4"	12"	A36	4	YES

SCHEDULE 4: VESSEL CONNECTION - EXPANSION ANCHORS

EQUIPMENT UNIT	PRODUCT	ANCHORAGE: HILTI KBII PER ICBO ER4627 GALVANIZED					SPECIAL INSPECTION REQUIRED
		DIAMETER	MIN. EMB.	MIN. EDGE DIST	STEEL	MIN. ANT. PER UNIT	
450 MP/HP/VHP	O2, N2, AR	#1/2"	5"	5"	A36	4	NO
1000 MP/HP/VHP	O2, N2, AR	#1/2"	5"	10"	A36	4	NO
1500 HP/VHP	O2, N2, AR	#1/2"	8"	11"	A36	4	NO
2000 VHP	O2, N2, AR	1/2"	8"	12"	A36	4	NO

NOTES

1. THE DATA IN THE TABLES SHALL BE USED FOR REFERENCE PURPOSES ONLY, AND CANNOT BE SUBSTITUTED FOR STRUCTURAL DESIGN FOR PARTICULAR SITE CONDITIONS.
2. THE DATA IN THE TABLES IS VALID ONLY WITHIN THE FOLLOWING (OR ANY LESS STRINGENT) DESIGN ASSUMPTIONS (1997 UBC-1998 CBC):
   A. SEISMIC ZONE 4, SOIL PROFILE "SD", NO CLOSER THAN 10 KM FROM FAULT TYPE "A", AND NO CLOSER THAN 5 KM FROM FAULT TYPE "B".
   B. MAXIMUM WIND SPEED 110 MPH, EXPOSURE "C".
   C. IMPORTANCE FACTORS: I = Ip = 1.5, Iw = 1.15.
   D. ALLOWABLE BEARING CAPACITY OF SOIL 1500 PSF WITH 1.33 INCREASE FOR TRANSIENT LOADS.
3. THE SPECIFIED BEARING CAPACITY OF SOIL REQUIRES GEOTECHNICAL INVESTIGATION.
4. ACTUAL INSTALLATION MAY REQUIRE SOIL IMPROVEMENT, INCLUDING SOIL REPLACEMENT, OVEREXCAVATION, SCARIFYING, RECOMPACTION, ETC. SOME INSTALLATINS REQUIRE ANTI-FROST MEASURES. REFER TO LOCAL CODES, GEOTECHNICAL REPORT, AND STRUCTURAL DESIGN DOCUMENTATION FOR SPECIFIC REQUIREMENTS.
5. THE INSTALLATION SITE SHALL BE SUPPLIED WITH ADEQUATE DRAINAGE (BY OTHERS) PREVENTING WATER PONDING/ACCUMULATION ON, AROUND, AND UNDER THE NEW CONCRETE.
6. ALL CONCRETE IS 2500 PSI NORMAL WEIGHT CONCRETE. SPECIAL INSPECTION NOT REQUIRED.
7. ALL REBARS ARE PER ASTM A615.
8. INSTALLATION PROCEDURE:
   A. INSTALL EQUIPMENT ON THE CURED (14 DAYS MIN.) PAD IN ACCORDANCE WITH THE PLANS BY SGE AND BY OTHERS.
   B. STRICTLY MAINTAIN SPECIFIED CLEARANCES AND EDGE DISTANCES. FOLLOW THE ANCHOR MANUFACTURER'S SPECS.
   C. USING THE HOLES IN THE BASEPLATES, DRILL HOLES FOR THE ANCHORS.
   D. INSTALL ALL SPECIFIED ANCHORS IN STRICT COMPLIANCE WITH MANUFACTURER'S SPECIFICATIONS.
   E. PROVIDE SPECIAL INSPECTION DURING ANCHOR INSTALLATION (UNO).
9. ALL INFORMATION STATED ON THIS DRAWING IS SUPPLIED BY THE CHART DOCUMENT; STRUCTURAL CALCULATIONS, FOUNDATION & ANCHORAGE REQUIREMENTS FOR ZONE 4, 100 MPH WIND PER CODE; 1997 CBC, MAY 2001. DISCLAIMER- SOME DATA WAS INTERPOLATED BY THE SUPPORT OF THE ABOVE DOCUMENT. TO THE BEST OF CHARTS KNOWLEDGE, THIS DATA IS CONSERVATIVETLY SOUND TO MEET THE GUIDELINES NOTED. THIS DOCUMENT IS AVAILABLE UPON REQUEST FROM CHART INDUSTRIES, INC, NEW PRAGUE, MN.

FOUNDATION & ANCHORAGE OF CRYOGENIC VESSELS

					APPROVED	DATE
					DRAWN BY TJS	8/08/01
A		ADDED 2000VHP MODELS	TJS	8/10/05	CHK'D BY ESB	8/8/01
REV.	ECO #	REVISION DESCRIPTION	BY	DATE	MFGR'S CHK'D C.JS	8/22/01
					INTL CHK'D TAN	8/22/01
					QUAL REV. -	-
					QUAL CONT. GHE	8/25/01

NEXT ASS'Y | USED ON | NEXT ASS'Y | TOTAL ASS'Y
APPLICATION | QUANTITY REQ'D

THE MATERIALS AND INFORMATION, INCLUDING THE PRINCIPLES OF DESIGN PRESENTED BY MVE PRINT, IS THE EXCLUSIVE PROPERTY OF MVE, INC AND IS CONFIDENTIAL INFORMATION. ACCORDINGLY, THIS INFORMATION IS SUBMITTED TO YOU WITH THE AGREEMENT THAT IT IS NOT TO BE REPRODUCED, COPIED, OR LOANED, IN PART OR IN WHOLE, NOR IS THE INFORMATION TO BE DELIVED TO ANY COMPANY. ACCEPTANCE OF THIS DRAWING WILL BE CONSTRUED AS AN AGREEMENT TO THE ABOVE.

MATL

PART NUMBER 11604475

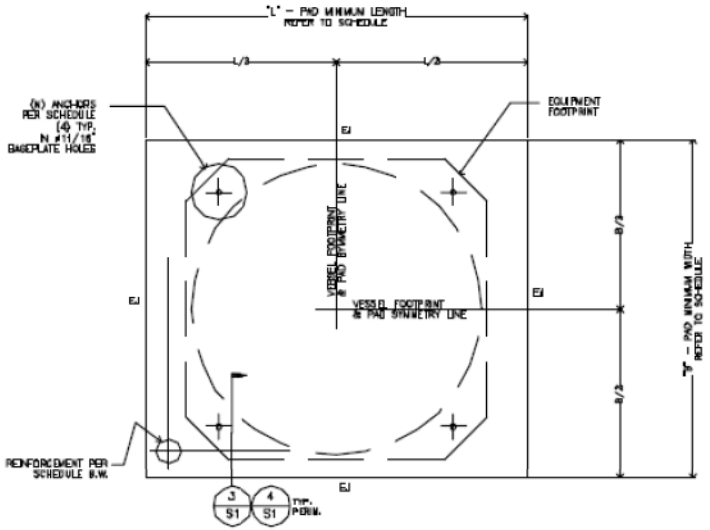
MVE MVE, Inc. NEW PRAGUE, MINNESOTA 56071

FOUNDATION LAYOUT PERMA-CYL

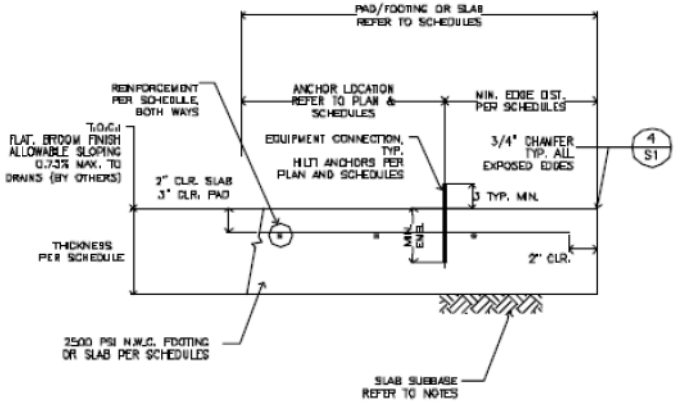
DRAWING NO. C-11604475 REV. A

SCALE N/A DO NOT SCALE DRAWING SHEET 1 OF 2

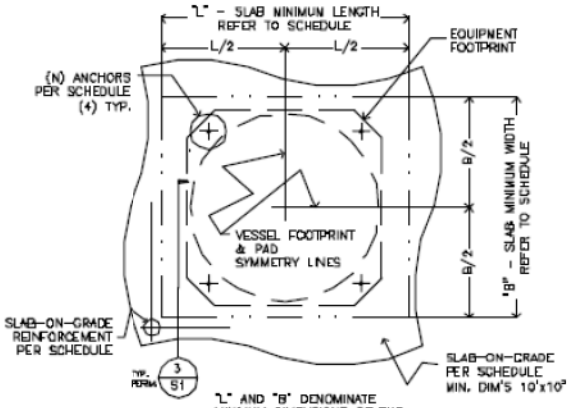
DWG NO. C-11604475



1 (N) EQUIPMENT PAD, VESSEL FOOTPRINT & ANCHOR LAYOUT
PLAN, NTS

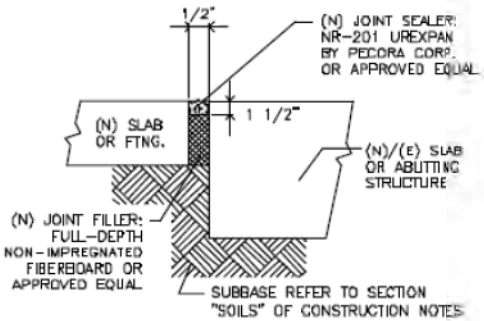


3 (N) EQUIPMENT PAD/SLAB
TYP. SECTION, NTS



"L" AND "B" DENOMINATE
MINIMUM DIMENSIONS OF THE
SLAB TRIBUTARY TO
(OCCUPIED BY) (N) VESSEL

2 (N) EQUIPMENT SLAB, VESSEL FOOTPRINT & ANCHOR LAYOUT
PLAN, NTS



4 EXPANSION JOINT (EJ)
TYP. VERTICAL NTS

REV.	ECO #	REVISION DESCRIPTION	BY	DATE

APPROVED | DATE
DRAWN: T.J.S | 6/12/01
CHK'D | -
ENG'R | -
MFG'L | -
ENG'L | -
QUAL | -
PROD | -
PURCH | -

NEXT ASSY | USED ON | NEXT ASSY | FINAL ASSY
APPLICATION | QUANTITY REQ'D

THE MATERIALS AND INFORMATION, INCLUDING THE PRINCIPLES OF DESIGN PRESENTED BY THIS PRINT, IS THE EXCLUSIVE PROPERTY OF MVE, INC. AND IS CONFIDENTIAL INFORMATION. ACCEPTANCE OF THIS INFORMATION IS SUBMITTED TO YOU WITH THE AGREEMENT THAT IT IS NOT TO BE REPRODUCED, COPIED OR LOANED, IN PART OR IN WHOLE, NOR IS THE INFORMATION TO BE RELATED TO ANY COMPANY. ACCEPTANCE OF THIS DRAWING WILL BE CONSTRUED AS AN AGREEMENT TO THE ABOVE.

MATL

PART NUMBER 11604475

MVE, Inc
NEW PRAGUE, MINNESOTA 56071

FOUNDATION LAYOUT
PERMA-CYL

DRAWING NO. C-11604475 | REV A
SCALE N/A | DO NOT SCALE DRAWING | SHEET 2of2