4001 CO2 portable

Operation and Maintenance Manual

LCO2-Westmor-70 Ton Portable Trailer

Section 1: Safety

1.1 General Safety

This operating manual is written for all employees who will be operating or working on the equipment. It is important that the information concerning potential hazards and safety practices contained in this section be given to and understood by all employees including supervisory and management personnel involved with the operation and/or maintenance of this system.

It should be emphasized to all personnel that each person has a safety responsibility and that they must understand and use the information contained in this manual.

1.2 Hazards

1.2.1 Modifications to the Equipment

WARNING

Independent changes to the equipment may result in significantly increased risks of hazards resulting in injury or death.

If the system requires modification in order to meet specific needs, a Linde Inc. representative should be contacted.

1.2.2 Cryogenic Gases and Liquids

WARNING

The liquid carbon dioxide in the storage vessel is very cold: -109°F.

Contact with liquid carbon dioxide or cold carbon dioxide gas can cause severe cold burns and frostbite.

Personal protective equipment must be worn when exposure to cold carbon dioxide is likely.

This equipment should include: insulated gloves, goggles or a face shield, and loose-fitting clothing resistant to extremely cold temperatures.

1.2.3 High Pressures

CAUTION

Liquid carbon dioxide pipelines can contain pressures up to 2000 psig and compressed carbon dioxide gas pipelines could contain pressures up to 2600 psig.

Pressurized gas lines can damage equipment and injure personnel.

Exercise care when working on or around these pressurized lines.

Ensure the pressures have been vented before breaking any connection. Tag out and lock out the line while performing any work. Wear a face shield when working on previously pressurized lines.

1.2.4 Asphyxiation

DANGER

High concentrations of carbon dioxide gas in a confined area will cause an oxygen deficient atmosphere.

An oxygen deficient atmosphere will cause suffocation and death.

Check the area with an oxygen monitor to ensure an oxygen concentration above 19.5%.

1.2.5 Electric Shock

DANGER

Voltages capable of causing fatal injury are used in this equipment.

Verify that the power source is OFF and locked out before making any repairs to, or replacement of electrical components.

1.3 Liquid Carbon Dioxide and Carbon Dioxide Gas Safety

1.3.1 Safety Precautions for Liquid Carbon Dioxide and Carbon Dioxide Gas

Each employee, working in an area where exposure to carbon dioxide gas is likely, must be trained to recognize the hazards, symptoms of over-exposure, emergency procedures, and proper precautions to minimize exposure. It is recommended that each employee be retrained at least once a year or whenever there is a process change.

Some Physical Properties of Carbon Dioxide	
Color of liquid	None
Color of gas	None
Taste of gas	None
Odor	None
Explosive limits	Not Explosive
Normal boiling point a 1 atmosphere	-109°F
Ratio of the volume of liquid to gas at 68°F and 1 atmosphere	416 to 1
Specific gravity of gas at 68°F and 1 atmosphere	1.555
Special information	Asphyxiate

1.3.2 Health Hazards

Hazards to health are due either to intense cold or to displacement of air by carbon dioxide gas leakage or by rapidly evaporating liquid carbon dioxide gas. Prolonged breathing of extremely cold gas may damage lung tissues. Carbon dioxide gas is toxic and does not support life. Even in acceptable ranges of oxygen, carbon dioxide is toxic.

Carbon Dioxide Content	Effect and Symptoms (At Atmospheric Pressure)
2-3%	Unnoticed at rest, but on exertion there may be marked shortness of breath
3%	Breathing becomes noticeably deeper and more frequent at rest
3-5%	Breathing rhythm accelerates. Repeated exposure provokes headaches
5%	Breathing becomes extremely labored, headaches, sweating and bounding pulse
7.5%	Rapid breathing, increased heart rate, headaches, sweating, dizziness, shortness of breath, muscular weakness, loss of mental abilities, drowsiness, and ringing in the ears
8-15%	Headache, vertigo, vomiting, loss of consciousness and possibly death if the patient is not immediately given oxygen
10%	Respiratory distress develops rapidly with loss of consciousness in 10-15 minutes
15%	Lethal concentration, exposure to levels above this are intolerable
25+%	Convulsions occur and rapid loss of consciousness ensues after a few breaths. Death will occur if level is maintained.

1.3.3 Cold Burns and Frostbite

Because of the low temperature of liquid carbon dioxide, -109°F, the liquid or cold vapor can produce damage to the skin similar to heat burns. Unprotected parts of the skin coming in contact with uninsulated items of cold equipment may stick fast to them and flesh may be torn or removed. Cold vapors or gases may cause frostbite and damage to lung tissues. Local pain usually gives warning of freezing but sometimes no pain is felt or it is short lived. Frozen tissues are painless and appear waxy with pale yellowish color. Thawing of the frozen tissue can cause intense pain. Shock may also occur.

For all cryogenic burns or frostbite injuries, seek immediate medical attention. Loosen any clothing that may restrict blood circulation. Do not apply dry heat, but, if possible, warm the part slowly with moist heat by placing the affected part in lukewarm water. Protect the frozen part from injury or from infection. DO NOT RUB. Dry, sterile dressings can be used for the purpose but they should not restrict blood circulation. Alcohol and cigarettes should not be allowed.

1.3.4 Hypothermia

Low air temperatures near liquid carbon dioxide gas can cause hypothermia and all persons in the area should be warmly clad. Hypothermia is possible in any environment below 50°F but susceptibility depends upon the length of exposure, the atmospheric temperature and the individual; older people are more likely to be affected.
The symptoms of hypothermia are:

- A slowing down of physical and mental responses
- Unreasonable behavior or irritability
- Speech or vision difficulty
- Stumbling
- Cramps and shivers

If possible, take the victim's temperature; the mouth temperature should be above 95°F. Persons apparently suffering from hypothermia should be wrapped in blankets and moved to a warm place. Seek immediate medical attention. No direct form of heating should be applied except under medical supervision.

1.3.5 Asphyxia

Leakage of carbon dioxide gas or evaporation of liquid carbon dioxide may cause oxygen deficient atmospheres, which will produce asphyxia if inhaled. Atmospheres containing less than 19.5% oxygen are dangerous and produce brain damage and perhaps death. Inhalation of pure carbon dioxide results in immediate unconsciousness; the victim falls as if struck down by a blow on the head. It is important to note that the victims will not be aware that he is being asphyxiated. The symptoms of asphyxia can include:

- Rapid breathing
- Nausea
- Vomiting
- Inability to move
- Convulsive movements
- Collapse
- Abnormal pulse
- Rapid fatigue
- Faulty judgment
- Insensitivity to pain
- Abnormal emotions

A person exposed to an oxygen deficient atmosphere should be immediately removed to an uncontaminated area. Get medical attention immediately. If not breathing use cardiopulmonary resuscitation. Rescuers should not attempt to enter an area suspected of being oxygen deficient without positive pressure breathing apparatus or they may be overcome as well.

1.3.6 Beware of Low or Confined Areas

Liquid carbon dioxide and carbon dioxide gas may accumulate in low or confined areas under certain conditions of use or storage. Adequate ventilation is required to ensure a safe working environment. Appropriate warning signs should be prominently displayed outside of areas where high concentrations of carbon dioxide may accumulate.

When entering areas where nitrogen gas may be present all requirements of OSHA 1910.146 (Confined Space Guidelines) must be followed, including proper respiratory protection. Self-contained breathing apparatus, or the type which feeds compressed air to the breathing mask, are required. Do not use cartridge or filter-type gas masks.
A "buddy system" must be used when entering a confined area or room which may contain high concentrations of carbon dioxide gas. One person should remain outside the area while the other goes inside to work. This method assures maximum safety to the

employee because one person is on the spot at all times in the event of an emergency.

1.3.7 Personal Protective Equipment (PPE)

When personal protective equipment is required, personnel must follow standard Linde personal protective equipment procedures. These procedures include the use of eye and face protection, hearing protection, hand & skin protection, head protection and foot protection. Reference: IMS-27-04-RNA-EN, PPE Requirements for Linde RNA.

- Hand protection: loose fitting leather gloves must be worn when operating valves. Rubber gloves are not suitable. The gloves should be a loose fit so that they can easily be removed if liquid should splash onto or into them. For this reason, gauntlet gloves are not recommended.
- Foot protection: steel-toed safety boots.
- Eye protection: safety glasses with side shields. Goggles or a face mask should be used when the possibility of splashing liquid exists.
- Hard hats: must be worn at all times.
- Hearing protection: should be worn where necessary. (e.g. when venting a vessel or other pressurized equipment/piping). Hearing protection must be worn to reduce any noise exposure below 80 Dba.
- Clothing: Protective clothing is intended to protect the wearer from accidental contact with liquid carbon dioxide. Wet clothing must not be worn around cryogenic liquids. Woven materials should be avoided but, if they are used, it is essential to ensure that they do not become saturated with cold liquid. Overalls or similar type clothing should be worn. These should preferably be made without open pockets or turn ups where liquid could collect. Trousers with no cuffs should be worn outside boots, insulated shoes or high-top shoes to shed spilled liquid. If clothing becomes contaminated with gas or vapor, the wearer should ventilate it for a minimum of five minutes by walking around a well ventilated, uncontaminated area.

1.3.8 Personal Monitors

Portable atmospheric monitors must be used when working on or near equipment or piping that contains carbon dioxide gas. If the personal monitor is out of calibration, follow the manufacturer's instructions for calibration.

1.3.9 Use of Water

Liquid carbon dioxide, being much colder than 32°F, rapidly freezes water. During clean up, etc., indiscriminate use of water on the cryogenic surfaces can lead to a buildup of ice and a considerable increase in weight which might not be structurally tolerable. Due to the water's relatively high temperature and heat content, it could also cause evaporation of the liquid carbon dioxide within the piping or equipment resulting in a dangerous pressure rise. Valve spindles may be rendered inoperable and relief valves, intended to release dangerous over-pressure can be plugged by ice formation resulting in pressure bursts. Avoid using water around the cryogenic equipment.

1.4 Energy Control Procedure

The energy control procedure shall be written, reviewed and used by authorized employees to make certain that the equipment is isolated from all potentially hazardous energy and is locked out and/or tagged out before performing any servicing or maintenance activities where the unexpected energization, start-up, or release of stored energy could cause injury or accident.
Reference: http://limss.linde.grp/imss_doc/IMS-26-07-RNA_EN/attachments.htm

1.5 Hazardous Work Permit

In addition to the energy control procedure, the hazardous work permitting system shall be used by authorized and trained employees to make certain that the equipment is isolated from all potentially hazardous energy and is locked out and/or tagged out before performing any servicing or maintenance activities where the unexpected energization, start-up, or release of stored energy could cause injury or accident. Reference: http://limss.linde.grp/imss_doc/IMS-26-05-RNA_EN/start.htm

1.6 Lockout or Tagout

(Occupational Safety and Health Admin., Labor Para. 1910.147)

1.6.1 Purpose

This procedure establishes the minimum requirements for the lockout or tagout of energy isolating devices. It shall be used to ensure that the machine or equipment are isolated from all potentially dangerous energy, and locked out or tagged out before employees perform any servicing or maintenance activities where the unexpected energization, start-up or release of stored energy could cause injury.
Reference: IMS-26-07-RNA, Energy Control Program (Lockout-Tagout)

1.6.2 Responsibility

Appropriate employees shall be instructed in the safety significance of the lockout or tagout procedure. Each new or transferred affected employee and other employees whose work operations are or may be in the area shall be instructed in the purpose and use of the lockout or tagout procedure.

1.6.3 Preparation for Lockout or Tag out

Make a survey to locate and identify all isolating devices to be certain which switch(s), valve(s) or other energy isolating devices apply to the equipment to be locked or tagged out. More than one energy source (electrical, mechanical, or others) may be involved.

1.6.4 Sequence of Lockout or Tag out System Procedure

1. Notify all affected employees that a lockout or tag out system is going to be utilized and the reason therefore. The authorized employee shall know the type and magnitude of energy that the machine or equipment utilizes and shall understand the hazards.
2. If the machine or equipment is operating, shut it down by the normal stopping procedure (depress stop button, open toggle switch, etc.).
3. Operate the switch, valve, or other energy isolating device(s) so that the equipment is isolated from its energy source(s). Stored energy (such as that in springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam or water pressure, etc.) must be dissipated or restrained by methods such as repositioning, blocking, bleeding down, etc
4. Lockout and/or tagout the energy isolating devices with assigned individual lock(s) or tag(s).
5. After ensuring that no personnel are exposed, and as a check on having disconnected the energy sources, operate the push button or other normal operating controls to make certain the equipment will not operate
6. Return operating control(s) to the neutral or off position after the test.
7. The equipment is now locked or tagged out.

1.6.5 Restoring Machines or Equipment to Normal Production Operations

1. After the servicing and/or maintenance are complete and equipment is ready for normal production operations, check the area around the machines or equipment to ensure that no one is exposed.
2. After all tools have been removed from the machine or equipment, guards have been reinstalled and employees are in the clear, remove all lockout or tag out devices. Operate the energy isolating devices to restore energy to the machine or equipment.

1.6.6 Procedure Involving More Than One Person

In the preceding steps, if more than one individual is required to lockout or tagout equipment, each shall place his/her own personal lockout device on the energy isolating devices(s). When an energy isolating device cannot accept multiple locks or tags, a multiple lockout or tagout device (HASP) may be used. If lockout is used, a single lock may be used to lockout the machine or equipment with the key being placed in a lockout box or cabinet which allows the use of multiple locks to secure it. Each employee will then use his/her own lock to secure the box or cabinet. As each person no longer needs to maintain his/her lockout protection, that person will remove his/her lock from the box or cabinet.

1.7 Safety Bulletin - Oxygen Deficient Atmospheres

The normal oxygen content of air is approximately 21%. Depletion of oxygen content in air, either by combustion or displacement with inert gas, is a potential hazard to personnel throughout industry. A general indication of what can potentially occur relative to the percentage of oxygen available is given in the table below:

Oxygen Content	Effect and Symptoms (At Atmospheric Pressure)
15-19.5%	Decreased ability to work strenuously. May impair coordination and may induce early symptoms in persons with coronary, pulmonary, or circulatory problems.
12-14%	Respiration increases in exertion, pulse up, impaired coordination, perception and judgment.
10-12%	Respiration further increases in rate and depth, poor judgment, lips blue.
8-10%	Mental failure, fainting, unconsciousness, ashen face, blueness of lips, nausea, and vomiting.
6-8%	8 minutes, 100% fatal; 6 minutes, 50% fatal; 4-5 minutes, recovery with treatment.
4-6%	Coma in 40 seconds, convulsions, respiration ceases, death.

DANGER

Exposure to atmospheres containing 12% or less oxygen will bring about unconsciousness without warning and so quickly that the individual cannot help or protect himself.

When personnel are required to enter or work in oxygen-deficient atmospheres, there are certain requirements that must be followed:

- Analyze the atmosphere to determine if there is an enrichment or deficiency of oxygen. Continue to monitor during work process.
- Train the worker on what to expect and how to handle it.
- Blank any incoming lines to confined area and ventilate the area.
- When it is necessary to work in any oxygen-deficient atmosphere, provide self-contained breathing apparatus for all workers.

1.8 Material Safety Data Sheets

The following safety literature is provided:

Material Safety Data Sheet – Carbon Dioxide, Gas located in GDMS: Cabinets/LG Plants NA/US/00 Oil and Gas/General/ MSDS

Material Safety Data Sheet – Carbon Dioxide, Refrigerated Liquid Located in GDMS: Cabinets/LG Plants NA/US/00 Oil and Gas/General/ MSDS

1.9 Training Checklist

When personnel are required to operate this equipment, complete the training checklist located in GDMS: Cabinets/LG Plants NA/US/00 Oil and Gas/General/ Forms

Section 2: System Description

2.1 General System Description

The 70-Ton Portable Trailer provides a safe, compact, mobile unit for storage of liquefied or gaseous carbon dioxide on the frack pad. It consists of a storage tank with associated hoses, piping, fittings, and safety devices. It is customized to Linde's specifications and designed to incorporate the company's extensive field experience from Linde's existing Oil and Gas Services. In addition, it complies with applicable NFPA, ASME, CGA and DOT codes and standards.

Operation of the unit requires one operator who controls the carbon dioxide delivery. The operator can control head pressure and flow to the operating equipment.

This is not a transport vehicle and must be empty when on the road.

2.2 System Specifications

This section contains information about the system's capacities, safety interlocks, component descriptions and a sequence of operations. Any operational set points are also included here. All who will operate, maintain or supervise the operation of this equipment should read this portion of the manual.

2.2.1 General Specifications

Model	70-Ton Portable Trailer
Service	Liquid Carbon Dioxide
Carbon Dioxide Liquid Density	8.824 lbs./gal @-15°F
Carbon Dioxide Vapor Density	0.3525 lbs./gal @-15°F
Carbon Dioxide Molecular Weight	44.01
Carbon Dioxide Liquid Viscosity	0.14 Centipoise

Temperature of Solid Carbon Dioxide	-109°F
MAWP	350 psi
Stationary Capacity	70 Tons (16,800 gal)
Over the Road Capacity	Not to be used for the transport of product
Overall Length	52'-3¼"
Maximum Width	8' – 6"
maximum Height	12'- 9¾"
Tare Weight	57,300 lbs. (Approximate)
Conventional Tractor Requirements	Front Axle = 8620 lbs. Rear Axle = 7260 lbs. Total = 15,880 lbs. Wheel base = 187 inches
Sleeper Tractor Requirements	Front Axle = 10,200 lbs. Rear Axle = 7960 lbs. Total = 18,160 lbs. Wheel base = 228 inches
Minimum Operating Temperature	-50°F @ 350 psig
Piping in Contact with Vessel	Schedule 80 Type 304 Stainless
Piping in General	ASTM A 106 Grade B Seamless Schedule 80
Front Liquid Connection (1)	4" hammer union Kemper PN 270479 or Cattawassa Fig #206 reduced to a 2" liquid connection with a brass male CGA fitting Acme PN 320-020-15-FE
Front Vapor Connection (1):	2" Acme PN320-020-10
Rear Liquid Connections (2)	4" hammer union Kemper PN 270479 or Cattawassa Fig #206 reduced to a 2" liquid connection with a brass male CGA fitting Acme PN 320-020-15-FE
Rear Vapor Connection (2):	2" Acme PN320-020-10

2.2.2 Safety Devices

- Primary Tank Safety Relief Valve: Anderson Greenwood Model 83 CM 68-8-350 psig (MAWP of vessel).
- Secondary Tank Safety Relief Valve: Anderson Greenwood Pilot Actuated Model 234NH152-S1-385 (385 psig which is 10% over design tank pressure)
- Safety relief valves between Block Valves: Generant CRV-500 B-K-550#

2.2.3 Instrumentation

- Gauging Devices (2 places – One at the front of the trailer and one at the rear) – Magnatel float type liquid level gauge.
- Pressure Gauges (2 places – One at the front of the trailer and one at the rear) – 6″ DIA 0-600 psi bottom mount.
- Trycocks (2 places – One at the front of the trailer and one at the rear) – 95% and 3%

Section 3: Installation

This section is intended as a general guide to installation of the equipment. It is not a step-by step procedure; it relies on the knowledge of Linde technicians, operators, and experienced electrical and pipe fitting contractors. Linde engineering personnel are available for installation assistance.

3.1 Installing the Equipment

3.1.1 Performing the Site Survey

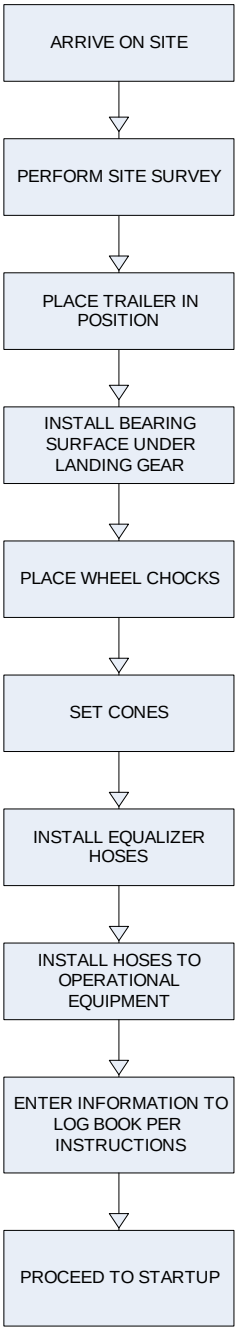
Reference site survey form located in GDMS: Cabinets/LG Plants NA/US/00 Oil and Gas/General/ Forms

3.1.2 Locating and Positioning the Equipment

- Position the equipment relative to all appropriate setbacks.
- Level the trailer.
- Utilize lumber or other appropriate methods to provide bearing surface under the landing gear

3.2 Setting up the Equipment

3.2.1 Setup Sequence



3.2.2 Making the Piping Connections

Do not allow water, dirt or debris to accumulate in the hoses or the hose ends.

Check that the pneumatic, gaseous and liquid product piping are sound and securely fixed.

Note: Use a soap or commercial leak detector solution to check for leaks in a gaseous or liquid system.

Pressure-test the equipment as appropriate.

- Front liquid connections (1): 4″ hammer union Kemper PN 270479 or Cattawassa Fig #206 reduced to a 2″ liquid connection with a brass male CGA fitting Acme PN 320-020-15-FE
- Front vapor connection (1): 2″ Acme PN320-020-10
- Rear liquid connections (2): 4″ hammer union Kemper PN 270479 or Cattawassa Fig #206 reduced to a 2″ liquid connection with a brass male CGA fitting Acme PN 320-020-15-FE
- Rear vapor connection (2): 2″ Acme PN320-020-10

3.2.3 Making the Electrical Connections

The LCO2-Westmor-70 Ton Portable Trailer does not require external power.

3.2.4 Equipment Chill Down Procedure

Refer to Linde Oil & Gas Procedure 001, Procedure for Cooling and Purging a Trailer located in GDMS: Cabinets/LG Plants NA/US/00 Oil and Gas/General/ Procedures

WARNING

Operation of this equipment without proper training exposes you to the risk of personal injury.

Do not operate this equipment unless you have been trained in its safe operation.

All operators must read and understand the safety section of this manual before operating the system. All operating and maintenance personnel must receive training and instruction from Linde representatives.

Section 4: Operation

4.1 Operational Overview

WARNING

Operation of this equipment without proper training exposes you to the risk of personal injury.

Do not operate this equipment unless you have been trained in its safe operation.

All operators must read and understand the safety section of this manual before operating the system. All operating and maintenance personnel must receive training and instruction from Linde representatives.

WARNING

This operational information is an overview only and is not intended for system operation. Read and understand the safety and operation sections of this manual before attempting to operate the system.

The 70-Ton Portable's function is to act as a stationary storage vessel providing product to operational equipment. This not a transport vehicle and should be empty when on the road.

4.2 Preparing to Run the Equipment

4.2.1 Initial Valve Positions

1	BV-1, Ball Valve – Isolation Valve - Liquid Connection Curbside Front	Closed
2	BV-2, Ball Valve – Isolation Valve - Vapor Connection Curbside Front	Closed
3	BV-3, Ball Valve – Isolation Valve – Pressure Indicator 2 Trailer Front	Closed
4	BV-4, Ball Valve – Bleed Valve – Liquid Line Curbside Front	Closed
5	BV-5, Ball Valve – Bleed Valve – Vapor Line Curbside Front	Closed
6	BV-6, Ball Valve – Trycock Valve – High Level 95%	Closed
7	BV-7, Ball Valve – Crossover Valve - Vapor to Liquid Curbside Front	Closed
8	BV-8, Ball Valve – Isolation Valve – Liquid Connection Curbside Rear	Closed
9	BV-9, Ball Valve – Isolation Valve – Vapor Connection Curbside Rear	Closed
10	BV-10, Ball Valve – Isolation Valve – Pressure Indicator 1 Trailer Rear	Closed
11	BV-11, Ball Valve – Bleed Valve – Liquid Line Curbside Rear	Closed
12	BV-12, Ball Valve – Bleed Valve – Vapor Line Curbside Rear	Closed
13	BV-13, Ball Valve – Trycock Valve Low Level 3%	Closed
14	BV-14, Ball Valve - Crossover Valve - Vapor to Liquid Curbside Rear	Closed
15	BV-15, Ball Valve – Isolation Valve – Liquid Connection Roadside Rear	Closed
16	BV-16, Ball Valve – Isolation Valve – Vapor Connection Roadside Rear	Closed
17	BV-17, Ball Valve – Bleed Valve – Liquid Line Roadside Rear	Closed
18	BV-18, Ball Valve – Bleed Valve – Vapor Line Roadside Rear	Closed
19	BV-19, Ball Valve - Crossover Valve - Vapor to Liquid Roadside Rear	Closed

4.3 Normal Startup

1. Depending on the configuration of the portable trailers used, open the vapor connections as appropriate.
2. Depending on the configuration of connections to the operating the equipment, open the liquid connections as appropriate.

4.4 Normal Shut Down

1. Depending on the configuration of the portable trailers used, close the vapor connections as appropriate.
2. Depending on the configuration of connections to the operating the equipment, close the liquid connections as appropriate.
3. Before transport vent all remaining carbon dioxide.

4.5 Emergency Shut Down

1. Immediately shut off all open liquid connection ball valves.
2. If there is no danger to your own health, recover persons from the hazard zone.
3. Initiate first aid measures if necessary.
4. Inform responsible person at the operational site.

4.6 Factors Affecting Performance

While pumping, monitor the carbon dioxide head pressure of the portable unit. This pressure should never fall below 200 psig. Decreasing carbon dioxide storage pressure below 200 psig must be avoided. The auto-refrigeration of liquid carbon dioxide will drop below the vessel design temperature of -20°F for storage tanks and -50°F for trailers and portables. These carbon steel vessels are subject to metal embrittlement at these low temperatures. Vessels subject to such conditions should not be repressurized or moved onto the highway until sufficient warming has occurred.

Section 5: Troubleshooting

DANGER

Voltages capable of causing fatal injury are used in this equipment.

Electric shock can cause injury or death.

Troubleshooting is to be performed only by personnel trained and qualified in safe electrical practices, including proper tag out/lock out procedures and procedures for operating and servicing live electrical systems.

Please refer to the Federal OSHA Code of Federal Regulations 29CFR, part 1910.331 Safety Related Work Practices and any applicable state or local regulations regarding safe work practices as they regard to working on live electrical equipment.

This section provides a list of faults, their probable causes, and corrective actions. The causes are listed from the most likely to the least likely.

This list is not exhaustive. It presents the most likely problems and their causes. If you cannot resolve the problem using this section, contact your local Linde representative for assistance.

5.1 Energy Control Procedure, Hazardous Work Permit Lockout-Tagout

Refer to Section 1.4 of this manual - Energy Control Procedures

Refer to Section 1.5 of this manual – Hazardous Work Permit

Refer to Section 1.6 of this manual – Lockout - Tagout

Section 6: Maintenance

This section explains the schedule and procedures for periodic maintenance.

WARNING

The moving parts of this machinery present a hazard for injury if guards are not in place or if body parts or clothing contact moving parts of the machinery.

Verify that all hazardous energy sources are OFF and locked out before making any repairs on moving parts.

DANGER

Voltages capable of causing fatal injury are used in this equipment.

Verify that the power source is OFF and locked out before making any repairs to, or replacement of electrical components.

WARNING

Product released accidentally during maintenance could cause severe cold burns.

To prevent an accidental release, the manual shut-off valve(s) to the equipment should be closed and locked out.

6.1 Preventive Maintenance

The following procedures give general guidance for maintenance. A maintenance frequency schedule is given in SAPPM.

6.2 Maintenance Schedule

6.2.1 Pre-Departure Checks

The Linde operator must observe all safety requirements set forth by the well safety coordinator. A copy of all special requirements should be obtained before departure.

1. Prior to departure to the site: Check tire air pressure – Adjust as necessary.
   - Steering Axle (Cold) = 100 psi (110 psi MAX)
   - Drive Axle (Cold) = 100 psi (110 psi MAX)
   - Trailer Axle (Cold) = 100 psi (110 Psi MAX)
2. Pressure-test the equipment as appropriate.
3. Check all flange bolts are installed and torqued to specification.
4. Check that all bolts extend two threads beyond the nuts.
5. Check ABS – With vehicle stationary and ignition turned on, ABS light should illuminate then go out. A continuous light means the ABS is inoperative.

6.2.2 Daily

1. Check tire air pressure – Adjust as necessary.
2. Check that the pneumatic, gaseous and liquid product and hydraulic piping are sound and securely fixed.

   Note: Use a soap or commercial leak detector solution to check for leaks in a gaseous or liquid system.

6.2.3 Every Five Years

Replace pressure safety valves per SAPPM

6.3 Exclusion of Implied Warranties

Your sole and exclusive remedy is product repair. Any implied warranties of merchantability or fitness for a particular purpose, are limited to the shortest period allowed by law. IN ALL EVENTS, LINDE IS NOT LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES, INCLUDING ANY LOSS OF BUSINESS, PRODUCTION, OR PROFITS."

Section 7: Recommended Spare Parts

GENERAL PARTS IDENTIFICATION

ITEM	DESCRIPTION	MANUFACTURER	PART NUMBER
1			
2			
3			

Section 8: Drawings

The following is an index of drawings.

DWG	DRAWING NUMBER	DESCRIPTION
1	019-LCO2-Oil & Gas-091	P&ID
2	Westmor 11284-12	Trailer Assembly

Section 9: Manufacturers' Literature

The following is an index of major components and the equipment manufacturers' literature.

ITEM	DESCRIPTION
1	
2	

Section 10: Customer Responsibility

10.1 Customer Ownership and Operation

This section provides a list of customer responsibilities. The system is owned by Linde and the installation, commissioning, maintenance, and decommissioning or removal of the system is the responsibility of Linde. The customer's operational responsibilities include maintenance of access roads, insuring that all electrical devices, open flames, & other ignition sources are outside of the hazardous area, and maintenance of utilities and area lighting. The customer must maintain clear access for Linde Service Technicians and equipment service.

10.2 Site Inspection

An overall review of the site should be made each day. The area should be checked for parked vehicles, trash, debris, and any problems from construction activities, vandalism or any other activity that might infringe on safe operation of the system. Visually inspect the site to ensure that all warning signs are visible and access routes & driver working areas are clear.

Snow removal is the customer's responsibility. Snow buildup presents a hazard to Linde and customer personnel and can result in the inability to deliver product to the customer in a timely manner.

10.3 System Inspection

A visual inspection of the system should be completed daily. The visual inspection should include the entire unit. All gauges should be inspected for operation within their normal range and for any signs of damage. The system evaporators and piping should be inspected for signs of leakage.

The use of a logbook to record pressure and daily consumption is recommended. This will provide a source of history and provide a source for data. The list below can be utilized as a daily checklist.

10.4 Customer Checklist

Customer Checklist		
1	There is no general damage or excessive deterioration of any item within the system.	☐
2	There are no audible or visible system leaks.	☐
3	All safety signs are in place, legible and unobstructed.	☐
4	There has been no change within the vicinity that could affect the safe operation of the equipment.	☐
5	The system installation area is kept clear at all times from debris, paper, cardboard boxes, rags, weeds, leaves, etc.	☐
6	The system installation area is not being used for the storage of materials or equipment, for example chemicals or tools.	☐
7	The system installation area & surrounding areas are kept clear of combustible materials.	☐
8	The access route for maintenance is clear.	☐

10.5 Customer Troubleshooting

Before taking the corrective action on this equipment, the customer must always contact Linde first. Linde will determine what the customer actions will be. The customer must never attempt any action unless advised or instructed first by a Linde Service Technician.

Section 11: Equipment Log

EQUIPMENT LOG INSTRUCTIONS

The purpose of the Log is to record data for future reference pertaining to cost of equipment mobilization, maintenance, and component life. Use the following guidelines when making entries. The equipment Log Form is located in GDMS: Cabinets/LG Plants NA/US/00 Oil and Gas/General/ Forms

1. Record the arrival and departure of the crew on a daily basis. This should include the name of the individuals operating the unit and the time they arrive and depart from the site on a daily basis. It is NOT necessary to record breaks, lunch or arrivals and departures for parts and so forth during the work day.

DATE	TIME	RECORDER	EVENT
8-1-2014	0700	Bill Znidarsic	Bill Z on site
			Jimmy Turner on site
8-1-2014	1800	Bill Znidarsic	Bill Z left site
			Jimmy Turner left site

2. Record modifications, breakdowns and repairs. This should include all items preventing the equipment from operating efficiently.

DATE	TIME	RECORDER	EVENT
8-15-2014	1000	Bill Znidarsic	Gas Analyzer transformer
			blowing 1 amp fuse.
			down for parts

3. Record filter and component changes. This should include the time of replacement using the PLC runtime meter if applicable.

DATE	TIME	RECORDER	EVENT
8-17-2014	0700	Bill Znidarsic	Started to replace
			Membrane MGB11

4. Record the arrival time of the unit on site. Record when setup started and when setup was complete. This includes the time it takes for the customer to pipe the unit.

DATE	TIME	RECORDER	EVENT
8-20-2014	0700	Bill Znidarsic	Arrived on site
			Started setup & pipefitting
8-20-2014	1200	Bill Znidarsic	Finished setup
			Customer still pipefitting

5. Record the departure time of the unit when leaving the site. Record when the disconnect started and when the disconnect was complete. This includes the time it takes for the customer to remove piping from the unit.

DATE	TIME	RECORDER	EVENT
8-22-2014	0700	Bill Znidarsic	Started disconnect
8-22-2014	1200	Bill Znidarsic	Finished disconnect
			ready for movement

6. Record the time of travel from location to location: Record the time that the equipment leaves the customer site and the time it reached its next location. Also record the time it leaves its pickup location and arrives on site. Include mileage as a line item.

DATE	TIME	RECORDER	EVENT
8-22-2014	1200	Bill Znidarsic	Departed customer site
8-22-2014	1600	Bill Znidarsic	Arrived Linde Bayport
			350 miles

7. Record the gas volume at the start and completion of the job if applicable: Record the total gas flow from the flowmeter.

DATE	TIME	RECORDER	EVENT
8-22-2014	1200	Bill Znidarsic	Feed gas flow meter reads
			4090 at start of run
8-28-2014	1600	Bill Znidarsic	Sales gas flowmeter reads
			8999 at start of run