

Making our world more productive



Cryogenic Supply Systems

An inside look



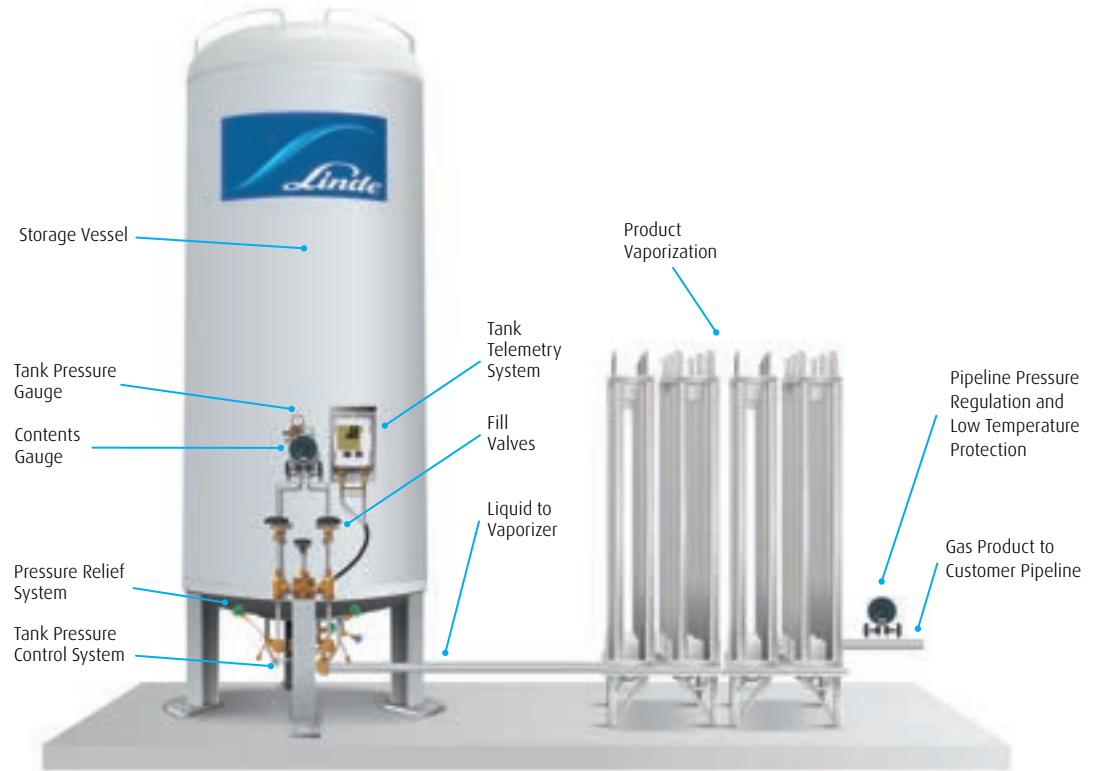


Figure 1: Overview of a Cryogenic Supply System

Committed to Excellence

Linde designs, installs, and maintains its cryogenic systems to provide a reliable, consistent supply of argon, nitrogen, and oxygen. Our goal is to provide supply reliability at the required purity and pressure.

To help us meet this goal, we regularly monitor the supply system through a combination of real-time remote monitoring, periodic inspections by our technicians, and driver checks at the time of each delivery. Installed at your site, our bulk supply systems replace the need for high-pressure cylinders and eliminate handling and change-outs while meeting applicable federal, state and local safety requirements. Our bulk supply systems are available in a large variety of sizes and flow capacities to satisfy the needs of many applications.

Supply System Overview

Linde has three cryogenic supply systems (Figure 1) available to customers for argon, nitrogen, and oxygen. The primary components of the cryogenic supply systems are designed to meet customer flow, pressure, and purity requirements. The entire system is designed to maintain consistent product pressure and purity.

The primary components include:

Cryogenic storage vessels

The cryogenic tank is sized to meet customer requirements.

Vaporizers

Vaporizers convert cryogenic liquid to near ambient temperature gas and are sized for peak flow requirements.

Safety Systems

Safety is our first priority at Linde. We install gas supply systems that are engineered to prevent over-pressure or low-temperature hazards.

Cryogenic Storage Vessels Cryogenic tanks are designed to store cryogenic liquids. The vessels are a tank within a tank. The inner vessel contains the product and is American Society of Mechanical Engineers (ASME) coded. It is made from nine percent nickel carbon steel, stainless steel, or aluminum. The space between the inner and outer vessels is filled with insulation and is under high vacuum to minimize heat transfer to the stored product.

Linde's standard tanks range in size from 500 to 13,000 gallons for argon, nitrogen and oxygen. Each tank has a mechanical contents gauge or an electronic Tracker™ device. These devices provide a visual indication of the tank level and are affected by many physical attributes.

Product Fill Valve Two main fill valves (Figure 2) are located directly in front of the cryogenic vessel and are labeled as "gas" and "liquid." The gas fill valve connects to the top of the tank and allows filling into the gas phase. The liquid fill valve connects to the bottom of the tank and allows filling into the liquid phase.

A Linde driver connects the product delivery hose to the Compressed Gas Association (CGA) fill connection to deliver the product. The driver maintains correct tank pressure by filling into the appropriate gas or liquid phase.

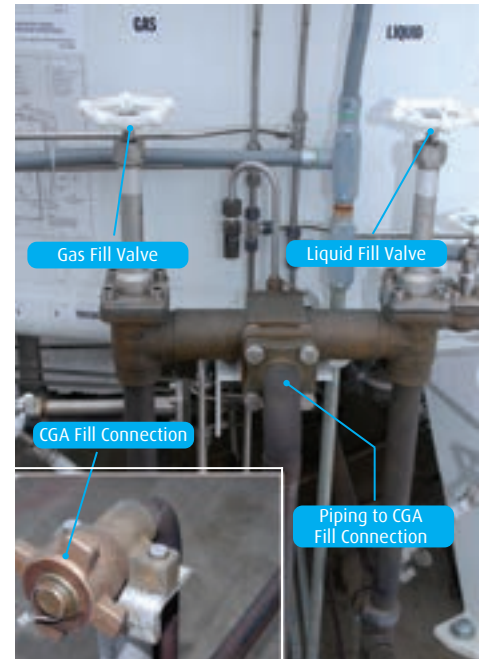


Figure 2: Fill Zone

Tank Contents Monitoring System Tank product level is measured with a contents gauge or the TRACKER™ remote telemetry unit. The contents gauge and the TRACKER system determine the liquid level of the tank by measuring differential pressure between the top and bottom of the tank. The contents gauge is visually read. The TRACKER unit can also be visually read, but its primary purpose is to automatically transmit liquid levels to Linde's North American Logistics Center in Tonawanda, NY. Additionally, there is a pressure gauge mounted near the contents gauge or TRACKER unit that measures the gas pressure in the tank.

Linde Express Linde Express is an online, web-based service that gives customers the ability to view their account on-line, at any time. Each department within your organization can access information according to their needs. Accounts payable can access invoices, purchasing can check inventory, shipping can view digital delivery documents and more.

As a new member, you will need to register by visiting lindeus.com/express.

Please choose Linde Express for bulk and on-site, and create a username and password. Once you are registered you can:

- Enter tank gauge readings and view history
- Access delivery history and order status
- Monitor product usage with Linde's TRACKER system
- View production usage changes
- Access invoices and shipping documents
- View and pay invoices
- Access safety data sheets (SDS)
- Retrieve digital delivery documents
- Automate communication and administrative reporting

Call 800.773.4877 for information or assistance with Linde Express



Figure 3: Ambient Vaporizers

Vaporizers

Liquid product flows from the tank through the vaporizer where it is heated and converted to a gas. Vaporizers are sized to match customer gas flow requirements. Atmospheric vaporizers exchange heat with ambient air, and do not require external power. Steam or electrically heated vaporizers are sometimes used in high-flow applications.

Medical Bulk Gas Installations

There are several differences between a standard cryogenic system and a medical gas system. Although the system components operate the same as a standard cryogenic system, additional equipment is added to the system in order to improve the reliability and comply with necessary industry codes.

In many medical bulk gas installations, two tanks are installed, a main tank and a reserve system. The main tank is the larger of the two tanks from which gases are supplied. The main tank normally has its own set of vaporizers (typically atmospheric) for converting cryogenic liquid to gas product.

Medical Reserve Systems

The reserve system in a medical gas installation is a smaller system, also with its own set of vaporizers.



Figure 4: Medical Bulk Gas Installation

The reserve system is designed to provide a secondary source of product when the main tank is not functioning. This redundancy helps ensure consistent product delivery in the case of product outages or malfunctions. Depending upon a facility's need, the reserve system can be another bulk gas tank (as seen in Figure 4) or a bank of cylinders.

Ordering Information

Every Linde cryogenic supply system has several informational decals attached to the unit. One of these is the order information decal. The order information decal (Figure 5) provides valuable information to the customer, driver, and technician.

The information included on the decal may include the recommended order level, the level at which the tank is full, the fill pressure, the maximum working pressure, the fill system type, the pipeline pressure, and other key information.

The decal features the Linde logo and the slogan "Making our world more productive". It contains the following fields and options:

- ORDER LEVEL:** [] INCHES (Note: Order level is dynamic and changes with use rate.)
- TANK FILLS AT:** [] INCHES
- DRIVER MAINTAIN PRESSURE AT:** [] PSIG
- TANK M.A.W.P.:** [] PSIG
- FILL SYSTEM TYPE:** [] A, B, C, or D
- Legend:**
 - A: SEPARATE LIQUID & GAS FILL VALVES
 - B: DIVERTER FILL VALVE
 - C: LIQUID FILL VALVE ONLY
 - D: GAS FILL VALVE ONLY
- PIPELINE PRESSURE:** [] PSIG
- PRESSURE BUILDER SET AT:** [] PSIG
- ECONOMIZER SET AT:** [] PSIG
- INSPECTION DATE:** []

Contact information at the bottom:

- Gauge Readings & Product Orders
- 24 Hours
- Call 1-800-621-7100
- For 24 Hour Service
- Call 1-844-44LINDE
- E-mail Inquiries to info@praxair.com

PX25530

Figure 5: Order Information Decal

Tank Specifications

Model	Gross Capacity (Gallons)	Net Capacity (Gallons)	MWAP* (PSIG)	Flow Capacity** (SCFH)	Diameter (Inches)	Height (Inches)	Weight*** (Pounds)	NER/Day O ₂ /Ar (Percent)	NER/Day N ₂ (Percent)
VS 1500SC	1,640	1,580	250	9,000	66	196	6,200	.35	.56
VS 3000SC	3,150	3,030	175 250	18,000	86	228	11,100 12,800	.25	.40
VS 6000SC	6,010	5,770	175 250	18,000	86	383	19,900 21,500	.15	.24
VS 9000SC	9,360	8,990	175 250	42,000	114	348	29,400 32,300	.10	.16
VS 11000SC	11,410	10,960	175 250	42,000	114	407	35,200 38,700	.10	.16
VS 13000SC	13,470	13,060	175 250	42,000	114	466	41,700 45,700	.10	.16
VS 15000SC	15,520	15,060	175 250	42,000	114	525	48,000 52,600	.10	.16

*MWAP - Maximum allowable working pressure. 400 psig and 500 psig tanks are available upon request.

**Flow capacity rating down to a 20% contents level with a maximum fall off in tank operating pressure of 15 PSIG.

***Weights are for ASME design.

(NER) = Normal evaporation rate

Note: Actual tanks may vary in dimension.

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