

Liquid helium – essential for research, technology and medicine



Helium – an extremely versatile gas

When the astronomer Sir Lockyer discovered a previously unknown element in the spectrum of the Sun in 1868, he named it after the Greek sun god Helios. Now, due to its unique properties, it is impossible to imagine our industrial society without helium.

Helium (He) is a colourless, odourless inert gas and is present in the Earth's atmosphere to the extent of 5 ppm (0.0005 vol.-%). It is non-flammable and non-poisonous.

Chemical symbol: He

Boiling point at 1.013 bar (T_b): 4.22 K (-268.93 °C)

Heat of vaporization: 20.3 kJ/kg

Conversion figures:

m ³ gas (15 °C, 1 bar)	l liquid at T _b	kg
1	1.336	0.167
0.749	1	0.125
5.988	8.000	1

Nowadays helium is produced almost exclusively from natural gas sources that are rich in helium and found in the midwest of North America, in eastern Europe and northern Africa.

Due to its favourable physical and chemical properties, such as low density, small atom radius, high thermal conductivity and low boiling point, helium can be used for a multitude of applications, e.g. as a "light gas" that can lift balloons and airships, as a detector gas to detect the smallest of leaks in pipelines and tanks, as an important component in shielding gases for welding, as a carrier gas in residue analysis, in the manufacture of optical glass fibres or as a coolant in space technology and medicine.

The wide variety of applications and its excellent safety and environment-compatibility have made helium an essential product.

He



Liquid helium – the absolute coolant for extreme conditions

Liquefied at the cryogenic temperature of -269°C , i.e. just above absolute zero, liquid helium (LHe) is the coldest liquid available. It is primarily used to cool metallic superconductors in research and in energy, transport and telecommunications engineering as well as in analysis and in medicine. The extremely cold liquefied state is also used to transport large quantities of helium.

Liquid helium (LHe), the coldest known fluid, is the most important coolant in cryogenics.

Applications of liquid helium (LHe) as a cryogenic coolant:

Research

- ▶ superconducting energy storage systems
- ▶ magnetic levitation trains
- ▶ superconducting materials and sensors
- ▶ space and the Earth's atmosphere
- ▶ gravitation
- ▶ nuclear fusion
- ▶ highest grade metals
- ▶ material properties at extremely low temperatures.

Technology

- ▶ NMR spectroscopy
- ▶ magnetic separation in mining and environmental protection
- ▶ cooling of sensors
- ▶ production of vacuums.

Medicine

- ▶ MR (Magnetic Resonance) tomography
- ▶ biomagnetometer.

-269°C

Since its introduction at the beginning of the 1980s magnetic resonance (MR) imaging has become one of the most important imaging procedures used in medical diagnosis. Liquid helium is used as a cryogenic coolant for the superconducting magnet. When the MR tomography system is filled with liquid helium (LHe), MR images can be evaluated.

MR imaging systems are cooled with liquid helium (LHe) for quality assurance (for tests and prior to transport).



The right liquid helium supply method for any application

Standard supply method for liquid helium (LHe)

Liquid helium (LHe) is available in 30, 50, 100, 250 and 450 l super vacuum-insulated cryogenic containers. They are made of non-magnetic, tough-at-subzero steel or an aluminium alloy. Four plate castors are permanently fitted so that the containers can be moved to where they are required. The containers are equipped with safety fittings and are approved for road and rail transport when full. For air transport slight alterations must be made to the fittings.

When filled at the factory, the containers will be equipped with a squeeze connection required by the customer. The helium can be transferred to a cryostat using a super vacuum-insulated filling siphon, which is inserted into the top of the container until it almost reaches the bottom of the container. During transfer gaseous helium is also needed to increase the pressure on the surface of the liquid phase.

Besides the liquid helium (LHe) containers Linde can also supply transfer siphons and various pressurization systems.

Linde uses its own special vehicles fitted with lifting platform and telephone to ensure reliable delivery. In accordance with Linde's quality standards the drivers are specially trained to handle liquid helium and LHe containers.

Linde has a widespread customer service and depot network to supply helium – either as a gas in pressurized gas cylinders or as a liquid in cryogenic containers – throughout Germany and Europe.



Filling an NMR spectrometer with liquid helium (LHe). The spectrometer is being used for the structural analysis of chemical compounds.

Expert delivery of LHe containers by special vehicles and a qualified service team.



A new idea for supply from 250 l and 450 l LHe containers

Linde has developed a new supply method for its 250 l and 450 l containers. Besides the safety fittings the new containers have a permanently installed, submersible withdrawal pipe with a cold valve and coupling to attach a LHe transfer pipeline. This transfer pipeline, which is fitted at its end either with a submersible pipe or a coupling, is attached to the submersible pipe. Thus the new LHe cryogenic containers with a submersible withdrawal pipe make it easier to withdraw LHe and no problems arise when trying to insert the siphon into the container when the room is too low (< 3.40 m).

Depending on the equipment in use, it is possible to leave the transfer pipeline on the cryostat to be filled. Containers can thus be changed rapidly.

Besides helium Linde can also supply the transfer pipeline and the pressurization system. A new electronic internal pressurization system (EIPS) with adjustable pressure settings will replace external pressurization from a pressurized helium gas cylinder. The EIPS shows the actual pressure. The desired pressure can be set and the build-up in pressure can be started/stopped. A superconducting probe indicates how full the tank is and, when the container is empty, automatically switches off the internal pressurization system and sends a signal.

Linde's new idea is simple and fast: provide a container, attach the transfer pipeline, set pressure, cool siphon and LHe transfer can begin.



New LHe container with submersible withdrawal pipe, level meter and electronic internal pressurization system.



Liquid helium, know-how and service – all from one single source

Linde provides:

- ▶ experts and information to help customers plan their helium supply and handle helium safely
- ▶ safe and reliable delivery in special vehicles
- ▶ drivers trained in handling LHe, who can help our customers on site on delivery
- ▶ super vacuum-insulated containers in practical sizes and modern design
- ▶ any necessary transfer equipment – either to be loaned or purchased
- ▶ delivery with additional transfer service on arrangement
- ▶ assurance of a LHe emergency supply thanks to a 24-hour telephone service.

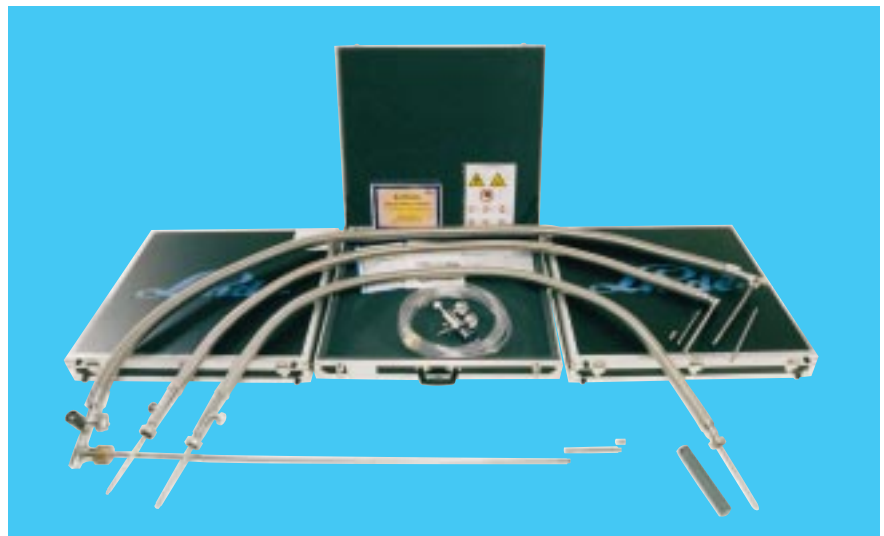
Besides reliable and safe supply and all necessary services Linde can also provide comprehensive know-how in plant construction: e.g. cryogenic components, helium liquefaction and systems for the cleaning, retrieval and storage of helium.

Safety aspects

When extremely cold liquid helium vaporizes, there should be appropriate ventilation to ensure that the oxygen content of the surrounding air does not fall below 19 vol.-%. In the case of direct contact with the skin, cryogenic gas or liquid helium causes frostbite and cold injuries.

Linde can provide safety instructions and safety leaflets on the handling of gases.

Liquid helium (LHe) - service-case.



Protection equipment and information on the handling of liquid helium (LHe).

Complete equipment for the supply of liquid helium by Linde

Pressurization

Two systems are available for standard pressurization up to 50-350 mbar from a helium pressurized gas cylinder.

Proven system for MR tomography, consisting of:

- ▶ cylinder support and station regulator in the supply room
- ▶ withdrawal regulator with micromanometer and PVC hose to the container in the examination room.

Simpler system, consisting of:

- ▶ cylinder support and two-stage cylinder regulator
- ▶ PVC hose to the LHe container.

Upon request the simple pressurization system or the new electronic internal pressurization system for 250 l and 450 l containers is also available for one-off delivery.

Protection equipment

- ▶ protective helmets with face shields or closed full-view protective goggles (UVEX)
- ▶ cold-protection gloves.

Linde transfer siphons and transfer pipelines (super vacuum-insulated version)

Features/Description	U-shaped siphon	L-shaped transfer pipeline	Straight transfer pipeline
For the LHe container	Submersible pipe 600 mm 780 mm extension 140 mm extension Ø 16 mm	OMT-coupling for attachment to the LHe-container	OMT-coupling for attachment to the LHe-container
Length of the flexible adaptor*	3000 mm	2500 mm	2500 mm
For the container to be filled	Submersible pipe 300 mm + 300 mm extension Ø 12.7 mm	Submersible pipe 370/530 mm 200 mm extension Ø 12.7 mm, Ø 12 mm Ø 10 mm	OMT-coupling
Note	with foot valve	*special lengths available on request	

Linde standard containers (available volumes with M/m values of the containers):

Technical data Maximum/minimum (M/m) values		CS 30 LHe	CS 50 LHe	CS 100 LHe	CS 250 LHe*	CS 450 LHe*
Effective volume	l	30	50	100	250	450
Operating excess pressure	bar	1.2	1.2	1.2	1.2	1.2
Full weight (M/m)	kg	95/75	141/79	163/110	340/171	461/303
Vaporization rate stat.	%/d	2.5	1.8	1.4	1.0	0.8
	*	–	–	–	1.4	1.2
Total height H (M/m)	mm	1330/1280	1600/1350	1630/1390	1820/1580	1980/1850
Total diameter D (m/M)	mm	550	550/750	700/780	750/1000	1040/1050
Immersion depth E (M/m)	mm	1010	1020/1010	1280/1180	1560/1180	1560/1400
Neck diameter Ø d	mm	32	32	32/40	50	50
Inlet for siphon	Small flange DN 25 with squeeze connection (Ø 10, 12, 12.7, 16, 18 mm) and additional coupling for transfer pipeline.					
Note	*Also available on request with fitted submersible pipe and electronic pressurization system (EIPS).					
Please note ball valve position for storage and transport of LHe containers.	Red ball valve in the open position : lever points in the direction of the outlet. All blue ball valves in the closed position : lever is transverse to the outlet.					

Competence Where You Need It – With Linde Gases

Know-how
Application and supply equipment

Service
Service on the spot

Advice
Competent, thorough advice

Production
Air separation plant

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Cylinders

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Glass
Medicine
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Microelectronics
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Linde industrial gases are used for welding, freezing or driving purposes, and where heating, industrial cleaning, artificial respiration or testing is required. They improve the quality of life, helping you to produce more economically and thus safeguarding your future.

We offer advice, know-how, customer-specific hardware, and carry out tests for our customers and do all the gas-related handling.

It goes without saying that we customize an economic supply system according to customer specifications: Gas cylinders and cylinder bundles, tank supply of cryogenic liquid gases, the ECOVAR® supply system and pipeline supply.



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