Precious Droplets: Liquid Helium.

Liquid helium is supplied in dewars – special insulated vessels that have nominal capacities of 60, 100, 250 or 380 litres. Dewars are also known as LHe (liquid helium) transport containers.

Helium liquefies at temperatures close to absolute zero: the thermometer has to show between -272.2 and -268.9 °C for the noble gas to begin to flow. This extreme cold makes liquid helium much in demand in industry, research and medicine.

How can it be economically supplied in this sought-after liquid form? And what do you need to watch out for? All the answers are on the following pages.

Dewar flasks.

Thanks to their inventor, the Scottish physicist Sir James Dewar, transport and storage vessels for liquefied gases have been available since 1893 - in fact we still use his name today as a generic term for these vessels. Modern versions are still based on the original principle, similar to that of a thermos flask: within the outer container is a mirrored, double-walled, evacuated vessel. The helium is held in this, and because of the excellent thermal insulation it remains liquid for a long time.

For cost-effective supply tailored to customers' requirements Westfalen offers four types of dewars with different capacities. Since the vessels are non-magnetic they are also suitable for nuclear magnetic resonance applications.

Requirements above 45 kilograms can be met by our special ISO containers, with which we can deliver up to 41,000 litres of liquid helium.

If your demand structure is different however we'll find a suitable solution from our intermediate sizes, which are available on request.

Dewars for Liquid Helium (Standard delivery modes): Technical Data.				
Type	CS 60 HDS	CS 100 HDS	CS 250 HDS	Stratos® 380
Diameter (cm)	55	60	75	75
Height (cm)*	119	166	189	190
Nominal capacity (l)	60	100	250	380
Tare weight (kg)*	90.0	128.0	192.0	109.4
Net weight of helium (kg)	7.0	11.5	31.0	45.0
Gross weight when full (kg)*	97.0	139.5	223.0	154.4
Integrated liquid withdrawal stinger	–	–	●	●
Heating	–	–	–	●
Lifting slots	–	○	○	–
Vaporisation rate/day (%)	2.5	1.4	1.4	1.4
● included ○ optionally included – not included *Values may vary				

Well equipped.

Even the best container for helium is useless if you can't withdraw the contents effectively. Our dewars come equipped as standard with certain fittings and withdrawal systems; we also support your specific applications via a range of components that are available on request.

Getting the basics right: The essentials.

Dependent on dewar model, standard fittings comprise:

1. Overflow valve

The overflow valve is a safety mechanism for transport: a ball valve serves to open the valve during transport and close it during withdrawal and filling.

2. Exhaust steam pipe/pressurisation pipe

A gas bag or hose for the support pressure is connected to the exhaust steam and pressurisation pipe. The line is closed for transport by means of a ball valve, but opened for helium withdrawal and filling.

3. Stop valve for filling and withdrawal

The stop valve is only opened in order to fill and withdraw the liquid helium.

4. Pressure gauge

The pressure gauge shows the current pressure inside the container.

5. Small flange and ferrule fitting

The small flange and ferrule fitting connects the dewar to the withdrawal system.

6. Safety valve

The safety valve opens on over-pressure if the exhaust steam pipe is closed or the overflow valve does not respond.

7. Integrated liquid withdrawal stinger (optional)

The CS 250 HDS and Stratos® 380 dewars also feature an integrated liquid withdrawal stinger with a special connection coupling.

For quick connection: Small flanges.

Quick connections.

For connecting the withdrawal system to the storage vessel every dewar is provided as standard with the most common connectors, comprising a DN25 small flange plus 10, 12 and 16 mm diameter ferrule fittings. Other adapters can be provided on request

Fully fitted:
1) Overflow valve with ball valve
2) Exhaust steam pipe/ pressurisation pipe
3) Stop valve for filling and withdrawal
4) Pressure gauge
5) Small flange and ferrule fitting
6) Safety valve
7) CS 250 HDS and Stratos® 380 dewars: integrated liquid withdrawal stinger

Withdrawal under pressure.

To be able to withdraw liquid helium from the dewar, pressure build-up is needed. This is done by:
- using a pressurisation bag connected to the appropriate pipe, or
- using gaseous helium supplied by hose to the pressurisation pipe from a separate gas cylinder, or
- using an integrated heater, supplied as standard with the Stratos® 380

Some dewars such as the CS 250 HDS feature an integrated liquid withdrawal stinger .

Putting the pressure on: pressurisation bag (left), helium pressurisation (top) or integrated heater (top left - Stratos® 380 only).

System supplies: Transfer pipes.

For easy and effective liquid withdrawal we can supply super-insulated vacuum transfer pipes on request. These systems with their wide range of variants offer appropriate solutions for almost every application, such as the following example configurations:

Variant 1:
Coupling – transfer pipe – dip tube
Variant 2:
Coupling – transfer pipe – coupling
Variant 3:
Dip tube – transfer pipe – dip tube

Extendable dip tubes of various diameters ensure compatibility with a wide range of dewars and cryostats.

Various coupling adapters are also available, enabling connection to virtually all types of tomograph.

How much is left in the dewar? – Every container carries a fill level chart, allowing you to quickly and easily establish the amount remaining just by using a dipstick to measure the container fill level.

“Oxford/Siemens male“ coupling.

Left: Transfer pipe with “Oxford/Siemens male“ coupling (left) and dip tube(right).

Right: Transfer pipe with dip tube for cryostat (right), “Oxford/Siemens male“ coupling and the dewar dip tube to be connected. Both dip tubes are extendable.

A little physics: Helium in numbers.

What's the heat of evaporation of helium? And its density? What's the critical point? Does it have an ignition point? What's the weight of one litre of helium? Find out here:

Physical data.	
Molar mass	4.00 g mol^{-1}
Liquid state	
Boiling point	4.22 K (–268.9 °C)
Heat of evaporation	20.42 kJ kg^{-1}
Liquid density	125 kg m^{-3}
Gaseous state (at 1.013 bar)	
Density (at 273.15 K)	0.18 kg m^{-3}
Density ratio to air (at 288.15 K)	0.14
Specific heat (at 298.15 K)	5.20 kJ $kg^{-1}K^{-1}$
Thermal conductivity (at 288.15 K)	0.1482 J $s^{-1}m^{-1}K^{-1}$
Critical point	
Temperature	5.2 K (–268 °C)
Pressure	2.28 bar
Density	69.6 kg m^{-3}
Triple point	
Temperature (at conversion point)	2.177 K (–271 °C)
Vapour pressure	0.051 bar
Heat of fusion	3.49 kJ kg^{-1}
Ignition point	– K (°C)
Ignition range in air	– Vol.-%
Calorific value	– kJ m^{-3}

Conversions	m^3	l_{liquid}	kg
1 m^3 at 288.15 K (15 °C); 1 bar	1	1.336	0.167
1 l_{liquid} at $T_{boiling\ point}$; 1 bar	0.784	1	0.125
1 kg	5.988	8.00	1

In practice: Applications.

Liquid helium produces extremely low temperatures, necessary for instance for measuring particular physical properties. These include:

- Electrical conductivity
- Hall effect
- Thermal conductivity
- Heat capacity
- Determination of magnetic properties of solids
- Electron spin resonance
- Nuclear magnetic resonance

Liquid helium enables strong magnetic fields to be built up – an essential condition for operating magnetic resonance tomographs.

Know-how for practitioners.

For further questions on liquid helium, delivery modes, accessories and applications, Westfalen's Specialty Gases experts are at your disposal at any time. Use our personal consultation!

We would also be happy to send you previous publications in the "Speciality Gases Practice" range:

- Specialty Gases Practice (1) – Using Gas Mixtures: Handling, Connection, Special Cases.
- Specialty Gases Practice (2) – Gases in the Laboratory: Risk Factor Tube Material.
- Specialty Gases Practice (3) – Accredited Test and Calibration Laboratory: The Westfalen Specialty Gases Centre.
- Specialty Gases Practice (4) – Nuclear Species: Isotopes.

It takes a lot of helium - in fact 41,000 litres of the liquid noble gas, delivered in Westfalen's special ISO container – to get a particle accelerator going.

Westfalen

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