

Safety Advice. 7 – Safe handling of gas cylinders and cylinder bundles.



1. Introduction

These Safety Advice contain recommendations concerning safe storage, in-house transport and emptying of gas cylinders and cylinder bundles. They supplement relevant regulations. The recommendations are based on practical experience gained from accidents and mishaps. They are valid both for gas cylinders and cylinder bundles and to a certain extent for pressure drums (e. g. pressure receptacles equipped with rolling hoops, on skids or in frames) even though the term "gas cylinders" is mostly used below.

2. How to store gas cylinders safely

Basic principles:

- Protect gas cylinders to prevent excessive heat, fire, dangerous corrosion, mechanical damage or access by unauthorized persons.
- Do not allow stored gas cylinders to inconvenience access or escape routes.

Storage in rooms:

- The storage room should be made of fire-resistant materials. It must have natural or mechanical ventilation and must not be used for other purposes.
- Maintain a distance of approx. 2 m between gas cylinders containing flammable gases (e.g. acetylene) and fire-stimulating gases (e.g. oxygen). The gap may however be filled with gas cylinders containing inert gases (e.g. nitrogen).
- Do not store gas cylinders in underground rooms, on or next to stairs, in corridors, passages or garages. (Exceptions in accordance with national regulations are possible.)

Storage in the open:

- Maintain a safety distance to reduce possible risks from the surroundings (fire, mechanical damage).
- Special protection from sunlight is not necessary.

Storage in rooms and in the open:

- Do not store gas cylinders together with flammable materials.
- Store gas cylinders containing liquid gases upright.
- Secure gas cylinders to prevent them falling over. Special precautions are not necessary if the gas cylinders are sufficiently secured as a result of their construction (e.g. propane cylinders), the type of storage (e.g. in closed pallets) or placement in large groups.

3. How to transport gas cylinders safely

Practical information on how to transport gas cylinders safely on public roads can be found in Linde Safety Advice No. 11 "Transport of gas receptacles in vehicles".

In-house transport using vehicles:

- in the pallet using a fork-lift truck or a pallet truck,
- in the pallet using a crane (the protecting cap, the protecting cage and the cylinder valve are unsuitable for use as holding points for transport by crane),
- with the cylinder cart,
- in a suitable, ventilated vehicle, with the gas cylinders secured to prevent them falling.
- Before moving gas cylinders from their site of use, ensure that the cylinder valve is closed and leakproof. If possible put on the valve cap.

Manual transport for short distances:

- Before moving a gas cylinder by holding the protecting cap, pull the cap briefly to check that it is fastened securely. A loose protective cap is an accident risk.
- Carry small gas cylinders that do not have a protecting cap such that they cannot fall and the cylinder valve accidentally open. Transport in a carrying box is recommended.



Cylinder bundles are best transported by a fork-lift truck. Before moving a cylinder bundle from its site of use, remove the connected pipe or hose from the cylinder bundle.

Attach a fourfold sling chain to the four jack rings of the bundle to transport a cylinder bundle by crane. Alternatively, use a spreader attached to opposing jack rings.

4. How to empty gas cylinders safely

Before using a gas cylinder, ensure that it has the right type of gas. The only reliable information on the type of gas is the dangerous goods label, which must be on every gas cylinder. Engravings such as "Test gas" and the colour of the gas cylinder do not always provide reliable information on

the type of gas. Never use a gas cylinder when in doubt about the contents or the condition of the cylinder (damage, burns, signs of mechanical impact). Such cylinders should be clearly marked and returned to the gas supplier.

All specified, regular examinations of the gas cylinders will be arranged by the gas supplier. The user need not concern himself with this problem and can empty gas cylinders at any time even after expiry of the examination deadline.

Starting / finishing work

- At the site of use, secure gas cylinders to prevent them from falling over.
- Unscrew the protecting cap and, if present, the (not always a hexagon nut) nut on the valve. Unscrew the protecting cap by hand and with care to ensure that the cylinder valve is not accidentally opened. Instead of a protecting cap there may be a protecting cage that serves as permanent protection for the valve. The cage should not be removed.
- Brief opening of the cylinder valve to check the pressure is not necessary and should be avoided. This action is dangerous in the case of gas cylinders with a quick opening valve (e.g. carbon dioxide or nitrogen cylinders for fire-extinguishing purposes) because the



cylinder can start to move uncontrollably as a result of the repulsive force produced by the released gas. Furthermore, the cylinder can contain a hazardous gas.

- The delivery device, e.g. pressure reducer, adapter or high-pressure hose, must be suitable for the working pressure of the cylinder (e.g. 300 bar).
- Open the cylinder valve by hand without using any tools.
- Set the desired working pressure on the pressure reducer and open the outlet valve.
- Check that the connection between cylinder valve and pressure reducer does not leak.
- Close the cylinder valve during any break and at the end of work to prevent uncontrolled release of gas.
- Empty gas cylinders so that there is still slight pressure in the cylinder to prevent foreign matter from entering into the cylinder.

- When the gas cylinder has been emptied except for the residual gas, first close the cylinder valve and then unscrew the delivery device. The reverse order can be dangerous because an apparently empty gas cylinder, in particular in the case of pressurized liquid gases, can still contain gas subject to a considerable amount of pressure.
- Screw the cap nut and the protecting cap on again. The cylinder is now ready for return to the gas supplier.

5. Further information

When using pressurized liquid gases, observe the following information:

Some gases can be liquefied simply by compression. These include for example propane and carbon dioxide, which are available in gas cylinders as pressurized liquid gas. These gases can be delivered either as a gas from the top of the cylinder or as a liquid through a submerged pipe from the bottom of the cylinder. Gas cylinders with a submerged pipe have the same colour and the same valve connection as cylinders containing the same type of gas without a submerged pipe. They can be differentiated merely by means of an appropriate label, e.g. "dip tube cylinder" for carbon dioxide cylinders, or by special features, e.g. welded on valve collar for propane cylinders.

If you require the gaseous phase to be delivered, use a cylinder without dip tube and a pressure reducer. The cylinder must be upright during delivery. Gaseous delivery requires heat for vaporization. This is taken mainly from the liquid itself, which thus becomes colder. As a result the vaporization rate decreases so that the gas flow can stop after some time if large quantities are delivered even though the gas cylinder is more or less full and the cylinder valve is open. The following precautions can be helpful:

- You can use several gas cylinders of the



Pressure warning

- same type in parallel and empty them together.
- You can heat the gas cylinder to max. 50 °C in a water bath.
- You can increase the pressure in the gas cylinder by introducing a "neutral" compressed gas that cannot react with the

liquefied gas. A suitable gas is nitrogen for example. The pressure must never be increased to a level exceeding the test pressure of the gas cylinder or the set pressure of a fitted bursting disk or safety valve.

Liquid delivery is only possible from a dip tube cylinder. Do not use a pressure reducer. With liquid delivery the flow volume is several times greater than with gaseous delivery. Dangerous situations can occur if a dip tube cylinder is connected by mistake to equipment that is designed for gaseous delivery. For example, a propane burner that is designed for gaseous propane can become a dangerous flame thrower if it is operated with liquid propane because of the excessive delivery volume.

When using propane cylinders, you may also need to observe the following information (e.g. in Germany):

Tighten the screw connection between the cylinder valve and the pressure reducer, using a gland to make it gas-tight. In the case of small cylinders (6 or 11 kg nominal capacity) the gland is in the cylinder valve. In the case of large cylinders (22 or 33 kg nominal capacity) it is in the pressure reducer. If a pressure reducer intended for small cylinders is connected to a large cylinder by mistake, the gland is missing. The connection cannot be tightened to be gas-tight and liquid gas flows out at this leak when the cylinder valve is opened. Avoid this dangerous situation by using a pressure reducer with a gland when using large cylinders.

When using "Formier gas", observe the following information:

"Formier gases" are mixtures of hydrogen with nitrogen or argon that are used as shielding gases during welding work. Depending on the hydrogen content, "Formier gas" is either flammable or non-flammable. "Formier gas" cylinders can be identical to hydrogen cylinders with regard to cylinder colour and valve connection. Thus, there is a danger of confusing non-flammable "Formier gas" with flammable "Formier gas" or hydrogen. Such mistakes can only be avoided by reading the information on the dangerous goods label.

When using non-flammable gases, you may also need to observe the following information:

Gas cylinders for various non-flammable, non-toxic gases have the same valve connection and may have the same colour. This can apply for example to argon, helium and carbon dioxide but not to nitrogen. Confusing gas cylinders in this group does not seem to be a problem as the gases have the same chemical properties. However, there are differences in the physical

properties, e.g. in their behaviour when pressurized. The said gases can be filled into the cylinders either at up to 300 bar as a gas or at 57 bar (carbon dioxide) or 21 bar (sulphur hexafluoride) as a liquid. If a delivery device designed for the carbon dioxide pressure is fitted to a full argon cylinder by mistake, the delivery device can burst. Such mistakes can also be avoided by reading the dangerous goods label carefully.

When using nitrogen, you may also need to observe the following information (e.g. in Germany):

Nitrogen and oxygen cylinders have their own valve connections in compliance with DIN 477, which are however similar. The valve connection for oxygen cylinders has a slightly larger outer diameter than that for nitrogen cylinders whereas the thread pitch is the same in both cases. It is technically possible to screw an oxygen delivery device to a nitrogen cylinder valve. However, because of the different thread diameter this delivery device cannot be tightened sufficiently and can therefore rip off and be thrown off with great force. Avoid this danger by using the correct delivery device.

When using oxygen, observe the following information:

Oxygen is a fire-stimulating gas that can react with all flammable materials to cause a fierce fire. This also includes materials that do not burn in air, e.g. some metals. This property of oxygen is all the more prominent, the greater the pressure is. If high-pressure oxygen flows into a low-pressure area, the surrounding material may ignite due to the pressure rise. This process is aggravated by the presence of traces of oil and grease but it can also occur without these other substances.

The following safety precautions are necessary to prevent an oxygen fire:

- Do not allow parts of the installation that are in contact with oxygen to come into contact with oil, grease or other flammable substances. If necessary, clean the installation before start-up.
- Particles in the system can hitting a surface can ignite usually non-flammable materials.
- Check the delivery device – pressure reducer or high-pressure pipe
- When changing seals, e.g. in the pressure reducer, use original parts whose material has been tested for its oxygen compatibility.

- Before starting to use an oxygen cylinder with a variable pressure reducer, unscrew the adjusting screw for the working pressure until the spring is fully released. Then open the cylinder valve and slowly set the desired working pressure on the pressure reducer. This sequence protects that the membrane in the pressure reducer is damaged. (Cf. Linde Safety Advice No. 23 "Working safely with oxygen pressure reducers on cylinders and cylinder bundles").
- Open oxygen cylinder valves slowly and without jerks in order to prevent pressure rise in the delivery device.

When using cylinder bundles, observe the following information:



Hazard warning

- Gas is usually taken from cylinder bundles by means of a high-pressure pipe or hose. Tighten the connector by hand only and not by using a tool.
- Do not open the valve of a cylinder bundle until the delivery pipe is securely fastened at both ends.
- Bundles intended for a filling pressure of 300 bar may have two delivery valves, one supplying the full pressure and the other limiting the delivery pressure to max. 100 bar. Both valves are appropriately marked so that the delivery device can be connected in accordance with its pressure to the right delivery valve.

If gas flows out uncontrollably, please observe the following information:

Filled gas cylinders and cylinder bundles are technically gastight when they leave the filling factory. However, in rare cases they may leak during storage, transport or emptying around the valve, a pressure relief device (bursting disk on carbon dioxide cylinders or safety valve on propane cylinders) or on the pipe (cylinder bundle). The risks involved depend on the type of gas, the size of the leak and the circumstances at the installation site. Never accept a leak. Repair it as soon as possible. In this case however, never tighten screw connections

subject to pressure because the connection could break so that the gas flow is then completely uncontrollable.

The first and most important step in the event of uncontrolled gas flow is to close the cylinder and bundle valve. If you cannot stop the gas flow in this way, carry out the following steps:

- Take the cylinder or bundle to a safe place in the open and empty it carefully.
- If you cannot take the cylinder or bundle into the open and gas is still being released, leave the room, lock and ventilate it and do not enter the room again until the danger of gas has certainly cleared, which you can confirm by measuring the concentration.
- If burning gas flows out into the room and the fire cannot be stopped by closing the valve, the flame should usually be allowed to burn until it extinguishes itself due to a lack of gas. If the flame were to be put out with a fire extinguishing agent, combustible gas could accumulate in the room and cause an explosion. (A different procedure should be used for burning acetylene cylinders – see Linde Safety Advice No. 2 "Handling of Gas Cylinders at and after Fire / Heat Exposure").
- If burning gas flows out in the open, extinguish the flame and cool the cylinder or bundle in water until no further heating can be detected.

6. Conclusion

Gas cylinders and cylinder bundles are reliable items with many uses. To avoid risks during storage, transport and emptying, follow these Safety Advice in practice. Linde gas experts can assist you with further information and also with the hardware required.



Linde AG

Linde Gas Division, Linde Gas Germany, Seitnerstraße 70, 82049 Pullach
Phone 018 03.85 000-0*, Fax 018 03.85 000-1, www.linde-gas.com