



Information for employees and students working at the Faculty of Science (W&N)

This AMD information sheet describes the hazards of, and the safe handling of gasses and gas cylinders or lecture bottles.

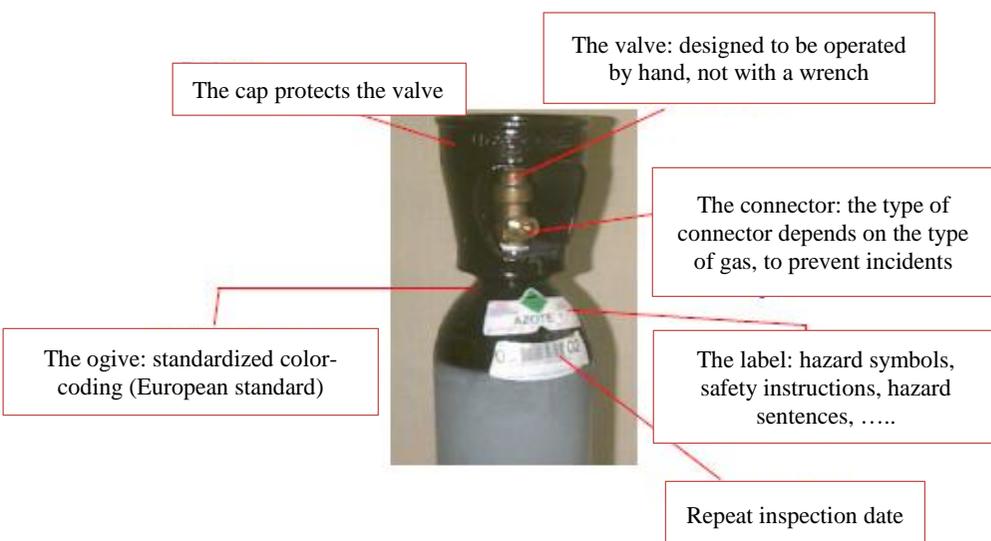
1 Introduction

In a research environment, gasses are used on a regular basis. Gasses are stored in a gas cylinder, a metal pressurized container equipped with a valve. These gas cylinders or gas bottles may contain permanent gasses (such as nitrogen, methane, and hydrogen), liquefied gasses (such as ammonia), or dissolved gasses (such as acetylene). Gasses under pressure are indicated with the adjoining symbol (the Dutch: “Bevat gas onder druk”, means: “Contains a gas under pressure”).



1.1 The gas cylinder

A gas cylinder consists of a cylindrical part on which a so-called head or shoulder is mounted, and a valve covered with a cap.



The (protective) cap lowers the chance of the valve breaking off. In case of breaking, uncontrolled expelled gas may launch the gas cylinder like a rocket.

The colour of the shoulder (the ogive) stands for the property of the gas type (Please refer to section 2.2 for the meaning of the colours).

The gas bottle is provided with 2 labels: a label from the supplier with hazard information, and a label containing the repeat inspection date. Most gas bottles need to be retested after 10 years (sometimes 5 years or less in case of aggressive gasses) to prevent unintended gas release due to corrosion and suchlike. If the inspection label is not/no longer attached, the most recent inspection year may also be read from the stamped marking on the bottle.

According to our environmental permits, no gas bottles beyond their inspection date are allowed on the terrain and/or in the buildings. This means that at the moment of ordering the amount of gas must be already be tailored to the expected period of use. So, please, do not accept bottles approaching their inspection date if you need the gas for a long period of time; make sure to mention this when ordering! Please, also do not accept gas bottles with any flaws, take care of their immediate return to the supplier!

2 The risks of gasses

2.1 Classification into hazard classes

Gas cylinders may constitute a risk due to the chemical properties of the gas as well as due to the physical hazards (pressure, temperature). Therefore, gasses are considered to be chemicals as well. Chemicals to which, in addition to the symbol for gas, the hazard symbols from AMD information sheet VOM011 *Working safely with chemicals*, apply. The material safety data sheets (MSDSs) from our supplier Linde Gas may be found [here](#).

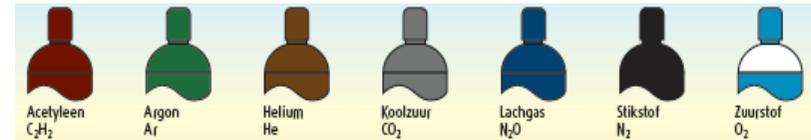
Broadly, gases may be divided into five categories, based on their intrinsic properties:

1. flammable	(Highly) flammable gas. If flammable gasses are present in air in the right mixing ratio, they will burn or explode in the presence of an ignition source.	
2. oxidizing	Oxidizing substances are not flammable on their own, but promote the burning of other materials by providing oxygen. In the picture you can see an O-ring.	
3. toxic	Toxic gasses may have harmful effects on the human body if inhaled (with potentially lethal consequences).	
4. corrosive	Corrosive gasses may be etching for chemicals. The valve of the gas cylinder or the pipework may be damaged by corrosion. In cases of extreme corrosion the valve of the bottle or the piping may start to leak or even break off.	
5. inert	Suffocation risk only. Please be aware: all gasses may displace the oxygen in the air . However, inert gasses have no additional risk and are 'merely' suffocating. Air contains 21% oxygen. If the oxygen percentage falls below 16%, human beings become ill. At 6% human beings slip into a coma within 1 minute, start to convulse, and suffer respiratory arrest with lethal consequences.	

2.2 Recognizing gas cylinder contents by colour coding

The colour of the cylindrical part tells you nothing about the properties and may vary per supplier. The contents of a gas cylinder are identified by the colour of the shoulder (upper part) of the gas bottle (this does not apply to lecture bottles). In case of a gas mixture with several properties, a maximum of two coloured rings is presented on the shoulder.

Gas property	colour	
Toxic and/or corrosive	Yellow	
Flammable	Red	
Oxidising	Light Blue	
Inert ¹	Bright Green	



Color code of gas cylinders with pure gasses according to NEN-EN 1089-3

The specific contents (name, hazard symbols, CAS numbers) can only be identified by reading the label attached to the shoulder, except for the 7 pure gasses to which specific colours were appointed, as shown in the above diagram (Please refer to the links in Chapter 4 for the other colours of Linde Gas.)

3 Handling gas cylinders at the workplace

3.1 General rules for gas cylinder work

- Please always choose the gas bottle with the smallest possible volume, bearing the safety in the buildings in case of fire or leakage in mind. Acquaint yourself with the hazards using the MSDSs (Please see AMD information sheet VOM010 *Chemicals*), in other words, know what you are working with, but also inform you colleagues about the risks and emergency response procedures.
- The protective cap should be placed over the valve during transport of a gas bottle, but also when cylinders are not attached to a set-up. This protects the valve against breaking off in case of accidental tumbling.
- A gas bottle should always be secured against falling. This may be done with a bracket, strapping band, or chain, at about 2/3 of its height. Please be careful in case of a chain and make sure it is not too slack. If there is no bracket, strapping band, or chain present at a temporary storage location, a stable gas bottle cart may also be used as securing device. Tie wraps do not satisfy regulations!
- Never place a gas bottle next to a heat source (explosion hazard) or on a moist surface (corrosion hazard).

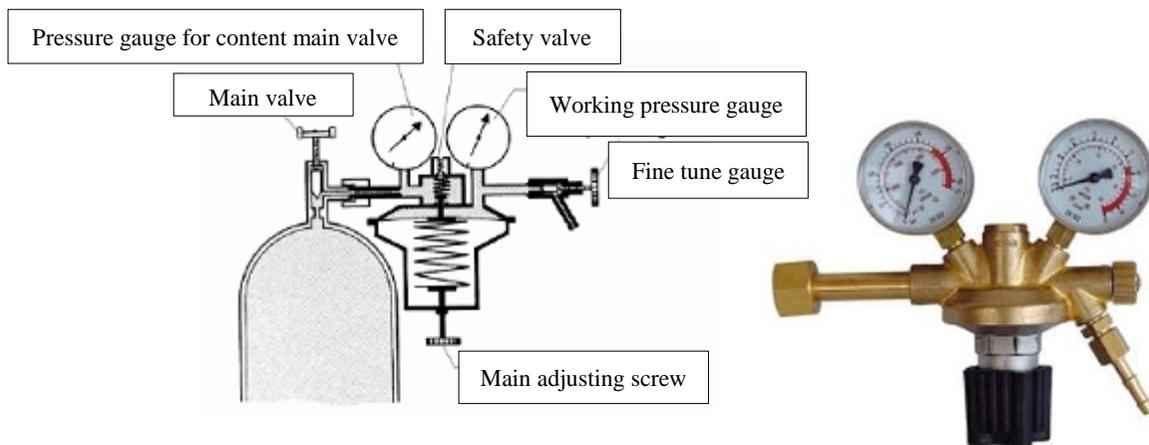
- Gas cylinders containing gas + liquid (for example carbon dioxide) or dissolved gas (for example acetylene), may be used standing in an upright position only.
- Prevent internal contamination of the gas cylinder by:
 - Using non-return valves
 - Always leaving some residual pressure in the cylinder
 - Closing the main valve after use
- Lecture bottles are a special kind of gas bottles. Despite their small sizes these may contain gas under high pressure. Lecture bottles that are not in use, should be stored in a gas bottle vault after use. There is often a sizeable deposit on empty lecture bottles; Please make sure to return them to the supplier within the stated return period.
- Cargas bottles contain a small amount of gas (0.5 to 1 litre) under pressure (up to 10 bar). Cargas bottles that are not attached to a set-up, are stored in a fire resistant cupboard (chemicals/gas cupboard). After use, the empty bottles are disposed of through the waste processing service.
- It is not allowed to store spare bottles for permanent equipment in a waiting queue for more than a few days before use. These too are secured in a storage location. However, using switchover equipment (“wisselautomaat”) is preferable.
- Empty bottles should be marked with “LEEG” (Dutch for 'empty') and immediately be registered for disposal. This is because the law makes no distinction, regarding risk assessment, between empty or full. This also implies that empty bottles should still be secured as well.
- It is not allowed to suspend lecture bottles by their necks only. These must be supported under all circumstances. Furthermore, these must be attached to the set-up away from passageways to prevent breaking off.

Temporary or permanent set-up of gas cylinders?

- Gas bottles for *temporary (< 1 day)* use with fumehoods must be returned to the external storage after use.
- If the use is *temporary, but longer than one day*, a risk assessment that justifies the use of the experiment/said set-up, must be made first, and, furthermore, any necessary additional temporary measures must be taken as well. Please refer to AMD information sheet RhL010 *Research risk assessment*.
- Set-ups with gas cylinders that are in use *for more than one week*, are considered to be permanent, and, depending on the type of gas, are subject to additional technical/organisational measures that follow from the risk assessment of the set-up. In any case, flammable, oxidizing (fire promoting), and toxic gasses must be placed in a (60 minutes fire resistant) safety cupboard with exhaust for gasses, and connected through permanent piping.
- These regulations apply to lecture bottles as well!
- If you work with toxic gasses or hydrogen, the presence of gas detection equipment is mandatory. The risk assessment should show if room detection and/or personal monitoring is required. Please make sure that all colleagues in the lab and adjoining hallway, as well as the emergency response team (Dutch name: “BHV”) know what the alarm sound is, and how to respond to it.
- If a gas bottle, which is attached to a set-up, is not in use, the main valve of the gas bottle must be closed manually, by turning it into the closed position.

3.2 Connecting a gas cylinder

Connecting is done by an experienced employee (not by students) and during working hours. If no experienced employee is present, please ask for assistance from the Linde Gas employee. If a set-up depends on a constant flow, it may happen that a gas bottle needs to be replaced in the weekend. If this happens frequently, the best solution is to use a switchover system that automatically switches over to the full bottle. If, in exceptional cases, you still have to replace a gas bottle outside of normal office hours, please make a risk assessment first; in any case there have to be two persons present with approval of the manager. One person to make the exchange, and the other to sound the alarm the moment things go wrong. During carbon monoxide exchange the person must wear gas detection equipment for additional safety.



Schematic gas bottle diagram

Linde Gas arranges the transport (external as well as internal) of the gas cylinders. This way, it is clear which gas cylinder is where. They also monitor if a gas cylinder approaches its inspection date.

In practice replacement proceeds as follows:

- Check the contents of the cylinder. Please make sure the cylinder contains the gas you intend to use.
- The gas cylinder must be have a stable set-up and be secured.
- Remove the protective cap. (If there is enough space to connect the pressure reducing valve, the cap may remain where it is.)
- Connect a pressure reducing valve with the proper type of screw thread for the gas used, and check if the sealing ring is undamaged. Please refer for the type of connection to the link “Valve guide” in Chapter 4. (Most connectors on gas bottles with oxygen do not have a sealing ring. Please check each connection. If a sealing ring is necessary, please use a special ring that does not contain any kind of grease.) Please note: Convertors from one type to another type of screw thread between cylinder valves and pressure reducing valves are not permitted!
- Please never grease the couplings for lubrication when connecting an oxygen cylinder. Grease and oxygen do not mix and there may be a spontaneous combustion.
- Please close all valves (turn the main adjusting screw until there is no more tension on the spring and close the fine tune gauge) before opening the gas cylinder with the main valve
- The hoses must be secured to the hose spigots using hose clips. Please check if the hoses are still of good quality, if they are not, replace them.
- Slowly open the main valve on the gas cylinder (to protect the membrane).
- Check the connections for leaking (using the special soap called “snoop”).
- Then open the other valves (pressure reducing valve and/or needle valve.)

3.3 Disconnecting a gas cylinder

- Close the main valve of the gas cylinder.
- Close the pressure reducing valve and/or needle valve.
- Let off the pressure in the hoses.
- Disconnect the pressure reducing valve.
- Put the protective cap on the gas cylinder.
- If the gas cylinder is empty, please have it marked with the text: “leeg” (Dutch for 'empty').
- Have Linde Gas move the gas cylinder to the gas storage facility.

3.4 Storage of gas cylinders

The storage of gas cylinders is subject to the rules stated in the PGS15 (2016 version).

A gas bottle connected to a set-up is not considered to be part of the storage.

- The law makes no distinction between empty and full containers. Therefore, the same demands that apply to full bottles in the lab and storage, apply to empty gas bottles as well!
- The maximum storage capacity (“daily stock”) in a fire resistant compartment (Please be aware this states: per compartment, not per lab!) is 125 l water capacity. In practice, this means that only spare cylinders that are meant for cylinders that are spent within one day, may be present within the buildings, or the recently connected cylinder and its empty counterpart. As long as it is equipped with a valve, it is a gas bottle, without the valve it is scrap metal.
- Therefore, gas cylinders should be returned to the external storage as soon as possible after use.
- Alternatively, in case of frequent use, the gas bottle may be stored indoors in a closed and exhausted gas bottle cupboard.
- The opening of cylinders within the gas bottle storage facility is not allowed.
- The gas bottle storage facility must remain empty of goods that play no part in the management or handling of gas bottles.
- The storage of gas bottles is strictly per type, to avoid confusion. Therefore, the compatibility of the contents (as applies in the case of chemicals) plays no role, because the risk of any gas bottle in case of fire, is explosion as a result of pressure build-up. This is also why outside storage is preferable.

3.5 Calamities

- A gas that is released, will spread quickly through a room. Therefore, please pay special attention to procedural and technical emergency measures, taking the effects on nearby set-ups into account as well.
- In cases of acute danger, such as leaking of toxic/flammable gasses (possibly after being alarmed by gas detection equipment), a damaged gas cylinder or a too high pressure: Please call the alarm number immediately and evacuate the room.
- Incidents and near-incidents with gas cylinders must be reported by way of the report form on the faculty website, the: '*Meld Incident*'-form ('Meld incident' is Dutch for: 'Report incident').

3.6 Transport

- Please make sure to close the main valve of the cylinder, even if it is empty.
- It is not allowed to transport gas cylinders with a mounted (connected) pressure reducing valve.
- Any gas cylinder to be transported should be fitted with a protective cap.
- Any transport of any gas cylinder from delivery location to work places and vice versa, should be done by a Linde Gas employee.
- This transport will take place on special, well-maintained, dedicated gas cylinder transport carts.

4 Information on Linde gas

[Linde Gas website](#)

- [Safety guidelines for handling gasses \(in Dutch\)](#)
- [Safety advice 12: Working with CO2](#)
- [Safety advice 17 – Handling leaking compressed gas cylinders](#)
- [Safety advice 23: Working safely with oxygen pressure reducers on cylinders](#)
- Brochure [Linde Gas Valve guidelines](#) (to choose the proper screw thread connections)
- Brochure [Retest periods per gas type](#)
- Poster [Linde Gas gas cylinder colour coding](#) (all colours and colour combinations)