

SAFETY AND HYGIENE REGULATIONS



Servei de Prevenció de Riscos Laborals
UNIVERSITAT POLITÈCNICA DE CATALUNYA

PRESSURE EQUIPMENT: CYLINDERS

CODE

SHR 310

Date:

July 2003

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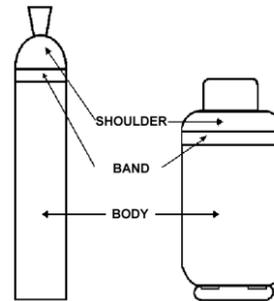
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DESCRIPTION OF HIGH-PRESSURE CYLINDERS

FIELD OF APPLICATION

Cylinders and tanks for compressed, liquefied and dissolved gases under pressure. Specifically, this includes welded and seamless steel cylinders, dissolved acetylene cylinders, aluminium alloy cylinders, cylinder bundles and cryogenic tanks, as well as their closing, safety and additional elements.

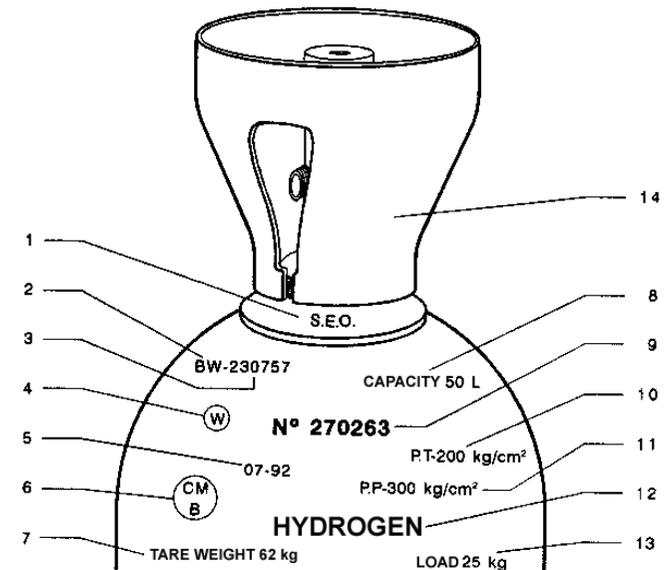


This complementary technical instruction does not include vessels whose maximum working pressure is less than 0.5 bars. It also excludes aerosols, LPG canisters and fire extinguishers, as well as other pressure vessels that are subject to specific regulations.

MARKING OF CYLINDERS

Because gas cylinders are very versatile and have a wide range of uses, users must have clear, concise information about a vessel and its content. This information is obtained through markings on the cylinders, in accordance with the provisions in Regulations on Pressure Equipment. The markings replace the tags that were formerly used for design information, and are mandatory on all pressurised vessels.

Markings must be made in visible, indelible letters and situated on the shoulder of the cylinder, on a reinforced part of the cylinder, or on the neck. However, they are generally placed on the shoulder as this part is normally thicker than the body of the cylinder, due to the way it is formed during manufacturing.



1. Name of the owner
2. Name of manufacturer
3. Serial number
4. Symbol for a tempered cylinder
5. Date of the hydrostatic test
6. Identification mark
7. Tare weight of the cylinder
8. Capacity of the cylinder in water
9. Number of the cylinder, given by its owner
10. Working pressure (compressed gases only)
11. Test pressure
12. Gas contained in the cylinder
13. Weight of the product in kg (liquid gases only)
14. Valve guard

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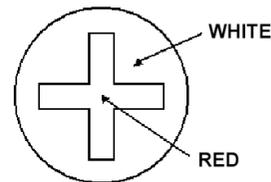
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Exceptionally, on bottles of butane, propane or mixtures of these gases, marking may be engraved on the ring or the handle of the bottle.

COLOUR OF THE CYLINDERS

To ensure that information about the content of the cylinders can be obtained at first glance, they must be painted according to the provisions established in the Regulations on Pressure Equipment. This is an important factor in terms of safety.

Cylinders containing **medical gases** must have the Geneva Cross (a red cross on a white background) painted on the shoulder.



Colour of the cylinder body

The colour of the cylinder body depends on the family of gases to which the gas in the cylinder belongs. According to the aforementioned regulations, these are as follows:

Colour of the cylinder shoulder and band

Each gas corresponding to one of these families is defined by the colour of the shoulder and band. The band is sometimes the same colour as the shoulder, to form one block of colour.

The colour that corresponds to each gas is specified in the Regulations on Pressure Equipment, ITC – MIE – AP07.

Colour of cylinders that contain gas mixtures

In the case of industrial gas mixtures, the body of the cylinder must be painted the colour that corresponds to the main gas in the mixture. The shoulder must be painted in quarters, with the colours that would correspond to those of the shoulders of separate cylinders of the gases in the mixture, according to the following criteria for the distribution of colours:

Type of gas	Colour
Flammable and combustible	Red
Oxidising and inert gases	Black
Corrosive	Yellow
Toxic	Green
Industrial butane and propane	Orange
Calibration gas mixtures	Grey

MIXTURES OF COMPONENTS		
Two components	Component 1	
	Component 2	
Three components	Component 1	
	Component 2	
	Component 3	
Four components	Component 1	
	Component 2	
	Component 3	
	Component 4	

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Cryogenic tanks

To improve the identification of cryogenic tanks, they must have a label (painted on or using a similar procedure) that identifies the content gas and has the following characteristics:

Two labels will be placed on the tank body in such a way that they can always be read, regardless of how the tank is positioned.

Cryogenic gas	Background	Letters
Oxygen	White	Black
Nitrogen	Black	White
Argon	Green	White
Carbon dioxide	Grey	Black
Nitrous oxide	Blue	White

LABELLING CYLINDERS

Cylinder labels contain a set of data, such as the following:

- The name and address of the manufacturer.
- The main characteristics of the gas.
- The formula.
- The corresponding pictogram.
- The main measures that should be considered for its safe use.

Pictograms are comprised of a diamond, whose colour depends on the family of gases to which the cylinder content belongs, and a specific picture for each family of gases.

Labels for combustible contents distinguish between flammable and self-igniting gases: one of these words is written on the label, and the colour of the diamond used for self-igniting gases is half red, half white.



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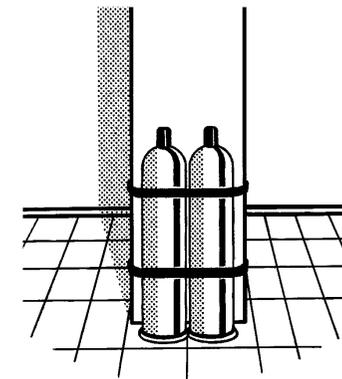
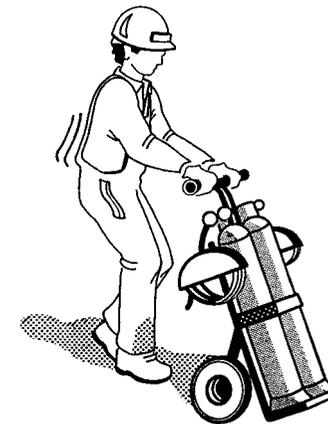
GENERAL RECOMMENDATIONS

RISKS OF MOVING CYLINDERS

This section presents the main risks associated with handling gas cylinders and preventive measures that can be taken to avoid them.

When gas cylinders are moved to different places for use or work, the following preventive measures must be taken in particular:

- Safety gloves and safety footwear must be worn.
- Cylinders must be moved using gas cylinder trolleys. Moving cylinders by dragging them, rolling them, etc. may damage them and cause dents, marks, gouges, etc. that reduce the thickness of the cylinder wall and therefore increase the risk of explosion.
- When cylinders need to be lifted, this must be done using a gas cylinder trolley or in appropriate cages. Electromagnets, ropes, etc. should never be used, as the cylinder could fall if there is a problem with the current or the rope.
- Cylinders of toxic gas must always be moved with the safety cap on.
- For small distances, such as from the gas cylinder trolley to the point of connection of the line, cylinders can be moved by tilting them slightly and turning them on their base.
- If, as a result of a knock or accidental fall, the bottle is deformed, marked, or has gouges or cracks, it should be returned to the supplier without using it.
- Once the cylinder has been put in the place where it will be used, **it must be secured with a safety chain**. If it is not safely secured, it could fall and cause injuries to people or a break in connections, which could lead to a gas leak.



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GENERAL RECOMMENDATIONS

RISKS OF GAS EXPANSION IN THE CYLINDERS

The gases contained in cylinders may be at very different pressures (200 bars for nitrogen, 18 bars for acetylene, etc.). In all cases, the pressure should be reduced so that the gas can be used without damaging or destroying instruments and apparatus, with the resulting risk of flying parts and jets of pressurised fluid.

To avoid these risks, follow the instructions below:

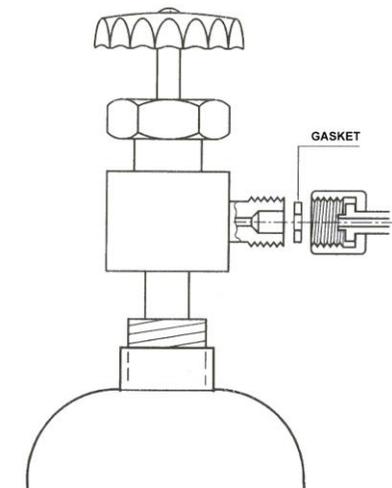
- A suitable gas regulator must be used that is compatible with the gas, in terms of the pressure, the materials used, and the threads for connecting to the cylinder.
- The gas flow from the cylinder should not be regulated by simply leaving the valve half-open. This is a dangerous operation that must be absolutely prohibited.
- Regulators that have broken manometers should not be used. In addition to their inefficacy, they may cause leaks and parts may fly off due to the pressure.
- When gas is collected from two groups of cylinders, a gas control panel must be used to ensure continuous flow from one source of gas in safe conditions.

RISKS IN THE USE OF CONNECTORS

The connection of a cylinder to a pressure reducing valve, a pipe, etc. must be carried out using a part that corresponds to the gas that is used, in accordance with the provisions established in the Regulations on Pressure Equipment, ITC – MIE – AP07.

The following indications should be followed:

- Connectors must be in good condition. In particular, parts with threads should be checked carefully, and should not be used if the thread shows appreciable signs of wear or deterioration.
- It is very dangerous to use connectors with a faulty or worn thread or one that has similar, but not identical, features to the right part. In this case, a connection can be made, but there will be a risk of leaks or unexpected expulsion of the connector due to the effects of pressure.
- Gaskets used to ensure that connectors are air-tight must be made from a material that is compatible with the gas in the cylinder, and must be provided by the gas supplier. The use of unsuitable gaskets that are incompatible with the gas could cause serious accidents. For example, gaskets made from organic material are incompatible with oxygen.
- When a gasket shows any kind of change in its structure, it must be replaced by a new one with the same characteristics as the original. Gaskets should be changed regularly.



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USE OF GAS CYLINDERS

SAFETY RECOMMENDATIONS FOR THE USE OF GAS CYLINDERS

Cylinders may be used in many different ways. For example, some cylinders are kept in gas cylinder cages and connected via lines, whilst others are used for welding in the workplace.

The following preventive measures should be adopted when gas cylinders are used:

- Cylinders should be used as provided by the gas supplier. In no case should the valve guard be removed. This part is designed to protect the valve from knocks and falls, as the valve is the weakest part of the cylinder. The guard therefore helps to prevent gas leaks or the valve flying off.
- The colour of gas cylinders is a safety feature that rapidly indicates what they contain. Repainting of cylinders should only be undertaken by the gas supplier.
- Gas cylinders should not be used as a support for hammering parts or as a roller for transporting machines, parts, etc. These actions involve a serious risk as they may reduce the strength of the cylinder, leading to a danger of explosion.
- Cylinders should not be used to prime arcs or as a support for welding parts: this could change the characteristics of the material that the cylinder is made from, and cause cracks where the wall is thinner, etc., which could lead to a risk of explosion.
- When work is carried out using cylinders for oxy-acetylene welding, the arc welding guns should not be left turned on and hanging from the cylinder during pauses in the work, as the heat acting on a specific point could change the resistance of the cylinder's material and lead to the decomposition of acetylene, causing a risk of explosion.
- Gas cylinders should not be exposed to low temperatures without the authorisation of the gas supplier; depending on the characteristics of the steel from which they are made, they may become fragile due to the effect of the cold and subsequently explode. The use of steel with a suitable composition solves this problem.
- Before you use a gas cylinder, check its content and read the markings and labels on it. In case of any doubts about the content of the cylinder or its use, first consult the gas supplier.
- If a purchased cylinder has an out-of-date hydraulic pressure test, return it to the supplier without using it.
- The place of use should only contain the cylinder that is being used and a spare cylinder, if necessary. In accordance with the provisions established in Chemical Storage Regulations ITC-MIE-APQ05, if there are more cylinders in the workplace, the premises shall be considered a store and must therefore meet the requirements established in the aforementioned regulation.

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- The cylinder's valve must be opened slowly and progressively. If it is difficult to open the valve, the cylinder should be returned to the supplier. In no case should tools be used or the valve forced to open the cylinder.
- Cylinder valves should never be greased or manipulated with cloths, gloves, etc. that are full of oil or grease: some gases react explosively with these elements.
- To open a cylinder, the valve must be pointing away from the operator and in no case towards other people. This prevents accidents due to leaks of pressurised gas or components flying off in the case of a fault.
- When several cylinders are connected to the same line, the outlets from the valves should not be facing each other. This will help to prevent a fire caused by a leak from acting on the valves of other cylinders, for example.
- When a greater flow of gas than that provided by one cylinder is required, in accordance with the supplier's specifications, various cylinders can be used arranged in parallel or in a cylinder bundle. Heat should never be applied to increase the flow from a cylinder, as there is a risk of explosion.
- Cylinders should never be completely used up. They should be disconnected when their content drops to 5% of the initial volume. This prevents contamination of the cylinder by back-pressure. If back-pressure does occur, the supplier must be informed.
- Once the work with gas cylinders has been completed, or during breaks, valves must be closed. Turning off arc welding guns should not be relied on to seal the system, as there is a high probability of a gas leak.

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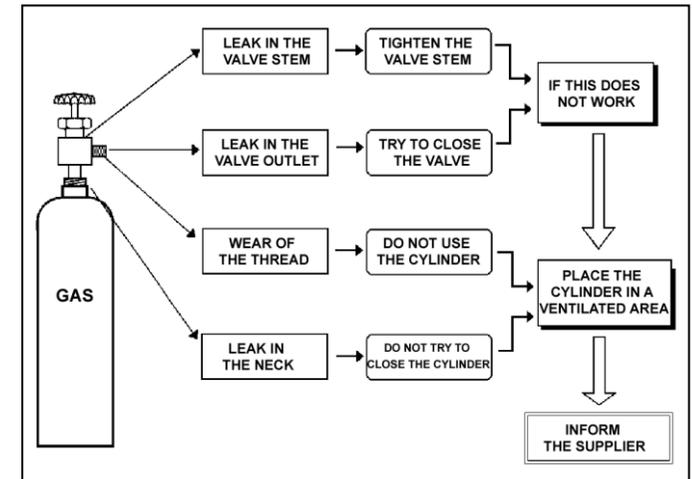
EMERGENCIES: LEAKS FROM CYLINDERS

RECOMMENDATIONS IN THE CASE OF A LEAK FROM A CYLINDER

If a gas cylinder is leaking, it is essential to act as quickly as possible. Consequently, those who work with gas cylinders should be trained to resolve these potential problems.

The following diagram shows the places from which a cylinder can leak and the action that should be taken in each case. However, other measures may be necessary, depending on the gas that the cylinder contains. The most general measures are described below.

- **Inert gases:** inert gases can cause oxygen-depleted atmospheres when they displace air. If there is a leak from an inert gas cylinder, the necessary precautions must be taken to determine whether the atmosphere is oxygen depleted, particularly in enclosed or semi-enclosed areas. Nobody should enter the area where the leak has occurred without self-contained breathing apparatus.



If the leak is from a cryogenic tank, a fine water spray should be used to dissipate the fog that forms. Nobody should enter the area unless they are equipped with self-contained breathing apparatus. The vaporisation of an inert gas in a liquid state leads to 691 litres of gas for every litre of liquid, at a temperature of 15°C and 1 bar of pressure.

- **Oxidising gases:** given that these gases, such as oxygen, promote combustion, it is important to ensure that clothing has not been impregnated by the gas. Once outside, clothing should be aired for at least 15 minutes. You should not get close to points of heat or flames or smoke cigarettes, etc.
- **Combustible gases:** approach these cylinders with the wind behind you so that you will not be surrounded by flames if they catch on fire. Some gases, such as hydrogen, burn with a bluish flame, which is almost imperceptible. Consequently, these cylinders should be approached with a pole that has a piece of paper attached to the end of it. If the paper burns, it will show that there is a flame.
- **Toxic gases:** you must wear suitable protection equipment and approach the cylinder with the wind behind you. A suitable method must be used to check whether there is a leak. For example, aqueous ammonia can be used to reveal a chlorine leak, as white smoke will be produced in this case.
- **Corrosive gases:** Use the right protection equipment and approach the cylinder with the wind behind you. The leak should be checked using appropriate means, for example, colorimetric tubes in the case of ammonia.

These are general recommendations on how to act. You should contact the gas supplier who will provide information on the most suitable specific actions to take in each case.

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EMERGENCIES: CYLINDERS ON FIRE

If there is a fire, all of the gas cylinders that are exposed to it could explode, with the resulting hazard of projection of parts and/or fragments of the cylinder, the gas that it contains, which could be toxic, corrosive, etc., and blast waves.

If there is a fire, to prevent cylinders from exploding, adopt the following measures:

- Inform all staff and evacuate the area.
- Inform the fire service.
- Make an inventory of the number of cylinders, their contents and their location. These data could be very useful to the firefighters when they arrive.
- Evacuate as many cylinders as possible if this operation is not risky.
- Only if possible, close the valves of the cylinders that are closest to the fire, if they are not affected.
- Use jets of water to cool cylinders that cannot be evacuated, those that have got hot or those that are beginning to heat up. This must be done from a safe distance and with the right protection.

Cylinders that have been affected by a fire should not be handled without first consulting the gas supplier.

It is important to have the safety data sheet of the various gases contained in the cylinders, as this document specifies the measures to adopt and the protection equipment that needs to be used to handle the cylinders or to deal with an emergency situation under the safest conditions for the user. Ask the supplier of the cylinder or bottles for this sheet.