SAFE OPERATION OF COMPRESSED GAS CONTAINERS: A TRAINING SYLLABUS

Getting familiar with the national standard ČSN 078304

"Compressed gas containers – safety rules"

1 Transportation, handling, and use of gas cylinders

1.1 All compressed gas cylinders and drums must be secured against impact and falling.

1.2 Cylinders must be kept at such a distance from sources of heat that their surface temperature does not exceed 25°C (methyl chloride) or 50°C (all the other gases), respectively. Cylinders and drums must be kept at least 3 meters away from open flame.

1.3 Cylinders must be appropriately secured against falling. Drums must be appropriately secured against rolling.

1.4 Before use, read instructions and inspect the cylinder for irregularities. Faulty cylinders will be labeled as such and returned to the plant.

1.5 Maximum eight cylinders (50-liter type) containing identical or different gases may be stored in a room in a multi-story building.

Fire safety sectors containing multiple rooms may accommodate no more than 24 cylinders (50-liter type) per fire safety sector.

1.6 For non-toxic and non-corrosive gases kept in single-story buildings the total number of cylinders per room is unrestricted, provided the cylinders are stored in units of maximum 24 with minimum 10-meter gaps between individual units. Flammable or oxidizing gases may only be stored in units of maximum four cylinders with minimum 10-meter gaps between individual units.

1.7 The national standard ČSN 01 8003 applies to the use of cylinders in laboratories. Similar regulations apply to the use of cylinders in medical installations and in halogen and sodium-vapor lamp factories.

1.8 Cylinders may not be stored or used in apartments, basements, passageways, in emergency exits and stairwells, in attics, offices, locker rooms, kitchens, dining halls, restrooms, parking garages, furnace rooms, light shafts, in objects constructed from combustible materials, in unventilated enclosures, places that are not easily accessible, and in public places.

National standards ČSN 05 0601 and ČSN 05 0610 apply to the use of cylinders in oxy-fuel welding and cutting. The ČSN 38 6460 regulates the storage of propane-butane cylinders.

For storage of CO2 cylinders in restaurant facilities , see 1.13

1.9 For storage of cylinders, see also 4.30 and 4.33.

1.10 Rooms and facilities where cylinders are stored and used must be ventilated in compliance with fire safety and health and safety regulations as well as with regard to the character of the stored gases.

1.11 Cylinders equipped with a safety cap must have the cap on when not used.

1.12 One maximum 10-kg CO2 cylinder may be used in one room as part of a beverage dispenser.

Maximum two active and two replacement CO2 cylinders may be kept in an underground beverage storage area.

2 Gas installations and discharge of containers

2.1 Gas may only be piped or dispensed into secured containers and low-pressure equipment using a pressure regulator which is specifically designed for the gas that is used, labeled as such, and set to operating pressure.

Pressure regulators are not required, provided pressure in the pipeline, equipment, or secured container is positively prevented from exceeding the safety limit.

2.2 The downstream (outlet) part of a pressure regulator must be equipped with a pressure gauge and safety valve.

A pressure gauge is not required if the pressure regulator is attached to a manifold equipped with an in-line pressure regulator. Manifolds must be equipped with both upstream and downstream pressure gauges.

A safety valve is not required if the pipeline or secured container into which the gas is dispensed is equipped with its own safety valve.

2.3 Cylinders with faulty valves or regulators that prevent safe use must be returned, if safe to do so, and the supplier must be notified to send the cylinder to the repair facility.

If it is unsafe to return the cylinder, the supplier is asked to send a specialist to take appropriate measures.

Compressed gas railroad tank cars with faulty unloading valves may be unloaded using emergency procedures. These procedures must be attached to the car frame. Valves may be operated only by trained personnel.

After the car has been unloaded, the valves must be returned to the original position and the owner of the car must be notified of the fault.

2.4 All valves must be tightly closed after each use of a cylinder. Cylinders with flammable, toxic and corrosive gases (excluding acetylene and hydrogen) must have their outlets secured with a sealed screw cap.

2.5 Cylinders to be returned must have a minimum pressure reading of 0.5 bar.

2.6 Discharge of cylinders may not be expedited using open flame. Radiators with a surface temperature of no more than 100°C, warm air fans, warm water baths, and other means may be used, provided the surface temperature of the cylinder never exceeds the limit set in 1.2.

Chlorine cylinders may not be warmed or cooled with a water hose.

2.7 When large quantities of gas are used, a vaporizer may be used to convert liquefied gas.

2.8 Acetylene cylinders may not be used sooner than one hour after the cylinder has been trucked to the point of use.

This does not apply in case cylinders are kept and transported in an upright position.

2.9 When used, an acetylene cylinder must be in an upright position or inclined at an angle of not less than 30 degrees from horizontal to protect against loss of acetone.

2.10 Acetylene may be discharged from the cylinder at an even rate not exceeding 1000 liters per hour. For larger hourly rates, more cylinders need to be used in tandem. A maximum pressure of 1.5 bar at the pressure regulator outlet must not be exceeded.

2.11 In chlorine installations, the system must be equipped with a non-return valve or other safety item positioned between the chlorine container and the point of use to prevent suck-back of the chlorinated product into the container.

2.12 Before and during the use of chlorine, measures need to be taken to prevent moisture from getting into the pipework.

2.13 Placement and construction of a stand-alone gas manifold unit is subject to the same regulations as the storage of compressed gas containers.

2.14 The hardware of a manifold unit is usually positioned in a designated sector of the work area.

The hardware of a gas manifold unit may also be placed outdoors in which case it must be appropriately protected against unauthorized use and against the elements.

2.15 A gas manifold unit for non-toxic, non-flammable, and non-oxidizing gases may be positioned inside a work area. Such a unit may comprise a maximum of six stand-alone cylinders or a cluster containing no more than 12 cylinders (50 liter type).

2.16 A manifold unit containing clusters of cylinders or drums with toxic, flammable or oxidizing gases that is positioned within a work area must be treated as a separate fire protection sector.

An acetylene manifold unit supplied from a cluster truck must be fitted with a flashback arrestor.

2.17 Electrical installations in manifold units for flammable gases are subject to the national standard ČSN 33 2320.

3 Inspection and maintenance of gas containers

3.1 Inspection, repair and maintenance of gas containers may only be performed by authorized organizations.

3.2 Fittings may be removed from the container that is completely empty, following the standard operating procedure. Gas is removed by venting or rinsing. When venting containers used for toxic, corrosive and flammable gases, care must be taken to prevent dangerous levels of the gas in the air both indoors and outdoors.

3.3 Containers that are new or have been treated as described in 2 may be stored or transported without fittings but must be plugged to prevent air moisture or particles from entering the inside of the container.

3.4 Only empty containers may have old paint renewed or replaced.

4 Storage

4.1 Areas where cylinders are stored, whether indoors or outdoors, with the exception of temporary storage areas, constitute separate fire protection sections.

4.2 Cylinder storage areas, excepting those described in 3.3, must be separated from work areas, residential buildings and other buildings a distance compliant with regulations and standards, and in case of flammable, oxidizing, and toxic gases may not exceed the distance given in Table 1.

Table 1. Compressed gas storage guidelines:

Number of cylinders (50-liter type) stored	Minimum distance from	Distance (meters)
76 to 500	Storage areas, work areas and underground areas (see 3.4)	12
500 to 3000		15
3000 or more		20
0 to 75	Residential buildings	12
76 and more		25
Any number	Public buildings and civil defense shelters	30

Cylinder storage areas may not be positioned inside high fire hazard areas of another fire safety sector or object (in compliance with ČSN 73 0804 and ČSN 73 0802).

4.3 A small storage unit of up to 75 cylinders, whether full or empty, out of which a maximum of 50 cylinders (50-liter) contain toxic, corrosive, flammable or oxidizing gases, including cylinders that are part of manifold installations, may be attached to a single-story work building.

Such a unit will constitute a separate fire protection sector (see ČSN 73 0804).

4.4 Toxic, flammable and oxidizing gases that are heavier than air and hard to ventilate may not be stored in close proximity to terrain depressions, shafts, basement windows, or basement entrances.

Entrances and openings to underground spaces must be separated a minimum distance of five meters from small gas storage areas (defined in 3.3). Minimum distance from other storage areas is given in Table 1.

4.5 A storage must be separated a minimum 10 meters from a public road, unless other regulations do not state otherwise. This does not apply to small storage areas defined in 3.3.

4.6 Underground cylinder storage may only be allowed under exceptional conditions, well supported from an architectural point of view, e.g. in construction of subway and other underground installations. Flammable gas storage areas must be equipped with gas leak detectors.

4.7 Design and construction of gas storage objects are subject to the same regulations as gas filling facilities.

4.8 Where more than four cylinders (50-liter) containing gases forming an explosive or otherwise dangerous mixture with each other are stored indoors, these cylinders must be kept in separate fire protection sectors and each sector must be independently ventilated.

When stored outdoors, these cylinders must be kept in separate cages.

4.9 To ensure adequate ventilation and lighting, storage ceiling height must be at least 2.1 meters.

4.10 Doors and windows must be made from fire-resistant materials, excepting small storage units defined in 3.3. Doors must exit into an open space outside the building.

Windows must be at least 1.5 meters above the floor.

4.11 Storage floors must be made in compliance with applicable standards.

4.12 Emergency exits in storage areas are regulated by ČSN 73 0804. In terms of minimum emergency evacuation time, areas where flammable, oxidizing, toxic and corrosive gases are stored are classified 7 (fire safety). Non-flammable gas storage areas are classified 3 (fire safety).

4.13 Indoor storage areas where flammable gases are kept must be ventilated at a minimum rate of three air changes per hour, thus constituting a fire safety zone defined in ČSN 33 2320, and being equal to outdoor storage areas.

4.14 Cylinder storage areas must be protected against the weather in compliance with ČSN 34 1390.

4.15 Cylinder storage areas may only be heated using hot water radiators, low-pressure steam radiators, forced hot air or electrical heaters.

4.16 Storage area temperature may never exceed the temperature at which any one cylinder with any kind of gas may be caused to rupture.

4.17 A maximum 15% floor space of a gas storage fire safety sector may be occupied by areas such as restrooms, offices etc., provided no more than 15 personnel are present.

These quarters may not be heated using solid, liquid, or gas fuels.

4.18 Storage area doors must have a sign indicating the kind of gas stored (see ČSN 01 8014), no smok-

ing sign, no access with open flame sign, and only authorized personnel sign. If flammable, oxidizing, toxic or corrosive gases are stored in the area, appropriate signs must be on, in compliance with ČSN ISO 3864.

4.19 Both forced and natural ventilation is required in indoor storage areas with toxic and harmful gases. Harmful or otherwise hazardous (e.g. explosive) substances in the air must not exceed safe limits during normal operation both inside and outside the area. Areas where heavier-than-air gases are stored must have ventilation openings positioned diagonally across the area and at ground level.

4.20 Forced ventilation of areas where toxic and harmful gases are stored must be controllable from the outside of these areas. A forced ventilation system must be capable of a minimum 10 air changes per hour, if other regulations do not state otherwise. In case of an accident, ventilation is subject to the gas emergency escape plan for the particular area and its surroundings.

4.21 Areas where toxic and corrosive gases are stored must be equipped with a wind direction indicator so that personnel might be alerted in case of a large leak.

A wind direction indicator is not required for areas where no more than 20 cylinders (50-liter) are kept.

4.22 Personal protection gear, first aid kit, antidotes, neutralizing agents, and spare parts must be kept in a designated sector (room or cabinet) in close proximity to the storage area

4.23 Appropriate fire extinguishers must be provided inside, or even outside the entrance to, the area where flammable and oxidizing gases are stored. Firefighting water supply used to fight flammable gas fires is calculated using ČSN 73 0876.

4.24 One indoor fire safety sector may hold no more than

a) 500 cylinders (50-liter) containing flammable, oxidizing, toxic or corrosive gases,

b) 1000 cylinders (50-liter) containing other gases.

4.25 Figures in 3.24 do not apply to outdoor storage. Figure in 3.24 b) applies also to non-toxic and non-corrosive gases in filling facilities.

4.26 Each sector defined in 3.24 must have an independent exit into an open space.

4.27 Stand-alone cylinders must be appropriately secured against falling. Stand-alone cylinders are kept in sectors not exceeding 1000 units.

4.28 Cylinders may be stored on their side and onto each other with the valves on the same side and the stack's hight not exceeding 1.5 meters. The valves must be easily accessible. Stacks must be secured against rolling.

4.29 No combustible materials may be stored and no unauthorized operations involving open flame may be performed within five meters of a gas storage area (see ČSN 05 0601).

4.30 Cylinders may not be stored together with radioactive substances, corrosive substances, etc.

4.31 Service aisles between stored cylinders must be at least one meter wide.

4.32 Empty cylinders must be stored separately from full cylinders. Each sector must have a sign: FULL CYLINDERS, and EMPTY CYLINDERS, respectively.

4.33 Empty cylinders must be stored under the same conditions as full cylinders.

4.34 Storage areas situated outside the guarded premises must be fenced off.

4.35 Storage of drums and cluster trucks is subject to the same regulations as cylinders. Each unit is treated as typical 50-liter cylinder.

Drums must be secured against rolling.

4.36 Cluster trucks with non-flammable gases connected to a manifold must not be positioned in another fire safety sector or object.

Positioning of cluster trucks with other gases is subject to distance regulations given in 3.2. Internal volume of a cluster truck is calculated using the figure used for a typical 50-liter cylinder.

5 Transportation

5.1 Gas containers may not be transported together with corrosive substances that are in breakable containers (e.g. glass carboys).

5.2 Oxygen cylinders may not be transported together with hydrocarbons (e.g. grease, oils).

5.3 Gas cylinders may not be transported together with flammable liquids, explosive substances or items containing explosive substances.

5.4 Vinyl methyl ether, vinyl chloride, and vinyl bromide may only be transported if appropriately stabilized. Ethylene oxide may only be transported if it is free from polymerization promoters (acids, chlorides, etc.) and if containers that are polymerization promoter-free (water, iron oxides and chlorides) are used.

5.5 Gas cylinders may be transported using only one towed trailer. For transportation of more than 400 kg, a minimum two axle trailer with brakes must be used. Road transportation of gas containers is regulated by The European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR).

5.6 Loading and unloading of gas containers using a crane or other machinery is subject to ČSN 27 0140 and corresponding regulations.

Individual cylinders may be loaded and unloaded only with a protective safety cap on.

5.7 Containers may be transported by elevators only after appropriate safety measures have been taken. Containers must be secured against toppling and movement.

5.8 Acetylene cylinders filled with porous material may be transported using elevator trucks. This is regulated by ČSN 26 8805 and ČSN 26 8811.

5.9 Railroad transportation of gas containers is subject to The Regulation concerning the International Carriage of Dangerous Goods by Rail (RID).

5.10 Cylinders heavier than 50 kg may only be carried by two or more physically capable persons.

5.11 When transported on a cargo bed, cylinders must be secured against movement in any direction. Gas cylinders may not be transported on dump trucks.

5.12 Only authorized personnel may be present during road transportation of gas cylinders.

5.13 All cylinder valves must be positioned to the same side and must be easily accessible.

5.14 Both full and empty cylinders may only be transported with valves shut and protective caps on.

This regulation does not apply to medicinal gases in emergency vehicles and to other cases where gases are used during transportation.

5.15 Toxic, corrosive and flammable gases with the exception of acetylene and hydrogen may only be transported after the safety crew cap has been fitted on the outlet.

5.16 Vehicles carrying full or empty containers may not be left unattended while parked in freely accessible places.

5.17 Vehicles carrying chlorine may not stop or be parked in residential areas, except subject to traffic code or in case of malfunction.

5.18 Vehicles transporting containers with toxic, corrosive and oxidizing gases must be accompanied by

personnel familiar with the characteristics of the transported gas and trained in handling the containers.

5.19 Road vehicles carrying gas cylinders must be equipped with an appropriate fire extinguisher. Personnel accompanying the transport must be provided with protective gear.

5.20 Gas cylinders may not be transported in personal vehicles or in vehicles in which cargo area is not separated from the driver's cabin.

This does not apply to cylinders of an internal volume no greater than 12 liters and to cylinders containing a maximum of 40 kg propane-butane.

5.21 Apart from the cylinders connected to the medical equipment, emergency vehicles may carry two replacement gas cylinders not exceeding 20-liter total volume.

6 Occupational safety and health issues

6.1 To operate filling devices and manifold units, a local operating regulation in compliance with ČSN 38 6405 must be prepared.

To use, discharge, storage and transport individual cylinders, only a set of instructions and safety principles must be prepared.

In preparing these documents, local conditions, type of container and type of use need to be taken into account.

6.2 Manufacturer specifications and instructions will suffice for use of individual cylinders in breathing support, scuba diving, soda water and soft drink making, as well as for use of small welding and soldering kits using five-liter cylinders and smaller.

6.3 An emergency escape plan must be prepared where more than 500 cylinders (50-liter) of toxic, corrosive and flammable gases are used and stored. This plan will define principles and measures to be taken in case of an accident and gas leakage.

6.4 Local operating procedure and instructions for use must be available at the point of use.

6.5 Only trained personnel may operate or service a filling device or manifold unit.

6.6 Personnel operating gas cylinders must be trained in use, storage and transportation (as specified in 6.1) and with regard to the emergency escape plan (see 6.3) and have their training renewed every three years.

Use of gas cylinders in oxy-fuel welding and cutting is subject to ČSN 05 0601 and ČSN 05 0610.

6.7 Personnel filling, discharging, repairing, storing, and transporting gas cylinders must be provided with protective equipment that is appropriate for the gas used.

Work clothes (including underwear and footwear) used by personnel handling flammable gases where explosion hazard regulations apply, must comply with ČSN 33 2030.

6.8 In filling and using cylinders with toxic and corrosive gases, at least two persons must be present. These persons must take regular medical checks subject to regulations by the Ministry of Health.

6.9 At least two industrial breathing sets must be available at a filling facility or at a point-of-use where cylinders with toxic and corrosive gases are used. Breathing sets are not required where specifically only cylinders are used.

6.10 Storage and work areas requiring an emergency escape plan as specified in 5.3 must be appropriately equipped, e.g. alarm device, built-in firefighting system, cleanup supplies, tools.