

University of Chemistry and Technology, Prague

Title	DIRECTIVE No. A/S/961/6/2022
Subject	Rules for safe manipulation with pressure cylinders and tubing for technical gases
Applicability	All-university
Effective from	1 January 2023
Effective to	Unlimited
Revision	As needed
Cancelled	DECREE No. A/V/961/1/2019 DECREE No. A/V/961/1/2021
Prepared by	
Issued by	Prof. Dr. RNDr. Pavel Matějka– Rector

INTRODUCTORY PART

Article 1

Introductory provisions

- (1) This Directive serves to ensure occupational safety and health (OSH) and fire protection (FP) of employees and other individuals at UCT Prague during manipulation and storage of pressure cylinders and when working with distribution of technical gases from source to delivery points.
- (2) This Directive imposes on heads of departments where gas pressure cylinders are handled the obligation to appoint and authorize in writing subordinates responsible for safe manipulation with gas pressure cylinders on the UCT Prague premises (hereinafter referred to as “responsible employees”).
- (3) The Directive was prepared in line with the requirements on work safety, based on related safety and technical requirements stipulated in the following regulations (as amended):
 - Act No. 262/2006 Coll., the Labour Code, as amended,
 - Act No. 133/1985 Coll., on Fire Protection, as amended,
 - Decree No. 48/1982 Coll., laying down basic requirements for ensuring safety of work and of technical equipment, as amended,
 - Decree No. 87/2000 Coll., stipulating fire safety conditions during welding and asphalt heating in melting vessels, as amended,
 - Decree No. 246/2001 Coll., of the Ministry of the Interior on stipulation of fire safety conditions and on state fire supervision performance (decree on fire prevention), as amended,
 - Government Decree No. 101/2005 Coll., on detailed requirements for workplaces and working environment, as amended,
 - Government Decree No. 192/2022 Coll., on reserved technical pressure equipment and requirements for ensuring their safety, as amended,
 - Government Decree No. 119/2016 Coll., on conformity assessment of simple pressure vessels when they are made available to the market, as amended,
 - Government Decree No. 219/2016 Coll., on conformity assessment of pressure equipment when made available on the market, as amended,
 - CSN 07 8304 Gas cylinders. Operation rules,
 - CSN EN ISO 7225 Gas cylinders – Precautionary labels,
 - CSN EN 1089-3 Transportable gas cylinders – Gas cylinder identification (excluding LPG). Part 3: Colour coding,
 - CSN EN ISO 13769 Gas cylinders – Stamp marking,
 - CSN 01 8014 Plates for indicating of spaces with pressure gas bottles,
 - CSN ISO 3864-1 Graphical symbols – Safety colours and safety signs – Part 1, Design principles for safety signs and safety markings,
 - CSN ISO 3864-3 Graphical symbols – Safety colours and safety signs – Part 3, Design principles for graphical symbols for use in safety signs,
 - CSN 268805 Powered industrial trucks - Operation, maintenance, repair work and technical inspections,
 - CSN EN IEC 62990-2 Workplace atmospheres – Part 2, Gas detectors: Selection, installation, use and maintenance for detectors for toxic gases and vapours,
 - CSN EN ISO 21029-2 Cryogenic vessels - Transportable vacuum insulated vessels of not more than 1 000 litres volume – Part 2, Operational requirements,
 - CSN EN 12257 Transportable gas cylinders - Seamless, hoop-wrapped composite cylinders,

- CSN 01 8003 Safety code for working in chemical laboratories,

Article 2

Terms and definitions

- (1) **Gas pressure cylinder** – a cylinder, a large-volume cylinder, a pressure tube, a closed cryogenic vessel, a metal hydride storage system, a cylinder bundle or a collection container.
- (2) **Cylinder** – a transportable pressure vessel with a water volume of up to 150 l.
- (3) **Cylinder bundle** – an assembly set of cylinders that are linked and connected by tubing and transported as one unit with a combined water volume of up to 3,000 litres; bundles for transportation of toxic gases are limited to a total water volume of 1,000 litres.
- (4) **Operational room** – a room where gas from cylinders is used or consumed.
- (5) **Vessel equipment** – fittings and equipment or other parts necessary to operate, control, inspect and ensure safe operation of cylinders (e.g., shut-off fittings, safety devices, protective caps).
- (6) **Closed protective cap** – a device that is fixed to the valve during manipulation, transport and storage and that is removed when access to the valve is needed.
- (7) **Open protective cap** – a device that is fixed to the valve during manipulation, transport and storage and to which a pressure regulator can be attached. The cap is secured to the vessel.
- (8) **Laboratory work** – any handling of chemical substances and chemical mixtures carried out in a prescribed manner in laboratory conditions.
- (9) **Laboratory personnel** – natural persons that are authorized to perform laboratory work in a laboratory or in a school laboratory.
- (10) **Responsible person/employee** – a natural person aged 18+ designated by a statutory body of the operator of the laboratory or school laboratory to ensure safe operation of the laboratory or school laboratory in accordance with the rules of operation; the responsible person shall have the necessary knowledge and practical experience for safe handling of chemical substances and chemical mixtures.
- (11) **Rules of operation of the laboratory** – a document that sets out a set of rules and activities necessary for running a laboratory or a school laboratory.
- (12) **Operational laboratory** – an operational room where work is done with the use of hazardous substances and mixtures (HCSM) whose combined weight does not exceed 5 kg, 10 litres and where pressure cylinders with internal volume of up to 20 litres regardless of the type of gas are placed. If any of these values is exceeded, the laboratory is a chemical laboratory.
- (13) **Chemical laboratory** – an operational room where work is done with the use of hazardous substances and mixtures (HCSM) whose combined weight exceeds 5 kg, 10 litres and where pressure cylinders with internal volume of 20 litres and more regardless of the type of gas are placed.
- (14) **School laboratory** (training, scientific, research, experimental) – an independent, structurally separated space or group of spaces dedicated to work with the use of HCSM that are used for teaching, research and scientific purposes in school and training establishments where cylinders are placed. They can be school operational laboratories or school training laboratories. In school laboratories, special operating conditions are applied to students and outside workers.

Article 3

Properties of gases

- (1) The majority of provisions that follow from technical and legal regulations apply to all types of gases. However, some provisions must be applied only to certain types of gases in connection with their physical and chemical properties. In this respect, the following properties are decisive:

- a) **density of the gas** in comparison with the air (lighter or heavier than air),
- b) **what state or form the gas in the vessel is in** (gaseous, liquefied or dissolved in a medium),
- c) **physical hazard** (explosiveness, flammability, ...)
- d) **toxicological effects on humans.**

- (2) In Table No. 1, properties of selected gases or gas mixtures that are most often used in the laboratories at UCT Prague are given. Table No. 1 does not provide all physical, chemical and toxicological properties of gases. More detailed information about the properties of the given gases and gas mixtures are given in the relevant safety data sheets that are prepared by the suppliers of the gas.

Table No. 1: Properties of gases most often used at UCT Prague

name of gas	density of the gas compared to air	state of the gas in the vessel	physical hazard	toxicological effects
acetylene	lighter	Dissolved under pressure in a medium	flammable	low toxicity
hydrogen	lighter	gaseous	flammable	non-toxic
propane – butane	heavier	liquid	flammable	non-toxic
forming gas	lighter	gaseous	flammable	non-toxic
gas mixture P10	heavier	gaseous	flammable	non-toxic
oxygen	heavier	gaseous	supports combustion	non-toxic
nitrous oxide	heavier	liquid	supports combustion	non-toxic
argon	heavier	gaseous	inert	non-toxic
nitrogen	lighter	gaseous	inert	non-toxic
helium	lighter	gaseous	inert	non-toxic
carbon dioxide	heavier	liquid	inert	non-toxic
air	-	gaseous	inert	non-toxic
sulphur hexafluoride	heavier	gaseous	inert	non-toxic
sulphur dioxide	heavier	gaseous	inert	toxic
hydrogen sulphide	heavier	gaseous	inflammable	toxic

Article 4

Gas pressure cylinders

- (1) Pressure cylinders for storage of gases can have different volumes. Pressure cylinders with the water volume of 40 l, or 5, 6, 7, 10, 20, 50 l and more are the most common. Pressure cylinders can have different shapes and colour markings. They can be made of metal or composite material.
- (2) They can be further divided according to the state or form of the gas in the vessel:
- a) gases dissolved under pressure – they are gases dissolved in a liquid, e.g. ammonia water, acetylene,
 - b) compressed gases (e.g. oxygen, hydrogen, nitrogen, argon),
 - c) liquefied gases (e.g. carbon dioxide, propane-butane, ammonia).

Pressure cylinders are further divided according to:

- a) the filling gas:
 - low-pressure (up to 2.5 MPa),
 - high-pressure (over 2.5 MPa),
 - b) construction of the pressure cylinder:
 - welded sheet (LPG),
 - seamless (oxygen, acetylene),
 - composite,
 - c) equipment of the pressure cylinder:
 - with a foot,
 - without a foot,
 - with a safety element,
 - without a safety element.
- 3) The pictures below show protective caps of pressure cylinder valves. Figure No. 1 shows an open protective cap. Figure No. 2 shows a closed protective cap.



Figure No. 1: Open cap



Figure No. 2: Closed cap

PRESSURE CYLINDERS MARKING

- (1) Every pressure cylinder must be clearly and permanently marked by the manufacturer to avoid confusion. The information is stamped at the cap of the cylinder, where a safety label is placed. Another important type of pressure cylinders marking is the colour coding.

Article 5

Marking of vessels with precautionary labels

- (1) The style, content (i.e. the hazard symbols and the text) and the use of precautionary labels designed for use on individual cylinders for transportation of gases containing one type of gas or gas mixture are stipulated in CSN EN ISO 7225 Gas cylinders – Precautionary labels. This international standard does not concern labels on vessels in cylinder bundles nor labels for bundles.
- (2) The purpose of the precautionary labels is to make the labelling of cylinders and their content simple and to warn about the main hazards. The labels include the following information:
 - a) the full name and description of the gas (composition) according to ADR (European Agreement concerning the International Carriage of Dangerous Goods by Road),
 - b) a UN number (a four-digit number that identifies dangerous goods in international transportation),
 - c) an ES number (identification according to international lists),
 - d) standard sentences on hazards according to CLP (H),
 - e) instructions for safe handling according to CLP (P),
 - f) precautionary labels according to ADR and CLP,
 - g) name, address, phone number and other information about the manufacturer.
- (3) Information labels must be done, fixed and maintained so that they are clearly visible during the entire lifespan of the cylinder with the same type of gas.
- (4) Examples of precautionary labels are provided in Figure No. 3 and 4.

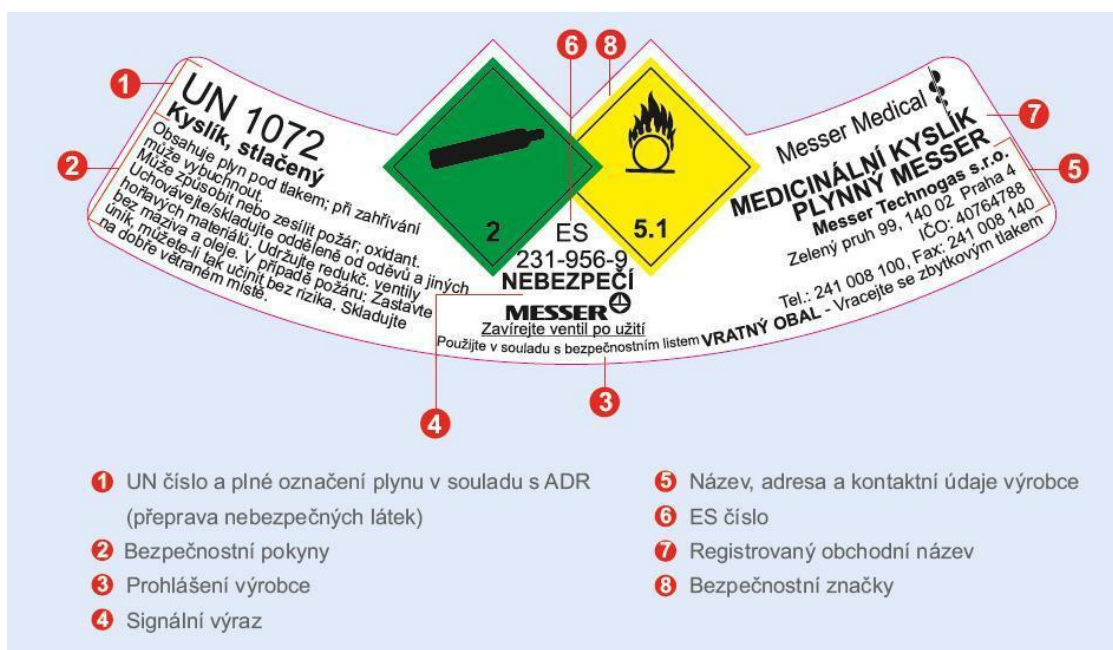


Figure No. 3: Precautionary label



Figure No. 4: Types of precautionary labels for inert, combustion supporting and flammable gases

Article 6

Colour coding of cylinders

- (1) Colour coding of cylinders is regulated by CSN EN 1089-3: Transportable gas cylinders – Gas cylinder identification (excluding LPG). Part 3: Colour coding. The standard stipulates a system for identification of the content of technical gas cylinders, breathing gases and medical gases cylinders, primarily with respect to the properties of the gas or gas mixture. This European standard does not apply to liquefied petroleum gases (LPG), gases used as coolants, gases for portable fire extinguishers or for stable fire-fighting equipment. Colour coding of cylinder bundles is not regulated in this standard nor in other standards.
- (2) Cylinders colour coding is an auxiliary coding to precautionary labels. It is important primarily when precautionary labels cannot be read, for example when the cylinders cannot be accessed.

- (3) Figure No. 5 shows the placing of the colour coding on the cylinder. Figure No. 6 shows the placing of the colour coding of gases with multiple properties and mixtures of inert gases. Each component in a mixture is given on the curved part of the cylinder. In the horizontal layout, colour 2 must not be the same as the colour of the cylinder's body.

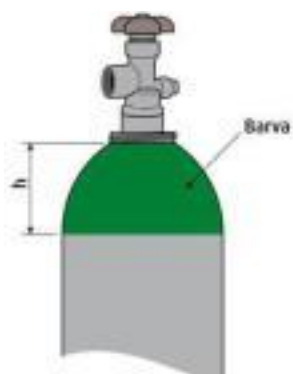


Figure No. 5: Placing of the colour coding on a cylinder

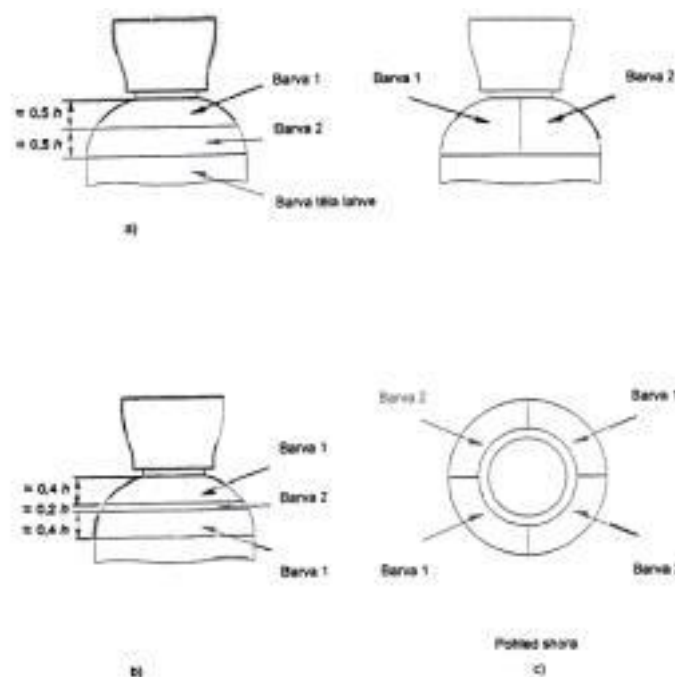


Figure No. 6: Placing of the colour coding of gases with multiple properties and mixtures of inert gases

- (4) Table No. 2 shows the colour coding of pressure cylinders according to properties of the gases. “Bright green” cannot be used for cylinders for air aimed for inhalation (i.e. for breathing apparatuses). Table No. 3 includes the colour coding of cylinders in case of two hazardous properties of the gas, where the colour coding is done according to the main hazard, or according to the main and the secondary hazard in parallel, as is shown in the given table. Table No. 4 provides the colour coding for cylinders with specialty gases. Table No. 5 shows the colour coding for cylinders with gas mixtures for medicine, while the given colours mustn’t be used for technical gaseous mixtures containing the same types of gases.

Table No. 2: Colour coding according to the properties of the gas

toxic and corrosive gases	YELLOW
flammable gases	RED
oxidizing gases	LIGHT BLUE
inert gases	BRIGHT GREEN

Table No. 3: Colour coding of cylinders in case of two hazardous properties of the gas

toxicity and flammability	YELLOW and RED
toxicity and oxidation	YELLOW and LIGHT BLUE

Table No. 4: Colour coding for cylinders with specialty gases

acetylene	AUBURN
hydrogen	RED
oxygen	WHITE
nitrous oxide	BLUE
argon	DARK GREEN
nitrogen	BLACK
carbon dioxide	GREY
helium	BROWN

compressed air	BRIGHT GREEN
----------------	---------------------

Table No. 5: Colour coding for cylinders for medicine

air, synthetic air	WHITE and BL
helium/oxygen	WHITE and BR
oxygen /carbon dioxide	WHITE and C
oxygen /nitrous oxide	WHITE and BLU

Article 7

Marking of cylinders with stamps

- (1) The details of this kind of marking of gas cylinders are provided in CSN EN ISO 13769 Gas cylinders – Stamp marking. This refers to a permanent marking of cylinders with hard metal stamping, engraving, casting (cast) or other similar methods. In case of composite cylinders, permanent marking can sometimes be done with the use of a printed label embedded in resin. An example of stamp marking is shown in Figure No. 7.



Figure No. 7: Stamp marling of cylinders

Article 8

Sizes of threads of the cylinder valves

- (1) Another measure aimed at preventing confusion when connecting the cylinder to the instrumentation is the fitting of cylinders with different thread sizes. In addition, flammable gases have a left-hand thread, while other gases have a right-hand thread. Table No. 6 provides an overview of the connecting threads for pressure regulators for select gases.

Table No. 6: An overview of connecting threads for pressure regulators for select gases according to DIN 477-1

Gas	Valve - cylinder	Cylinder bundle	Marking stamped on the union nut
acetylene	yoke	M 28x 1.5 LZ	3
oxygen	W 21.8	W 21.8	6
nitrous oxide	G 3/8"	G 3/8"	11
nitrogen	W 24.32	W 24.32	10
argon	W 21.8	W 21.8	6
helium	W 21.8	W 21.8	6
carbon dioxide	G 3/4"	G 3/4"	9
compressed air	G 5/8"	G 5/8"	13
hydrogen, ethene, methane, butane, propane	W21.8 LH	W21.8 LH	1

forming gas	W21.8 LH	W21.8 LH	1
testing gas	M 19	-	14
mixed gas	W21.8	W21.8	14

PLACING AND STORAGE OF PRESSURE CYLINDERS

Article 9

Precautionary labels, marking of storage rooms and places with cylinders

- (1) Precautionary labels must be placed on the doors of storage rooms and places where cylinders are permanently stored (operational and spare) or next to such doors (see the appendix to CSN 01 8014). Precautionary labels can also include the number of cylinders. If necessary, no smoking, no open flames and authorized personnel only labels can also be added. Figure No. 8 shows examples of precautionary labels:
 - a) stating the specific type of gas if cylinders with one gas are placed or stored there,
 - b) stating the total number of cylinders if the number is stable and does not change,
 - c) without stating the number of cylinders if the number of cylinders changes operationally.
- (2) Precautionary labels can be combined and can include combined data, e.g. „HYDROGEN 6 pcs.)“.

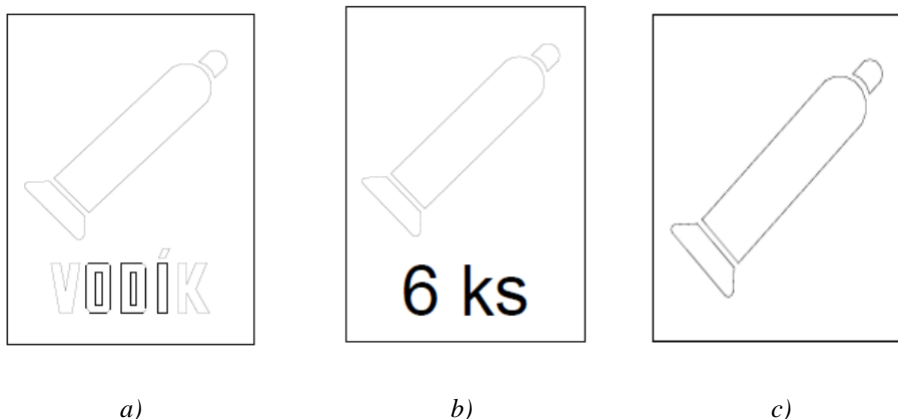


Figure No. 8: A precautionary label

- (3) If cylinders with flammable, combustion supporting, toxic and/or corrosive gases are stored in a storage room or in a place where operational or spare cylinders are placed, a relevant label in accordance with CSN ISO 3864-1 and CSN 3864-3 must also be put up there.
- (4) Multiple labels on the door or next to the door are required in case the labels on or next to another door are not visible upon entry to the storage room and the place where cylinders are permanently stored (operational and spare).
- (5) The number of cylinders on a precautionary label is given for different types of gases or as the total number of cylinders. The number of cylinders is given in accordance with the data in the Fire Safety Solutions or in accordance with the data given in the Local Rules of Operation.
- (6) Precautionary labels must be done in accordance with CSN 01 8014. The material and design of the precautionary label must be legible and distinguishable at 500 °C.
- (7) Precautionary labels must be done in accordance with CSN 01 8014 and the following rules:
 - a) black letters, the primary colour of the label is white, the symbol of a cylinder, the caption, or the edges of the label are black,

- b) the type of gas and the name in Czech, the label's primary colour is white,
 - c) for mixtures of gases according to the main hazard, or according to the main and the secondary hazard in parallel,
 - d) for mixtures of inert gases and/or gases for which the hazard is difficult to determine, a white primary colour and the caption MIXTURE OF GASES.
- (8) Precautionary labels stating the type of gas or types of gases are placed where cylinders are stored for each cylinder separately. In case cylinders are placed so that they are not visible from the point of entry, a corresponding number of precautionary labels must be added. Each precautionary label must be visible from the place where another precautionary label is placed.
- (9) Examples of labelling of operational cylinders are given in Figure No. 9 and 10.

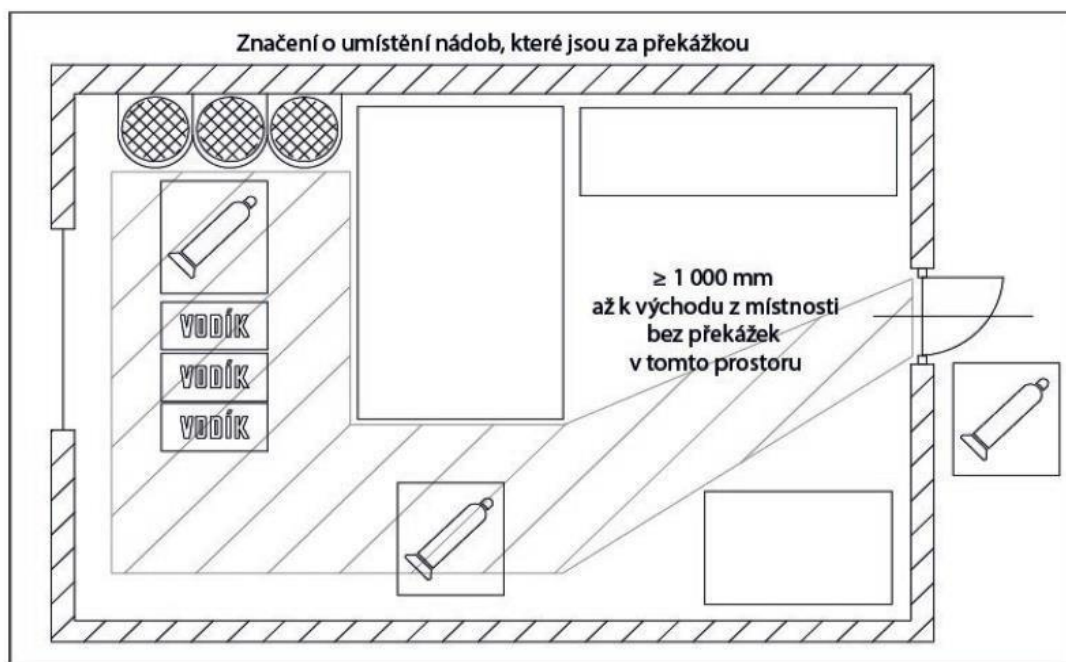


Figure No. 9: Example of labels of operational cylinders

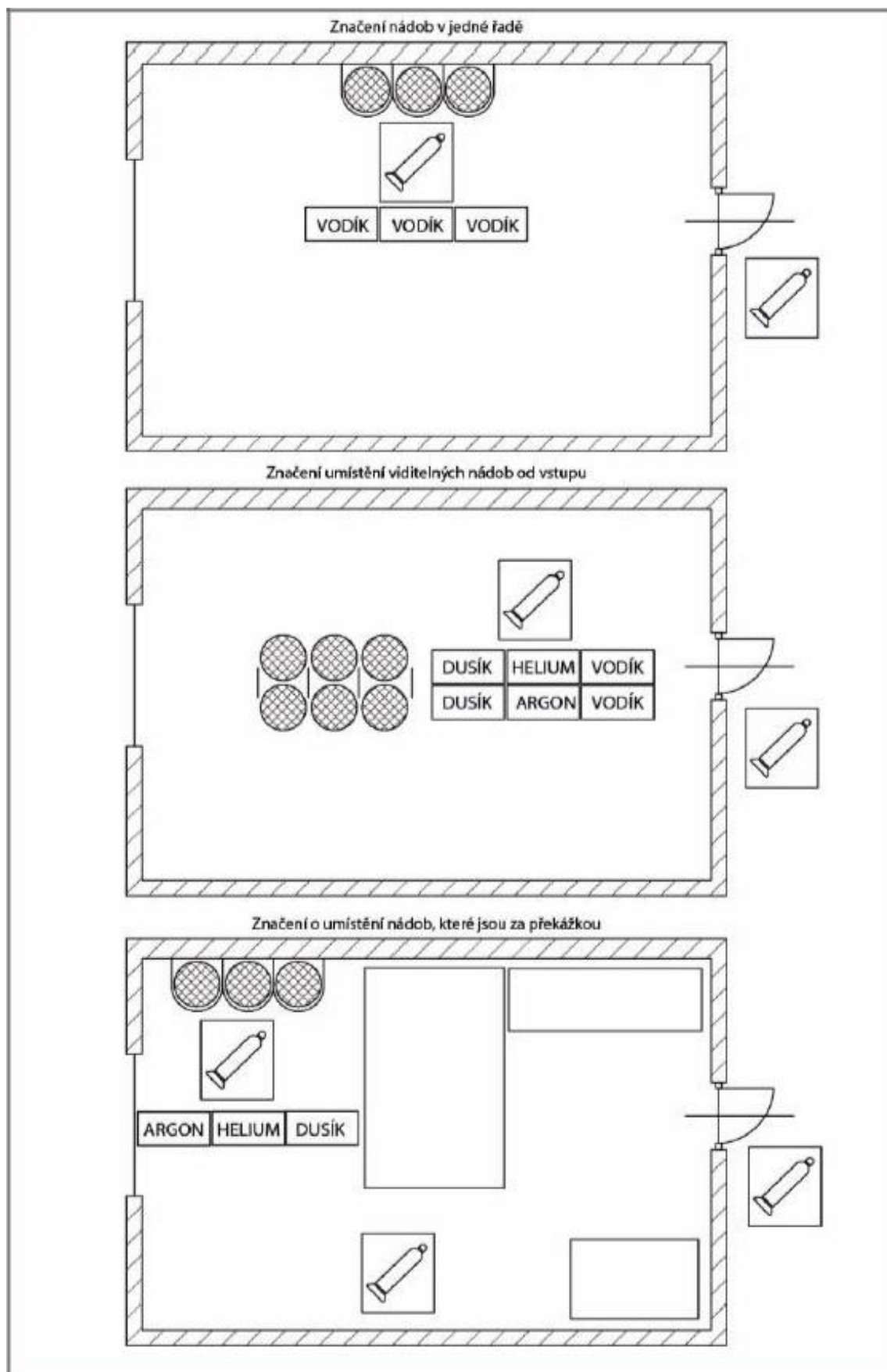


Figure No. 10: An example of labels on operational cylinders

Article 10

Placement of pressure cylinders at workplaces

- (1) At a workplace and in a school laboratory, such number of cylinders can be placed that corresponds to the needs and the operation of the school laboratory. No spare cylinders can be placed in a school laboratory, only operational cylinders can be placed there that are indispensable for its operation. In accordance with this Directive and with other regulations, the cylinders must be:
 - a) fixed or stored in accordance with this Directive,
 - b) labelled so that upon entry to the room or area it is clear that they are placed or stored there, or on which equipment they are installed,
 - c) access to the cylinders must be ensured in accordance with this Directive,
 - d) unused and/or empty cylinders must be immediately removed to a designated place or storage room,
 - e) the room where the cylinders are placed must be clearly labelled at the entrance or entrances in accordance with the requirements stipulated in this Directive.
- (2) In one operational room located in a multi-storey building, a maximum of 12 cylinders (converted to cylinders with internal volume of 50 l) with the same or different type of gas can be placed. If a fire-fighting zone has more operational rooms, the total number of cylinders in one fire-fighting zone must not exceed 24 cylinders (converted to cylinders with internal volume of 50 l).
- (3) The number of cylinders for non-toxic and non-corrosive gases is not limited in one operational room located in a one-storey building provided the distance between the cylinder bundles (for flammable and combustion supporting gases a maximum of 6 cylinders, for other gases a maximum of 24 cylinders) is at least 10 m.
- (4) Only operational and spare pressure cylinders can be placed in laboratories; pressure cylinders must never be stored in laboratories.
- (5) A free space of at least 1 m must be left to access the cylinders from at least one side.
- (6) At all times a free space that allows manipulation (primarily in case of an emergency) must be ensured between the cylinder or the cylinder bundle and the entrance that is 1 m wide as a minimum. The width of the entrance door (one wing) must be at least 0.6 m.
- (7) If the cylinders can be accessed only from one side, the cylinders must be placed in one row; if they are placed in two rows, access to them must be ensured from all sides.
- (8) The distance between the cylinder and the wall must be at least 0.1 m.
- (9) The distance between cylinders must be at least 0.5 m.
- (10) The minimum vertical clearance of a vessel must be 2 m, or it must correspond to the height of the cylinder plus a clearance space above the protective cap, see Figure No. 11.
- (11) The cylinder must be fixed so that any damage and/or movement or fall is prevented. The fixing system must be done so that it can withstand temperatures of 500 °C, it mustn't recoil, it must allow a proper fixation that must be easy to remove, no spring-hooks, bolts etc. can be used. The fixing system must be anchored to a stable structure made from non-flammable materials so that the anchor can withstand a tensile strength of 1kN (in accordance with Appendix A to CSN 07 8304), see Figure No. 11.
- (12) The distance between cylinders and tubes and heaters and radiation heating surfaces with surface temperature of 50 °C and higher must be such that the temperature of the cylinder surface does not surpass critical temperature (in accordance with the data on the safety data sheet), the minimum being 1 m; for liquefied gases and other gases it is 50 °C and for methyl

chloride it is 25 °C. The cylinders must be placed at least 3 m from open flame sources or other initiators that produce flame or that have a heating surface.

- (13) In laboratories, burners with an open flame can be placed closer to cylinders provided:
- a) they are sufficiently shielded by an inflammable obstacle and the cylinders do not contain flammable and/or explosive gases, or
 - b) mechanical exhaust ventilation with 6-fold air circulation is permanently in operation in the room and this ventilation must have an alternative energy source with an automatic switching to provide power (emergency ventilation) for a minimum period of 60 min.
- (14) Special operating conditions must be set in school laboratories, which must be included in the Rules of Operation of the laboratory. As a minimum, they must include a ban on manipulation with HCSM and cylinders for students and individuals who have not been instructed in the use of HCSM and cylinders. Based on local conditions, the Rules of Operation must be prepared for each laboratory independently and they must include a specific description of activities in the school laboratory and the placement of cylinders, including a drawing indicating the place and manner of how the cylinders are fixed and the specification of the minimum width of the free space in front of the cylinders and free space between the cylinders and the door to the room. For research, scientific and experimental laboratories, the operator of activities must include these conditions in a reasonable extent as part of the research, development or experiment, always stating the expected conditions for the number, type and location of the cylinders.

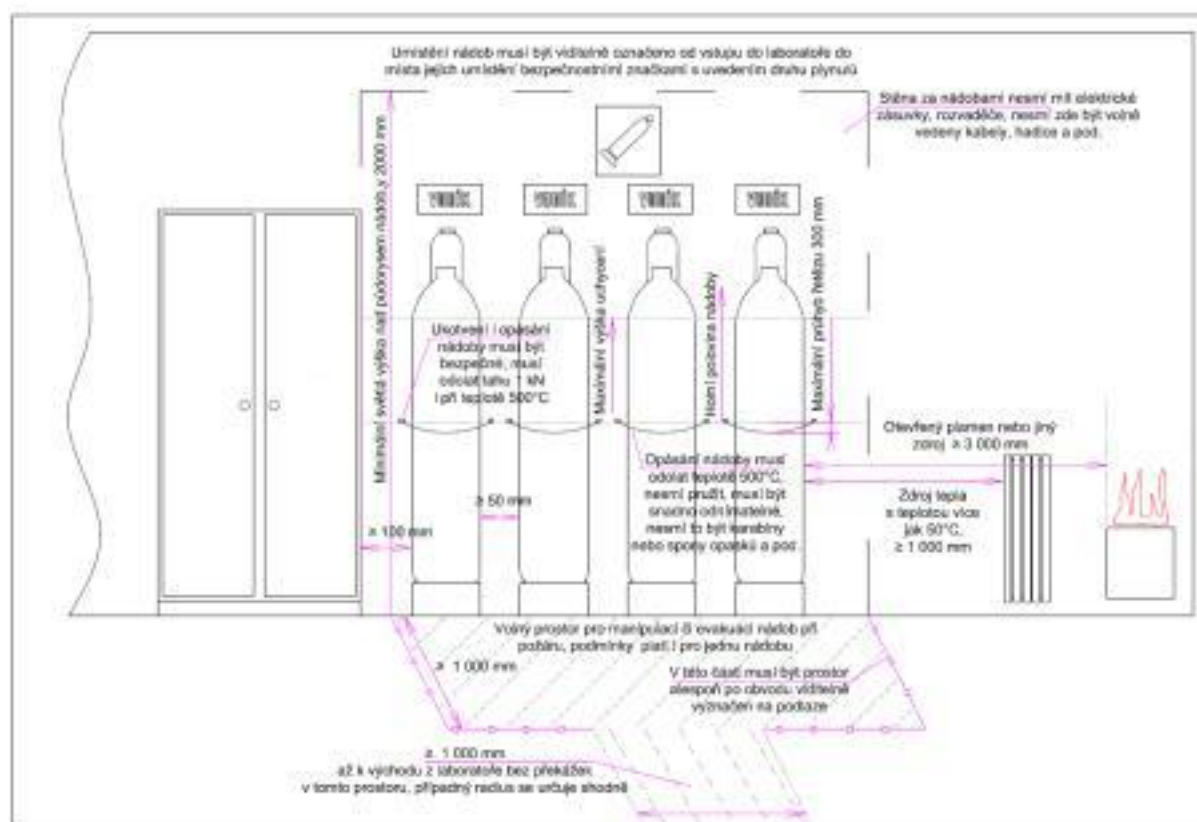


Figure No. 11: Conditions for placement of operational (spare) cylinders

- (15) A pressure station with non-toxic and non-corrosive gases in a one-storey building can be placed in a designated area. Such pressure station can house a maximum of 12 free standing cylinders (converted to cylinders with water volume of 50 litres) or cylinder bundles containing a maximum of 32 cylinders (converted to cylinders with water volume of 50 litres). A workplace

where flammable and combustion supporting gases are located in an amount greater than the amount specified in the above paragraph must be equipped with equipment for the detection of flammable gases which will trigger optical and acoustic signalization when 10% LEL is reached. When 20% LEL is reached, all activities must cease and the working area must be evacuated, while all necessary measures must be taken to prevent an unsafe state in accordance with the operational regulation.

(16) The number of cylinders in a building or its part shall not be stipulated provided the following conditions are met:

- a) the laboratory and the adjacent area must be equipped with equipment for the detection of flammable gases and vapours which must be configured so that it ensures the following:
 - when 10% LEL is reached, optical and acoustic signalization is activated,
 - when 20% LEL is reached, all activities must cease and all persons must leave the working area, while all necessary measures must be taken to prevent an unsafe state in accordance with the operational regulation,
 - when 50% LEL is reached, fire alarm is activated.

the fire alarm must be activated automatically. If a system of electrical fire signalization is installed in the fire-fighting zone where the school laboratory is located, the equipment for the detection of flammable gases and vapours must be controlled by it. In a fire safety solution or in another similar document, the adjacent areas must be identified in accordance with the specific conditions where the fire alarm will be activated (sectional alarm, general alarm). If no system of fire signalization is installed in the fire-fighting zone of the school laboratory, the manner of raising the alarm under the same technical conditions as in case of the system of electrical fire signalization (automatic triggering of the fire alarm, audibility, ensured function in case of power outage and other necessary connections) must be set out in a fire safety solution or in another similar document. The necessary, specified area in the building where cylinders are placed will be set out by the person who prepares the fire safety solution – an authorized person in the field of in fire safety of buildings, or a competent person in the field of in fire safety defined in the Local Rules of Operation, prepared together by the operator in accordance with CSN 38 6405.

- c) the equipment for the detection of flammable gases and vapours must be able to detect all gases that can occur in a school laboratory.

Article 11

Ban on pressure cylinders storage

(1) It is banned to store operational and spare cylinders in places that can pose a safety risk, such as:

- in flats,
- in cellars and basement areas,
- in passages and thoroughfares or in their immediate vicinity,
- in lofts,
- in escape routes and stairways,
- in garages,
- in offices, cloakrooms, kitchens, canteens,
- in bathrooms,
- in boiler rooms,

- in air shafts,
 - in unventilated spaces and spaces that are difficult to access,
 - in closed unventilated spaces (e.g. in a cupboard or in a box) unless conditions for ventilation are met,
 - in publicly accessible areas.
- (2) Pressure cylinders that contain toxic gases must not be stored in the central warehouse for pressure cylinders, nor in any other area in the school. Only the so-called operational pressure cylinders that contain toxic gases that are used for research, exams, etc., can be present on the school premises. If, for any reason, a pressure cylinder with a toxic gas is no longer used, it must be taken away by a specialized company without delay.

HANDLING OF PRESSURE CYLINDERS

Article 12

Handling of gas cylinders

- (1) Workplaces where gas cylinders are present must be kept clean and in order, in case of combustion supporting gases primarily with regard to fatty and organic substances.
- (2) Cylinders must be checked before they are used. If a defect is detected in a cylinder, it must be returned to the central warehouse and the defect must be specified. It is prohibited to repair or modify cylinders.
- (3) It is prohibited to use pressure cylinders whose regular inspection has expired.
- (4) Cylinders must be handled with outmost caution, in particular they must not be thrown or rolled on the casing.
- (5) Gas cylinders can only be handled when they have protective caps fitted on them.
- (6) Spare and empty cylinders fitted with removable protective caps must have the protective cap fitted on them.
- (7) Protective caps must not be used for purposes other than the intended purpose, i.e. to close the valve cover. The caps must be properly tightened.
- (8) When handling cylinders and placing them at a workplace, a space must be reserved for easy and fast escape. Fire extinguishers, fire hydrants and other fire safety equipment must not be blocked by cylinders and palettes.
- (9) Gas cylinders must be placed at a workplace so that in case an emergency incident occurs (e.g. a fire) a fast access to them is ensured at all times and they can be disconnected and evacuated from the space at risk to a safe place.
- (10) Empty cylinders must be stored under the same conditions as cylinders with gas.
- (11) Emptied cylinders must have a residual pressure of at least 0.5 bar (0.005 MPa).
- (12) Surface temperature of cylinders must not exceed the critical temperature in liquefied gases and 50 °C in other gases. For liquefied petrol gases, the temperature is 40 °C. If this temperature is exceeded, the cylinders must be cooled down in an appropriate manner.
- (13) Keys or other tools are prohibited to use to close cylinder valves.
- (14) It is prohibited to drain the cylinders at the workplace.
- (15) A suitable detector or a bubble solution for the detection of leaking gases must be available at the workplace.

- (16) When transferring gases from one cylinder to another cylinder, the same provisions as when filling cylinders must be observed.
- (17) Emptying of bottles must not be sped up by immediate heating with an open flame.
- (18) After the cylinder has been delivered to the workplace, acetylene can only be collected from the cylinders after at least one hour has elapsed. This does not apply if the cylinders are delivered in a vertical position and are not laid down before use.
- (19) When acetylene is taken from a cylinder, the cylinder must either be positioned vertically, or it must be tipped at an angle of at least 30 degrees to horizontal plain, the valve facing upwards, so that acetone is not taken with the gas.
- (20) Acetylene must be taken from the cylinder evenly so that the volume does not exceed 1000 litres per hour. If the hourly consumption is greater, more cylinders must be used. The working pressure of 1.5 bar must not be exceeded behind the pressure regulator.
- (21) Depending on the type of work and the nature of the gas, workers who empty, store and transport vessels must be equipped with personal protective equipment.
- (22) Before any work for which gas from an operational cylinder will be used starts, ventilation in the room must be ensured and the stipulated protective and fire extinguishing equipment must be prepared. Also the tightness of joints, tubing and equipment must be checked.
- (23) At least two people must be present when handling cylinders with toxic and corrosive gases. These individuals must be sufficiently competent and comply with health requirements.
- (24) At least two autonomous breathing apparatuses must be available at all times at a workplace where cylinders with toxic and corrosive gases are handled.
- (25) Workplaces where toxic gases are handled must be equipped with suitable detectors of the given toxic gases. The selection and placement of detectors must be carefully considered and the physical chemical properties of the given gas or mixture (e.g. density, hygroscopic and adsorption properties, ...) and natural/automatic air circulation in the room must be taken into account. Toxic gas and vapour detectors are dealt with in standard CSB EN IEC 62990-2 Workplace atmospheres – Part 2, Gas detectors: Selection, installation, use and maintenance for detectors for toxic gases and vapours.
- (26) Work with toxic gases must be carried out in a hood or in accordance with safety regulations provided in operational documentation of the given equipment.
- (27) Tubing and pressure hoses must be:
 - a) properly fixed so that they cannot get caught on something or damaged,
 - b) labelled with a description or colour coding according to the type of gas,
 - c) fitted with an accessible and possibly easily visible cap so that in case of a gas leakage, the gas flow can be safely closed by the people present or by fire fighters in action,
 - d) fitted with safety elements if these are required by the regulations.
- (28) When working with and handling cylinders, their accessories, hoses and tubing, it is prohibited to:
 - a) use cylinders that are damaged or that have a defect,
 - b) hit the cylinders or strain them mechanically,
 - c) use tools or other mechanical means or brute force to open the valves,
 - d) change, modify or cover the colour coding on a vessel or hose or tube connected to the vessel,
 - e) connect pressure regulators or other equipment that is not intended or approved for the given vessel.
 - f) carry out any replacement installations or modifications of the vessel, hose or tubing connected to the vessel,
 - g) drain gas unless it is part of the working procedure,
 - h) speed up the draining of gas from LPG cylinders in any way,

- i) technical gas tubing, for which regular inspections are set (1x in 3 years) must not be used without valid inspections,
- j) it is only possible to speed up gas draining from cylinders using a water bath or hot air provided the following temperatures are not exceeded:
 - methyl chloride 25°C
 - carbon dioxide 30°C
 - chlorine 35°C
 - other gases 40°C.
- k) For Dewar cylinders in laboratories that are placed together with cylinders the requirements set out in CSN EN ISO 21029-2 must be obeyed. The local Rules of Operation must take into account both the requirements for storage of cylinders and Dewar cylinders, primarily in relation to conditions for ensuring access and potential incidents.

Article 13

Transportation of pressure cylinders

- (1) The transportation of cylinders by road is regulated by the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR).
- (2) When cylinders are transported, any contact with corrosive substances must be prevented.
- (3) Oxygen must not be transported together with fatty substances (e.g. lubricants, fats, etc.).
- (4) Cylinders must not be transported together with flammable liquids, explosive substances or objects filled with explosive substances.
- (5) When transporting cylinders with lifting machines (cranes, etc.), respective regulations must be observed. Individual cylinders can be lifted using the cap or the protective equipment only provided they are equipped with an open protective cap or protective equipment constructed and tested for such purposes.
- (6) Transport of cylinders by cargo elevators is allowed only provided the relevant safety measures are observed. Cylinders must be secured to prevent tipping or uncontrolled movement.
- (7) Electric forklifts can be used for handling and transportation of cylinders. When using electric forklifts for transportation of gas cylinders, CSN 26 8805 and connected regulations shall apply.
- (8) Pressure cylinders transported using a handcart must always be secured against falling, for example with a chain. It is prohibited to use a staircase with the cart and a cargo elevator must be used preferentially. Cylinders weighing more than 50 kg must be carried by at least 2 people (men only) who are physically fit for such work. PPE (personal protective equipment) must be used when transporting cylinders, primarily safety footwear (sandals, flip-flops etc. are prohibited).

PRESSURE CYLINDERS WITH PRESSURE REGULATORS

Article 14

Fitted pressure regulators

- (1) A pressure regulator is a precision device which regulates the pressure of the gas taken from the pressure cylinder to the level required by the subsequent technology. There are two basic types of pressure regulators:

- a) Single-stage pressure regulators (see Figure No. 12),
 - b) Double-stage pressure regulators (see Figure No. 13).
- (2) Figure No. 14 shows a pressure regulator with the description of its parts and Figure No. 15 shows a wall-mounting plate.



Figure No. 12: Single-stage pressure regulator



Figure No. 13: Double-stage pressure regulator



Figure No. 14: Description of a pressure regulator (Czech Association for Technical Gases)



Figure No. 15: Pressure regulator on a wall-mounting plate

Article 15

Rules for the use of pressure regulators

- (1) Gases can be released from cylinders to tubing and/or stable vessels and equipment designed for power pressure using a pressure regulator designed and labelled for the given gas and set at the required outlet pressure.
- (2) The low-pressure part of the pressure regulator must have a manometer and a safety device fitted on it.
- (3) A manometer is not required in a pressure reducing valve in case the pressure reducing valve is part of a pressure station and a manometer is installed on the pipes in the pressure station. In a pressure station, also the high-pressure part must be fitted with a manometer.
- (4) The safety device in a pressure regulator is not required in case the tubing or the stable vessel, to which gases are released, are fitted with own safety device.
- (5) In case the cylinder valve in cylinders for flammable gases, combustion supporting gases or toxic gases displays signs of untightness and this cannot be prevented by closing the cylinder valve (the valve is damaged), a closing nut with a washer or a device that will close the outlet of the cylinder gas-tight, such as a close pressure regulator, must be fitted to the cylinder valve connector. Subsequently, the cylinder is put in a free, ventilated area, where it is secured against manipulation by unauthorized individuals and against falling over.
- (6) In case of a defect in the gas cylinder (e.g. a defect in the valve), provided safety is not compromised in transport, the cylinder must be returned to the supplier, stating the type of defect. If it is not possible to transport the cylinder directly to the filling facility of the supplier for safety reasons, the consumer will ask the supplier to send a specialist who will take the necessary measures.

Article 16

Safe procedure for replacement of pressure cylinders and the start of the gas consumption

- (1) Check if the gas in the cylinder and overpressure are compatible with the pressure regulator or the instrumentation with the function of the pressure regulator, if the right hose connectors are available and if the cylinder is in a position as recommended by the supplier.
- (2) Remove the cylinder cap to gain access to the cylinder valve with a screw connector. In case of toxic gases, unscrew the lock nut.
- (3) Before connecting the cylinder, check the functionality and intactness of the gaskets in the union nut of the pressure regulator or the instrumentation with the function of the pressure regulator. If stated so by the manufacturer, the gaskets must be replaced every time the pressure regulator is replaced.
- (4) Check the cleanliness of the bottle valve and the union nut of the pressure regulator or the instrumentation with the function of a pressure regulator. In case of gases supporting combustion (e.g. oxygen), pay special attention to the presence of oils and organic substances.
- (5) Check that all lock segments in the pressure regulator or the instrumentation with the function of a pressure regulator are closed – whether the disconnected manometer shows the value “0”, then screw it onto the cylinder valve. Do not use any tools or technical devices to insert the screw thread.
- (6) To tighten the union nut to the pressure regulator or the instrumentation with the function of a pressure regulator to the cylinder valve, use a spanner of the right size and intended for this purpose.
- (7) Then slowly open the cylinder valve spindle towards the upper position. In case the cylinder valve spindle cannot be opened by hand because it has been fastened too tightly or the valve has a defect, mark the cylinder as defective and return it to the supplier. If it is not possible to transport the cylinder directly to the filling facility of the supplier for safety reasons, the consumer will ask the supplier to send a specialist who will take the necessary measures. Do not use any tools or preparations to open the cylinder valve.
- (8) Any gas leaks from the connectors to the tubing must be prevented.
- (9) Use a bubble solution to check any possible leaks in the tubing.
- (10) If the bubble solution check indicates a leak in the compression fitting, it needs to be tightened. If the leak is not removed, the fitting needs to be replaced (the same type needs to be used). Extension of gas tubing must be made of the same material and the same compression fittings. Welding or soldering of the tubing can be performed only by a qualified person. If the manometers on the pressure regulator and at the delivery point differ by more than 5%, they need to be replaced.
- (11) When working with a pressure regulator or the instrumentation with the function of a pressure regulator in order to collect gas, follow the manufacturer’s instruction manual for the given equipment.
- (12) In case of clearly labelled non-flammable and non-toxic gases, it is possible to open the outlet valve shortly before using the gas and let part of the gas escape into the air.
- (13) The pressure indicator of the manometer should rise, depending on the type of the gas, to 100–200 bar (10–20MPa). Check repeatedly that the maximum operation pressure on the manometer (marked red) is not exceeded.
- (14) After using the cylinder and the tube, close the valve tightly. In case of flammable, toxic and corrosive gases (with the exception of acetylene and hydrogen), secure the valve connector with a lock nut with a washer.
- (15) Empty cylinders must have a residual pressure of at least 0.5 bar.
- (16) Empty cylinders are to be returned to the central warehouse. Pressure cylinders that are not in use must have a protective cap covering the valve.

- (17) Before and after using chlorine from a cylinder, take measures to prevent moisture from entering the tubing.

Article 17

End of gas consumption from a pressure cylinder with a valve

- (1) End of use of gas consumption from a cylinder is regulated by the instruction manual of the manufacturer of the pressure regulator or the instrumentation with the function of a pressure regulator.
- (2) Slowly close the cylinder valve spindle towards the lower position.
- (3) Depressurize the high-pressure part of the connected pressure regulator or the instrumentation with the function of a pressure regulator in accordance with the manufacturer's instruction manual.
- (4) Using a spanner of the right size and intended for this purpose, untighten the union nut of the pressure regulator or the instrumentation with the function of a pressure regulator on the cylinder valve.
- (5) Unscrew the pressure regulator or the instrumentation with the function of a pressure regulator from the cylinder valve.
- (6) To disconnect the pressure regulator or the instrumentation with the function of a pressure regulator in case of flammable, toxic and corrosive gases (with the exception of acetylene and hydrogen), secure the valve connector with a lock nut with a washer.
- (7) Cover the protective cap with the cylinder valve.

PROCEDURE IN CASE OF FIRE AT A WORKPLACE WITH PRESSURE CYLINDERS

Article 18

- (1) If the gas is on fire at the opening of the cylinder valve or because of untightness of equipment (tubing, instrumentation, etc.), the fire must be put out by closing the cylinder valve. If this fails, all flammable materials must be removed from the area and you must proceed in accordance with the fire protection documentation of the given workplace (the Fire Alarm Directive, the Fire Emergency Evacuation Plan, etc.).
- (2) All cylinders must be removed from the workplace that is threatened by fire or where fire has broken out to ensure that they will not be heated or heat strained. If this is no longer possible, the cylinders must be cooled down with water from a sheltered place. A sheltered place is, for example, a walled structure, a technical obstacle, etc., which reduces the risk of putting the health and lives of responders at risk. This activity is regulated by the fire protection documentation of the given workplace.
- (3) In case the flame travels back to the cylinder in an acetylene cylinder that consequently heats up (the acetylene inside the cylinder decomposes), the cylinder must be cooled down with water from a sheltered place. Warning – the cylinder does not have to be heated up along the whole length, and a local heating effect may occur. It is advisable to place the acetylene cylinder in which acetylene decomposes in a container with water, where it will be cooled down for a longer period of time. At the same time, the fire protection documentation of the given workplace must be observed.
- (4) After the arrival of the fire fighter unit, the commander of the unit must be informed about the location, number and type of cylinders in the building immediately before the fire broke out, and about the state they are in.

- (5) Cylinders that came into contact with fire must be labelled and returned to the filling facility of the supplier. If it is not possible to transport the cylinder directly to the filling facility of the supplier for safety reasons, the consumer will ask the supplier to send a specialist who will take the necessary measures.

RESPONSIBLE PERSONNEL AND THEIR COMPETENCE

Article 19

Competence criteria

- (1) Only individuals older than 18 who are mentally and physically fit for the task can manipulate with pressure cylinders and their accessories.
- (2) Each person manipulating with a pressure cylinder must be acquainted with the safety data sheet of the transported gaseous substance.
- (3) A person manipulating with pressure cylinders must be provably instructed, trained and examined in the scope of Article 12.6 CSN 07 8304 before they start manipulating with pressure cylinders and then again every 3 years.

Article 20

Responsible personnel at UCT Prague

- (1) Only responsible personnel can manipulate with gas pressure cylinders in an authorized manner who have been authorized to do so in writing in accordance with the safety regulations in place and who have been provably trained in manipulation with gas pressure cylinders. An authorized manner of manipulation includes primarily transport/transfer of pressure cylinders and their secure fastening, connection/disconnection of the pressure cylinder to/from tubing and assembly/dismantling of the pressure regulator.
- (2) Other individuals can manipulate with gas pressure cylinders only to a limited extent, i.e. they can open or close the main valve of the pressure cylinder.
- (3) Students in Bachelor's, Master's and PhD study programmes can manipulate with gas pressure cylinders only when supervised by a responsible employee of UCT Prague.
- (4) An authorization form template for employees pursuant to Para 1 of this Article is provided in Appendix No. 1 to this Directive. The authorization is done in three copies, one for the responsible employee, one to be stored with the head of department where the responsible employee works, or where pressure cylinders are manipulated with, and one to be stored with the head of the Department of Safety at Work (972).
- (5) Authorizations issued before this Directive came into effect continue to be valid until they are replaced by new authorizations or until legitimate reasons arise for them to become invalid (e.g., expired training, termination of an employee's employment contract, etc.).
- (6) A written record of the training of a responsible employee and their examination must be made, which will be stored with the head of department with whom also one copy of the authorization of the responsible employee is stored (see Para 4, Article 20 of this Directive). A copy of the written record will be registered at the Department of Safety at Work.
- (7) The training of responsible personnel is organized by the Department of Safety at Work. The training is valid for 3 years and it can be given only by a certified inspector of pressure cylinders for transportation of gas designated by UCT Prague.

- (8) Heads of departments are obligated to appoint and authorize in writing a sufficient number of responsible employees, at least 2.
- (9) In case of termination of an employment contract of the responsible employee, or revocation of authorization, the head of department is obligated to appoint and authorize in writing another responsible employee in good time. The training of the newly appointed responsible employee will be organized by the Department of Safety at Work.
- (10) The head of department is obligated to appoint and authorize in writing an employee responsible for safe handling, manipulation and storage of gas pressure cylinders.
- (11) The registry of responsible employees, indicating their workplace, validity of their authorization and training is kept by the head of departments of the relevant departments. The central registry of responsible employees is kept by the Department of Safety at Work.

FINAL PROVISIONS

Article 21

- (1) The Department of Safety at Work is responsible for supervision of compliance with obligations set out in this Directive, their interpretation and updates.
- (2) Appendix No. 1, which includes the “Authorization” template, is an inseparable part of this Directive.

In Prague, on 22 December 2022

Prof. Dr. RNDr. Pavel Matějka, m.p.
Rector

Appendix No. 1.

AUTHORIZATION

The University of Chemistry and Technology, Prague, registered address Prague 6, Technická 5, post code 166 28, company ID 60461373, as the employer, authorizes in accordance with Government Regulation No. 119/2016 Coll., Government Regulation No. 219/2016 Coll., Government Regulation No. 192/2022 Coll. and CSN EN 12257 and CSN 07 8304 (including supplements) employee:

Employee:	
Personal number:	
Workplace:	

as **employee responsible for secure handling, manipulation and storage of gas pressure cylinders** for an **indefinite period of time**, but not beyond the period of the employee's employment contract, unless the employee and employer agree otherwise.

An essential condition for the validity of this authorization is the completion of valid training in accordance with this Directive.

This document was done in three copies, one for the employee and two to be stored with the employer.

The authorization comes into effect on the day of the signature.

The head of department authorizes:

Academic title, first name, last name	Date, signature

The employee accepts the authorization:

Academic title, first name, last name	Date, signature