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Gas cylinders — Operational procedures for the safe removal of valves from gas cylinders

Bouteilles à gaz — Modes opératoires de dépose en toute sécurité des robinets de bouteilles à gaz

Reference number
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Foreword

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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ISO 25760 was prepared by Technical Committee ISO/TC 58, *Gas cylinders*, Subcommittee SC 4, *Operational requirements for gas cylinders* and is based on EIGA Document 129/05 *Pressure receptacles with blocked or inoperable valves*. EIGA has granted permission to reproduce excerpts from their document.

Introduction

Cylinders are devalved for many purposes, such as periodic inspection and testing, cylinder cleaning, change of service, replacement of a damaged valve, installation of a new valve, preparation for filling or scrapping.

Occasionally, gas cylinder valves can become blocked by corrosion or foreign material or become inoperable due to external or internal damage. It is an essential safety requirement that such valved cylinders be identified and treated with special care as soon as practicable. The operation of removing a valve should only be carried out if the cylinder is made safe with respect to residual gas and pressure. It is recommended that gas suppliers be prepared with both the proper equipment and trained operators for dealing with such valved cylinders. Practical techniques that have been tried and tested over many years within the gas industry are described.

Valve removal activities can pose hazards to the life and physical safety of the operator, especially if the cylinder is under pressure.

Valves should only be removed after ensuring there is no residual pressure in the cylinder.

Gas cylinders — Operational procedures for the safe removal of valves from gas cylinders

1 Scope

This International Standard is intended for suppliers, operators in testing facilities, operators performing cylinder maintenance and any person authorized to remove valves from gas cylinders. It details procedures for the safe removal of valves from cylinders and includes techniques for the identification of inoperable valves.

Only the risks due to gas and gas mixtures under pressure are addressed; other technical issues relating to the removal of a valve from a cylinder are not covered.

Some specialized equipment and procedures are in use in parts of the gas industry to safely remove cylinder valves from low pressure gas cylinders while under pressure, e.g. liquefied petroleum gas (LPG); these techniques are not included in this International Standard.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 11114-1, *Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 1: Metallic materials*

ISO 11114-2, *Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 2: Non-metallic materials*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply:

3.1
gas cylinder
pressure receptacle including individual cylinder, tube, pressure drum or manifold combination of these

3.2
valve
device that allows gas to enter or exit a gas cylinder and retains the pressure in the cylinder when in the closed position

NOTE This also includes the fittings of cylinders in bundles and battery vehicles.

3.3
inoperable valve
valve that is blocked, broken or malfunctioning or that in any way prevents gas from entering or exiting the gas cylinder

NOTE See Annex A.

3.4
operable valve
device that allows gas to enter or exit a gas cylinder

3.5
residual pressure valve
RPV
type of valve that prevents the gas cylinder from being totally depressurized by holding back a specific amount of residual pressure

NOTE 1 Requirements for this type of valve are specified in ISO 15996.

NOTE 2 This valve type is very often associated with a non-return function.

3.6
valve with integrated pressure regulator
VIPR
device intended to be permanently fitted to a gas cylinder connection and comprising a shut-off valve system and pressure reduction system

NOTE 1 Adapted from ISO 22435:2007, definition 3.3.

NOTE 2 Requirements for this type of valve are specified in ISO 15996.

3.7
pressure relief device
PRD
device that is fitted to the cylinder or cylinder valve and designed to relieve gas pressure in the event of abnormal conditions resulting in the development of excessive pressure inside the cylinder or when the cylinder is subjected to high temperatures

NOTE 1 This might be a pressure relief valve, a non-reclosing PRD or a non-reclosing PRD in combination with a pressure relief valve.

NOTE 2 The expression "pressure relief" is synonymous with "safety relief", as used in various applicable regulations, codes, standards or specifications.

3.8
quick connect valve
clip-on valve
valve that does not contain an operating device, such as a handwheel

3.9
low pressure gas cylinder
gas cylinder with test pressures no higher than 60 bar[1)]

3.10
compressed gas
gas which, when packaged under pressure for transport, is entirely gaseous at all temperatures above – 50 °C

NOTE This category includes all gases with a critical temperature less than or equal to – 50 °C.

1) 1 bar = 100 kPa (exactly)

4 General requirements

4.1 Application

This clause gives general information to be considered. Clause 5 gives a choice of methods for inoperable valves. Procedures to be followed are given in Clause 6.

4.2 Hazards

Especially if the cylinder is under pressure, valve removal methods pose certain hazards to the operator, such as:

— stored energy from residual pressure (particularly important if the cylinder is not in a vertical position);

— residual gas hazards, including

  — fire resulting from flammable gas ignitions

  NOTE Oxidizing gases in the presence of contamination can also cause severe ignition.

  — asphyxiation,

  — oxidation,

  — toxicity/corrosivity,

  — projection of pieces under pressure,

  — cold burns due to vaporization of liquefied gases; and

— operating devalving machinery and equipment, such as pinch points, rotation and powered machines.

4.3 Operator safety and protection

When an operator is removing a blocked or inoperable valve, other individuals should be on site and able to respond in case of an emergency.

A risk assessment shall be performed in order to avoid the exposure of the operator and other persons who could be affected by hazards. The minimum hazards to take into account for this risk analysis are listed in 4.2.

After the risk assessment is completed, risks shall be eliminated or minimized as far as reasonably practicable by engineering or process changes, such as shields or bunkers. The required or appropriate personnel protective equipment shall be chosen.

4.4 Operator qualifications

4.4.1 General

All operators shall have

— appropriate training,

— understanding of the cylinder content, when known, and the precautions which might be necessary to prevent the release or exposure to the gas (see 4.2, 4.3 and 5.2), and

— good practical understanding of the cylinder valve and the method of fitment to the cylinder.

4.4.2 Specific process qualifications

Due to additional hazards that are present, operators shall receive specific training for the processes outlined in this International Standard.

Such processes can include

- the pressure check,
- the devalving process,
- the inoperable valve process.

Proper precautions shall be taken in the work area to protect operators from gas and particle discharges.

Appropriate personal protection equipment shall be worn, and emergency equipment shall be readily available.

Personal protection during devalving shall be adopted according to the hazards that may be present, such as those indicated in 4.2.

4.5 Operator errors

As a minimum, the following possibilities shall be considered in the context of operator errors.

- Incorrectly assuming that a cylinder has no pressure (e.g. placing valved cylinders that have been checked with valved cylinders that have not been checked).
- Incorrectly assuming that a cylinder has been checked for pressure (e.g. devalving more than one cylinder at the same time could lead to this error).
- Incorrectly assuming that a cylinder is empty of a liquefied gas, based upon the marked tare weight.
- Incorrectly assuming that a cylinder with a valve in the open position is no longer under pressure and proceeding to remove the valve.

  NOTE The primary risk in this situation is the possibility that the valve is broken or blocked, although the valve appears to be in the open position and the cylinder is still under pressure.

- Relying on a pressure gauge (the operator might incorrectly assume, due to a malfunctioning pressure gauge, that there is no or little pressure in the cylinder). Such malfunction can occur if gauges are
  - obstructed,
  - broken,
  - damaged,
  - out of calibration,
  - designed for only high pressure measurements, or
  - otherwise defective.

4.6 Special valve designs

4.6.1 Valves (e.g. RPV, VIPR) with residual pressure device

All valves with a residual pressure device have a particular risk that the residual pressure has not been discharged before devalving. It is for this reason that the residual pressure from cylinders equipped with such a device shall be safely discharged using the appropriate equipment. If the device is unknown or if the operator is unsure, obtain information from a knowledgeable source.

4.6.2 Quick connect valves (clip-on valve)

Cylinders equipped with such valves shall be safely discharged by using appropriate equipment to release the pressure before being devalved.

4.6.3 Other valves

Valves with a special operating mechanism, such as

— valves without handwheels,

— internal valves (inside the cylinder), and

— solenoid operated valves

need special handling.

5 Methods for inoperable valves

5.1 Summary of methods

There are several methods to release the pressure from a cylinder with an inoperable valve. Some methods are as follows.

— Careful loosening or removal of the cylinder valve or the PRD.

— Creation of an additional vent in the cylinder valve.

— Creation of an additional vent in the cylinder wall.

— Dismantling of the cylinder valve.

Examples of methods for depressurizing gas cylinders with inoperable valves are given in Annex B.

Application of the preceding methods results in one of two modes of cylinder depressurization:

a) where the gas is directly released to atmosphere. This mode is recommended for inert gases permitted for release to the atmosphere by relevant environmental regulations, or

b) where the gas is not directly released to the atmosphere, but transferred from the original gas cylinder into a secondary gas containment area until disposed (see Figure B.2). This mode is recommended particularly for gases that pose a human and/or environmental hazard (such as toxic, corrosive, flammable or pyrophoric gases) as regulated by the relevant authority.

5.2 Choice of method

An appropriate method for handling pressurized gas cylinders with inoperable valves shall be chosen according to the hazard presented by the gas and the highest possible stored energy (pressure) in the cylinder.

When mode 5.1 a) is used, the work shall be carried out in a well-ventilated area or under a fume hood/inside a fume cabinet.

Mode 5.1 b) is used for gases such as toxic, corrosive, flammable or pyrophoric gases and also in cases of unknown gas content.

6 Procedures

6.1 Procedures to identify and segregate cylinders with inoperable valves

A valved cylinder shall only be devalved using a procedure described as follows:

Immediately prior to devalving any cylinder, it is essential to strictly apply a method for checking if gas pressure still remains in the cylinder. The method adopted shall be one described as follows or one that provides equivalent safeguards (for special valve designs, see 4.6).

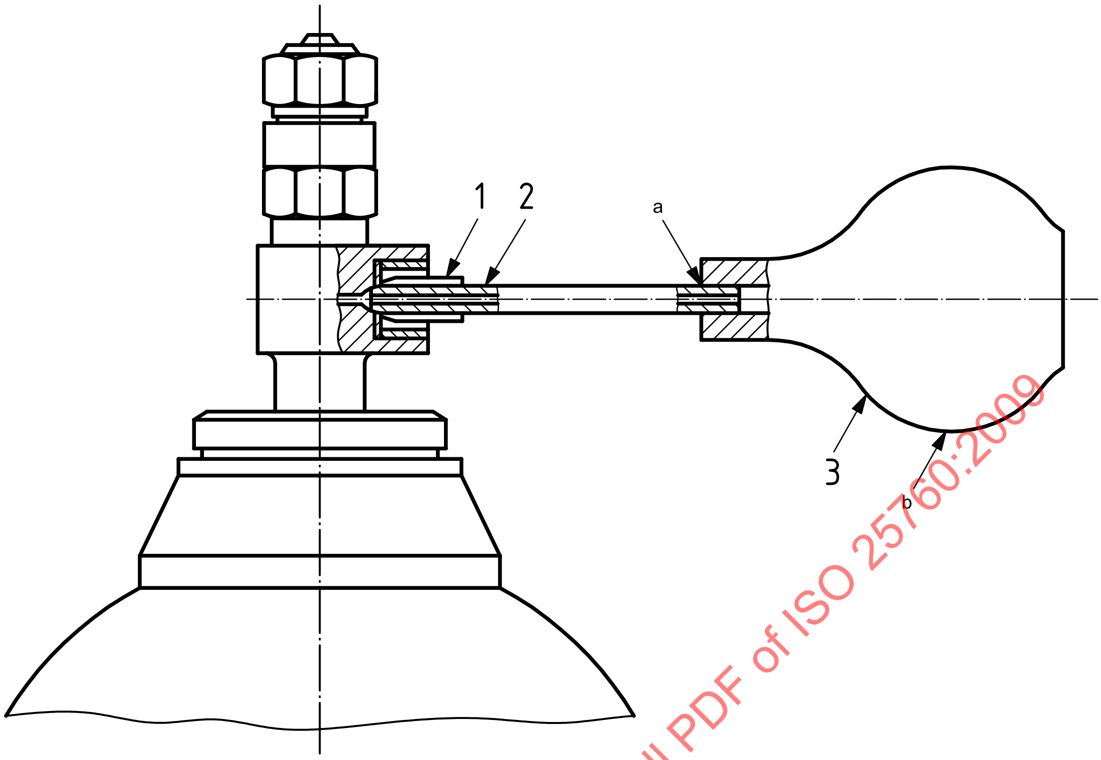
— Use a device (e.g. rubber bulb) to hand pump atmospheric air (if gas content is compatible with air) into the cylinder and verify whether or not the gas flows unhindered into the cylinder (see Figure 1).

— Introduce a gas (inert and non-reactive to the cylinder content from a pressure source of approximately 5 bar) through the valve outlet and verify whether or not the gas flows unhindered into the cylinder.

— Introduce a sufficient quantity of gas (inert and non-reactive to the cylinder content from a pressure source of approximately 5 bar) through the valve outlet in order to verify whether or not gas flow is heard or seen exiting the cylinder.

After performing one of the preceding methods, any failed attempt to put gas through an open valve indicates that the valve is inoperable. Any valve that is found to be inoperable by any of the above methods shall be closed, if it was opened for the test, until further processed. Such a valved cylinder shall be treated as specified in 6.3.

Where procedures exist to vent a compressed gas safely and completely through the cylinder valve, including the recognition of a positive gas flow, and then to immediately remove this valve by the same operator, the preceding three methods need not be performed (see also 4.6.3).



Key

1 flexible tube (internal diameter 8 mm, external diameter 13 mm) ground to olive shape and bonded

2 tube (internal diameter 3 mm, external diameter 8 mm)

3 flexible bulb

a Bonded.

b Hand pressure.

Figure 1 — Typical device for detecting an inoperable cylinder valve

6.2 Standard devalving procedure for treating cylinders with operable valves

6.2.1 Devalving procedure

Immediately after establishing that the cylinder is depressurized by having determined that the valve is operable, the devalving procedure may be started by using a devalving device in a safe manner (see 6.2.2). It can be necessary, for example in the case of toxic gas service, to purge the cylinder prior to the devalving procedure. If the valve is inoperable, see 6.3.

Any relevant valve removal recommendation from the cylinder/valve manufacturers shall be considered, where available.

A cylinder or valve can be damaged in this procedure. If this is the case, a determination shall be made whether the equipment can be repaired or be condemned. In any case, follow the relevant standards/regulations.

6.2.2 Devalving device

The devalving operation shall be performed with equipment and tools appropriate for the method and the contained gas, having considered potential operator errors (see 4.5). Attachment of equipment to the cylinder/valve shall be appropriate for the procedure and shall be safe for the operator.

6.3 Procedures for treating cylinders with inoperable valves

6.3.1 Facilities

Operations to depressurize cylinders with blocked or inoperable valves shall be carried out in a responsible manner to ensure that no hazardous conditions are created and that the environment is not harmed. Subsequent disposal of gases shall conform to requirements of the relevant authority (such as an environmental agency).

The area where this operation shall be performed shall be clearly designated. Affected employees of the facility shall be informed of the area, the type of operation and when work is being undertaken in this area. It is recommended that such an area be free of obstacles for an easy and quick exit. It should be possible for emergency personnel to easily access this area.

6.3.2 Equipment

Equipment shall be designed to withstand the maximum anticipated pressure and shall comply with relevant statutory requirements relating to gas cylinders.

The equipment shall also be compatible with the gas(es) with which it will be used, as specified in ISO 11114-1 and ISO 11114-2. In particular:

— For oxygen and other oxidizing gases (see ISO 10156-2), the equipment shall be constructed of compatible materials, free from flammable materials and clean for oxygen service.

  NOTE For certain very powerful oxidants such as fluorine, passivation of the equipment might be necessary.

— For flammable and pyrophoric gases, the gas-wetted parts of the equipment shall be purged with an inert gas and free from air and oxidants or shall be able to withstand a fire or explosion.

— For corrosive gases, the equipment shall be constructed from compatible materials and dried before use.

— Spark-resistant tools shall be used for acetylene.

6.3.3 Depressurization

Depressurization of gas cylinders with inoperable valves requires operators with specialized training and experience. Annex B gives some examples of methods for depressurization of gas cylinders with inoperable valves. A full risk assessment of the chosen depressurization procedure(s) addressing all the hazards given in 4.2 shall be performed before starting the depressurization.

7 Damaged valves and cylinders

Any inoperable valve or damaged cylinder that is not repaired or cannot be repaired shall not be allowed to re-enter gas service. Any repaired equipment shall still comply with its relevant standard (periodic inspections) and regulations.

Annex A
(informative)

Reasons cylinder valves become inoperable

A.1 Introduction

Cylinder valves can become either blocked or inoperable in the open or closed position. The reason is usually one of those given in A.2 to A.4.

A.2 Internal corrosion

Internal corrosion can prevent the operation of a valve when its operating mechanism is constructed from materials that are prone to corrosion by the environment or the gas. Many corrosive gases are hygroscopic, i.e. they absorb water from the atmosphere, and if gas users fail to purge valve outlets properly before and after use, highly corrosive conditions can occur inside the valve. If the valve operating mechanism is in contact with this corrosive material, seizure can occur.

A.3 Mechanical failure

Mechanical failure can directly result from internal corrosion as noted in A.2 (e.g. seizure of the valve operating mechanism followed by breakage due to attempts to overcome the seizure).

Mechanical failures can also occur as a result of material or construction faults, excessive wear in the valve's moving parts, impact damage and weaknesses in the valve design or because the operator has forced the valve closed by applying too much tightening torque. In some valve designs, the spindle can be operated without lifting the valve sealing device. Therefore, a full cylinder can appear empty, but the valve sealing device can suddenly lift and release gas.

A.4 Blockages

Blockage of a cylinder valve is usually due to one or more of the following materials entering the valve and compacting at the point where there is minimal cross section in the gas passage.

— Debris from inside the cylinder. Examples include polytetrafluoroethylene (PTFE) thread tape, shot and grit remaining from cylinder cleaning operations, and rust/corrosion or production/mill scale from cylinder walls.

— Debris compacted into the valve during filling. Examples include PTFE thread tape, grit and dirt, and purifier bed packings, such as alumina and molecular filter.

— Decomposition or other reaction products of the gas. Examples include:

  — ethylene oxide polymer;

  — metal and silicon oxides, which can result from their gaseous hydrides, e.g. phosphine and silane, coming into contact with air;

  — various reaction products, which can result if the user permits feedback of reactive materials into the cylinder or cylinder valve;

  - metal halides, which can result from reaction of halogens with the cylinder or valve material, for example ferrous and ferric chloride, which can be produced from the action of wet hydrogen chloride on steel.

- Valve seat material. Valves fitted with a soft seat can become blocked by extrusion of the soft valve seat into the gas passage.

- Valve outlet connection cap seal. This can cause a blockage to the valve outlet when the connection cap seal has been extruded into it;

- Restricted flow orifice. Restricted orifice screwed inside the valve outlet connection can be easily blocked because of the small diameter, typically 0,5 mm.

For valves with a residual pressure function and valves incorporating an integrated pressure regulator, specific procedures are required (see 4.6.1).

Annex B
(informative)

Examples of methods for depressurization of gas cylinders with inoperable valves

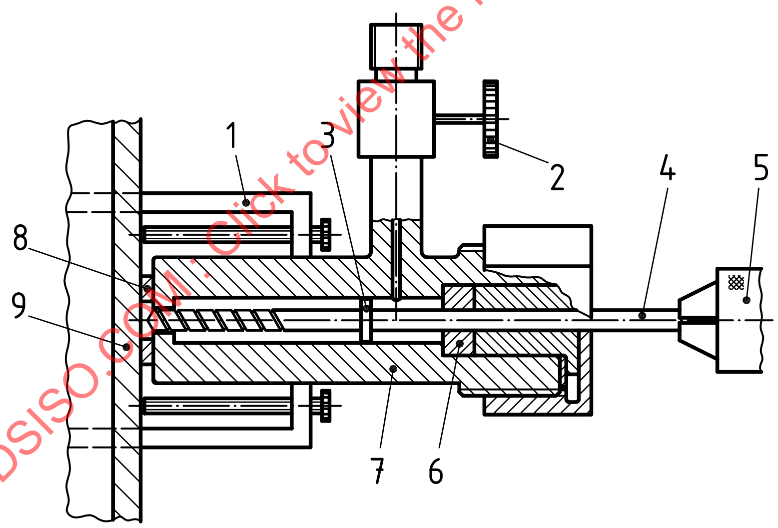
B.1 General

The methods described in this Annex are not intended to be detailed working procedures; rather, they are presented in a way to show variations of each case.

B.2 Methods

B.2.1 Release of gas by the creation of an additional vent in cylinder wall

An additional vent in the cylinder wall may be created to release gas by drilling into the cylinder wall where the drilling device forms a gas-tight seal to the cylinder wall via the use of a gasket (see Figure B.1).



Key

1 device to firmly clamp drilling adaptor to cylinder wall
2 auxiliary valve
3 retaining collar
4 drill
5 hand drill machine
6 gland packing and gland nut (around drill)
7 drilling adaptor
8 gasket
9 cylinder wall

Figure B.1 — Drilling into cylinder wall (under pressure)

B.2.2 Cylinder and valve enclosed inside coffin or jacket (that can hold the released pressure)

Procedure:

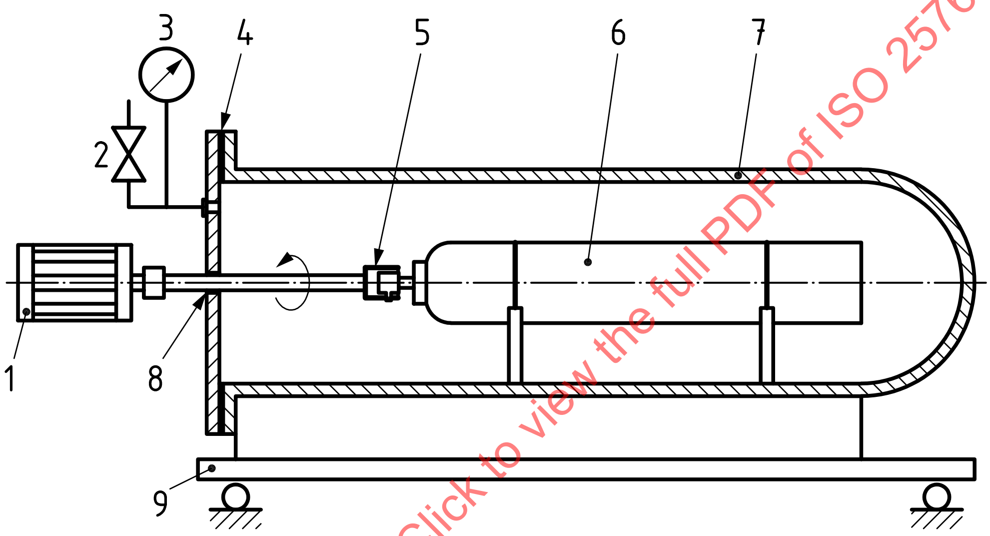
a) Secure the cylinder.

b) Fit the devalving head.

c) Seal the coffin or gas jacket, if required (see Figures B.2 and B.3).

d) Loosen the valve slowly by a manually operated or motor-driven tool.

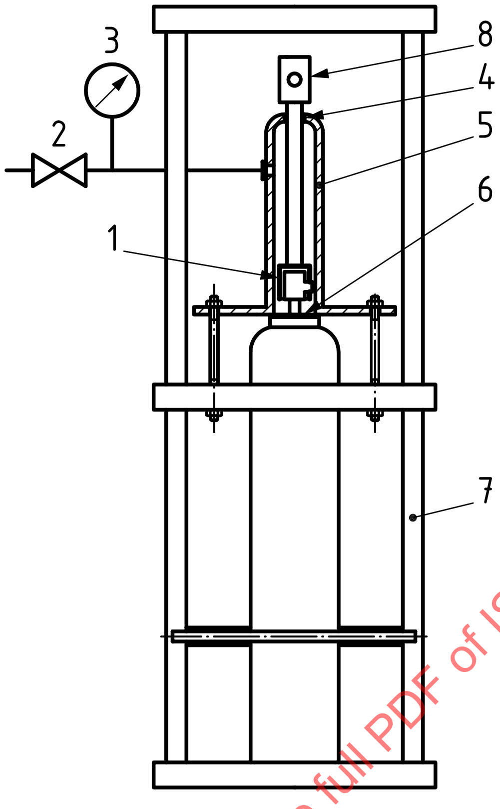
e) If possible, control gas release in a coffin or, if permissible, to the atmosphere.



Key

1 manually operated or motor-driven tool
2 auxiliary valve
3 pressure gauge
4 gasket
5 devalving head
6 cylinder
7 coffin
8 gas-tight gland
9 portable support

Figure B.2 — Cylinder and valve enclosed inside coffin or jacket (that can hold the released pressure)



Key

1 devalving head
2 auxiliary valve
3 pressure gauge
4 gas-tight gland
5 gas-tight cap
6 gasket
7 cylinder securing frame
8 manually operated (as shown) or motor-driven tool

Figure B.3 — Valve end of cylinder enclosed (that can hold the released pressure)

B.2.3 Release of gas by creation of an additional vent in the cylinder valve

If the stem passage of the valve is blocked, the following methods do not work. When following these methods, extra care shall be taken before devalving to establish that no residual pressure remains in the cylinder.

An additional vent in the cylinder valve may be created to release gas by:

a) Sawing into the valve stem (if the release of gas to atmosphere is permitted);

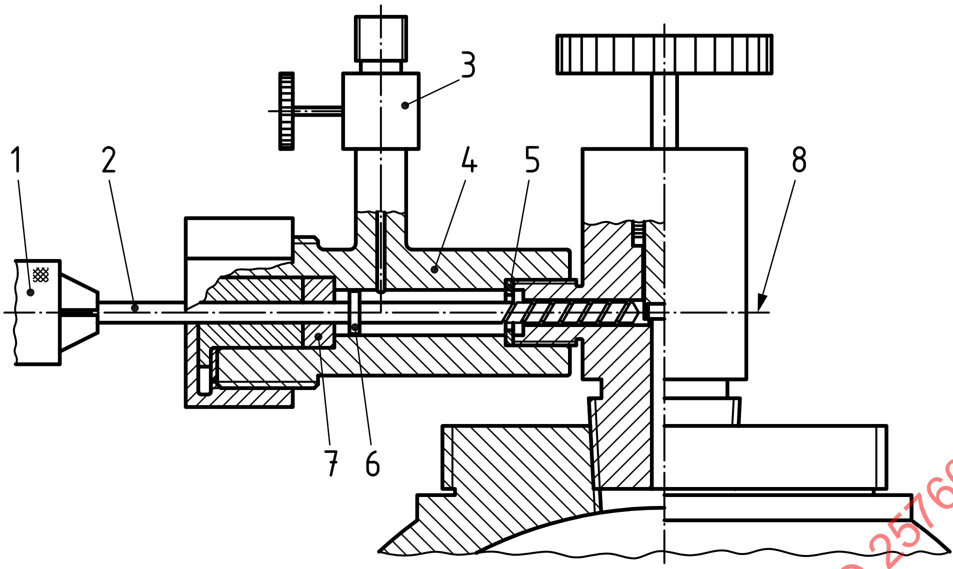
b) Drilling along the axis of the valve outlet (under pressure) (see Figure B.4);

c) Drilling into the valve body with the valve under a cylinder cap with a gas-tight seal, designed to the test pressure of the cylinder, which collects the released gases (see Figure B.5).

NOTE 1 This method is not suitable for gas cylinders with riveted or shrunk-on neckrings.

d) Drilling into the valve body where the drilling device is gas tightened and fixed via a gasket to the valve body (see Figure B.6).

NOTE 2 The procedures mentioned in c) and d) are not recommended for test pressures greater than 30 bar.



Key

1 hand drill machine
2 drill
3 auxiliary valve
4 drilling adaptor
5 gasket
6 retaining collar
7 gland packing and gland nut (around drill)
8 axis of the valve outlet

Figure B.4 — Drilling on axis of valve outlet (under pressure)