PRESSURE RECEPTACLES WITH BLOCKED OR INOPERABLE VALVES

Document 129/17

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Prepared by WG-4 Special Gases

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Amendments to Doc 129/11/Corr

Section	Change
7	Techniques that are not used anymore because safer alternatives are available have been considered obsolete and have been removed from the document. A new technique has been added in section 9.
8	
9	

Technical changes from the previous edition are underlined.

1 Introduction

Gas receptacle valves can become blocked by corrosion and foreign material, or made inoperable due to external or internal damage. When this happens, there is a tendency for receptacles to be put to one side and left for long periods of time. If left, such receptacles can become a potentially serious hazard. It is an essential safety requirement that such receptacles are dealt with without delay – the difficult operation of safely releasing the trapped residual gas shall be carried out, the receptacle emptied, purged and made safe. It is recommended that Gas Suppliers are prepared with both equipment and trained personnel for dealing with such receptacles.

All the quoted EIGA publications are downloadable at https://www.eiga.eu

2 Scope and purpose

2.1 Scope

This document gives recommendations on how to handle receptacles with non-operational valves for suppliers of industrial, medical and specialty gas receptacles.

2.2 Purpose

It sets out practical techniques which have been tried and tested over some years within the Gas Industry. It shall be used in conjunction with the latest revision of the EIGA Doc. 30 *Disposal of Gases*.

The techniques described should only be followed by those who already have appropriate equipment in place and a good working knowledge of gas receptacle maintenance and who are fully trained in handling a wide range of industrial and medical gases including specialty gases.

Before any intervention on a problem receptacle, a specific risk assessment shall be carried out and documented by a competent team taking into account the type of valve, material of the cylinder and valve, the content and any other characteristic of the receptacle that would influence the risks of the operation.

3 Definitions

3.1 Publications terminology

3.1.1 Shall

Indicates that the procedure is mandatory. It is used wherever the criterion for conformance to specific recommendations allows no deviation.

3.1.2 Should

Indicates that a procedure is recommended.

3.1.3 May

Indicates that the procedure is optional.

3.1.4 Will

Is used only to indicate the future, not a degree of requirement.

3.1.5 Can

Indicates a possibility or ability.

3.2 Technical definitions

3.2.1 Receptacles

In this document “receptacles” means “pressure receptacles” as defined by the UN Recommendations on the Transport of Dangerous Goods. Pressure receptacles comprise cylinders, pressure drums, tubes, cryogenic receptacles (up to 1000 litres) and bundles of cylinders.

3.2.2 Cylinder recovery vessel

Means a pressure vessel which is designed to safely contain a cylinder and its content for transportation and storage, until it can be safely emptied. A cylinder recovery vessel could be fitted with a gauge to indicate internal pressure and valves to enable purging. A cylinder recovery vessel is identified as a “salvage pressure receptacle” in the Regulations for the international transport of dangerous goods (UN Model regulations, ADR/RID, etc.).

4 Why receptacle valves become inoperable

Receptacle valves can become either blocked or inoperable in the open or closed position. The reasons are usually one of the following:

4.1 Internal corrosion

Internal corrosion may prevent the operation of the valve where the valve operating mechanism is constructed from materials that are prone to corrosion by the environment or the gas. Many corrosive gases are hygroscopic, i.e. 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.

4.2 Mechanical failure

This may be directly resulting from internal corrosion as per 4.1 above (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 receptacle can appear empty but the valve sealing device may suddenly lift and release gas.

4.3 Blockages

Blockage of a receptacle valve is normally 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:

4.3.1 Debris from inside the receptacle

Examples include: PTFE thread tape, shot and grit remaining from receptacle cleaning operations, rust/corrosion production/millscale from receptacle walls**.**

4.3.2 Debris compacted into the valve during filling

Examples include: Swarf, PTFE thread tape, grit and dirt, purifier bed packings such as alumina and molecular sieve**.**

4.3.3 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 that can result if the user permits feedback of reactive materials into the receptacle or receptacle valve,
- metal halides which can result from reaction of halogens with the receptacle or valve material, e.g. ferrous and ferric chloride can be produced from the action of wet hydrogen chloride on steel.

4.3.4 Valve seat material

Valves fitted with a soft seat may become blocked by extrusion of the soft valve seat into the gas passage.

4.3.5 Valve outlet connection cap seal

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

4.3.6 Restricted flow orifice

Restricted orifice screwed inside the valve outlet connection can be easily obstructed by particles or reaction products of the residual gas with air because of the small diameter, typically 0.5 mm.

5 Precautions when releasing gas from receptacles with blocked or inoperable valves

5.1 Personnel safety and training

Operations to depressurize receptacles with blocked or inoperable valves shall only be undertaken by trained and competent experienced technicians operating in accordance with the fundamental safe practices for handling gas receptacles.

Technicians who undertake this work shall also have:

- A formal training in the EIGA Doc. 30 *Disposal of Gases*.
- A good understanding of the properties of the receptacle content and the necessary precautions to be taken.
- A good practical understanding of the receptacle valve and the method of fitment to the receptacle.
- A practical knowledge of action to be taken in the event of an emergency situation developing.

A second person should be in the work area during all operations involving the depressurization of receptacles with blocked or inoperable valves.

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

Appropriate personal protective equipment (PPE) shall be worn and emergency equipment shall be readily available. The precise equipment shall be determined following a risk assessment.

5.2 Equipment

All equipment shall be designed to withstand the maximum anticipated pressure and shall comply with relevant statutory requirements relating to pressure vessels or systems.

The equipment shall also be compatible with the gas(es) with which it will be used:

- For oxygen (in excess of 23.5 volume percent) and for other oxidants (some of which have a higher oxidising potential than oxygen), the system shall be constructed of compatible materials free from combustible materials and cleaned in accordance with the EIGA Doc. 33 *Cleaning of equipment for oxygen service-Guideline*. For certain very powerful oxidants (such as fluorine) pre-passivation of the equipment may be necessary.

- For flammable and pyrophoric gases, the system shall be purged and free from air and oxidants.

- For flammable and pyrophoric gases, the dedicated work area shall comply with the requirements of the ATEX directive.

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

5.3 Facilities

Operations to depressurize receptacles with blocked or inoperable valves should be carried out in a responsible manner to ensure no hazardous conditions are created and that the environment is not harmed. Subsequent disposal of gases should be in accordance with the EIGA Doc. 30 *Disposal of Gases*:

- For flammable gases released to atmospheres, ignition sources should be excluded.

- For flammable gases contained in a system for subsequent disposal, the system shall be purged and free from air and other oxidants to avoid the build-up of explosive flammable gas/air or oxidant mixtures.

- For toxic gases, forced draft ventilation is preferred.

6 Introduction to depressurisation techniques.

6.1 Summary of techniques

There are three basic techniques for release of gas from receptacles with blocked or inoperable valves:

- Unconventional operation of the receptacle valve.

- Loosening or removal of the receptacle valve.

- Creation of an additional vent in the receptacle valve or receptacle body.

Application of the above techniques will result in one of two modes of receptacle depressurization:

- Where the gas remains contained until disposed of.

- Where the gas is released to atmosphere.

6.2 Choice of techniques

Examples are provided to illustrate the principles of the techniques.

Where practicable, methods which contain the gas (for subsequent disposal) should be chosen for flammable or toxic gases. Where it is necessary to use techniques which release such gases to atmosphere, the work should be carried out in a well-ventilated area or under a fume hood/inside a fume cabinet.

In the event of doubt, or the absence of identification of the receptacle content, the selected method shall make it possible to safely deal with all possible hazards that may arise, with operators anticipating the most hazardous.

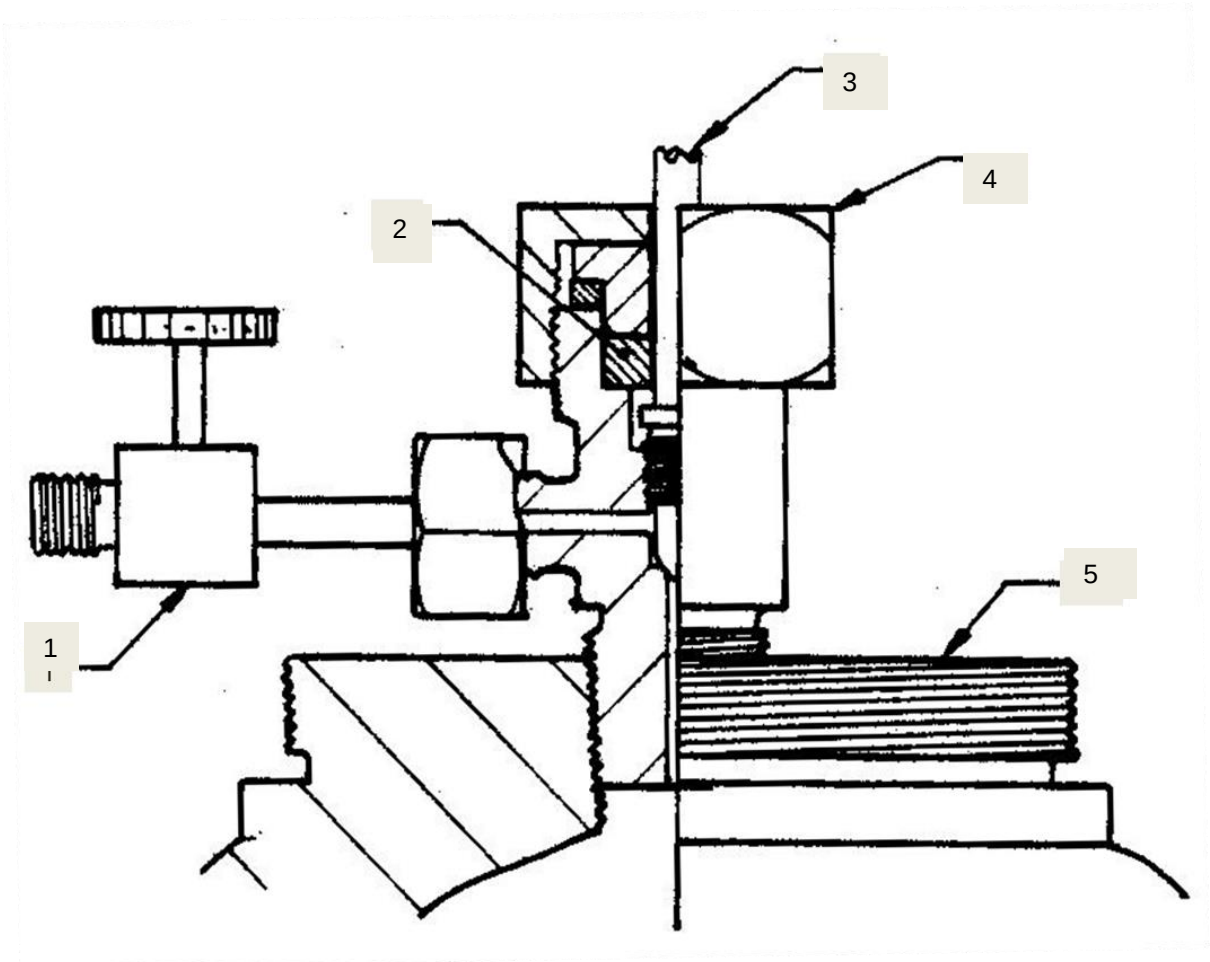
7 Release of gas by unconventional operation of the receptacle valve

7.1 Partial stripping of the valve to facilitate movement of a broken spindle

7.1.1 Application:

Gland packed valves fitted with a solid one-piece spindle where the spindle has sheared. This application is limited to valves where the gland nut is independent of the spindle thread.

7.1.2 Typical arrangement:



1 - Auxiliary valve
2 - Gland packing
3 - Broken valve spindle
4 - Gland nut
5 - Receptacle

Drawing 1: Partial stripping of the valve to facilitate movement of a broken spindle

7.1.3 Procedure:

- The receptacle is secured to prevent it falling over.

- Removal of the gland nut and packing will often reveal a sufficient part of the spindle to enable a wrench to be fitted. Penetrating oil can be sparingly applied (except in the case of oxygen and oxidants) and left to penetrate around the spindle operating threads. The auxiliary valve is fitted to the receptacle valve outlet and opened.

- The broken valve spindle is then gripped with a suitable wrench and the valve is opened. Gas will escape from the valve outlet (through the auxiliary valve) and from around the spindle. The packing and gland nut is replaced. The auxiliary valve is closed. Subsequent disposal of the gas is in accordance with the EIGA Doc. 30 *Disposal of Gases*.

7.1.4 Key safety points:

- Do not attempt unless a sectioned drawing and/or example of the valve is available. There shall also be a good understanding of its arrangement and operation.

- Wear appropriate personal protective equipment (PPE).

- When removing the gland nut, ensure that the valve spindle does not rotate with it.

- When the gland nut is removed, take care not to unscrew the valve spindle completely from the valve body.

- Beware of the possibility of a sudden gas release, and ejected valve parts/particulate matter.

- Care shall be taken when using penetrating oil. Oil shall not be used on valves in oxygen or oxidant service. If the gaseous components are unknown, penetrating oil shall not be used.

- This technique involves some gas discharge to atmosphere. Consider carrying out work involving flammable and toxic gases under forced ventilation. The gas released should be disposed of in accordance with the EIGA Doc. 30 *Disposal of Gases*.

- Before removing the valve from the receptacle, ensure the valve port or opening is clear of obstruction by blowing nitrogen or air through the opening into the receptacle and observing the free passage in and out.

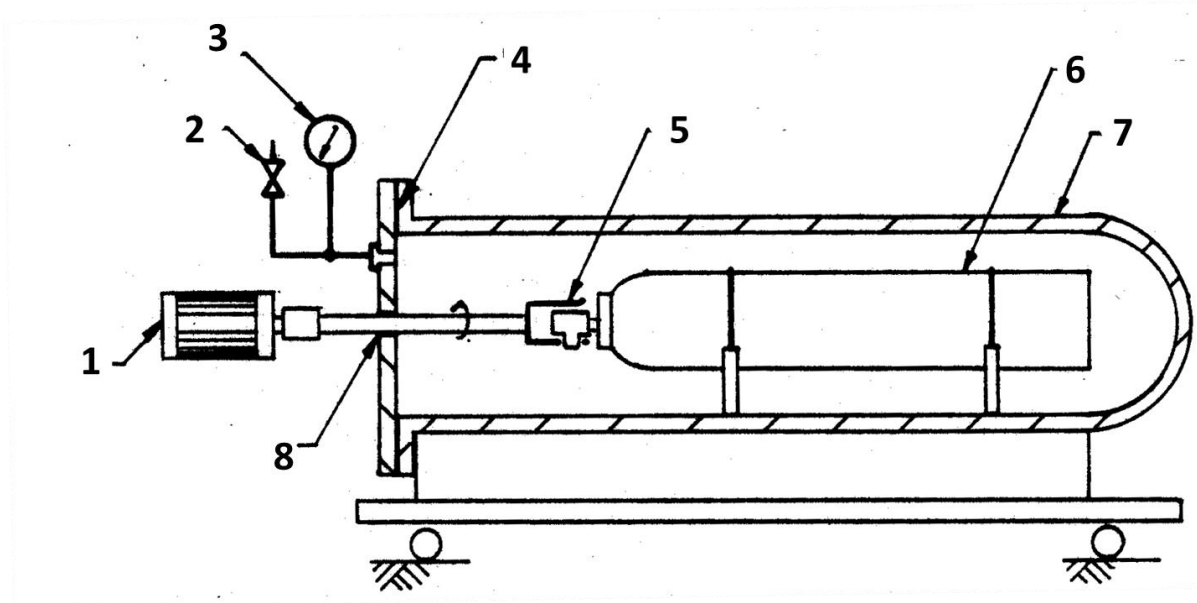
8 Release of gas by loosening or removal of the receptacle valve

8.1 Receptacle and valve enclosed inside a cylinder recovery vessel (gas contained)

8.1.1 Application

All gases (except acetylene).

8.1.2 Typical arrangement



1 - Motor drive (or hand wrench)
2 - Valve A
3 - Pressure gauge
4 - Gasket
5 - Devalving head
6 - Receptacle
7 – Recovery vessel
8 – Endplate

Drawing 2: Receptacle and valve enclosed inside recovery vessel (gas contained)

8.1.3 Procedure:

There shall be a documented operating procedure applicable to the design of the recovery vessel being used and the gas contained. Generally the following applies:

- The receptacle is inserted into the recovery vessel and secured if necessary.
- The devalving head is fitted to the valve.
- The end plate/motor drive or hand wrench is fitted.
- Where necessary the system is pressurized with inert gas to ensure absence of leaks, and/or purged of air and moisture.
- The receptacle valve is loosened or removed to permit gas discharge by opening valve A.

8.1.4 Key safety points:

- The recovery vessel shall be constructed from materials compatible with the gas to be contained. Special care shall be taken in selecting materials for highly oxidising gases.
- The recovery vessel shall be capable of withstanding the resultant pressure after release of gas from the receptacle.
- A gas recovery vessel is a pressure vessel and shall be designed and periodically tested to conform to relevant legislation.
- For flammable gases, one shall ensure that the recovery vessel is free from air. This can be done by evacuation and/or purging with an inert gas such as nitrogen, either through valve A or through additional connections.

- For oxygen (in excess of 23.5 volume percent) and oxidants, the recovery vessel, gaskets and external surface of the receptacle and valve shall be compatible, degreased and dried. (Ref. EIGA Doc. 33 *Cleaning of equipment for oxygen service*).

- For corrosive gases, the system shall be dry.

- For toxic gases, the system shall be pressurized and leak tested prior to operation.

- Subsequent disposal of the waste gas should be in accordance with the EIGA Doc.30 *Disposal of Gases*.

- After use, the recovery vessel shall be purged and free from all contaminants.

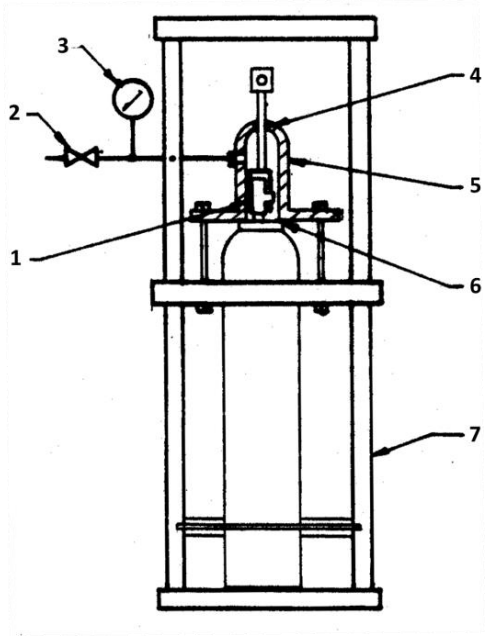
- Before opening the recovery vessel, ensure the pressure has been released by blowing nitrogen or air through valve A into the recovery vessel and observing free passage in and out.

8.2 Valve end of receptacle enclosed (gas contained)

8.2.1 Application

All gases, except acetylene.

8.2.2 Typical arrangement



1 - Devalving head
2 - Valve A
3 - Pressure gauge
4 - Gas tight gland
5 - Gas tight cap
6 – Gasket
7 - Receptacle securing frame

Drawing 3: Valve end of receptacle enclosed (gas contained)

8.2.3 Procedure

The receptacle is secured firmly into the frame. The devalving head is fitted to the valve and the gas tight cap is secured. Where necessary the system is pressurized with inert gas to ensure absence of leaks and purged either through valve A or through additional connections. The receptacle valve is loosened to permit gas discharge through valve A.

8.2.4 Key safety points

- The equipment shall be constructed from materials compatible with the gas to be contained. Special care shall be taken in selecting materials for highly oxidising gases.

- The receptacle neck ring shall be secure and in good condition in order to obtain a gas tight seal on its surface.

- The cap/mechanical securing system shall be periodically inspected and capable of withstanding the resultant pressure and force after release of gas from the receptacle. Local statutory requirements relating to pressure testing shall be complied with.

- For flammable gases, the cap shall be freed from air. This can be done by evacuation and/or purging with an inert gas such as nitrogen.

- For oxygen (in excess of 23.5 volume percent) and oxidants, the cap, gaskets and receptacle valve shall be compatible, degreased and dried in accordance with the EIGA Doc. 33 *Cleaning of equipment for oxygen service*.

- For toxic gases, the system shall be pressurized and leak tested prior to operation.

- For corrosive gases, the system shall be dry.

- Subsequent disposal of the waste gas should be in accordance with the EIGA Doc. 30 *Disposal of Gases*.

- Before removing the gas tight cap, ensure the pressure is released by blowing nitrogen or air through valve A into the cap and observing free passage in and out.

8.3 Receptacles contents cooled by external refrigeration and inoperable valve exchanged (gas contained)

8.3.1 Application

Gases transported in receptacles (except pyrophoric gases or acetylene) that can be positively identified and be cooled below their boiling point at atmospheric pressure (e.g. Chlorine -34°C) in receptacles that can be cooled without embrittlement occurring (see below).

8.3.2 Procedure

- The receptacle is evenly cooled in a controlled manner to below the boiling point of its content. The cooling method used is dependent on the required temperature.

- The temperature of the cooling medium and the top of the receptacle shoulder is monitored during the cooling process.

- When the desired cooling has been achieved (i.e. stable temperature of the receptacle shoulder) and the receptacle has been secured against falling over, the faulty valve is carefully loosened, removed and replaced with a serviceable, pre-taped valve with the same inlet thread inserted at a sufficient torque to create a seal.

- As the receptacle begins to warm the gas can be transferred to another receptacle or disposed of in accordance with the EIGA Doc. 30 *Disposal of Gases*.

8.3.3 Key safety points

- Due account shall be taken of the physical properties of the receptacle content to ensure it will fully condense at the proposed refrigeration temperature. Special consideration is necessary when dealing with liquefied gas mixtures whose composition may change as cooling takes place.

- Cooling should be evenly distributed to avoid excessive temperature gradients across the receptacle.

- Precautions shall be taken when cooling down receptacles. The cooling process shall be slow enough to ensure that the gas and the receptacle shell remain at the same temperature. This is

particularly important with steel receptacles where cold embrittlement may occur. Advice on the minimum acceptable temperature for any particular receptacle should be sought from a competent expert e.g. a metallurgist. In the absence of such advice, the following minimum temperatures shall be observed:

- Seamless steel receptacles: -20 °C.

  If the temperatures used are lower than those given above or accepted by the competent expert, seamless steel receptacles shall be hydraulically tested before being put back into service.

- For welded steel receptacles similar temperatures may be used after ensuring the good behaviour of the weld at low temperature.

- Aluminium alloys are not sensitive to cold embrittlement. Consequently they may be cooled down slowly even to cryogenic temperatures provided **the mechanical integrity of** the valve and the receptacle to valve connection are not compromised.

- Care should be taken when handling cold receptacles. They shall not be dropped or handled violently. Receptacles with loosened valves should not be moved if they contain gas.

- Cooling operations involving the use of gaseous coolants should only be undertaken in well-ventilated areas and operators shall be made aware of the risks of asphyxiation.

- Wear appropriate safety equipment which includes protection against cold burns.

- For flammable gases, special precautions may be necessary as air may enter the receptacle during the valve exchange operation.

- For toxic gases, valve exchange should be carried out in a well-ventilated area, fume hood or fume cubicle.

- Disposal of the gas released should be in accordance with the EIGA Doc. 30 *Disposal of Gases*.

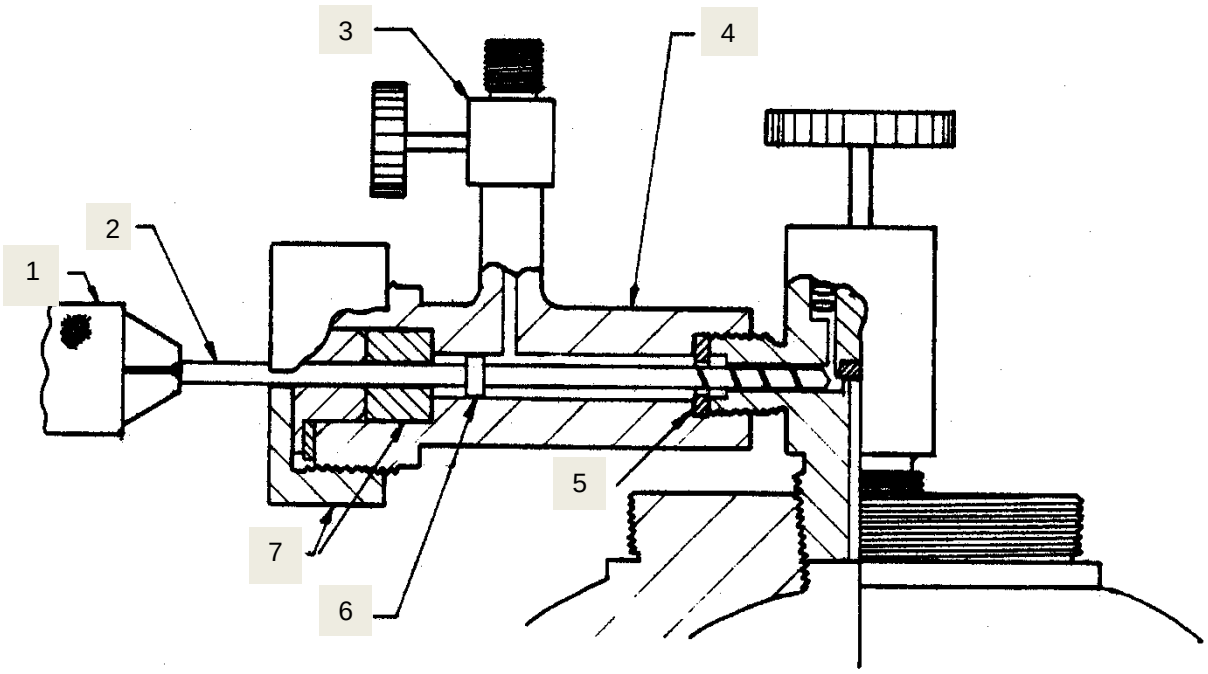
9 Release of gas by creation of additional vent in receptacle valve or receptacle body

9.1 Drilling on axis of valve outlet (gas contained)

9.1.1 Application

Valves whose design permit destruction of the seat by drilling on the axis of the valve outlet. This application is not suitable for powerful oxidants and acetylene. A remotely operated machine drill is preferred where available - see 9.3

9.1.2 Typical arrangement



1 - Hand drill
2 - Drill
3 - Valve A
4 - Drilling adaptor
5 - Gasket
6 - Retaining collar
7 - Gland packing and gland nut (around drill)

Drawing 6: Drilling on axis of valve outlet (gas contained)

9.1.3 Procedure

The receptacle is secured to prevent toppling and the drilling adaptor is fitted to the valve outlet using an appropriate gasket. Where necessary the system is pressurized to ensure absence of leaks and purged with inert gas. The drill is rotated slowly until a gas path across the valve seat is obtained Gas is discharged by opening valve A. The discharge rate can be monitored by a pressure indicator installed on the purge/vent line. If leakage occurs around the drill, the gland nut is tightened.

9.1.4 Key safety points

- The equipment shall be constructed from materials that are compatible with the gas to be contained.
- Wear appropriate personal protective equipment (PPE).
- A sectional drawing and/or example of the valve should be available to enable the operator to drill into the gas path.
- The largest practicable drill diameter compatible with the valve outlet union should be used to minimise the risk of breakage.
- Special care should be taken if the receptacle is fitted with a dip tube and contains a liquefied gas.
- The drill should be fitted with a collar to prevent its ejection under pressure.
- Drill thread needs to be limited to the final part of the drill length, gaskets located on the non threaded part of the drill

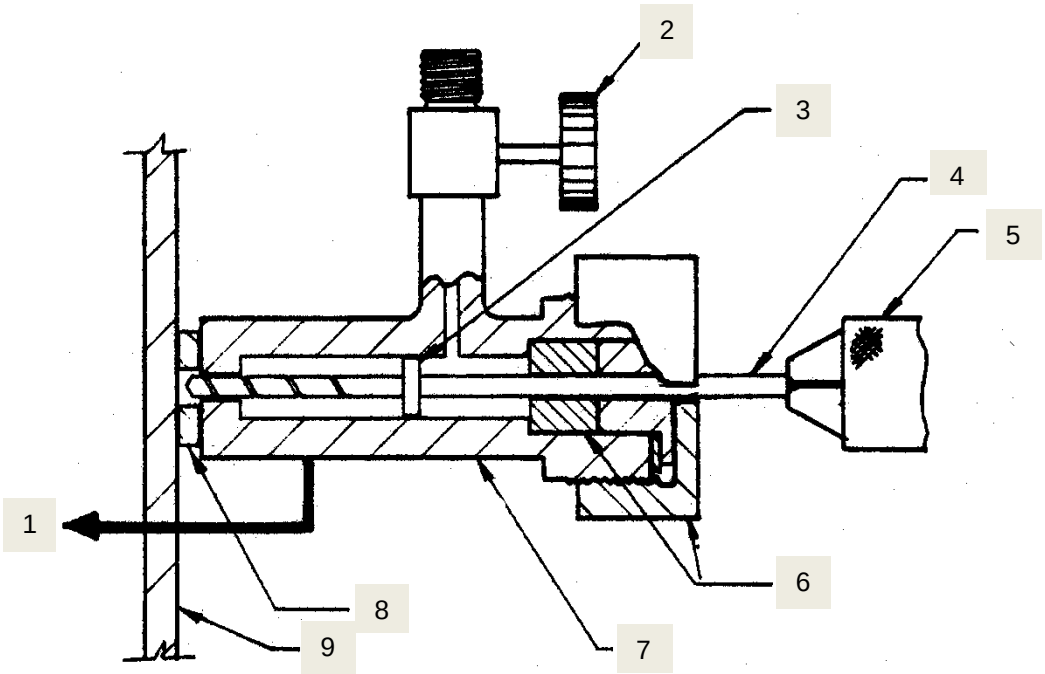
- A mark should be made on the visible part of the drill to avoid excessive entry into the valve body.
- For flammable gases, the system shall be freed from air. This can be done by evacuation and/or purging with an inert gas such as nitrogen.
- For oxygen (in excess of 23.5 volume percent) and oxidants, all components shall be compatible and degreased. (Reference: EIGA Doc. 33 *Cleaning of equipment for oxygen service.*).
- The drilling shall proceed very slowly to avoid risk of hot spots. This method is not suitable for powerful oxidants such as fluorine, fluorine mixtures and nitrogen trifluoride.
- For toxic gases, the system shall be pressurized and leak tested prior to operation.
- Subsequent disposal of waste gas should be in accordance with the EIGA Doc.30 *Disposal of Gases*.
- Before removing the valve from the receptacle, ensure the valve port or opening is clear of obstruction by blowing nitrogen or air through the opening into the receptacle – observing the free passage in and out.

9.2 Drilling into receptacle body (gas contained)

9.2.1 Application

All gases except acetylene and powerful oxidants. Receptacles with a low working pressure (less than 20 bar). A remotely operated machine drill is preferred where available - see 9.3

9.2.2 Typical arrangement



1 - Device to firmly clamp drilling adaptor to receptacle wall
2 - Valve A
3 - Retaining collar
4 - Drill
5 - Drill chuck
6 - Gland packing and gland nut (around drill)
7 - Drilling adaptor
8 - Gasket
9 - Receptacle wall

Drawing 9: Drilling into receptacle body (gas contained)

9.2.3 Procedure

- The receptacle should be properly secured in a convenient position.
- The drilling adaptor is secured to the receptacle wall. Various methods of securing can be used including a belt and heavy steel jaws mounted to a frame in which the receptacle is inserted.
- Where necessary the system is pressurized and leak tested prior to operation.
- The drill is rotated until a gas path through the receptacle wall is obtained. If leakage occurs around the drill, the gland nut is tightened.
- The gas is discharged through valve A.

9.2.4 Key safety points

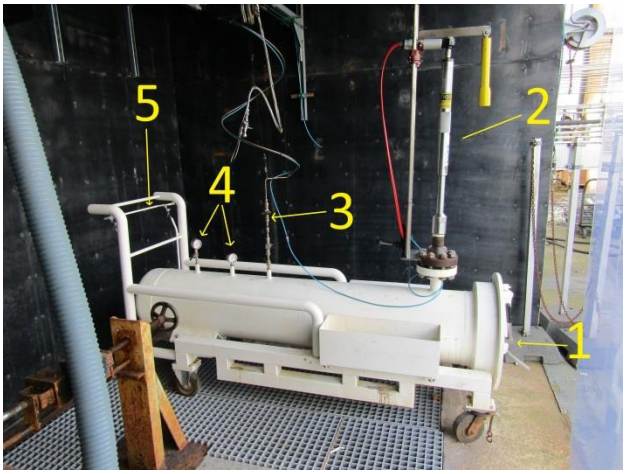
- When dealing with receptacles at pressures greater than 20 bar, it should be noted that only limited experience is available in the industry. The operator should only use this method if he is confident that the receptacle wall is in good condition and that drilling the hole will not impair the overall safety of the receptacle.
- Equipment shall be constructed from materials that are compatible with the gas to be contained.
- The drill diameter should not be too small to minimise the risk of breakage and not too large to minimise the risk of receptacle rupture. A diameter of between 3mm and 5mm is recommended.
- The drill should be fitted with a collar to prevent its ejection under pressure.
- Special care should be taken with liquefiable gases. Drill into the vapour space.
- For flammable gases, the system shall be free from air. This can be done by evacuation and/or purging with an inert gas such as nitrogen.
- For oxygen (in excess of 23.5 volume percent) and oxidants, all components shall be compatible and degreased, (including gaskets) and the drilling shall proceed very slowly to avoid the risk of hot spots. Drilling chips may be hot enough to trigger a dangerous reaction with oxidants. The method is not suitable for powerful oxidants.
- For toxic gases, the system shall be pressurized and leak tested prior to operation.
- Subsequent disposal of waste gas should be in accordance with the EIGA Doc. 30 *Disposal of Gases*.
- Before removing the valve from the receptacle, ensure the opening made by drilling is clear of obstruction by blowing nitrogen or air through the opening into the receptacle and observing the free passage in and out.
- The receptacle shall be destroyed after it has been emptied and purged.

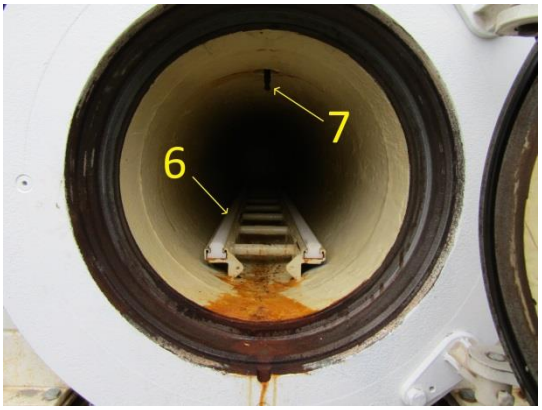
9.3 Drilling into receptacle body in salvage receptacle (gas contained)

9.3.1 Application

All gases except acetylene, liquefied gases and powerful oxidants (like fluorine mixtures and nitrogen trifluoride). It should be noted that no experience is available in the industry for the use of this technique with oxygen cylinders. Receptacles with a working pressure up to 300 bars.

9.3.2 Typical arrangement





1 – Door 2 –Drilling mechanism
3 – Valve A – Connection to the appropriate disposal manifold
4 – Pressure gauges
5 – Brake
6 – Receptacle cylinder support
7 – Drill bit

9.3.3 Procedure

There shall be a documented operating procedure applicable to the design of the recovery vessel. Generally the following applies:

- The state of the drill and the drill bit must be checked prior any drilling operation
- The bit must be raised up to allow the receptacle to be inserted into the recovery vessel without obstacle.
- The receptacle is inserted into the recovery vessel and tightened firmly inside.
- The system is evacuated and then pressurized with an inert gas before drilling the receptacle in order to ensure the absence of leaks and remove air and moisture.
- The speed of rotation of the drill shall be slow.
- The speed of boring must be slow – the spindle shall be moved down slowly.
- Do not exert a continuous pressure on the drill: Follow the “rule”: three steps forward, two steps back
- When the pressure starts to increase inside the recovery vessel, the drilling must be stopped until the pressure stabilizes.
- Finish the drilling.
- The recovery vessel shall be purged and free from all contaminants using an inert gas.
- Before opening the recovery vessel, ensure the pressure has been released by blowing an inert gas through valve A into the recovery vessel and observing free passage in and out.

9.3.4 Key safety points

- The recovery vessel shall be constructed from materials compatible with the gas to be contained. Special care shall be taken in selecting materials for oxidising gases.

- The recovery vessel shall be capable of withstanding the resultant pressure after release of gas from the receptacle.

- The recovery vessel should be equipped with a brake system in order to ensure its stability and immobility while it is in use.

- A gas recovery vessel is a pressure vessel and shall be designed and periodically tested to conform to relevant legislation.

- For flammable gases, one shall ensure that the recovery vessel is free from air. This can be done by evacuation and/or purging with an inert gas such as nitrogen.

- For oxygen (including mixtures in excess of 23.5 volume percent) and oxidants, the recovery vessel, gaskets and external surface of the receptacle and valve shall be compatible, degreased and dried. (Ref. EIGA Doc. 33 *Cleaning of equipment for oxygen service*).

- For corrosive gases, the system shall be dry.

- For toxic gases, the system shall be pressurized and leak tested prior to operation.

- Subsequent disposal of the waste gas should be in accordance with the EIGA Doc. 30 *Disposal of Gases*.

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