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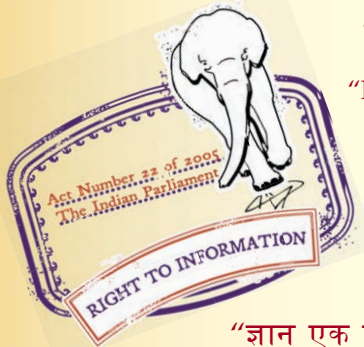
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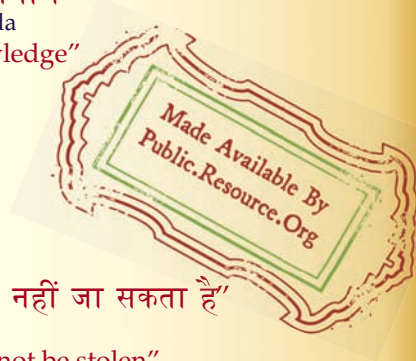
IS 8198-12 (1982): Code of practice for steel cylinders for compressed gases, Part 12: Gases for medical use [MED 16: Gas Cylinders]



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“Knowledge is such a treasure which cannot be stolen”





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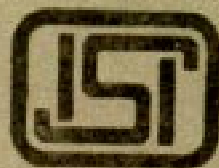


IS : 8198 ( Part XII ) - 1982

*Indian Standard*

CODE OF PRACTICE FOR  
STEEL CYLINDERS FOR COMPRESSED GASES  
PART XII GASES FOR MEDICAL USE

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*Indian Standard*CODE OF PRACTICE FOR  
STEEL CYLINDERS FOR COMPRESSED GASES

## PART XII GASES FOR MEDICAL USE

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# *Indian Standard*

## CODE OF PRACTICE FOR STEEL CYLINDERS FOR COMPRESSED GASES

### PART XII GASES FOR MEDICAL USE

#### 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 21 January 1982, after the draft finalized by the Gas Cylinders Sectional Committee had been approved by the Mechanical Engineering Division Council.

**0.2** The earlier version of this standard was printed as IS : 3870-1966 'Code of practice for handling gas cylinders and related equipment intended for medical use'. However, since a new series of standards relating to codes of practice for steel cylinders for various types of gases in different parts was started, it was thought worthwhile to publish this standard as one of such series.

**0.3** For safe handling of cylinders containing compressed gases, one should be thoroughly conversant with the properties and characteristics of these gases. There are several precautions and safe practices which are to be observed on account of the nature of the gas and also because of the pressure to which the cylinders are subjected.

**0.4** Manufacturers, fillers and users of gas cylinders covered by this standard should be familiar with the precautions laid down in this standard in order to ensure safe and efficient operating conditions. For general information on different gases conveyed in cylinders, SP : 9-1973\* may also be referred to.

**0.5** For the purpose of easy reference the standard is being issued in different parts as under:

IS : 8198 ( Part I )-1976 Code of practice for steel cylinders for compressed gases : Part I Atmospheric gases

IS : 8198 ( Part II )-1976 Code of practice for steel cylinders for compressed gases : Part II Hydrogen gas

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\*Technical data sheet for gases conveyed in cylinders.

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IS : 8198 ( Part III )-1976 Code of practice for steel cylinders for compressed gases : Part III High pressure liquefiable gases

IS : 8198 ( Part IV )-1976 Code of practice for steel cylinders for compressed gases : Part IV Dissolved acetylene gas

IS : 8198 ( Part V )-1976 Code of practice for steel cylinders for compressed gases : Part V Liquefied petroleum gases ( LPG )

IS : 8198 ( Part VI )-1979 Code of practice for steel cylinders for compressed gases : Part VI Liquefied chlorine gas

IS : 8198 ( Part VII )-1979 Code of practice for steel cylinders for compressed gases : Part VII Ammonia gas

IS : 8198 ( Part VIII )-1979 Code of practice for steel cylinders for compressed gases : Part VIII Common organic refrigerant gases

IS : 8198 ( Part IX )-1980 Code of practice for steel cylinders for compressed gases : Part IX Sulphur dioxide gas

IS : 8198 ( Part X )-1980 Code of practice for steel cylinders for compressed gases : Part X Methyl bromide gas

IS : 8198 ( Part XI )-1980 Code of practice for steel cylinders for compressed gases : Part XI Methyl chloride gas

IS : 8198 ( Part XII )-1982 Code of practice for steel cylinders for compressed gases : Part XII Gases for medical use

**0.6** The precautions to be observed for ensuring safety in the use of these cylinders have been classified under the following headings:

- a) General properties of gas;
- b) Approved specifications and general guidance for manufacture;
- c) Inspection;
- d) Testing;
- e) Fittings;
- f) Filling;
- g) Marking and labelling;
- h) Transportation;
- j) Storage;
- k) Handling and usage; and
- m) General precautions.

**0.7** Manufacture, possession and use of any gas, when contained in cylinders in a compressed or liquefied state, is regulated under the Gas Cylinder Rules, 1981, of the Government of India as amended from time



to time. Although the standard has been prepared in consultation and agreement with the statutory authorities under these rules, should anything in the code conflict with the provisions of Gas Cylinder Rules the latter shall be adhered to.

**0.8** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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## 1. SCOPE

**1.1** This standard ( Part XII ) covers filling, inspection, testing, maintenance and use of portable steel cylinders for the storage and transportation of gases for medical use in cylinders exceeding 500 ml water capacity. The following gases have been covered:

Carbon dioxide, cyclopropane, ethylene, helium, nitrogen nitrous oxide, oxygen and gas mixtures.

**1.1.1** Separate codes of practice for some of the gases used in medical cylinders have been already published. The following three codes are relevant:

IS : 8198 ( Part I )-1976†,

IS : 8198 ( Part III )-1976‡, and

IS : 8198 ( Part VIII )-1976§.

The present code, therefore, covers only those aspects of medical cylinders which have not been touched in the above codes. Thus, inspection during manufacture, usage, periodic testing, disposal of condemned cylinders, filling, marking, labelling, bringing the cylinders in service, transportation and records have not been covered in this code.

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\*Rules for rounding off numerical values ( revised ).

†Code of practice for steel cylinders for compressed gases : Part I Atmospheric gases.

‡Code of practice for steel cylinders for compressed gases : Part III High pressure liquefiable gases.

§Code of practice for steel cylinders for compressed gases : Part VIII Common organic refrigerant gases.

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### 2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 7241-1981\* shall apply.

### 3. PROPERTIES AND PHYSICAL CONSTANTS OF GASES FOR MEDICAL USE

3.1 The important properties of gases for medical use are described in Table 1.

### 4. GENERAL

4.1 For permanent gases for medical use, that is helium, nitrogen and oxygen, the general stipulations of IS : 8198 ( Part I )-1976† shall apply.

4.2 For high pressure liquefiable gases for medical use, that is carbon dioxide, ethylene and nitrous oxide, the general stipulations of IS : 8198 ( Part III )-1976‡ shall apply.

4.3 For cyclopropane, the general stipulations of IS : 8198 ( Part VIII )-1976§ shall apply.

4.4 The cylinders used for the storage and transportation of gases for medical use shall conform to the specifications listed under Table 1.

4.5 **Acceptance** — Hospital authorities and other persons responsible for the acceptance of gas cylinders shall satisfy themselves that the cylinders, as supplied, comply with all the requirements of IS : 3933-1966|| as regards colour marking and labelling. Cylinders of which the paint, stencilled name, symbols or label is substantially damaged or defaced, interfering with easy identification, shall not be taken into store but returned to the filler as soon as practicable.

4.5.1 Any unidentified cylinder shall be returned to the filler immediately.

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\*Glossary of terms used in gas cylinder technology ( *first revision* ).

†Code of practice for steel cylinders for compressed gases: Part I Atmospheric gases.

‡Code of practice for steel cylinders for compressed gases: Part III High pressure liquefiable gases.

§Code of practice for steel cylinders for compressed gases: Part VIII Common organic refrigerant gases.

||Colour identification of gas cylinders and related equipment intended for medical use.

**TABLE 1 PROPERTIES OF GASES FOR MEDICAL USE**

( Clause 3.1 )

Name of Gas	Carbon Dioxide	Cyclopropane	Ethylene	Helium	Nitrogen	Nitrous Oxide	Oxygen
Chemical Formula	CO <sub>2</sub>	C <sub>3</sub> H <sub>6</sub>	C <sub>2</sub> H <sub>4</sub>	He	N <sub>2</sub>	N <sub>2</sub> O	O <sub>2</sub>
Classification	High pressure Liquefiable	Low Pressure Liquefiable	High Pressure Liquefiable	Permanent	Permanent	High Pressure Liquefiable	Permanent
Flammability Range	Not Flammable	2.4 to 10.4	2.7 to 34	Not Flammable	Not Flammable	Not Flammable	Not Flammable
Toxicity ( MAK value )	5 000 ppm	400 ppm	Over 500 ppm	Over 500 ppm	Over 500 ppm	Over 500 ppm	Over 500 ppm
Whether Corrosive	No	No	No	No	No	No	
Critical Temperature, °C	31.1	124.4	9.7	-267.9	-147	36.5	-118.4
Critical Pressure	72.85 atm					71.7 atm	

( Continued )

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TABLE 1 PROPERTIES OF GASES FOR MEDICAL USE — *Contd*

Name of Gas	Carbon Dioxide	Cyclopropane	Ethylene	Helium	Nitrogen	Nitrous Oxide	Oxygen
Boiling Point in °C at Atm Pressure		-32.8	-103.7		-195.80		-182.97
Developed Pressure at 65°C	191.28	19.06	146.98	—	—	172.99	—
Approved Specifications for Cylinders	<i>See</i> Appendix A of IS : 8198 ( Part III )-1976	<i>See</i> Appendix B of IS : 8198 ( Part VIII )-1976	<i>See</i> Appendix A of IS : 8198 ( Part III )-1976	<i>See</i> Appendix A of IS : 8198 ( Part I )-1976	<i>See</i> Appendix A of IS : 8198 ( Part I )-1976	<i>See</i> Appendix A of IS : 8198 ( Part III )-1976	<i>See</i> Appendix A of IS : 8198 ( Part I )-1976
Filling Ratio	0.667	0.48	0.270	Not Applicable	Not Applicable	0.667	Not Applicable
Physical Properties	Colourless, odourless, slightly acidic in taste				It is a colourless, odourless and tasteless gas. It is only slightly soluble in water and is a poor conductor of heat and electricity.	Colourless, odourless and tasteless	It is a colourless, odourless and tasteless gas. It is only slightly soluble in water and is a poor conductor of heat and electricity.

Chemical Properties	Not flammable, slightly acidic in taste				It does not react readily with other elements. It neither burns nor supports combustion. It combines with some of the more active metals, such as calcium, sodium and magnesium to form nitrides.	Not flammable, supports combustion to a lesser extent than oxygen	It is an active element; although does not burn, supports combustion and combines directly or indirectly with all elements except the rare gases.
Molecular Mass	44.01				28.016		32
Density of Liquid ( Normal Boiling Point ), g/cm <sup>3</sup>	0.824 at 15°C	0.615 at 15°C			0.808 1	0.817 at 15°C	1.139 6
Density of Gas, g/m <sup>3</sup> at °C and 1 Atm	1.977 0				1.250 5	1.978 2	1.429 0
Volume of Expansion Liquid to Gas at 15.56°C and 1 Atm					1/678.1		1.839 9
Periodical Inspection Interval	5	5	5	5	5	5	5

## 5. FITTINGS

**5.1** Valves for medical cylinders, where required, shall have the appropriate pin index in accordance with IS : 3745-1978\*.

**5.2** Foot ring, if provided, shall be strong and sound in fitting to give the cylinder sufficient stability and shall conform to the requirements of the specification to which the cylinder is manufactured.

**5.3** Safety device, if fitted to the valve, shall be properly maintained.

## 6. IDENTIFICATION AND MARKING

**6.1 Gas Cylinders** — The cylinders shall be painted with the colour specified in Gas Cylinder Rules. The colour of the paint on the cylinders shall always be maintained by periodically repainting them. In this regard, IS : 3933-1966† may also be referred to.

**6.2 Pipelines and Tubing** — The pipelines for distribution of medical gases in hospitals and visible connecting tubing of anaesthetic apparatus shall be marked with bands at least at each end and at every joint by the colour appropriate for the gases, according to IS : 3933-1966†.

**6.2.1** Outlet points on anaesthetic pipelines shall be permanently marked with the name of the gas or its symbol.

**6.3 Name Plates** — For name plates on storage racks, pressure regulators and control valves, the following colours shall be adopted:

Carbon dioxide	Grey with black lettering
Cyclopropane	Orange with white lettering
Ethylene	Violet with white lettering
Helium	Brown with black lettering
Nitrogen	Black with white lettering
Nitrous oxide	Blue with white lettering
Oxygen	White with black lettering

**6.3.1** To facilitate reading, the lettering shall be in characters at least 10 mm high.

## 7. FLUSHING

**7.1** Flushing shall be carried out for all cylinders, whether empty or containing residual gases.

\*Specification for yoke type valve connections for small medical gas cylinders (*first revision*).

†Colour identification of gas cylinders and related equipment intended for medical use.

## 8. STORAGE ( AT CONSUMER'S END )

**8.1** Special precautions are necessary where large number of cylinders are stored. Cylinder shall not be stored in open.

**8.2** Cylinders shall preferably be stored under cover, where they can be protected against corrosion and frost. Wherever possible, the store shall be in a detailed building of non-combustible construction. If the cylinders are stored in the part of a building used for some other purpose, the store shall be:

- a) in ground floor of the building in a room against an outside wall with a door or doors leading to the open;
- b) separated from the rest of the building by walls and floors having a fire resistance of at least two hours; and
- c) entirely of non-combustible construction.

**8.3** The store shall not be used for any purpose other than storage of cylinders.

**8.4** The store shall be provided with good natural ventilation and shall have ventilation openings at both high and low levels.

**8.5** The location of the doors and the layout of the store shall be such that the cylinders may be removed easily in the event of fire.

**8.6** Stores shall be indicated by suitable notices and exits shall be kept free from obstruction.

**8.7** Cylinders shall be stored in suitably constructed racks, lined with material which will minimize the possibility of the colouring or labelling being defaced by abrasion.

**8.7.1** The design of the racks shall be such that cylinders shall be selected in rotations as would result from the use of a sloping rack where upon the cylinder roll down in succession as each cylinder is removed, the most recently delivered cylinders being stacked at the higher end of the rack ( see Appendix A ).

**8.7.2** A system shall be instituted whereby all cylinders are used in rotation and cylinders held in reserve in wards or theatres are brought periodically into use and replaced by fresh cylinders.

**8.8** In each storage room and wherever reserve cylinders are kept, a colour chart showing the identifying colours in the various medical gases shall be prominently displayed.

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**8.9** Empty cylinders shall be kept separated from filled ones. This arrangement makes it unnecessary to open valves to see if cylinders are full or empty.

**8.9.1** Distinctive notice shall be displayed to prevent confusion. A common practice is to chalk mark 'MT' on empty cylinders.

**8.10** Protective caps, where provided, shall be screwed down over valves when cylinders are not in use.

**8.11** All cylinders not in use shall be kept in an appropriate store.

**8.12** Valves of empty cylinders shall be kept closed at all times.

**8.13** Cylinders shall not be exposed to continuous dampness and shall not be stored near salt or other corrosive chemical or fumes. Rusting will damage the cylinders and may cause the valve protection caps to stick.

### **8.14 Storage of Oxygen Cylinders**

**8.14.1** Additional precautions are necessary for storing oxygen cylinders. Some means of venting an explosion shall be provided. In a single-storey building, the best method is to make the roof of light construction as this will help to vent an explosion upwards. If the store is a part of a building used for other purposes, special arrangement will be necessary to vent explosions safely. These may include more substantial internal walls and ceilings, if there are storeys above the store, to protect occupants from blast and panels of light construction in external walls to vent explosions outwards, provided there is no risk of injury to people outside.

**8.14.2** Conspicuous signs shall be posted in the storage area forbidding smoking, open lights or other open flames.

**8.14.3** Oxygen cylinders shall be kept separated from cylinders containing flammable gases, wherever possible in a separate room.

**8.14.4** Oxygen cylinders shall never be stored where oil, grease or other readily combustible substance may come in contact with them. Oil and oxygen may combine with explosive violence.

**8.14.5** Cylinders shall not be stored in operating rooms.



### **8.15 Storage of Nitrous Oxide Cylinders**

**8.15.1** Special care shall be taken for storing nitrous oxide cylinders to avoid contamination with oil. These shall not be stored where oil, grease or readily combustible substances may come in contact with them.

**8.15.2** Nitrous oxide cylinders shall be stored in a little-frequented place, making sure not to store them in the same room with cylinders containing reserve stocks of flammable gases. Medical gas cylinders of nitrous oxide shall never be stored in operating rooms.

## **9. USE OF CYLINDERS**

**9.1** No cylinder shall be encased in any covering when used in operating theatres or wards, as this defeats the identification of cylinders by colour or label.

**9.2** Gas cylinders shall be returned to the fillers at regular intervals in order that the filler may maintain the identifying colours and labels in good conditions and be in a position to effect any modification in labelling and colouring that may be subsequently recommended to improve identification of the gaseous contents.

**9.3** A carbon dioxide cylinder for use on anaesthetic trolleys and in portable anaesthetic apparatus shall not be of a water capacity greater than 1.25 litres.

## **10. HANDLING ( AT CONSUMER'S END )**

**10.1** The gas shall be called by its name, so that no confusion exists.

**10.2** Adequate care shall be taken in handling cylinders, so that they are not dropped or struck against one another violently. Cylinders shall be adequately supported to prevent falling during use. In horizontal position, the cylinders shall be secured so that they cannot roll. Trolleys and cradles shall be used while moving them.

**10.3** Repairing, painting or altering colour of cylinders or valves shall not be done. If the cylinder valve is leaking around the spindle, the gland nut shall be tightened.

**10.4** Cylinders shall not be placed where they might become part of an electric circuit. Where cylinders are used near or in conjunction with electric welding, precaution shall be taken against accidental grounding of compressed gas cylinders and their burning by electric welding arc.

**10.5** Marking stamped on cylinders shall not be tampered.

**10.6** Markings which are used for identification of contents of cylinders shall not be defaced or removed. This also applies to labels, tags and stencilled marks.

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**10.7** Cylinders shall never be used as rollers, supports or for any purpose other than those for which they are intended.

**10.8** In moving cylinders, it is important to remember that they shall not be subjected to abnormal mechanical shocks which might damage the cylinders and the valves. Care shall be taken to ensure that cylinders are not dropped or permitted to strike against one another violently.

**10.9** Valve protection caps shall never be used for lifting cylinders from one position to another. For raising a cylinder provided with valve protection cap from a horizontal to a vertical position, it shall be seen that the cap is properly tightened by hand before the cylinder is raised by grasping the cap.

**10.10** Horizontal movement of cylinders is easily accomplished by the use of a hand truck. When a hand truck is used, some method, such as chaining, shall be used to hold cylinders securely in an upright position. Cylinders shall not be transported lying horizontally on truck with valve over-hanging in a position to collide with stationary objects. Cylinders shall never be dragged from place to place.

**10.11** Valves shall always be closed before cylinders are moved.

**10.12** It is sometimes necessary to transport cylinders by crane or derrick. Lifting magnets, slings of rope or chain, or any other device in which the cylinders themselves form a part of the carrier shall never be used for hoisting cylinders. Instead, when a crane is used, a platform, cage or cradle shall be provided which will protect the cylinders from damage by slamming against obstructions and will keep them from falling out. The preferred construction is to build one which will take one or more cylinders.

**10.13** Cylinders shall not be:

- a) lifted with an electromagnet;
- b) kept near an elevator, a gangway or in a location where moving object can fall on it;
- c) left near a source of heat like furnace, flame or naked light or hot slag;
- d) kept close to welding or cutting work, so that spark may fall on it;
- e) use as rollers, supports or for any purpose other than storing gas;
- f) kept in contact with an electric wire or fitting, so that it may become a part of an electric circuit;
- g) kept near acid or corrosive substances;
- h) kept at a place where they obstruct the approach to a fire extinguisher;

- j) lifted by its cap;
- k) dragged or slid on floor. A suitable hand cart shall be used; and
- m) rolled over oily or greasy floor.

**10.13.1** Oxygen cylinders, particularly their valves, shall be kept away from oily hands, gloves or rags.

### **10.14 Handling of Nitrous Oxide Cylinders**

**10.14.1** All the precautions, necessary for the safe handling of an compressed gas and of any gas used medicinally, shall be observed with nitrous oxide.

**10.14.2** Oil, grease or any other readily combustible substance shall never be permitted to come in contact with cylinders or other equipment containing nitrous oxide. Oil and nitrous oxide may combine with explosive violence.

**10.14.3** Care shall be taken to avoid exhausting a nitrous oxide cylinder completely when using it with either in anaesthesia, in order to prevent the possibility of having the ether drawn back into the cylinder. Nitrous oxide cylinders shall always be protected against feed back of other gases or foreign material by suitable traps or check valves in lines to which the cylinders are connected.

**10.14.4** Nitrous oxide shall not be transferred from one cylinder to another. Instead, the cylinders shall always be returned to charging plants for refilling under recognized safe practices.

**10.14.5** Paper wrappings, if any, shall be removed, so that the cylinder label is clearly visible before placing cylinders in service.

## **11. NON-INTERCHANGEABLE COUPLINGS ON OUTLET POINTS**

**11.1 Pipelines** — Outlet points on anaesthetic pipelines shall be fitted with suitable non-interchangeable, self-sealing couplings and flexible tubing that connect the outlet points to the anaesthetic apparatus having corresponding mating couplings.

**11.2 Anaesthetic Trolleys and Apparatus** — Wherever detachable connecting tubes are provided in anaesthetic apparatus, suitable non-interchangeable couplings shall be provided which will preclude accidental or wrongful connection of the tubing for any one gas to the pressure regulator or flowmeter inlet of any other gas.

## **12. INSPECTION AND MAINTENANCE**

**12.1** All gas cylinders, anaesthetic apparatus incorporating gas cylinders and pipeline installations shall be inspected at intervals not exceeding three months by the manufacturers of the apparatus or some qualified persons.

**12.2** Dismantling of the apparatus, other than for routine use, shall only be conducted by the manufacturer of the apparatus or some qualified person.

### **13. PERSONNEL**

**13.1** It is recommended that all personnel whose duties bring them into association with the storage, transport, maintenance or handling of the gas cylinders and anaesthetic apparatus be reliable individuals, adequately trained and fully informed of the nature of risks to others as well as to themselves arising from a dereliction of duty.

## **A P P E N D I X A**

*( Clause 8.7.1 )*

### **UNIT TYPE STORAGE RACK FOR MEDICAL GAS CYLINDERS**

**A-1.** Figure 1 shows a suggested arrangement for a cylinder storage rack. It is recommended that the rack shall be of welded construction.

**A-2.** The cylinders are intended to rest on the steel cross members. The upper surface of the cross members may be fitted with wood battens, rubber or felt, in order to assist in preserving the appearance of the cylinders.

**A-3.** The height of the rack shall be such that no undue effort may be necessary on the part of an operator to place a cylinder on it, or to remove one from any shelf. The shelves shall be slightly inclined, so that the cylinders may roll towards the left after the cylinder has been removed. To avoid wedging of the cylinders, the inclination shall not be excessive.

**A-4.** It is suggested that the rack be employed for the storage of full cylinders only, and that when a cylinder is to be removed for service, it shall be taken from the left. The remaining cylinders shall then roll down the incline, leaving a space at the right-hand side for fresh supplies.

**A-5.** It will be observed that the overall height of the rack being 1 500 mm the indicator board can readily be seen. The wording of the board shall be in 80 mm or larger letters. This, together with the colour scheme, shall assist in preventing mistakes.

**A-6.** Since the racks are of the unit type, any number can be used and placed so as to form a continuous rack.

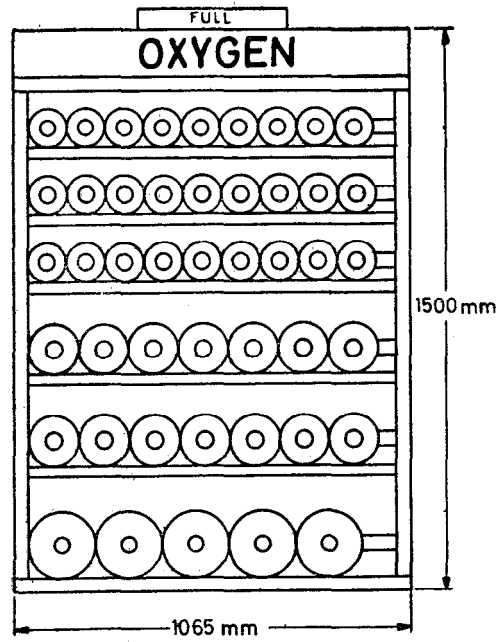
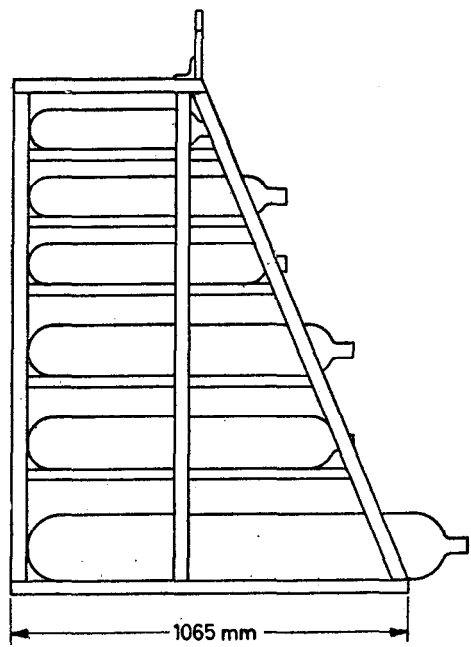


FIG. 1 UNIT TYPE STORAGE RACK FOR MEDICAL GAS CYLINDERS

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