भारतीय मानक
Indian Standard

IS 10245 (Part 2) : 2023

श्वसन सुरक्षा संयत्र — विशिष्टि

भाग 2 स्व-निहित मुक्त प्रणाली श्वसन संयत्र

(दूसरा पुनरीक्षण)

Respiratory Protective Devices — Specification

Part 2 Self-Contained Open Circuit Breathing Apparatus

(Second Revision)

ICS 13.340.30

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

February 2023 **Price Group 10**

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Occupational Safety and Health Sectional Committee had been approved by the Chemical Division Council.

This standard was first published in 1982. As breathing apparatus is one of the most important lifesaving equipment, the need was felt to standardize this equipment to ensure the quality of production. Accordingly, the standard on breathing apparatus was issued in four parts. Part 1 deals with closed circuit breathing apparatus, Part 2 deals with open circuit breathing apparatus, Part 3 deals with fresh air hose and compressed airline, and Part 4 deals with escape breathing apparatus.

The first revision of the standard was carried out in 1994, in which relevant Indian Standards were referred for specifying the requirements of thread connections, mouthpiece, and full face piece. The requirements for weight, frequency range of warning device, resistance to breathing, resistance to temperature and method of test for practical performance test were also modified.

The second revision has been taken up to keep pace with the latest technological developments and international practices. In this revision following major changes have been made:

a) Terminology has been updated;
b) Requirements for auxiliary components have been added;
c) Requirements for thread connection between face mask and apparatus have been modified;
d) Requirement of flammability and resistance to radiant heat has been added;
e) Specification for electronic pressure indicator and warning device has been added;
f) Requirement of static pressure has been included;
g) Test methods have been harmonized with latest ISO standards;
h) Requirement of leak-tightness has been added;
j) Pre-conditioning of samples before testing has been added;
k) Requirements and tests for pressure reducer has been modified; and
m) Test for warning device has been modified.

In the preparation of this standard, considerable assistance has been derived from the following standard:

EN 137 : 2006	Respiratory protective devices — Self-contained open-circuit compressed air breathing apparatus with full face mask — Requirements, testing, marking

It is recommended that reference should be made to IS 9623 for guidance on the type of respiratory protection that should be provided for particular conditions. In addition, care should be taken in the choice of breathing apparatus itself, where such equipment is to be used in very high (60 °C ± 3 °C) or very low (-30 °C ± 3 °C) ambient temperatures and the instructions provided by the suppliers should be carefully noted.

Certain toxic substances which may occur in some atmospheres can be absorbed by the skin. Where these do occur, respiratory protection alone is not sufficient and the whole body should be protected.

The composition of the committee responsible for formulation of this standard is listed in Annex E.

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 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded value should be the same as that of the specified value in this standard.

Indian Standard

RESPIRATORY PROTECTIVE DEVICES — SPECIFICATION

PART 2 SELF-CONTAINED OPEN CIRCUIT BREATHING APPARATUS

(Second Revision)

1 SCOPE

This standard specifies minimum performance requirements for self-contained open-circuit breathing apparatus with full face mask used as respiratory protective devices, except escape apparatus and diving apparatus.

Such equipment is intended for use in work situations where the risk of over pressurization of the cylinders due to hot environmental conditions is low.

Laboratory and practical performance tests are included for the assessment of compliance with the requirements.

2 REFERENCES

The standards listed below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below:

IS No.	*Title*
IS 8347 : 2008	Respiratory protective devices — Definitions, classification and nomenclature of components (*first revision*)
IS 14138	Respiratory protective devices : Threads for facepieces — Specification:
(Part 1) : 1994	Standard thread connection
(Part 2) : 1994	Centre thread connection
IS 14166 : 1994	Respiratory protective devices — Full-face masks — Specification
14700 (Part 6/Sec 2) : 2019	Electromagnetic compatibility (EMC): Part 6 Generic standards, Section 2 Immunity for industrial environments
IS 17274	Respiratory protective devices — Methods of test and test equipment
(Part 2) : 2019	Determination of breathing resistance
(Part 5) : 2019	Breathing machine, metabolic simulator, RPD head forms and torso, tools and verification tools
(Part 6) : 2019	Mechanical resistance/strength of components and connections
(Part 10) : 2019	Resistance to ignition, flame, radiant heat and heat
IS/IEC 60079 (Part 0) : 2017	Explosive atmospheres: Part 0 Equipment — General requirements (*third revision)*
IS/IEC 60079 (Part 11) : 2011	Explosive Atmospheres: Part 11 Equipment protection by intrinsic safety “i” (*first revision)*

3 TERMINOLOGY

For the purpose of this standard the definitions given in IS 8347 and the following shall apply.

3.1 Positive Pressure Devices

Respiratory protective devices having compressed air supply for inhalation of the wearer such that there is positive pressure inside the face mask.

3.2 Rated filling pressure

Maximum allowable pressure to which the valved cylinder is intended to be filled.

3.3 Rated working pressure

Maximum allowable pressure for which the breathing apparatus is designed.

3.4 Self-Contained Open Circuit Breathing Apparatus

This apparatus comprises of valved cylinder(s) and typically body harness, lung governed demand valve, pressure indicator(s), warning device(s), connecting hoses and tubes, and full face mask. It may include a pressure reducer, pressure reducer relief valve, supplementary air supply, second medium pressure connector, ambient air bypass device or other components and parts.

The apparatus functions by enabling the wearer to breathe compressed air on demand. The exhaled air from the wearer then passes without re-circulation to the ambient atmosphere.

4 CLASSIFICATION

Self-contained open circuit breathing apparatus are classified into the following classes according to the purpose:

a) Class 1 — Apparatus for industrial use

b) Class 2 — Apparatus for fire fighting

5 REQUIREMENTS

5.1 General

All test samples shall meet all the prescribed requirements. Auxiliary equipment, if fitted, shall meet the requirements listed in Annexes A and B.

5.2 Ergonomics

For ergonomic satisfaction of the wearer, the apparatus shall conform to the requirements given in **5.3**, **5.9** and **5.11**.

5.3 Design

The apparatus shall satisfy the following requirements when tested as per **6.4** and **6.5**.

The diameter of pressurized parts with a pressure greater than 0.5 bar downstream of the shut-off valve(s) shall not exceed 32 mm.

5.3.1 The design of the apparatus shall be such as to allow its inspection in accordance with the information supplied by the manufacturer. All parts requiring manipulation by the wearer shall be readily accessible and easily distinguishable from one another by touch. All adjustable parts and controls shall be constructed so that their adjustment is not liable to accidental alteration during use.

5.3.2 The apparatus shall be sufficiently robust to withstand the rough usage it is likely to receive in service with respect to its classification.

5.3.3 The apparatus shall be so designed that there are no protruding parts or sharp edges likely to be caught on projections in narrow passages. The surface of any part of the apparatus likely to be in contact with the wearer shall be free from sharp edges and burrs.

5.3.4 The apparatus shall be so designed that the wearer can remove it and while still wearing the facepiece, continue to breathe air from the apparatus. The apparatus shall be designed to ensure its full function in any orientation.

5.3.5 The main valve(s) of the cylinder(s) shall be arranged so that the wearer can operate them while wearing the apparatus.

5.3.6 If apparatus (of the same class) are designed for use with different sizes of cylinders, changing of cylinders shall be possible without the use of special tools. Where the manufacturer claims the apparatus can be used with a different range of cylinders then the worst case(s) shall be identified and tested.

5.3.7 Apparatus fitted with more than one cylinder may be fitted with individual valves on each cylinder. It shall not be possible to simultaneously fit two or more cylinders of different rated filling pressures to the same apparatus. It shall also not be possible to fit an apparatus which is designed to operate with a lower rated working pressure to a cylinder with a higher rated filling pressure.

5.4 Materials/Components

5.4.1 All the materials used in the construction shall have adequate mechanical strength and resistance to deterioration by heat when tested as per methods given in **6.4**, **6.5** and **6.6**.

5.4.2 Exposed parts, that is, those which may be subjected to impact during practical performance tests shall not be made of magnesium, titanium, aluminium or alloys containing such proportions of these metals which on impact, give rise to frictional sparks capable of igniting flammable gas mixtures.

5.4.3 Materials that may come into contact with the skin of the wearer shall not be known to be likely to cause irritation or any other adverse effect to health. Testing shall be done as per **6.4** and **6.5**.

5.5 Cleaning and Disinfection

All material shall be visibly unimpaired after cleaning and disinfection by the agents and procedures specified by the manufacturer. Testing shall be done in accordance with **6.4** and **6.5**.

5.6 Mass

The mass of the apparatus as ready for use with full face mask and fully charged cylinder(s) shall not exceed 18 kg. Testing shall be done in accordance with **6.4**.

5.7 Water Immersion

The apparatus shall continue to function satisfactorily after being submerged in water. Before immersion and after removal from the water the apparatus shall meet the requirements of **5.21**. Testing shall be done according to **6.10**.

5.8 Connections

5.8.1 *General*

The design and construction of the apparatus shall permit its component parts to be readily separated for cleaning, examination and testing. All demountable connections shall be readily connected and secured, where possible by hand. Any means for

sealing used shall be retained in position when the joints and couplings are disconnected during normal maintenance. Testing shall be done in accordance with **6.4** and **6.5**.

5.8.2 *Couplings (if Fitted)*

The construction of the apparatus shall be such that any twisting of the hoses and tubes do not affect the fit or performance of the apparatus, or cause the hoses and or tubes to become disconnected. The design of the couplings shall be such as to prevent unintentional interruption of the air supply. Testing shall be done in accordance with **6.4** and **6.5.**

5.8.3 *Strength of Connections*

Connections of the breathing hose (if fitted) to the full face mask connector and to the demand valve or between the full face mask connector and the demand valve shall be able to withstand a force of 250 N when tested in accordance with **6.11**.

5.8.4 *Connection Between Apparatus and Full Face Mask*

The connection between the apparatus and the full face mask may be achieved through a permanent, special or thread type connector. If a thread connector is used, either it shall comply with the requirements of one of the following two specifications;

a) IS 14138 (Part 1) for breathing apparatus without positive pressure; and
b) Annex D for breathing apparatus with positive pressure.

or, if any other thread type connector is used, it shall not be possible to connect it with the threads of the above mentioned specifications.

The thread according to IS 14138 (Part 2) shall not be used with the equipment covered by this standard.

If a thread connector in accordance with Annex D is used then the requirements of Annex C shall be met, when tested in accordance with Annex C.

For standardized threads a thread gauge shall be used to check dimensions.

For all equipment connectors of the full face mask having the potential of being hooked or snagged, a pull test as described in **6.10** of IS 17274 (Part 6) shall be carried out and the connection shall be robust enough to withstand a force of 500 N without separation.

5.8.5 *High, Medium and Low Pressure Connections*

High, medium and low pressure connections shall not be interchangeable. Testing shall be done in accordance with **6.4**.

5.9 Full face masks

Full face masks conforming to IS 14166 shall be used.

5.10 Body Harness

The body harness shall be designed to allow the user to don and doff the apparatus quickly and easily without assistance and shall be adjustable. The adjustable joints shall be such that once adjusted, they shall not slip inadvertently.

Where the body harness incorporates means for attachment of a lifeline, the harness together with the snap hook shall be capable of withstanding a drop test of 1 m when loaded with 75 kg.

The harness shall be constructed such that when the breathing apparatus is tested for practical performance tests in accordance with **6.5**, the apparatus shall be worn without avoidable discomfort and the wearer shall show no undue sign of strain attributable to wearing the apparatus and the apparatus shall impede the wearer as little as possible when in crouched position or when working in a confined space with restricted movement. The body harness shall be considered satisfactory if during the practical performance test it does not slip and continues to hold the apparatus securely to the wearer's body throughout the duration of test.

5.11 Practical Performance

The complete apparatus shall undergo practical performance tests under realistic conditions. These general tests serve the purpose of checking the apparatus for imperfections that cannot be determined by the tests described elsewhere in this standard.

Testing shall be done in accordance with **6.5** and **6.6.2**.

If during any activity by any test subject, the test subject fails to finalize the selected activity due to the apparatus being not fit for the purpose for which it has been designed, the apparatus shall be deemed to have failed.

After completion of the activities the test subjects are asked to assess the apparatus as per **6.5.4.1** (**a**) – (**h**). This assessment will be used to determine if the apparatus passes or fails. Full details of those parts of the practical performance tests which revealed imperfections shall be mentioned in the test report.

5.12 Resistance to Temperature and Flammability

5.12.1 *Temperature Performance*

5.12.1.1 *General*

The apparatus shall be able to operate over the temperature range of -30 °C to 60 °C. Apparatus specifically designed for temperatures beyond these limits shall be tested and the temperature(s) shall be marked on the apparatus.

Apparatus shall conform to the requirements of breathing resistance given in **5.12.1.2** and **5.12.1.3** at the extremes of the temperature range given.

5.12.1.2 *Breathing resistance at low temperature*

For breathing apparatus without positive pressure the inhalation resistance shall not exceed 10 mbar. For breathing apparatus with positive pressure a positive pressure shall be maintained in the cavity of the mask adjacent to the face seal.

The exhalation resistance of all classes of apparatus shall not exceed 10 mbar. Testing shall be done in accordance with **6.6.1.1**.

5.12.1.3 *Breathing resistance at high temperature*

For breathing apparatus without positive pressure the inhalation resistance shall not exceed 7 mbar and the exhalation resistance shall not exceed 3 mbar. For breathing apparatus with positive pressure a positive pressure shall be maintained in the cavity of the mask adjacent to the face seal. The exhalation resistance shall not exceed 10 mbar.

Testing shall be done in accordance with **6.6.1.2**.

5.12.2 *Flammability*

5.12.2.1 *Components*

The material of the straps and buckles shall not burn or continue to burn for more than 5 s after removal from the flame. The breathing hose(s) (leading to full face mask), medium pressure tube(s) and lung governed demand valve shall not be of highly flammable nature and the parts shall not continue to burn for more than 5 s after removal from the flame. The components shall remain leak-tight after the test although they may be deformed when tested according to **6.2** of IS 17274 (Part 10).

5.12.2.2 *Flame engulfment*

Class 2 breathing apparatus shall be subjected to a flame engulfment test. No after-flame shall continue for more than 5 s. Additionally, no component that secures the apparatus to the user's body or that secures the cylinder(s) to the apparatus shall separate or be displaced to such an extent that would cause the breathing apparatus to become detached from the wearers body or to fail the breathing resistance requirement given in **5.21**. Testing shall be done in accordance with **6.6.1.3**.

5.12.2.3 *Resistance to radiant heat*

For class 2 breathing apparatus, whole apparatus shall be exposed to radiant heat of 8.0 kW/m^2 for 5 min at the flow rate of 105 l/min. The apparatus is considered to be resistant to radiant heat if it fulfils the breathing resistance requirements of **5.21** throughout the period of the test although it may be deformed. Testing shall be done in accordance with **6.3** of IS 17274 (Part 10).

5.13 Protection Against Particulate Matter

The parts of the apparatus that supply compressed air shall be protected against particulate matter that might be present in the compressed air. Testing shall be done in accordance with **6.4**.

5.14 High and Medium Pressure Parts

Metallic high pressure tubes, valves and couplings shall be capable of withstanding a pressure of 50% above the maximum filling pressure of the cylinder without damage. Non-metallic parts shall be capable of withstanding a pressure of twice the maximum filling pressure of the cylinder without damage.

All medium pressure parts downstream of the pressure reducer shall be capable of withstanding twice their maximum attainable working pressure without damage. Testing shall be done in accordance with **6.4**.

5.15 Cylinder(s) and Main Valve

5.15.1 The cylinders shall comply with the requirements for cylinder for breathable air given in the Gas Cylinder Rules, 2016, of the Government of India, with such modifications as may be ordered from time to time by the Chief Inspector of Explosives, Government of India, or any other duly constituted authority. The cylinder shall be approved with respect to the appropriate filling pressure.

5.15.2 The cylinder valves shall comply with the requirements for the applicable valves as given in the Gas Cylinder Rules, 2016, of the Government of India, with such modifications as may be ordered from time to time by the Chief Inspector of Explosives, Government of India, or any other duly constituted authority.

The design of the cylinder valve shall be such as to ensure safe performance. The valve shall be so designed that the valve spindle cannot be completely unscrewed from the assembly during normal operation of the valve. The valve shall be designed so that it cannot be closed inadvertently by contact with a surface by one of the following methods:

a) The valve shall be designed so that a minimum of two turns of the hand wheel are required to open the valve fully;
b) The valve shall be lockable in open position; and
c) Apparatus fitted with more than 2 cylinders may be fitted with individual valve in each cylinder.

Testing shall be done as per **6.4** and **6.5**.

5.15.3 *Outlet Valve*

It shall not be possible to connect apparatus with a higher maximum filling pressure to an apparatus which is designed for a lower maximum filling pressure. Testing shall be done as per **6.4** and **6.5**.

5.16 Pressure Reducer

5.16.1 *General*

If the apparatus is designed with a pressure reducer, any adjustable medium pressure stage shall be reliably secured against accidental alteration and adequately sealed so that any unauthorised adjustment can be detected.

A pressure reducer relief valve shall be provided if the downstream parts of the apparatus cannot withstand the full pressure of the cylinder. Testing shall be done in accordance with **6.4**.

5.16.2 *Apparatus with a Pressure Reducer Relief Valve*

The pressure reducer relief valve shall be designed to pass an air flow of 400 l/min at a medium pressure not exceeding 30 bar. With the pressure reducer relief valve activated the inhalation and exhalation breathing resistance shall not exceed 25 mbar. Testing shall be done in accordance with **6.7** and **6.7.1**.

5.16.3 *Apparatus without a Pressure Reducer Relief Valve*

Where a pressure reducer relief valve is not provided, the inhalation and exhalation breathing resistance shall not exceed 25 mbar. Testing shall be done in accordance with **6.7** and **6.7.2**.

5.17 Pressure Indicator and Tube

5.17.1 *General*

The information given by the pressure indicator and the warning device (*see* **5.18**) shall be complementary in every case.

NOTE — Whatever technology is used the devices should be designed in order to avoid a common mode fault unless failure mode is fail to safe.

The apparatus shall be equipped with a reliable pressure indicator which will read the pressure in the cylinder(s) on opening the valve(s) to ensure that the individual or equilibrated pressure is measured respectively. Moreover, the pressure indicator shall be placed in a manner that it can be conveniently viewed by the wearer. The pressure indicator tube shall be sufficiently robust to withstand rough usage which it is likely to receive in service with respect to its classification. Where the tube is protected by a cover the enclosed space shall be vented to the atmosphere. Testing shall be done in accordance with **6.4** and **6.5**.

5.17.1.1 The pressure indicator shall be resistant to water and shall withstand immersion in water at a depth of 1 m for 24 h. After the test no water shall be visible inside the device. Testing shall be done in accordance with **6.4.**

5.17.1.2 The pressure indicator shall be graduated from zero up to a value of at least 50 bar above the maximum filling pressure of the cylinder. It shall be possible to read the gauge marking in poor light. Testing shall be done in accordance with **6.4**

5.17.1.3 Table 1 shall apply regarding the accuracy when reading at decreasing pressure when compared with control manometer. The maximum diameter of the case shall not exceed 63 mm. The design of the gauge shall allow the reading of the indicated pressure with 10 bar. Testing shall be done in accordance with **6.4.**

5.17.1.4 When pressure indicator and connecting hose are removed from the apparatus then the flow shall not exceed 25 l/min at 200 bar. Testing shall be done in accordance with **6.4**.

Table 1 Accuracy of Pressure Gauge Reading at Decreasing Pressure
(*Clause* 5.17.1.3)

Sl No.	Pressure Gauge Reading	Accuracy
(1)	(2)	(3)
i)	40 bar	+ 0 bar - 5 bar
ii)	100 bar	± 10 bar
iii)	200 bar	± 10 bar
iv)	300 bar	± 10 bar

5.17.2 *Pressure Indicator, Pointer Type*

The pressure indicator shall be provided with a blow out release which protects the wearer against injuries. The gauge window shall be made of a material being non-splintering when breaking. Testing shall be done in accordance with **6.4**.

5.17.3 *Pressure Indicator, Tactile Type*

The indicator shall be secured against accidental blow out. Testing shall be done in accordance with **6.4**.

5.17.4 *Electronic Pressure Indicator*

If the pressure indicator is equipped with an electrical energy source, it shall comply with the class Ex ia IIC T4 in accordance with IS/IEC 60079-11, or for mining industry, with class Ex ia I in accordance with IS/IEC 60079-0. Testing shall be done in accordance with IS/IEC 60079-11 and IS/IEC 60079-0 at normal conditions as well as at –30 °C and 60 °C. The measurement accuracy shall be maintained when testing the device on electromagnetic compatibility in accordance with IS 14700 (Part 6/Sec 2).

5.18 Warning Device

5.18.1 *General*

The information given by the warning device and the pressure indicator (*see* **5.17**) shall be complementary in every case.

NOTE — Whatever technology is used the devices should be designed in order to avoid a common mode fault unless failure mode is fail to safe.

The apparatus shall have a suitable warning device that operates when the pressure inside the cylinder drops to a predetermined level to warn the wearer. The warning device shall either be activated automatically when the cylinder valve(s) is/are opened or, if manually activated, it shall not be possible to use the apparatus before the device is activated.

The warning device shall activate at a pressure of 55 bar ± 5 bar or at such higher pressure as will ensure that at least 200 litres of air remain within the cylinder. If an audible warning device is used, the sound pressure level shall be at least 90 dB(A) measured at the ear nearest to the device and the frequency shall be between 2 000 Hz to 4 000 Hz. The audio signal may be either continuous or intermittent. When activated, the duration of the warning at 90 dB(A) shall be at least 15 s for a continuous signal and 60 s for an intermittent signal and thereafter shall continue to sound down to 10 bar. After response of the warning device the wearer shall be able to continue breathing without difficulty. Testing shall be done in accordance with **6.4** and **6.8**.

5.18.2 *Pneumatic Warning Device*

The air loss that might be caused by the warning signal shall not exceed an average of 5 l/min from response of signal to a pressure of 10 bar. The warning device shall continue to operate in a temperature range of 0 °C to 10 °C at a relative humidity of 90 %. Testing shall be done in accordance with 6.8.

5.18.3 *Electronic Warning Device*

Warning devices which operate electrically shall comply with the class Ex ia IIC T4 in accordance with IS/IEC 60079-11, or for mining industry, with class Ex ia I in accordance with IS/IEC 60079-0. Testing shall be done in accordance with IS/IEC 60079-11 and IS/IEC 60079-0 at normal conditions as well as at –30 °C and 60 °C. The measurement accuracy shall be maintained when testing the device on electromagnetic compatibility in accordance with IS 14700 (Part 6/Sec 2).

5.19 Flexible Hoses and Tubes

5.19.1 *Resistance to Collapse*

When tested as per **6.12**, the air flow shall not be reduced by more than 10 percent at the specified air flow rate. There shall be no visible deformation within 5 min after the completion of the test.

5.19.2 *Medium Pressure Connecting Tube*

Tubes to the demand valve (connections included) shall withstand for at least 15 min twice the operating pressure of pressure reducer safety valve or at least 30 bar whichever is higher. Testing shall be done as per **6.4**.

5.20 Lung Governed Demand Valve

5.20.1 *General*

The air supply shall be such that a sinusoidal flow of 40 x 2.5 l/min can be maintained at pressures above 20 bar in the cylinder and a sinusoidal flow of 25 x 2 l/min can be maintained at cylinder pressure of 10 bar. Testing shall be done as per **6.13**.

5.20.2 *Apparatus without Positive Pressure*

The negative pressure for opening the lung governed demand valve shall be between 0.5 mbar and 3.5 mbar when tested using a continuous flow of 10 l/min from maximum filling pressure to 10 bar. A self-opening of the demand valve at negative pressures of less than 0.5 mbar shall not occur. Testing shall be done in accordance with **6.4.**

5.20.3 *Apparatus with Positive Pressure*

The lung governed demand valve for positive pressure apparatus shall be fitted with a manual or an automatic change-over switch. Testing shall be done in accordance with **6.4**.

5.20.4 *Supplementary Air Supply*

Apparatus without positive pressure shall be provided with a manually operated means of providing a supply of air at a flow rate of at least 60 l/min at all cylinder pressures above 50 bar. It is optional to provide this device in apparatus with positive pressure. Testing shall be done in accordance with **6.4**.

5.21 Breathing Resistance

5.21.1 *Inhalation Resistance*

5.21.1.1 *Apparatus without positive pressure*

a) The inhalation resistance of an apparatus without full face mask fitted shall not exceed 4.5 mbar at all cylinder pressures from maximum filling pressure to 10 bar, when tested at 25 x 2 l/min. Where a lung governed demand valve is attached to a full face mask, the negative pressure shall not exceed 7 mbar; and

b) The inhalation resistance of an apparatus without full face mask fitted shall not exceed 10 mbar at all cylinder pressures from maximum filling pressure to 20 bar, when tested at 40 x 2.5 l/min.

Testing shall be done in accordance with **6.13.**

5.21.1.2 *Apparatus with positive pressure*

The apparatus shall be designed such that positive pressure is maintained in the cavity of the mask adjacent to the face seal. The pressure shall be positive but not exceed 5 mbar.

a) At a sinusoidal flow of 40 x 2.5 l/min this requirement shall be met at all cylinder pressures above 20 bar; and

b) At a sinusoidal flow of 25 x 2 l/min the requirement shall be met down to a cylinder pressure of 10 bar.

Testing shall be done in accordance with **6.13.**

5.21.2 *Exhalation Resistance*

5.21.2.1 *General*

This requirement applies only to apparatus with incorporated full face mask.

5.21.2.2 *Apparatus without positive pressure*

The exhalation resistance shall not exceed 3.0 mbar when tested in accordance with **6.13**.

5.21.2.3 *Apparatus with positive pressure*

The exhalation resistance shall not exceed 6 mbar at a continuous flow of 10 l/min; 7 mbar at a sinusoidal flow of 25 x 2 l/min; and 10 mbar at a sinusoidal flow of 40 x 2.5 l/min. Testing shall be done in accordance with **6.13**.

5.21.3 *CO_2 Content of Inhaled Air*

During the breathing resistance test as per **6.13**, the carbon dioxide content of the inhaled air (including dead space effects) shall not exceed 1.5 percent (by volume).

5.22 Static Pressure

For apparatus with positive pressure, the static pressure in the mask cavity under conditions of equilibrium shall not exceed 5 mbar. Testing shall be done in accordance with **6.4**.

5.23 Leak-Tightness

5.23.1 *General*

The assembled apparatus shall satisfy the following requirements for leak-tightness, at both low and high pressures. Any leakage of the full face mask (if fitted) at the dummy head is prevented by sealing the facepiece to the dummy head.

NOTE — These tests are not intended to simulate face fit testing.

5.23.2 *Low Pressure*

The assembled apparatus without full face mask fitted shall be tested for leak-tightness at a negative and a positive pressure of 7.5 mbar. After the

pressure has stabilized the pressure change shall not be greater than 0.3 mbar in 1 min. Testing shall be done in accordance with **6.9.1**.

5.23.3 *High Pressure*

5.23.3.1 *Apparatus without positive pressure*

When tested in accordance with **6.9.2**, the pressure change shall not be greater than 10 bar in 1 min.

5.23.3.2 *Apparatus with positive pressure*

When tested in accordance with **6.9.2**, the pressure change shall not be greater than 20 bar in 1 min.

6 TEST METHODS

6.1 Pre-Conditioning

The apparatus shall undergo the following pre-conditioning cycle before carrying out the tests:

a) At (70 ± 3) °C in dry atmosphere for (72 ± 3) h;
b) At (70 ± 3) °C in wet atmosphere for (72 ± 3) h; and
c) At (-30 ± 3) °C in dry atmosphere for (24 ± 1) h.

WARNING — The cylinders shall be filled not more than 50 % of filling pressure during conditioning.

6.2 General

For tests involving human subjects, any national regulation related to examination of fitness of test subject with regard to medical history or any other factors shall be addressed.

Positive pressure apparatus shall be tested with complete apparatus including full face mask. If not specified otherwise, two apparatus shall be tested.

6.3 Testing Atmosphere and Tolerances

Except for temperature limits, values which are not stated as maxima or minima shall be subject to a tolerance of ± 5 %. Unless specified otherwise, the ambient conditions for testing shall be 27 ºC ± 2 ºC and 65 percent ± 5 percent relative humidity.

6.4 Visual Inspection

This test shall be carried out before other performance tests. During visual inspection, the apparatus shall be examined with respect to manufacturer's instructions for maintenance, safety data sheets, marking and other information supplied. Dismantling and re-assembling of device may be required. If no special measuring devices or measuring methods are specified, commonly used methods and devices should be applied.

6.5 Practical Performance

Practical performance test shall be performed with two apparatus and four subjects. Two subjects shall be used for walking test and the other two for work simulation test.

6.5.1 *Test Subjects*

Breathing apparatus is tested by test subjects who practise regularly with breathing apparatus and whose medical history is known to be satisfactory. They shall be medically examined immediately before the tests and certified fit to undertake the test procedure. Each subject is suitably clothed.

6.5.2 *Medical Supervision*

The tests shall be carried out under the supervision of a registered medical practitioner.

6.5.3 *Preparation of Apparatus to be Tested*

The high pressure cylinder is purged with air before being fully charged to the prescribed pressure. The apparatus is assembled, the resistance to breathing is measured (*see* **6.13**) and the apparatus is tested for leak tightness (*see* **6.9**). If the apparatus satisfies the requirements of breathing resistance (*see* **5.21**) and leak tightness (*see* **5.23**), then only they are used.

The cylinder pressure at the start of the practical performance test should correspond to the prescribed filling pressure.

6.5.4 *Test Procedure*

6.5.4.1 All tests shall be carried out at normal room temperature and test pressure and humidity shall be recorded.

During the test, the apparatus will be subjectively assessed by the wearer and the wearer’s comments on the following points shall be recorded after the test:

a) Harness comfort;

b) Security of fastenings and couplings;

c) Accessibility of controls and pressure gauge;

d) Clarity of vision on the visor of the facemask;

e) Supplementary supply (if fitted);

f) Speech transmission;

g) Audible warning device; and

h) Any other comments reported by the wearer on request.

6.5.4.2 *Walking test*

Two subjects wearing the apparatus walk on a level treadmill with full headroom at a regular rate of 6 km/h for a period equal to the working duration of the apparatus or 30 min whichever is less. The test has to be continuous without removing the apparatus.

If the product is claimed to be suitable for use with corrective lens interface, one test subject shall wear corrective eyewear specified by the manufacturer (uncorrected lenses may be used). The other test subject shall not wear any corrective eyewear except contact lenses.

If the product is not claimed to be suitable for use with corrective lens interface, both test subjects shall conduct the test without any corrective eyewear except contact lenses.

If the audible warning device has not operated during the 30 min test period, the cylinder pressure shall be reduced manually to the audible warning pressure range, to check the effectiveness of the latter, which shall comply with the requirements of **5.18**.

6.5.4.3 *Work simulation test*

The apparatus is tested under conditions which can be expected during normal use using two test subjects. During this test the following activities shall be done to simulate the practical use of the apparatus. The test shall be completed within a total working time of 30 min.

The sequence of activities is at the discretion of the test authority. The individual activities shall be arranged so that sufficient time is left for the measurements prescribed:

a) Lift a box, which is positioned on the left side of the test subject, off the floor and place on a shelf which is positioned in front of the test subject and at the same level as the top of the subject's head (0 + 0.1) m. Release the box and wait approximately 10 s, then place box back on the floor at the right side of the test subject. Start with the box on the right and repeat the sequence alternating between the left and right side of the subject. Perform this sequence 10 times in total.
The box shall weigh (1.50 ± 0.25) kg and shall be not less than 200 mm and not greater than 400 mm in height, width, or depth;

b) Crawling on the level with headroom of less than 0.75 m (total distance 100 m);

c) A hopper (1.50 ± 0.05) m tall shall be placed on the floor and filled with chippings of wood or cork or similar with a length of 10 mm to 30 mm. The hopper shall have an open top and an opening at the bottom to allow the contents to be removed with a small shovel (*see* Fig. 1).

During the exercise, the wearer shall stoop or kneel as preferred and partially fill a container, such as a basket or bucket of approximately 8 l capacity, with the chippings. The wearer shall then stand and empty the chippings from the container back into the top of the hopper. This activity shall be repeated approximately 2 times each min for 5 min;

d) A hopper (1.50 ± 0.05) m tall shall be placed on the floor and filled with chippings of wood or cork or similar with a length of 10 mm to 30 mm. The hopper shall have an open top and an opening at the bottom to allow the contents to be removed with a small shovel (*see* Fig. 1).

During the exercise, the wearer shall stoop or kneel as preferred and partially fill a container, such as a basket or bucket of approximately 8 l capacity, with the chippings. The wearer shall then stand and empty the chippings from the container back into the top of the hopper. This activity shall be repeated approximately 2 times each min for 5 min;

e) Roll a metal or plastic drum along a level floor. The drum shall contain dry sand or an equivalent inert substance such that the drum has a total mass of (15 ± 2) kg. At least one hand shall be in contact with the drum at all times. The drum shall be between 450 mm and 600 mm in diameter and 800 mm to 900 mm high. Perform the activity for 3 min;

f) Climb continuously up and down a staircase of at least four steps of height (190 ± 15) mm. The subject shall ascend a total of 20 steps and shall face the direction of travel during both the ascent and descent. It is permitted to use a handrail;

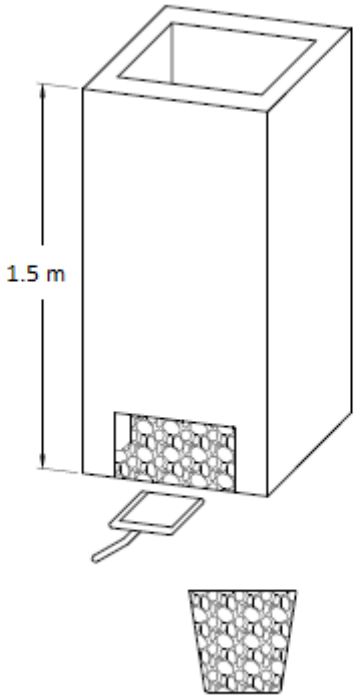


FIG. 1 BASKET AND HOPPER WITH CHIPPINGS

g) Crawling through a narrow section (4 m long) which is so low that the test subject has to doff the apparatus and push it in front of him or pull it behind him while still breathing from the apparatus;

h) Clarity of vision — The test subject shall read a sign consisting of five random black letters 150 mm in height on a white background at a distance of 6 m in a normally illuminated room. The test subject shall correctly identify all five letters. If the test subject cannot identify all five letters, the test subject shall comment on the reasons for failure, for example. distortion or fogging. Perform the activity within 2 min; and

i) Communication performance (hearing and speech) — Two test subjects shall wear the same RPD type and stand at a distance of (2 ± 0.5) m in an environmental background level of 65 dBA to 70 dBA.

The test officer shall write down the numbers "1" to "20" in random order and pass the list to the first test subject. The first test subject shall call out the numbers in the given order. A second test subject shall be able to understand the numbers called out by the first test subject and write them down.

This test shall be continuous, without removal of the apparatus, for an initial period of approximately 15 min after which the test subject shall have a rest period of 5 min during which he can be medically assessed and allows for time to change the cylinder if the testing officer considers that there may be insufficient air to complete the test. The second section of the test shall then be continued to complete a working time of 30 min. If the exercises have been completed within less than 30 min the remaining time is to be used by the subject to walk at 6 km/h.

If the product is claimed to be suitable for use with corrective lens interface, then one test subject shall wear corrective eyewear specified by the manufacturer (uncorrected lenses may be used) and the other test subject shall not wear any corrective eyewear except contact lenses.

If the product is not claimed to be suitable for use with corrective lens interface, both test subjects shall conduct the test without any corrective eyewear except contact lenses.

6.6 Resistance to Temperature and Flammability

6.6.1 *Tests with Breathing Machine*

6.6.1.1 *Tests at low temperature*

The apparatus including the cylinder(s) and full face mask shall be cooled in an ambient temperature of (-30 ± 3) °C for (4 ± 1) h. In the case of wrapped composite cylinders the time shall be at least 12 h.

Subsequently, the apparatus is taken out of the cooling chamber, mounted on the RPD torso and headform specified in IS 17274 (Part 5), connected to a breathing machine operated at 25 x 2 l/min and shall be tested in accordance with Method 2 of IS 17274 (Part 2). The breathing machine shall be operated until the compressed air supply is exhausted (20 bar). Thereafter the empty cylinder(s) are replaced with fully charged cylinder(s) previously stored at room temperature and the breathing machine shall be operated until the compressed air is exhausted.

6.6.1.2 *Tests at high temperature*

The apparatus including cylinder(s) (filling pressure:100 bar) and full face mask is stored in a chamber at a temperature of (60 ± 3) °C and a relative humidity of not more than 50 % for (4 ± 1) h. In the case of wrapped composite cylinders the time shall be at least 12 h.

Subsequently, the apparatus is taken out of the chamber, mounted on the RPD torso and headform specified in IS 17274 (Part 5), connected to a breathing machine operated at 25 x 2 l/min and shall be tested in accordance with Method 2 of IS 17274 (Part 2). The breathing machine shall be operated until the compressed air supply is exhausted (20 bar).

6.6.1.3 *Flame engulfment*

One apparatus shall be tested for flame engulfment. The breathing machine shall be set to operate at a rate of 25 x 2 l/min. The apparatus mounted on the test manikin shall be placed in an oven which has been pre-heated to (90 ± 5) °C. After the oven door is closed and the temperature recovers to (90 ± 5) °C, the apparatus shall be exposed to the conditions for (15 ± 1) min.

The test oven recovery time shall not exceed 1 min. At the completion of the (15 ± 1) min exposure, the apparatus mounted on the test manikin shall be moved out of the oven and tested for flame engulfment according to **6.2.5** of IS 17274 (Part 10).

6.6.2 *Practical Performance at Low Temperature*

6.6.2.1 *Test at low temperature*

Two ready for use apparatus sets shall be kept in a chamber at (-30 ± 3) °C for (4 ± 1) h. Thereafter, two warmly clothed subjects shall don the cooled apparatus in a cold chamber set at an ambient temperature of (–15 ± 3) °C and perform work. The test is continuous without removal of the apparatus over a period of 30 min or at least until the warning device starts to operate.

The work shall be equally divided between:

a) walking and crawling slowly as per **6.5.4.3**; and
b) carrying and building with wooden blocks or similar as per **6.5.4.3**.

At the end of the test, the resistance to breathing shall be measured by mounting the apparatus on the RPD torso and head form specified in IS 17274 (Part 5), connecting to a breathing machine operated at 25 x 2 l/min and using Method 2 of IS 17274 (Part 2) to determine whether there is any obstruction, and the apparatus is examined for malfunction due to the low temperature.

6.6.2.2 *Test at low temperature after storage at room temperature*

Two ready for use apparatus sets shall be kept at room temperature of (27 ± 2) °C for (4 ± 1) h. Thereafter, two warmly clothed subjects shall don the apparatus and enter a cold chamber set at an ambient temperature of (– 6 ± 2) °C and perform work. The test is continuous without removal of the apparatus over a period of 30 min or at least until the warning device starts to operate.

The work shall be equally divided between:

a) walking and crawling slowly as per **6.5.4.3**; and
b) carrying and building with wooden blocks or similar as per **6.5.4.3**.

At the end of the test, the resistance to breathing shall be measured by mounting the apparatus on the RPD torso and head form specified in IS 17274 (Part 5), connecting to a breathing machine operated at 25 x 2 l/min and using Method 2 of IS 17274 (Part 2) to determine whether there is any obstruction, and the apparatus is examined for malfunction due to the low temperature.

6.7 Pressure Reducer

The apparatus along with full face mask is mounted on the RPD torso and head form specified in IS 17274 (Part 5) and connected to a breathing machine operated at 25 x 2 l/min.

6.7.1 Apparatus with a Pressure Reducer Relief Valve

With the breathing machine not operating, a suitable flow measuring device is connected to the outlet of the relief valve and air is supplied to the medium pressure side of the pressure reducer. The air supply pressure is gradually increased until a flow of 400 l/min passes through the relief valve.

Maintainingthis condition the breathing machine is started and the breathing resistance is measured as per **6.13** at the appropriate pressure sample point.

6.7.2 *Apparatus without a Pressure Reducer Relief Valve*

The outlet of the demand valve is connected to a suitable flow measuring device. Air is supplied to the medium pressure side of the pressure reducer and the air supply pressure is gradually increased. The medium pressure required to create a continuous flow of 400 l/min through the demand valve is recorded. Under these conditions, the breathing machine is started and the breathing resistance of the complete apparatus including full face mask is measured as per **6.13** at the appropriate pressure sample point.

6.8 Warning Device

The performance of the warning device is measured using a breathing machine set at 25 x 2 l/min. To test the warning device at temperatures between 0 °C and 10 °C, air shall be passed through the apparatus in a climatic test chamber using a breathing machine outside the climatic chamber at room temperature. During the test the environment of the apparatus shall have a temperature of (3 ± 1) °C and a relative humidity of > 90 %. Every 5 min, water shall be sprayed on for 3 s directed at the warning device from a distance of 200 mm.

6.9 Leak-tightness

6.9.1 *Low Pressure Test*

The apparatus is tested with the cylinder(s) closed and with the demand valve connected to a device which will create a negative and a positive pressure of 7.5 mbar and also to a manometer.

NOTE — It may be necessary to seal the warning device during the negative pressure test.

6.9.2 *High Pressure Test*

The apparatus with fully charged cylinder(s) shall be assembled according to the manufacturers' instructions. The full face mask shall be completely sealed using a RPD head form. The cylinder valve is opened and when the apparatus is completely pressurized the cylinder valve(s) is (are) closed and the pressure drop is measured by observing the pressure gauge of the apparatus.

6.10 Water Immersion

The RPD head form is connected to a breathing machine by a flexible hose. The full face mask of the apparatus is fitted to the RPD head form.

The test is conducted with the breathing machine operated at 25 x 2 l/min. The complete apparatus as worn is immersed in water to a depth of between 0.25 m and 0.80 m for a period of not less than 3 and not more than 5 full breathing cycles. A series of tests is carried out with the apparatus immersed and with the RPD head form in two orientations, which represent respectively the maximum and minimum differential pressures between the lung governed demand valve and the exhalation valve. The apparatus and head form are removed from the water after each test at each orientation.

Measurements of breathing resistance shall be made at the appropriate pressure sample points using a precision gauge. The breathing resistance is recorded prior to and immediately after each immersion. The presence of water in the full face mask after the test does not constitute a reason for failure and any water present may be removed prior to measurement of breathing resistance.

6.11 Strength of Connections

Connections of the breathing hose (if fitted) to the full face mask connector and to the demand valve or between the full face mask connector and the demand valve shall be tested as per **6.10** of IS 17274 (Part 6) using an axial pull force of 250 N.

6.12 Resistance to Collapse of Breathing Hose

Resistance of breathing hoses against compressive load shall be tested as per **6.2** of IS 17274 (Part 6).

6.13 Breathing Resistance

For testing breathing resistance (both inhalation and exhalation resistance), the apparatus (with or without positive pressure) is to be mounted on a RPD torso and head form as specified in IS 17274 (Part 5), connected to a breathing machine and to be tested in accordance with Method 2 of IS 17274 (Part 2).

7 TESTING SCHEDULE

Table 2 provides list of tests along clause no., requirement clause no., pre-conditioning requirement, and sample size.

Table 2 Testing Schedule
(*Clause* 7)

Sl No.	Test Title	Test Method Clause	Requirement Clause	Pre-conditioning as per 6.1	Sample size
(1)	(2)	(3)	(4)	(5)	(6)
j)	Visual Inspection	**6.4**	**5.3, 5.4.1, 5.4.3, 5.5, 5.6, 5.8.1, 5.8.2, 5.8.5, 5.13, 5.14, 5.15.2, 5.15.3, 5.16.1, 5.17.1, 5.17.1.1, 5.17.1.2, 5.17.1.3, 5.17.1.4, 5.17.2, 5.17.3, 5.18.1, 5.19.2, 5.20.2, 5.20.3, 5.20.4, 5.22, A-2.1.3, A-2.1.4, A-2.3, B-2.4**	Yes	All
ii)	Cleaning and Disinfection	**5.5**	**5.5**	Yes	2
iii)	Practical performance	**6.5**	**5.3, 5.4.1, 5.4.3, 5.5, 5.8.1, 5.8.2, 5.10, 5.11, 5.15.2, 5.15.3, 5.17.1, A-2.1.1, A-2.3, B-2, B-2.1, B-2.3, B-2.4**	Yes	2
iv)	Temperature test with breathing machine at low temperature	**6.6.1.1**	**5.12.1.2**	Yes	2
v)	Temperature test with breathing machine at high temperature	**6.6.1.2**	**5.12.1.3**	Yes	2
vi)	Flame engulfment	**6.6.1.3**	**5.12.2.2**	Yes	1
vii)	Flammability	**5.12.2.1**	**5.12.2.1**	Yes	2
viii)	Practical performance at low temperature	**6.6.2**	**5.11**	Yes	2
ix)	Pressure reducer	**6.7**	**5.16.2, 5.16.3**	Yes	2
x)	Warning device	**6.8**	**5.18.1, 5.18.2, B-2.4**	Yes	2
xi)	Leak-tightness	**6.9**	**5.23.2, 5.23.3**	Yes	2
xii)	Water Immersion	**6.10**	**5.7**	No	2

Table 2 (*Concluded*)

Sl No.	Test Title	Test Method Clause	Requirement Clause	Pre-conditioning as per 6.1	Sample size
(1)	(2)	(3)	(4)	(5)	(6)
xiii)	Strength of Connections	**6.11**	**5.8.3, A-2.1.2**	Yes	2
xiv)	Resistance to collapse of breathing hose	**6.12**	**5.19.1**	Yes	2
xv)	Breathing resistance	**6.13**	**5.20.1, 5.21, A-2.2, B-2.2,**	Yes	2

Minimum number of samples needed: 2(CD) + 2(WI) + 1(FE) + 2(F) + 2(All other tests) = 9

where,

CD = cleaning and disinfection

WI = water immersion

FE = flame engulfment

F = flammability

8 INFORMATION SUPPLIED BY THE MANUFACTURER

Breathing apparatus manufactured in compliance with this standard shall be accompanied by operating instructions, in one or more national official languages, for maintenance and use which shall include where appropriate:

a) Application and limitation;
b) Nominal working duration;
c) Guidance on donning and fitting of facepiece, and adjustment of face seal where required;
d) Checks prior to use;
e) Maintenance – shall include periodic inspection and testing of cylinder(s);
f) Storage conditions of the apparatus;
g) Information on spare parts (if needed);
h) The air supplied to the respiratory interface by the cylinders shall meet the requirements of breathable air specified by national regulatory agency;
j) Explanation of markings on the apparatus; and
k) Any other information deemed necessary by the manufacturer.

9 MARKING

9.1 Breathing apparatus manufactured in compliance with this standard shall be marked with the following particulars:

a) Name, trade-mark or other means of identification of the manufacturer/supplier/importer;
b) Model no. and serial no. of the device;
c) Size of full face mask (if more than one size is available);
d) Year and month of manufacture;
e) Where the apparatus meets temperature requirements outside those specified in **5.12.1.1**, it shall be marked with the range;
f) Where the apparatus meets the requirements of **5.12.2.2** the full face mask shall be marked with "cl 3+";
g) Where the recommendations of Annex C have been adopted, the demand valve shall be marked with "A";
h) Where the reliable performance of parts may be affected by ageing, means of identifying the date (at least the year) of manufacture shall be given;
j) Sub-assemblies and components with considerable bearing on safety shall be marked so that they can be identified. If sub-assemblies with considerable bearing on safety are too small to be marked, the information shall be given in the information supplied by the manufacturer; and
k) The pressure reducer shall be durably marked with a serial number. The marking shall be such that the year of production

can be ascertained. In addition, provision shall be made to mark the date (year and month) and test marks of the last testing performed.

9.2 The markings shall be as clearly visible and as durable as possible.

9.3 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

ANNEX A
(*Clause* 5.1)

SECOND MEDIUM PRESSURE CONNECTOR

A-1 GENERAL

A-1.1 Outlet Connector

A second medium pressure outlet connector is used for the supply of air to a second person for the purposes of rescue.

A-1.2 Inlet Connector

A second medium pressure inlet connector is used for the supply of air from an alternative medium pressure air source.

A-1.3 Combined Connector

A second medium pressure combined connector is used for the supply of air to a second person as in **A-1.1** and for the supply of air from an alternative air source as is in **A-1.2**.

A-2 REQUIREMENTS

A-2.1 General

A-2.1.1 The connector shall be arranged such that the wearer of the self-contained open-circuit breathing apparatus can operate (connect and disconnect) it without assistance or doffing the apparatus. Testing shall be done in accordance with **6.5**.

A-2.1.2 The connector shall be attached such that in connected position, the proper use of the apparatus shall not be impaired if a pull of 250 N is applied. Testing shall be done in accordance with **6.11**.

A-2.1.3 When disconnected, the connector shall be self-sealing. Testing shall be done in accordance with **6.4.**

A-2.1.4 When not in use the connector shall be protected from contamination. Testing shall be done in accordance with **6.4**.

A-2.2 Outlet Connector

A-2.2.1 The breathing resistance requirements as per this standard (*see* **5.21**) shall be met by the self-contained open-circuit breathing apparatus whilst a constant flow of 110 l/min is taken out of the connector. Testing shall be done in accordance with **6.13**.

A-2.2.2 Where the manufacturer has defined a compatible rescue device, the breathing resistance requirement as per this standard (*see* **5.21**) shall be met by the self-contained open-circuit breathing apparatus whilst a sinusoidal flow of 25 x 2 l/min is taken out of the connector. Only compatible rescue devices shall be used. Testing shall be done in accordance with **6.13**.

A-2.3 Inlet Connector

When the connector is used for an alternative source of medium pressure air, the cylinder(s) of the self-contained open-circuit breathing apparatus shall be excluded either by an automatic switch valve or by a manual operation. Testing shall be done in accordance with **6.4** and **6.5**.

A-3 INFORMATION SUPPLIED BY THE MANUFACTURER

A-3.1 The manufacturer shall specify those auxiliary devices which may be used in conjunction with the self-contained open-circuit breathing apparatus.

A-3.2 When using the connector as inlet connector for an alternative source of medium pressure air (for example. compressed air line breathing apparatus) the manufacturer shall specify the compatible maximum and minimum medium pressure value of the alternative source to be connected. Reference shall be made as to how the air supply from cylinder(s) of the self-contained open-circuit breathing apparatus shall be closed off, to avoid loss of air from these cylinder(s). The user shall be given a warning that the detailed procedure described in the information supplied by the manufacturer shall be followed in order to avoid exposure to higher risks (for example. air loss).

A-3.3 All necessary information to allow planning of any intervention shall be given. The user shall be given a warning when using the outlet connector for rescue purposes about the reduced duration of use resulting from the increased consumption of breathing air by the person being rescued.

ANNEX B
(*Clause* 5.1)

AMBIENT AIR BYPASS DEVICE

B-1 GENERAL

An ambient air bypass device is used for the supply of breathable ambient air to the wearer of a self-contained open-circuit breathing apparatus before entering and after leaving irrespirable atmospheres.

B-2 REQUIREMENTS

The ambient air bypass device shall be arranged such that the wearer of the self-contained open-circuit breathing apparatus can operate it with the apparatus pressurised, without assistance and readily distinguish it by touch from any other component. Testing shall be done in accordance with **6.5**.

B-2.1 If the ambient air bypass device is in open mode no significant air loss shall occur from the demand valve of the self-contained open-circuit breathing apparatus, that is pressure change shall not exceed 20 bar in 1 min. Testing shall be done in accordance with **6.5**.

B-2.2 With the ambient air bypass device in open mode the inhalation resistance of the apparatus shall not exceed 7 mbar when tested according to **6.13**.

B-2.3 It shall not be possible to inadvertently open the ambient air bypass device during use of the apparatus or by contact with another object. Testing shall be done in accordance with **6.5**.

B-2.4 The device shall be fitted with a warning facility that actively draws the attention of the wearer to the fact that the ambient air bypass device is in open mode.

If an acoustic warning device is used the sound pressure level shall be at least 90 dB(A) measured at the ear nearest to the warning device. This warning shall be distinguishable from any other warning fitted to the apparatus. Testing shall be done in accordance with **6.8** but with a breathing rate of 20 x 1.5 l/min.

If alternative warning devices are used testing shall be done in accordance with **6.4** and **6.5**.

B-3 INFORMATION SUPPLIED BY THE MANUFACTURER

Information supplied by the manufacturer shall provide full details of the operation and shall include a warning that incorrect use of the ambient air bypass device or failure to close it will negate the protection afforded by the apparatus.

Warning shall be given that the correct closing mode of the ambient air bypass device is checked prior to entering the irrespirable atmosphere.

ANNEX C
(*Clause* 5.8.4)

REQUIREMENTS FOR STATIC AND DYNAMIC PRESSURE FOR APPARATUS WITH THREAD CONNECTOR IN ACCORDANCE WITH ANNEX D

C-1 GENERAL

This annex is provided for apparatus with thread connectors according to Annex D which may be inadvertently connected to an existing full face mask with Annex D thread connector. In the event of inadvertent coupling of such full face masks to the apparatus as per this standard, these additional clauses are recommended to ensure safe compatibility.

This annex does not imply that apparatus and full face masks which have not been tested and approved as complete apparatus may be used.

C-2 STATIC PRESSURE

The lung governed demand valve of apparatus designed with a connector according to Annex D shall maintain a static pressure of ≤ 3.9 mbar in the positive pressure mode.

For testing, the lung governed demand valve shall be fitted with a cap that can be ventilated and has a port for measuring the pressure using a precision manometer. An air flow of 5 l/min shall be released for a short time. The static pressure shall be measured after the ventilation is shut off.

C-3 DYNAMIC PRESSURE

A positive pressure shall be maintained when the apparatus is tested with a breathing machine operating at 40 x 2.5 l/min at all cylinder pressures above 20 bar. During the inhalation phase the positive pressure shall not exceed 4.2 mbar.

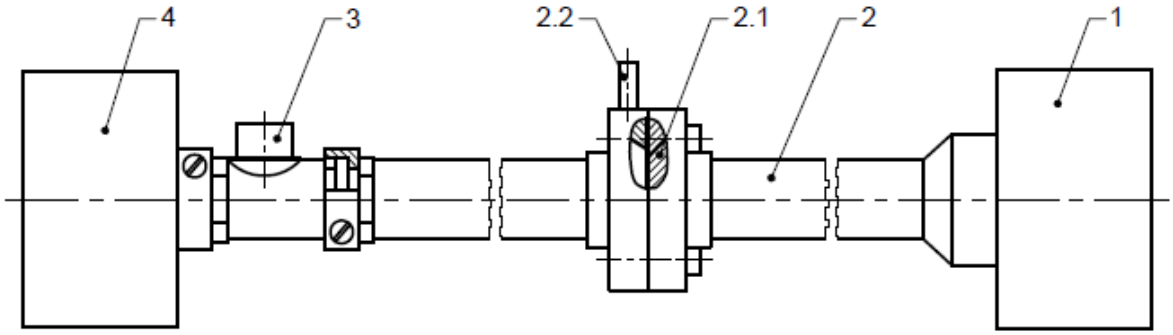
C-4 EXHALATION VALVE

If the lung governed demand valve has an exhalation valve the opening pressure of this exhalation valve shall be at least 4.2 mbar measured at a continuous flow of 10 l/min.

C-5 TESTING OF DYNAMIC PRESSURE

For testing, a test rig as shown schematically in Fig. 2 is used.

A breathing machine delivering sinusoidal flow shall be used. The pressure shall be measured at the port near the orifice. The orifice module shall be designed to have a resistance to airflow of 3.5 mbar at a continuous flow of 300 l/min.



Key
1 M 45 x 3 threaded connector
2 orifice module
2.1 orifice
2.2 measuring point
3 exhalation valve
4 breathing machine connector

FIG. 2 SCHEME OF A TEST RIG FOR DYNAMIC PRESSURE

ANNEX D
(*Clause* 5.8.4)

D-1 GENERAL

This annex specifies thread connection, M 45 × 3, which may optionally be used for facepieces for positive pressure breathing apparatus.

D-2 DIMENSIONS, DESIGNATION

D-2.1 The dimensions shall be as shown in Fig. 3 to Fig. 7. The connections may not correspond to the pictorial details of Fig. 3 to Fig. 7.

D-2.2 Thread connections with an external thread (code PA) on equipment shall be as shown in Fig. 3 and Fig. 4. For single duct systems (*see* Fig. 3) the code shall be PAA and for dual duct systems (*see* Fig. 4) the code shall be PAB.

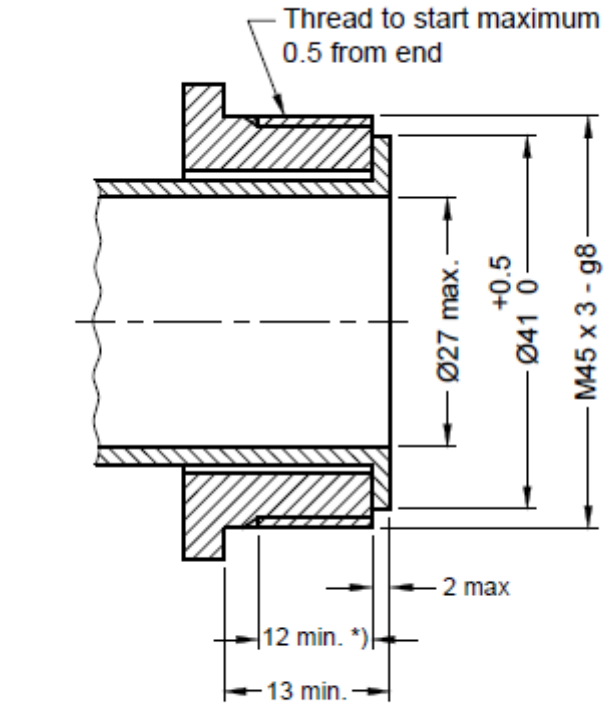


FIG. 3 THREAD CONNECTIONS WITH EXTERNAL THREAD FOR SINGLE DUCT SYSTEMS

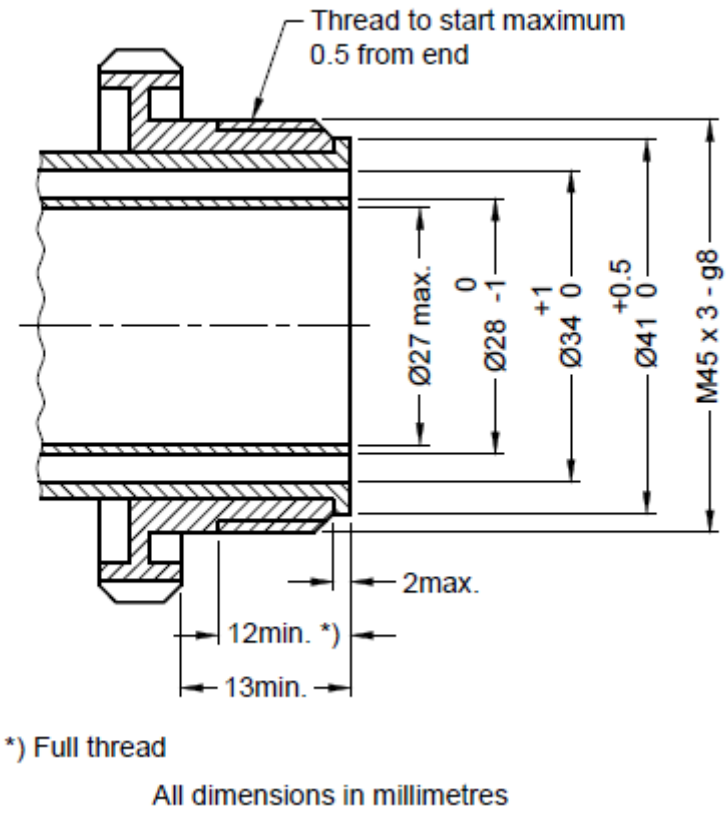


FIG. 4 THREAD CONNECTIONS WITH EXTERNAL THREAD FOR DUAL DUCT SYSTEMS

D-2.3 Thread connections with internal thread (code PI) on facepiece shall be as shown in Fig. 5 and Fig. 6. For single duct systems (*see* Fig. 5) the code shall be PIA and for dual duct systems (*see* Fig. 6) the code shall be PIB.

D-2.4 Gasket shall be as shown in Fig. 7.

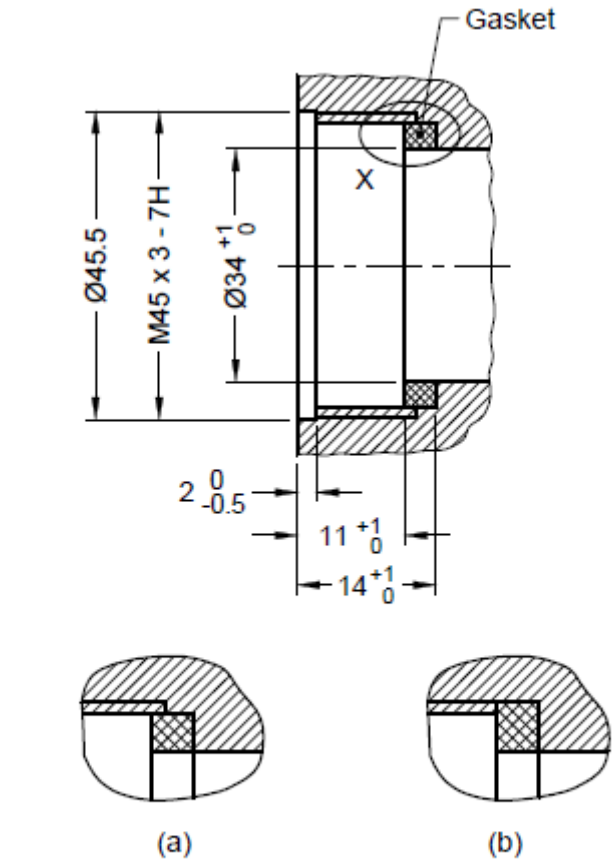


FIG. 5 THREAD CONNECTIONS WITH INTERNAL THREAD FOR SINGLE DUCT SYSTEMS

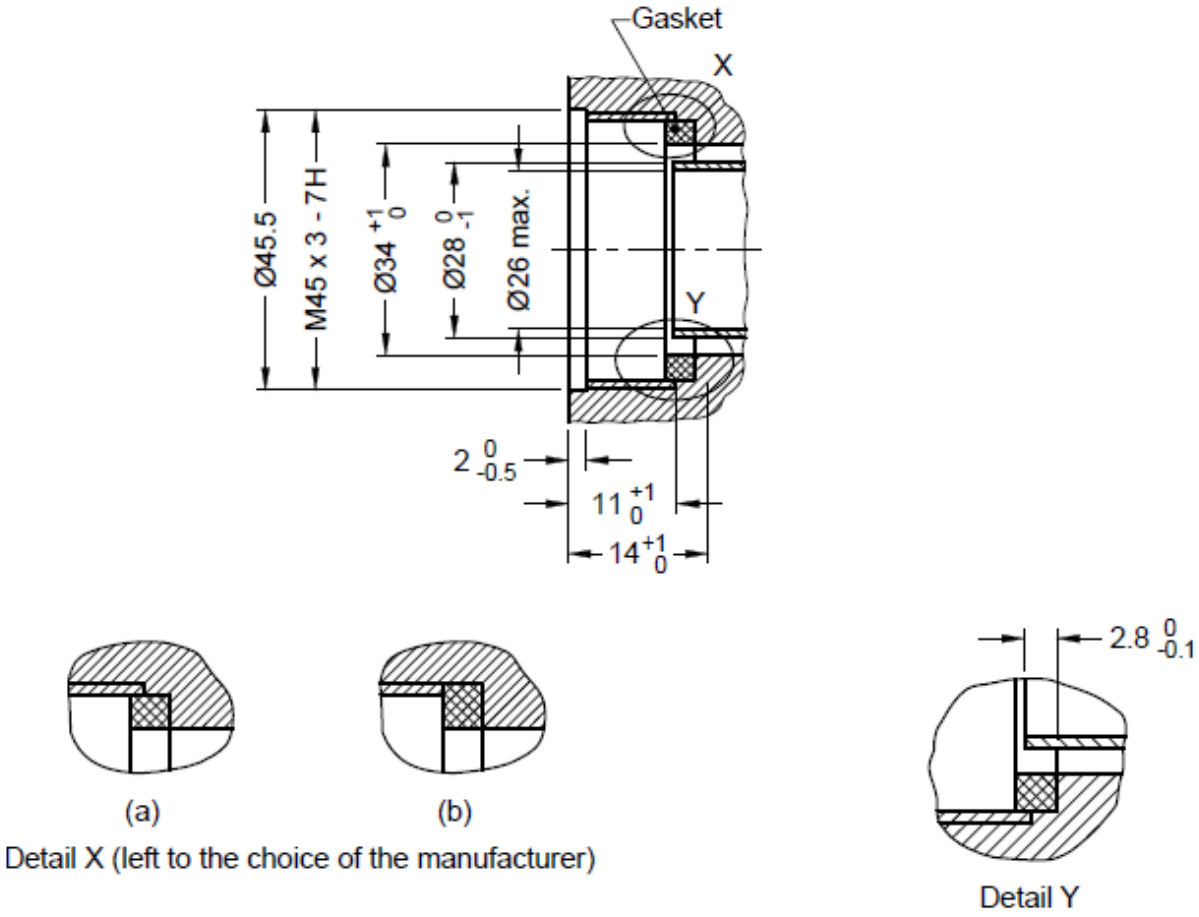
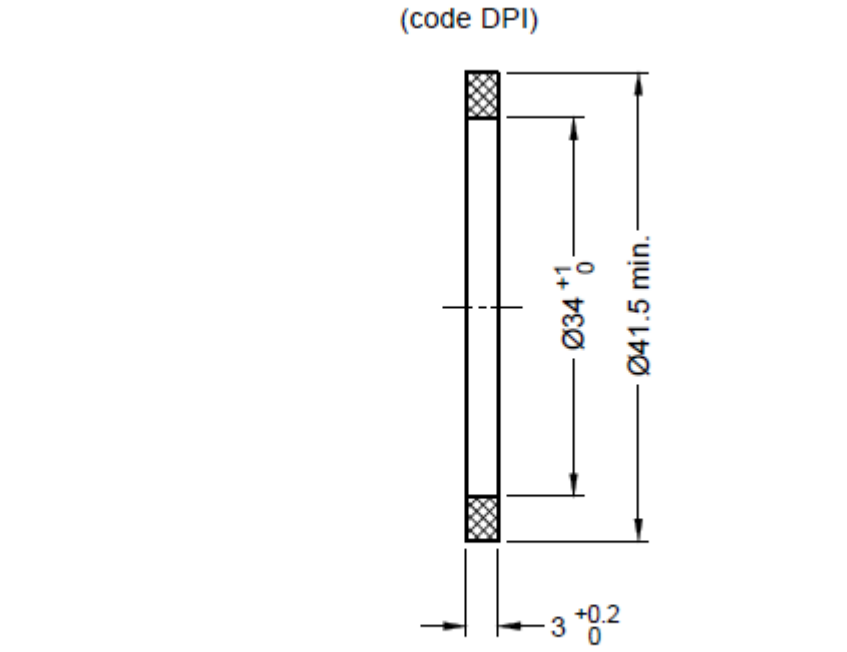


FIG. 6 THREAD CONNECTIONS WITH INTERNAL THREAD FOR DUAL DUCT SYSTEMS



NOTE - Material: Elastomer left to the choice of the manufacturer

All dimensions in millimetres

FIG. 7 GASKET

ANNEX E
(*Foreword*)

COMMITTEE COMPOSITION
Occupational Safety and Health Sectional Committee, CHD 08

Organization	*Representative(s)*
National Safety Council, Navi Mumbai	SHRI LALIT R. GABHANE (***Chairperson***)
3M India Limited, Bengaluru	SHRI GIRIDHAR M. SHRI SALEEM BASHA (*Alternate* I) SHRI MANISH DEV NAUTIYAL (*Alternate* II)
Atomic Energy Regulatory Board, Mumbai	SHRI DIPTENDU DAS SHRIMATI PAMMY GOSWAMI (*Alternate* I) SHRI PAVAN KUMAR PATEL (*Alternate* II)
Bhabha Atomic Research Centre, Mumbai	SHRI G NAGARAJU SHRI PRAVEEN DUBEY (*Alternate*)
CSIR - Central Institute for Mining and Fuel Research, Dhanbad	DR J. K. PANDEY
CSIR - Central Leather Research Institute, Chennai	SHRI M. SURIANARAYANAN
CSIR - Indian Institute of Toxicology Research, Lucknow	DR D. K. PATEL DR SHEELENDRA PRATAP SINGH (*Alternate*)
Centre for Fire and Explosive Environment Safety, Defence Institute of Fire Research, Delhi	DR ARTI BHATT DR S. MARRY CELIN (*Alternate*)
Coal India Limited, Kolkata	SHRI SANJAY KUMAR SHRIVASTAVA SHRI BIKRAM DAS (*Alternate*)
Confederation of Indian Industry, New Delhi	SHRI SHIKHAR JAIN SHRIMARI ANJALI (*Alternate*)
Consumer Education and Research Centre, Ahmedabad	SHRIMAR DOLLY A. JANI SHRIMAR ANINDITA MEHTA (*Alternate*)
Defence Research Development Organization, Ministry of Defence, New Delhi	SHRI AMIT PASI SHRI AJAY KUMAR SHAW (*Alternate*)
Department of Space, Bengaluru	SHRI T. SUBHANATHAN SHRI R. MANOJ (*Alternate*)
Directorate General Factory Advice Service and Labour Institutes, Mumbai	SHRI H. M BHANDARI SHRI AMIT GOLA (*Alternate*)
Directorate General of Mines Safety, Dhanbad	SHRI SAIFULLAH ANSARI SHRI A. RAJESHWAR RAO (*Alternate*)
Directorate of Standardisation, Ministry of Defence, DTE of Standardization Government, New Delhi	GP CAPT M. K. PANI
Draeger India Pvt. Ltd, Mumbai	SHRI HIRENDRA CHATTERJEE
ICMR - National Institute of Occupational Health, Ahmedabad	DR B. RAVICHANDRAN
Intech Safety Private Limited, Kolkata	SHRI SUBRATA MUKHERJEE SHRI GAUTAM BANERJEE (*Alternate*)
Joseph Leslie Dynamics Manufacturer Private Limited, Nehru Place, New Delhi	SHRI DEAN LESLIE ROY SHRI CYRIL PEREIRA (*Alternate*)
Karam Industries, Noida	SHRI RAJESH NIGAM SHRI MOHAMMAD (*Alternate*)

Larsen and Toubro Limited, Mumbai	SHRI P. V. BALARAMAKRISHNA
Ministry of Labour and Employment, New Delhi	SHRI B. N. JHA SHRI G. P. NIJALINGAPPA (*Alternate*)
Ministry of Home Affairs, New Delhi	SHRI D.K. SHAMI
National Safety Council, Navi Mumbai	SHRI A. Y. SUNDKAR SHRI K. D. PATIL (*Alternate*)
Northern India Textile Research Association, Ghaziabad	DR M. S. PARMAR SHRIMATI SHWETA SAXENA (*Alternate*)
Nuclear Power Corporation of India Limited, Mumbai	SHRI ALOK VARSHNEY SHRI M. U. VINCY (*Alternate*)
Oil Industry Safety Directorate, Noida	SHRI DEVENDRA M MAHAJAN
Petroleum and Explosives Safety Organisation, Nagpur	SHRI P. KUMAR DR YOGESH KHARE (*Alternate*)
Quality Council of India, New Delhi	SHRI A. K. BAHL SHRI ABHAY PATHAK (*Alternate*)
Reliance India Limited, Mumbai	DR PRASAD TIPNIS SHRI NEERAJ SHARMA (*Alternate*)
Safety Appliances Manufacturer's Association, Mumbai	SHRI DEVANG MEHTA SHRIMATI NEHA NAIK (*Alternate*)
Unicare Emergency Equipment Private Limited, Mumbai	SHRI CLINT LESLIE PEREIRA SHRI SHIRISH SATHE (*Alternate* I) SHRI RAJASEKHARAN M. K. (*Alternate* II)
Venus Safety and Health Private Limited, Navi Mumbai	SHRI HARSHAL PATIL SHRI SANJEEV MINHAS (*Alternate*)
In Personal Capacity	SHRI S. D. BHARAMBE
BIS Directorate General	SHRI A. K. LAL, SCIENTIST 'F'/SENIOR DIRECTOR AND HEAD (CHEMICAL) [REPRESENTING DIRECTOR GENERAL (*Ex-officio*)]

Member Secretary
PUJA PRIYA
SCIENTIST 'C'/DEPUTY DIRECTOR
(CHEMICAL), BIS

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 2016 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the website-www.bis.gov.in or www.standardsbis.in.

This Indian Standard has been developed from Doc No.: CHD 08 (15683).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.gov.in

Regional Offices:		*Telephones*
Central	: 601/A, Konnectus Tower -1, 6th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002	2323 7617
Eastern	: 8th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091	2367 0012 2320 9474
Northern	: Plot No. 4-A, Sector 27-B, Madhya Marg, Chandigarh 160019	265 9930
Southern	: C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113	2254 1442 2254 1216
Western	: Plot No. E-9, Road No.-8, MIDC, Andheri (East), Mumbai 400093	2821 8093

Branches : AHMEDABAD. BENGALURU. BHOPAL. BHUBANESHWAR. CHANDIGARH. CHENNAI. COIMBATORE. DEHRADUN. DELHI. FARIDABAD. GHAZIABAD. GUWAHATI. HIMACHAL PRADESH. HUBLI. HYDERABAD. JAIPUR. JAMMU & KASHMIR. JAMSHEDPUR. KOCHI. KOLKATA. LUCKNOW. MADURAI. MUMBAI. NAGPUR. NOIDA. PANIPAT. PATNA. PUNE. RAIPUR. RAJKOT. SURAT. VISAKHAPATNAM.

Published by BIS, New Delhi