भारतीय मानक

Indian Standard

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श्वसन तंत्र संरक्षी युक्तियाँ — वर्गीकरण, नामावली और घटकों की परिभाषाएँ

(दूसरा पुनरीक्षण)

Respiratory Protective Devices — Definitions, Classification and Nomenclature of Components

(Second Revision)

ICS 01.040.13; 13.340.30

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Occupational Safety and Health Sectional Committee, CHD 08

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 refers to respiratory protective devices. It contains definitions for commonly used terms of this area. The object of this standard is to achieve a uniform interpretation of these terms in order to prevent ambiguous use of them. The object is to describe a general classification for a logical grouping of the respiratory protective devices and to avoid confusion and achieve uniform interpolation of such components.

This standard was first published in 1977, taking assistance from AS CZ 11-1968 'Respiratory protective devices', BS 4275 : 1968 'Recommendation for the selection, use and maintenance of respiratory protective equipment' and ANSI Z 88.2-1969 'Practices for respiratory protections'. The concerned technical committee felt the need to revise the standard in 2008 based on the experiences gained and the technological developments in the last two and a half decades in this area. During the first revision, this standard was made compatible with IS 9623 : 2007 'Selection, use and maintenance of respiratory protective devices — Code of practice (*first revision*)'.

This second revision has taken up in order to align with ISO 16972 : 2020 ‘Respiratory protective devices — Vocabulary and graphical symbols’. The main changes compared with the previous revision are as follows:

a) The terminology used in the field of respiratory protective devices (RPD) have been updated; and
b) Clause **4**, Terms related to human factors has been added;

The composition of the Committee responsible for the formulation of this standard is given in Annex B.

Indian Standard

RESPIRATORY PROTECTIVE DEVICES — DEFINITIONS, CLASSIFICATION AND NOMENCLATURE OF COMPONENTS

(Second Revision)

1 SCOPE

This standard cover nomenclature of components in respiratory devices. It specifies a classification of the environment where the use of respiratory protective devices [RPD] may be necessary and a classification of respiratory protective devices according to their design. The standard defines the commonly used terms and pictograms of this area. The natural composition of air and the requirements for the purity of breathable air are given in Annex A.

2 REFERENCES

The standards given below contain provisions which, through reference in this text, constitute provision 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 edition of these standards:

IS No	*Title*
IS 9623 : 2008	Selection, use and maintenance of respiratory protective devices — Code of practice (*second revision*)
IS 17274 (Part 5) : 2019/ISO 16900 - 5 : 2016	Respiratory protective devices —— Methods of test and test equipment: Part 5 Breathing machine, metabolic simulator, RPD head forms and torso, tools and verification tools
ISO 7933 : 2023	Ergonomics of the thermal environment — Analytical determination and interpretation of heat stress using calculation of the predicted heat strain
ISO 11079 : 2007	Ergonomics of the thermal environment — Determination and interpretation of cold stress when using required clothing insulation (IREQ) and local cooling effects
ISO 16972 : 2020	Respiratory protective devices — Vocabulary and graphical symbols
ISO 17420-3 : 2012	Respiratory protective devices — Performance requirements — Part 3: Thread connection

3 TERMINOLOGY

A

3.1 Abrasive Blasting Respiratory Protective Devices — Breathing apparatus incorporating a protective hood or a blouse fitted with an impact resistant visor.

3.2 Accessory — Item, or items, that are attached to the respiratory protective devices that are not necessary for the RPD to meet the requirements of the RPD performance standard and do not compromise its protection.

3.3 Adequacy Assessment — Selection method identifying the RPD is able to reduce the wearer's inhalation exposure to acceptable levels.

3.4 Adequate RPD — RPD Capable of reducing the inhalation exposure to an acceptable level.

Aerodynamic Diameter — Diameter of a unit density sphere having the same settling velocity as the particle in question.

3.5 Aerosol — Suspension of solid, liquid or solid and liquid particles in a gaseous medium, having a negligible falling velocity (generally considered to be less than 0. 25 m/s).

3.6 Aerosol Penetration — Ability of particles to pass through a particle filtering material.

3.7 Air Flow Resistance — Pressure difference between upstream and downstream locations caused by the flow of air through the parts and components of a RPD such as exhalation valve, inhalation valve, filter and tube etc.

3.8 Air Supply Hose — Hose delivering air to RPD at about atmospheric pressure.

3.9 Ambient Air Bypass — Means to enable the wearer to breathe the ambient atmosphere before entering and after leaving a hazardous atmosphere.

3.10 Ambient Air System — Device used to deliver ambient air at low pressure directly to breathable gas RPD (manually or power assisted).

3.11 Ambient Atmosphere — Air surrounding the wearer.

3.12 Ambient Concentration — Concentration of compound in the air surrounding the wearer.

3.13 Ambient Laboratory Conditions — Atmosphere where the temperature is between 16 °C to 32 °C and the relative humidity is between 20 percent to 80 percent.

3.14 Apertometer — Extended hemispherical dome for measuring the angular area of the field of vision of RPD when mounted on a RPD headform.

3.15 As Received — Not preconditioned or modified to carry out test.

3.16 Assigned Protection Factor — Anticipated level of respiratory protection that would be provided by a properly functioning RPD or class of RPD within an effective RPD programme.

3.17 Assisted — Describes a filtering device or a fresh air hose breathing apparatus in which air is delivered to the facepiece by an assisting device.

3.18 Atmospheres or Conditions Immediately Dangerous to Life or Health — A situation that possesses a threat of exposure to airborne contaminant, when that exposure is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment.

3.19 Averaged Interactive Flow Rate — Interactive flow rate averaged over 10 consecutive breathing cycle of the breathing machine.

3.20 Averaged Maximum Interactive Flow Rate — Average of the highest flow rate within each breathing cycle of the breathing machine.

3.21 Averaged Minimum Interactive Flow Rate — Average of the lowest flow rate withing each breathing cycle of 10 consecutive breathing cycle of breathing machine.

3.22 Averaged Peak Interactive Flow Rate — Average of the maximum peak flow rate within each breathing cycle of 10 consecutive breathing cycles of breathing machine.

B

3.23 Blouse — Garment, used as a facepiece which covers the head and upper part of the body to the waist and wrists and to which air is supplied.

3.24 Body Harness — Means to enable a user to wear certain components of a respiratory protective device (RPD) on the body.

3.25 Body Temperature Pressure Saturated — Standard condition for the expression of ventilation parameter.

NOTE — Body temperature (37 °C), atmospheric pressure 101.3 kPa and water vapour pressure (6.27 kPa) in saturated air.

3.26 Breakthrough Concentration — Concentration of test gas in effluent air at which a gas filter undergoing test is deemed exhausted.

3.27 Breakthrough Time — Time taken from the start of the test until the test gas and specified reaction products are detected at the specified breakthrough concentration at the downstream side of the filter under test.

3.28 Breathable Air — Air of a quality that makes it suitable for safe respiration (*see* Annex A).

3.29 Breathable Gas — Mixture of gases that is suitable for respiration without adverse effect to health.

3.30 Breathable Gas Cylinder — Integral part of the RPD that contains the breathable gas supply.

3.31 Breathing Apparatus — Apparatus which enables the wearer to breathe independently of the ambient atmosphere.

3.32 Breathing Apparatus for Use in Abrasive Blasting Operations — Breathing apparatus incorporating a protective hood or a blouse fitted with an impact resistant visor. Breathing air is supplied to the wearer from a source of air not carried by the wearer.

3.33 Breathing Bag — Component of RPD that compensates for variations in the breathable gas supply or demand and provides for peak inhalation flow requirements.

3.34 Breathing Cycle — Respiratory period comprising an inhalation and an exhalation phase.

3.35 Breathing Frequency — Number of breathing cycles taken in minute.

NOTE — It is expressed in breaths per minute.

3.36 Breathing Gas Regeneration — Process whereby a RPD absorbs carbon dioxide from inhaled gas delivers oxygen, and controls the water vapour and temperature of gas to be rebreathed.

3.37 Breathing Hose (Low Pressure) — Flexible, for instance corrugated, hose connected to the facepiece through which breathable air enters at atmospheric pressure or at a pressure slightly above or below atmospheric pressure.

3.38 Breathing Machine — Ventilation machine that simulates respiratory ventilation using waveforms, which can be sinusoidal or representative of the breathing cycle.

NOTE — *See* also metabolic simulator.

3.39 Breathing machine assembly — Breathing machine plus all connecting tubes, control valves and other necessary hardware leading to the trachea tube assembly.

3.40 Breathing Resistance — Resistance of a respiratory protective device to the flow of air during inhalation (Termed Inhalation Resistance) or exhalation (Termed Exhalation Resistance).

3.41 Breathe-Responsive — Actively or passively responsive following the wearer's demand for air.

3.42 Bypass Valve — Component part of RPD that is furnished as an emergency manual valve to supply necessary breathable gas when the ordinary supply path is out of order.

C

3.43 Capacity — Volume of available breathable gas of a RPD.

3.44 CO_2 Concentration Limits — Maximum allowed concentration of CO_2 within inhaled breathable gas.

3.45 Char Length — Length of brittle residue found when a fabric or material is exposed to thermal energy.

3.46 Checking Device — A device to enable the user to check that the manufacturer's minimum design air flow rate or minimum design conditions are achieved or exceeded.

3.47 Class Sxxxx RPD — Supplied breathable gas RPD, where Sxxxx equals the amount of breathable gas available for respiration in litres.

3.48 Cleaning/Disinfection Resistance — Ability of the device to withstand the cleaning and disinfection processes defined by manufacturer.

3.49 Chemical Filter — A container with either a filter, sorbent or catalyst, or a combination of these items, which removes specific gaseous and vapour contaminant(s) from the atmosphere passed through the container.

3.50 Clogging — Accumulation of particles on a filter with consequent increase in its resistance to flow.

3.51 Combined Filter — Filter intended to remove dispersed solid and/or liquid particles and specified gases and vapours from the flow of air passing through it.

3.52 Combined RPD — RPD that is capable of operating in either a filtering or breathable gas supply mode.

3.53 Compatibility — Ability of a RPD to be used in conjunction with another item of PPE.

3.54 Competent Fit-Test Operator — Person with suitable and sufficient experience and with practical and theoretical knowledge of fit-test methods who conducts the fit-testing procedures.

3.55 Competent Person — Person with suitable and sufficient experience and with practical and theoretical knowledge of the elements of RPD programme for which (s) he is responsible.

3.56 Compressed Air Filter — Filter intended to remove dispersed solid and/or liquid particles and specified gases and vapors from compressed air passing through it.

3.57 Compressed Air Line Breathing Apparatus — Apparatus which is not self-contained and in which the facepiece supplied with breathable air from a source of compressed air.

3.58 Compressed Air Supply Tube — Tube that delivers breathable air at maximum pressure of 10 bar from a source of compressed air.

3.59 Confined Space — Area with limited access, as described in national regulations, which requires special considerations for entry.

3.60 Contaminant — Undesirable solid, liquid or gaseous substance in the air.

3.61 Continuous Flow Valve — Valve which allows the wearer of a breathing apparatus to regulate a continuous air flow within prescribed limits.

3.62 Count Median Diameter — Particle size of a particle distribution for which one-half the total number of particles are larger and one-half are smaller.

D

3.63 Dead Space <technical> — Space in which exhaled gas has not been purged and it subject to being rebreathed.

3.64 Dead Space <anatomical> — Conducting regions of the pulmonary airways that do not contain alveoli and, therefore, where no gas exchange occurs.

NOTE — These areas include the nose, mouth, trachea, large bronchia and the lower branching airways. This volume is typically 150 ml in a male of average size.

3.65 Dead Space <physiological> — Sum of all anatomical dead space as well as under-perfused (reduced blood flow) alveoli that are not participating in gas exchange.

NOTE — The volume of the physiological dead space can vary with degree of ventilation. Thus, the physiological dead space is the fraction of the tidal volume that does not participate in gas exchange in the lungs.

3.66 Demand Type — A type of respiratory protective device which is fitted with a demand valve governed by the breathing action of lungs.

3.67 Demand Valve — A valve governed by the breathing action of lungs, supplying the breathable gas on demand.

3.68 Desorption — Process in which one substance (the filter medium) releases an absorbed or adsorbed substance.

3.69 Dew Point — Temperature of air at a specified pressure below which condensation will occur.

3.70 Doffing — Process of removing or taking off the RPD.

3.71 Donning — Process of putting on the RPD.

3.72 Downstream Valve — Valve that opens with the pressure of the air and is normally kept shut by means of a spring.

3.73 Drip — To run or fall in drops or blobs.

3.74 Dynamic Breathing Resistance — Differential pressure caused by a RPD when the breathable gas is delivered by a breathing machine adjusted to a specified breathing minute volume and waveform.

3.75 Dynamic Flame Test — Test where the specimen is moving over the flame for the exposure.

3.76 Disposable Respirator — A device for which maintenance is not intended and which is designed to be discarded after excessive breathing resistance, sorbent exhaustion, physical damage or end of service life renders it unsuitable for use.

3.77 Dust — General term denoting solid particles (*see* also Fume and Smoke).

E

3.78 Elastance — Pressure change resulting from a volume change.

NOTE — It is expressed in kPa/l.

3.79 End of Service Life Indicator — A system that warns the user of the approach of the end of adequate respiratory protection.

3.80 Escape — Type Respiratory Protective Device- Respiratory protective device to be used only during escape from hazardous atmospheres.

3.81 Exhalation Valve — Non-return valve which allows the escape of exhaled and excess air from the facepiece.

3.82 Exhaled Air — Air breathed out by the wearer.

3.83 Exposed Part — Part that can be touched in an as-worn state by the exposed surface identification probe-specified in IS 17274 (Part 5).

F

3.84 Face Blank — The main body of a facepiece to which the functional components are attached.

3.85 Facepiece — The part of a respiratory protective device which connects the wearer's respiratory tract to other parts of the device and isolates the respiratory tract from ambient atmosphere.

3.86 Facepiece Incorporating Head Protection — A facepiece either attached to or integrated with a safety helmet.

3.87 Face Seal Leakage — Inward leakage of the ambient atmosphere between the face and the facepiece, when measured in the laboratory in the specific test atmosphere. It is expressed as a percentage of total inhaled air.

3.88 Filter — Device intented to remove specific contaminants from the ambient air passing through it.

3.89 Filter Housing — Component which is attached to either a facepiece or other part of the device and into which a filter, either encapsulated or unencapsulated, is inserted.

3.90 Filter-Self Rescuer — RPD exclusively intended for escape, incorporating a filter against CO_2 through which the ambient air is drawn to a facepiece.

3.91 Filtering Device — Respiratory protective device in which air passes through filter(s) before being inhaled. The device may be unassisted or powered.

3.92 Filtering Facepiece or Filtering Half Mask — Facepiece or half mask entirely or substantially constructed of filter material.

3.93 Flow Rate — Volume (mass) of breathable gas passing through the device time.

3.94 Fog — An atmosphere in which visibility is reduced because of a cloud of some substance.

3.95 Force Fitting — Practice of repeating a failed fit test with the same RPD more than three times, re-donning, or otherwise adjusting the RPD, until a passing fit test is finally achieved.

3.96 Fresh Air Hose Breathing Apparatus — Respiratory protective device in which breathable air is obtained through an air supply hose either assisted or unassisted.

3.97 Full Face Mask — A tight fitting facepiece covering mouth, nose, eyes and chin.

3.98 Fume — Fine solid aerosol which may be chemically generated or of metallic origin.

G

3.99 Gas — Fluid that is in a gaseous state at a standard temperature and pressure that expands to occupy the space or enclosure in which it is confined.

3.100 Gas Filter — Filter intended to remove specific gases and vapours from atmospheres passing through it.

3.101 Gas Filter Capacity — Mass or volume of a specific test agent that is removed or retained by a gas filter or combined filter under specified conditions of temperature, humidity, challenge test gas concentration and flow rate at breakthrough concentration. NOTE The mass or volume is determined by measuring the breakthrough time at a defined breakthrough concentration. The formula to calculate the gas capacity is:

$$C = V_{fl} \times c_{gas} \times t_{br} \times 10^{-6}$$

where

C = gas capacity (in l);

V_{fl} = volume flow rate (in l/min);

c_{gas} = gas concentration (in ml/m^3); and

t_{br} = breakthrough time (in min).

Example

V_{fl} = 30 l/min

c_{gas} = 1 000 ml/m^3

t_{br} = 30 min

C = 30 l/min × 1000 ml/m^3 × 30 min × 10^{-6} = 0.9 litre

3.102 Gas Filter Change Schedule — Time interval after which a gas filter is replaced with new one.

3.103 Gas Filter Validation Test at Specified Flow Rates — Test to evaluate the ability of filter to achieve a minimum performance level at its work rate classification.

3.104 Gas filtering RPD — RPD consisting of a respiratory interface with a filter that removes certain gases or vapours from the air to be inhaled by the wearer for a limited period.

H

3.105 Head Net — Head harness in the form of a net (mesh fabric).

3.106 Half Mask — A tight fitting facepiece covering mouth, nose and chin.

3.107 Half Mask Without Inhalation Valves — Filtering device with a half mask and without inhalation valves, which may or may not have exhalation valves.

NOTE — It comprises a half mask and separable and replaceable filters.

3.108 Hand Wheel Diameter — Nominal value of twice the largest radius from the centre of the hand wheel.

NOTE — It is expressed in mm.

3.109 Hazard Ratio — Measured airborne concentration of a substance divided by the occupational exposure limit.

3.110 Hazardous Atmosphere — An atmosphere that contains a contaminant in excess of its permissible exposure level or that is oxygen deficient.

3.111 Hazardous Substance — Substance that presents a potential to cause injury or ill health if it is inhaled, ingested or comes into contact with, or is absorbed through, the skin.

NOTES

1 A hazardous substance may be a pure substance or generated as a by-product during work activities. For example, wood dust and stone dust welding fume.

2 Hazardous substance can be present in the atmosphere in a number of physical states as:

a) gases
b) Vapours
c) Particles

3.112 Head Harness — Means of holding a facepiece in place on the head.

3.113 Heads up Display — Visual monitor or warning in the line of sight of the wearer.

3.114 Heavy Duty Construction — Mechanical properties of RPD designed to be used in work situations with need for a mechanically robust device.

NOTE — *See* also light duty construction.

3.115 Helmet — A part of respiratory protective device used as a facepiece offering head protection.

3.116 High Pressure — Pressure between the source of compressed gas and pressure reducer, normally over 100 bar.

3.117 Hood — A loose fitting facepiece which covers at least the face, and may cover the entire head.

3.118 Hose — A hollow conduit to carry air at or around ambient pressure.

3.119 Hydrostatic Test — Calibrated expansion pressure test of the structural integrity of cylinders.

I

3.120 Immediately Dangerous to Life or Health (IDLH) Level — Any atmosphere that poses an immediate hazard to life or poses immediate irreversible debilitating effects on health or impairs the ability to escape.

3.121 Impact Resistance — Ability of RPD to withstand mechanical shock and dynamic stress from the environment.

3.122 Inhalation Valve — Non-return valve which allows breathable gas to enter the facepiece and prevents exhaled air from leaving via the same inlet path.

3.123 Inhaled Air — Air breathed in by the wearer.

3.124 Inhaled Breathable Gas — Breathable gas breathed by the wearer.

3.125 Inspection — Process that assesses the RPD components, marking information supplied by the RPD manufacturer and any safety data sheets (if applicable) or declarations relevant to the materials used in its construction.

3.126 Integral Dose — Volume of the test gas on the effluent side of the filter released during the testing period.

NOTE — This calculated as the integral of the instant effluent concentration (function of time) of the test gas during the testing time multiplied by the volume flow rate.

3.127 Integral Filter — Filter that is not separable from the rest of the respiratory interface.

3.128 Interactive Flow — Flow resulting from the combined action of a power assisted device and a tidal breathing pattern at the respiratory interface.

3.129 Interactive Flow Rate — Flow rate through the filters of an assisted filtering RPD resulting from the combined action of the assisted filtering RPD and the breathing pattern generated by the breathing machine.

3.130 Intrinsic (type of) protection where the RPD is not a source of ignition in explosive atmospheres.

3.131 Inward Leakage — Leakage of the ambient atmosphere into the respiratory interface from all sources excluding the filter(s), where present, when measured in the laboratory in the specific test atmosphere.

NOTE — It is expressed as a percentage ratio of contaminant concentration inside a RPD and ambient atmosphere.

L

3.132 Leak-Tightness — Ability to withstand a loss of pressure inside a RPD over a given time as determined by a laboratory test.

3.133 Life Cycle — Time between the date of manufacturing of the device to the date when the device has to be withdrawn from service.

3.134 Light Duty Construction — Mechanical properties of a RPD designed to be used in work situations with little risk of mechanical damage.

NOTE — See also heavy-duty construction.

3.135 Loose Fitting Facepiece — A respiratory inlet covering that is designed to form a partial seal with the face, does not cover the neck and shoulders and may or may not offer head protection against impact and penetration.

3.136 Loose Fitting Respiratory Interface — RI does not rely on forming a complete seal to the wearer's skin.

3.137 Low Boiling Organic Compound — Organic compound having a boiling point of ≤ 650 °C at atmospheric pressure.

3.138 Low Pressure — Pressure within a facepiece or in a breathing hose directly connected to the

facepiece, approximately ambient atmospheric pressure.

3.139 Lung Governed Demand Valve — A valve for a breathing apparatus by which air supply is regulated in accordance with the wearers breathing.

M

3.140 Manufacturers Design Duration — The time as stated by the manufacturer, for which the manufacturer, for which the manufacturer's minimum design flow rate is exceeded.

3.141 Manufacturer's Minimum Design Condition — The lowest level of operating conditions of the device as stated by the manufacturer at which the complete device will still meet the requirements for the designated class.

3.142 Manufacturer's Minimum Design Flow Rate — The minimum airflow rate, as stated by the manufacturer at which the class requirements are met.

3.143 Marking — Information included on the device to indicate specific RPD characteristics.

3.144 Mass Median Aerodynamic Diameter — Point in an aerodynamic particle size distribution where half of the mask lies in particles with a diameter less than the MMAD and half in particles with a diameter greater than the MMAD.

3.145 Maximum Flow Condition — Factors appropriate to the design specified by the manufacturer that give rise to the highest flow rate.

3.146 Maximum Use Concentration — Maximum atmospheric concentration of a hazardous substance from which the wearer can be expected to be protected when wearing a RPD.

NOTES

1 This is determined by the assigned protection factor of RPD or class of the RPD and the occupational exposure limit of the hazardous substance.

2 The MUC can usually be determined mathematically by multiplying assigned protection factor specified for RPD by the occupational exposure limit used for the hazardous substance.

3.147 Measured Maximum Flow Rate — Volumetric flow rate of an assisted filtering RPD, determined in a laboratory test, when the RPD is in the condition that results in the highest air flow rate.

NOTE — This condition takes into account the influence of temperatures, settings of RPD, pre-conditionings, use of accessories and others.

3.148 Measured Minimum Flow Rate — Volumetric flow rate of an assisted filtering RPD, determined in laboratory test, when the RPD is in the condition that results in the lowest air flow rate.

NOTE — This condition takes into account the influence of temperatures, settings of RPD, pre-conditionings, use of accessories and others.

3.149 Mechanical Strength of Visor — Ability of the device to withstand mechanical stress to the visor.

3.150 Mechanical Stress — Dynamic force on the device during a fall from a given height as determined by a laboratory test.

3.151 Medium Pressure — Pressure between a demand valve and a pressure reducer or upstream of a continuous flow valve, normally 2 bar to 10 bar gauge pressure.

3.152 Medium Pressure Connecting Tube — A tube connecting the demand valve or the control valve with the air supply system at medium pressure.

3.153 Metabolic Simulator — Programmable automatic breathing machine that can simulate the characteristics of both human breathing and metabolic functions.

3.154 Metabolic Simulator Assembly — Metabolic simulator plus all the connecting tubes, control valves and other necessary hardware to the trachea tube assembly.

3.155 Minimum Flow Condition — Factors appropriate to the design specified by the manufacturer that give rise to the lowest flow rate.

3.156 Minute Ventilation — Total volume of inhaled (or exhaled) in the lungs during 1 min.

NOTE — It is expressed in l/s body temperature pressure saturated (BTPS).

3.157 Minute Volume — Volume of air inhaled in one minute.

3.158 Mist — General term denoting liquid aerosols.

3.159 Mode of Operation — Primary means of supplying the wearer with breathable gas, for example, particle filtering, gas and vapour filtering, or breathable gas supplying.

3.160 Monitor — Component of RPD to enable the wearer to continuously assess the manufacturer’s minimum design air flow rate or manufacturer’s minimum design conditions are met.

3.161 Mounting Flange — Device to fix tightly together a full-face mask and a helmet.

3.162 Mouthpiece Assembly — Device held by the teeth, sealing against the lips and through which air is inhaled and exhaled while the nose is closed by a clip.

3.163 Multi-Functional RPD — RPD that is capable of operating within its mode of operation using different operating methods, for example:

a) assisted filtering RPD;
b) power on/off; and
c) compressed breathable gas system with compressed breathable gas RPD.

3.164 Multiple Filters — Constructions where the full air flow for a respiratory protection device is divided between two or more filters.

3.165 Multi Type Gas Filter — Gas and vapor filters which meet the requirements of more than one type of gas filter.

N

3.166 Negative Pressure — Pressure inside the respiratory interface, hose, etc that is lower than that ambient atmosphere.

3.167 Negative Pressure Respirator — A respirator in which the air pressure inside the respiratory inlet covering is less than the ambient air pressure during inhalation.

3.168 Nominal Protection Factor — Ratio of the concentration of contaminant present in the ambient atmosphere to its concentration in the air inhaled by the wearer of a respiratory protective device, calculated at maximum permitted inward leakage in prescribed tests.

3.169 Nominal Working Duration — Working time of a device, used for the classification determined in laboratory tests with a specified flow rate.

NOTE — The nominal or rated working duration does not give an indication of the possible effective working duration of the device in practical use. Possible effective working durations can differ from the nominal or rated working duration in both directions, positive and negative, depending upon the actual work rate.

3.170 Nose Clip — A device designed to occlude the nostrils to prevent air inhalation. Used in conjunction with mouthpiece.

3.171 Nuisance Dusts — These dusts may dissolve and pass into the blood stream or may remain in the lungs either producing local or systemic effects. Dust or grain, flour, wood, etc., are common examples. But these dusts may cause irritation or produce allergy.

O

3.172 Occupational Exposure Limit — Maximum concentration of airborne contaminants deemed to be acceptable, as defined by the authority having jurisdiction.

3.173 Open Circuit — Technical solution where the exhaled air passes without recirculation into the ambient atmosphere.

3.174 Operating Pressure — Pressure developed within the RPD during service.

3.175 Overflow Valve — Non-return valve, fitted to the breathing hose that is specially designed to allow the excess air supply to escape into the atmosphere.

3.176 Oxygen Compatibility — Capacity of RPD to allow direct contact with pressurized oxygen without risk of fire or explosion by being oil and grease free.

3.177 Oxygen Deficiency — Condition based on an oxygen concentration or partial pressure below which a person can be adversely affected.

NOTE 1 to entry — Each authority having jurisdiction may establish an alternative definition or specific limit.

3.178 Oxygen Deficient Air — Describes air containing oxygen below 17 percent by volume (dry air) where filtering devices cannot be used.

3.179 Oxygen-Enriched Breathable Gas — Breathable gas containing oxygen at a higher concentration than that of atmospheric air at sea level.

P

3.180 Particle — Solid or liquid substance in the finely divided state:

a) Inhalable — The mass fraction of particles which can be inhaled by nose or mouth and have a 50 percent cut-point of 100 µm. These particles may be hazardous when deposited in the head airway region;

b) Respirable — The mass fraction of particles that reaches the alveoli; It has been shown that 50 percent of the particles with an aerodynamic diameter of 4 µm belong to the respirable fraction; and

c) Thoracic — The mass fraction of particles that passes the larynx; it has been shown that 50 percent of the particles in air with an aerodynamic diameter of 10 1m belong to the thoracic fraction.

3.181 Particle Filter — Filter which is intended to remove airborne particles.

3.182 Particle Filter Efficiency — Degree to which a filter removes aerosols from the ambient atmosphere.

3.183 Particle Filter RPD — Device consisting of a respiratory interface with a particle filter that removes finely divided particles from the air to be inhaled by the wearer.

NOTE — The filter medium may be replaceable or be an integral part of the construction.

3.184 Particulate — The generic name of dusts, mists, smoke and fumes.

3.185 Peak Inspiratory Flow Rate — Highest instantaneous flow rate during the inhalation phase of a breathing cycle.

NOTES

1 It is expressed in l/s body temperature pressure saturated.

2 l/s is the preferred unit as the flow takes place during only a short fraction of the breathing cycle.

3.186 Pendulum Type Respiratory Protective Device — Respiratory protective device in which the wearer alternatively inhales and exhales by the same route.

3.187 Peripheral Isopter — Field of vision while wearing a RPD, indicated by the lighted area, which is measured by a solid line connecting the points.

3.188 Permeation — Process by which a chemical move through a RPD material on a molecular level.

3.189 Permissible Exposure Level — Permissible exposure limit is a time-weighted average (TWA) or absolute value setting out the maximum permitted exposure to a hazardous chemical/substance.

3.190 Poor Warning Properties — A substance whose odour, taste, or irritation effects are not detectable or not persistent at concentrations at or below its permissible exposure level.

3.191 Porous Device — RPD incorporating materials, excluding filters, that can be penetrated by gases and vapours during an inward leakage test leading to an increase of the inward leakage.

3.192 Positive Pressure Respirator — A respirator in which the pressure inside the respiratory inlet covering is higher than the ambient air pressure.

3.193 Powered Filtering Devices (Turbo Filtering Device) — Filtering device in which air is delivered to the facepiece, hood or helmet by means of a blower worn by the wearer. The letters T can be used for Turbo and H for Hood in its classification.

3.194 Powered Fresh Air Hose Breathing Apparatus Incorporating Hood — Apparatus that is not self-contained and in which breathable fresh air is blown from an air source by means of a powered air supply to the hood.

3.195 Practical Performance — Evaluation of a RPD during the simulation of typical work or escape activities in laboratory.

3.196 Pre-filter — Filter which removes coarse particles, situated in front of the main filter.

3.197 Pressure Gauge — Pressure indicator giving the pressure in a part of an apparatus.

3.198 Pressure Reducer – Device which reduces pressure to a lower pressure.

3.199 Protection Class — Numerical designation from PC1 to PC6 allocated to an individual RPD based upon laboratory testing indicating its relative protection.

3.200 Protection Factor — Ratio of the concentration of contaminant present in the ambient atmosphere to its concentration in the air inhaled by the wearer of a respiratory protective device.

3.201 Protection Level — Degree of respiratory protection allocated to RPD for the purpose of selection and use that is expected to be provided to wearers when used within an effective RPD programme.

3.202 Psychological Impact on the Wearer — Positive and negative influences on the wearer's state of mind from wearing the RPD or by its appearance and/or design.

Q

3.203 Qualitative Fit Factor — Qualitative estimate of the minimum fit of particular tight-fitting respiratory interface to a specific individual when a qualitative fit test is passed, i.e. the test agent is not detected by the subject's senses.

3.204 Qualitative Fit Test — Pass/fail test method that relies on test subject's sensory response to detect a challenge agent in order to access the adequacy of a RPD fit.

3.205 Quantitative Fit Factor — Numeric value of a particular tight-fitting respiratory interface to a specific individual.

3.206 Quantitative Fit Test — Test method that uses an instrument to access the amount of face-seal leakage into the RPD in order to access the adequacy of its fit.

3.207 Quarter Mask — A tight fitting facepiece covering mouth and nose.

R

3.208 Radionuclide — An atom that spontaneously emits atomic particles (proton, electron, neutron) gamma or X-ray radiation.

3.209 Rated Filling Pressure — Maximum allowable pressure to which the valved pressure vessel is intended to be filled.

3.210 Rated Working Pressure — Maximum allowable pressure for which the apparatus is designed.

3.211 Ready for Assembly State — Component with seals, plugs or other environmental protective means, if applicable, still in place.

3.212 Ready for Use Configuration — Complete RPD, which may not be fully assembled, but is in state which allows the immediate start of the donning by the wearer.

3.213 Ready for Use State — RPD ready to be donned as described by the manufacturer.

3.214 Reconstituted Air — Gaseous mixture prepared from pure liquid or gaseous oxygen and pure liquid or gaseous nitrogen.

3.215 Relief Valve — Valve to release overpressure.

3.216 Required Fit Factor — Numeric value established as a pass/fail point or acceptance criterion for quantitative fit testing.

3.217 Respirator — A personal protective device to protect the user from inhalation of hazardous atmosphere.

3.218 Respirator Inlet Covering — The portion of a respirator that connects the user's respiratory tract to a filter (air purifying device) or a respirable gas source or both. It may be a facepiece, helmet or hood. It serves as a barrier against the contaminated atmosphere and as a framework to which air purifying or air supplying elements may be attached.

3.219 Respiratory Interface — Part of RPD that forms the protective barrier between the wearer’s respiratory tract and the ambient atmosphere.

3.220 Respiratory Protective Device (RPD) — Personal protective equipment designed to protect the wearer’s respiratory tracts against inhalation of atmospheres that would normally cause adverse-health effects.

3.221 Respiratory Protective Device Head form — Laboratory test head simulating human heads used in testing a RPD.

3.222 RPD Head form Assembly — RPD head form with trachea tube assembly included.

3.223 RPD Manufacturer — Natural or legal person who:

a) design and/or manufactures an RPD or who has an RPD designed and/or manufactured with a view to placing it on the market or for other use, under his/her own name or trademark; and

b) places RPD on the market and/or puts it into service, under his/her own name or trademark.

3.224 RPD Programme — Process of selecting, using and maintaining an RPD to ensure adequate protection to the wearer.

3.225 RPD Programme Administrator — Individual designed to ensure the development, implementation and maintenance of an RPD programme.

3.226 RPD Tool — Device that assists the testing of an RPD.

3.227 RPD Torso — Generic body form used in combination with an RPD head form used in testing an RPD.

3.228 RPD Verification Tool — Test device that simulates a specific performance characteristic(s) of an RPD.

3.229 Reusable Particle or Combined Filter — Particle filter or combined filter intended to be used for more than a single shift.

3.230 Risk Assessment — Process of hazard, adequacy and suitability assessments relating to the selection of an RPD.

S

3.231 Second High Pressure Inlet Connector — Component for emergency purposes that receives breathable gas from an alternative high-pressure breathable gas source while in use.

3.232 Second Medium Pressure Inlet Connector — Component of RPD to receive breathable gas from an alternative medium pressure breathable gas source.

3.233 Second Medium Pressure Outlet Connector — Component of RPD to supply breathable gas to second person for the purpose of rescue.

3.234 Self-Containing Breathing Apparatus — Breathing apparatus where the breathing gas supply is carried by the wearer.

3.235 Self-Contained Closed-Circuit Oxygen Breathing Apparatus — Self-contained breathing apparatus which removes carbon dioxide from the exhaled air and adds oxygen to the inhaled air for breathing by the wearer and is independent of the ambient atmosphere.

3.236 Self-Contained Open-Circuit Compressed Air Breathing Apparatus — Self-contained breathing apparatus which has a portable supply of compressed air and is independent of the ambient atmosphere. The exhaled air passes without recalculation to the ambient atmosphere.

3.237 Separator — Device to remove liquid from compressed air.

3.238 Service Life — The period of time that a respirator provides adequate protection to the user.

3.239 Service life of Gas Filter — time until the breakthrough of contaminants during actual use.

3.240 Shelf Life — Time a RPD component can be stored without deteriorating prior to use when stored in accordance with the information supplied by the RPD manufacturer.

3.241 Single Use — RPD or filter that is not designed for repeated applications after the first use.

3.242 Single-Shift Use — Descriptor for identifying a RPD or RPD component that is not designed for reuse after one shift.

3.243 Smoke — General term denoting an aerosol generated by incomplete combustion.

3.244 Smoke Hood — RPD for escape only.

NOTE — Function based upon a filter through which ambient air is drawn to a hood.

3.245 Sorbent — Filter medium which captures gases by chemical or physical means.

3.246 Sorption — Process in which one substance (the filter medium) takes up or holds another, either by adsorption or absorption.

3.247 Special Application — Requirement related to a specific area(s) of RPD use.

3.248 Spiral Coiled Tube — Tube that is manufactured such that being in its relaxed state it assumes a natural spiral coil.

3.249 Spray — Mechanically produced liquid particles with sizes generally in the visible or microscopic range.

3.250 Standard Temperature Pressure Dry — Standard condition for the expression of oxygen consumption.

3.251 Standardized Connector — Device that allows an option connection between a filter and respiratory interface.

NOTE — Standardized connectors are defined in ISO 17420-3.

3.252 Static Breathing Resistance — Differential pressure caused by a RPD when the breathable gas is passed through the RPD at a constant flow.

3.253 Static Flame Test — Test where the specimen is maintained still over the flame for the exposure.

3.254 Suit — Garment which covers the whole body to wrists and ankles and to which breathing air is to be supplied.

3.255 Suitability Assessment — Selection method identifying a RPD able to provide adequate protection during intended use, taking into consideration the wearer, the task and the workplace environment.

3.256 Suitable RPD — RPD that is adequate and is matched to the requirements of the wearer, the task and the working environment.

3.257 Supervisor — Employer or a person assigned by the employer having responsibility for the wearer and control over the workplace.

3.258 Supplied Breathable Gas RPD — RPD that supplies the wearer with breathable gas from a source independent of the ambient atmosphere either individually carried or supplied by the stationary source.

T

3.259 Task — Working activity to be undertaken by wearer.

3.260 Temperature of Operation — Environmental temperature during the expected conditions of use.

3.261 Test Subject — Human being selected from a panel used for testing RPD.

3.262 Threshold Limit Value (TLV) — Air-borne concentration of toxic substances and represents conditions under which it is believed that nearly all workers may by repeatedly exposed day after day without adverse effect.

3.263 Tidal Volume — Size of breath.

NOTE — It is expressed in litres.

3.264 Tight Fitting Facepiece — A respiratory inlet covering that is designed to form a complete seal with the face such as a half-face mask and full-face mask.

3.265 Tight Fitting Respiratory Interface — RI that forms a protective barrier between the wearer's respiratory tract and the ambient atmosphere by forming a seal to the wearer's skin.

3.266 Time Weighted Average (TWA) — The concentration of a contaminant in air determined by adding together the products of each concentration and the corresponding time over which that concentration was measured, and dividing the sum by the total time over which the measurements were taken.

3.267 Total Inward Leakage — Leakage of the ambient atmosphere into the respiratory interface from all sources including filter(s), where present, or a RPD, when measured in a laboratory in the specific test atmosphere.

3.268 Trachea Tube Assembly — Tube that simulates the human trachea, containing ports for the measurements of pressure, carbon dioxide content and temperature of breathed breathable gas and interface connections permitting seating to the RPD head form, RPD torso or alternative fixture.

3.269 Tube — Hollow conduit to carry breathable gas at pressure in excess of the ambient pressure.

U

3.270 Unassisted Filtering RPD — Filtering RPD in which air is drawn through the filter solely by the breathing of the wearer.

3.271 Unencapsulated Filter — Filter that in itself is not contained in a rigid housing.

3.272 Units for Gas and Vapour Concentrations — Gas concentrations in this standard are expressed in parts per million (ppm) by volume. The following formula can be used to convert from ppm to mg/m^3:

$$\text{Concentration in } \frac{\text{mg}}{\text{m}^3} = \frac{\text{molecular weight} * \text{ concentration in ppm}}{24.4}$$

where

24.4 = molar volume in litres at 250 °C and 101.3 kPa.

It should be noted that gravimetric units of mg/m^3 are affected by temperature and pressure variations and, when used in this standard, are expressed relative to standard conditions of 25 °C and 1 atmosphere (atm), where 1 atm = 101.3 kPa.

3.273 User — Person or organization who makes use of RPD, for example, those involved in selecting, maintaining and wearing.

V

3.274 Validated method — Documented procedure that has been scientifically evaluated by qualified persons and determined to be appropriate and acceptable with regards to reproducibility, accuracy, precision and other necessary parameters.

3.275 Valve Filtering Half Mask — RPD fitted with exhalation valves and inhalation valves.

3.276 Vapour — Gaseous phase of a substance which is liquid or solid at 20 °C and 1 bar (absolute).

3.277 Visor — The part of the facepiece which can also provide face protection and may be present in a respiratory protective device and which gives maximum field of vision for that particular respirator.

3.278 Visual Clarity — Measure of a visor(s) to affect the sight within the field of vision of a RPD.

3.279 Visual Field Score — Summation of grid points contained within the peripheral isopter shadow cast onto the apertometer by the RPD.

Volume-Averaged Pressure — Work of breathing divided by its tidal volume.

NOTES

1 It is expressed in kPa

2 The WOB/VT can be determined separately for an inspiration, an expiration or for a whole breath.

W

3.281 Warning Device — A device to inform the user that the respiratory protection device will soon stop or has already stopped operating at the desired conditions.

3.282 Water Based Aerosol — Aerosols produced from solutions and/or suspensions of particulate materials in water.

3.283 Water Based Aerosol — Aerosols produced from solutions and/or suspensions of particulate materials in water such that the only workplace contaminant is attributed to this solid material.

3.284 Wearer — Person who actually wears the RPD.

3.285 Wearer-Seal Check — Action conducted by the wearer to determine if the tight-fitting RPD is properly donned and sealed on the face.

3.286 Work of Breathing — Work required for an entire breathing cycle.

NOTE — It is expressed in Joules.

3.287 Work rate — Demand for breathable gas by the wearer per time due to workload.

3.288 Work Rate Class — Numerical designation from W1 to W4 allocated to an individual RPD

based upon laboratory testing indicating its relative ability to meet the wearer's demand for breathable gas at different activity levels.

3.289 Working Pressure — Settled pressure of a compressed gas at a uniform reference temperature of 15 °C in a full gas cylinder.

NOTE — It is expressed in bar.

4 TERMS RELATED TO HUMAN FACTORS

A

4.1 Aerobic Energy Production — Biochemical process in human cells that delivers energy by combustion of fat, carbohydrates and, to a lesser extent, protein in the presence of oxygen, with water and carbon dioxide as end products.

4.2 Aetiopathology — Cause of the pathological state or disorder

4.3 Alveoli S. Alveolus — Terminal air sacs of the lungs in which respiratory gas exchange occurs between the alveolar air and the pulmonary capillary.

NOTE — The alveoli are the anatomical and functional unit of the lungs

4.4 Ambient Temperature Pressure Humidity ATPH — Standard condition for the expression of ventilation (4.20) parameters related to inspired air.

4.5 Ambient Temperature Pressure Saturated (ATPS) — Standard condition for the expression of ventilation (4.20) parameters related to expired air.

4.6 Anaerobic Energy Production — Biochemical process in human cells that delivers energy by combustion of carbohydrates without oxygen, with lactic acid as the end product.

4.7 Anxiety — State of being uneasy, apprehensive or worried about what might happen.

C

4.8 Carbaminohaemoglobin ($HbCO_2$) — Hemoglobin that has bound carbon dioxide at the tissue site for transport to the lungs

4.9 Cardiac Arrhythmia — Variation from the normal rhythm of the heartbeat.

4.10 Claustrophobia — Abnormal fear or dread of being in an enclosed or confined space.

4.11 Clo — Unit for the expression of the thermal insulation of clothing.

NOTE — clo is equal to 0.155 K m2/W.

4.12 Compliance — Change in volume of the human lung that results from a change in pressure

NOTES

1 It is expressed in 1kPa-1.

2 This term is the typical term for the elastic behavior of the lungs and chest. Compliance is the inverse of elastance.

D

4.13 Dyspnoea — Sense of air hunger, difficult or laboured breathing, or a sense of breathlessness.

4.14 Dysphoria — Sensation of disquiet, restlessness or malaise

E

4.15 End-tidal Carbon Dioxide ET CO_2 — Volume fraction of carbon dioxide in the breath at the mouth at the end of exhalation.

NOTE — End-tidal carbon dioxide corresponds closely to alveolar carbon dioxide.

H

4.16 Haemoglobin (Hb) — Specific molecules contained within all red blood cells that bind oxygen or carbon dioxide under normal physiological states and transport either oxygen or carbon dioxide to or from the tissues of the body.

4.17 Hearing — Manner in which the brain and central nervous system recognizes and interprets sounds.

4.18 Hypercapnia — Excess amount of carbon dioxide (CO_2) in the blood.

4.19 Hyperoxia — Volume fraction or partial pressure of oxygen in the breathing environment greater than that which is found in the Earth's atmosphere at sea level, which contributes to an excess of oxygen in the body.

NOTE — This can occur when a person is under hyperbaric conditions (that is. diving), subjected to breathable gas mixtures with an elevated oxygen fraction, or during certain medical procedures.

4.20 Hyperventilation — Increase in overall respiration resulting from an increase in both the depth and frequency of breathing.

NOTE — This can be voluntary or result from an increase in activity, fear or breathing excess carbon dioxide (CO_2).

4.21 Hypocapnia — Volume fraction or partial pressure of carbon dioxide in the breathing environment or in the body that is lower than that which is found in the Earth's atmosphere at sea level.

NOTE — This usually occurs under hyperventilation (4.34) conditions (that is, diving) or in medical settings that contribute to a reduction of carbon dioxide in the body.

4.22 Hypoxia — Volume fraction or partial pressure of oxygen in the breathing atmosphere below that found in the atmosherer at sea level.

I

4.23 Inotropic — Affecting the force of muscle contraction.

NOTE — A negative inotropic effect reduces and a positive inotropic effect increases the force of muscular contraction (for example both skeletal and heart muscle).

4.24 Insulation Required (IREQ) — Cold stress index as determined in accordance with ISO 11079.

M

4.25 Medulla Oblongata and Pons — Areas of the brain where the respiratory control centre is located.

4.26 Metabolic Rate — Physiological energy utilization per unit of time.

4.27 Metabolism — Energy produced in human cells by aerobic or anaerobic processes.

N

4.28 Noise — Unwanted sound.

O

4.29 Ototoxicity — Damage to hearing from overexposure to drugs or toxic substances.

4.30 Oxyhaemoglobin (HbO_2) — Haemoglobin that has bound oxygen from the lungs for transport to the body tissues.

4.31 Oxygen consumption (Vo_2) — Amount of oxygen consumed by human tissues for aerobic energy production.

NOTE — It is expressed in l/min standard temperature pressure dry (STPD)

4.32 Oxygen Saturation (SaO_2) — Degree of saturation of haemoglobin with oxygen in arterial blood.

NOTE — It is expressed as a percent of total saturation.

P

4.33 Paresthesia — Abnormal sensation without an objective cause, such as numbness, prickling and tinging.

4.34 Partial Pressure — Pressure exerted by each of the components of a gas mixture to form a total pressure.

Example:

Air is a mixture of oxygen, nitrogen, carbon dioxide, inert gases (argon, neon) and water vapour. The volume fraction of oxygen in air is about 20.9 percent. At sea level, total atmospheric pressure is 101.3 kPa (760 mmHg). Water vapour pressure is 6.26 kPa (47 mmHg) (fully saturated in the lungs at a body temperature of approximately 37 °C). To find the partial pressure of oxygen, subtract vapour pressure from total atmospheric pressure and then multiply the oxygen volume fraction by the dry atmospheric pressure Thus, 101.3 - 6.3 = 95.1 kPa (760 mmHg - 47 mmHg = 713 mmHg); 0.21 percent 95.1 kPa = 19.9 kPa (= 149 mmHg). If the ambient pressure increases (as in diving), the partial pressure of each component gas increases. Thus, at 2 atm absolute, the partial pressure of oxygen in dry gas is 101.3 × 2 = 202.6 kPa (760 mmHg × 2 = 1 520 mmHg), 0.21 ~ 202.6 = 42.6 kPa (0.21 × 1 520 mmHg = 319 mmHg) oxygen.

NOTES

1 Partial pressure is dependent on the volume fraction of the component gas.

2 The partial pressure of a gas can increase or decrease while its relative volume fraction remains the same. Partial pressure drives the diffusion of gas across cell membranes and is, therefore, more important than the relative volume fraction of the gas.

4.35 Phobia — Persistent and irrational fear of a specific object, activity or situation that results in a compelling desire to avoid the feared stimulus.

4.36 Physical Work Capacity — Ability of a person to engage in muscular work.

4.37 Predicted Heat Strain PHS — Heat stress index as determined in accordance with ISO 7933.

4.38 Presbycusis — Gradual sensorineural hearing loss due to natural ageing.

4.39 Psycho-Physical Effect — Effect that pertains to the mind and its relation to physical manifestations.

4.40 Psycho-Physiological Effect — Psychological trait(s) and responses to a given situation that can provoke a physiological response, and the physiological responses to a given situation that can provoke a psychological reaction.

R

4.41 Relaxation Volume — Functional residual capacity, FRC, expiratory reserve volume

ERV lung volume when respiratory muscles are relaxed, i.e. the volume at the beginning of an inspiration.

4.42 Respiratory Quotient (R_Q) — Ratio of the volume of carbon dioxide exhaled to the volume of oxygen consumed.

NOTES

1 R_Q is calculated as follows:

$$R_Q = \frac{V_{co2}}{V_{o2}}$$

Vco_2 is the volume of carbon dioxide exhaled;

Vo_2 is the volume of oxygen consumed.

2 to entry: RQ gives an estimate of the content of substrate utilization during steady-state respiration and metabolism. At rest, R_Q = 0,82 reflects a substrate utilization of a combination of carbohydrates and fats as the primary energy source.

4.43 Respiratory System — Tubular and cavernous organs (mouth, trachea, bronchi, lungs, alveoli etc) and structures that bring about pulmonary ventilation and gas exchange between ambient air and blood.

4.44 Root Mean Square Sound Pressure (RMS Sound Pressure) — Deviation from the ambient atmospheric pressure caused by a sound wave at an instant in time over a given period of time.

S

4.45 State-Trait Anxiety Inventory — Psychological assessment tool used to determine the presence and type of anxiety in an individual and to differentiate between situational anxiety chronic feelings of anxiety as part of the overall personality structure (trait anxiety).

4.46 Stereoacuity — Visual clarity in three dimensions.

4.47 Sound — Form of energy that moves through media in waves of pressure.

4.48 Sound Pressure — Local pressure deviation from the ambient atmospheric pressure caused by a sound wave.

NOTE — It is expressed in pascals (Pa).

T

4.49 Tachycardia — Increased heart rate due to exercise, pain, anxiety (4.29) or pathophysiological state.

4.50 Transcutaneous Carbon Dioxide — Level of CO_2 in tissue vasculature, as measured by a transcutaneous CO_2, detector attached to the earlobe.

V

4.51 Ventilation — <general> process of exchange of air between the lungs and the ambient environment.

4.52 Vital Capacity (VC) — Volume of the largest breath a person can take, i.e. the volume difference between maximum inspiration and a maximum expiration.

NOTE — It is expressed in litres temperature pressure saturated (BTPS).

5 CLASSIFICATION

5.1 General

The environment may be contaminated by particles and/or by gases and vapours. There may also be an oxygen deficiency. Temperature and humidity are also to be taken into consideration. Different types of environment as encountered in general are given in Fig. 1.

5.2 Classification of Respiratory Protective Devices

There are two distinct methods of providing personal respiratory protection - either by purifying the ambient air to be breathed using filters able to remove contaminants in the air through filtering devices or by supplying the wearer with breathable gas from an uncontaminated source through respiratory protective device called breathing apparatus.

Respiratory protective devices can thus be categorized into following two types based on the methods of providing personal respiratory protection against contaminated atmospheres (*see* Fig. 2):

a) Filtering Facepiece Devices — By purifying the air; and

b) Breathing Apparatus — By supplying breathable air from an uncontaminated source.

5.3 Filtering Devices

Filtering devices remove contaminants from the ambient air by filtration and can only protect against limited concentration ranges of known contaminants in air if a suitable filter and facepiece are chosen.

5.3.1 Types

The facepiece can be a mask, filtering facepiece, hood, mouthpiece, helmet, etc. The airflow through the filter(s) may be assisted or unassisted. The means of supplying breathable gas may consist of pressure cylinders, compressed air line system, fresh air supply system or another suitable supply system.

Air which is to be inhaled passes through a filter to remove contaminants. The filtering devices can be divided into following three grades unassisted or power-assisted:

a) Particle Filter — For protection against particles;

b) Gas Filter — For protection against gases and vapours; and

c) Combined Filter — For protection against particles and gases/vapours.

5.3.2 Particle filters are divided into the following classes:

a) Low efficiency filters;

b) Medium efficiency filters; and

c) High efficiency filters.

NOTE — Low, medium and high efficiency filters are graded according to their ability to remove solid and liquid or solid particles only.

5.3.3 Gas filters are divided into the following classes:

a) Low capacity filters,
b) Medium capacity filters, and
c) High capacity filters.

NOTE — Gas filters are further divided into types according to the gases they protect against, for example, filter Types A, B, E or K.

5.3.4 The different varieties of filtering devices are given in Fig. 3.

5.4 Breathing Apparatus

The main types of breathing apparatus are represented in Fig. 4.

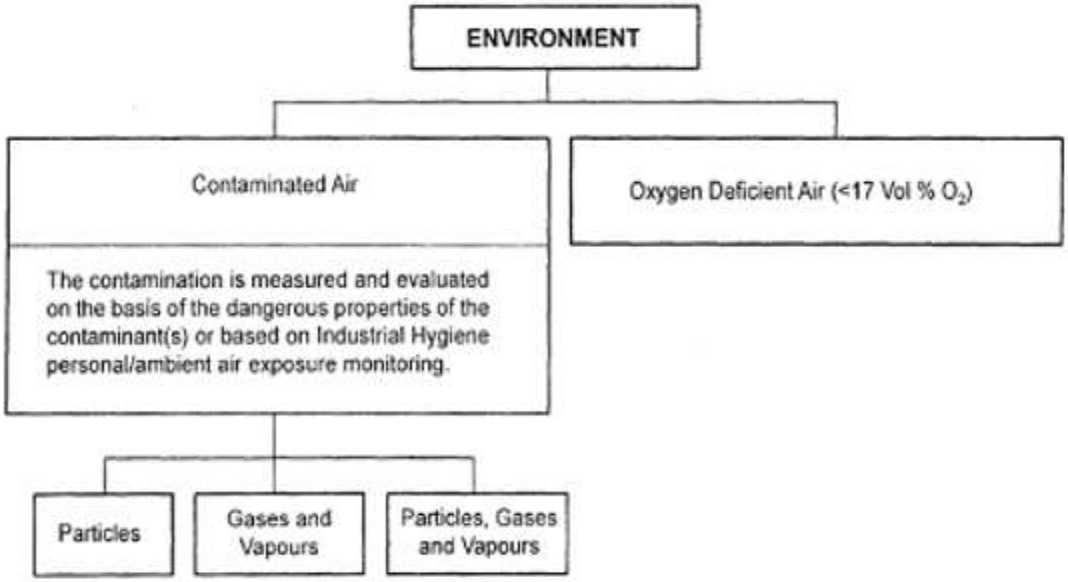


FIG. 1 DIFFERENT TYPES OF ENVIRONMENT

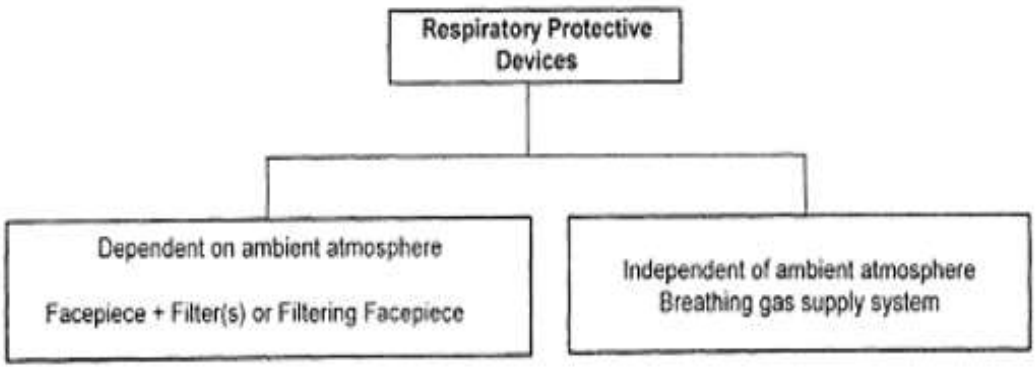


FIG. 2 CLASSIFICATION OF RESPIRATORY PROTECTIVE DEVICES

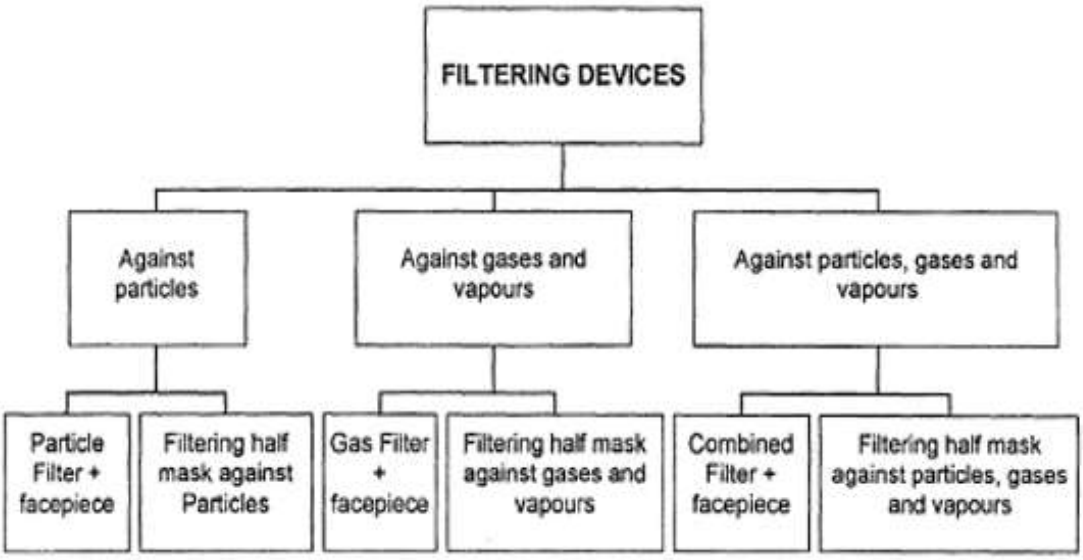


FIG. 3 FILTERING DEVICES

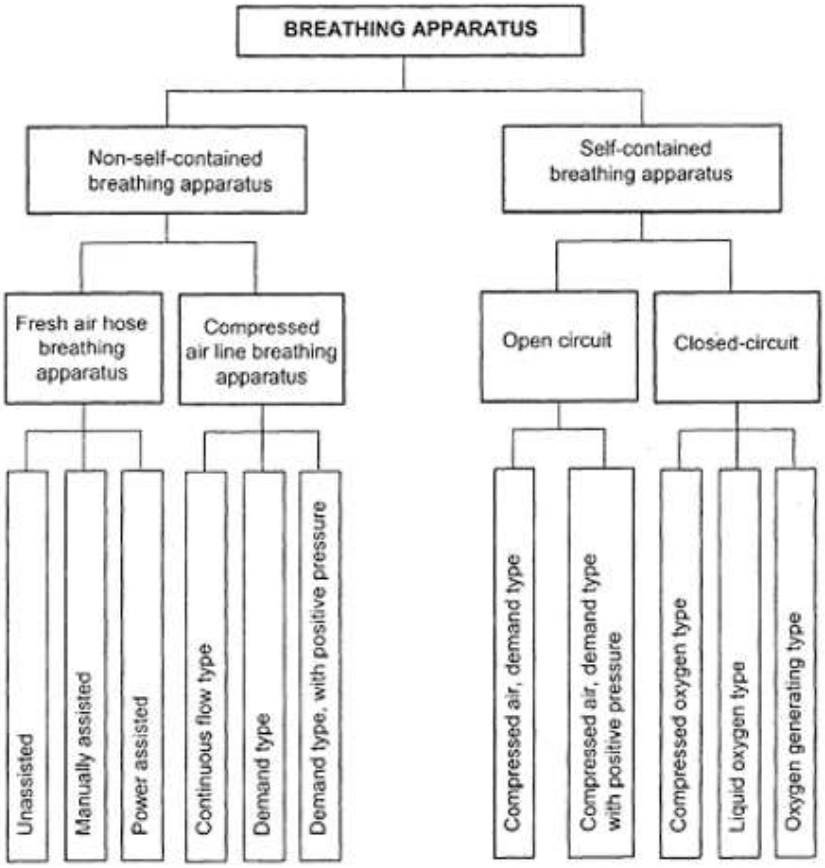
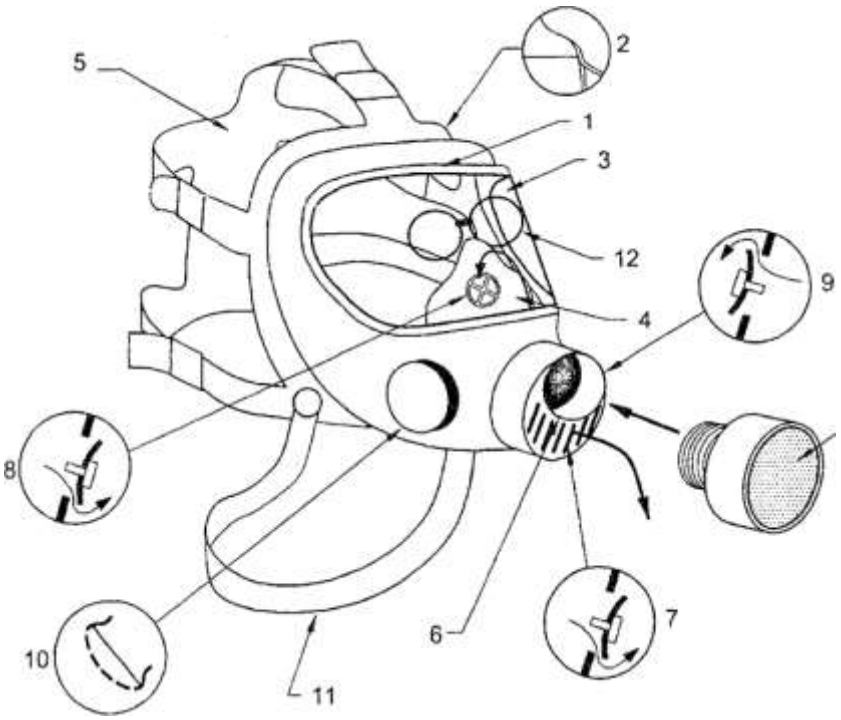


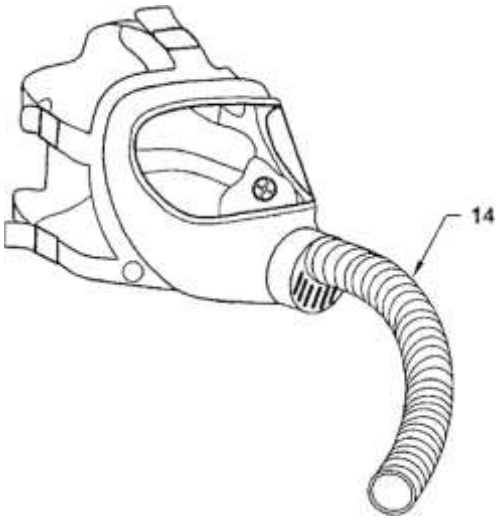
FIG. 4 BREATHING APPARATUS

6 NOMENCLATURE

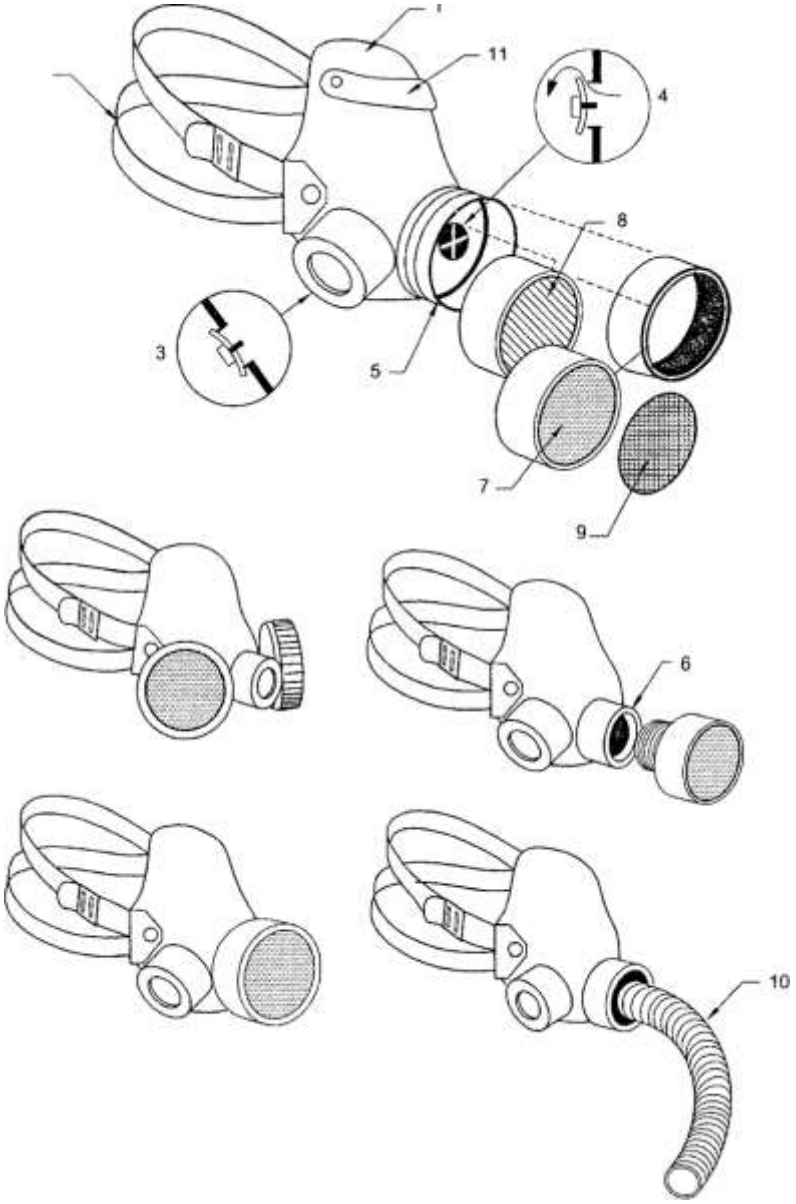
6.1 Facepieces

6.1.1 *Full Facepiece*





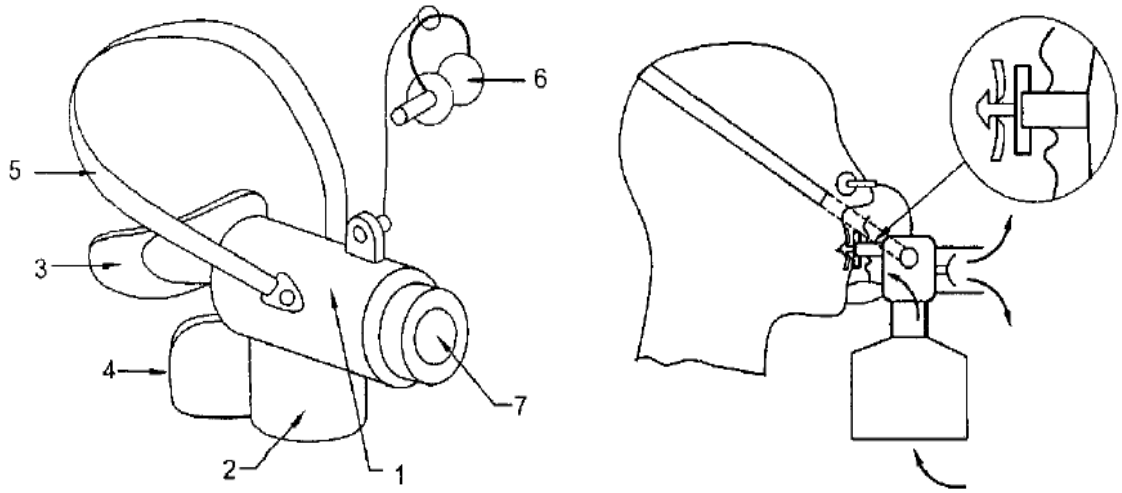
1. Faceblank
2. Facepiece seal
3. Visor
4. Inner mask
5. Head harness
6. Equipment connector
7. Exhalation valve
8. Check valve
9. Inhalation valve
10. Speech diaphragm
11. Neck strap (Carrying strap)
12. Spectacles (Kit - Optional)
13. Filter
14. Breathing hose



1. Faceblank
2. Head harness
3. Exhalation valve
4. Inhalation valve
5. Filter housing
6. Equipment connector
7. Particle filter
8. Gas filter
9. Pre-filter
10. Breathing hose
11. Nose piece

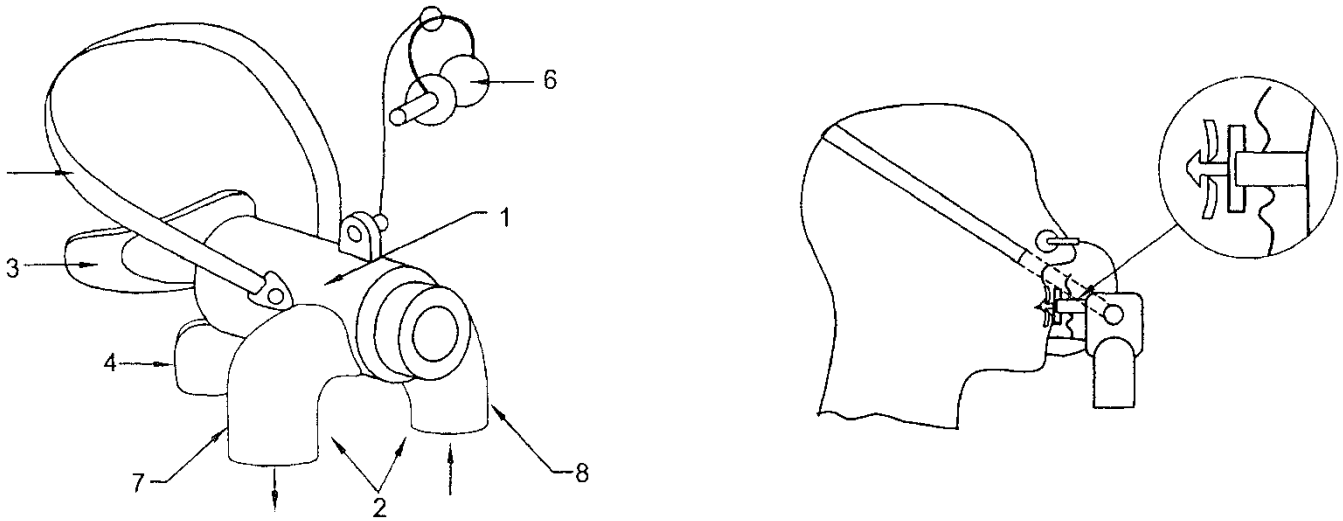
6.1.3 *Mouthpiece Assembly*

6.1.3.1 For filtering devices and open-circuit breathing apparatus



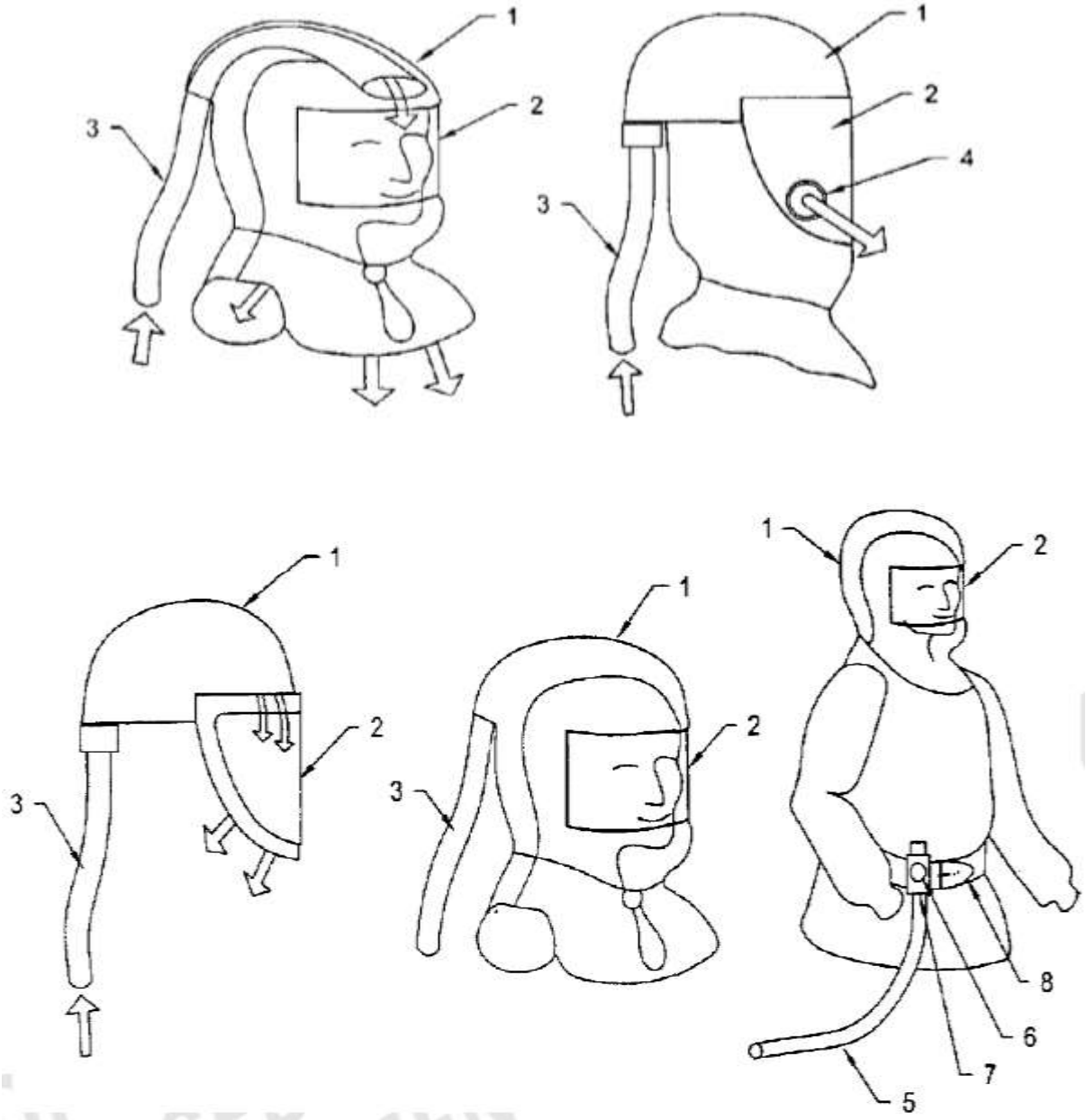
1 Mouthpiece body
2 Equipment
3 Mouthpiece
4 Chin support
5 Head harness
6 Nose clip
7 Exhalation valve

6.1.3.2 For closed-circuit breathing apparatus



1 Mouthpiece body
2 Equipment connector
3 Mouthpiece
4 Chin support
5 Head harness
6 Nose clip
7 Exhalation valve
8 Inhalation

6.1.4 *Hood, Helmet or Blouse*

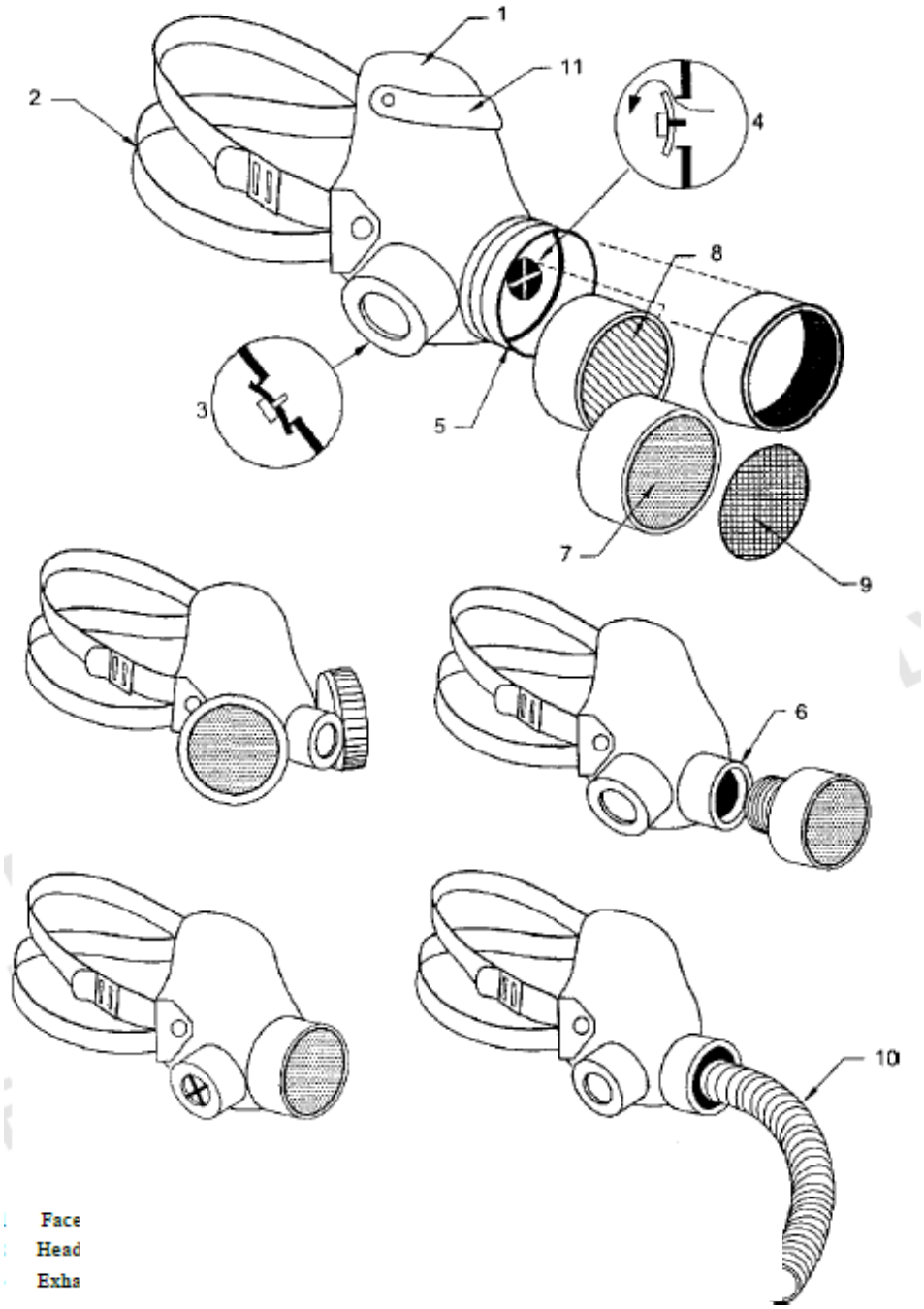


1	Hood, helmet or blouse	5	Compressed air supply tube
2	Visor	6	Continuous flow valve
3	Breathing hose (Connector)	7	Coupling
4	Exhalation valve	8	Waist belt or carrying strap

6.2 Unassisted

6.2.1 *Unassisted Filtering Devices*

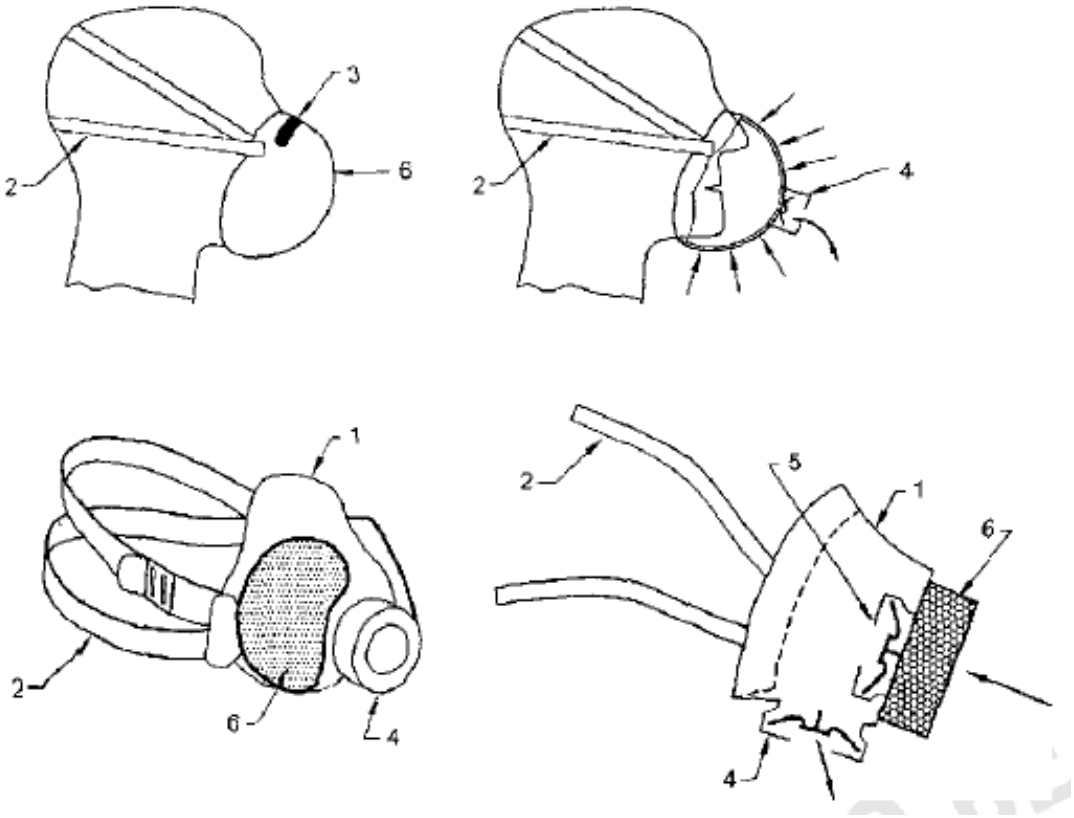
6.2.1.1 *Facepiece and filter*



Face
Head
Exha

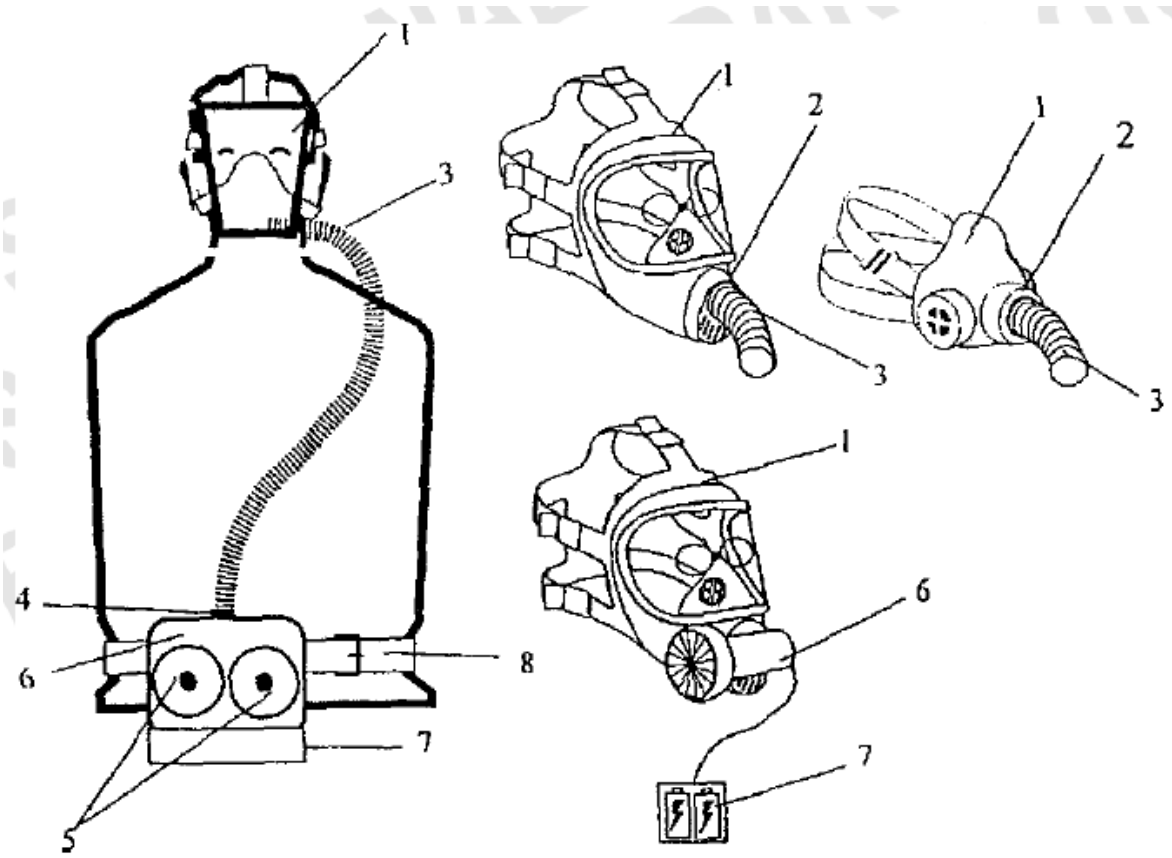
1. Faceblank
2. Head harness
3. Exhalation valve
4. Inhalation valve
5. Filter housing
6. Equipment connector
7. Particle filter
8. Gas filter
9. Pre-filter
10. Breathing hose
11. Nose piece

6.2.1.2 *Filtering facepiece*



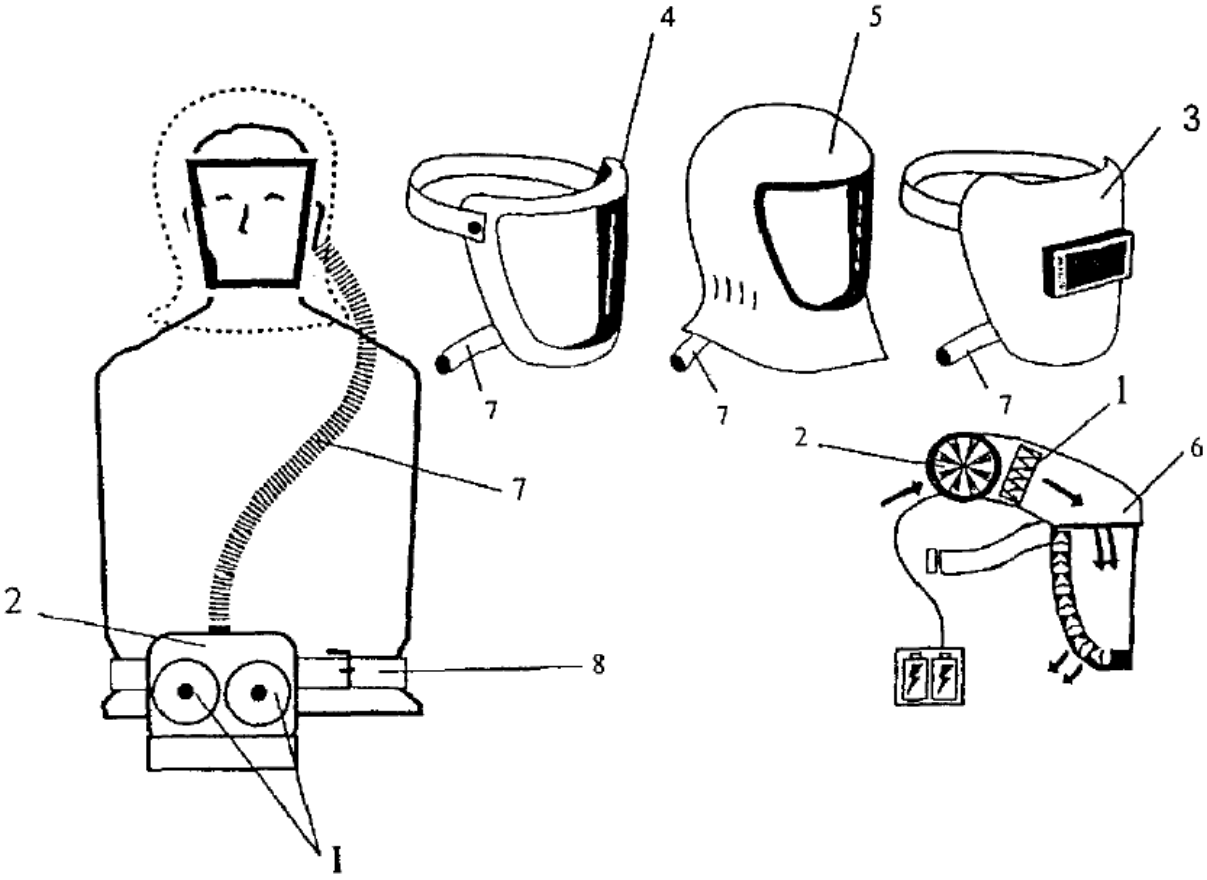
1	Faceblank	4	Exhalation valve
2	Head harness	5	Inhalation valve
3	Nose piece	6	Filter

6.2.2 *Powered Filtering Device* (*Turbo Filtering Device*)



1	Facepiece	5	Coupling
2	Equipment connector	6	Filter
3	6 blower	7	Battery
4	Breathing hose	8	Waist belt or carrying strap

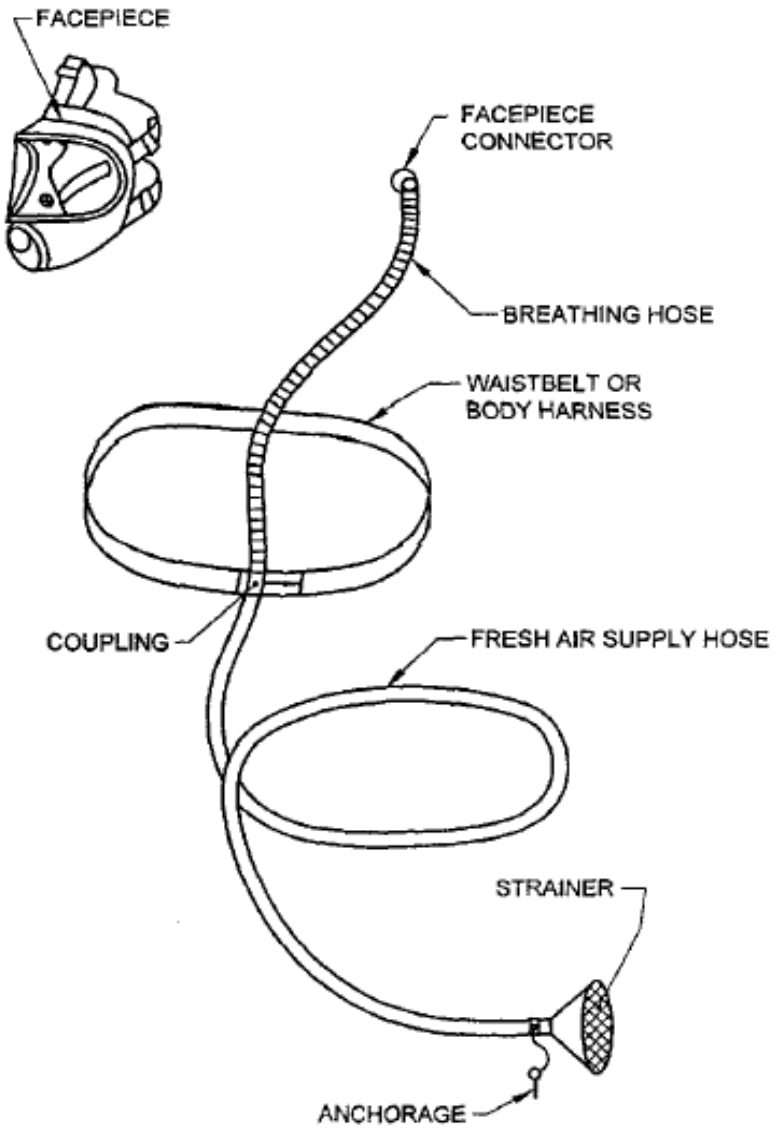
6.2.3 *Powered Filtering Device Incorporating Helmets or Hoods*



1	Filter	5	Hood
2	Blower	6	Helmet
3	Welding shield	7	Breathing hose
4	Face shield	8	Waist belt or carrying strap

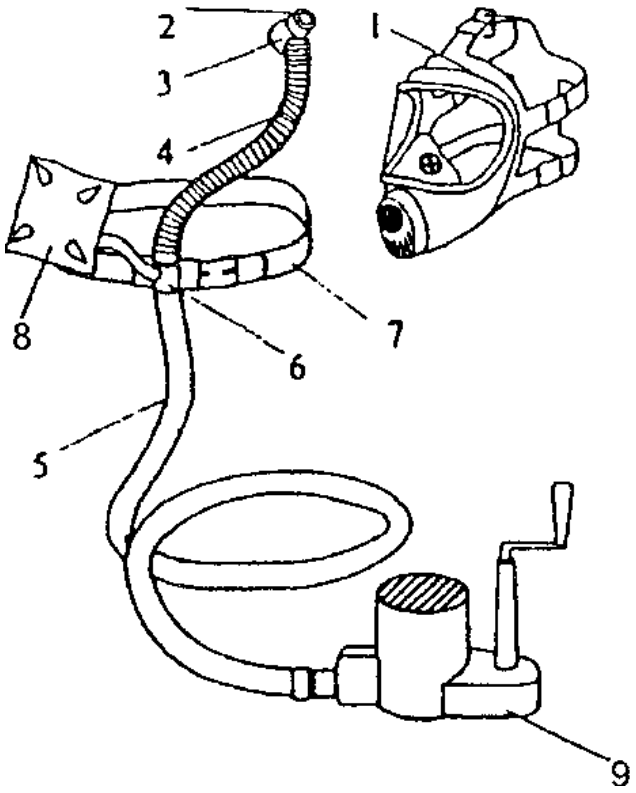
6.3 Breathing Apparatus

6.3.1 *Unassisted Fresh Air Hose Breathing Apparatus*



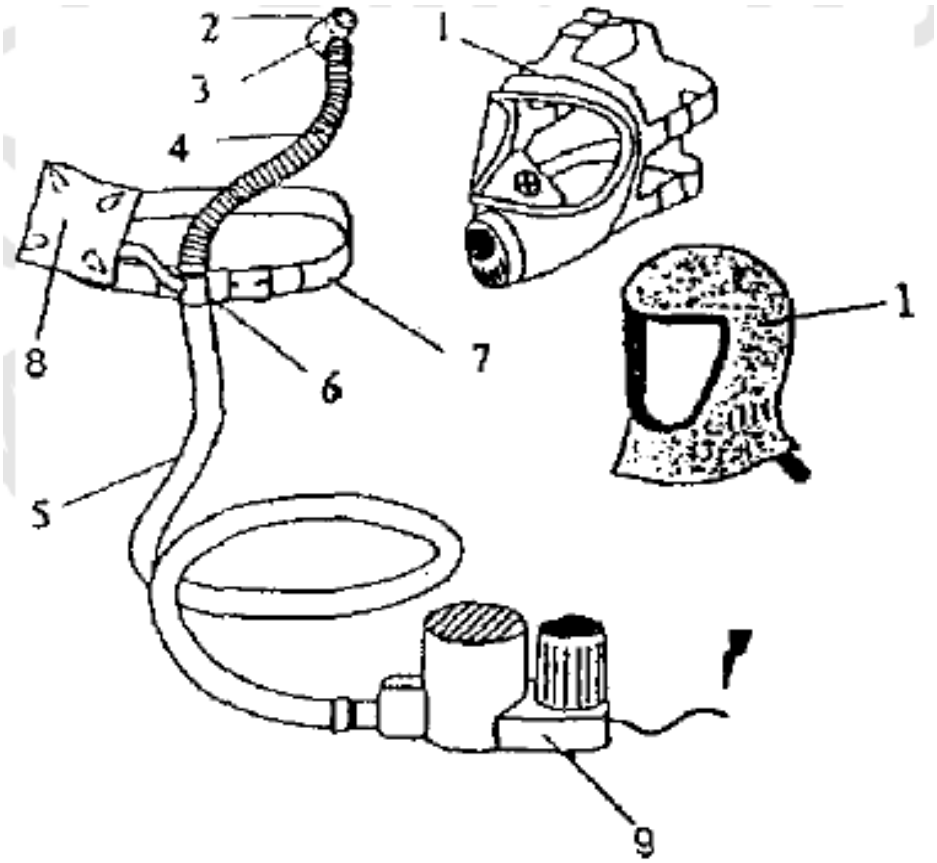
6.3.2 *Assisted Fresh Air Hose Breathing Apparatus*

6.3.2.1 *Manually assisted type*



1	Facepiece	6	Coupling
2	Facepiece connector	7	Waist belt or body harness
3	Overflow valve	8	Breathing bag
4	Breathing hose	9	Blower (hand operated)
5	Air supply hose (fresh air supply hose)		

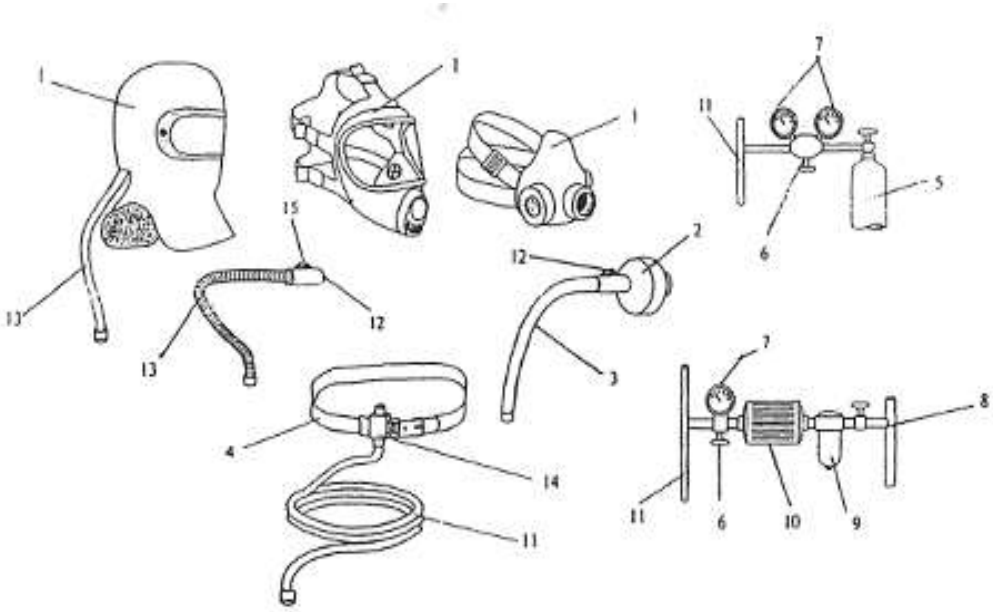
6.3.2.2 *Power assisted type*



1	Facepiece	6	Coupling
2	Facepiece connector	7	Waist belt or body harness
3	Overflow valve	8	Breathing bag
4	Breathing hose	9	Blower motor driven or compressed air
5	Air supply hose (fresh air supply hose)		

6.3.3 *Compressed Air Line Breathing Apparatus*

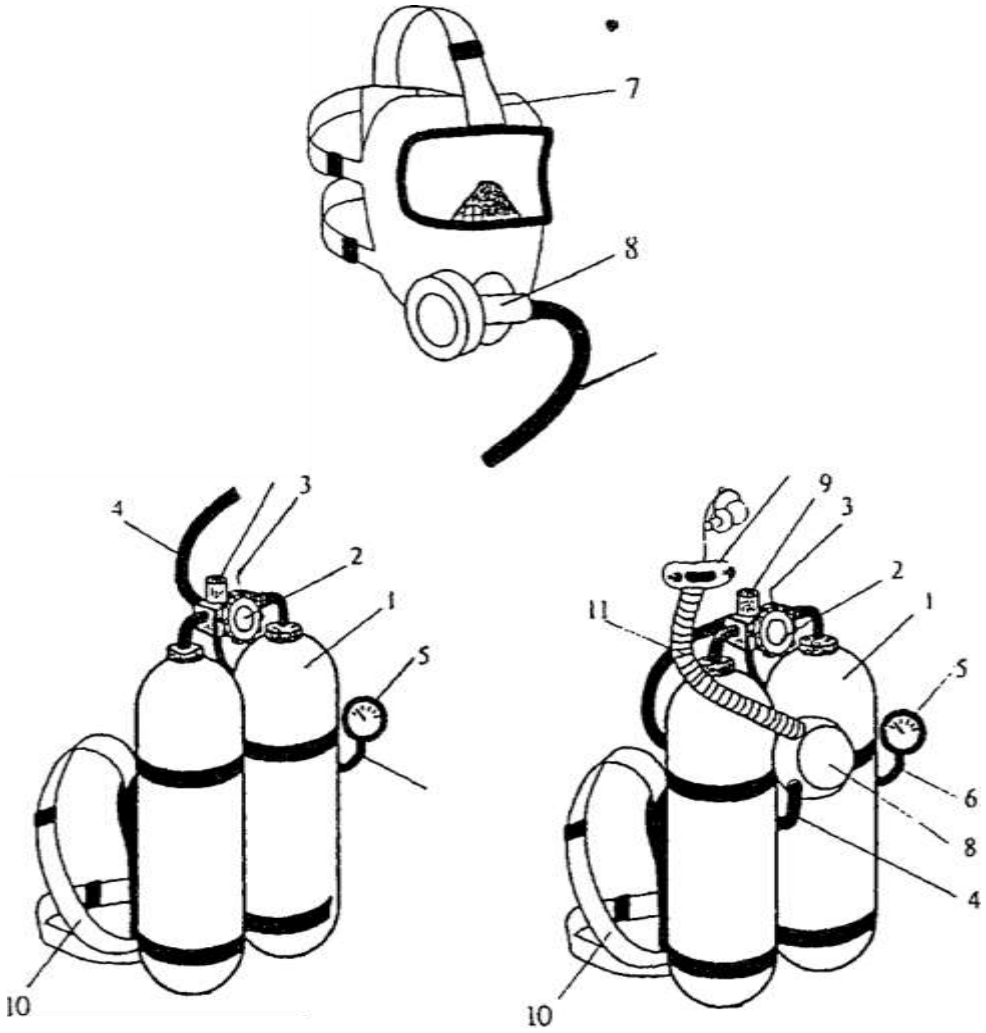
6.3.3.1 *Continuous flow type*



1	Facepiece	9	Separator
2	Demand valve	10	Compressed air filter
3	Medium pressure connecting tube	11	Compressed air supply tube
4	Waist belt or body harness	12	Facepiece connector
5	Compressed air cylinder	13	Breathing hose
6	Pressure reducer	14	Coupling and continuous flow
7	Pressure gauge	15	Overflow valve
8	Compressed airline		

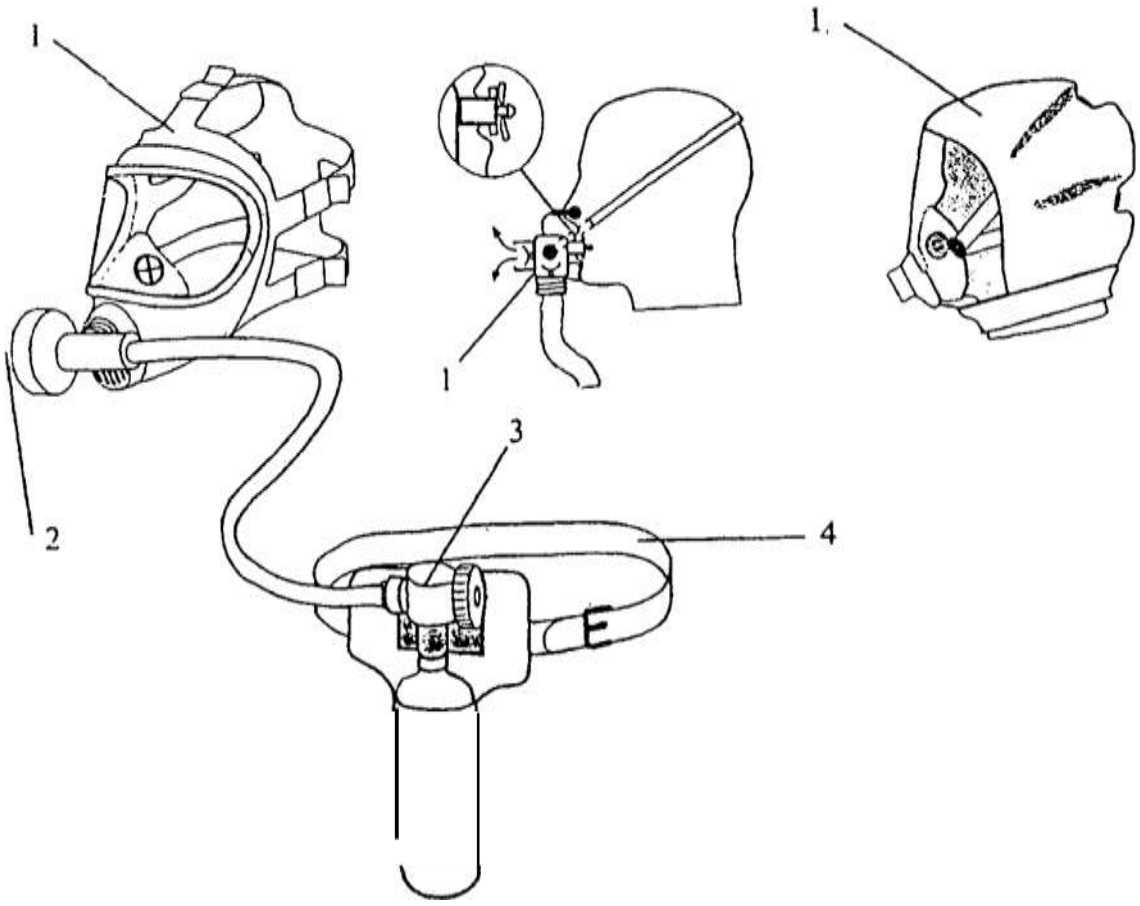
6.3.4 *Self-Contained Open-Circuit Compressed Air Breathing Apparatus*

6.3.4.1 *Demand type*



1	Compressed air cylinder	7	Facepiece
2	Cylinder valve	8	Demand valve (lung governed)
3	Pressure reducer	9	Warning device
4	Medium pressure connecting tube	10	Body harness
5	Pressure gauge	11	Breathing hose
6	Pressure gauge tube		

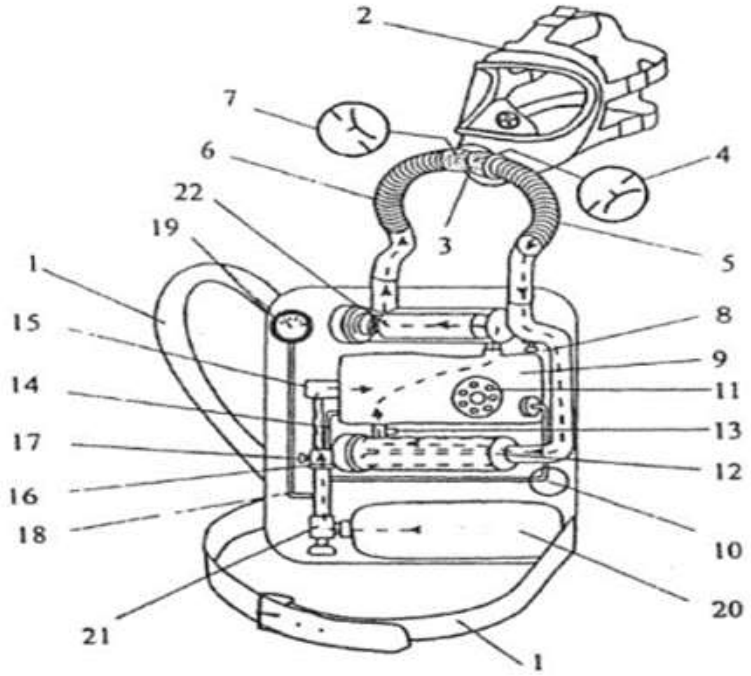
6.3.4.2 Self-contained open-circuit compressed air breathing apparatus for escape with full face mask or mouthpiece assembly.



1 Facepiece
2 Demand valve
3 Pressure transducer
4 Waist belt
5 Compressed air cylinder

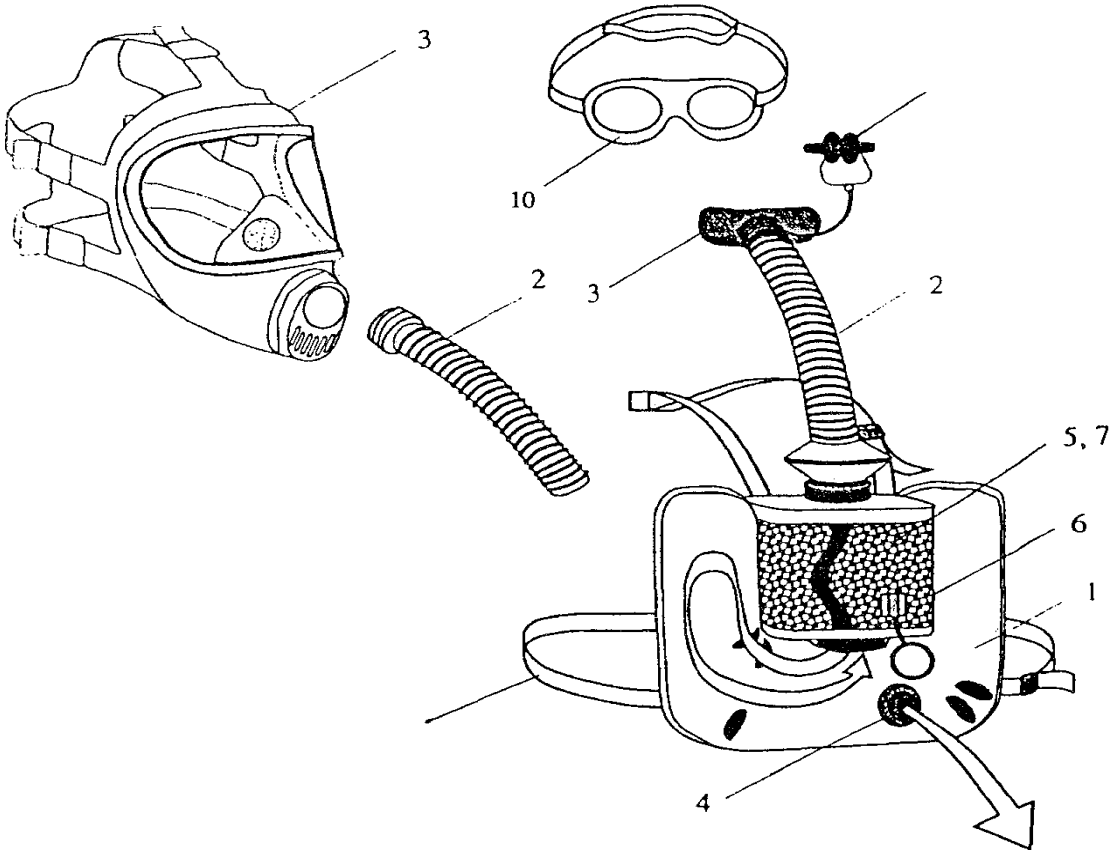
6.3.5 *Self-Contained Closed-Circuit Oxygen Breathing Apparatus*

6.3.5.1 *Compressed oxygen type*



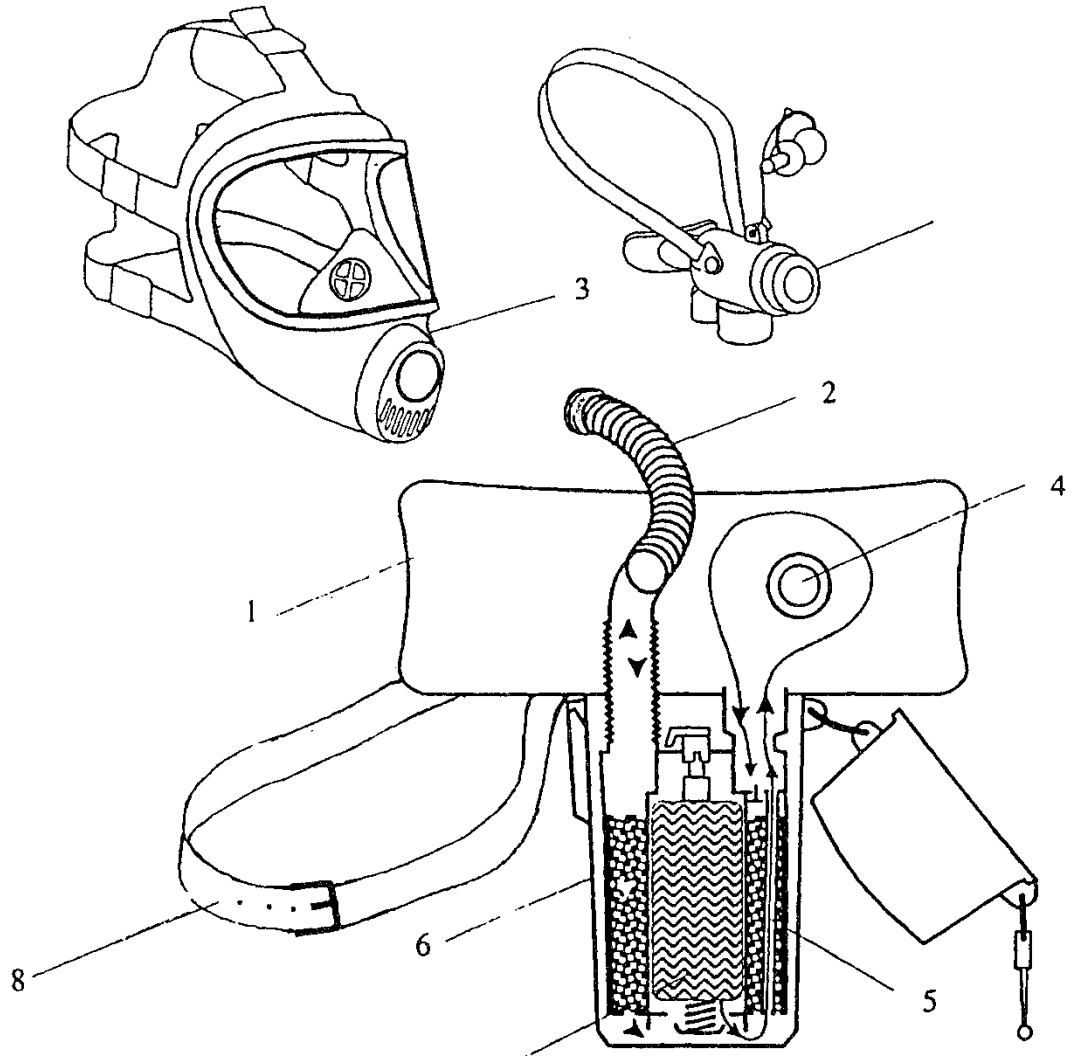
1	Body harness	12	Regeneration cartridge
2	Facepiece	13	Flushing device
3	Equipment connector	14	Oxygen supply tube
4	Exhalation valve	15	Demand valve (lung governed)
5	Exhalation hose	16	Pressure reducer
6	Inhalation valve	17	Supplementary oxygen supply valve
7	Inhalation hose	18	Pressure gauge tube
8	Saliva trap	19	Pressure gauge
9	Breathing bag	20	Oxygen cylinder
10	Warning device	21	Cylinder valve
11	Relief valve	22	Cooler

6.3.5.2 *Self-contained closed circuit breathing apparatus for self-rescue*



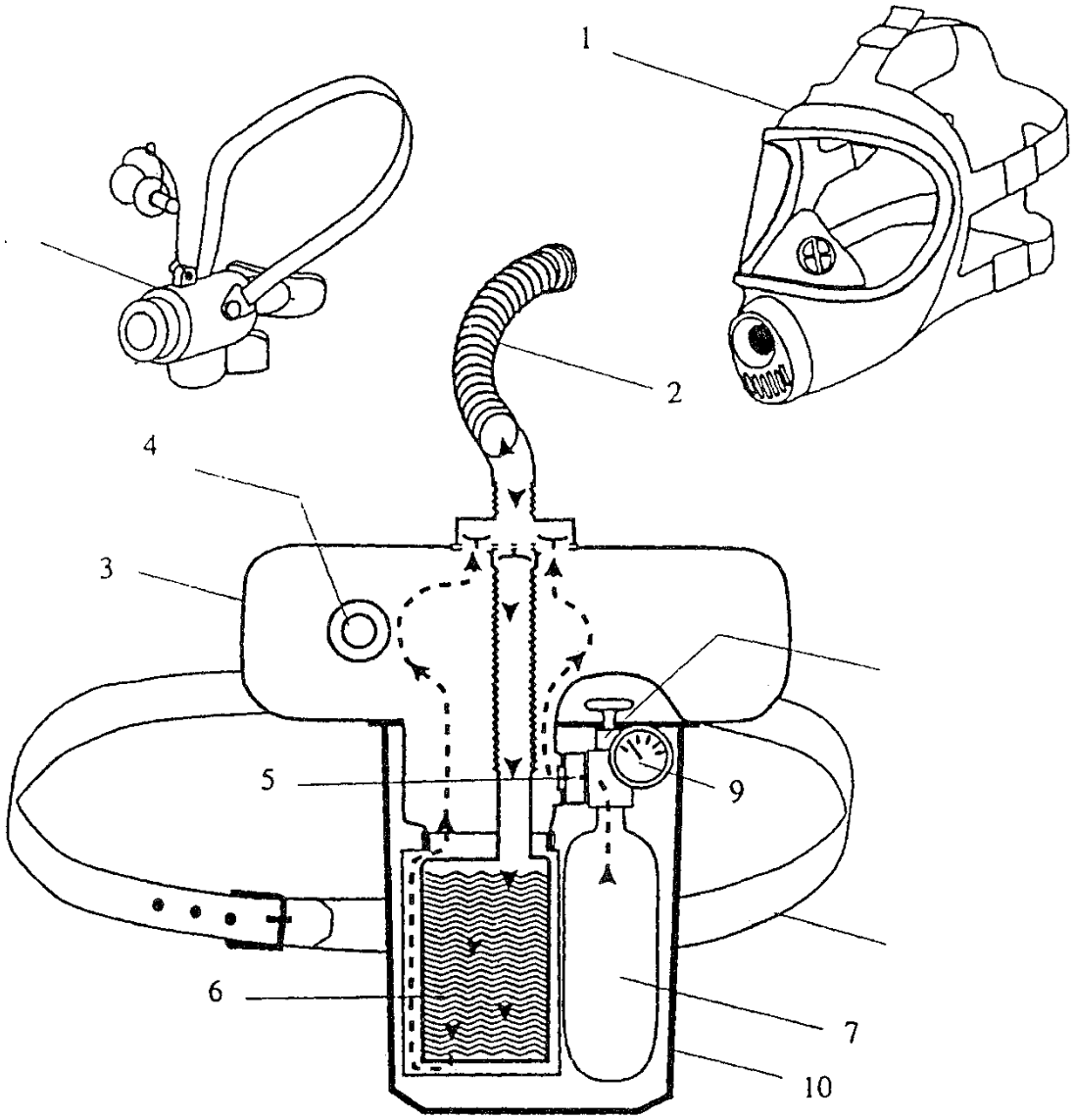
1	Breathing bag	6	Casing
2	Breathing hose	7	02 generator
3	Facepiece	8	Body harness
4	Relief valve	9	Nose clip
5	CO_2 absorber	10	Goggles

6.3.5.3 *Chemical oxygen ($NaClO_3$) type escape apparatus*



1	Breathing bag	5	CO_2 absorber
2	Breathing hose	6	Casing
3	Facepiece	7	02 Generator
4	Relief valve	8	Body harness

6.3.5.4 *Compressed oxygen escape*



1	Facepiece	7	Oxygen
2	Breathing hose	8	Cylinder valve
3	Breathing bag	9	Pressure
4	Relief valve	10	Casing
5	Pressure reducer	11	Waist belt
6	CO_2 cylinder		

ANNEX A

(*Clauses* 1 *and* 3.28)

COMPOSITION AND PURITY OF BREATHING

A-1 COMPOSITION OF AIR

Air for respiratory protective devices may be natural or synthetic. A typical composition of natural air is given in Table 1.

A-2 AIR QUALITY

Air quality (compressors or cylinders) for supplied air respirators shall meet the requirements specified in Annex A of IS 9623.

Table 1 Composition of Natural Air

(*Clause* A-1)

Sl No.	Components	Mass, Percent (Dry Air)	Vol, Percent (Dry Air)
(1)	(2)	(3)	(4)
i)	Oxygen (O_2)	23.14	20.947 6
ii)	Nitrogen (N_2)	75.72	78.084
iii)	Argon (Ar)	1.288	0.934
iv)	Carbon dioxide (CO_2)	0.048	0.031 4
v)	Hydrogen (H_2)	0.000 003	0.000 05
vi)	Neon (Ne)	0.001 27	0.000 818
vii)	Helium (He)	0.000 073	0.000 524
viii)	Krypton (Kr)	0.000 330	0.000 114
ix)	Xenon (Xe)	0.000 039	0.000 008

ANNEX B

(*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 RISHI RAJ ARYA (*Alternate* I) SHRI BIDYUT CHETIA (*Alternate* II)
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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 SHRIMATI ANJALI (*Alternate*)
Defence Research Development Organization, Ministry of Defence, New Delhi	SHRI AMIT PASI SHRI AJAY KUMAR SHAW (*Alternate*)
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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 General of Quality Assurance, CQA(Textiles and Clothing), Kanpur	SHRI BRAJESH TOMAR SHRI A. K. PATRA (*Alternate*)
Directorate General Fire Services, Civil Defence and Home Guards, New Delhi	SHRI MORESHWAR KUDKILWAR SHRI DR DHANANJAY KUMAR SINGH (*Alternate*) SHRIMATI VAISHALI SINGH (*Alternate*)
Directorate of Standardisation, Ministry of Defence, New Delhi	GP CAPT M. K. PANI
Draeger India Pvt Ltd, Mumbai	SHRI HIRENDAR CHATERJEE SHRI GANESAN MURUGESAN (*Alternate*)
ICMR - National Institute of Occupational Health, Ahmedabad	DR B. RAVICHANDRAN
Intech Safety Private Limited, Kolkata	SHRI SUBRATA MUKHERJEE SHRI GAUTAM BANERJEE (*Alternate*)

Organization	*Representative(s)*
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Venus Safety and Health Private Limited, Navi Mumbai	SHRI HARSHAL PATIL SHRI SANJEEV MINHAS (*Alternate*)
In Personal Capacity (*T02/103 and 104 Plot No.* 64 *and* 65, *Mayuresh Trinity Opp. Poonam Tower Sector* 16A *Nerul, Navi Mumbai*-400706*)*	SHRI S. D. BHARAMBE
BIS Directorate General	SHRI AJAY KUMAR LAL, SCIENTIST 'F'/SENIOR DIRECTOR AND HEAD (CHEMICAL) [REPRESENTING DIRECTOR GENERAL (*Ex-officio*)]

Member Secretary
SHRI SUSHANT KUMAR
SCIENTIST 'C'/DEPUTY DIRECTOR
(CHEMICAL), BIS

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