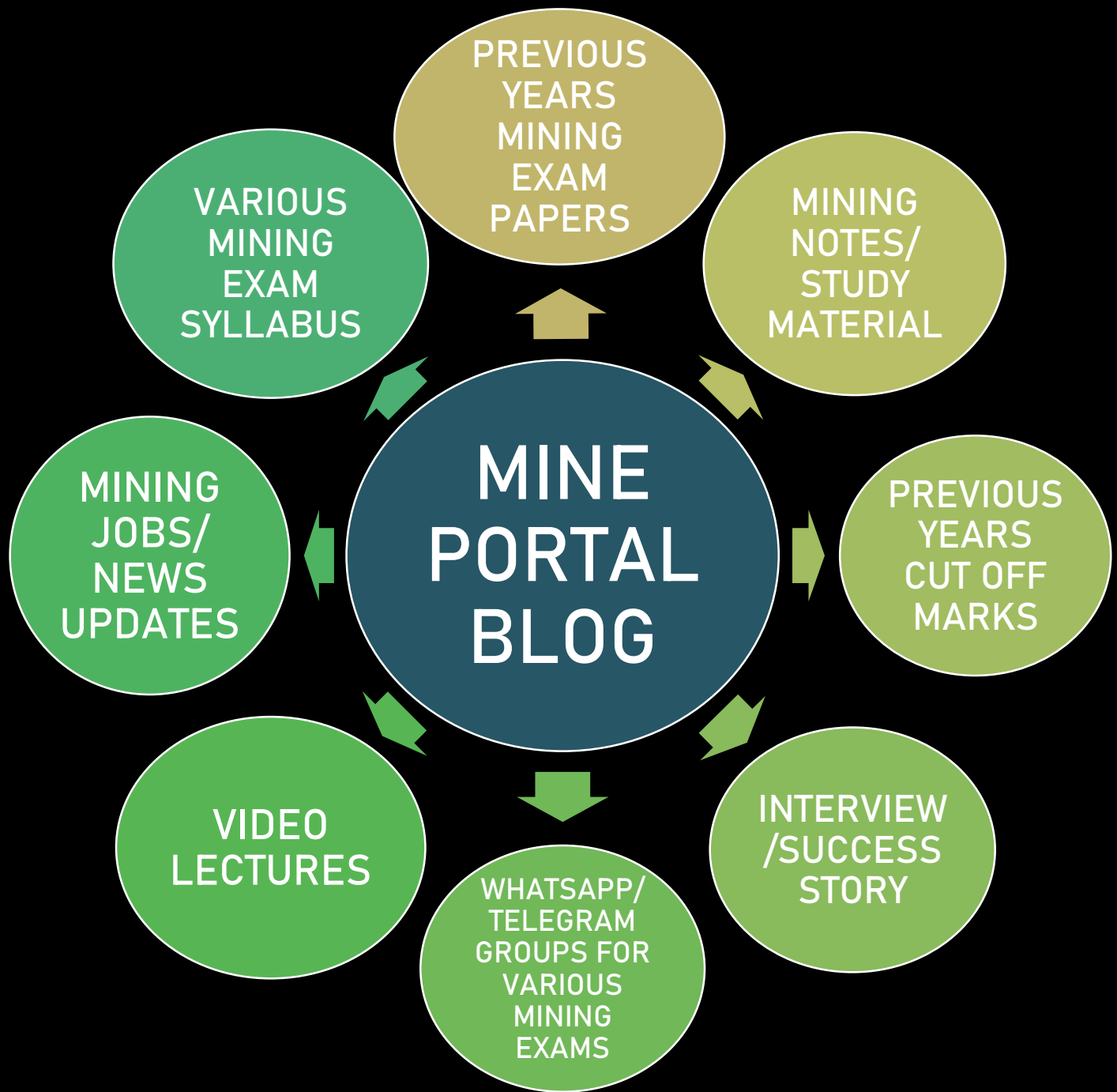


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**SHORT NOTES ON**  
**INDIAN STANDARD**  
**CLOSED CIRCUIT BREATHING APPARATUS**  
**(COMPRESSED OXYGEN CYLINDER)**

# BREATHING APPARATUS

## CLOSED CIRCUIT BREATHING APPARATUS

### ( COMPRESSED OXYGEN CYLINDER )

#### Terminology

*Working Duration:* The maximum period of time for which the apparatus should be used.

*Effective Duration:* **working time duration + reserve time period.**

*Inhaled Air:* The atmosphere breathed in by the wearer.

*Exhaled Air:* The atmosphere breathed out by the wearer.

#### Method of Operation

- In closed-circuit breathing apparatus exhaled air passes from a face piece (mouthpiece) through a breathing tube into a purifier containing chemicals.
- The chemical absorbs the exhaled carbon dioxide.
- Oxygen is fed into the breathing circuit from a cylinder of compressed oxygen.
- The oxygen and purified gas mix and are fed to the wearer who inhales from a breathing bag.
- The excess gas is released through a relief valve.

#### Construction

##### Materials

- All materials used should have adequate mechanical strength, durability and heat resistance, fire resistance, etc.
- Exposed parts of the apparatus, excluding cylinders, shall not be made of such materials which give rise to frictional sparks capable of igniting flammable gas mixtures.
- Materials that may come into contact with the skin shall be non-staining, soft, pliable and shall not contain known dermatitic substances.

##### Strength and Resistance in Water

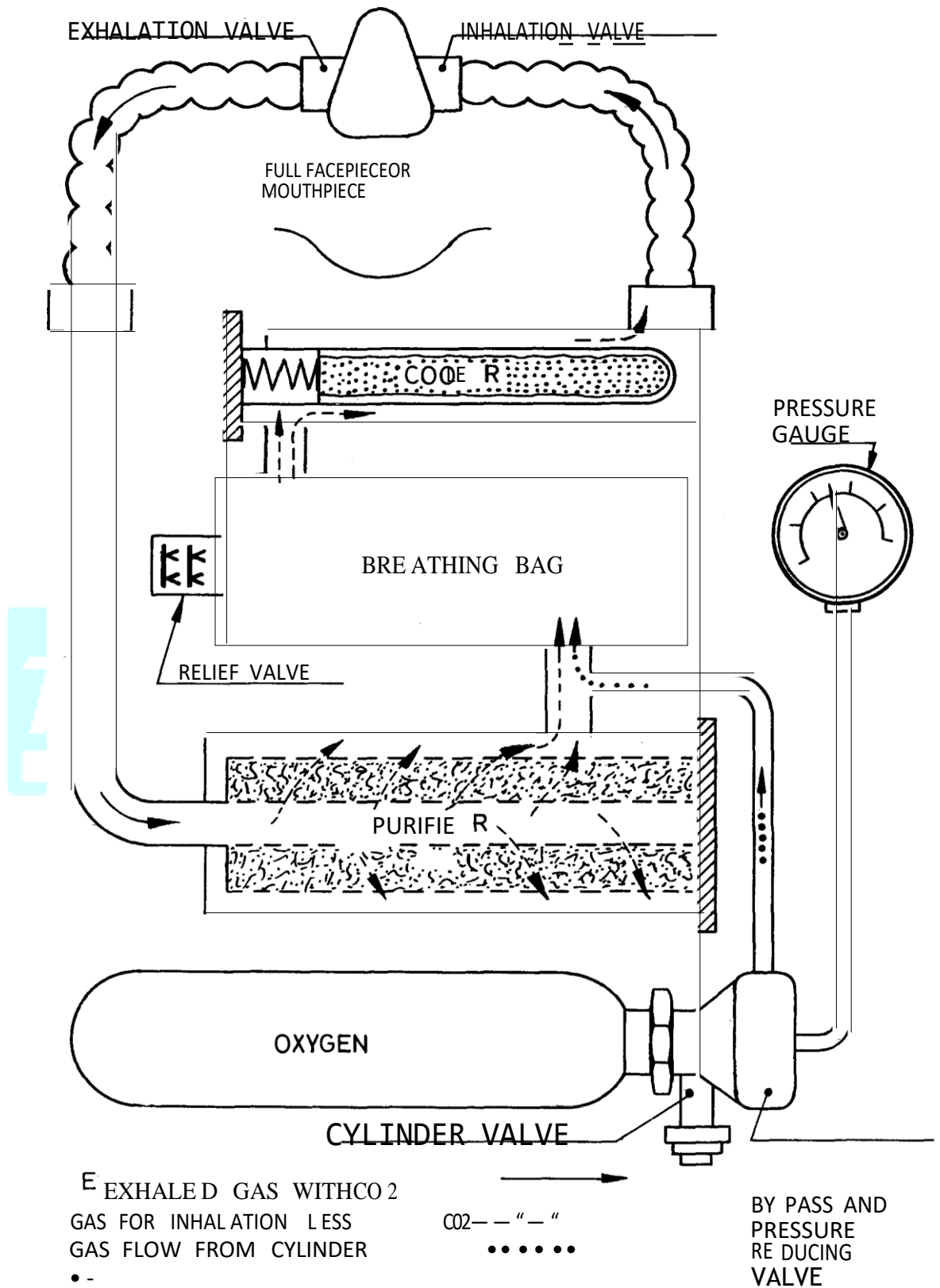
- The apparatus shall be sufficiently robust to withstand the rough usage.
- It will not be rendered defective if temporarily submerged in water.

#### Separation of Parts

- The design and construction of the apparatus shall permit its component parts to be readily separated for cleaning, examination and testing.
- The couplings required to achieve this 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.

#### Adjustable Parts

- 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 so constructed that their adjustment is not liable to accidental alteration during use.



### *Mass*

- The mass of the breathing apparatus, fully charged and ready for use shall not exceed 16.0 kg, (including breathing fittings).

### *Leak Tightness*

- The apparatus shall be so designed and constructed as to prevent ingress of the external atmosphere within the limits set out in this standard.

### *Cleaning and Decontamination*

- The design of the apparatus shall be such as to facilitate cleaning.

### **Facepiece**

- Facepieces are not suitable for persons with beards. Unless special fabrications are made.
- They will also not be suitable for wearers with spectacles, having side arms. In such situations, a mouthpiece with nose clips should be preferred.

Where face pieces are used, they shall be designed to meet the following requirements.

- The component parts, including breathing tubes, shall withstand a test under water at an air pressure of 1.7 KN/m and shall be proved free from leakage.
- Face piece shall cover the eyes, nose, mouth and chin and shall provide adequate sealing on the face of the wearer of the breathing apparatus against the outside gas.
- Face piece shall fit against the contours of the face.
- Facepieces shall be light in mass and comfortable to wear for long periods. The mass shall be systematically balanced to ensure the maximum retention of face seal and to minimize muscular strain.
- Facepieces shall have suitable and, preferably, replaceable eye-pieces or eyeshields.
- Eyepieces or eyeshields shall be made of non-splinterable, clear and non-inflammable material.
- Facepieces shall be secured to the face by means of an adjustable and replaceable head harness.
- Means for speech transmission shall be incorporated.
- The manufacturer shall provide means to reduce misting of the eyepieces or eyeshields in order that vision is not interfered.
- The dead space in the facepiece shall be as low as possible.
- The facepiece shall give wide field of vision
- Where manual wipers are provided in the facepiece, they shall be effective, durable, easy to operate and should not irritate the eyebrow of the wearer
- The head harness shall hold the facepiece or mouthpiece firmly and comfortably in position.
- It shall be simply fitted and adjusted, and shall be capable of ready cleaning and decontamination.
- Any fabric used in the construction of a head harness shall be resistant to shrinkage and shall not cause any irritation to the skin of the wearer.

### **Nose Clip**

- A nose clip shall be provided if a mouthpiece is used.
- Nose clip should be designed to afford, maximum security against accidental displacement,
- Nose clip should be reasonable comfort to the wearer.

### **Body Harness**

- The body harness shall be designed to allow the user to don the apparatus quickly and easily without assistance and shall be adjustable for fit.

- Buckles fitted to the waist and shoulder harness shall be so constructed that once adjusted they will not slip.
- Fabric used in the construction shall be resistant to shrinkage.
- The component parts shall not retain water.
- Where the body harness incorporates means for attachment of a life line, the harness, together with the snap hook, shall be capable of withstanding a drop test of 1 -m when loaded to 75 kg.

#### **Inhalation and Exhalation Valves**

- The design of valve assemblies shall be such that valve discs or the assemblies can be readily replaced;
- The inhalation and exhalation valves shall be protected against external influence.
- The design and construction of exhalation valves shall be such as to prevent inward leakage of contaminated air.
- Any nonreturn valve (inhalation or exhalation), controlled by the breathing action of the wearer, shall have minimum slip.
- The materials used in the construction of valves should be such that the efficiency of the valve shall not be impaired by any heat or moisture.
- The disc valves shall offer least resistance in operation.

#### **Relief Valve**

- General Breathing apparatus of the closed-circuit type shall be provided with a relief valve operated automatically by the pressure in the breathing circuit.
- Inward leakage of the external atmosphere shall not exceed 0.0025 percent when the moist valve is tested.
- The relief valve, which shall include an additional non-return valve, shall be protected against dirt and mechanical damage. Means shall be provided for sealing the relief valve to permit leak testing.
- Breathing apparatus fitted with a manual relief valve shall also be permissible.

#### **Reducing Valve or Pressure Reducer**

- In an apparatus using a reducing valve or pressure reducer alone, that is, without a supplementary lung-governed oxygen supply the flow of oxygen shall be not less than 4 l/min for the effective duration of the apparatus.
- Except that for apparatus with a pressure reducer the oxygen flow during the reserve period may fall to not less than 1.8 Ymin:
- The flow of oxygen from a reducing valve of constant flow type shall remain constant to within 10 percent of the preset flow at all cylinder pressures above ten atmospheres.
- The reducing valve, if adjustable, shall be provided with a suitable locking device to prevent accidental alteration of the oxygen supply.

#### **Lung-Governed Oxygen Supply (Demand Valve)**

- The opening pressure of the lung-governed supply mechanism measured at a constant flow of 10 Ymin, shall not exceed 35 mm H<sub>2</sub>O.
- Apparatus operating with a lung-governed supply alone or with constant supply of less than 2 l/min shall have an automatic scavenging device by means of which sufficient 'air' is removed from the circuit to the outside to maintain an oxygen content of not less than 21 percent.
- The lung governed oxygen supply valve shall function so as to provide oxygen in accordance with the breathing requirements of the wearer of the apparatus and be capable of passing sufficient oxygen to replace the oxygen consumed when he is breathing at the rate of 50-90 Ymin with any cylinder pressure above 1000 kN/m<sup>2</sup>.

#### **By-Pass Valve**

- Apparatus equipped with a pressure reducer or a reducing valve and/or lung/governed valve, shall be provided with a manually operated by-pass valve of self-closing type, whereby the wearer can obtain a supply of oxygen at a flow of between 50 Umin and 90 Umin at all cylinder pressures above 5000 kN/m<sup>2</sup> independently of the reducing valve or lung governed valve.
- The shape and size of the valve control shall be such that it can be operated even with a wet or slippery hand.

### **Pressure Gauge**

- Apparatus using compressed oxygen shall have a pressure gauge which shall incorporate a suitable blow-out release so that in event of an explosion or fracture of the pressure element of the gauge, the blast will be away from the front. The gauge shall have a window of non-splintering glass or of clear plastic material.
- An efficient valve shall be provided to isolate the gauge and connections to it from the rest of the circuit.
- The pressure gauge shall be placed to enable the gas cylinder pressure to be read conveniently by the wearer.
- The pressure gauge shall incorporate a means of indicating an adequate warning period and shall be shown in red colour.
- The pressure gauge shall withstand pressure greater than the maximum cylinder pressure so that it will operate continuously and accurately without overstrain. Pressure gauge for use with such apparatus shall be shock-resistant.

### **Warning Device**

- The apparatus shall be so designed that the wearer is warned immediately if the main valve is closed or if the cylinder fitted is empty.
- If this warning device is controlled by the oxygen pressure, an immediate warning shall be given to the wearer when any leakage in excess of 0.4 Umin occurs in the parts of the warning device containing oxygen. The loss of oxygen from one warning system shall not exceed 0.6 l/min at full cylinder pressure.
- As an option, an indication of low cylinder pressure is permitted.

### **Flexible Tubes**

- Flexible tubes and fittings of the high pressure system shall be capable of withstanding without damage a test pressure of twice the maximum designed working pressure. It shall not be possible to fit in low pressure part or those into a higher pressure part of the circuit.

### **Gas Cylinder and Main Valve**

- Gas cylinders and the valves fitted there shall comply with the provisions of *Gas Cylinder Rules, 1981*, as amended from time to time.
- Cylinders shall be coloured in accordance with IS.
- The main valve shall comply with the requirements of IS.
- The valve shall be either lockable in the open position or designed so that it cannot be closed inadvertently by contact with a surface.
- The main valve should be easily accessible and distinguished by touch.

### **Oxygen Supply**

- The total volume of oxygen available shall be sufficient to meet an average consumption of not less than 4 l/min for breathing apparatus without lung-governed demand valve and 1.5 l/min for that with lung-governed demand valve. In apparatus without a supplementary lung-governed oxygen supply an additional 10 percent capacity shall be provided to allow for the possible use of the by-pass valve.

### **Breathing Bag**



- The breathing bag shall be made of strong, flexible material and shall be protected against collapse of damage by external agencies. It shall be made from anti-static material.
- The breathing bag shall be reliably and tightly joined to the couplings. The coupling at the inhalation side shall be shaped in such a way that its opening cannot be closed by the bag itself.
- In apparatus using compressed oxygen, the capacity of the breathing bag, when correctly fitted and with the casing closed, shall be at least 5 litre..
- The number of connections of the breathing bag with the breathing circuit should be minimum for proper maintenance of the breathing bag.

#### Breathing Tubes

- Breathing tubes shall be flexible and non- kinking and of sufficient length to permit free head movement of the wearer. They shall be made from anti-static material.
- The design of the breathing tubes shall be such as to offer least breathing resistance.
- The breathing tubes shall not flatten to impede the flow of gas.
- The dead space of the breathing tube should be as low as possible.

#### Condition of the Inhaled Air

- **Oxygen Content:** the oxygen content of the inhaled air shall not fall below 21 percent (by volume).
- **Carbon Dioxide Content:** The carbon dioxide content of the inhaled air shall not exceed an average of 1.25 percent (by volume) and shall at no time exceed 1.5 percent (by volume) during the working duration of the apparatus.
- **Temperature and Humidity:** The temperature of the inhaled air independence of humidity shall not exceed 45°C.

#### Purity of Oxygen:

- In Circuit breathing apparatus, the purity of oxygen to be used shall be not less than 99 percent.
- A saliva trap to accumulate saliva of the wearer, if provided, shall be fixed with the inhalation tube.

#### Protective Casing

The whole breathing apparatus should be covered by a protective casing to protect the breathing bag, regulator, reducing valve and other vital parts of the apparatus against direct blows and falling materials.

It shall be made of light metal of adequate strength or of tough moulded fibre glass. It shall be so designed that it permits ease of passage through narrow spaces.

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