

Anesthetic Breathing system (breathing circuit)

An breathing system is defined as an assembly of components, which connect the patient's airway to the anesthetic machine creating an artificial atmosphere, from and into which the patient breathes. And Delivery O₂ and inhaled An. From anesthesia machine to patient and remove CO₂ from exhaled gases. **Breathing systems must fulfil three objectives:** 1. Delivery of oxygen. 2. Removal of carbon dioxide from the patient. 3. Delivery of inhaled anaesthetic agents.

Properties of the ideal breathing system

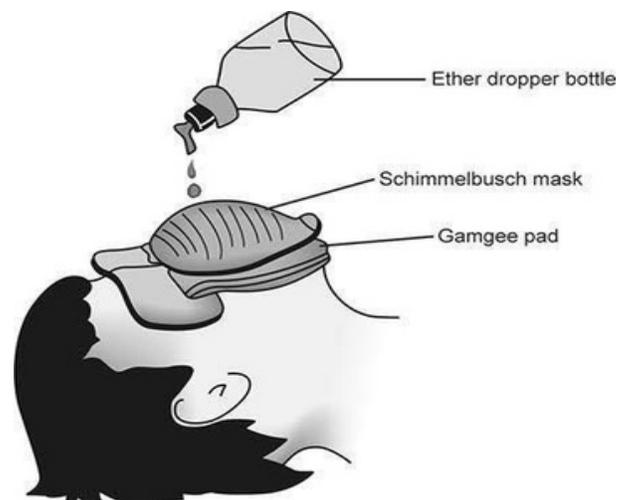
1. Simple and safe to use.
2. Delivers the intended inspired gas mixture.

3. Permits spontaneous, manual and controlled ventilation in all age groups
4. Efficient, requiring low FGF rates.
5. Protects the patient from barotrauma.
6. Sturdy, compact and lightweight in design.
7. Permits the easy removal of waste exhaled gases.
8. Easy to maintain with minimal running costs.



Classification Of Breathing Systems (McMohan in 1951) :

- **Open:** No **rebreathing** (Nasal cannula and gauze with drop of anesthesia agent and allow venting)
- **Semiclosed:** Partial **rebreathing** (Mapleson)
- **Closed:** Total **rebreathing** (circle system) with CO₂ absorber



functional classification (Conway2) :

classified according to the method used for CO₂ elimination as:

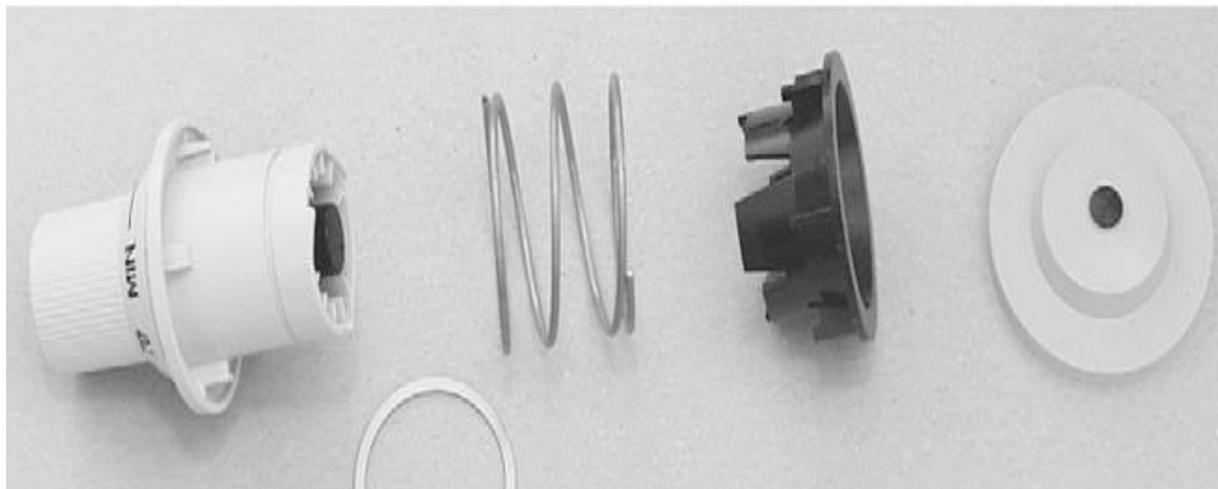
- Breathing systems **with CO₂ absorber**
- Breathing systems **without CO₂ absorber**

Componentsofthe breathingsystems

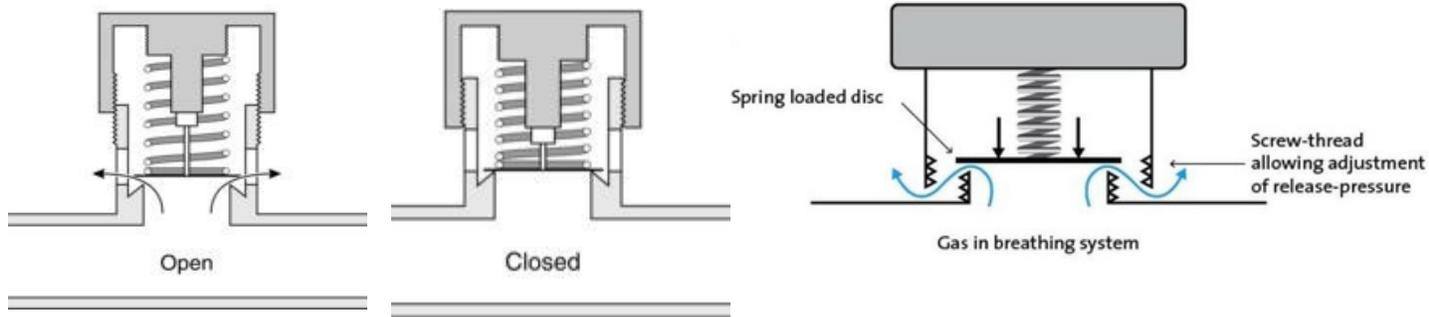
1. Adjustable Pressure Limiting (APL) Valve 2. Reservoir Bag 3. Tubings

1. Adjustable Pressure Limiting (APL) Valve

This is a valve which allowsthe exhaled gases and excess FGF to leave the breathing system . It does not allow room air to enter the breathing system. Synonymous terms for the APL valve are expiratory valve, spill valve and relief valve.

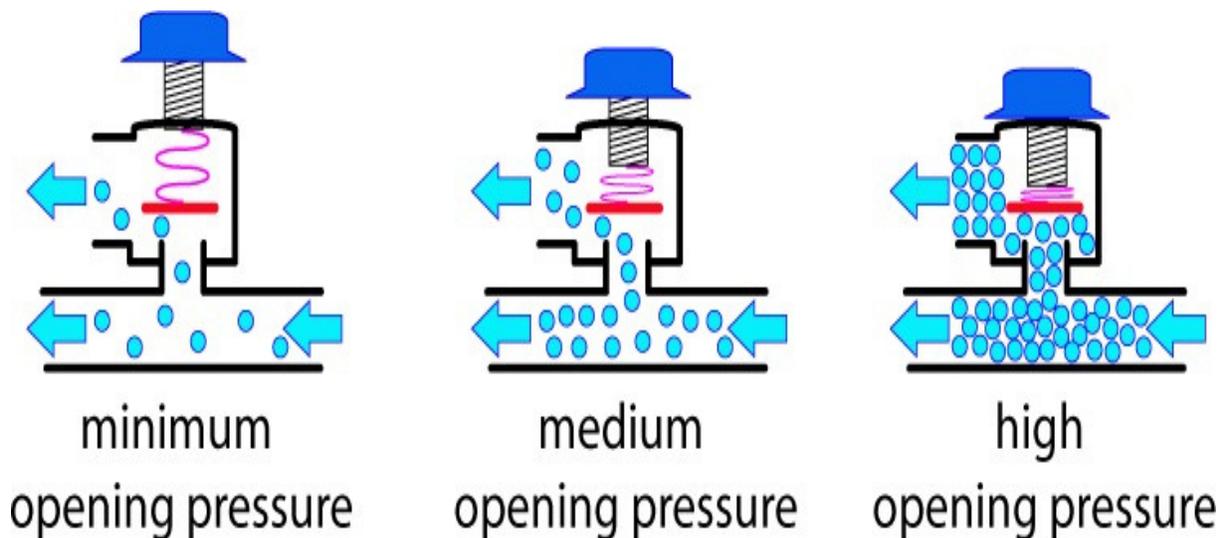


Components 1. **Three ports:** the **inlet**, the **patient** and the **exhaust** ports. The latter can be open to the atmosphere or connected to the scavenging system using a shroud 2. A **lightweight disc** rests on a **knife-edge seating**. The disc is held onto its seating by a spring. The tension in the spring, and therefore the valve's opening pressure, are controlled by the valve dial.



Mechanism of action

1. This is a **one-way, adjustable, spring-loaded valve**. The **spring** is used to **adjust** the **pressure** required to **open the valve**. The disc rests on a knife-edge seating in order to minimize its area of contact.
2. The **valve allows gases to escape when the pressure in the breathing system exceeds the valve's opening pressure**.
3. During **spontaneous** ventilation, the **patient generates a positive pressure** in the system during expiration, causing the valve to **open**. A pressure of less than 1 cm H₂O (0.1 kPa) is needed to actuate the valve when it is in the open position.
4. During **positive pressure ventilation**, a controlled leak is produced by adjusting the valve dial during inspiration. This allows control of the patient's airway pressure.



Problems in practice and safety features

1. **Malfunction of the scavenging system** may cause **excessive negative pressure**. This can lead to the APL valve remaining open throughout respiration. This leads to an unwanted enormous increase in the breathing system's dead space
2. **The patient may be exposed to excessive positive pressure if the valve is closed** during assisted ventilation. A pressure relief safety mechanism actuated at a pressure of about 60 cm H₂O is present in some designs
3. **Water vapour** in exhaled gas may condense on the valve. The surface tension of the condensed water may cause the valve to stick. The disc is usually made of a hydrophobic (water repelling) material, which prevents water condensing on the disc.

2. Reservoir Bag

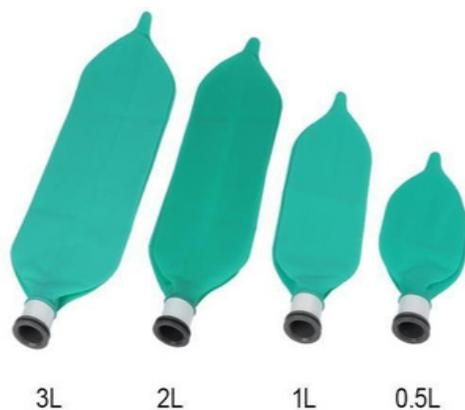
The reservoir bag is an important component of most breathing systems.

Components

1. It is made of **anti-static rubber or plastic**. Latex-free versions also exist. Designs tend to be ellipsoidal in shape
2. The standard **adult size is 2 L**. The smallest size for **pediatric use is 0.5 L**. Volumes from **0.5 to 6 L** exist. Bigger size reservoir bags are useful during inhalational induction, e.g. adult induction with sevoflurane.

Uses

1. **Accommodates the FGF during expiration acting as a reservoir** available for the following inspiration.
2. It acts as a **monitor of the patient's ventilatory pattern during spontaneous breathing**. It serves as a very inaccurate guide to the patient's tidal volume
3. It can be used **to assist or control ventilation**.



Problems in practice and safety features 1. Because of its **compliance**, the reservoir bag can **accommodate rises in pressure** in the breathing system better than other parts. When grossly overinflated, the rubber reservoir bag can limit 2. The **size of the bag depends on the breathing system and the patient**. A small bag may not be large enough to provide a sufficient reservoir for a large tidal volume 3. **Too large a reservoir bag makes it difficult for it to act as a respiratory monitor**.

3. Tubings

These **connect one part of a breathing system to another**. They also act as a reservoir for gases in certain systems. They tend to be made of plastic, but other materials such as silicone rubber and silver impregnated bactericidal plastics are available. The length of the breathing tubing is variable depending on the configuration of the breathing system used.. The size for adults is 22 mm wide. However, pediatric tubing is 15 mm wide, to reduce bulk. The corrugations resist kinking and increase flexibility

