Oxygen mask

An oxygen mask provides a method to transfer breathing oxygen gas from a storage tank to the lungs. Oxygen masks may cover the nose and mouth (oral nasal mask) or the entire face (full-face mask). They may be made of plastic, silicone, or rubber.

(Note: In certain circumstances, oxygen may be delivered via a nasal cannula instead of a mask; cannulas are described in a separate article.)

Medical plastic oxygen masks

Plastic masks are used primarily by medical care providers for oxygen therapy because they are disposable and so reduce cleaning costs and infection risks. Mask design can determine accuracy of oxygen delivered with many various medical situations requiring treatment with Oxygen. Oxygen is naturally occurring in room air at 21% and higher percentages are often essential in medical treatment. Oxygen in these higher percentages is classified as a drug with too much oxygen being potentially harmful to a patient’s health resulting in oxygen dependence, over time, and in extreme circumstances patient blindness. For these reasons oxygen therapy is closely monitored. Masks are light in weight and attached using an elasticated headband or ear loops, they are transparent allowing the face visible for patient assessment by healthcare provider and reducing a sensation of claustrophobia experienced by some patients when wearing an oxygen mask. The vast majority of patients having an operation will at some stage wear an oxygen mask, they may alternatively wear nasal cannula but oxygen delivered in this way is less accurate and restricted in concentration.

Silicone and rubber masks

Silicone and rubber oxygen masks are heavier than plastic masks. They are designed to provide a good seal for long-duration use by aviators, medical research subjects, and hyperbaric chamber and other patients that require administration of pure oxygen, such as carbon monoxide poisoning and decompression sickness victims.\(^1\) Valves inside these tight-fitting masks control the flow of gases into and out of the masks, so that rebreathing of exhaled gas is minimised.

Hoses and tubing and oxygen regulators

Hoses or tubing connect an oxygen mask to the oxygen supply. Hose is larger in diameter than tubing and can allow greater oxygen flow. When hose is used it may have a ribbed or corrugated design to allow bending of the hose while preventing twisting and cutting off the oxygen flow. The quantity of oxygen delivered from the storage tank to the oxygen mask is controlled by a valve called a regulator. Some types of oxygen masks have a breathing bag made of plastic or rubber attached to the mask or oxygen supply hose to store a supply of oxygen to allow deep breathing without waste of oxygen with use of simple fixed flow regulators.
Oxygen masks for aviators

Three main kinds of oxygen masks are used by pilots and crews who fly at high altitudes: continuous flow, diluter demand, and pressure demand.[2]

In a continuous-flow system, oxygen is provided to the user continuously. It does not matter if the user is exhaling or inhaling as oxygen is flowing from the time the system is activated. Below the oxygen mask is a rebreather bag that collects oxygen during exhalation and as a result allows a higher flow rate during the inhalation cycle.[3]

Diluter-demand and pressure-demand masks supply oxygen only when the user inhales.[4] They each require a good seal between the mask and the user’s face.

In a diluter-demand system, as the altitude increases (ambient pressure, and therefore the partial pressure of ambient oxygen, decreases), the oxygen flow increases such that the partial pressure of oxygen is roughly constant. Diluter-demand oxygen systems can be used up to 40,000 feet.[3]

In a pressure-demand system, oxygen in the mask is above ambient pressure, permitting breathing above 40,000 feet.[3] Because the pressure inside the mask is greater than the pressure around the user’s torso, inhalation is easy, but exhalation requires more effort. Aviators are trained in pressure-demand breathing in altitude chambers. Because they seal tightly, pressure-demand-type oxygen masks are also used in hyperbaric oxygen chambers and for oxygen breathing research projects with standard oxygen regulators.[1]

Many designs of aviator's oxygen mask contain a microphone to transmit speech to other crew members and to the aircraft's radio. Military aviators' oxygen masks have face pieces that partially cover the sides of the face and protect the face against flash burns, flying particles, and effects of a high speed air stream hitting the face during emergency evacuation from the aircraft by ejection seat or parachute. They are often part of a pressure suit.

An early 1919 high-altitude oxygen system used a vacuum flask of liquid oxygen to supply two people for one hour at 15,000 feet. The liquid passed through several warming stages prior to use, due to evaporative expansion making the gasified oxygen so cold that it could cause instant frostbite of the lungs.[5]
Aviation passenger masks and emergency oxygen systems

Most commercial aircraft are fitted with oxygen masks for use when cabin pressurization fails.[6] In general, commercial aircraft are pressurized so that the cabin air is at a pressure equivalent to no more than 8,000 feet altitude (usually somewhat lower altitude), where one can breathe normally without an oxygen mask. If the oxygen pressure in the cabin drops below a safe level, risking hypoxia, compartments containing the oxygen masks will open automatically, either above or in front of the passenger and crew seats, and in the lavatories. For the safety of the craft and passengers (including crew) all oxygen is ported into the cockpit for the pilots to maintain awareness to attempt an emergency maneuver (i.e.; water landing.) All of those in the pressurized cabin would in this case fall asleep only to awake shortly thereafter to find that the aircraft has landed and oxygen of lower altitudes has been replenished in the craft, be it the doors have been opened or the outflow valve has purged the carbon dioxide from the craft interior.

In the early years of commercial flight, before pressurized cabins were invented, airliner passengers sometimes had to wear oxygen masks during routine flights.

Self-contained breathing apparatus (SCBA)

Firefighters and emergency service workers use full face masks that provide breathing air as well as eye and face protection.[8] These masks are typically attached to a tank carried upon the back of the wearer and are called self-contained breathing apparatuses (SCBA).[9] Because oxygen breathing is hazardous in areas where fires may be burning, and because open-circuit compressed-air breathing sets are easier to refill than rebreathers, SCBA units are normally filled with compressed breathing air rather than oxygen.

Specialized masks for divers and astronauts

Specialized full-face masks that supply oxygen or other breathing gases are used by divers and astronauts to remove nitrogen from their blood before space walks (EVA) or underwater decompression.[10]

Anaesthesia oxygen masks

Anesthesia masks are face masks that are designed to administer anesthetic gases to a patient through inhalation. Anesthesia masks are either made of anti-static silicone or rubber, as a static electricity spark may ignite some anesthetic gases. They are either black rubber or clear silicone. Anesthesia masks fit over the mouth and nose and have a double hose system. One hose carries inhaled anesthetic gas to the mask and the other brings exhaled anesthetic gas back to the machine. Anesthesia masks have 4 point head strap harnesses to securely fit on the head to hold the mask in place as the anaethesia doctor controls the gases and oxygen inhaled.
Masks for high-altitude climbers

Oxygen masks are used by climbers of high peaks such as Mt. Everest.[11] Because of the severe cold and harsh conditions oxygen masks for use at extreme altitude must be robust and effective. The oxygen storage tanks used with the masks, called oxygen bottles are made of light-weight, high-strength metals and are covered in high-strength fiber such as kevlar. These special oxygen bottles are filled with oxygen at a very high pressure which provides a longer time duration of oxygen for breathing than standard pressure oxygen bottles. These systems are generally only used above 7000 meters.

The makers of the "Top Out" high-altitude oxygen system claim that "Oxygen is delivered to the mask as a constant flow adjusted according to need by a regulator. While the climber breaths out the constant flow oxygen is diverted by an internal valve to an accumulator as in the TopOut oxygen system. When an inhalation is made the accumulated oxygen and the amount of constant flow is delivered as the first part of the breath, deep into the lungs for best effect onto the alveoli. The rich oxygen mix is the first part of the breath until the accumulator empties then a secondary valve opens to allow ambient air to complete the filling of the anatomical dead space, the pipe work feeding the deep lung where no oxygen exchange can take place. All the oxygen from the cylinder must now process through the lungs without waste and in a preferred order to prolong the extraction time into the bloodstream."

Oxygen helmets

Oxygen helmets are used in hyperbaric oxygen chambers for oxygen administration.[1] They are transparent light weight plastic helmets with a seal that goes around the wearer's neck that looks like a space suit helmet. They offer a good visual field. Light weight plastic hoses provide oxygen to the helmet and remove exhaled gas to the outside of the chamber. Oxygen helmets are often preferred for oxygen administration in hyperbaric oxygen chambers for children and patients that are uncomfortable wearing an oxygen mask.

Mask retention systems

Medical oxygen masks are held in place by medical personnel or the user by hand, or they may be fitted with a light weight elastic headband so the mask can be removed quickly. Full-face masks are secured by several straps. Tightly fitting oxygen masks are secured at four points by two head straps. Aviators’ masks are often equipped with "quick don" harnesses that allow those in pressurized aircraft to rapidly don the masks in emergencies. Military aviators' oxygen masks are secured to flight helmets with quick-release systems.

References


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