



**Listed below are some industry facts that pertain to supplemental oxygen that pilots may find of interest.*

Oxygen Facts:

The air we breathe is a mixture of 20.94% oxygen, 79.02% nitrogen and .04% carbon dioxide by volume. This relative composition of the atmosphere does not vary appreciably up to at least 70,000 feet.

The quantity of oxygen that can be absorbed by the bloodstream is proportional to the partial pressure of oxygen (PPO₂) in the lungs.

PPO₂ at sea level is 107 mm Hg.

PPO₂ at 10,000 ft is 71 mm Hg.

PPO₂ at 40,000 ft is 14 mm Hg.

At sea level, oxygen saturation in the blood is approximately 95%, which does not appreciably decrease up to 10,000 ft where it reaches 90%. Above 10,000 ft the saturation rate drops more rapidly and human faculties begin to be impaired. Above 14,000 ft, physiological troubles begin to appear.

This is why 14,000 ft has been selected as the altitude above which oxygen masks must be used in unpressurized aircraft.

The blood carrying oxygen from the lungs into the body is the arterial blood and the returning blood is the venous blood, which still contains some oxygen, The pressure of the venous blood is about 40 mm Hg. When the oxygen pressure in the lungs is sufficiently below this value, the venous blood restores its oxygen and a very rapid decline in “the time of useful consciousness” (TUC) takes place. This varies with the altitude and the speed of decompression.

Time of Useful Consciousness

Altitude	Slow Decompression	Rapid Decompression
25,000 ft	5 minutes	2 minutes 30 seconds
30,000 ft	1 to 2 minutes	30 seconds to 1 minute
40,000 ft	18 seconds	18 seconds



Hypoxia is the physical condition induced by an inadequate concentration of oxygen in the blood. The danger of hypoxia is that not only does the subject not notice his gradual deterioration but he may actually experience a feeling of well-being (euphoria).

Prolonged exposure to severe hypoxia could result in brain damage to the extent of total intellectual deficiency. At 40,000 ft it is estimated that without oxygen, death would ensue in ninety seconds.

Other consequences of a decompression are the following:
Deep breathing without exercise (hyperventilation) leads to an inappropriate loss of carbon dioxide from the body. After a few minutes, this leads to numbness, tingling and even unconsciousness. Hyperventilation often accompanies fear or excitement. Holding the breath or “shallow” breathing cures these symptoms.

The heart works much harder when oxygen is low, which can lead to heart trouble.

Gas at sea level pressure will expand to 5 times its volume at 40,000 ft. Sea level lung capacity is approximately 6 liters. Therefore, during rapid decompression, a continuous exhalation is experienced. Holding the breath would result in bursting of the lungs. Persons suffering from asthma or partially blocked lung passage due to age would be adversely affected by a rapid decompression.

In the event of rapid decompression, the first consideration must be given to administration of oxygen. Allow air to exhale from the lungs (do not hold the breath and do not swallow) and do not accelerate breathing.

Up to 38,000 ft, a regulator delivers a mixture of ambient air and oxygen which is automatically controlled to give an adequate partial pressure of oxygen. At 38,000 ft and above, 100% oxygen is necessary. Hypoxia will still occur if oxygen pressure is not higher than ambient pressure.

When decompression occurs above 38,000 ft the oxygen masks must be donned within 5 seconds to prevent a short period of unconsciousness (in 18 seconds, unconsciousness with brain damage, in 90 seconds death). Even with the oxygen mask on when decompression takes place, some shakiness of the extremities and dizziness will



be experienced for a few seconds, as the nitrogen in the lungs must be exhausted before 100% oxygen can be breathed.

Because of these hazards and of the various problems, especially of effectively getting oxygen to infants, elderly or sick people, it is essential that the flight crew be aware of the necessity:

- That one of the crew members must breathe oxygen above 41,000 ft with the selector in the NORMAL position (operational requirements),
- That a rapid descent must be initiated immediately in case of decompression.
- That masks must be ensured for proper donning and operation of the passenger system.