Life Support Reference Guide

Topics: ECLS System Components, Oxygen, Carbon Dioxide

During a massive solar storm Space Station Alpha may be exposed to high doses of dangerous radiation. Life support computers on board may be affected. Fortunately, NASA is able to monitor the levels of vital environmental components and remedy the situation if needed.

ECLS—Environmental Controls and Life Support
This system on board the space station monitors and reports all major environmental levels to ensure the health and safety of the astronauts.

The system monitors environmental components such as water vapor, temperature, humidity, water management, and especially oxygen and carbon dioxide levels.

Oxygen and Astronaut Health

Hypoxia: A Concern for Astronauts

Hypoxia is a physical condition caused by a decrease in oxygen entering the blood in the lungs and flowing to the brain and muscles. This occurs on Earth when the partial pressure of oxygen drops below 159 mmHg (typically around 21 percent). Hypoxia is very dangerous because people often do not notice its symptoms.

Hypoxia keeps the brain and other organs of the body from working the way they should. For instance, dizziness is an early warning symptom of hypoxia. Dizziness may be brought on by drinking too much alcohol, or flying at an unpressurized altitude of 8,000 to 9,000 feet without an oxygen mask. Flying or working on sensitive equipment while you're dizzy can be very dangerous.

Victims of hypoxia have been studied on Earth, especially in regard to various altitudes. We know, for instance, that if you hold all temperature and pressure variables constant but decrease the level of O_2, you would expect to see the following symptoms:

Amount of O_2	**Symptoms**
20.95 percent	• Normal functions
Moderate: O_2 158 mmHg or 20.94 to 17.11 percent	• Difficulty seeing at night. • Rapid breathing • Increased heart rate
Severe: O_2 134 mmHg or 17.10 to 15.14 percent	• Increased heart rate, rapid breathing, tiredness • Headaches, dizziness • Fatigue • Difficulty making decisions
Life threatening: O_2 115 mmHg or less or 15.13 percent and lower **Note:** Without a gas mask at 20,000 feet, human beings can live for only 15-20 minutes.	• Headache, hyperventilation, fatigue, weakness, and extreme dizziness • Impaired vision • Loss of touch and pain senses • Difficulty with problem solving • Slow thinking, poor judgment, bad memory • Poor muscular coordination • Basic personality traits and emotions are affected, making people behave as though they had consumed too much alcohol.

Oxygen Generation

There are several ways to produce oxygen for the astronauts:

1) A machine called **Elektron** produces oxygen continually using "electrolysis." It is powered by the solar panels and batteries.

2) Perchlorate candles produce oxygen through a chemical reaction. Perchlorate (per-KLOR-ate) is packed inside a metal canister, and the astronauts heat the canister to begin the reaction. **Each canister releases enough oxygen for one person for one hour in one room.** Perchlorate is the same chemical used in the breathing masks that drop down during emergencies on airplanes.

3) Astronauts can also use a **portable breathing apparatus (PBA),** which is like a gas mask. **PBAs give the astronauts 15 minutes of oxygen.**

Carbon Dioxide and Astronaut Health

In the space station astronauts breathe out carbon dioxide. It must be continually removed from the air in the space station because it can be a danger to astronauts' health and safety if concentrations become too high.

Air-circulation equipment and the carbon dioxide removal systems constantly check and control the levels of CO_2.

Carbon Dioxide (CO_2) Control

The **carbon dioxide removal assembly** moves carbon dioxide from the air by using a material called zeolite.

Lithium hydroxide (LiOH) canisters may be used in an emergency to clean the air of CO_2:

- **There are 10 canisters on board to be used only in case of extreme emergency. These canisters are stored in the Destiny module**.
- **Each LiOH canister lasts about a day**.
- The canisters can only scrub 10 liters of air per hour. One human generates 20 liters of CO_2 per hour.
- Must use air fans to circulate the air throughout the modules.

Effects of CO_2 on the Body

	Concen-tration	Pressure (mmHg)	Description
Mild to Moderate Symptoms	0.03%	0.23	Normal carbon dioxide concentration in air on Earth.
	0.37%	2.81	Average level of CO_2 maintained on the Space Station—can reach as high as 0.7 percent
	0.50%	3.80	Continuous exposure may be dangerous to the astronauts' health, especially if accompanied by lower levels of oxygen.
	1.00%	7.60	The astronauts can suffer serious symptoms within an hour or two. Symptoms include nausea, feeling hot and clammy, lack of attention to details, fatigue, clumsiness, shaking, and vomiting.
Severe to Life Threatening	2.00%	15.2	Severe headache after several hours exposure. Disrupted body functions resulting in loss of energy and feeling run-down for several days.
	3.00%	22.80	Astronauts can suffer serious symptoms almost immediately. If exposure persists, they may pass out.
	5 - 10%	38-76	Violent panting and fatigue to the point of exhaustion with severe headache. Can result in irreversible effects to health, including death.
	10 - 15%	77-114	Extreme panting, severe headaches and rapid exhaustion. Exposure for a few minutes will result in unconsciousness and suffocation without warning.
	25% to 30%	190-228	Coma and convulsions within one minute of exposure. Certain death.