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DOCUMENT TITLE
HUMAN PERFORMANCE AND LIMITATIONS

CHAPTER 13 – TOXIC HAZARDS

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TOXIC HAZARDS

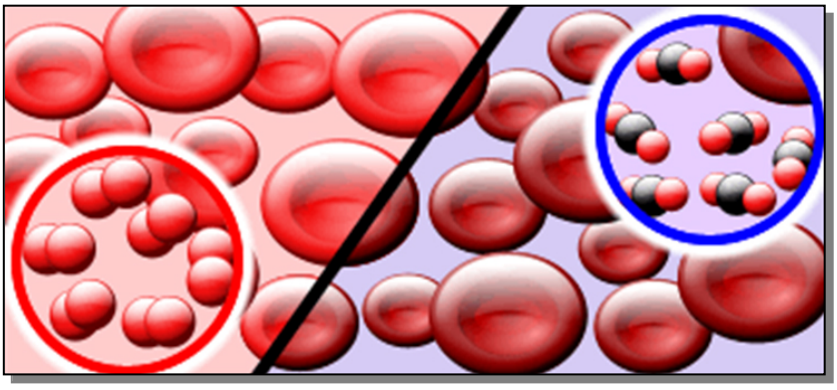
13.1 Carbon Monoxide

Carbon monoxide (CO) is a product of combustion of organic matter under conditions of restricted oxygen supply, which prevents complete oxidation to carbon dioxide (CO_2). **Carbon monoxide is colorless, odorless, tasteless, and non-irritating, making it difficult to detect. It is poisonous**.

Carbon monoxide is a significantly toxic gas. Symptoms of mild poisoning include headaches and flu-like effects; while larger exposures can lead to significant toxicity of the central nervous system and heart, ultimately leading to death. Carbon monoxide can also have severe effects on the foetus of a pregnant woman.

CO inhalation has been the preferred method of suicide by many people.

When carbon monoxide is inhaled, it takes the place of oxygen in hemoglobin, the red blood pigment that normally carries oxygen to all parts of the body. **Because carbon monoxide binds to hemoglobin several hundred times more strongly than oxygen,** the oxygen will be displaced, causing oxygen starvation throughout the body. Prolonged exposure to fresh air (or pure oxygen) is required for the CO-tainted hemoglobin (carboxyhemoglobin) to clear.



The effects of sustained exposure to CO are cumulative.

Our susceptibility to CO poisoning increases with altitude because of the lower levels of ppO_2 available in the air.

13.1.1 Sources

13.1.1.1 Cigarette smoke

CO links 200 times more readily with the haemoglobin in the blood and reduces the ability of the blood to carry O_2. A person smoking 20 cigarettes a day will have a carboxyhaemolobin concentration in the blood of about 7%. This gives an effect of a non-smoker at a cabin altitude of 4000 to 5000 feet.

13.1.1.2 Exhaust gases

Often from faulty cockpit heating systems. Piston engines produce more CO than turbines, because of the incomplete burning of fuel in the cylinders.

13.1.2 Symptoms

- **Feeling too warm**
- **Drowsiness**
- **Cherry-red complexion**
- **Dimming or blurring of vision**
- Severe headaches
- Feelings of sluggishness
- Tightness across the forehead
- Pressure in temples
- Possible personality change
- Flu-like symptoms
- Weakness
- Dizziness - impaired judgement
- Slower breathing rate, or breathlessness
- Loss of muscular power
- And eventually, unconsciousness, coma and death.

13.1.3 Pilot actions if CO contamination is suspected

- **Shut off heating**
- **Open fresh air vents**

- Avoid smoking
- **Use O2 if available**
- Land if symptoms do not diminish.

13.2 Other Toxic Hazards

There are other toxic chemicals that we may be exposed to in aircraft operations, particularly in agricultural and general aviation activities. These include, but not limited to:

- **Exhaust gases**
- Fuel vapour
- Lubricants, hydraulic fluids
- Anti icing fluids
- Fire extinguishing fluids
- Agricultural chemicals (insecticides are particularly toxic)
- Poorly packed dangerous goods
- Ozone (but removed by O3 scrubbing devices in RPT aircraft)
- Products of combustion, particularly plastics.

13.2.1 Symptoms

Depending on the chemical involved, there are many possible symptoms, including:

Anaphylactic shock, difficulty in breathing, chest pains and asthma, skin irritation, contact dermatitis, and hives or other forms of skin rash, headaches, "brain fog" (short term memory loss, cognitive dysfunction, including attention deficit), neurological symptoms (nerve pain, paralysis, weakness, trembling, restless leg syndrome, etc), tendonitis, seizures, visual disturbances (blurring, halo effect, inability to focus), extreme anxiety, panic and/or anger, suppression of immune system, digestive difficulties, nausea, indigestion/heartburn, vomiting, diarrhea, food intolerances, (e.g., lactose intolerance, celiac disease: commonly wheat and dairy), joint and muscle pains, extreme fatigue, lethargy and lassitude, vertigo/dizziness, abnormally acute sense of smell, sensitivity to natural plant fragrance, insomnia, dry mouth, dry eyes, and an overactive bladder.

As can be seen, the question of exposure to toxic chemicals is one of extreme importance. ‘Dangerous Goods’ training is essential for general aviation commercial pilots.