

Human Performance & Limitations · Module C — The Thin Air

The Silent Killers

Chapter 7 — Two hazards that give no honest warning: carbon monoxide, the colourless killer that steals your haemoglobin, and hyperventilation, the panic that mimics hypoxia.

BOOK

Human Performance & Limitations

AUTHOR

Ghost Aviator

EXAM

DGCA CPL / ATPL — HPL

CHAPTER

7 of 26 · Module C

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2. [Hyperventilation — and how to tell it from hypoxia](#)



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§ 11

Carbon Monoxide (CO) Poisoning

11.1 The Colourless Killer

WHAT CO IS

Carbon monoxide is a **colourless, odourless, tasteless gas** that is a **product of incomplete combustion**.

WHY CO IS SO DANGEROUS — THE 200× RULE

Haemoglobin, the oxygen-carrying chemical in the blood, picks up carbon monoxide **over 200 times more readily** than it picks up oxygen.

Thus, even **minute quantities in the cockpit** (often from improperly vented exhaust fumes) **may result in pilot incapacitation**. Exhaust gases from piston engines can consist of **as much as 9 % carbon monoxide**. So, gases from **leaking exhausts** can cause carbon monoxide poisoning in pilots.

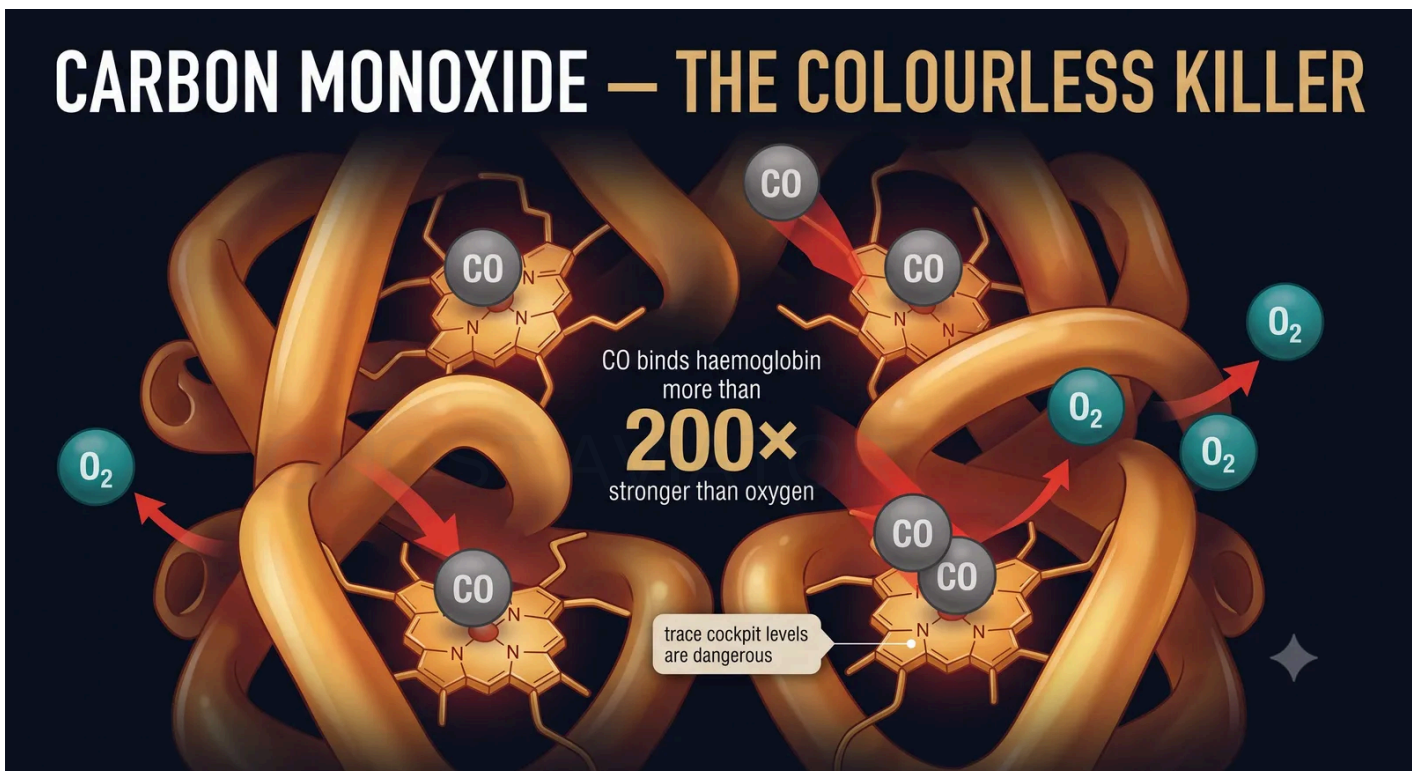


Figure 7.1 — Carbon monoxide binds haemoglobin more than 200× more strongly than oxygen, crowding oxygen off the blood.

SOURCES OF COCKPIT CO — THE USUAL SUSPECTS

- **Improperly vented exhaust fumes** entering the cabin via the heating system.
- **Leaking exhaust manifolds / muffler shrouds** (especially common in piston singles where cabin heat is drawn over the exhaust).
- **Engine combustion gases**, which can contain up to 9 % CO.
- **Tobacco smoke** in confined cabins.

11.2 Symptoms · Actions · Prevention

Carbon Monoxide Poisoning – Symptoms

- **Initially, there is an INABILITY TO CONCENTRATE**
- Headache
- Dizziness
- Nausea
- Impaired vision
- Lethargy or weakness
- Impaired judgment
- Personality change
- Impaired memory
- **Flushed cheeks and cherry-red lips** (*classic CO sign*)
- Convulsions

Actions if CO Poisoning is Suspected

1. **Turn off cabin heating**
2. **Open cabin ventilators**
3. **Consider using oxygen if available**
4. **Land as soon as possible**
5. **Take medical aid**
6. **Do not fly till cleared by doctor**

DGCA-QUOTED PREVENTION RULE — COPY VERBATIM INTO YOUR EXAM ANSWER

AT ALL TIMES WHEN THE CABIN HEATING IS USED, FRESH AIR MUST BE CIRCULATED TO REDUCE PRESENCE OF CO.

WHY THE "CHERRY-RED" COLOUR?

Carboxyhaemoglobin (Hb-CO) is a *bright cherry red* — much brighter than oxygenated Hb. The pilot's cheeks and lips therefore flush bright pink/red. **Don't confuse this with the bluish CYANOSIS seen in hypoxic hypoxia.** They look opposite:

- **Hypoxic Hypoxia** → blue extremities (cyanosis)
- **CO Poisoning** → bright cherry-red lips/cheeks

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CARBON MONOXIDE — WHAT TO DO

SUSPECT CO POISONING — headache · dizziness · cherry-red lips

1. Turn **OFF** cabin heating — removes the source

2. Open cabin ventilators — flush with fresh air

3. Use **OXYGEN** if available — displaces CO from haemoglobin

4. **LAND** as soon as possible

5. Get medical aid — hyperbaric oxygen may be needed

6. Do **NOT** fly until medically cleared

Figure 7.2 — Carbon monoxide poisoning: symptoms, immediate actions and prevention.

CO AFFINITY FOR HB (VS O₂)

> 200 ×

CO IN PISTON-ENGINE EXHAUST

up to 9 %

FIRST SYMPTOM

Inability to concentrate

CLASSIC SKIN SIGN

Cherry-red lips

FIRST ACTION

Turn off cabin heat

HYPOXIA TYPE INVOLVED

Anemic (Type b)

§ 12

Hyperventilation

DEFINITION — "OVER-BREATHING"

"Hyperventilation" is another word for "over-breathing" and may be defined as **lung ventilation in excess of the body's needs**. Good training is the best way to avoid Hyperventilation in pilots.

MITIGATION FOR PASSENGERS

The chances of Hyperventilation affecting your passengers can be reduced by **giving them a thorough pre-flight briefing on every aspect of the flying sortie**. (Briefed passengers = calm passengers; calm passengers don't hyperventilate.)

12.1 Causes at Low Altitude

At low altitude — where hypoxia is *not* a factor — the most common causes of hyperventilation are psychological or environmental rather than physiological.

The most common causes of Hyperventilation at low altitude	
Category	Cause
Cognitive load	Intense concentration on a difficult task
Emotional	Fear
Emotional	Anxiety
Physical	Motion sickness
Physical	Shock
Environmental	Vibration
Environmental	Heat
Aerodynamic / Manoeuvring	High G-forces

12.2 Symptoms · Treatment · the Paper-Bag Trick

Symptoms of Hyperventilation

- Dizziness
- Tingling
- Visual disturbances
- Hot or cold sensation
- Anxiety
- Loss of muscular co-ordination
- Increased heart rate
- Spasms
- Loss of consciousness
- **Cramping and spasms of the hands and feet**
- Cold clammy skin
- Paleness

Treatment of Hyperventilation

1. **Breathe oxygen at 100 percent.** If hypoxia is the cause, the symptoms will improve markedly after **three or four breaths**.
2. **If the symptoms persist**, consciously slow the rate of breathing to **10–12 breaths per minute** and **do not breathe deeply**.
3. **If you are flying below 10,000 feet, hypoxia is unlikely and hyperventilation may be assumed.**

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4. If you suspect that any occupant of your aircraft is suffering from hyperventilation, try to calm them down. Give them a **simple task to fulfill that might take their mind off their anxiety**.
5. One of the direct causes of hyperventilation is a **reduction in the carbon dioxide level in the blood**. The condition may be alleviated by getting the sufferer to **breathe into a PAPER BAG**. This action will **increase the blood's carbon dioxide level**, causing the brain to **reduce the breathing rate**.

THE SCIENCE BEHIND THE PAPER BAG

Hyperventilation drives off too much CO_2 from the blood (**respiratory alkalosis**). Since the **brain's breathing centre is regulated by CO_2** (see §8.4), low CO_2 causes the urge to keep over-breathing — a vicious circle. A **paper bag** traps exhaled CO_2 which is then re-inhaled, raising blood CO_2 back to normal and breaking the loop.

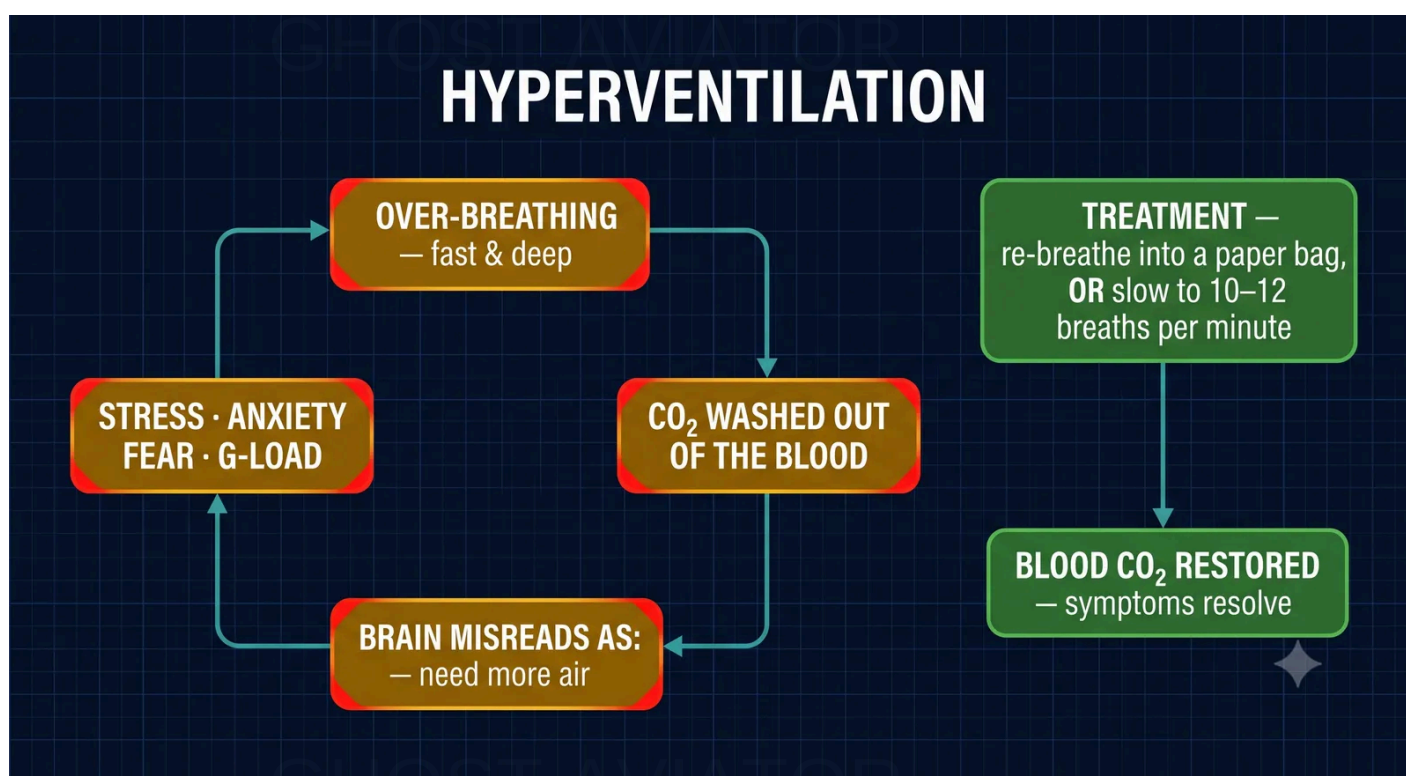


Figure 7.3 — Hyperventilation: causes, symptoms and treatment, including the paper-bag technique.

12.3 Hypoxia vs Hyperventilation — Telling Them Apart

A VITAL DISTINCTION — THE SYMPTOMS OVERLAP

Many symptoms of hypoxia and hyperventilation overlap (dizziness, tingling, visual disturbances, loss of consciousness). The DGCA syllabus gives you a clean **altitude rule** to distinguish:

- If flying **BELOW 10,000 ft** → hypoxia is *unlikely* → **assume HYPERVENTILATION**.
- If flying **AT or ABOVE 10,000 ft** → hypoxia is plausible → **provide O₂ AND descend**. If symptoms clear after 3–4 breaths of 100 % O₂, it was hypoxia.

Hypoxia vs Hyperventilation — side-by-side		
Parameter	Hypoxia	Hyperventilation
Typical altitude	> 10,000 ft	Any altitude (often below 10,000 ft)
Onset	Insidious, slow	Rapid — linked to a trigger (stress, fear)
Skin sign	Cyanosis (bluish)	Paleness · cold clammy skin
Heart rate	Often increased	Increased
Feeling of well-being?	Yes — euphoria	No — anxiety, fear
Blood CO ₂ level	Variable / often normal	LOW
First-line treatment	100 % O ₂ + descend below 10,000 ft	Slow breathing to 10–12/min, or breathe into paper bag
How to confirm in flight	Symptoms improve in 3–4 breaths of 100 % O ₂	Symptoms persist on O ₂ ; resolve with re-breathing technique

EXAMINER'S FAVOURITE TRAP

A pilot at **9,500 ft** reports tingling in the fingers and dizziness. **Hypoxia is unlikely below 10,000 ft** → **assume hyperventilation**. Slow your breathing, calm down, optionally use a paper bag — do *not* declare an emergency and descend for a hypoxia event that isn't happening. (However — if O₂ is available, the standard advice "**breathe 100 % O₂; if symptoms clear in 3–4 breaths it was hypoxia**" lets you confirm safely.)

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END OF CHAPTER 7

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