EASA
European Aviation Safety Agency

GENERAL AVIATION

SAFETY BRIEFING:

PREVENTING HYPOXIA

Hypoxia Conditions, Associated Risks and Mitigating Measures

General Information

Pilots may encounter hypoxia conditions in various situations: crossing high terrain, sight-seeing tour in mountains, flying IFR at higher flight levels than expected due to degrading weather conditions, icing, turbulence, high performance gliding and ballooning, etc.

The operational rules in Part-NCO (NCO.OP.190 and associated AMCs/GMs) provide means to help the pilot assess the need to carry supplemental oxygen before the fight and to take the appropriate precautions in case oxygen equipment is not installed or portable bottles are not carried. This is particularly relevant for private pilots of light aircraft.

The purpose of this leaflet is to provide additional information on:

- hypoxia conditions and symptoms,
- assessment of individual conditions before the flight,
- how to brief passengers on hypoxia,
- monitoring and detection of hypoxia early symptoms in flight,
- use of personal equipment, such as finger-mounted pulse oximeters.

Hypoxia Conditions

Human beings need oxygen to live. The higher you fly, the lower is the quantity of available oxygen.

Lack of oxygen impairs pilot's awareness and passenger's comfort and health.

Hypoxia may be defined as a state of oxygen deficiency in the body sufficient to impair function of the brain and other organs.

As flight altitude increases, without oxygen supply, dimness of vision, sleepiness and poor judgement are discreetly increasing threats, until the last fatal stage: faintness.

Hypoxia also impairs night vision. Because the rod cells in the eye, which give us night vision, require a lot of oxygen, a lack of oxygen causes visual impairment.

Unfortunately, our body doesn't give us reliable signals at the onset of hypoxia. The brain is the first part of the body to reflect a diminished oxygen supply, and the evidence of that is usually a loss of judgement.

Early **symptoms** of hypoxia are subtle and may include rapid breathing, headache, drowsiness, nausea, behavioural changes (e.g. euphoria, irritability), slurred speech, and diminished thinking capacity.

A pilot experiencing hypoxia has a limited amount of time to recognise signs and symptoms. The time of useful consciousness ranges from a few minutes at lower altitudes to seconds at higher altitudes and it is within this timeframe that a pilot must take the correct decisions and actions.

Always plan carefully flights at high altitudes.
Do not improvise!

Assessment of individual conditions before the flight

People react differently to lack of oxygen, this is why it is preferable to talk about hypoxia conditions using fixed altitude limits for hypoxia occurrence.

Some people are sensitive to hypoxia as low as 7 000 feet, while others, with outstanding aptitudes and training, achieved ascent up to the Everest summit, ca FL290, without supplemental oxygen.

Personal factors are numerous: being accustomed to high altitude conditions (due to location of residence/work), smoking habit, stress, illness, medication, chronic illness, etc.

The effects of hypoxia can be safely experienced under professional supervision at Aeromedical centres in altitude chambers. Pilots may consider to take such specific trainings to increase their ability to recognise hypoxia.

Pilots should always exercise their own judgement even below the 10 000 ft altitude threshold.

Briefing passengers

In order to assess the individual situation of all persons on board before the flight, it is essential to have an open and trustful communication with your passengers.

How to improve **collaboration** of passengers?

Your passengers might be your relatives, friends, formal relationships, etc.

In order to generate mutual trust, handover of this leaflet could encourage them to advise you about any relevant health conditions. So they shouldn't be shocked, should you question them on personal matters, as this is aiming to prevent unsafe conditions in flight.

Before the flight always ask your passengers to notify you immediately if they experience or even only think they are experiencing any of the symptoms during the flight.

During Flight

Monitor Early Symptoms of Hypoxia Conditions

Self-Assessment Methods during flight.

Without additional equipment

Run periodic 'Mastermind'-type drills or simple exercise as touch your nose with finger. You may also involve your passengers in monitoring your state.

Be aware of false evaluation or of no evaluation at all, due to euphoria triggered by hypoxia.

With Additional equipment

For example a finger mounted **pulse oximeter** (or similar device) may be used. It measures the oxygen saturation in your blood with a relatively inexpensive sensor device that clips over your finger tip. Reading is immediate.

A 100-percent level is normal, and 95 percent is considered a minimum. An oxygen saturation level below 90 percent is a warning sign. That's when patients — and pilots — usually begin to experience hypoxia.

Whatever methods used, as Pilot-in-command, please, react immediately as soon as early symptoms appear.

Suspicion of Hypoxia?
No Question! Action!!

Once you, or one of your passengers, experiences early hypoxia symptoms, only one mitigating measure exists: increase oxygen resource. To achieve that, two options are possible:

1. descent to lower altitude, or
2. use supplemental oxygen.

The first option is largely weather and terrain dependant, the second is equipment dependant, so both options must have been assessed in details during pre-flight phase.

When flying over high terrain areas, options for descent must have been established during pre-flight preparation phase.

When using supplemental oxygen equipment consider the following:

Pure oxygen, or nearly pure oxygen gaseous oxygen, is stored and transported in high-pressure cylinders that are typically painted green.

Different types of mask are on the market, appropriate for private pilot and private operations. Comprehensive reading of manufacturer's instruction is mandatory.

Caution: Cylinders marked as "*Aviator's breathing oxygen*" have been tested for the presence of water. At altitudes of hypoxia conditions, subzero temperatures are often encountered and water in cylinders could freeze and block valves and regulators. Don't use oxygen cylinders aimed for medical use or diving.

Note: Airliners prohibit transport of cylinders in passengers' luggage.

Case Studies

a) A Mountain-seeing Tour

It is a typical case of **High Altitude** (7 000 to 13 000 ft) and **Short Time** local flight, **without** supplemental oxygen on board.

Pre-flight:

- Identify "safe zones" where rapid descent is possible to 7 000 ft and lower.
- Brief passengers about early symptoms of hypoxia and the possibility to descent to lower altitude to escape hypoxia conditions and to recover.

During flight:

Monitor your own condition periodically and be prepared to descent as soon as any early symptoms show up.

Ask your passengers about their condition and reassure them about possible descent if necessary.

b) An IFR Flight crossing high terrain with challenging weather conditions

Pre-flight:

1. Identify altitudes of icing conditions, of turbulence, of towering cumulus (TCU), etc., and possibility to fly at higher altitude.
2. Check every passenger, even if holding a pilot license, about precedent experience of altitude as high as the one planned and about any health conditions or smoking habits.
3. Clearly identify that combination of risk of insidious euphoria and risk of lack of opportunity to descent is detrimental.
4. Identify "safe zones" where rapid descent would be possible to 7 000 ft and lower.

5. If not, consider carrying on-board supplemental oxygen equipment.
6. Pay serious attention to realistic risk of being overloaded when having simultaneously to manage diversion options (due to degrading flight conditions), to negotiate with ATC, and having to activate supplemental oxygen system for yourself and your passengers.

Once the decision is made to carry supplemental oxygen:

- Consider that procurement of supplemental oxygen might need advance planning as it is not easily available, especially in small airports.
- Read carefully user's instructions, and make sure you know well all the steps in the process.
- Brief and train your passengers to use mask and regulator. As mentioned above, this could be a very critical step as you could be very busy at the time of activation of supplemental oxygen.

c) High Performance Gliding

Rapid descents are rarely a suitable option for glider pilots, especially when crossing high terrain. Usage of supplemental oxygen is more often the only option.

In Europe, gliding is mainly practiced in well organised structures. Valuable advice can be obtained from those organisations. The confined space of glider cockpit is an issue for handling cylinders and mask. Every practical issue must be addressed on the ground.

Glider and balloon pilots can envisage much longer flights at higher altitude than private pilots of light aircraft. Preparation of such high performance flights is a complex matter, supplemental oxygen is only one piece of that preparation and it is beyond the scope of this leaflet.

d) Easy VFR Flight

Flying perfect VFR weather conditions at high altitude for enjoying nice temperature, with autopilot engaged, could lead to false confidence and lower vigilance, thus increasing the risk of entering hypoxia conditions.

Never drop vigilance once at high altitude.

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