Northern California Soaring Association

2010 Safety Seminar

High Altitude Wave Flight Considerations
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Outline

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Pilot physiology

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What is it and what should you expect?

- Flying in wave has some interesting weather, equipment and pilot physiology considerations. Here are some key points to remember:
  - Wind – Good wave days ride into town on stiff breezes. Also, the rotor can setup over the airport and shift the winds in the opposite direction from expected.
  - Clouds – With some moisture in the air, we can identify the wave structure, but we need to be careful not to be blown back into a standing lenny.
  - Turbulence – Maintaining tow position through the rotor can be difficult and increases the possibility of a rope break. Watch your V_A!
  - Temperature – It's cold up there. By the time you are at 20k feet (not hard at Minden), it's going to be approximately 60F colder than when you started. Bring warm clothes!
  - Sunset – The sun sets much sooner on the ground than at altitude. It can take 30 minutes to descend from the top of the wave window (28k feet) with your spoilers deployed.
  - Hypoxia – As a result of decreasing pressures as we ascend, oxygen has a more difficult time passing through our lung membranes into the bloodstream. Proper equipment and pilot education can combat hypoxia
  - Dehydration – Just because its cold doesn't mean you can't be dehydrated.
  - Frosted Canopy – Rubbing with gloves will ruin the canopy. Open the vent
  - V_{NE} – Wave formation depends in part on increasing winds at altitude and that will require an increase in IAS as you climb. Flutter of control surfaces above V_{NE} is based on TAS. Remember that TAS increases by 2% over IAS for every 1k.
  - Wave Windows – ATC has granted us a waiver to play in airspace that is normally off-limits. This usually results in certain procedural requirements. Let's keep them happy.

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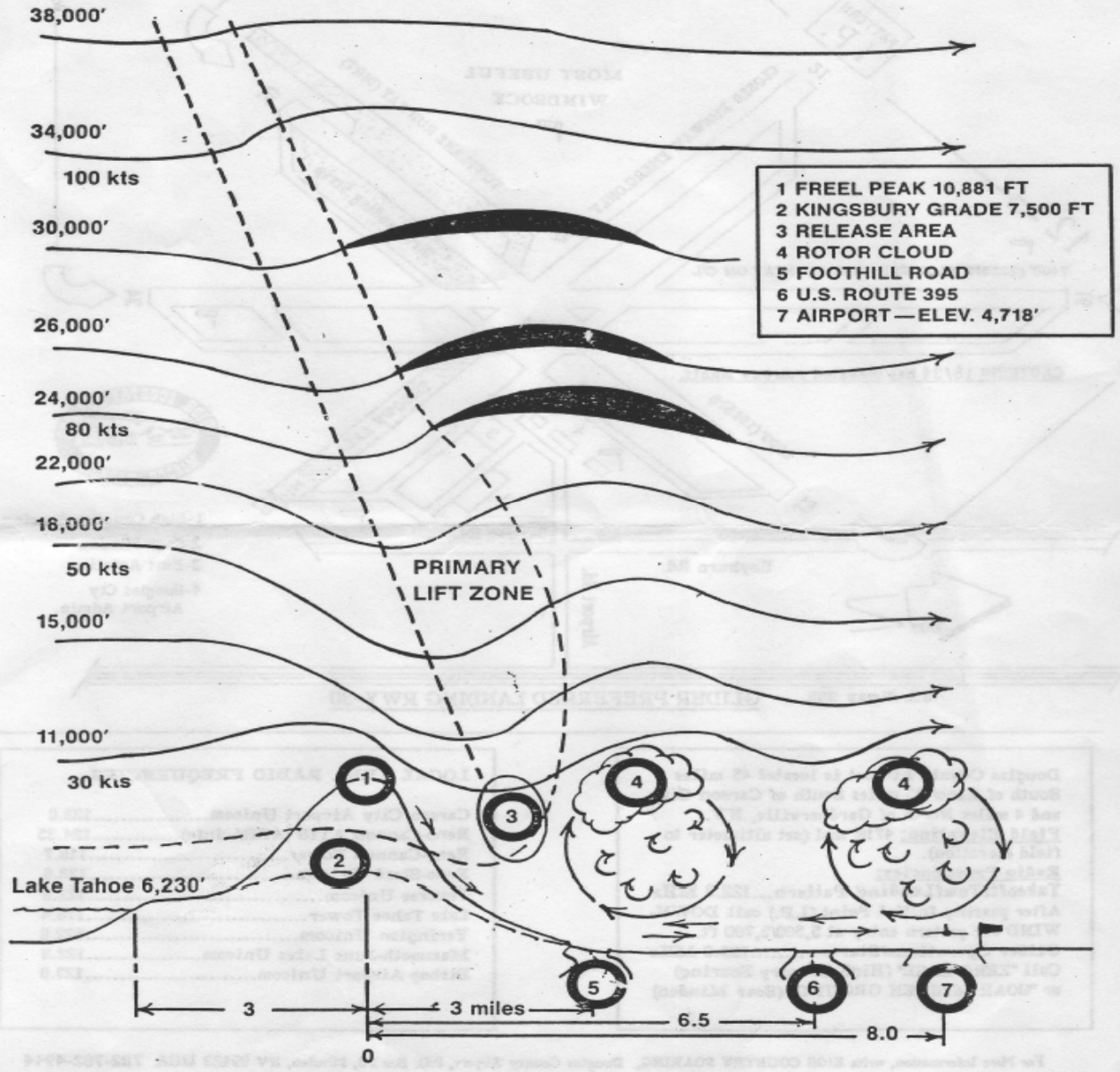
PASCO WAVE CAMP



Minden, Nevada

Pilot Physiology

Hypoxia – Probably our most critical concern when flying at high altitudes for extended periods of time.

- Even at altitude, the mixture of oxygen and nitrogen is the same as sea level. What changes is the partial pressure of a similar volume of air. Basically, the lungs need a certain minimum pressure behind the oxygen to push it through the lung membranes. At lower altitudes, this is achieved through atmospheric pressure. As we go higher, we need to rely on oxygen systems to help achieve higher partial pressures than the surrounding atmosphere can produce.
- A person's susceptibility to hypoxia can be made worse by fatigue, alcohol, smoking, exhaust, and other foreign substances that manage to latch on to our blood cells. In other words, think about your state of health before you strap in.
- Unfortunately, the body does not give reliable signals at the onset of hypoxia. As a matter of fact, the brain is typically the first part of the body to reflect a diminished oxygen supply. The evidence of hypoxia is usually a loss of judgment and a feeling of euphoria.
- Some symptoms to watch for include: increased breathing rates, dizziness, headache, sweating, poor coordination, and tunnel vision.
- The higher you go, the more significant the impact on your bodies ability to use the available oxygen and the time of useful consciousness.

Altitude in Flight level	Time of Useful Consciousness	Altitude in meters	Altitude in feet
FL 150	30 min or more	4,572 m	15,000
FL 180	20 to 30 min	5,486 m	18,000
FL 220	5-10 min	6,705 m	22,000
FL 250	3 to 6 min	7,620 m	25,000
FL 280	2.5 to 3 mins	8,534 m	28,000
FL 300	1 to 3 mins	9,144 m	30,000
FL 350	30 sec to 60 sec	10,668 m	35,000
FL 400	15 to 20 sec	12,192 m	40,000
FL 430	9 to 15 sec	13,106 m	43,000
FL 500 and above	6 to 9 sec	15,240 m	50,000

← Top of Minden Wave Window

Pilot Physiology

Hypothermia – It may be warm, or relatively warm on the ground, but it's going to get cold up there.

- Temperature can and will decrease considerably at altitude (average 3.5F per 1k). Wave flights out of Minden up to 28k can see temperature decreases of 90F. Dress warmly (long johns, gloves, wool cap).
- Loose fitting, layers are the best defense against cold.
- Wear synthetic or wool layers next to the body. When preparing the glider on the flight line, you will sweat and cotton layers do a poor job of moisture management. Wet feet at those temperatures is not good.
- Look out for constant shivering, slurred speech, confusion, drowsiness and clumsiness.

Dehydration – Just because it's cold, doesn't mean we aren't susceptible to dehydration.

- Force yourself to drink liquids during the flight.
- Look out for thirst, loss of appetite, dry mouth, dark colored urine and fatigue.

Sunburns – That Plexiglas canopy doesn't offer much UV exposure at high altitudes.

- Cover exposed areas of skin with a decent UV rated sunblock
- Be careful! Petroleum based products can spontaneously combust when exposed to oxygen. So be mindful where you apply.

Oxygen Equipment

Components: - Three basic components

- Storage system – oxygen can be stored in three forms; gas, liquid and solid. All of our gliders are equipped with gas storage systems pressurized to approximately 1,800 to 2,200 psi.
- Delivery system:
  - Continuous flow – delivers a constant flow of oxygen from the storage container. Most economical system in that it doesn't require complicated masks or regulators to function, but it is very wasteful. This system can be used up to 28,000 feet. Our aircraft are equipped with this type of delivery system.
  - Diluter demand – provides on demand oxygen, during inhalation and stops during exhalation. Additionally, the incoming oxygen is mixed with cabin air and provides the proper percentage of oxygen for a given altitude. This system is typically used up to altitudes of 40,000 feet.
  - Pressure demand – here the breathing gets interesting. Positive pressure is a forceful oxygen flow that is intended to slightly over-inflate the lungs. You have to relax on inhalation and exhale forcibly. This has been known to produce hyperventilation in pilots. This is for altitudes in excess of 40,000 feet.
- Oxygen masks and cannulas
  - Cannulas – designed for constant flow delivery systems with comfort in mind. They are restricted to 18,000 by federal regulation.
  - Oral-nasal rebreather – includes an external plastic bag that inflates when you exhale. This is then mixed with incoming oxygen. Intended to be used up to 25,000 feet.
  - Face mask – the mask should be snug and flush around the edges. Beards will interfere with the effectiveness of the mask. Masks are typically rated up to altitudes of 40,000 feet.

Wave Windows

- Hard working glider pilots like Rolf Peterson liaison with the FAA and relevant ATC to work out Letters of Agreement that allow us to fly into Class A airspace.
- Some of the more common, local wave windows are above Minden, East of Lake Tahoe. These are under a letter of agreement that has Rolf's signature on it. Here are some important points to remember:
  - Must be sufficiently familiar with local terrain so that flight will be contained within Glider Area
  - Must stay inside wave window boundaries
  - Must remain clear of clouds (1,000 feet and 1 mile)
  - Must operate Mode C transponder
  - Must notify Oakland center immediately if you exit edges of wave window.
- There are lots of fast moving planes zooming around outside these boxes under positive control and separation. ATC is relying on you to color between the lines.
- To open the Minden wave windows, call down to the local FBO and they will open it for you.
- Also, be sure to call Reno approach before entering the box and tell them you're squawking 0440.

Relevant FAR's

- FAR Part 91.211 "Supplemental Oxygen"
  - Oxygen is required to be provided and used by pilots if they are above 12,500 up to and including 14,000 feet for more than 30 minutes.
  - Pilots must use oxygen at all times when above 14,000 feet.
  - Passengers must be provided oxygen when above 15,000 feet.
- FAR Part 23.1447 "Equipment Standards for Oxygen Dispensing Units"
  - If the oxygen system is certified for use up to 18,000 feet, the dispensing unit must cover the nose and mouth.
  - Ah, the caveat… You can use a nasal cannula, provided a mask to cover the nose and mouth is available (in the glider, where you can reach it)
  - Above 18,000 feet, you must use a mask that covers the nose and mouth.
- FAR Part 23.1441 "Oxygen Equipment and Supply"
  - This doesn't necessarily pertain to gliders, but is good advice.
  - The FAA requires all aircraft certified to fly above 25,000 feet must be outfitted with demand oxygen equipment
  - If certified above 40,000 feet, the oxygen equipment must be pressure demand.

NCSA Club Rules

NCSA has four primary club rules in place for oxygen use:

- NCSA pilots must use oxygen in accordance with FAR requirements (91.211)
- Members who fly higher than 18,000 feet are required to have attended a high altitude FAA-USAF physiological training course.
- If oxygen is to be used during the flight, the pilot must get a thorough briefing on the oxygen system from a pilot experienced with that system.
- For flights over 18,000 feet, the pilot must have a back-up oxygen system and be familiar with its use.

These Acronyms Could Save Your Life

D – Drugs
E – Exhaustion
A – Alcohol
T – Tobacco
H – Hypoglycemia

P – Pressure
R – Regulator
I – Indicator
C – Connection
E – Emergency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