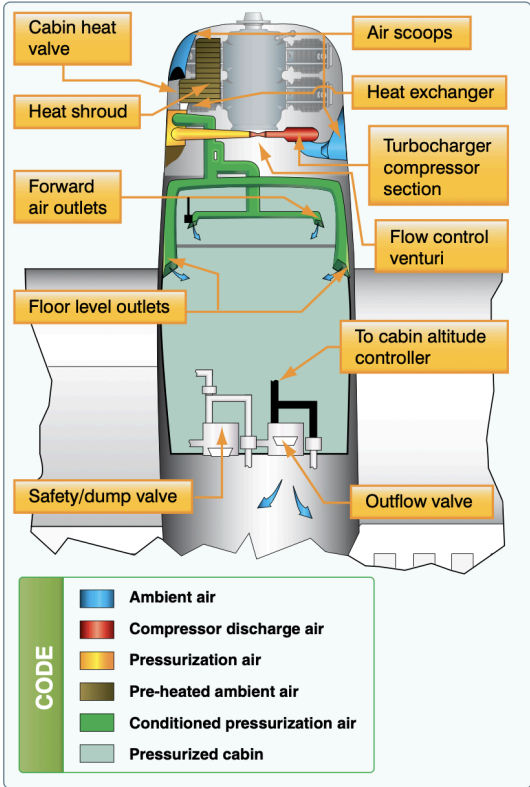


## High Altitude Operations - Pressurization

<b>Objective</b>	
<p>To ensure the applicant learns the physiological dangers of high altitude flight and introduces aircraft pressurization systems, as well as their failure modes.</p>	
<b>Purpose</b>	
<p>Flying higher increases aircraft performance, but without proper precautions, it can be dangerous. Higher-performance aircraft are frequently pressurized to allow operation at these higher altitudes without the discomfort or inconvenience of personal oxygen devices, however these systems can be complex. This lesson introduces pilots to the dangers of hypoxia, aircraft pressurization systems, and their failure modes.</p>	
<b>Schedule</b>	<b>Equipment</b>
<ul style="list-style-type: none"> <li>● <b>Ground Lesson:</b> 15 minutes</li> <li>● <b>Student Q&amp;A:</b> 10 minutes</li> </ul>	<ul style="list-style-type: none"> <li>● Whiteboard / Markers (optional)</li> </ul>
<b>Student Actions</b>	<b>Instructor Actions</b>
<ul style="list-style-type: none"> <li>● Ask any questions, receive study material for the next lesson.</li> <li>● Watch linked video.</li> <li>● Review listed references.</li> </ul>	<ul style="list-style-type: none"> <li>● Deliver the ground lesson (below).</li> <li>● Answer student questions.</li> </ul>
<b>Completion Standards</b>	
<ul style="list-style-type: none"> <li>● Student can explain the following concepts: <ul style="list-style-type: none"> <li>● Dangers of hypoxia and hyperventilation, effects on vision</li> <li>● Regulatory requirements for use of supplemental oxygen</li> <li>● The types of oxygen systems commonly used</li> <li>● The basic concept of operation for pressurized aircraft and the dangers of rapid cabin decompression</li> </ul> </li> </ul>	

## References

- David Moran - "High Altitude Hypoxia Flight Training"
  - YouTube - <https://www.youtube.com/watch?v=CptmVSXnEfc>
- FAA-H-8083-25C (Pilot's Handbook of Aeronautical Knowledge) - Chapter 7, Page 34-37 [Pressurized Aircraft], Chapter 17, Page 3-5 [Hypoxia/Hyperventilation]
- FAA-S-ACS-7B (Commercial Pilot ACS) - Area VIII Task B
- FAA-S-ACS-25 (CFI ACS) - Area II Task O

## Ground Lesson Outline

- Hazards of High Altitude Flight
  - Hypoxia - Similar to drunkenness, confusion, etc. Can lead to loss of consciousness.
    - Hypoxic Hypoxia - Not enough oxygen partial pressure, caused by high altitude
    - Hypemic Hypoxia - Blood can't bind oxygen, usually CO poisoning
    - Histoxic Hypoxia - Cells can't use oxygen, usually drugs/alcohol
    - Time of Useful Consciousness - *See supplement*
  - Vision Impairment - Especially at night, over 5,000 feet MSL.
- Pressurized Aircraft
  - Concept - Pressurized air source, Outflow valve, max cabin pressure differential
    - *See supplement*
  - Operation - Cabin Altitude, Cabin Climb Rate
  - Regulatory Requirements - § 91.211(b)
    - Above FL250 - At least a 10-minute supply of supplemental oxygen for each occupant
    - Above FL350 - One pilot at the controls of the airplane is wearing and using an oxygen mask that is secured and sealed and that either supplies oxygen at all times or automatically supplies oxygen whenever the cabin pressure altitude of the airplane exceeds 14,000 feet (MSL).
      - Except, while below FL450 if there are two pilots at the controls and each pilot has a quick-donning type of oxygen mask that can be placed on the face with one hand from the ready position within 5 seconds.
  - Risks Unique to Pressurized Aircraft
    - Slow pressurization failure
      - Can occur slowly, must monitor pressurization systems
      - Many famous examples of this: Payne Stewart, Helios Airways Flight 522
    -
  - Dangers of Rapid Decompression
    - Potential for structural damage, etc.
    - Solutions
      - Requires emergency oxygen and rapid decrease in altitude (See Time of Useful Consciousness)

## Ground Lesson Supplement

<b>Altitude</b>	<b>Time of Useful Consciousness</b>
45,000 feet MSL	9 to 15 seconds
40,000 feet MSL	15 to 20 seconds
35,000 feet MSL	30 to 60 seconds
30,000 feet MSL	1 to 2 minutes
28,000 feet MSL	2½ to 3 minutes
25,000 feet MSL	3 to 5 minutes
22,000 feet MSL	5 to 10 minutes
20,000 feet MSL	30 minutes or more

