



Interagency Aviation Accident Prevention Bulletin



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Page 1 of 2

Subject: Spatial Disorientation, Vertigo, and Head Movement/Position Changes

Area of Concern: Flight Safety

Distribution: All Aviation Activities

Discussion: A recent SAFECOM ([#19-0520](#)) describes a situation where a pilot began to feel ill while conducting heli-torch operations on a prescribed burn. The pilot described a vertigo sensation and feeling queasy while flying through smoke and opted to land and shutdown the helicopter. Once safely on the ground, the pilot felt the need to rest for about 20 minutes before continuing the mission. While the helicopter was shutdown, prescribed fire personnel were unable to make radio contact with the pilot. As a result, the Helicopter Manager requested that an Emergency Medical Technician (EMT) on the burn crew hike to the landing area to assess the pilot's condition. After assessing the pilot, the decision was made to discontinue the heli-torch mission for the day and for the pilot be evaluated by a higher level of care. The pilot visited a physician the following morning and was cleared to return to work.

It is not uncommon for those flying in fire operational environments to encounter these types of symptoms. Prior to feeling ill, the pilot had been operating in an area with visual horizons that varied in slope, elevation and angle, along with smoke laying over the ridgetops. The mission profile required constant change in airspeeds ranging from hovering to 50 knots, varying altitudes in order to cross ridgetops, and frequent turns due to the small size of the burn area. Additionally, the mission was relatively new to the pilot who was approaching the 12th hour of duty day. The constant airspeed and altitude changes, smoke, heat, fatigue, and constant head-down/head movement required to operate within the fire environment, can contribute to debilitating and incapacitating physiological responses while in flight. The onset of conditions such as vertigo, spatial disorientation and airsickness can occur and worsen in these types of flight environments.



While the pilot did not indicate feeling spatially disoriented or airsick, refreshing knowledge of these conditions and risk factors is a good idea. According to the Federal Aviation Administration (FAA), these episodes contribute to 15% of all aviation accidents, most often at night or during IFR conditions. Spatial disorientation, vertigo, and airsickness are very different things, but they have similar effects on pilots and passengers. The attached video links are from the FAA's Civil Aerospace Medical Institute regarding the [physiology of flight](#), and a [spatial disorientation](#) exercise demonstrating the effects of prolonged turns with the head down.

Vertigo or Positional Vertigo is a broad term with several definitions in medical literature, it is described as a false sense of movement, off-balance, spinning sensations, unsteadiness, lightheadedness, and so on. Vertigo can be brought on by a benign single event, such as a sudden rapid head movement, or it can be the result of an inner ear disease or infection, and less commonly, nervous system disorders. Exposure to carbon dioxide and hydraulic fluid can also induce vertigo in high concentrations. More information on vertigo can be found at the [Mayo Clinic Website](#).

Spatial disorientation is a person's inability to determine their position relative to the earth or their surroundings. According to the FAA, spatial orientation in flight is difficult to achieve because the various types of sensory

stimuli (visual, vestibular, and proprioceptive) vary in magnitude, direction, and frequency. Any differences or discrepancies between visual, vestibular, and proprioceptive sensory inputs result in a “sensory mismatch” that can produce illusions and lead to spatial disorientation.

Conditions present in aerial firefighting mission profiles increase the risks of SD and vertigo. Preconditions and risk factors for spatial disorientation include: degraded visual environments, lack of visual cues and horizon, poor weather, unfamiliar terrain, task saturation, high workload, dynamically evolving missions, stress, fatigue, and others (reference: U.S Army Aeromedical Literature). Additionally, consistently leaning out of door or bubble window with one’s head down to observe ground conditions and cargo loads puts pilots in a position more susceptible to vertigo and vestibular illusions.

Airsickness is described by the FAA as a normal response of healthy individuals when exposed to the flight environment. Airsickness can be marked by symptoms such as vertigo, nausea, cold sweating, confusion, dizziness, headache, and fatigue. Severe airsickness can lead to incapacitation and the FAA recommends landing as soon as possible if a pilot experiences these symptoms.

Experiencing spatial disorientation, airsickness, or vertigo in flight is a very stressful event. Typical physiological responses to stress such as increased heart rate, high blood pressure, rapid breathing, nausea, and muscle tension will likely present.



Mitigations and Countermeasures:

- Understand the risks of spatial disorientation (SD) and vertigo
- Anticipate, plan for, and brief the conditions present that might induce SD and vertigo
- Assess the terrain and weather, do not fly in deteriorating weather or reduced visual environments
- Maintain a visual horizon
- Avoid rapid head movements
- Manage workloads, get plenty of rest and stay hydrated, maintain good physical condition, and reduce nicotine and alcohol consumption
- Manage the flight to minimize abrupt changes in speeds, heading, altitudes
- If the mission requires long periods of single direction turns or head down/out the window operations, take a rest in straight and level flight to “re-cage your internal gyro”
- Conduct a good cross check of instruments
- Train for spatial disorientation, practice unusual attitude recoveries

******Flying in the fire environment will create demanding conditions for any pilot--- being able to understand the situation and making the decision to land while feeling ill is commendable.******

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