

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



Medical Factual Memorandum for Record

February 18, 2026

A. CASE

NTSB ID: CEN24LA145
Location: Alpine, Arkansas
Date: April 4, 2024
Time: About 10:56 a.m. local time

B. MEDICAL SPECIALIST

Specialist Turan Kayagil, MD, FACEP
National Transportation Safety Board
Washington, DC

C. DETAILS

1.0 Description of Review

According to the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), the surviving pilot reported that he shut down his airplane's engine and performed a forced landing in a field because he was concerned that he was experiencing carbon monoxide (CO) poisoning. This review was performed to evaluate the surviving pilot for potential CO poisoning or other impairing medical factors. The above Medical Specialist reviewed the following sources of medical information, along with selected relevant regulation, medical literature, and NTSB investigator reports.

- NTSB Pilot/Operator Aircraft Accident/Incident Report (NTSB Form 6120.1)
- Federal Aviation Administration (FAA) public Airmen Inquiry Search Page
- Post-accident medical treatment records (pilot-provided)

2.0 Summary of Medical Facts

2.1 Information from Reviewed Records

The 50-year-old male pilot reported on his NTSB Form 6120.1 that his last aviation medical examination before the accident was December 4, 2023, and that he was issued a first-class medical certificate limited by a requirement to use corrective lenses to meet vision standards at all required distances. As of this writing, the FAA's Airman Inquiry Search Page shows that the pilot's most recent aviation medical examination was in July 2025, and that he currently holds a first-class medical certificate limited by a requirement to use corrective lenses to meet vision standards at all required distances.

According to the narrative history of the flight provided by the pilot on his NTSB Form 6120.1, the accident flight was planned as a 2-hour-15-minute day visual flight rules flight from one airport to another. Preflight, taxi, engine run-up, takeoff, climb, and initial cruise were normal. Flight altitude remained below 5,000 feet mean sea level for the entire flight and there was no supplemental oxygen aboard. During cruise, the pilot was audibly and visually alerted to the presence of CO in the cockpit by both of two electronic CO detectors aboard the airplane. In response, the pilot reconfigured the vents, opened the cockpit window, and noted the nearest available airport. Simultaneously, his concern turned to intense worry and fear as he noticed a feeling of lethargy and confusion something like slow motion coupled with graying peripheral vision. He tried to open the cockpit door without success. Thinking he was going to die if he did not escape the airplane, he decided that a forced landing was his only option for survival. He identified a suitable field and cut the throttle and mixture hoping to stop the CO source. He attempted to breathe fresh air through the side window while descending. He felt that shutting down the engine provided the relief hoped for as his symptoms gradually dissipated. He performed a forced landing in the identified field. He did not lose consciousness.

According to the NTSB IIC, post-accident examination of the airplane by NTSB and FAA personnel identified issues with the exhaust system including a pin hole in the muffler, cracks on a repair weld, and repairs with unapproved parts. Additional details are available in the NTSB docket and final accident report.

According to reviewed medical records, the pilot was evaluated in a hospital emergency department following the accident. The account of the accident sequence that the pilot provided in the emergency department generally was consistent with the narrative information he documented on his NTSB Form 6120.1. He was found to have minor injury not requiring hospitalization. No CO poisoning was identified, nor was any other medical condition requiring hospitalization. The carboxyhemoglobin level in blood collected at 12:48 p.m. on the accident date was 1% (normal), as

measured by arterial blood gas testing with co-oximetry.¹ No oxygen administration was documented. The emergency department physician documented no pertinent past medical history. Documented testing did not include testing for alcohol or other drugs.

2.2 Information about Carbon Monoxide

Carbon monoxide is an odorless, tasteless, colorless, nonirritating gas that can be produced during hydrocarbon combustion. Exposure to carbon monoxide usually occurs by inhalation of smoke or exhaust fumes. When carbon monoxide binds to hemoglobin in blood, carboxyhemoglobin is formed, impairing the blood's ability to deliver oxygen to body tissues. Nonsmokers normally have carboxyhemoglobin levels of less than 1-3%, while heavy smokers may have levels as high as 10-15%. Symptoms of low-level carbon monoxide exposure are nonspecific and variable, and may include headache, nausea, and tiredness. Increasing levels of exposure may become impairing or incapacitating, causing more serious neurocognitive, cardiac, and/or vision problems, progressing to death above carboxyhemoglobin levels of about 50% (or lower if other serious medical conditions co-exist), although symptoms are not simply predictable from carboxyhemoglobin levels. After carbon monoxide exposure stops, the carboxyhemoglobin level typically takes about 4-5 hours to decrease by half; this time may be shortened to about 1-1.5 hours with medical administration of high-flow oxygen via mask. Carbon monoxide poisoning may be insidious and difficult for an exposed person to recognize; there is no reliable physical sign of exposure.²⁻⁶

The FAA and NTSB have published guidance and safety information for pilots emphasizing the dangers of carbon monoxide poisoning, especially in piston-engined airplanes with exhaust system faults. This guidance generally has emphasized the importance of taking mitigating actions as soon as carbon monoxide

¹ Results of the arterial blood gas testing also included mildly low partial pressure of carbon dioxide (pCO₂) with an upper-normal pH. The emergency department physician commented that the results were unremarkable.

² Maloney GE. Carbon monoxide. In: Tintinalli JE, Ma OJ, Yealy DM, et al., eds. *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*. 9th ed. New York, NY: McGraw-Hill Education; 2020:1414-1417.

³ Manaker S, Perry H. Carbon monoxide poisoning. In: Connor RF, ed. *UpToDate*. Wolters Kluwer. <https://www.uptodate.com/contents/carbon-monoxide-poisoning>. Updated November 26, 2024. Accessed February 18, 2026.

⁴ Spitz WU. Asphyxia. In: Spitz WU, Spitz DJ, eds. *Spitz and Fisher's Medicolegal Investigation of Death: Guidelines for the Application of Pathology to Crime Investigation*. 4th ed. Springfield, IL: Charles C Thomas; 2006:783-845.

⁵ Dolinak D, Matshes EW, Lew EO. Environmental injury. In: Dolinak D, Matshes EW, Lew EO, eds. *Forensic Pathology: Principles and Practice*. Burlington, MA: Elsevier Academic Press; 2005:239-258.

⁶ Hampson NB, Piantadosi CA, Thom SR, Weaver LK. Practice recommendations in the diagnosis, management, and prevention of carbon monoxide poisoning. *Am J Respir Crit Care Med*. 2012;186(11):1095-1101. doi:10.1164/rccm.201207-1284CI.

exposure is suspected in flight, including shutting off the cabin heater, opening fresh air vents and windows as possible, using supplemental oxygen if available, and landing as soon as practical. The benefit of using electronic carbon monoxide detectors also has been emphasized.⁷⁻¹²

According to the IIC, the two electronic carbon monoxide detectors aboard the airplane were a Forensics Detectors Car Aircraft Carbon Monoxide Detector and a ForeFlight Sentry device with a connection to a tablet-based ForeFlight application. According to information published on the website of the Forensics Detectors device, the device is designed to provide a visual alert after 60 seconds at a CO concentration of 9 ppm in the air, to provide visual and aural alerts after 60 seconds at 25 ppm, and to provide immediate visual and aural alerts at over 50 ppm.¹³ According to information published on the ForeFlight website, the Sentry device itself is designed to provide a visual alert at 75 ppm, and visual and aural alerts above 200 ppm. Additionally, the Sentry device triggers visual and aural notifications in the ForeFlight application when the CO concentration is elevated, displaying and

⁷ Federal Aviation Administration. *Carbon Monoxide: A Deadly Menace*. Aeromedical Safety Brochure OK-24-1154. September 2024. <https://www.faa.gov/pilots/safety/pilotsafetybrochures/CarbonMonoxide.pdf>. Accessed February 18, 2026.

⁸ Federal Aviation Administration. Aeromedical Factors. In: *Pilot's Handbook of Aeronautical Knowledge*. FAA-H-8083-25C. Oklahoma City: United States Department of Transportation, Federal Aviation Administration, Airman Testing Standards Branch, AFS-630; 2023. https://www.faa.gov/sites/faa.gov/files/regulations_policies/handbooks_manuals/aviation/phak/19_phak_ch17.pdf. Accessed February 18, 2026.

⁹ Federal Aviation Administration. Medical Facts for Pilots: Fitness for Flight. In: *Aeronautical Information Manual (AIM) Basic*. Washington, DC: United States Department of Transportation, Federal Aviation Administration, Mission Support Services, Policy Directorate, AJV-P; Change 2 effective January 22, 2026. https://www.faa.gov/air_traffic/publications/atpubs/aim_html/chap8_section_1.html. Accessed February 18, 2026.

¹⁰ Federal Aviation Administration. Carbon Monoxide (CO) Contamination in Aircraft Detection and Prevention. Advisory Circular AC 20-32B. November 24, 1972. Cancelled March 9, 2020. https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/22570. Accessed February 18, 2026.

¹¹ National Transportation Safety Board. Pilots: Prevent Carbon Monoxide Poisoning. NTSB Safety Alert 69. September 2017. <https://www.nts.gov/Advocacy/safety-alerts/Documents/SA-069.pdf>. Accessed February 18, 2026.

¹² National Transportation Safety Board. Require Carbon Monoxide Detectors in Certain General Aviation Aircraft. NTSB/AIR-22-01. December 20, 2021. <https://www.nts.gov/investigations/AccidentReports/Reports/AIR2201.pdf>. Accessed February 18, 2026.

¹³ Forensics Detectors FD-CAR001 User Manual. https://cdn.shopify.com/s/files/1/3012/7408/files/instructions_v16.0_968ec189-233e-4d85-b561-6e0c21577266.pdf. Accessed February 18, 2026.

announcing the concentration.^{14,15} An accident site photograph was reviewed showing the pilot's tablet running ForeFlight and displaying the notification, "Caution, Sentry CO level is 79 ppm. Tap to hide."¹⁶

The Occupational Safety and Health Administration's 8-hour time-weighted average occupational CO exposure limit (which also formerly was a maximum CO concentration limit in cabin air under FAA airworthiness standards) is 50 ppm in air.¹⁷ Some publications by the FAA and others have cited rough approximations for healthy adults that a 50 ppm concentration is unlikely to cause adverse effects with 8 hours of exposure, whereas at 800 ppm symptoms may occur within 45 minutes and unconsciousness may occur after 2 hours, and at 6400 ppm symptoms may appear within minutes and unconsciousness may occur after 10-15 minutes.^{18,19} As shown in the table, acute exposure guideline levels (AEGLs) also have been developed for carbon monoxide, indicating concentrations of the chemical in air at which health effects may occur in the general population, including susceptible individuals such as the very young, very old, and those with medical conditions.²⁰ At the AEGL-2 concentration for a given exposure time, the general population could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape. At the AEGL-3 concentration for a given exposure time, the general population could experience life-threatening health effects or death.²¹

¹⁴ ForeFlight. What are the Sentry and Sentry Plus carbon monoxide (CO) alert thresholds? ForeFlight Support Center. <https://support.foreflight.com/hc/en-us/articles/13592147336599-What-are-the-Sentry-and-Sentry-Plus-carbon-monoxide-CO-alert-thresholds>. Updated January 14, 2025. Accessed February 18, 2026.

¹⁵ ForeFlight Sentry Guide. <https://cloudfront.foreflight.com/docs/ff/1.9.1/Sentry%20Users%20Guide.pdf>. Updated February 16, 2026. Accessed February 18, 2026.

¹⁶ The ForeFlight Sentry Guide states, "Tap the notification to hide it for five minutes. If CO levels remain elevated, the alert reappears. If CO levels reach dangerous levels, a new audible and visual alert is triggered, even if the previous one was muted."

¹⁷ See [29 Code of Federal Regulations \(CFR\) 1910.1000](#) for the Occupational Safety and Health Administration limit. The former FAA limit was at [14 CFR 23.831](#). Current airworthiness standards for normal category airplanes at [14 CFR 23.2320\(c\)](#) do not specify a numeric CO concentration limit.

¹⁸ Cheraghi SH, Jorgensen MJ, Myose RY. *Detection and Prevention of Carbon Monoxide Exposure in General Aviation Aircraft*. Federal Aviation Administration. DOT/FAA/AR-09/49. October 2009. <https://rosap.ntl.bts.gov/view/dot/36961>. Accessed February 18, 2026.

¹⁹ National Fire Protection Association. NFPA 72: National Fire Alarm and Signaling Code. 2025 Edition. <https://link.nfpa.org/free-access/publications/72/2025>. Accessed February 18, 2026.

²⁰ For more information about AEGLs and their development, see the US Environmental Protection Agency website at <https://www.epa.gov/aeql>.

²¹ National Research Council Subcommittee on Acute Exposure Guideline Levels. *Standing Operating Procedures for Developing Acute Exposure Guideline Levels for Hazardous Chemicals*. National Academies Press; 2001. Available from: https://www.epa.gov/sites/default/files/2015-09/documents/sop_final_standing_operating_procedures_2001.pdf. Accessed February 18, 2026.

	10-minute exposure	30-minute exposure	60-minute exposure	4-hour exposure	8-hour exposure
AEGL-2 concentration	420 ppm	150 ppm	83 ppm	33 ppm	27 ppm
AEGL-3 concentration	1700 ppm	600 ppm	330 ppm	150 ppm	130 ppm

Table: Carbon Monoxide Acute Exposure Guideline Levels²²

Notably, it may be challenging for an affected person to distinguish symptoms caused by carbon monoxide poisoning from symptoms caused by physiological responses to acute stress. Such physiological responses may include hyperventilation, which is increased breathing that can lead to excessive loss of carbon dioxide from the blood, and which can be associated with lightheadedness, dizziness, vision changes, tingling sensations, shortness of breath, disorientation, or a sense of impending doom.^{8,9,23,24}

Submitted by:

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²² US Environmental Protection Agency. Carbon Monoxide Results - AEGL Program. Acute Exposure Guideline Levels. <https://www.epa.gov/aegl/carbon-monoxide-results-aegl-program>. Updated August 8, 2025. Accessed February 18, 2026.

²³ Stepanek J, Connolly DM, Pollock NW. Atmosphere, Hypoxia, and Decompression Stress. In: Davis JR, Stepanek J, Fogarty JA, Blue RS, eds. *Fundamentals of Aerospace Medicine*. 5th ed. Wolters Kluwer Health; 2022:300-349.

²⁴ Schwartzstein RM, Richards JB, Edlow JA, Roy-Byrne PP. Hyperventilation syndrome in adults. In: Connor RF, ed. *UpToDate*. Wolters Kluwer. <https://www.uptodate.com/contents/hyperventilation-syndrome-in-adults>. Updated February 28, 2024. Accessed August 5, 2025.