SAFETY ALERT 070

NTSB National Transportation Safety Board

September 2017

AVIATION
HIGHWAY
MARINE
RAILROAD
PIPELINE

Mechanics: Prevent Carbon Monoxide Poisoning

The risk of carbon monoxide poisoning is overlooked and underestimated!

The problem

- **Carbon monoxide (CO)** is a colorless, odorless, tasteless gas by-product of internal combustion engines found in exhaust gases. Sufficiently high levels of CO in the bloodstream will lead to oxygen starvation and the onset of symptoms (such as headaches, drowsiness, nausea, or shortness of breath).
- Many internal combustion engine airplanes are heated by air that has been warmed by circulating air around the exhaust system using a heater shroud. **A defect or leak in the exhaust pipes or muffler can introduce CO into the cockpit.**
- Cracks in exhaust/heater mufflers and tubes and unplugged holes in the firewall can go unnoticed during inspections and lead to CO entering an airplane's cabin during flight. Degraded door and window seals or leaks in the air ducting can also allow CO into the cabin.

Related accidents

The National Transportation Safety Board (NTSB) has investigated several accidents (some fatal) in which pilots were incapacitated following CO exposure, such as the following:

- **A Mooney M20C airplane crashed in a field following the pilot's incapacitation;** the pilot was seriously injured. Shortly after departure, the pilot lost consciousness and air traffic control was unable to contact the pilot. The airplane continued to fly for about 1.5 hours until the fuel in the selected tank was exhausted. The pilot's CO level was at least 28% (and likely higher) at the time of the accident. CO levels between 10% and 20% can result in confusion, impaired judgment, and difficulty concentrating. Postaccident examination of the airplane found a fracture in the exhaust/heater muffler (see left photograph in figure 1) and exhaust deposits inside the muffler shroud (right photograph in figure 1). This allowed the exhaust gas to enter the cabin, exposing the pilot to CO. (CEN17LA101)

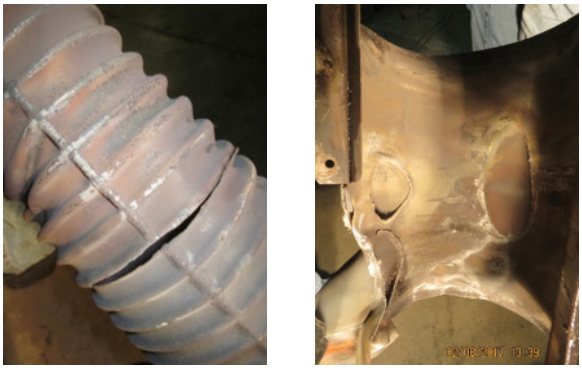

Figure 1. Photographs of a cracked muffler and exhaust deposits in the muffler shroud.

- **Witnesses observed an experimental amateur-built, Hefty Polar Cub airplane flying erratically at a low altitude before impacting terrain.** A postcrash fire ensued, and the pilot was fatally injured. Toxicology testing revealed that the pilot's CO level was 48%; no soot was found in his airways, indicating the CO was not a result of the fire; thus, the NTSB determined that the pilot's severe CO impairment likely caused the pilot's loss of airplane control. Examination of the airplane's exhaust system revealed that the exhaust/heater muffler was fractured, allowing CO to enter the cockpit (see figure 2). (ANC16FA065)

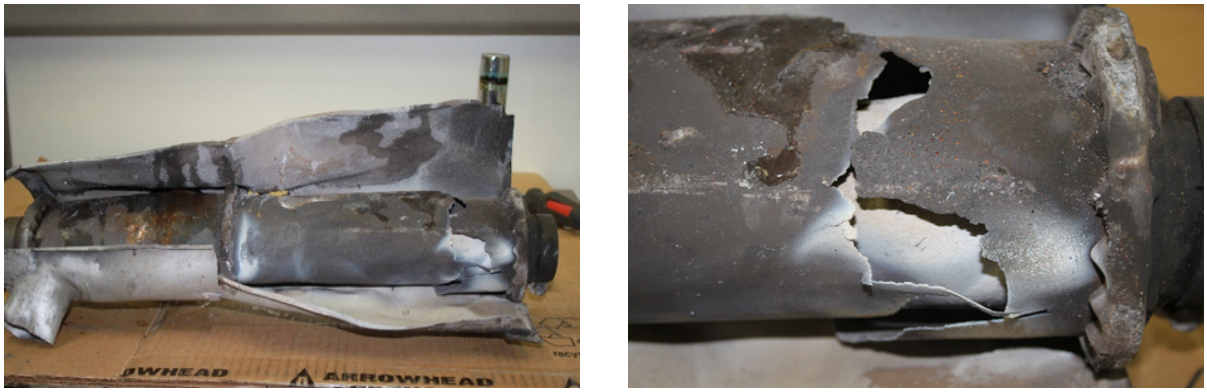

Figure 2. Fractured exhaust muffler from a Hefty Polar Cub airplane (left) and a close-up photograph of the fracture in the exhaust muffler (right).

- **About 3 hours into a 3.5-hour postmaintenance flight, a Cessna 207 airplane impacted trees and a river.** The pilot was fatally injured. Toxicology tests identified a CO level of 21% in the pilot's blood, which likely adversely affected his performance. The airplane's original cabin heat system had been modified with a "winter heat kit" that, according to maintenance records, had not been installed in accordance with Federal Aviation Administration (FAA) field approval procedures. The full heat system was not recovered, and it was not possible to determine the exact source of the CO. (ANC15FA032)
- **A Bellanca 14-19-3A descended from cruise flight at a rate of 2,900 ft per minute and collided with power lines and trees.** The pilot was fatally injured. The wreckage examination revealed cracks and holes in the muffler wall and exhaust gas penetration into the interior of the shroud. Toxicology tests identified a CO level of 37% in the pilot's blood. Most of the CO detected in the pilot's blood was likely from inhalation during the flight; the CO levels would have impaired his ability to safely fly the airplane. (CEN14FA024)

What can YOU do?

- **Inspect exhaust systems, air ducting, firewalls, and door/window seals thoroughly at every 100-hour or annual inspection to reduce the chance of CO being introduced into the cockpit.**
- **Inspect heater air inlet cockpit vents for evidence of sooting, consistent with the presence of CO.**
- **Talk to pilots about installing electrochemical CO detectors with aural and visual alerts in the cockpit.**
- **Be informed and review and comply with any airworthiness directives and service bulletins regarding the exhaust system. Speak with the owner about regular inspections and the replacement schedule of parts.**

Interested in more information?

The following FAA resources are accessible via www.faa.gov:

- "Acceptable Methods, Techniques, and Practices – Aircraft Inspection and Repair" (AC 43-13-1B) contains inspection methods and repair techniques in chapter 8 to prevent exhaust system failures that could lead to CO exposure.
- Special Airworthiness Information Bulletin CE-04-22 addresses the importance of properly inspecting and maintaining components to prevent CO poisoning
- AC 91-59A, Inspection and Care of General Aviation Aircraft Exhaust Systems emphasizes the safety hazards of poorly maintained aircraft exhaust systems and highlights points at which exhaust system failures occur.
- FAA brochure *Carbon Monoxide: A Deadly Menace* contains medical information concerning the symptoms of CO exposure and methods of avoiding exposure.

A companion video to this safety alert can be accessed from the Aviation Safety Alerts link.

The reports for the accidents referenced in this safety alert are accessible by NTSB accident number from the Aviation Accident Database link, and each accident's public docket is accessible from the Accident Dockets link for the Docket Management System. Related Safety Alert SA-022, "Mechanics: Manage Risks to Ensure Safety," can be accessed from the Aviation Safety Alerts link.

The NTSB's Aviation Information Resources web page, www.ntsb.gov/air, provides convenient access to NTSB aviation safety products. This Safety Alert and others can be accessed from the Aviation Safety Alerts link at www.ntsb.gov.

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The NTSB is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant accidents in other modes of transportation—highway, marine, railroad, and pipeline. The NTSB determines the probable cause of the accidents and issues safety recommendations aimed at preventing future accidents. For more information, visit **www.ntsb.gov.**