



U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: **INSPECTION AND CARE OF GENERAL AVIATION AIRCRAFT EXHAUST SYSTEMS** Date: **8/20/82** AC No: **91-59**
Initiated by: **AWS - 340** Change:

1. **PURPOSE.** This advisory circular (AC) **emphasizes** the safety hazards of **poorly maintained** single-engine aircraft exhaust systems (reciprocating powerplants) and highlights points at **which** exhaust system failures occur. Further, it provides **information on** the kind of problems to be expected and **recommends** the performance of ongoing preventive maintenance and maintenance by pilots and mechanics, respectively.

2. **BACKGROUND.** Malfunction or Defect Report, Federal Aviation Administration (FAA) Form 8010-4, submitted by aircraft owners/operators and maintenance personnel shows that there is an upward trend in exhaust system failures during the last 5 years.

a. Review of accident/incident **reports** reveal that there have been numerous fatalities and injuries to pilots and passengers as a **result** of **powerplant** exhaust system failures. Probable cause factors included:

- (1) Occupants became incapacitated due to carbon **monoxide** intoxication;
- (2) Engine malfunctions/failures;
- (3) Engine nacelle **compartment** fires;
- (4) A **combination** of the above.

b. In an effort to prevent these accidents/incidents, the FAA and the aircraft manufacturers have, **over** the years, taken various measures to reduce and/or eliminate these problems. For example, the FAA has issued several airworthiness directives (AD's) on **certain** make and **model** aircraft requiring specific maintenance and inspections to be performed on the exhaust system at specified time intervals.

3. **RELATED READING MATERIAL.** Several **AC's** have been published **which contain** important information to familiarize pilots/mechanics performing daily and preflight inspections, checks, and required or **recommended** maintenance.

a. These **AC's** include:

- (1) AC 20-106, Aircraft Inspection for the General Aviation Aircraft Owner (SN 050-007-00449-4).

(2) AC ~~43.13-1A~~, Acceptable Methods, Techniques and Practices, Aircraft Inspection and Repair (SN 050-007-00461-3).

(3) AC ~~65-12A~~, Airframe and Powerplant Mechanics ~~Powerplant~~ Handbook (SN 050-007-00373-1).

(4) AC ~~20-32B~~, Carbon Monoxide (CO) Contamination in Aircraft - Detection and Prevention.

(5) AC 43-16, General Aviation Airworthiness Alerts.

(6) AC 43-12, Preventive Maintenance.

Note: With the exception of AC's 43-12, 43-16, and ~~20-32B~~, all AC's shown above are for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. AC 43-16 is available, by request, from the U.S. Department of Transportation, FAA Flight Standards National Field Office, AFO-500, P. O. Box 25082, Oklahoma City, Oklahoma 73125. Advisory Circular 43-16 is also available for review at any local FAA Flight Standards District Office and contains a compilation of aircraft service experience problems reported to the FAA on the Malfunction or Defect Report, FAA Form 8010-4. AC's 20-32B and 43-12 are available from the U.S. Department of Transportation, Publications Section, M-443.1, Washington, D.C. 20590.

b. Aircraft manufacturers publish service letters, information letters, ~~service~~ bulletins, and maintenance manuals which inform the aviation public on the recommended maintenance, preventive maintenance, and how to correct exhaust system problems.

4. EXHAUST SYSTEMS

a. FAA's studies show that approximately 50 percent of exhaust system failures occurred in the exhaust &-to-air heat exchanger, resulting in carbon monoxide gas entering the cabin through the aircraft heater. The presence of exhaust gases in the cabin may effect the general efficiency of the pilot by causing impaired mental alertness, judgment, and reasoning, all of which contribute to or cause this type of accident/incident.

b. Approximately 20 percent of exhaust system failures occurred in the exhaust stack pipes, manifolds, and tail pipes, introducing carbon monoxide gas, smoke, or fire into the cabin area.

c. Approximately 20 percent of engine partial power loss and power failures resulted from internal muffler failure. Sheet metal baffles and/or defusers usually break off inside the muffler and completely or partially block the escape of exhaust gases from the engine cylinders. The severity of the power loss is proportional to the extent of blockage.

5. EXHAUST FAILURES.

a. A primary reason for **most** exhaust system failures is inadequate and infrequent inspections/checks and the lack of routine and **preventive** maintenance between inspections. Exhaust systems deteriorate for the following reasons:

- (1) Engine ~~operating~~ temperatures.
- (2) Vibration which causes metal **fatigue** in areas of stress concentration and wear at joints or connections.
- (3) . Engine backfiring and unburned fuel in the muffler.

Note: The above **conditions** begin ~~to~~ take effect the first **hour** of engine operation and deterioration progresses through the lifespan of the exhaust system **components**.

b Indication of cracked or leaking exhaust systems can **occur** in **any** area of the **system**; however, the following are found **to** be the most **prominent** **problem** areas:

- (1) Exhaust manifold and **slack** fatigue failures usually occur at welded or ~~claw~~ joints (e.g., exhaust stack flange, stack ~~to~~ manifold cross pipes, or muffler connections).
- (2) **Muffler** and heat-exchanger failures usually occur ~~on the inner~~ wall surface. A proper inspection can only ~~be accomplished~~ when the outer heat shield is removed. **This** inspection ~~should be~~ accomplished as ~~recommended~~ by the manufacturer or by a properly certificated mechanic or ~~repair~~ station.

6. INSPECTION/CHECK.

a. The ~~owner/operator~~ of an aircraft is made primarily responsible by Section **91.165** of the Federal Aviation Regulations (FAR) Part **91** ~~to see~~ that between required inspections (e.g., annual, **progressive**, and **100-hour** inspection), defects **are** repaired as ~~prescribed~~ in FAR Part **43**. In the interest of safety, owners/operators should perform daily preflight inspections which include a thorough **visual** external inspection/check-of the exhaust **system**.

b Because of the design of ~~some~~ aircraft ~~cowlings~~, an engine exhaust system ~~may~~ **not** be easily inspected/checked as needed. It is **necessary** that the cowling(s) be removed at frequent intervals (hours of **operations**) ~~to perform~~ a detailed inspection/check. Manufacturers service bulletins, information **letters**, and maintenance manuals **recommend** when maintenance inspections/checks should **be** performed. Persons performing **maintenance** and preventive maintenance should have this information available to them. Use of a high-intensity light and telescoping, hinge-handle **mirror** is recommended to facilitate a **good** inspection/check.

c. Visually **inspect/check**, in detail, the following external ~~components~~ of the exhaust system:

- (1) Muffler and heat exchanger for **general condition** and leaks.

- (2) **Leaking** exhaust stack gaskets (blown gaskets).
- (3) Loose or broken clamp **connections**, attachments, and stacks.
- (4) Cracked or broken stacks and tail pipes.
- (5) Dented stacks.
- (6) Cracks adjacent to welded areas and stack bends.
- (7) **Thinning** of joint areas due to vibrational wear.
- (8) Metal pitting due to internal erosion **by combustion** products.
- (9) **Turbo** supercharger for:
 - (a) Improper installation, including misalignment of exhaust stacks, ball joints, and/or connections **which** results in abnormal wear.
 - (b) Supercharger assembly for cracks and wear.
 - (c) Oil reservoir for improper service.

Note: In addition to the above, the **firewall** seal(s) should be carefully inspected **to** assure that the exhaust gases will **not** enter the cabin area. The engine **compartment** should also be free of **combustible** material **and** oil **to reduce** the possibility of a fire hazard.

d. Exhaust leaks and/or cracks are indicated by a gray-white or **sooty-black streak** or discoloration of the heat interchanger jacket. When defects **are** suspected, they should be further inspected by a qualified person for a determination of **whether** it should be repaired or replaced. An excessive engine **RPM** drop noted during the **application** of carburetor heat is also an indication of a cracked or leaking heat exchanger. If the owner/operator has any questions on **whether** they can perform an inspection or repair, AC **43-12**, Preventive Maintenance, **should** be reviewed and/or the local FAA District Office should be **contacted** for this information.

e. Any time exhaust fumes are detected in the cabin, **immediately** shut off the cabin heat **control**, **open** a fresh air vent, and land as soon as practical. A thorough inspection of the entire exhaust system should be conducted, especially the muffler and heat exchanger, in accordance with the manufacturer's **recommendation**. Repair, replacement, and inspection, must be recorded per **FAR 91.173** and this record retained in accordance **with FAR 91, Section 91.173**.

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M. Bat

Director of Airworthiness