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## **DEPARTMENT OF TRANSPORTATION**

### **Federal Aviation Administration**

#### **14 CFR Part 39**

**[Docket No. FAA-2007-0051; Directorate Identifier 2007-NE-37-AD; Amendment 39-15986; AD 2009-16-03]**

**RIN 2120-AA64**

### **Airworthiness Directives; Teledyne Continental Motors (TCM) IO-520, TSIO-520, and IO-550 Series Reciprocating Engines With Superior Air Parts, Inc. (SAP) Cylinder Assemblies Installed**

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final rule.

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**SUMMARY:** The FAA is adopting a new airworthiness directive (AD) for certain TCM IO-520, TSIO-520, and IO-550 series reciprocating engines, with certain SAP investment cast cylinder assemblies installed. This AD requires initial and repetitive inspections and compression tests to detect cracks in those cylinders with more than 750 flight hours (FH) time-in-service (TIS). This AD results from reports of cracks in the area of the exhaust valve and separation of cylinder heads from the barrels of SAP cylinder assemblies with certain part numbers. We are issuing this AD to prevent the separation of the cylinder head, which could result in immediate loss of engine power, possible structural damage to the engine, and possible fire in the engine compartment.

**DATES:** This AD becomes effective September 9, 2009. The Director of the Federal Register approved the incorporation by reference of certain publications listed in the regulations as of September 9, 2009.

**ADDRESSES:** You can get the service information identified in this AD from Teledyne Continental Motors, Inc., P.O. Box 90, Mobile, Alabama; telephone (251) 438-3411, or go to:  
<http://www.genuinecontinental.aero>.

The Docket Operations office is located at Docket Management Facility, U.S. Department of Transportation, 1200 New Jersey Avenue, SE., West Building Ground Floor, Room W12-140, Washington, DC 20590-0001.

**FOR FURTHER INFORMATION CONTACT:** Peter W. Hakala, Aerospace Engineer, Special Certification Office, FAA, Rotorcraft Directorate, 2601 Meacham Blvd., Fort Worth, TX 76137; e-mail: [peter.w.hakala@faa.gov](mailto:peter.w.hakala@faa.gov); telephone (817) 222-5145; fax (817) 222-5785.

**SUPPLEMENTARY INFORMATION:** The FAA proposed to amend 14 CFR part 39 with a proposed AD. The proposed AD applies to certain TCM IO-520, TSIO-520, and IO-550 reciprocating engines with SAP investment cast cylinder assemblies, part numbers (P/Ns) SA52000-A1, SA52000-A20P, SA52000-A21P, SA52000-A22P, SA52000-A23P, SA55000-A1, or SA55000-A20P, installed. We published the proposed AD in the Federal Register on April 11, 2008, (73 FR 19772). That action proposed to require initial and repetitive inspections and compression tests to detect cracks in those cylinders with more than 750 FH TIS.

### **Examining the AD Docket**

You may examine the AD docket on the Internet at <http://www.regulations.gov>; or in person at the Docket Operations office between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays. The AD docket contains this AD, the regulatory evaluation, any comments received, and other information. The street address for the Docket Operations office (telephone (800) 647-5527) is provided in the ADDRESSES section. Comments will be available in the AD docket shortly after receipt.

### **Comments**

We provided the public the opportunity to participate in the development of this AD. We have considered the comments received.

### **Requests to Not Issue an AD Against the SAP Cylinders**

Four commenters suggest we not issue an AD against the SAP cylinders because the SAP cylinder assemblies have a lower failure rate than the OEM cylinder assemblies. One commenter suggests that SAP should issue a detailed service bulletin to address the service difficulty conditions.

We don't agree. We confirmed that nine SAP cylinder assemblies failed with a head separation condition, which could result in loss of control of the airplane. Superior Air Parts, Inc. investigated the cause for the failure of the cylinder assemblies. Because the cylinder assemblies failed with a separation condition from propagation of metal fatigue cracks, we determined that this failure condition is a direct safety hazard to the airplane. This proposed AD is necessary to ensure that these cylinder assemblies are periodically inspected, and removed from service at engine overhaul to prevent this unsafe condition. We did not change the AD.

### **Absence of Data To Show Serial Number Distribution**

One commenter suggests we examine the distribution of the cracks across the range of serial numbers and perform a statistical analysis to try to identify a process change or a design change that may be a contributor to the failed SAP cylinder assemblies.

We agree. We examined the distribution of the cracks, and collected and analyzed in service data of the cylinder assemblies. We found the failed cylinder assemblies were not in any specific serial number sequence. The failed serial numbers ranged from low to high within the serial number range, so the time to failure of the cylinder assemblies were unpredictable. We did not change the AD.

### **Requests To Change 50-Hour Inspections to 100-Hour or Annual Inspections**

Twenty commenters suggest that requiring a 50-hour repetitive inspection for cylinder leaks is unnecessary and burdensome at 50-hour intervals. The commenters suggest that we change the repetitive inspection requirements to allow performing the inspections at the 100-hour or annual inspections.

We don't agree. We selected a 50-hour inspection interval so we can detect leaks and replace the cylinder before a head separation occurs. By removing leaking cylinder heads discovered with the periodic 50-hour inspections, the probability of having an in-flight separation is greatly reduced. Also, the 50-hour inspection coincides with the scheduled maintenance for normal engine oil and filter changes. The costs of compliance in the NPRM included costs for the additional cylinder assembly inspections. We did not change the AD.

### **Suggestion To Replace All SAP Cylinders With Fewer Than 823 Hours Time-In-Service**

One commenter suggests that we require replacing all SAP cylinders with fewer than 823 hours TIS. The commenter states that because of a lack of engineering data to justify the proposed corrective action, we should require removing all the remaining cylinder assemblies now in service, at no later than 823 hours TIS.

We don't agree. The lowest TIS of a failed cylinder assembly is 823 hours TIS. Many of the cylinders have operated well past 823 hours TIS and some to the time-between-overhaul limit. The initial 25 hour TIS inspection and subsequent 50 hour inspections will provide satisfactory safety oversight to prevent future head separations without putting an unnecessary burden on the public by requiring replacing all 23,000 of the SAP cylinders produced. We did not change the AD.

### **Request To Increase the Fuel-Air Ratios on TCM Engines That Use SAP Cylinders**

One commenter states the corrective action should be an immediate FAA authorization to increase the full power fuel flows above the type certificate limits as necessary to return the fuel-air ratios to those of stock TCM engines. The commenter stated that the SAP cylinders are not direct replacements for TCM cylinders because of their increased volumetric efficiency (more air without more fuel).

We don't agree. Superior Air Parts, Inc. has not made any public claims of increased horsepower or increased volumetric efficiency for the cylinders. Testing during certification of the SAP cylinders did not reveal any appreciable power output difference, outside of normal variation. While it may be due to a slightly higher volumetric efficiency, as compared to the original equipment manufacturer's (OEM) cylinders, the observed and resulting temperature differences were not of such a magnitude as to cause a safety of flight issue. The SAP cylinders are subject to the same FAA-approved cylinder head temperature limitation as the OEM cylinders. Both the SAP cylinders and the OEM cylinders were certified and approved to operate continuously at the maximum certificated temperature. We did not change the AD.

### **Observation That a Large Number of SAP Cylinder Failures Occurred in Alaska**

Six commenters state that a large number of SAP cylinder assembly failures occurred in Alaska among commercial operators that had airplanes with high-usage rates. They state that the operators have high-thermal cycles per hour. The commenters define a thermal cycle as an engine start, an aircraft takeoff, an aircraft landing, and an engine shutdown. One of the commenters stated that shock heating is far more destructive than shock cooling. Another commenter stated that their facility has installed the affected investment cast cylinders on hundreds of aircraft and has operated in an environment that would be expected to be as adverse as any other identifiable operating environment as measured by three critical engineering parameters:

- (1) The average repetitive internal temperature experienced by the cylinder head,
- (2) The number of thermal cycles, and
- (3) The magnitude of the maximum cylinder head temperature during exposure to peak thermal cycles.

That commenter goes on to state that they haven't encountered any cracks in this population of SAP cylinders over the last decade.

We accept these comments as possible metallurgical explanations for fatigue cracks starting and growing, however; other engine operating conditions could contribute to metal fatigue failures. We did not change the AD.

### **Type of Cylinder Head Casting Questioned**

One commenter asks if the cylinder head casting is a sand casting or an investment casting. The commenter states that the AD should specify the type of casting. The commenter also asks that the proposed AD should state that most failures were due to a high number of thermal cycles for the total number of engine operating hours. The commenter states that a thermal cycle should be defined as "an engine start up, airplane takeoff, airplane landing, and an engine shutdown" and not as a "high ratio of take offs and landings per flight hour."

We partially agree. The proposed AD does state that the cylinder assemblies have an investment cast aluminum head. After additional research, we agree that a high number of thermal cycles, for example engine start up, airplane takeoff, airplane landing, and engine shutdown can increase the thermal fatigue of the cylinder assemblies. However, the number of engine starts and thermal cycles are not recorded and cannot be correlated. We changed the AD for clarity to refer to the cylinder heads as "investment cast," and provided a process in paragraph (f) for determining the cylinder P/N if it is not in the engine records.

### **Conclusion**

We have carefully reviewed the available data, including the comments received, and determined that air safety and the public interest require adopting the AD with the changes described previously. We have determined that these changes will neither increase the economic burden on any operator nor increase the scope of the AD.

### **Costs of Compliance**

We estimate that this AD will affect 8,000 engines installed on airplanes of U.S. registry. We also estimate that it will take about 5 work-hours per cylinder to perform the actions, and that the average labor rate is \$80 per work-hour. Required parts will cost about \$1,150 per cylinder. Based on these figures, we estimate the total cost of this AD to U.S. operators to be \$12,400,000.

### **Authority for This Rulemaking**

Title 49 of the United States Code specifies the FAA's authority to issue rules on aviation safety. Subtitle I, Section 106, describes the authority of the FAA Administrator. Subtitle VII, Aviation Programs, describes in more detail the scope of the Agency's authority.

We are issuing this rulemaking under the authority described in Subtitle VII, Part A, Subpart III, Section 44701, "General requirements." Under that section, Congress charges the FAA with promoting safe flight of civil aircraft in air commerce by prescribing regulations for practices, methods, and procedures the Administrator finds necessary for safety in air commerce. This regulation is within the scope of that authority because it addresses an unsafe condition that is likely to exist or develop on products identified in this rulemaking action.

### **Regulatory Findings**

We have determined that this AD will not have federalism implications under Executive Order 13132. This AD will not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government.

For the reasons discussed above, I certify that this AD:

- (1) Is not a "significant regulatory action" under Executive Order 12866;
- (2) Is not a "significant rule" under DOT Regulatory Policies and Procedures (44 FR 11034, February 26, 1979); and
- (3) Will not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act.

We prepared a summary of the costs to comply with this AD and placed it in the AD Docket. You may get a copy of this summary at the address listed under ADDRESSES.

### **List of Subjects in 14 CFR part 39**

Air transportation, Aircraft, Aviation safety, Incorporation by reference, Safety.

### **Adoption of the Amendment**

Accordingly, under the authority delegated to me by the Administrator, the Federal Aviation Administration amends 14 CFR part 39 as follows:

### **PART 39—AIRWORTHINESS DIRECTIVES**

1. The authority citation for part 39 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701.

#### **§ 39.13 [Amended]**

2. The FAA amends § 39.13 by adding the following new airworthiness directive:



**2009-16-03 Superior Air Parts, Inc. (SAP):** Amendment 39-15986. Docket No. FAA-2007-0051; Directorate Identifier 2007-NE-37-AD.

**Effective Date**

(a) This airworthiness directive (AD) becomes effective September 9, 2009.

**Affected ADs**

(b) None.

**Applicability**

(c) This AD applies to Teledyne Continental Motors (TCM) IO-520, TSIO-520, and IO-550 series reciprocating engines with SAP investment cast cylinder assemblies, part numbers (P/Ns) SA52000-A1, SA52000-A20P, SA52000-A21P, SA52000-A22P, SA52000-A23P, SA55000-A1, or SA55000-A20P, installed. These engines are installed on, but not limited to, the airplanes listed in Table 1 of this AD.

**Table 1 – Teledyne Continental Motors-related Aircraft Models**

<b>Engine Model</b>	<b>Aircraft Manufacturer</b>	<b>Aircraft Model Designation</b>
IO-520-A	Cessna	210 D, E, F, G, & H
IO-520-A	Cessna	206
IO-520-A	Cessna	P206
IO-520-A	Rockwell	200 D
IO-520-B	Beechcraft	36 Bonanza
IO-520-B	Beechcraft	A36
IO-520-B	Navion	Range Master
IO-520-BA	Beechcraft	A36
IO-520-BA	Beechcraft	S & V35, V35A, V35B
IO-520-BA	Beechcraft	C33 A
IO-520-BA	Beechcraft	E33 A & C
IO-520-BA	Beechcraft	F33 A & C
IO-520-BA	Navion	Range Master

IO-520-BB	Beechcraft	A36
IO-520-BB	Beechcraft	V35B
IO-520-BB	Beechcraft	F33 A
IO-520-C & CB	Beechcraft	C55 - E55 Baron
IO-520-D	Bellanca	17-30 Viking
IO-520-D	Cessna	A188-300 AG Truck
IO-520-D	Cessna	185
IO-520-E	(Cessna 310)	Exec 600
IO-520-E	(Beech Baron)	Pres 600
IO-520-F	Cessna	207
IO-520-F	Cessna	U206
IO-520-K	Bellanca	17-30A
IO-520-L	Cessna	210 K, L, M, N & R
IO-520-L	Cessna	210N II
IO-520-L	Cessna	210R
IO-520-M	Cessna	310R
IO-520-MB	Cessna	310R
IO-550-A	Cessna	310 Conversion
IO-550-B	Beechcraft	A36
IO-550-B	(Beech Bonanza)	Foxstar
IO-550-C	Beechcraft	58 Baron
IO-550-D	Cessna	185/188 Conversion
IO-550-E	Cessna	310 Conversion
IO550-F	Cessna	206/207 Conversion
IO-550-L	Cessna	210 Conversion

### **Unsafe Condition**

(d) This AD results from reports of cracks in the area of the exhaust valve and separation of cylinder heads from the barrels of SAP cylinder assemblies with certain part numbers. We are issuing this AD to prevent the separation of the cylinder head, which could result in immediate loss of engine power, possible structural damage to the engine, and possible fire in the engine compartment.

### **Compliance**

(e) You are responsible for having the actions required by this AD performed within the compliance times specified unless the actions have already been done.

## **Inspecting SAP Cylinder Assemblies**

(f) If the engine records don't contain the P/N of the cylinder heads, do the following:

(1) Remove the valve cover from the cylinder assembly.

(2) Look at the cylinder head for the P/N SAC 52001 I or SAC 55001 I and the word "AMCAST."

(g) For TCM IO-520, TSIO-520, and IO-550 series reciprocating engines with SAP investment cast cylinder assemblies, P/Ns SA52000-A1, SA52000-A20P, SA52000-A21P, SA52000-A22P, SA52000-A23P, SA55000-A1, or SA55000-A20P, installed, with over 750 flight hours (FH) time-in-service (TIS), do the following within 25 FH TIS after the effective date of this AD:

(1) Inspect each cylinder head around the exhaust valve side for visual cracks or any signs of black combustion leakage.

(2) Replace any cracked or leaking cylinders before further flight.

(3) Perform a standard cylinder compression test. Guidance on standard cylinder compression tests can be found in Teledyne Continental Aircraft Engine Service Bulletin SB03-3, Differential Pressure Test and Borescope Inspection Procedures for Cylinders, dated March 28, 2003.

(i) If the cylinder pressure gauge reads below 60 pounds per-square inch, determine if the unacceptable pressure is due to a cracked cylinder.

(ii) To check the cylinder, apply a 2 percent soapy water solution to the side of the leaking cylinder.

(iii) If you see air bubbles, indicating air leakage, on the side of the cylinder head, or near the head-to-cylinder interface, replace the cylinder assembly before further flight.

(h) Thereafter, repeat the cylinder visual inspections and compression tests within 50 FH time-since-last inspection (TSLI) until the cylinders reach their time-between-overhaul (TBO) limits specified in Teledyne Continental Aircraft Engine Service Information Letter SIL98-9A, Revision A, dated March 28, 2003.

## **Replacing SAP Cylinder Assemblies**

(i) For TCM IO-520, TSIO-520, and IO-550 series reciprocating engines with SAP investment cast cylinder assemblies, P/Ns SA52000-A1, SA52000-A20P, SA52000-A21P, SA52000-A22P, SA52000-A23P, SA55000-A1, or SA55000-A20P, replace the SAP cylinder head assembly at the first TBO after the effective date of this AD. Engines that were already overhauled may continue in service until the first TBO after the effective date of this AD.

## **Prohibition Against Installing Certain P/N SAP Cylinder Assemblies**

(j) After the effective date of this AD, do not install any SAP investment cast cylinder assembly, P/Ns SA52000-A1, SA52000-A20P, SA52000-A21P, SA52000-A22P, SA52000-A23P, SA55000-A1, or SA55000-A20P, in any engine.

## **Alternative Methods of Compliance**

(k) The Manager, Special Certification Office, has the authority to approve alternative methods of compliance for this AD if requested using the procedures found in 14 CFR 39.19.

## **Special Flight Permits**

(l) Under 14 CFR part 39.23, we will not approve special flight permits for this AD for engines that have failed the visual inspection or the 50 hour periodic cylinder assembly compression test required by this AD.

## **Related Information**

(m) Teledyne Continental Service Bulletin No. SB03-3 "Differential Pressure Test and Borescope Inspection Procedures for Cylinders", dated March 28, 2003.

(n) Contact Peter W. Hakala, Aerospace Engineer, Special Certification Office, FAA, Rotorcraft Directorate, 2601 Meacham Blvd., Fort Worth, TX 76137; e-mail: [peter.w.hakala@faa.gov](mailto:peter.w.hakala@faa.gov); telephone (817) 222-5145; fax (817) 222-5785, for more information about this AD.

## **Material Incorporated by Reference**

(o) You must use Teledyne Continental Aircraft Engine Service Information Letter SIL98-9A, Revision A, dated March 28, 2003 to determine the times-between-overhaul required by this AD. The Director of the Federal Register approved the incorporation by reference of this service information in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Contact Teledyne Continental Motors, Inc., P.O. Box 90, Mobile, Alabama; telephone (251) 438-3411, or go to: <http://www.genuinecontinental.aero>, for a copy of this service information. You may review copies at the FAA, New England Region, 12 New England Executive Park, Burlington, MA; or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to: <http://www.archives.gov/federal-register/cfr/ibr-locations.html>.

Issued in Burlington, Massachusetts, on July 23, 2009.

Peter A. White,  
Assistant Manager, Engine and Propeller Directorate,  
Aircraft Certification Service.