[Federal Register: January 28, 1998 (Volume 63, Number 18)]
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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39 [63 FR 4154 NO. 18 01/28/98]

[Docket No. 94-ANE-44; Amendment 39-10291; AD 98-02-08]
RIN 2120-AA64

Airworthiness Directives; Certain Textron Lycoming 320 and 360 Series Reciprocating Engines

AGENCY: Federal Aviation Administration, DOT.

ACTION: Final rule.

SUMMARY: This amendment adopts a new airworthiness directive (AD), applicable to certain Textron Lycoming 320 and 360 series reciprocating engines, that requires visual inspections of the inside diameter (ID) of the crankshaft for corrosion pits, and if corrosion pits are found during this inspection, prior to further flight, performing a magnetic particle inspection (MPI) or fluorescent penetrant inspection (FPI) of the ID for cracks. In addition, this AD requires reporting findings of inspections to the FAA. Finally, terminating action to the inspections of this AD is the application of a preventive treatment coating on non-corroded crankshafts to prevent corrosion. This amendment is prompted by reports of cracks in crankshafts originating from corrosion pits in the ID. The actions specified by this AD are intended to prevent crankshaft failure, which can result in engine failure, propeller separation, forced landing, and possible damage to the aircraft.

DATES: Effective March 30, 1998.
The incorporation by reference of certain publications listed in the regulations is approved by the Director of the Federal Register as of March 30, 1998.

ADDRESSES: The service information referenced in this AD may be obtained from Textron Lycoming, 652 Oliver St., Williamsport, PA 17701; telephone (717) 327-7080, fax (717) 327-7100. This information may be examined at the Federal Aviation Administration (FAA), New England Region, Office of the Regional Counsel, 12 New England Executive Park, Burlington, MA; or at the Office of the Federal Register, 800 North Capitol Street, NW., suite 700, Washington, DC.

FOR FURTHER INFORMATION CONTACT: Rocco Viselli or Raymond Reinhardt, Aerospace Engineers, New York Aircraft Certification Office, FAA, Engine and Propeller Directorate, 10 Fifth St., Valley Stream, NY 11581-1200; telephone (516) 256-7531, fax (516) 568-2716.

SUPPLEMENTARY INFORMATION: On October 18, 1993, the Civil Aviation Authority (CAA), which is the airworthiness authority of the United Kingdom (UK), received a report that a Piper PA-28-161 aircraft, with a Textron Lycoming O-320-D3G reciprocating engine

installed, executed a forced landing due to an engine crankshaft failure which caused the propeller to separate from the aircraft. The cause of the crankshaft failure was determined to be due to a high cycle fatigue mechanism that had initiated from a number of corrosion pits in the crankshaft bore. After the cracks had progressed through a substantial proportion of the crankshaft section, the rate of advance had increased until the remaining unseparated portion had failed as a result of overload. The cracking occurred in high cycle fatigue and it had progressed over an extended period of service. At the time of the accident the engine had operated for 1,950 hours time in service (TIS) since overhaul and had accumulated 4,429 hours total time since new over a period of 16 years. In addition, the Federal Aviation Administration (FAA) has confirmed that four other failures in the United States and 10 in foreign countries were due to cracks initiating from corrosion pits in the crankshaft bore on certain Textron Lycoming 320 and 360 reciprocating engines with ratings of 160 horsepower or greater. Of the 10 failures in foreign countries, four resulted in the propeller separating from the aircraft inflight. Three of these four were from 1993 to 1996. The FAA utilized metallurgical failure analysis reports and other information to conclude that these failures were due to cracks originating from corrosion pits. This condition, if not corrected, could result in crankshaft failure, which can result in engine failure, propeller separation, forced landing, and possible damage to the aircraft.

A proposal to amend part 39 of the Federal Aviation Regulations (14 CFR part 39) to include an AD that would apply to Textron Lycoming 235 Series and 290 Series, and certain 320 and 360 series reciprocating engines, was published in the Federal Register on November 28, 1995 (60 FR 58580); the comment period was reopened in a reprinting of the original proposal on April 8, 1996 (61 FR 15430). That action proposed to require initial and repetitive inspections of the crankshaft inside diameter (ID) for corrosion and cracks, and replacement of cracked crankshafts with a serviceable part. In addition, the proposed AD would have permitted operation of engines with crankshafts that were found to have corrosion pits but were free of cracks provided repetitive inspections were performed until the next engine overhaul or 5 years after the initial inspection, whichever occurred first, at which time the proposed AD would have required those crankshafts with corrosion pits but no cracks to be replaced. Those proposed actions would be performed in accordance with Textron Lycoming Mandatory Service Bulletin (MSB) No. 505A, dated October 18, 1994.

The FAA had determined that fluorescent penetrant inspections (FPI) were warranted if corrosion pits were found. The FPI inspection program was developed due to reports from Textron Lycoming and other approved repair stations that most of the crankshafts that are pitted do not contain cracks. The FAA determined that visual inspections alone were not sufficient to detect a crack. The FPI inspection was based on crack propagation data developed by the FAA in conjunction with Textron Lycoming and with consideration of the technical base in the U.S. for performing non-destructive inspections. The FPI process was shown to be reliable for detection of cracks down to 0.050 inches in depth and 0.100 inches in length. The FPI inspection interval was based on the crack propagation data such that a crack could be reliably detected before the crankshaft failed. If an installed engine was found to have a pitted crankshaft, the FAA did not propose to allow the removal of metal to remove the corrosion pits due to possible contamination of the engine oil supply with metal filings and to ensure that the concentricity of the crankshaft would not be compromised.

Interested persons were afforded an opportunity to participate in the making of this amendment. Over 200 comments were received in response to the initial NPRM. In addition, the FAA met with the Aircraft Owners and Pilots Association (AOPA), Aeronautical Repair Station

Association (ARSA), and Textron Lycoming to discuss the data that formed the basis for this action. A summary of that meeting is contained in the docket file.

A Supplemental Notice of Proposed Rulemaking (SNPRM), in response to the comments, was published in the Federal Register on January 3, 1997 (62 FR 343). That SNPRM fully addressed the comments received in response to the NPRM and the issues raised at the meeting with AOPA, ARSA, and the manufacturer. That action proposed to revise the proposal by limiting the applicability of the proposed AD to only certain Textron Lycoming 320 and 360 series reciprocating engines, excluding additional engines installed in helicopters; permitting any certificated mechanic holding an airframe or powerplant rating to perform the FPI; permitting continued use of a pitted crankshaft as long as repetitive FPI inspections are performed; and deleting the five year limit on the use of crankshafts that are pitted but not cracked. Also, the FAA received new cost information, and revised the economic analysis with respect to the initial inspection time, the time to remove and replace crankshafts, the cost of the replacement crankshafts, and the cost for repetitive FPI inspections. Finally, the revised proposal introduced a public reporting survey to provide the FAA with a broader database on the condition of crankshafts when observed during the initial inspections.

Twenty-one comments were received in response to the SNPRM. Due consideration has been given to the comments received.

Seven commenters state that there have not been enough crankshaft failures to justify the AD, that the proposed actions are too costly, and that the FAA should acquire more data before promulgating this rule. The FAA does not concur. As stated in the SNPRM, the FAA received data and studies that substantiated the need for an AD. These studies and data confirm the crankshaft fracture occurred at a stress concentration caused by a corrosion pit on the inside of the crankshaft. In addition, since the NPRM was issued, six additional crankshaft failures on 160 horsepower Textron Lycoming engines are being investigated. The FAA has, however, performed additional analysis to limit the population of engines impacted by this proposed AD and has deleted the five year limit on pitted crankshafts undergoing repetitive FPI inspections. These measures will decrease the cost of the AD to the public.

Two commenters state that the corrosion problem is caused by a design flaw; i.e., the crankshafts should be solid instead of hollow. The FAA does not concur. A coating has been incorporated on the inside bore of new crankshafts shipped in engines and as spares from Textron Lycoming since February 15, 1997. Textron Lycoming has issued Service Bulletin (SB) No. 530 dated December 1, 1997, which describes applying Urethabond 104 as a protective coating on the inside bore of the crankshafts. This coating should only be applied during overhaul due to the preparation requirement of degreasing the inside bore prior to the application of the coating.

One commenter states that a dye penetrant inspection should be performed in lieu of the FPI, as it is more accurate in detecting cracks. The FAA does not concur. Dye penetrant actually includes both visible dye and fluorescent dye penetrant techniques. Recent use of the term within the inspector community has limited the meaning to visible dye penetrant. The reliability of inspection data available to the FAA indicates that FPI has a better probability of detection than visible dye penetrant (color contrast) inspection. The preferred dye penetrant inspection method is the FPI method.

One commenter states that a magnetic particle inspection (Magnaflux) should be performed in

lieu of the FPI, as it is more accurate in detecting cracks. The FAA concurs in part. The magnetic particle inspection (MPI) is the preferred method with the shaft removed from the engine at overhaul. An FPI should only be performed if the crankshaft is installed in the engine such as during an on-wing inspection. An MPI should not be performed with the crankshaft installed in the engine due to the difficulty in obtaining a suitable magnetic field. In addition, the residual field effects after the demagnetization process may have a harmful effect on the rotating components in the engine, including the bearings.

One commenter states that the AD should take into consideration the operation and service history for each engine in specifying corrective action. The FAA partially concurs. The FAA has taken into consideration service history and has limited the applicability of this AD to engines with 160 hp or greater. The survey to be completed for the initial inspection of the crankshaft may aid the FAA in determining other causal effects which may be used for future rulemaking.

Five commenters state that the AD should require application of a preventive treatment on the inside bore of the crankshaft to prevent future corrosion. The FAA concurs. Textron Lycoming has developed a preventive treatment known as Urethabond 104 and has issued MSB No. 530, dated December 1, 1997, which describes procedures for applying this coating. Crankshafts that are confirmed to have the letters "PID" stamped on the outside diameter of the propeller flange (PID stands for Painted Internal Diameter), do not require the inspection requirements of this AD. The application of the Urethabond 104 coating constitutes terminating action for the inspection requirements of this AD.

One commenter states that the FAA should impose a life limit of 4,000 hours time in service on all affected crankshafts. The FAA does not concur. To date, the FAA has no data from Textron Lycoming nor from any other source which would substantiate a 4,000 hour time in service life limit.

Two commenters state the FAA should distinguish in the AD between major and minor pitting action. The FAA does not concur. The FAA has no data to substantiate taking action for a minor versus a major pit other than what is presented in Textron Lycoming MSB 505B. The survey to be completed for the initial inspection of the crankshaft may assist the FAA in determining a relationship between the number of pits and the number of crankshafts cracked. This information may be used for future rulemaking.

One commenter states that pitted crankshafts should be replaced at overhaul. The FAA partially concurs. Textron Lycoming MSB 505B requires that the crankshaft be replaced at overhaul if it is pitted. However, from the data the FAA has received to date, many crankshafts are pitted but not cracked. In addition, the FAA has received no substantiation from Textron Lycoming or other sources to justify replacing a pitted crankshaft at overhaul as long as it has received an MPI and has been determined to have no cracks; and, when the engine is reinstalled in an aircraft, an FPI is performed every 100 hours TIS to ensure that the crankshaft is not cracked. The inspection survey will be utilized by the FAA to determine the number of engines under repetitive FPI inspections, the number of crankshafts that are found to be cracked, whether another failure mechanism is contributing to the crankshaft failures, and possible adjustment of the repetitive inspection interval. The information obtained by this survey may lead to future rulemaking.

After careful review of the available data, including the comments noted above, the FAA has

determined that air safety and the public interest require the adoption of the rule with the changes described previously. The FAA has determined that these changes will neither increase the economic burden on any operator nor increase the scope of the AD.

The total number of engines impacted worldwide is 16,357 (11,000, 160 hp, 320 series; and 5,357, 360 Series). The FAA estimates that 60% of that number, 9,814 engines are installed on aircraft of U.S. registry, and are affected by this AD. The FAA estimates that it will take approximately 8 work hours per engine to accomplish the initial visual inspection, and that the average labor rate is $60 per work hour; therefore the estimated cost impact for the initial visual inspections would be $4,710,720. The FAA also estimates, based on information received from the UK CAA regarding the number of engines undergoing repetitive inspections in the UK due to the UK CAA AD on the same subject, that 12%, or 1,178, of the affected engines may contain crankshafts that require FPI. The FAA estimates that each FPI will take approximately 8 hours, and that operators with corroded crankshafts may perform one FPI per year. The estimated cost for the repetitive FPI, therefore, is $565,286 annually. Lastly, the FAA estimates that 5 crankshafts will require replacement per year due to cracks, and that it will take 38 work hours per engine to replace cracked crankshafts. Assuming that a replacement crankshaft will cost approximately $6,000 per engine, the estimated cost for replacement of 5 crankshafts will be $41,400 annually. Therefore, the total estimated cost impact of this AD is $5,317,406 for the first year, and $606,686 each year thereafter.

The regulations adopted herein will not have substantial direct effects 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. Therefore, in accordance with Executive Order 12612, it is determined that this final rule does not have sufficient federalism implications to warrant the preparation of a Federalism Assessment. For the reasons discussed above, I certify that this action (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. A final evaluation has been prepared for this action and it is contained in the Rules Docket. A copy of it may be obtained from the Rules Docket at the location provided under the caption "ADDRESSES." List of Subjects in 14 CFR Part 39 Air Transportation, Aircraft, Aviation safety, Incorporation by reference, Safety.

Adoption of the Amendment

Accordingly, pursuant to the authority delegated to me by the Administrator, the Federal Aviation Administration amends part 39 of the Federal Aviation Regulations (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. Section 39.13 is amended by adding the following new airworthiness directive:

AIRWORTHINESS DIRECTIVE

Aircraft Certification Service
Washington, DC

U.S. Department
of Transportation
Federal Aviation Administration

The following Airworthiness Directive issued by the Federal Aviation Administration in accordance with the provisions of Federal Aviation Regulations, Part 39, applies to an aircraft model of which our records indicate you may be the registered owner. Airworthiness Directives affect aviation safety and are regulations which require immediate attention. You are cautioned that no person may operate an aircraft to which an Airworthiness Directive applies, except in accordance with the requirements of the Airworthiness Directive (reference FAR Subpart 39.3).

98-02-08 Textron Lycoming: Amendment 39-10291. Docket 94-ANE-44.

Applicability: Textron Lycoming 320 series limited to 160 horsepower, and 360 series, four cylinder reciprocating engines with fixed pitch propellers; except for the following installed in helicopters or with solid crankshafts: HO-360 series, HIO-360 series, LHIO-360 series, VO-360 series, and IVO-360 series, and Models O-320-B2C, O-360-J2A, AEIO-360-B4A, O-360-A4A, -A4G, -A4J, -A4K, -A4M, and -C4F. In addition, engines with crankshafts containing "PID" stamped on the outside diameter of the propeller flange are exempt from the inspection requirements of this AD. The affected engines are installed on but not limited to reciprocating engine powered aircraft manufactured by Cessna, Piper, Beech, American Aircraft Corporation, Grumman American Aviation, Mooney, Augustair Inc., Maule Aerospace Technology Corporation, Great Lakes Aircraft Co., and Commander Aircraft Co.

Note 1: This airworthiness directive (AD) applies to each engine identified in the preceding applicability provision, regardless of whether it has been modified, altered, or repaired in the area subject to the requirements of this AD. For engines that have been modified, altered, or repaired so that the performance of the requirements of this AD is affected, the owner/operator must request approval for an alternative method of compliance in accordance with paragraph (g) of this AD. The request should include an assessment of the effect of the modification, alteration, or repair on the unsafe condition addressed by this AD; and, if the unsafe condition has not been eliminated, the request should include specific proposed actions to address it.

Compliance: Required as indicated, unless accomplished previously.

To prevent crankshaft failure, which can result in engine failure, propeller separation, forced landing, and possible damage to the aircraft, accomplish the following:

(a) For engines shipped new from Textron Lycoming prior to and including December 31, 1984, and that have never been overhauled, or any engine remanufactured or overhauled and that has accumulated 1,000 hours or more time in service (TIS) since remanufacture or overhaul, visually inspect the inside diameter (ID) of the crankshaft for corrosion pits within the next 100 hours TIS after the effective date of this AD, or 6 months after the effective date of this AD, whichever occurs first, in accordance with Textron Lycoming Mandatory Service Bulletin (MSB) No. 505B, dated December 1, 1997.

(1) If corrosion pits are found during this inspection, prior to further flight, accomplish the following:

(i) If the crankshaft is installed in the engine such as during an on-wing inspection, perform a fluorescent penetrant inspection (FPI) in accordance with Textron Lycoming MSB No. 505B, dated December 1, 1997.

(ii) If the crankshaft is removed from the engine at overhaul, perform a magnetic particle inspection (MPI) in accordance with Textron Lycoming MSB No. 505B, dated December 1, 1997.

(2) Within 48 hours after these inspections, report the finding of the inspection in accordance with paragraph (e) of this AD.

(b) For engines shipped new from Textron Lycoming after December 31, 1984, and that have never been overhauled, or any engine remanufactured or overhauled and that has accumulated less than 1,000 hours TIS since remanufacture or overhaul, visually inspect the ID of the crankshaft for corrosion pits, at the earliest occurrence of any event specified in subparagraph (3) of this paragraph, and in accordance with Textron Lycoming MSB No. 505B, dated December 1, 1997.

(1) If corrosion pits are found during this inspection, prior to further flight perform an FPI or MPI in accordance with Textron Lycoming MSB No. 505B, dated December 1, 1997.

(2) Within 48 hours after these inspections, report the finding of the inspection in accordance with paragraph (e) of this AD.

(3) Visually inspect the ID of the crankshaft for corrosion pits at the earliest of the following:

(i) The next engine overhaul or disassembly.

(ii) Within 10 years of the original shipping date or 6 months from the effective date of this AD, whichever occurs later.

(iii) Within 1,000 hours TIS since remanufacture or overhaul, or 6 months from the effective date of this AD, whichever occurs later.

(c) Thereafter, if no corrosion pits or cracks are found on the ID of the crankshaft during the initial visual inspection, perform a visual inspection at intervals not to exceed 5 years since last inspection, or at the next engine overhaul or disassembly, whichever occurs first, in accordance with Textron Lycoming MSB No. 505B, dated December 1, 1997. If corrosion pits but no cracks are found on the ID of the crankshaft during the initial visual inspection and the ID does not exceed the maximum ID specified in Textron Lycoming MSB No. 505B, dated December 1, 1997, repeat the FPI at intervals not to exceed 100 hours TIS since last FPI or until a serviceable crankshaft is installed in the engine.

(d) Prior to further flight, remove from service and replace with a serviceable part any crankshaft found cracked during FPI or MPI performed in accordance with Textron Lycoming MSB No. 505B, dated December 1, 1997.

(e) After accomplishing the initial visual inspection and, if necessary, the FPI or MPI, required by this AD, complete Appendix 1 of this AD and submit to the Manager, New York Aircraft Certification Office, FAA, Engine and Propeller Directorate, 10 Fifth St., Valley Stream, NY 11581; fax (516) 568-2716. Reporting requirements have been approved by the Office of Management and Budget and assigned OMB control number 2120-0056.

(f) The application of Urethabond 104 to the inner bore of the crankshaft and confirmed by stamping of the letters "PID" on the outside diameter of the propeller flange in accordance with Textron Lycoming MSB No. 530, dated December 1, 1997, constitutes terminating action to the inspection requirements of this AD.

(g) An alternative method of compliance or adjustment of the compliance time that provides an acceptable level of safety may be used if approved by the Manager, New York Aircraft Certification Office. Operators shall submit their requests through an appropriate FAA Principal Maintenance Inspector, who may add comments and then send it to the Manager, New York Aircraft Certification Office.

Note 2: Information concerning the existence of approved alternative methods of compliance with this airworthiness directive, if any, may be obtained from the New York Aircraft Certification Office.

(h) Special flight permits may be issued in accordance with sections 21.197 and 21.199 of the Federal Aviation Regulations (14 CFR 21.197 and 21.199) to operate the aircraft to a location where the requirements of this AD can be accomplished.

(i) The actions required by this AD shall be done in accordance with the following Textron Lycoming MSB:

Document No.	**Pages**	**Date**
505B	1-5	December 1, 1997
Total Pages: 5		
530	1-2	December 1, 1997
Total Pages: 2		

This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies may be obtained from Textron Lycoming, 652 Oliver St., Williamsport, PA 17701; telephone (717) 327-7080, fax (717) 327-7100. Copies may be inspected at the FAA, New England Region, Office of the Regional Counsel, 12 New England Executive Park, Burlington, MA; or at the Office of the Federal Register, 800 North Capitol Street NW., suite 700, Washington, DC.

(j) This amendment becomes effective on March 30, 1998.

Appendix 1

TEXTRON LYCOMING CRANKSHAFT INSPECTION SURVEY
AD DOCKET NO. 94-ANE-44

Date of Inspection _____

Inspector's Information
Name _____
Address _____
State _____ Zip Code _____
Telephone No. _____ Facsimile No. _____

Engine Model Number _____
Engine Serial Number (S/N) _____
Date of Manufacture _____ (M/D/YR) Total Time (TT) _____ hrs
Time Since Major Overhaul (SMOH) _____ hrs
Crankshaft Part Number (located on prop flange) _____
S/N _____

Aircraft Make and Model_____
Frequency of Flights _____ per month (average)
Duration _____ hrs per Flight

How was aircraft being utilized?
____ Training, ____ Personal, ____ Banner Towing, ____ Glider Towing, ____ Agricultural,
Other (please explain) _____

Propeller Make and Model
_____

Has the aircraft ever experienced a propeller strike during service? _____ Yes _____ No
Was propeller ever removed for servicing or overhaul? _____ Yes _____ No
If yes, describe reason for removal in detail?
_____
_____

What was the condition of the crankshaft internal bore?
Corroded ____ Yes ____ No
If corroded, how many pits? ___ 1 to 5, ___ 6 to 10, ___ More than 10
Was a crack found? ____ Yes ____ No
If crack was found, complete the following:
_____ Distance from crankshaft end (Inches) _____ Crack Length (Inches)

COMMENTS:
_____
_____
_____