Connector Rod Fracture & Failure Analysis in Airplane Engine of 1979 Cessna-152 N49681

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Abstract

This analysis investigates the failure of a Lycoming O-235-N2C series 4 cycle engine in a Cessna-152 N49681 aircraft. The failure of this aircraft engine occurred in 2021 during a flight lesson at the San Luis Obispo Airport. Before takeoff, all seemed to be well with the aircraft as it was cleared for takeoff. Shortly after takeoff, the engine started rumbling and ultimately failed, where the flight instructor had to land the aircraft back at the airport. To investigate this failure, the connecting rod and piston were removed and examined to determine the exact cause of failure. Upon this examination, two failure modes were determined as possibilities. The first possibility of cause of failure is the fracture of the connecting rod from the adjoining piston, as this piece was fractured when received by the team. Another possibility investigated is the failure of the bronze bushing in between the connecting rod and piston that was not found as part of the engine when received by the team for investigation. As a result of the investigation, the team could not make a determination on what ultimately caused the failure of the engine due to the missing bronze bushing and continued cycling of the engine after the failure occurred. A further investigation into the bronze bushings within the connecting rod is warranted.

Introduction

The aircraft pertaining to this failure is Cessna-152 N49681. It is a fixed, wing single engine, two seater fabricated in 1979 (making the aircraft 42 years old). The associated serial number is 15283495. This aircraft is housed by Sunwest Aviation at San Luis Obispo County Regional Airport [KSBP]. The piece under inspection is a Lycoming O-235-N2C series 4 cycle engine capable of 115 horsepower. The part number for this engine is 9085. Specifically, analysis will be done on the connecting rod and the piston inside the cylinder block, as this is where the most outstanding fracture and failure occurred.

The following is a recount of the events that took place prior to, during, and after the engine failure. The failure occurred some time during the year of 2021. The pilot in command was instructing a student on basic flight lessons. Before the engine was started, a preflight was done. Fuel tanks were full and the oil level was nominal. Fuel was sumped and so were any possible contaminants. The checklist was followed and the engine was cold started as usual. No signs of failure were detected on startup. The engine was kept at 1,000 revolutions per minute for basic ground maneuvers. After this, N49681 taxied to the run-up area of runway 290. A full run-up was conducted. During run-up, the throttle was increased to 1,700 rpm with a fully rich mixture. Left and right magnetos were checked for a drop no less than 150 rpm. Amperage, suction, oil, temperature, fuel, and other engine gauges and flight instruments were inspected. The throttle was then brought to idle and carburetor heat was pulled in order to further minimize revolutions per minute. After the idle check was cleared, the engine was then brought back to rest at 1,000 rpm with default flight settings.

N49681 was cleared for takeoff on runway 290 by tower. N49681 proceeded to 290, applied full throttle and mixture to begin the takeoff procedure at 2,500 rpm. The aircraft took off and continued up-wind. At 700 feet mean sea level, just after a left crosswind turn, a failure occurred. A noticeable burst of rumbling originated from the engine, followed by a short gap of normal operation, followed by massive engine and cockpit vibrations. The pilot in command was able to communicate with the tower, do a full 180 degree turn and conduct a sharp right turn to realign on runway 110. The pilot in command successfully landed the aircraft and there were no casualties. The aircraft was later stripped of its engine for analysis. Primary fracture and failure zones seem to be at the tip of the connecting rod to the piston, and the piston cell itself. Further experimentation was done to fully comprehend the incident.

Methods & Materials

Lucky for her, the pilot in command was awarded the salvaged engine block as a ceremonial token of gratitude for saving the aircraft by the owner (of course after proper inspections were done by qualified authorities). Therefore, in order to maintain the integrity of the memento, the least destructive path of analysis was taken. First, the entirety of the engine block and all available pieces were documented and photographed before proceeding with any type of testing. See the appendix to find these associated images. Figure 1 displays a layout of the engine parts. It is important to note, however, that the only components documented were the ones given to the research team for analysis. Some parts may have been lost during the event, either tumbling out of the exhaust while the aircraft was in flight or simply accidentally discarded during the engine extraction procedure. This is necessary to explicitly state as it would be disingenuine to conclude without question a storyline of what exactly happened with missing information. Rather, this report aims to paint a picture of what has been recovered and discovered.

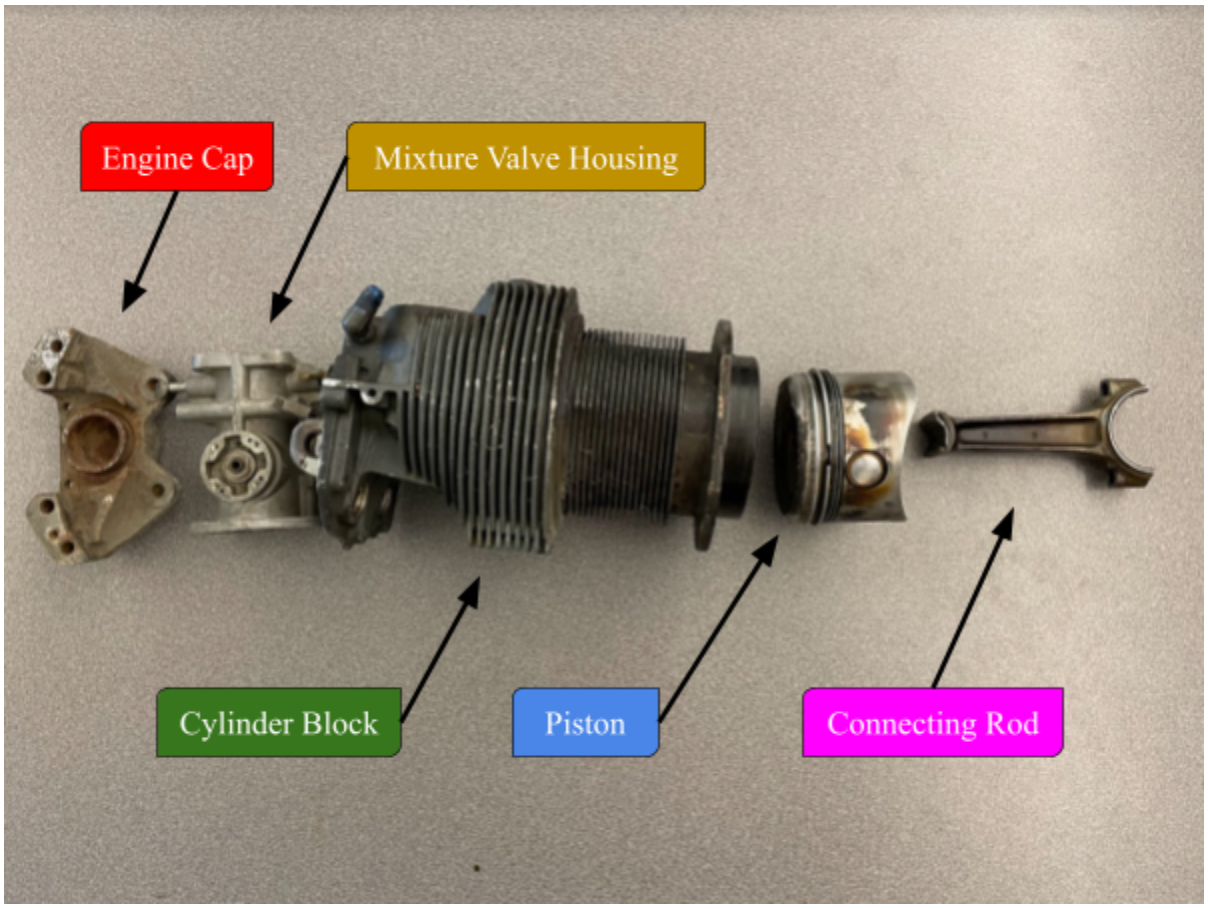

Figure 1. Displayed above is the full layout of all the available engine parts.

After all the parts of the setup were photographed, each piece was visually inspected. The goal was to locate and identify potential sources of catastrophic failure. Multiple fracture sites were discovered. The engine cap and the mixture valve housing seemed to be minimally affected, so attention was diverted to the other pieces. The cylinder block, although it appeared to be contaminated with carbon deposits, corrosion, and other combustion phenomena, was not nearly as interesting as the piston and connecting rod. These two parts were highly damaged and presented the largest amount of usable evidence. Figure 2 conveys the mutilated nature of these two parts and how they fit together.

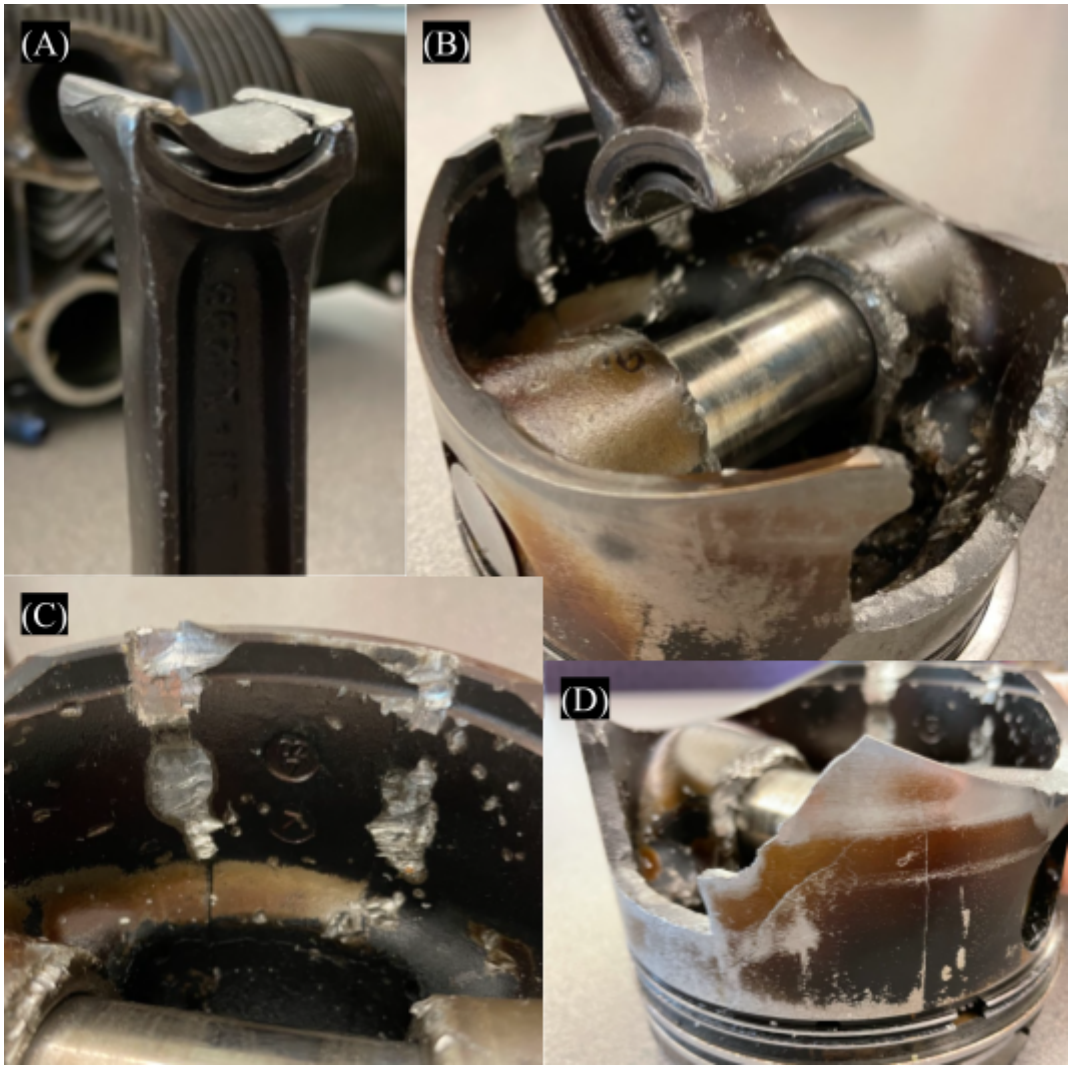

Figure 2. The disfigurement of each part can clearly be seen, as if a fragmentation grenade exploded, scaring the interior of the piston and connecting rod. (A) This is a picture of the ductile deformation of the connecting rod. (B) The connecting rod is fitted to the piston, which is missing a large section of material. (C) Evidence of shrapnel impact inside the piston walls. (D) Brittle crack propagation and trails are visible.

The team quickly theorized the origin of failure was the mate between the connecting rod and the piston. Unfortunately, as the connecting rod was detached, it was also repeatedly struck into the piston shaft. This bent the head of the rod into an unusual shape. The original fracture surface and initial site of crack propagation were mangled and trapped by this metal warpage. Therefore, in order to access the critical surfaces (which would be the interior of the connecting rod head), the team put together a cutting plan. This would isolate each surface in a manner that would allow optical and scanning electron microscopy. Two cuts were to be done. The first to separate the head from the rest of the rod with the aid of a high speed diamond saw. The second to open up the warped head and reveal the important surfaces under question utilizing a low speed precision diamond saw. Figure 3 presents the cutting plan for the connecting rod.

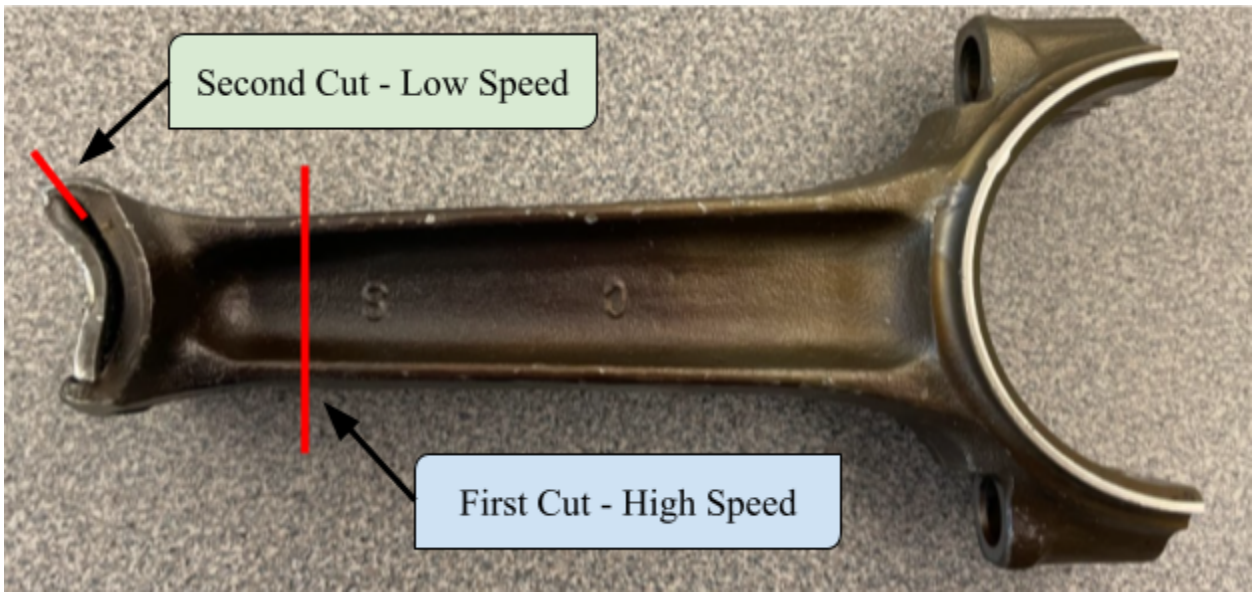

Figure 3. The connecting rod was subject to two cuts. The first cut was made in a high speed diamond saw to isolate the end of the connecting rod where the fracture and significant deformation occurred. The second cut was made in a low speed precision saw. This cut revealed the delicate and intimate surfaces under question.

The first cut was clean and successful. Complications were encountered during the second cut. Towards the end of the cut, the warped nature of the metal gaps and canyons resulted in extremely high frictional forces on the low speed diamond blade precision saw. Despite the use of excessive lubricant, the blade would often get caught and halt cutting progress. The cross section was simply too thick to pass through without perfect angular alignment. In an attempt to maintain safety standards and preserve equipment through proper protocol, the precision saw method was abandoned. Fortunately, the cut was almost complete before these errors occurred.

The metal deformed head still had to be split in two pieces to enable thorough analysis. To finish this cutting process, a rather unorthodox solution was proposed by Dr. Smith. The team would submerge the piece in liquid nitrogen, a chemically inert cryogenic fluid maintained at a temperature of -196 °C [-320 °F]. The large difference in liquid nitrogen and room temperature 20 °C [68 °F] could cause the artificial crack to fully propagate due to thermal shock, splitting the head like a large stone in an ice storm. This was tested to no avail, there was too much material left holding the head together. However, the liquid nitrogen treatment brought the metal temperature far below the ductile to brittle transition temperature of most steels (Chao, 2007, pp. 551-557). This meant that a sharp and sudden force could break the head open in one motion. So, the head was mounted on industrial vice jaws and a metal chisel was freshly sharpened. The chisel was inserted into the artificial cut and after a few strong blows from a hammer, the connecting rod head finally split, exposing the valuable interior surfaces. Figure 4 unveils the frozen fractured interior surface. After all this, the surfaces in question were finally prepared for optical and scanning electron microscopy.

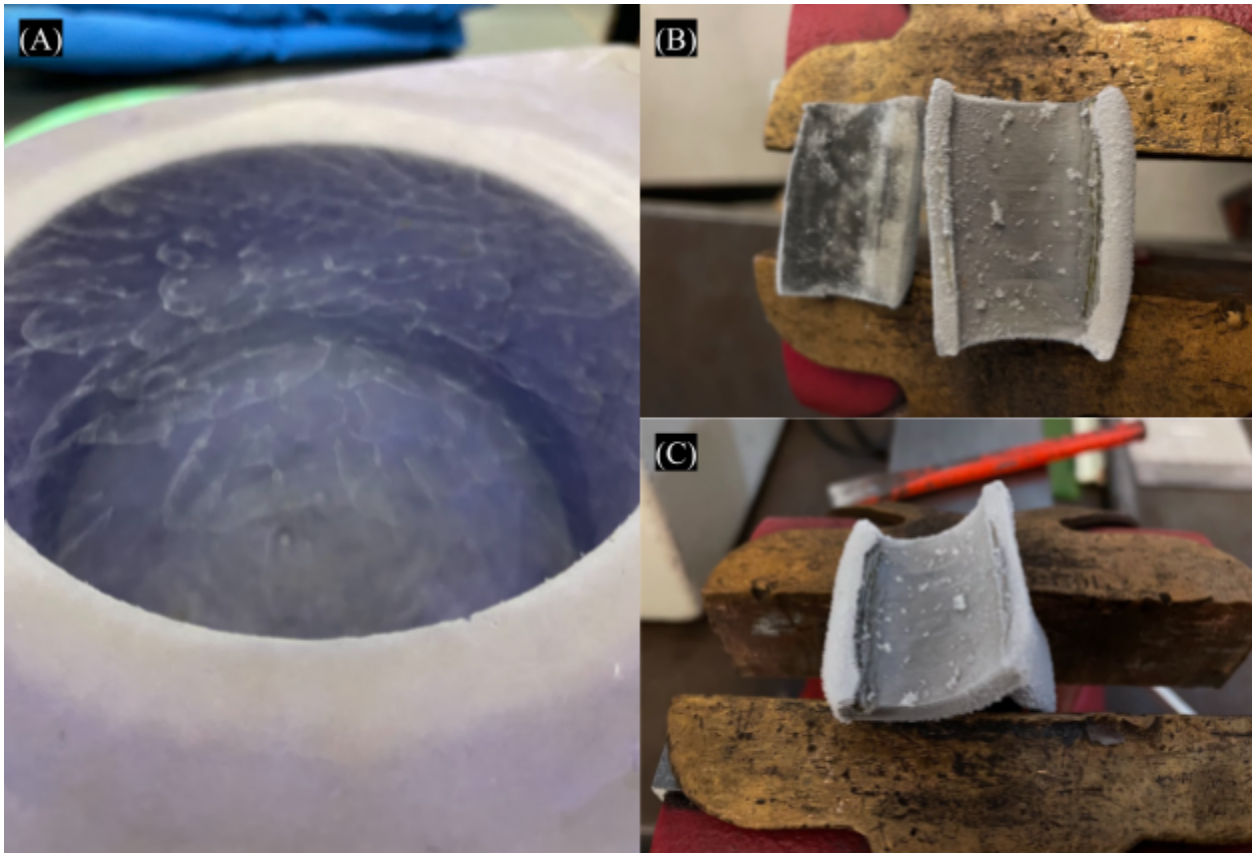

Figure 4. The effects of the ductile to brittle fracture temperature can be seen above. (A) This is a pool of liquid nitrogen with vapor forming at the surface generating a silky look. (B) The connecting rod split into two pieces to reveal the interior surfaces. (C) Another angle of the larger piece of the connecting rod head still inserted in the vice jaws.

Results & Data

The following series of figures are optical and scanning electron micrographs of the interior surface of the connector rod head. It is at this surface that clue the origin of this catastrophic failure.

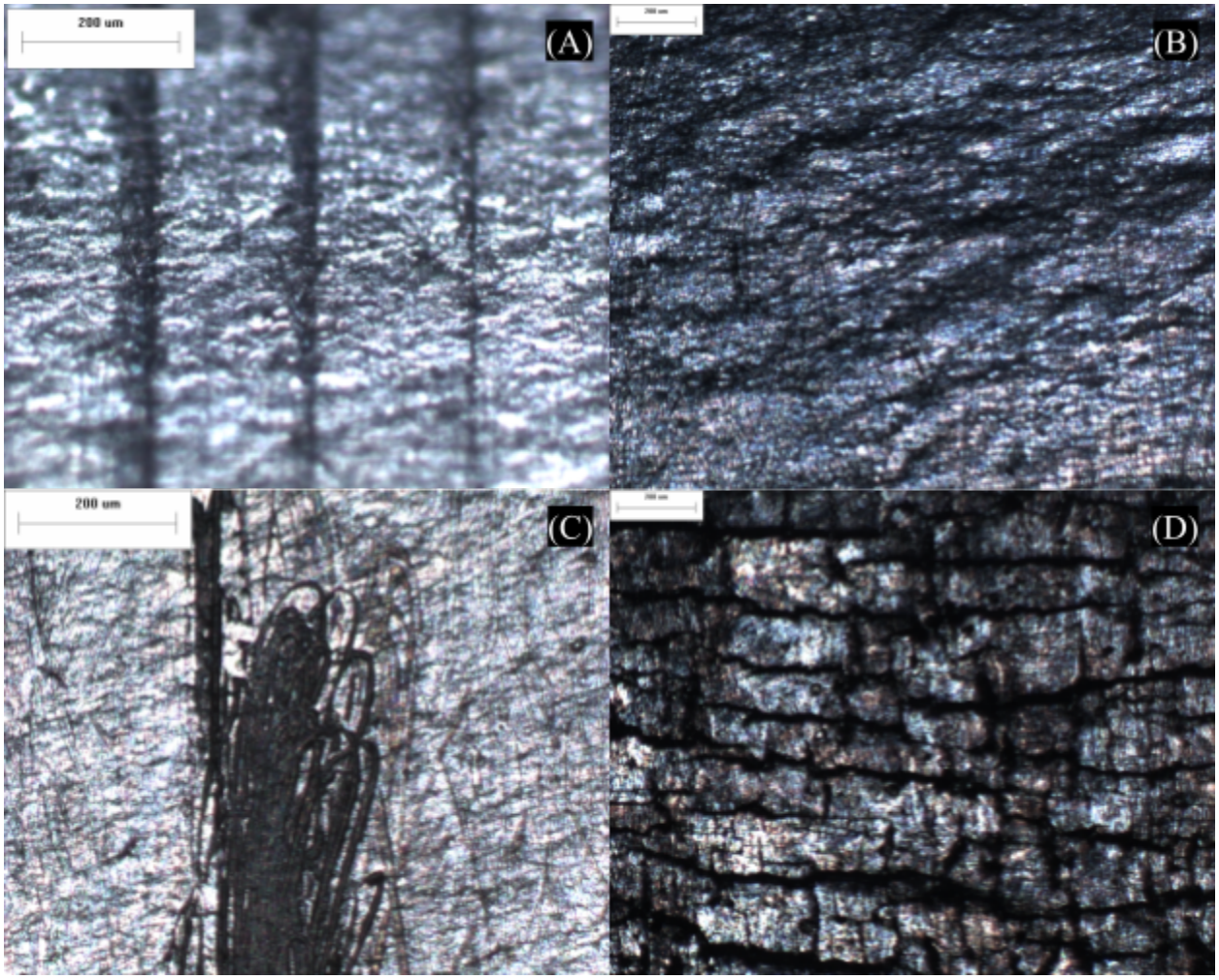

Figure 5. The above images are captures of the exposed connecting rod interior surface through Olympus brand optical lenses. Micron bars indicate the length of 200 microns. (A) This is the raw manufactured surface, clear machining marks can be seen precisely inline. (B) The machining marks have been worn away through stress and cracking. (C) Some kind of particle was causing cyclical abrasion, perhaps initiating the overall failure. (D) Mud-cracking is strong evidence of thermal wear due to high frictional environments.

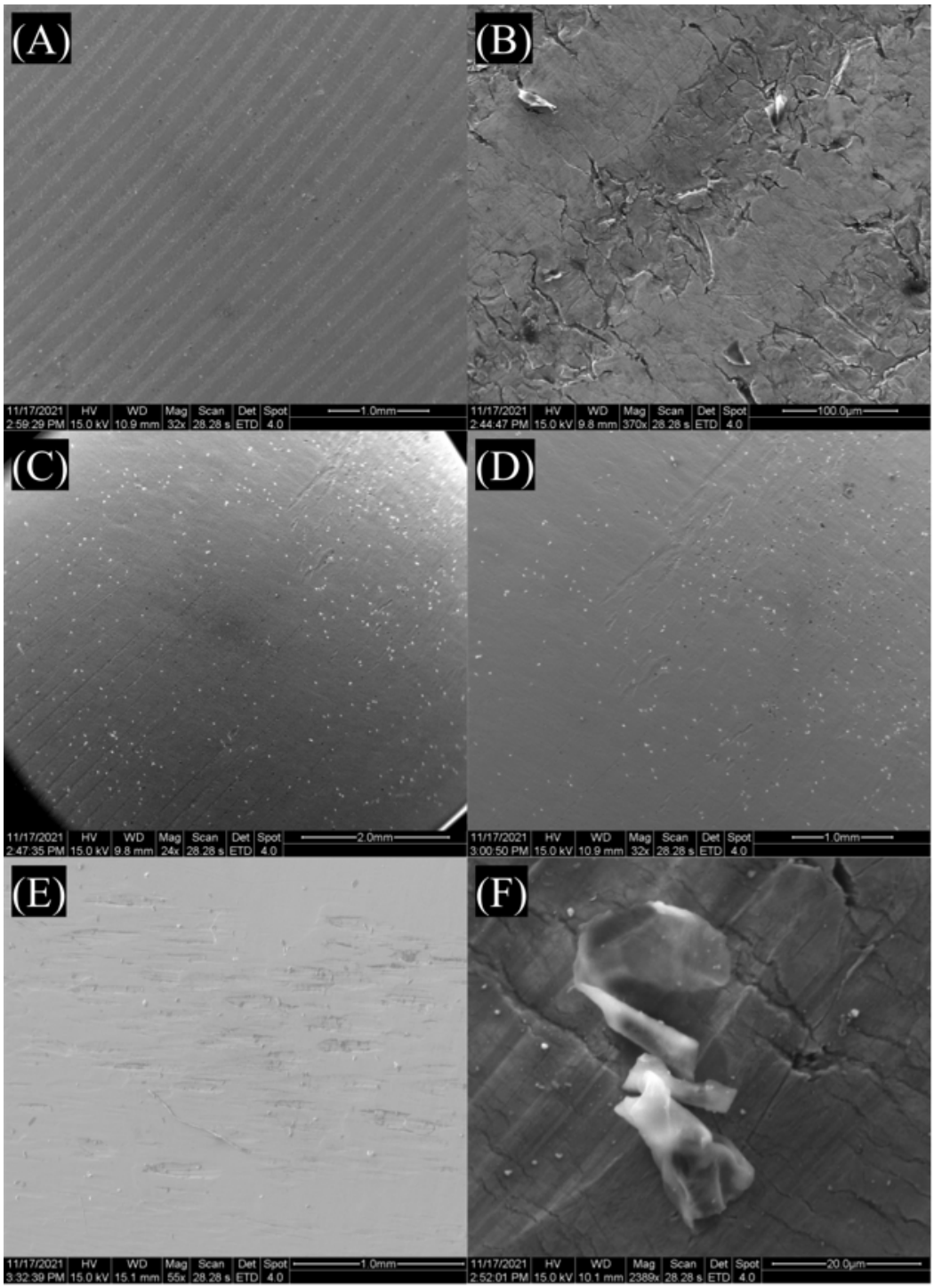

Figure 6. Scanning electron micrographs of the smaller split connecting rod piece. (A) This is how the surface is supposed to look, clear machining lines. (B) A closer look at machining lines. (C) The transition between a machined surface and a worn smoother surface. (D) The smooth almost polished surface is due to wear scatter with unknown bright particles. (E) Visible gouging and scraping are observed. (F) A magnified view of the bright particles on the surface.

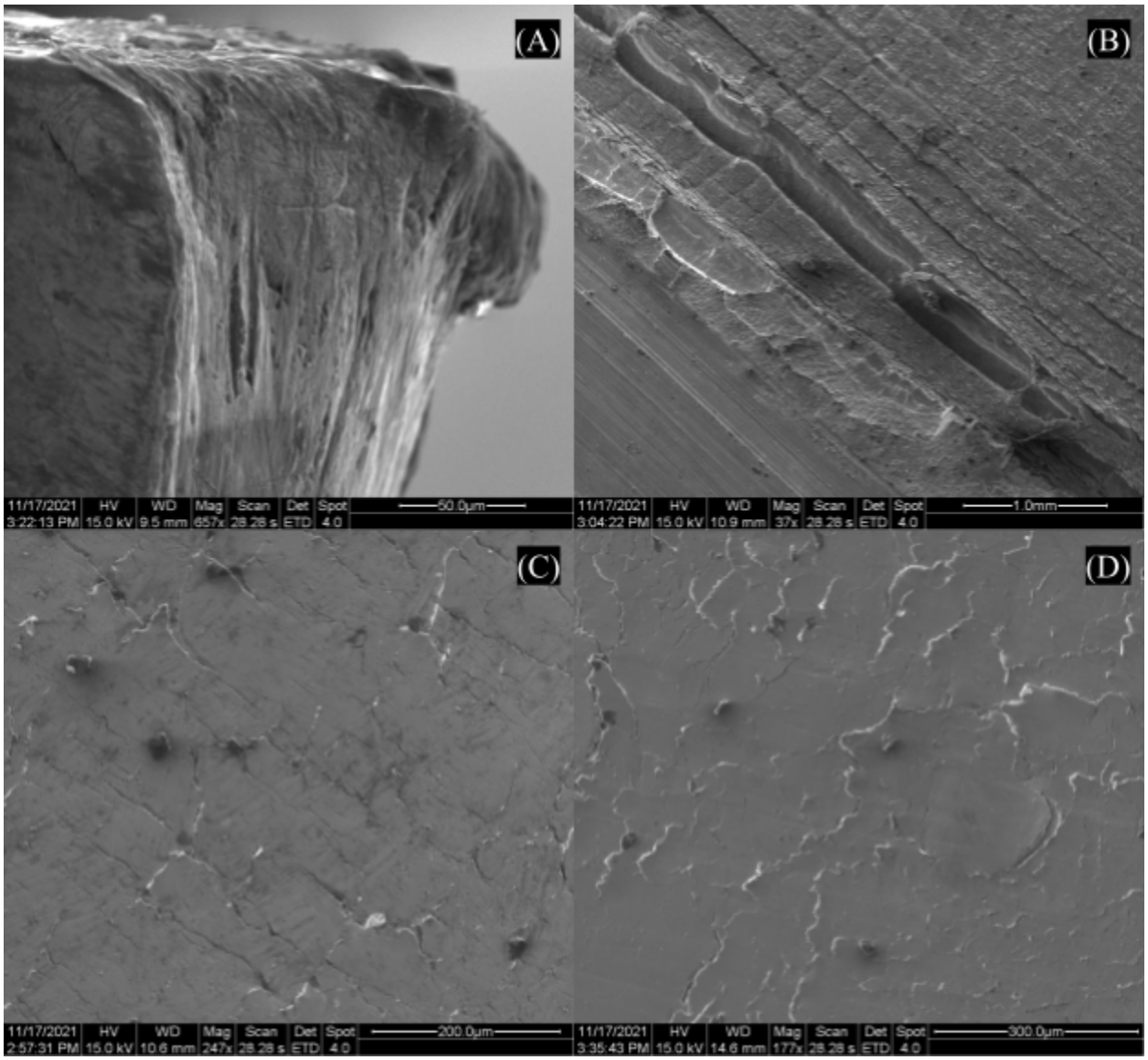

Figure 7. Scanning electron micrographs of the interior surface base piece of the split head connecting rod. (A) This could possibly be the crack initiation site, however, the tip is severely blunted due to cyclic ductile deformation. (B) Here is a primary canyon crack that developed due to high tensile stresses. (C) This is evidence that somewhat resembles mud-cracking. (D) A magnified image of a worn surface that seems to be slightly polished. No trail of machine lines remains which indicates some sort of unintended deformation resulting in a smooth finish.

Discussion

After everything was disassembled and inspected to the best of the research group's ability, individual features can start to be connected to paint an overall picture. The first and most obvious possible failure mode that may explain the detachment of the connecting rod is that the connecting rod itself fractured. This theory of failure is substantiated first by the testimony of the pilot, who stated the moment of failure felt like a sudden jolting burst. This is consistent with a fast propagating brittle fracture, which is likely what is observed in Figure 7. The potential crack initiation site in Figure 7A would also support the idea that the connecting rod failed at the point of connection with the piston. However, this theory of failure cannot be confirmed, as the primary piece of evidence is missing, the original fracture surface. If the original fracture surface was intact, not so heavily deformed, and contaminated as seen in Figure 3, then more definitive evidence such as chevron lines or other microstructural features may have been observed.

The second theory of failure looks beyond what parts of the engine are present and instead eyes the assembly as a whole. A drawing of the complete engine connecting rod assembly is available from Lycoming and is shown below. When comparing the drawing to the parts present in Figure 1, it is clear the split-type bronze bushing that should be between the piston pin and the connecting rod is not present.

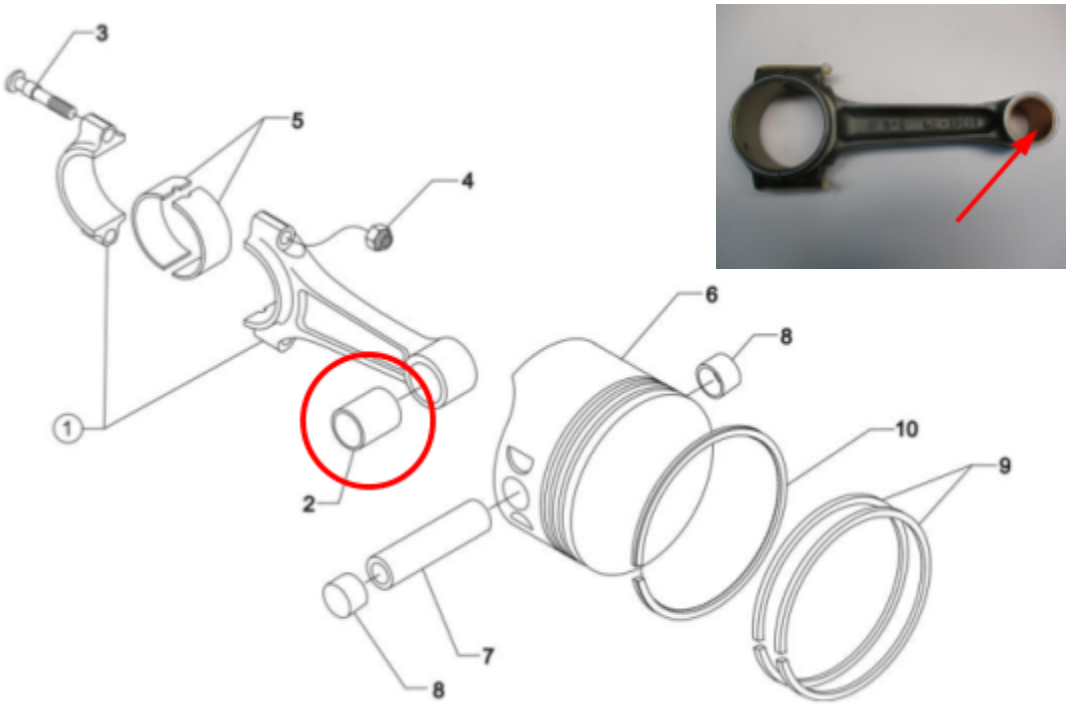

Figure 7. Lycoming O-235-N2C series 4 cycle engine connecting rod assembly exploded drawing. The bronze bushing is labeled with the number 2 (Lycoming, 2012, pp. 1-83).

The theory of failure via the bushing has evidence in observations made on the parts that are present. Comparing image A and image D from Figure 6 makes it clear that some areas of the interior of the connecting rod were worn and some had the original machining lines. This is evidence of the bushing rotating against the connecting rod, which is not how well designed bushings should act. Moreover, image D and F from Figure 6 show unknown particles embedded into the connecting rod interior surface. Additional techniques such as energy dispersive x-ray spectroscopy (EDS) could be performed on these particles to determine if they are bronze or some other material. The presence of bronze would give more evidence to wear between the bushing and the connecting rod. Beyond the micrograph evidence, there is also evidence of bushing failure in official Federal Aviation Administration (FAA) literature. Multiple uncontained engine failures similar to the one observed by the pilot in this case were reported to the Aircraft Owners & Pilots Association. The AOPA issued a letter to the FAA in August of 2017 arguing that Lycoming engines of the same make and model were failing due to non-conforming connecting rod bushings (Oord, 2017). As a result of this letter, the FAA issued an official Airworthiness Directive with accompanying mandatory service instructions requiring inspection and replacement of the bushing (Lycoming, 2020) (Ganley, 2017). Additional maintenance records may be able to identify the bushing that was installed in this particular engine and possibly find it to fall under these service instructions.

The evidence presented in this failure analysis is ultimately insufficient to confirm any one theory of failure. Separate pieces of evidence exist to support theories but ultimately due to how mangled the parts are from the violent fracture, no clear failure method can be confirmed. Evidence of the severity of this failure can be seen in the mud-cracked microstructure in image D of Figure 5. This type of microstructure is indicative of the extreme thermal conditions and deformation the part underwent during the failure event. Regardless of the exact failure mode, it is recommended that the connecting rod-bushing assembly be re-evaluated for design flaws.

Conclusion

In this experiment, the investigative team was tasked with determining the cause of failure of a Lycoming O-235-N2C series 4 cycle engine in a Cessna-152 N49681 aircraft. To prepare the samples for investigation the team used a high speed diamond saw to section the connecting rod down to a more manageable size for imaging. A second cut was then made using a low speed precision diamond saw and liquid nitrogen immersion to look at the interior of the connecting rod where the connecting rod and bushing made contact with the piston. Scanning electron microscopy was utilized to inspect the surface of the connecting rod. Irregularities were found and further investigated by the team.

Two theories of cause of failure were investigated which were: fracture of the connecting rod itself and fracture of the bronze bushing located between the connecting rod and piston leading to ultimate failure. Due to the severity of damage within the connecting rod and piston, a determination could not be made on what caused the failure of the engine. Since the engine continued to run after the initial decoupling of the connecting rod, further damage occurred to the area that should be investigated and clouded the data that could be gathered from the pieces under investigation.

Given all that has been presented, it is recommended that the connecting rod,bronze bushing specifications, and tolerances should be re-evaluated and further examined to gain a clear picture on what has happened in this instance of failure as well as to prevent future incidents.

References

Chao, Y. J., Ward, J. D., & Sands, R. G. (2007). Charpy impact energy, fracture toughness and ductile–brittle transition temperature of dual-phase 590 Steel. *Materials & Design*, *28*(2), 551–557. https://doi.org/10.1016/j.matdes.2005.08.009

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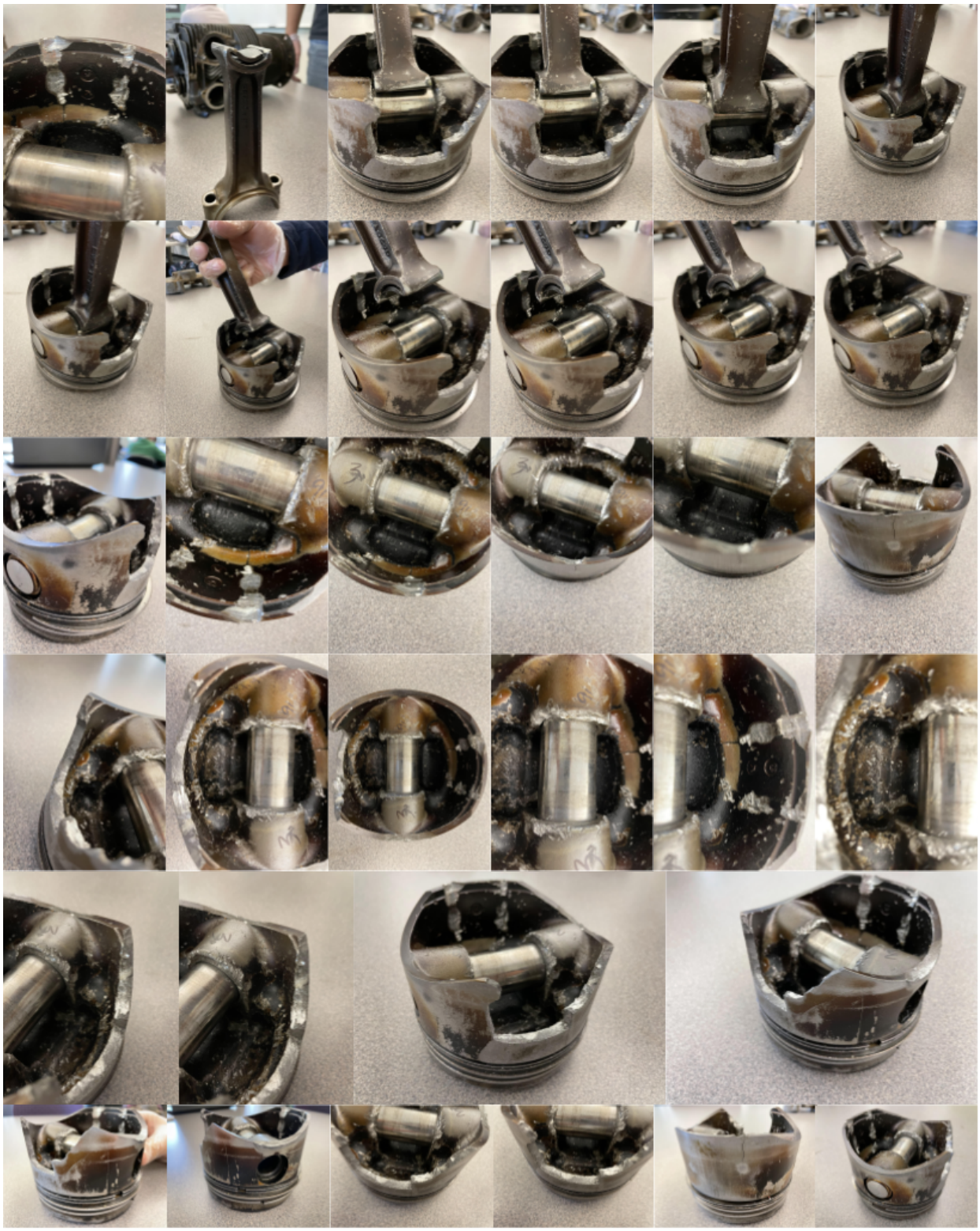
Oord, D., New, P., Ells, S., Sisk, J., & Busch, M. (2017, August 3). *Lycoming Service Bulletin No. 632A*. 0803_MSB_letter%20.pdf

Service Instruction No. 1575—New Connecting Rod Bushing. (2020). Lycoming.

Appendix



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MANDATORY SERVICE BULLETIN

DATE: August 4, 2017

Service Bulletin No. 632B
(Supersedes Service Bulletin No. 632A)
Engineering Aspects are
FAA Approved

SUBJECT: Identification of Connecting Rods with Non-Conforming Small End Bushings

MODELS AFFECTED:
(1) Engines with a serial number listed in Table 1 of this Service Bulletin
(2) Engines that have been overhauled or repaired that could contain connecting rod assemblies or connecting rod bushings shipped from Lycoming during dates identified in Table 2 of this Service Bulletin

TIME OF COMPLIANCE: Within the next 10 hours of engine operation

REASON FOR REVISION: Clarified MODELS AFFECTED; added NOTICE on page 1; clarified Steps 1.B and 4.B in "Required Action"; under the "Connecting Rod Bushing Press-Out Verification Procedure" - deleted Step 1 (reference to SB-630), added new Steps 7, 9, and 10 and new Figure 9 for better measuring procedure for indication of bushing movement, clarified the NOTICE after Step 11.A.(2) on page 5; added text to "use new seals and gaskets" in Steps 11.A.(4) and 11.B.(2) on pages 5 to 6; added IO-580 and AEIO-580 engine models to row for LW-12034 in the Top Overhaul Gasket Kit table on page 9

NOTICE: If you have completed the requirements of Service Bulletin 632 or Service Bulletin 632A, you are in compliance with this Service Bulletin, no further action is required.

NOTICE: Incomplete review of all the information in this document can cause errors. Read the entire Service Bulletin to make sure you have a complete understanding of the requirements.

This Service Bulletin contains required action 1) to identify connecting rods that contain bushings that do not meet Lycoming Engine's specifications and 2) any applicable follow-up corrective action.

Table 1 identifies affected engine models and serial numbers of new, rebuilt, or overhauled engines shipped from Lycoming Engines. Table 2 identifies the part numbers of suspect connecting rod bushings and connecting rods (that could contain the suspect connecting rod bushing) shipped from the factory within specified time ranges.

⚠WARNING: YOU MUST COMPLETE THE "REQUIRED ACTION" IN THIS SERVICE BULLETIN TO ENSURE THAT YOUR CONNECTING ROD BUSHINGS ARE PROPERLY SEATED. IF A CONNECTING ROD BUSHING BECOMES UNSEATED, THE CONNECTING ROD CAN FAIL, CAUSING AN UNCOMMANDED AND COMPLETE LOSS OF POWER.

Required Action

1. Identify and quarantine affected engines (Table 1) and engines with suspect connecting rod assemblies or connecting rod bushings (Table 2):
   A. Refer to the engine serial numbers in Table 1 and identify affected engines in your fleet.
   B. If your engine was overhauled or repaired on or after November 18, 2015, contact your Lycoming parts source to review your parts invoice shipment dates as well as maintenance and engine logbooks to identify any engine that could contain connecting rod assemblies or connecting rod bushings shipped from Lycoming during dates identified in Table 2 of this Service Bulletin.

General Aviation Manufacturers Association

2. As you complete the remaining "Required Action" steps, complete the online survey at www.lycoming.com/SB632.
3. Complete the "Connecting Rod Inspection" in this Service Bulletin on all affected engines in Table 1 and on any engine which could have suspect connecting rods or connecting rod bushings (Table 2).
4. Review your spares inventory records and physical inventory of all connecting rod bushings and connecting rod assemblies for part numbers and ship dates in Table 2:
   A. Remove and quarantine all suspect connecting rod bushings and connecting rod assemblies identified in Table 2 from your spares inventory.
   B. Arrange for the return of all suspect connecting rod assemblies and connecting rod bushings (identified in Table 2) through the Lycoming Distributor from which they were originally procured. Order replacement inventory as needed.
5. If applicable, file a warranty claim. Please refer to your Lycoming Engine's Limited Warranty for procedures, details, and limitations related to your warranty. Information is available online at www.lycoming.com/Warranty. Contact an Authorized Lycoming Distributor for assistance and to order all necessary parts.

Connecting Rod Inspection

1. For engines with serial numbers identified in Table 1 or for any engine that contains a suspect connecting rod assembly (in Table 2) or connecting rod bushing (in Table 2) installed in the field:
   A. Remove the rocker box cover, rocker box cover gasket, rockers, pushrods, and shroud tubes per instructions in the applicable Lycoming Engines' manual. Discard the rocker box gasket and shroud tube O-rings.
   B. Remove the cylinder fasteners at the base of each engine cylinder (Figure 1) to pull the cylinder out just enough to enable removal of the piston plugs and piston pin in the next step. **Do not pull the cylinder completely past the piston rings since it could require additional work and parts replacement.**

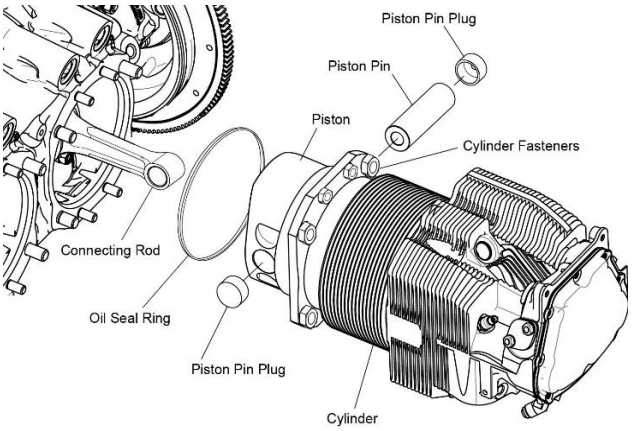

Figure 1
Cylinder, Piston Pin Plugs, Piston Pin, and Piston

NOTICE: A plastic drift and lightweight hammer can be used if the piston pin plugs are difficult to remove.

   C. Support the cylinder and piston and remove the piston pin plugs and piston pin from the connecting rod.
   D. Remove the cylinder and piston as a unit from the connecting rod.
   E. Remove the oil seal ring (Figure 1) from the cylinder base and install it on the two studs in the crankcase to support the connecting rod as shown in Figure 2.

Figure 2
Oil Seal Ring Installed on the Crankcase Studs

   F. Complete the "Connecting Rod Bushing Press-Out Verification Procedure" in this Service Bulletin.

Connecting Rod Bushing Press-Out Verification Procedure

NOTICE: A crescent wrench, 1/4-inch Allen socket, 1/4-inch or 3/8-inch ratchet, and extensions as necessary are required to complete this procedure.

1. Remove the bottom section from the ST-531, Connecting Rod Bushing Press-Out Verification Tool (Figure 3) (available from Lycoming Engines).

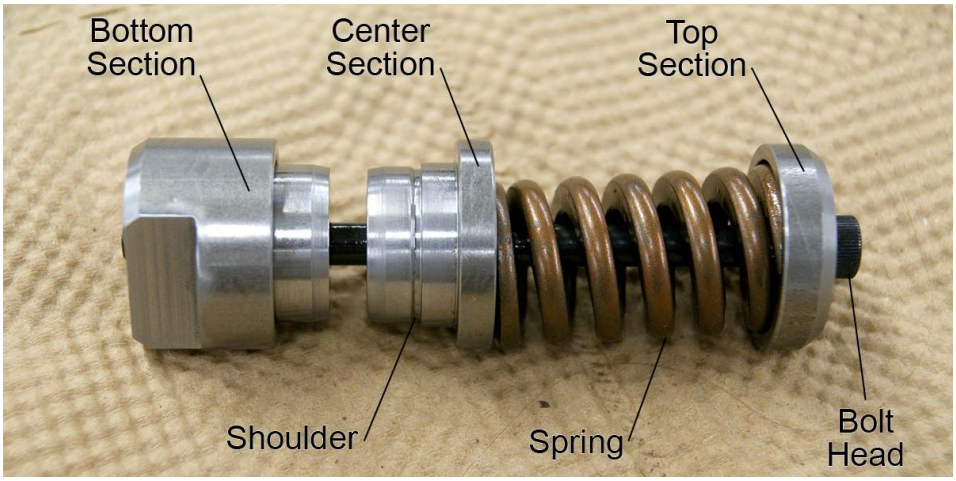

Figure 3
ST-531, Connecting Rod Bushing Press-Out Verification Tool

2. Apply a coating of clean engine oil to the threads of the bolt, the shoulder on the center section, and under the head of the bolt of the ST-531 (Figure 4).

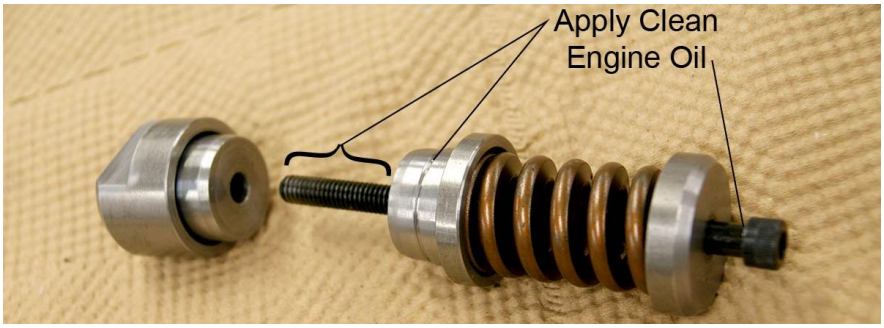

Figure 4
ST-531 Lubrication Points

3. Install the tool in the piston end of the connecting rod (Figure 5) and reinstall the bottom section.
4. Hold the bottom section of the ST-531 and turn the bolt head until finger-tight (Figure 6).

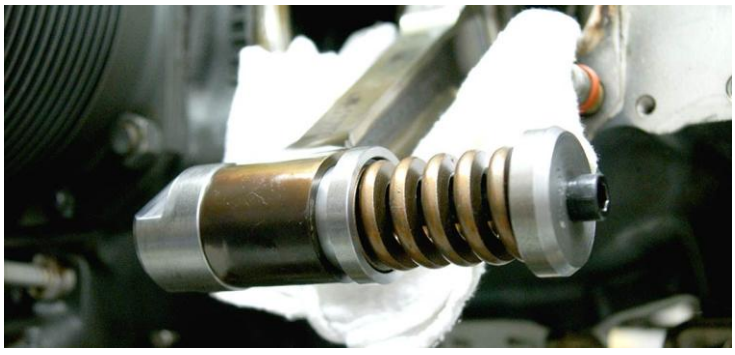

Figure 5
ST-531 Installed in the Connecting Rod

Figure 6
Turn the Bolt Head of the ST-531

5. Make sure:
   - The bottom section of the tool is in contact with the connecting rod
   - The shoulder of the center section of the tool is in contact with the connecting rod bushing
   - The head of the bolt is in contact with the top section of the tool
   - The spring is seated correctly in the tool as shown in Figure 7. Figure 8 shows **incorrect** seating of the spring.

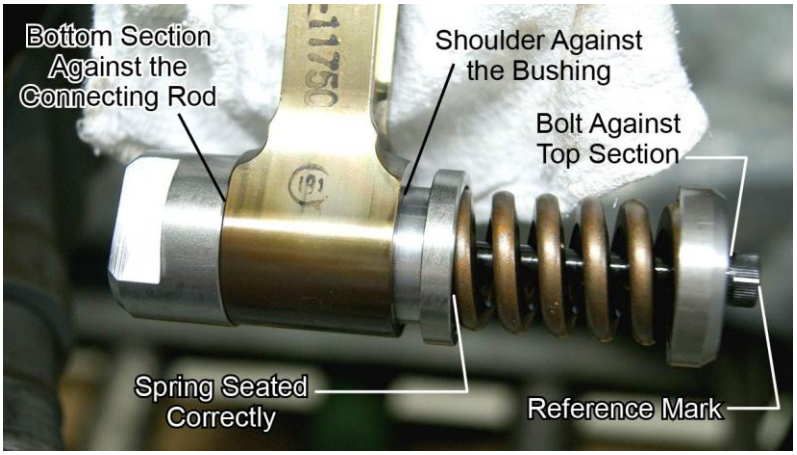

Figure 7
ST-531 Correctly Installed in the Connecting Rod

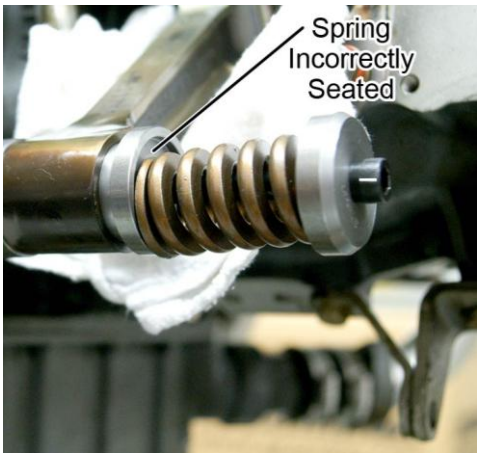

Figure 8
Spring Incorrectly Seated in the Tool

6. Use a marker to make a reference mark on the bolt head (Figure 7) to ensure an accurate count of the required number of turns during the procedure.
7. Measure the distance from the collar on the center section of the ST-531 to the edge of the connecting rod (Figure 9).

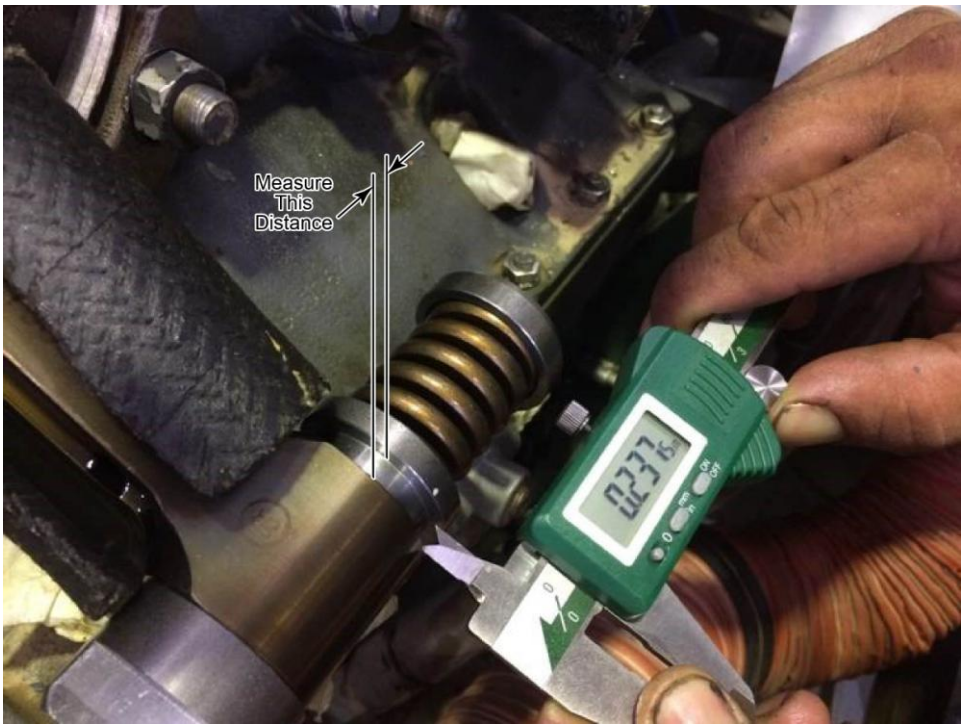

Figure 9
Measure this Distance with the Bolt Finger-Tight

8. Use a wrench to hold the bottom section of ST-531 and turn the bolt with the ratchet and 1/4-inch Allen socket clockwise six full turns (Figure 10). **Do not exceed 6 turns.**

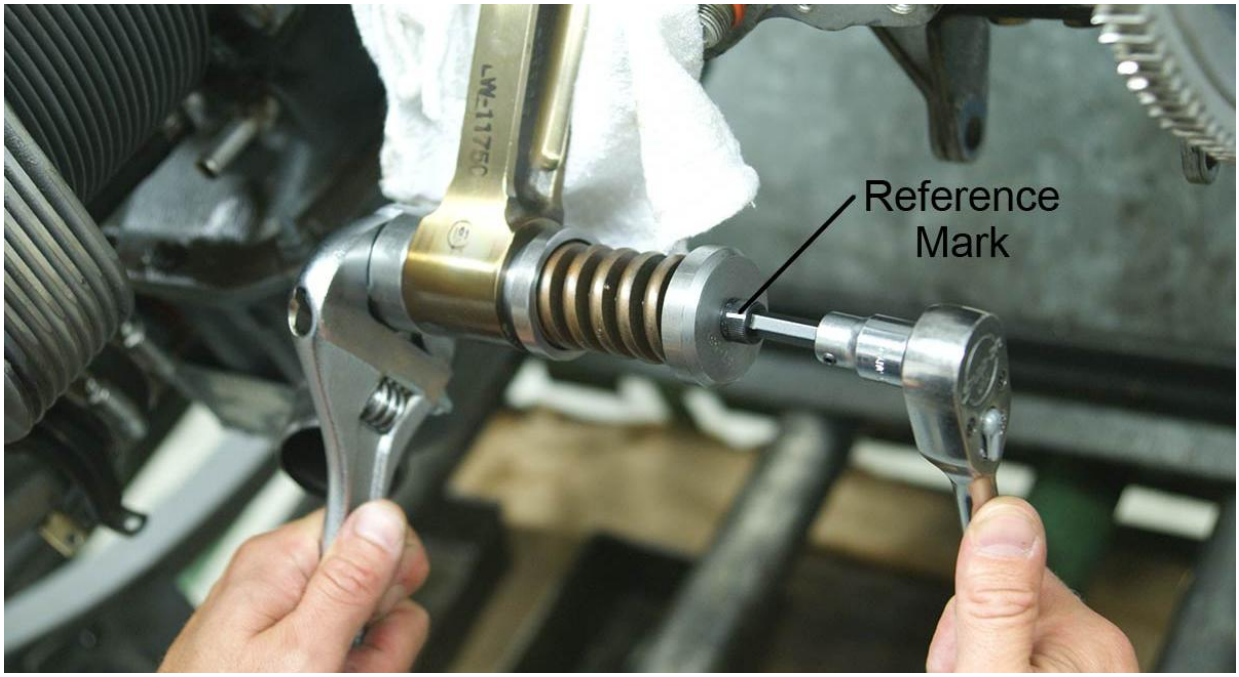

Figure 10
Turn the Bolt 6 Turns

9. Re-measure the distance from the collar on the center section of the ST-531 to the edge of the connecting rod (Figure 9).
10. If the collar to connecting rod measurement has changed after turning the bolt six full turns, the connecting rod bushing has moved.
11. Turn the bolt counter-clockwise until the bottom section can be removed from the ST-531 and the tool can be removed from the connecting rod.
    A. If the connecting rod bushing has moved:
        (1) Order new parts as necessary. Refer to the "Parts Required Table" in the "Parts Required for Reassembly" section of this Service Bulletin.
        (2) Remove the connecting rod assembly from the affected engine per the "Connecting Rod Removal" procedure in this Service Bulletin.

NOTICE: If the connecting rod bushing moved during the "Connecting Rod Bushing Press-Out Verification Procedure," and:

- If the bushing is part of a factory engine listed in Table 1 or part of a connecting rod assembly identified in Table 2, then do not remove the bushing completely from the connecting rod assembly. Send the entire connecting rod assembly (with bushing partially installed) to Lycoming Engines, through an Authorized Lycoming Distributor.
- If the bushing was purchased separately and is identified in Table 2, then send only the removed bushing to Lycoming Engines, through an Authorized Lycoming Distributor.

        (3) Install the replacement connecting rod with new connecting rod bearings per instructions in the "Connecting Rod Installation" procedure in this Service Bulletin.
        (4) Reinstall the piston, piston pin, piston pin plugs, and cylinder per instructions in the applicable Lycoming Engines' manual using new seals and gaskets identified in the Top Overhaul Gasket Kit in this Service Bulletin. Use new hardware where specified in this Service Bulletin.

(5) Record the results of the "Connecting Rod Bushing Press-Out Verification Procedure" and the part number (Figure 11), lot number, and serial number (Figure 12) of each connecting rod on Lycoming Engines' online survey at www.lycoming.com/SB632.

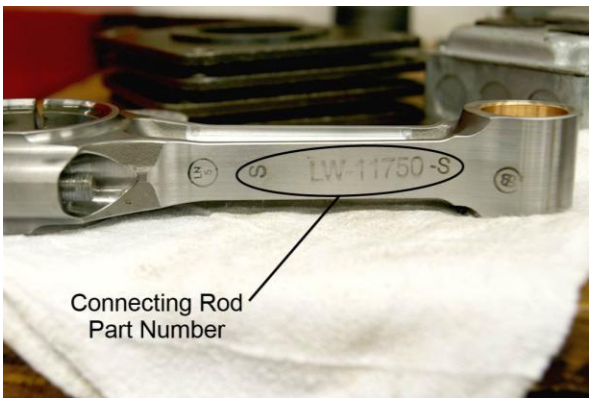

Figure 11
Connecting Rod Part Number

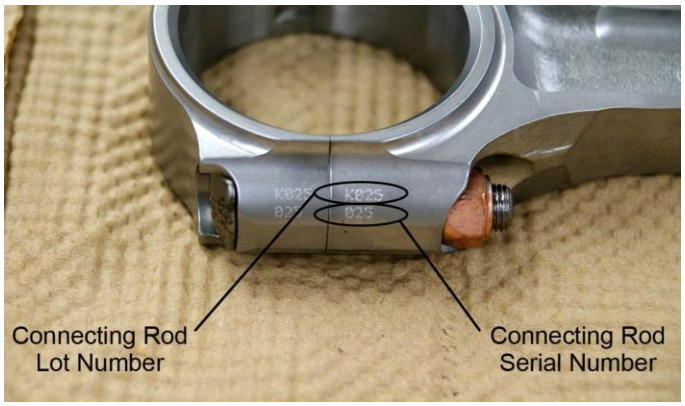

Figure 12
Connecting Rod Lot Number and Serial Number

B. If the connecting rod bushing has not moved:

(1) Order new parts as necessary. Refer to the "Parts Required Table" in the Parts Required for Reassembly section of this Service Bulletin.

(2) Reinstall the piston, piston pin, piston pin plugs, and cylinder per instructions in the applicable Lycoming Engines' manual using new seals and gaskets identified in the Top Overhaul Gasket Kit in this Service Bulletin. Use new hardware where specified in this Service Bulletin.

(3) Record the results of the "Connecting Rod Bushing Press-Out Verification Procedure" and the part number (Figure 11), lot number, and serial number (Figure 12) of each connecting rod on Lycoming Engines' online survey at www.lycoming.com/SB632.

NOTICE: Since the piston rings and piston were not removed, it will not be necessary to complete an engine break-in to seat the piston rings.

Connecting Rod Removal

NOTICE: If the two nuts in the connecting rod cap cannot easily be removed, use a soft (plastic head) mallet and gently tap on the end of the two bolts to remove the nuts and the bolts.

1. Remove and discard the two nuts (Figure 13) and the two bolts that attach the connecting rod cap to the connecting rod.

⚠ **CAUTION:** DO NOT RE-USE THE CONNECTING ROD BEARINGS, BOLTS, AND NUTS.

2. Remove the connecting rod cap and connecting rod.
3. Remove and discard the two connecting rod bearings.

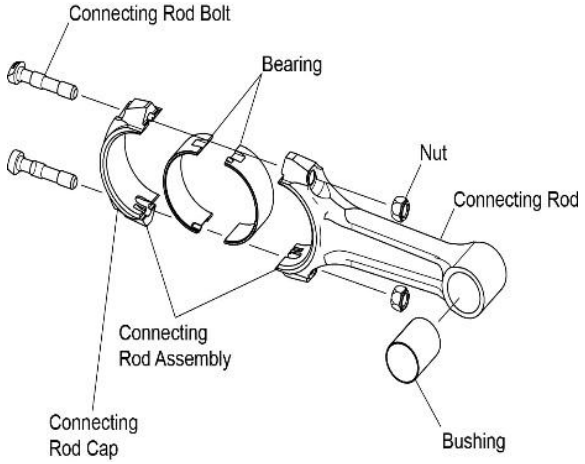

Figure 13
Connecting Rod Parts

Connecting Rod Installation

NOTICE: Each connecting rod is identified by a letter (A, E, S, etc.) as a designation for weight class. All of the connecting rods installed on the crankshaft must be of the same weight class, except "S" weight rods (service rods) can be used with either "A" or "E" weight rods depending on parts availability.

1. Ensure that all of the connecting rod assemblies in the engine have the same weight class letter.
2. Apply specified lubricant to the connecting rod and bearing inserts (per the latest revision of Service Instruction No. SI-1059) where shown in Figure 14. Different lubricants are used on the various areas on the connecting rod and bearing surfaces.

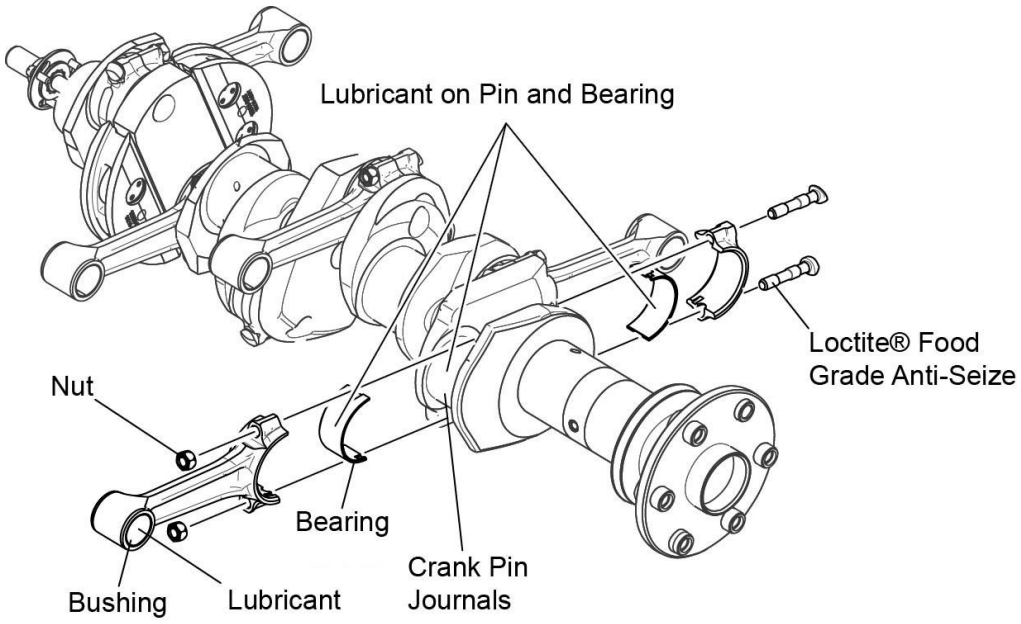

Figure 14
Connecting Rod Assembly Lubrication

NOTICE: Any time either the connecting rod bolt and/or nut pairs are removed from a Lycoming engine, replace **both** the bolt and nut pairs with new "Service Use Only" hardware regardless of apparent condition.

3. Refer to the latest revision of Service Instruction No. SI-1458 to identify the correct part numbers (P/Ns) for the new connecting rods bolts and nuts.
4. Make sure the new connecting rod bolt and new nut pairs are clean, free of dirt and debris and that the threads are not damaged.
5. Install the new lubricated matched set bearing pair on each connecting rod, one bearing on the connecting rod and the other bearing on the connecting rod cap. Ensure that the tang of each bearing fits and seats within the slot of the connecting rod as well as the connecting rod cap.

NOTICE: Do not install standard size connecting rod bolts in connecting rods with oversize bolt holes.

6. Apply engine oil mixture (mixture of 15% pre-lubricant (STP or equivalent) and 85% SAE No. 50 mineral base aviation grade lubricating oil) to the crank pin journal.
7. Install the connecting rod bolts in the connecting rod cap.

8. Apply Loctite® Food-Grade Anti-Seize Lubricant or equivalent to the bottom two or three threads of the new connecting rod bolts (Figure 14). Wipe away excess lubricant with a clean, lint-free cloth.

9. Install the connecting rod cap (with the bearing installed) on the back side of the respective crank pin on the crankshaft (where the numbers on the connecting rods and bearing locks point down - toward the oil sump.)

⚠ **CAUTION:** ENSURE THE NEW NUT ON EACH NEW CONNECTING ROD BOLT IS INSTALLED CORRECTLY. EACH CONNECTING ROD NUT HAS TWO DIFFERENT SURFACES, ONE SURFACE IS FLAT AND THE OTHER HAS A RAISED LIP. BE SURE TO INSTALL EACH NUT ON THE CONNECTING ROD BOLT WITH THE FLAT FACE TOUCHING THE ROD. THE RAISED LIP SURFACE IS AWAY FROM THE ROD. THE CONNECTING ROD BOLT CANNOT BE TIGHTENED CORRECTLY IF THE NUT ON THE CONNECTING ROD IS INSTALLED INCORRECTLY.

10. Install the connecting rod on the crank pin journal aligned with the connecting rod cap.

11. Install a new nut on each new connecting rod bolt where the flat face of the nut touches the connecting rod as shown in Figure 15.

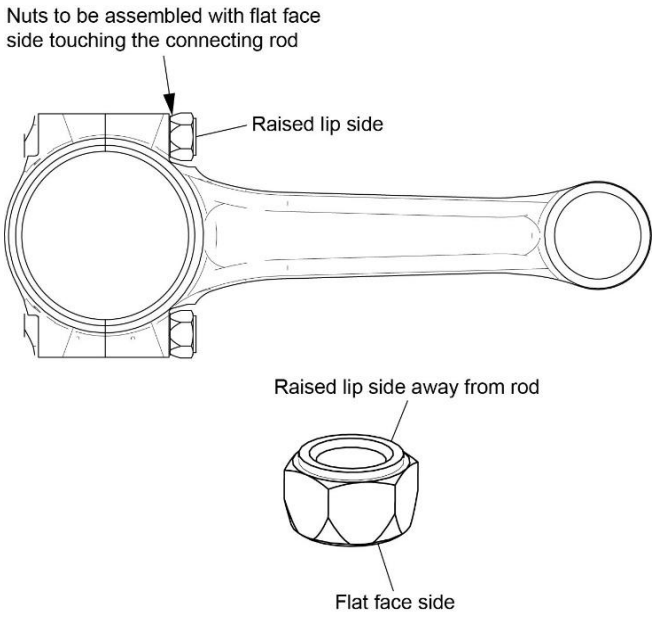

Figure 15
Connecting Rod Nut Installation

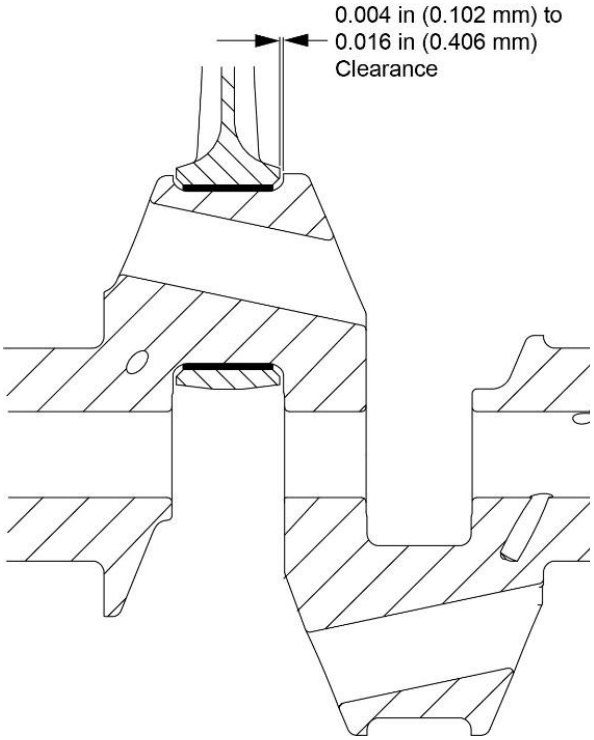

Figure 16
Connecting Rod Clearance

NOTICE: It will be necessary to use an ST-488, Stretch Bolt Micrometer and Set Master to ensure correct connecting rod bolt stretch when applicable.

12. Torque the connecting rod bolts per the torque values in the latest revision of Service Instruction No. SI-1458. (Stretch bolts require an initial torque and are then torqued to the correct stretched length.)

13. Measure the side clearance between the connecting rod and crankshaft with a feeler gage where shown in Figure 16. The clearance is to be 0.004 to 0.016 in (0.102 to 0.406 mm).

Parts Required for Reassembly

Parts Required Table

Top Overhaul Gasket Kit	Refer to the Top Overhaul Gasket Kit table
Replacement connecting rod (includes connecting rod bolts and nuts)	For each connecting rod removed and returned to Lycoming Engines through an Authorized Lycoming Distributor, refer to the Replacement Connecting Rod Assemblies table
Connecting rod bearings	For each connecting rod removed, order the same P/N bearings as removed (refer to Figure 17 for connecting rod bearing P/N location)

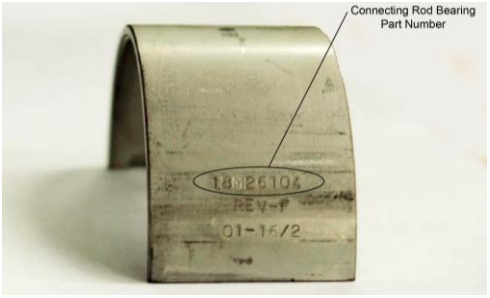

Figure 17
Connecting Rod Bearing Part Number

Replacement Connecting Rod Assemblies

LW-13865-S-85	LW-11750-S-85
78030-S	LW-19332-S-85

Top Overhaul Gasket Kit

Kit Part Number	Applicable Overhaul Gasket Kit
LW-12040	Four Cylinder Parallel Valve Head Engines – O-235 Series
LW-12038	Four Cylinder Parallel Valve Head Engines – O-290; O, IO, LIO-320; AIO, AEIO-320; O-340; O-360-A, -B, -C, -D, -F, -J; IO-360-B, -E, -F, -L; LO-360-A; AEIO-360-B, -H; HO-360-A, -B; HIO-360-B; VO, IVO-360
05K22949	Four Cylinder Parallel Valve Head Engine – IO-360-M1A
LW-12039	Four Cylinder Angle Valve Head Engines – IO-360-A, -C, -D, -J, -K; AIO-360-A, -B; AEIO-360-A; HIO-360-A, -C, -D, -E, -F; LIO-360-C; LHIO-360-C, -F; TO, LTO-360-A; TIO-360-A
LW-15838	Four Cylinder Angle Valve Head Engines – TO, TIO-360-C1A6D, -F1A6D
LW-16916	Four Cylinder "76" Series Engines – O-320-H; O, LO, TO, LTO-360-E
05K26565	Kit – Gasket – Top overhaul IO-390 Series
LW-12032	Six Cylinder Parallel Valve Head Engines – O-540-A, -B, -E, -F, -G, -H, -J, -L, -V; AEIO-540-D; IO-540-C, -D, -J, -N, -R, -T, -W, -V, -AB; TIO-540-C, -E, -G, -H, -K, -AA, -AB, -AF, -AG; LTIO-540-K
LW-12036	Six Cylinder Parallel Valve Head Engine – O-435-A
LW-12033	Six Cylinder Angle Valve Head Top Exhaust Engines – IO-540-B, -E, -M, -U; TIO-540-A, -S, -T; TIO, LTIO-540-F, -J, -N, -R; TIO-541-A; IGO, IGSO-540-B
LW-12034	Six Cylinder Angle Valve Head Down Exhaust Engines – GO, VO, TVO-435; GO, GSO, IGSO-480; IO-540-A, -G, -K, -L, -P, -S, -AA; AEIO-540-L;TIO-540-W, -AE, -AH; TIO, LTIO-540-U, -V, -W; VO, IVO, TVO, TIVO-540; IGO, IGSO-540-A IO-580, AEIO-580
LW-12035	Six Cylinder Angle Valve Head Engines – IO-540-AC1A5; TIO-540-AJ1A; TIO, TIGO-541-D, -E
LW-12036	Six Cylinder Parallel valve Head engine – O-435-A
LW-12037	Eight Cylinder Angle Valve Head Down Exhaust Engines – IO-720-A, -D
LW-18758	Eight Cylinder Angle Valve Head Top Exhaust Engines – IO-720-B, -C

Table 1 (Cont.)
Affected Lycoming Engines

Engine Model	Serial Number	Engine Model	Serial Number	Engine Model	Serial Number
YIO-540-D4A5	EL-36660-48E	YIO-540-D4A5	EL-36686-48E	YO-540-EXP26	EL-27663-40E
YIO-540-D4A5	EL-36668-48E	YIO-540-D4A5	EL-36715-48E	YTEO-540-B1A	EL-107-84E
YIO-540-D4A5	EL-36671-48E	YIO-540-D4A5	EL-36728-48E	YTEO-540-B1A	EL-108-84E
YIO-540-D4A5	EL-36681-48E	YIO-540-K1A5	EL-36677-48E		
Engine Model	**Serial Number**	**Engine Model**	**Serial Number**	**Engine Model**	**Serial Number**
AEIO-580-B1A	L-463-79E	AEIO-580-B1A	L-481-79E	AEIO-580-B1A	L-493-79E
AEIO-580-B1A	L-464-79E	AEIO-580-B1A	L-482-79E	AEIO-580-B1A	L-494-79E
AEIO-580-B1A	L-466-79E	AEIO-580-B1A	L-483-79E	AEIO-580-B1A	L-495-79E
AEIO-580-B1A	L-467-79E	AEIO-580-B1A	L-484-79E	AEIO-580-B1A	L-496-79E
AEIO-580-B1A	L-468-79E	AEIO-580-B1A	L-485-79E	AEIO-580-B1A	L-497-79E
AEIO-580-B1A	L-470-79E	AEIO-580-B1A	L-486-79E	AEIO-580-B1A	L-498-79E
AEIO-580-B1A	L-471-79E	AEIO-580-B1A	L-487-79E	AEIO-580-EXP	EL-469-79E
AEIO-580-B1A	L-472-79E	AEIO-580-B1A	L-488-79E	AEIO-580-EXP	EL-476-79E
AEIO-580-B1A	L-473-79E	AEIO-580-B1A	L-489-79E	IO-580-B1A	L-477-79E
AEIO-580-B1A	L-474-79E	AEIO-580-B1A	L-490-79E	YIO-580-EXP18	EL-478-79E
AEIO-580-B1A	L-475-79E	AEIO-580-B1A	L-491-79E	YIO-580-EXP18	EL-479-79E
AEIO-580-B1A	L-480-79E	AEIO-580-B1A	L-492-79E		
Engine Model	**Serial Number**				
IO-720-D1C	RL-1019-54A				

Table 2
Part Numbers and Ship Date Ranges of Suspect Connecting Rods and Suspect Connecting Rod Bushings Shipped as Spares

Part Number (P/N)	Description	Shipped from the Factory Between
LW-13923	Connecting Rod Bushing	18 November 2015 and 15 November 2016
LW-11750-S	Connecting Rod Assembly	20 November 2015 and 2 February 2017
78030-S	Connecting Rod Assembly	1 April 2016 and 2 February 2017
LW-19332-S	Connecting Rod Assembly	4 January 2016 and 2 February 2017

MANDATORY

SEL-71-07

TITLE

POWER PLANT - TRANSMITTAL OF LYCOMING SERVICE BULLETIN NO. 632A IDENTIFICATION OF CONNECTING RODS WITH NON-CONFORMING SMALL END BUSHINGS

EFFECTIVITY

Airplanes delivered from the factory.

MODEL	SERIAL NUMBERS
172S	172S11669, 172S11672, 172S11673, 172S11676 thru 172S11703, 172S11705 thru 172S11731, 172S11736 thru 172S11777, 172S12001, 172S12002, 172S12004 thru 172S12014, 172S12016 thru 172S12021, 172S12023 thru 172S12025
182T	18282428, 18282433, 18282434, 18282440 thru 18282450, 182082452, 182082455, 18282462 thru 18282464, 18282470, 18283001 thru 18283006
T206H	T20609228 thru T20609258, T20609501 thru T20609509

Cessna and Beechcraft model airplanes that have replaced original engine or engine components with those identified in Lycoming Service Bulletin No. 632A Table 1 or Table 2.

All serial number airplanes that follow and have Lycoming Engines with a serial number listed in Table 1 of the Lycoming Service Bulletin No. 632A and engines that have been overhauled or repaired after January 1, 2015 using replacement parts identified in Table 2 of the Lycoming Service Bulletin No. 632A.

Cessna model airplanes: 152, A152, F152, FA152, 172I, 172K, 172L, F172L, 172M, F172M, 172N, F172N, 172P, F172P, 172RG, 172Q, 177, 177A, 177B, 177RG, F177RG, R182, FR182, T182, TR182.

Cessna model airplanes (1996 & On): 172R, 172S, 182S, 182T, T182T, 206H, T206H.

Beechcraft model airplanes: 23, A23-19, A23-24, A-24, A24R, 19A, B19, M19A, B-23, B24R, C-23, C24R, C-35, D-35, 77.

Textron Aviation Customer Service, P.O. Box 7706, Wichita, KS 67277, U.S.A. 1-316-517-5800

MANDATORY **SEL-71-07**

REASON

This service letter transmits Lycoming Service Bulletin No. 632A, Identification of Connecting Rods with Non-Conforming Small End Bushings. The Lycoming service bulletin has instructions to inspect engine serial numbers, connecting rod and connecting rod bushing part numbers, remove the cylinders and complete a connecting rod bushing press-out procedure. If a connecting rod, or connecting rod bushing is suspect, they must be replaced.

WARNING: You must complete the "required action" in this service bulletin to ensure that your connecting rod bushings are properly seated. If a connecting rod bushing becomes unseated, according to Lycoming the connecting rod can fail, causing an uncommanded and complete loss of power.

DESCRIPTION

This service document provides instructions to comply with Lycoming Service Bulletin No. 632A, Identification of Connecting Rods with Non-Conforming Small End Bushings.

COMPLIANCE

MANDATORY. This service document must be accomplished within 10 flight hours.

NOTE: If the airplane is operated before the incorporation of Lycoming Service Bulletin No. 632A the pilot should monitor the engine for abnormal vibrations or knocking. It is recommended that pilots consider operating only daytime VFR and familiarize themselves with the emergency procedures for a precautionary or emergency landing.

A service document published by Textron Aviation may be recorded as *completed* in an aircraft log only when the following requirements are satisfied:

1) The mechanic must complete all of the instructions in the service document, including the intent therein.
2) The mechanic must correctly use and install all applicable parts supplied with the service document kit. Only with written authorization from Textron Aviation can substitute parts or rebuilt parts be used to replace new parts.
3) The mechanic or airplane owner must use the technical data in the service document only as approved and published.
4) The mechanic or airplane owner must apply the information in the service document only to aircraft serial numbers identified in the *Effectivity* section of the document.
5) The mechanic or airplane owner must use maintenance practices that are identified as acceptable standard practices in the aviation industry and governmental regulations.

No individual or corporate organization other than Textron Aviation is authorized to make or apply any changes to a Textron Aviation-issued service document or flight manual supplement without prior written consent from Textron Aviation.

Textron Aviation is not responsible for the quality of maintenance performed to comply with this document, unless the maintenance is accomplished at a Textron Aviation-owned Service Center.

TOOLING

NAME	NUMBER	MANUFACTURER	USE
Connecting Rod Bushing Press-Out Verification Tool	ST-531	Textron Aviation Parts Distribution 7121 Southwest Boulevard Wichita, KS 67215	This tool is used to do a press-out test of the connecting rod bushing.
Stretch Bolt Micrometer and Set Master	R-ST-488	Lycoming 652 Oliver St Williamsport, PA 17701	Used to verify the stretch bolt installation on certain connecting rod installations.

REFERENCES

Lycoming Service Bulletin No. 632A, Identification of Connecting Rods with Non-Conforming Small End Bushings, Dated July 17, 2017 or latest revision

Lycoming Service Bulletin No. 630A, Connecting Rod Bushing Inspection After Cylinder Removal, Dated June 13, 2017 or latest revision

Lycoming Overhaul Manual Direct Drive Engine PN 60294-7-14 or latest revision

Lycoming Service Instruction No. 1059E, Pre-Lubrication of Parts Before Assembly, Dated January 27, 2016 or latest revision

Lycoming Service Instruction No. 1458G, Connecting Rod Bolts (Identification and Installation), Dated November 10, 2015 or latest revision

Lycoming Special Service Publication No. SSP-1776-3, Service Table Of Limits And Torque Value Recommendations, Dated January 31, 2017 or latest revision (This document is available at Lycoming.com.)

PUBLICATIONS AFFECTED

None

ACCOMPLISHMENT INSTRUCTIONS

1. Review Lycoming Service Bulletin No. 632A, Identification of Connecting Rods with Non-Conforming Small End Bushings.
   A. Determine whether your engine is in the engine serial list identified in Service Bulletin No. 632A Table 1.
   B. Determine whether your engine could contain connecting rods or connecting rod bushings shipped from Lycoming during dates identified in Service Bulletin No. 632A Table 2.
   C. If engine or components are not affected, go to step 10.
2. Prepare the airplane for maintenance.
   A. Make sure that the airplane is electrically grounded.
   B. Make sure that all switches are in the OFF/NORM position.
   C. Disconnect electrical power from the airplane.
      (1) Disconnect the airplane battery.
      (2) Disconnect external electrical power.
   D. Attach maintenance warning tags to the battery and external power receptacle that have **"DO NOT CONNECT ELECTRICAL POWER - MAINTENANCE IN PROGRESS"** written on them.
3. Remove the upper and lower engine cowl as necessary.
4. Remove baffling, induction, fuel injection, and exhaust system components as necessary to gain access to accomplish Service Bulletin Instructions.

5. Complete Lycoming Service Bulletin No. 632A, Identification of Connecting Rods with Non-Conforming Small End Bushings. (Refer to the referenced Lycoming documents to reassemble the engine.)
6. Install components removed in Step 4.
7. Complete an engine operational and leak check in accordance with local shop practices and the airplanes owner manual or POH.
8. Install the upper and lower engine cowl that was removed in Step 3.
9. Complete a return to service maintenance flight.
10. Make an entry in the airplane logbook that states compliance and method of compliance with this service document.

MATERIAL INFORMATION

Refer to Lycoming Service Bulletin No. 632A, Parts Required for Reassembly and an Authorized Service Facility for a list of additional parts necessary to complete this service letter.

There is no labor allowance available for the engines that have ordered and installed the LW-13923 Connecting Rod Bushing.

* Please contact a Textron Aviation Authorized Service Facility for current cost and availability of parts listed in the Lycoming Service Bulletin No. 632A.

SEL-71-07

TITLE

POWER PLANT - TRANSMITTAL OF LYCOMING SERVICE BULLETIN NO. 632A IDENTIFICATION OF CONNECTING RODS WITH NON-CONFORMING SMALL END BUSHINGS

TO:

Owners of the airplanes that follow:

Cessna model airplanes: 152, A152, F152, FA152, 172I, 172K, 172L, F172L, 172M, F172M, 172N, F172N, 172P, F172P, 172RG, 172Q, 177, 177A, 177B, 177RG, F177RG, R182, FR182, T182, TR182.

Cessna model airplanes (1996 & On): 172R, 172S, 182S, 182T, T182T, 206H, T206H.

Beechcraft model airplanes: 23, A23-19, A23-24, A-24, A24R, 19A, B19, M19A, B-23, B24R, C-23, C24R, C-35, D-35, 77.

REASON

This service letter transmits Lycoming Service Bulletin No. 632A, Identification of Connecting Rods with Non-Conforming Small End Bushings. The Lycoming service bulletin has instructions to inspect engine serial numbers, connecting rod and connecting rod bushing part numbers, remove the cylinders and complete a connecting rod bushing press-out procedure. If a connecting rod, or connecting rod bushing is suspect, they must be replaced.

WARNING: You must complete the "required action" in this service bulletin to ensure that your connecting rod bushings are properly seated. If a connecting rod bushing becomes unseated, according to Lycoming the connecting rod can fail, causing an uncommanded and complete loss of power.

COMPLIANCE

MANDATORY. This service document must be accomplished within 10 flight hours.

NOTE: If the airplane is operated before the incorporation of Lycoming Service Bulletin No. 632A the pilot should monitor the engine for abnormal vibrations or knocking. It is recommended that pilots consider operating only daytime VFR and familiarize themselves with the emergency procedures for a precautionary or emergency landing.

Textron Aviation Customer Service, P.O. Box 7706, Wichita, KS 67277, U.S.A. 1-316-517-5800

LABOR HOURS

WORK PHASE	LABOR-HOURS
Cylinder removal, inspection and reinstallation (4-cylinder engine)	12.0
Cylinder removal, inspection and reinstallation (6-cylinder engine)	16.0
Exhaust manifold removal and reinstallation (6-cylinder turbocharged engines)	3.0
Cylinder removal, inspection and reinstallation (8-cylinder engine)	20.0
Bushing Press-Out Procedure	0.25 per connecting rod
Connecting Rod Removal and Replacement (if required)	1.0 per connecting rod

NOTE: Additional labor hours may be considered. Please submit a claim form online for the actual hours at ww2.txtav.com/Parts or email the completed Textron Aviation Claim Form to warranty@txtav.com.

MATERIAL AVAILABILITY

For a list of part numbers, refer to the Parts Required for Reassembly section in the Lycoming Service Bulletin No. 632 Rev A or later.

Please contact a Textron Aviation Authorized Service Facility for current cost and availability of parts listed necessary to complete this service document.

WARRANTY

This service document is *mandatory*. Eligible airplanes may qualify for parts and labor coverage to the extent noted in the *Labor Hours* and *Material Availability* sections of this document.

Eligibility: All engine serials identified in Table 1 of the Lycoming Service Bulletin No. 632 Rev A or later or have had an engine that has been overhauled or repaired after January 1, 2015 and used replacement connecting rod assemblies identified in Table 2 of the Lycoming Service Bulletin No. 632 Rev A or later

Parts Coverage: Textron Aviation-owned and Textron Aviation-authorized Service Facilities, operators, or other maintenance facilities may submit a claim for the parts required to accomplish this service document as defined in the *Material Availability* section of this document.

Labor Coverage: Textron Aviation-owned and Textron Aviation-authorized Service Facilities rated to perform maintenance on the specific model of Beechcraft or Cessna Aircraft may submit a claim for the labor necessary to accomplish this service document as defined in the *Labor Hours* section of this document.

There is no labor allowance available for the engines that have ordered and installed the LW-13923 Connecting Rod Bushing.

Credit Application: After this service document has been accomplished, a claim must be submitted to Textron Aviation within 30 days of the service document completion. Claims for compliance of this service document are to be filed as a W4 type claim.

Please submit your claim form online at *ww2.txtav.com/Parts* or email the completed Textron Aviation Claim Form to *warranty@txtav.com*. If submitted on-line a Return Authorization will be provided. If a paper claim is submitted your claim will be entered into the system and a Return Authorization will be sent to you.

The Return Authorization must accompany any required return parts (see *Material Availability*), to the point of purchase.

Parts to be returned to Textron Aviation Parts Distribution should be forwarded to:

Textron Aviation Parts Distribution
Warranty Administration
285 South Greenwich Road
Bldg B89, Docks 1-4
Wichita, KS 67206
USA

Expiration: July 26, 2018 (after this date the owner/operator assumes the responsibility or compliance costs)

Textron Aviation reserves the right to void continued airplane warranty coverage for the parts affected by this service document until the service document is accomplished.

LYCOMING
652 Oliver Street
Williamsport, PA 17701 U.S.A.
Telephone +1 (800) 258-3279 (U.S. and Canada)
Telephone +1 (570) 323-6181 (International)
Facsimile +1 (570) 327-7101
Email Technicalsupport@lycoming.com
www.lycoming.com

MANDATORY SERVICE BULLETIN

DATE: July 23, 2017

Service Bulletin No. 632A
(Supersedes Service Bulletin No. 632)
Engineering Aspects are
FAA Approved

SUBJECT: Identification of Connecting Rods with Non-Conforming Small End Bushings

MODELS AFFECTED: (1) Engines with a serial number listed in Table 1 of this Service Bulletin; and

(2) Engines that have been overhauled or repaired after January 1, 2015 using replacement parts identified in Table 2 of this Service Bulletin.

TIME OF COMPLIANCE: Within the next 10 hours of engine operation

REASON FOR REVISION: Clarified "Models Affected" and Warning on Page 1and verbiage in Steps 1, 1-B, and 5 under "Required Action"; deleted "Limited Warranty" section

NOTICE: Incomplete review of all the information in this document can cause errors. Read the entire Service Bulletin to make sure you have a complete understanding of the requirements.

This Service Bulletin contains required action 1) to identify connecting rods that contain bushings that do not meet Lycoming Engine's specifications and 2) any applicable follow-up corrective action.

Table 1 identifies affected engine models and serial numbers of new, rebuilt, or overhauled engines shipped from Lycoming Engines. Table 2 identifies the part numbers of suspect connecting rod bushings and connecting rods (that could contain the suspect connecting rod bushing) shipped from the factory within specified time ranges.

⚠WARNING: YOU MUST COMPLETE THE "REQUIRED ACTION" IN THIS SERVICE BULLETIN TO ENSURE THAT YOUR CONNECTING ROD BUSHINGS ARE PROPERLY SEATED. IF A CONNECTING ROD BUSHING BECOMES UNSEATED, THE CONNECTING ROD CAN FAIL, CAUSING AN UNCOMMANDED AND COMPLETE LOSS OF POWER.

Required Action

1. Identify and quarantine affected engines (Table 1) and engines with suspect connecting rod assemblies or connecting rod bushings (Table 2):
   A. Refer to the engine serial numbers in Table 1 and identify affected engines in your fleet.
   B. If your engine was overhauled or repaired after January 1, 2015, contact your Lycoming parts source to review your parts invoice shipment dates as well as maintenance and engine logbooks to identify any engine in your fleet that could have one or more suspect connecting rod bushings (identified in Table 2) or connecting rod assemblies (identified in Table 2).
2. As you complete the remaining "Required Action" steps, complete the online survey at www.lycoming.com/SB632.
3. Complete the "Connecting Rod Inspection" in this Service Bulletin on all affected engines in Table 1 and on any engine which could have suspect connecting rods or connecting rod bushings (Table 2).
4. Review your spares inventory records and physical inventory of all connecting rod bushings and connecting rod assemblies for part numbers and ship dates in Table 2:
   A. Remove and quarantine all suspect connecting rod bushings and connecting rod assemblies identified in Table 2 from your spares inventory.

B. Arrange for the return of all suspect connecting rod assemblies and connecting rod bushings (identified in Table 2) through the Lycoming Distributor from which they were originally procured in exchange for conforming replacement parts.

5. If applicable, file a warranty claim. Please refer to your Lycoming Engine's Limited Warranty for procedures, details, and limitations related to your warranty. Information is available online at http://www.lycoming.com/warranty. Contact an Authorized Lycoming Distributor for assistance and to order all necessary parts.

Connecting Rod Inspection

1. For engines with serial numbers identified in Table 1 or for any engine that contains a suspect connecting rod assembly (in Table 2) or connecting rod bushing (in Table 2) installed in the field:
   A. Remove the rocker box cover, rocker box cover gasket, rockers, pushrods, and shroud tubes per instructions in the applicable Lycoming Engines' manual. Discard the rocker box gasket and shroud tube O-rings.
   B. Remove the cylinder fasteners at the base of each engine cylinder (Figure 1) to pull the cylinder out just enough to enable removal of the piston plugs and piston pin in the next step. **Do not pull the cylinder completely past the piston rings since it could require additional work and parts replacement**.

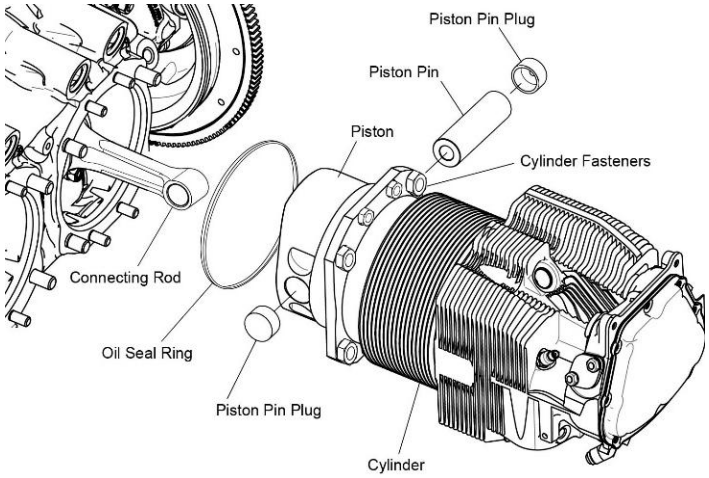

Figure 1
Cylinder, Piston Pin Plugs, Piston Pin, and Piston

NOTICE: A plastic drift and lightweight hammer can be used if the piston pin plugs are difficult to remove.

C. Support the cylinder and piston and remove the piston pin plugs and piston pin from the connecting rod.

D. Remove the cylinder and piston as a unit from the connecting rod.

E. Remove the oil seal ring (Figure 1) from the cylinder base and install it on the two studs in the crankcase to support the connecting rod as shown in Figure 2.

Figure 2
Oil Seal Ring Installed on the Crankcase Studs

F. Complete the "Connecting Rod Bushing Press-Out Verification Procedure" in this Service Bulletin.

Connecting Rod Bushing Press-Out Verification Procedure

NOTICE: A crescent wrench, 1/4-inch Allen socket, 1/4-inch or 3/8-inch ratchet, and extensions as necessary are required to complete this procedure.

1. Use the "Connecting Rod Bushing Inspection" in the latest revision of Service Bulletin No. SB-630 to identify an initial reference point or measurement for the connecting rod bushing position to determine if connecting rod bushing movement has occurred during this procedure.
2. Remove the bottom section from the ST-531, Connecting Rod Bushing Press-Out Verification Tool (Figure 3) (available from Lycoming Engines).

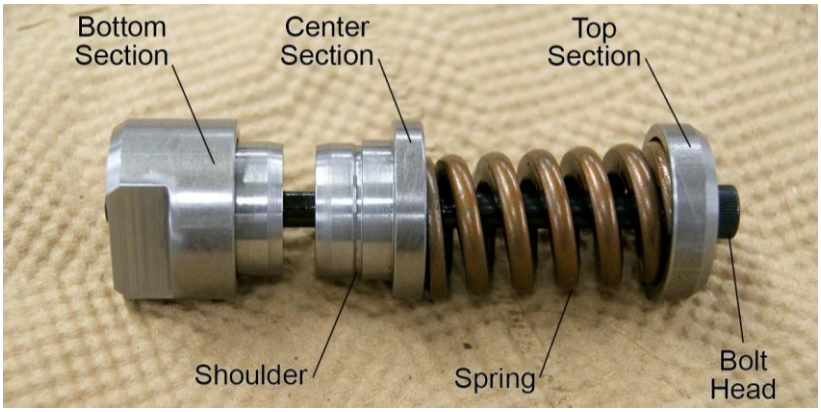

Figure 3
ST-531, Connecting Rod Bushing Press-Out Verification Tool

3. Apply a coating of clean engine oil to the threads of the bolt, the shoulder on the center section, and under the head of the bolt of the ST-531 (Figure 4).

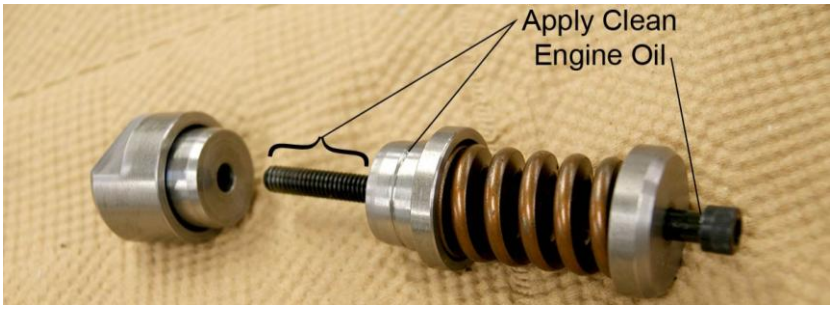

Figure 4
ST-531 Lubrication Points

4. Install the tool in the piston end of the connecting rod (Figure 5) and reinstall the bottom section.
5. Hold the bottom section of the ST-531 and turn the bolt head until finger-tight (Figure 6).

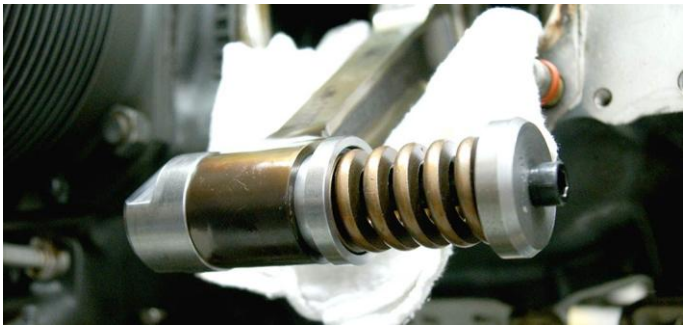

Figure 5
ST-531 Installed in the Connecting Rod

Figure 6
Turn the Bolt Head of the ST-531

6. Make sure:
   - The bottom section of the tool is in contact with the connecting rod
   - The shoulder of the center section of the tool is in contact with the connecting rod bushing
   - The head of the bolt is in contact with the top section of the tool
   - The spring is seated correctly in the tool as shown in Figure 7. Figure 8 shows **incorrect** seating of the spring.

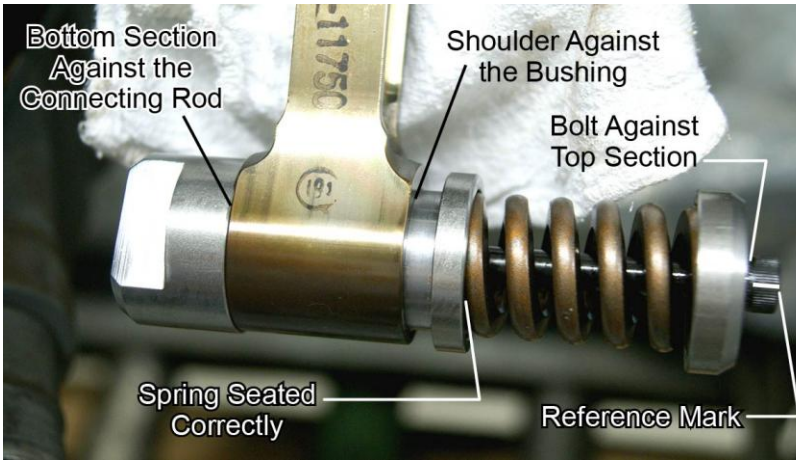

Figure 7
ST-531 Correctly Installed in the Connecting Rod

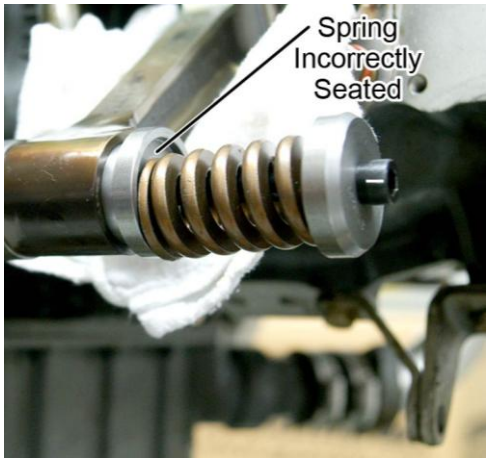

Figure 8
Spring Incorrectly Seated in the Tool

7. Use a marker to make a reference mark on the bolt head (Figure 7) to ensure an accurate count of the required number of turns during the procedure.
8. Use a wrench to hold the bottom section of ST-531 and turn the bolt with the ratchet and 1/4-inch Allen socket clockwise six full turns (Figure 9). **Do not exceed 6 turns.**

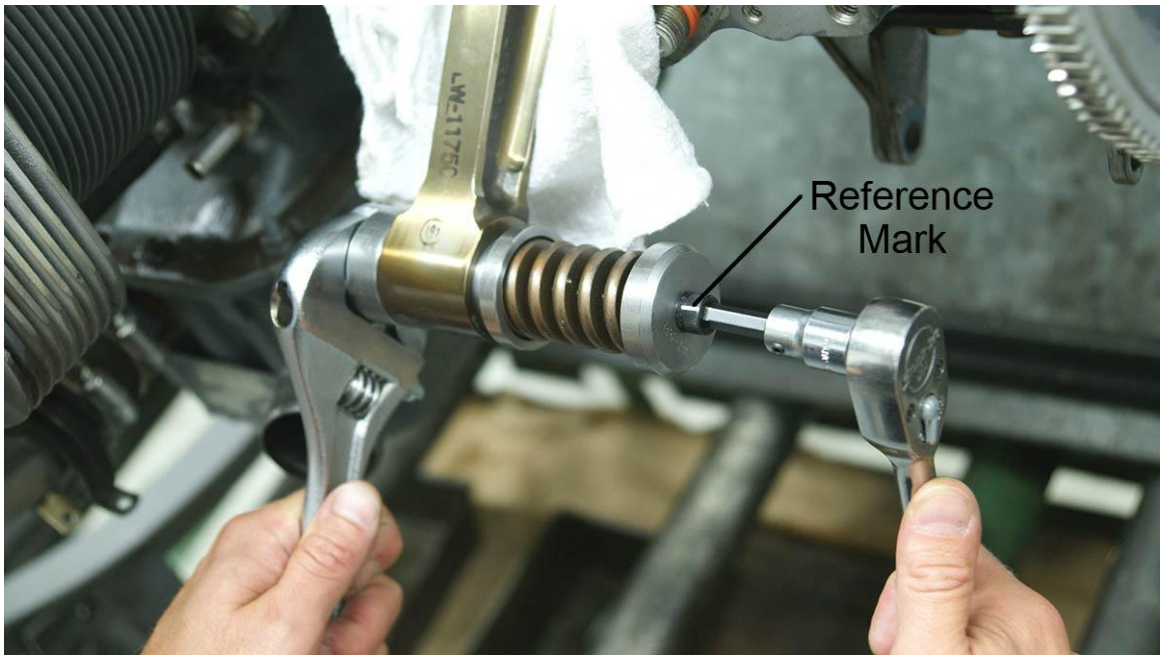

Figure 9
Turn the Bolt 6 Turns

9. Turn the bolt counter-clockwise until the bottom section can be removed from the ST-531 and the tool can be removed from the connecting rod.

10. Compare the reference point or measurement after removing the ST-531 to the initial reference point or measurement to determine connecting rod bushing movement.

A. If the connecting rod bushing has moved:

(1) Order new parts as necessary. Refer to the "Parts Required Table" in the "Parts Required for Reassembly" section of this Service Bulletin.

(2) Remove the connecting rod assembly from the affected engine per the "Connecting Rod Removal" procedure in this Service Bulletin.

- Lycoming will replace connecting rods removed from engines listed in Table 1 and connecting rod assemblies sold separately in Table 2.
- Lycoming will provide a replacement bushing sold separately in Table 2.

NOTICE: If either your engine or connecting rod assembly are still under warranty, do not remove the connecting rod bushing from the connecting rod. You will need to send the entire connecting rod assembly to Lycoming Engines, through an Authorized Lycoming Distributor, for verification and replacement.

(3) Install the replacement connecting rod with new connecting rod bearings per instructions in the "Connecting Rod Installation" procedure in this Service Bulletin.

(4) Reinstall the piston, piston pin, piston pin plugs, and cylinder per instructions in the applicable Lycoming Engines' manual.

(5) Record the results of the "Connecting Rod Bushing Press-Out Verification Procedure" and the part number (Figure 10), lot number, and serial number (Figure 11) of each connecting rod on Lycoming Engines' online survey at www.lycoming.com/SB632.

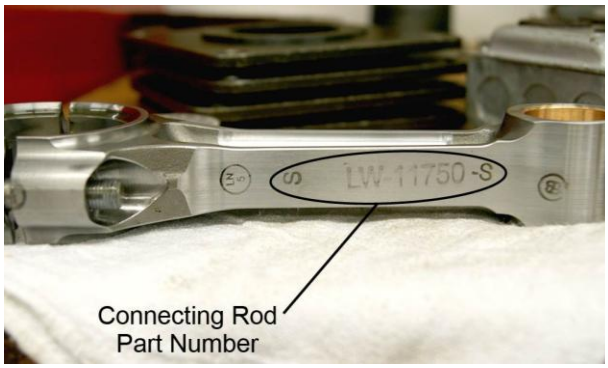

Figure 10
Connecting Rod Part Number

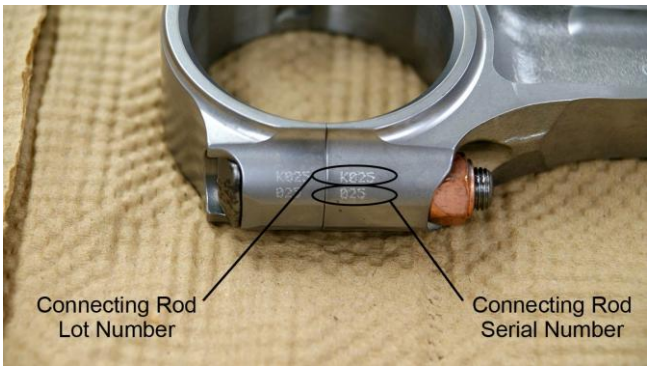

Figure 11
Connecting Rod Lot Number and Serial Number

B. If the connecting rod bushing has not moved:

(1) Order new parts as necessary. Refer to the "Parts Required Table" in the Parts Required for Reassembly section of this Service Bulletin.

(2) Reinstall the piston, piston pin, piston pin plugs, and cylinder per instructions in the applicable Lycoming Engines' manual.

(3) Record the results of the "Connecting Rod Bushing Press-Out Verification Procedure" and the part number (Figure 10), lot number, and serial number (Figure 11) of each connecting rod on Lycoming Engines' online survey at www.lycoming.com/SB632.

NOTICE: Since the piston rings and piston were not removed, it will not be necessary to complete an engine break-in to seat the piston rings.

Connecting Rod Removal

NOTICE: If the two nuts in the connecting rod cap cannot easily be removed, use a soft (plastic head) mallet and gently tap on the end of the two bolts to remove the nuts and the bolts.

1. Remove and discard the two nuts (Figure 12) and the two bolts that attach the connecting rod cap to the connecting rod.

   ⚠ **CAUTION:** DO NOT RE-USE THE CONNECTING ROD BEARINGS, BOLTS, AND NUTS.

2. Remove the connecting rod cap and connecting rod.
3. Remove and discard the two connecting rod bearings.

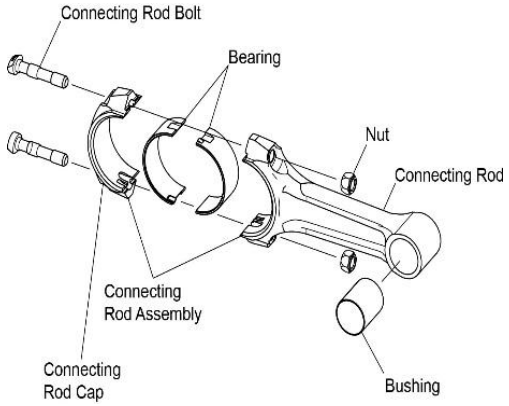

Figure 12
Connecting Rod Parts

Connecting Rod Installation

NOTICE: Each connecting rod is identified by a letter (A, E, S, etc.) as a designation for weight class. All of the connecting rods installed on the crankshaft must be of the same weight class, except "S" weight rods (service rods) can be used with either "A" or "E" weight rods depending on parts availability.

1. Ensure that all of the connecting rod assemblies in the engine have the same weight class letter.
2. Apply specified lubricant to the connecting rod and bearing inserts (per the latest revision of Service Instruction No. SI-1059) where shown in Figure 13. Different lubricants are used on the various areas on the connecting rod and bearing surfaces.

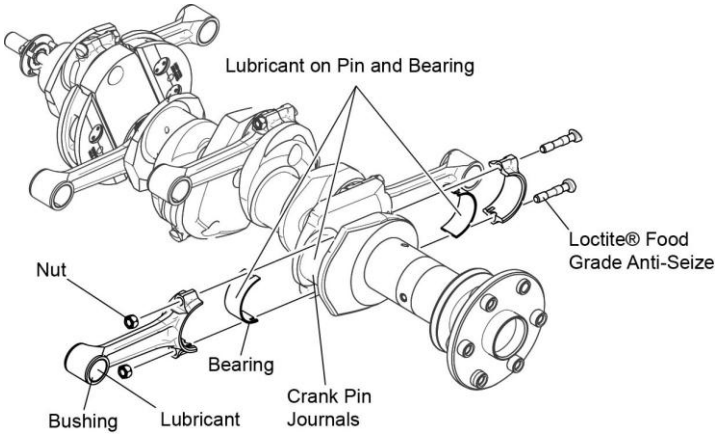

Figure 13
Connecting Rod Assembly Lubrication

NOTICE: Any time either the connecting rod bolt and/or nut pairs are removed from a Lycoming engine, replace **both** the bolt and nut pairs with new "Service Use Only" hardware regardless of apparent condition.

3. Refer to the latest revision of Service Instruction No. SI-1458 to identify the correct part numbers (P/Ns) for the new connecting rods bolts and nuts.
4. Make sure the new connecting rod bolt and new nut pairs are clean, free of dirt and debris and that the threads are not damaged.
5. Install the new lubricated matched set bearing pair on each connecting rod, one bearing on the connecting rod and the other bearing on the connecting rod cap. Ensure that the tang of each bearing fits and seats within the slot of the connecting rod as well as the connecting rod cap.

NOTICE: Do not install standard size connecting rod bolts in connecting rods with oversize bolt holes.

6. Apply engine oil mixture (mixture of 15% pre-lubricant (STP or equivalent) and 85% SAE No. 50 mineral base aviation grade lubricating oil) to the crank pin journal.
7. Install the connecting rod bolts in the connecting rod cap.
8. Apply Loctite® Food-Grade Anti-Seize Lubricant or equivalent to the bottom two or three threads of the new connecting rod bolts (Figure 13). Wipe away excess lubricant with a clean, lint-free cloth.
9. Install the connecting rod cap (with the bearing installed) on the back side of the respective crank pin on the crankshaft (where the numbers on the connecting rods and bearing locks point down - toward the oil sump.)

⚠ **CAUTION:** ENSURE THE NEW NUT ON EACH NEW CONNECTING ROD BOLT IS INSTALLED CORRECTLY. EACH CONNECTING ROD NUT HAS TWO DIFFERENT SURFACES, ONE SURFACE IS FLAT AND THE OTHER HAS A RAISED LIP. BE SURE TO INSTALL EACH NUT ON THE CONNECTING ROD BOLT WITH THE FLAT FACE TOUCHING THE ROD. THE RAISED LIP SURFACE IS AWAY FROM THE ROD. THE CONNECTING ROD BOLT CANNOT BE TIGHTENED CORRECTLY IF THE NUT ON THE CONNECTING ROD IS INSTALLED INCORRECTLY.

10. Install the connecting rod on the crank pin journal aligned with the connecting rod cap.
11. Install a new nut on each new connecting rod bolt where the flat face of the nut touches the connecting rod as shown in Figure 14.

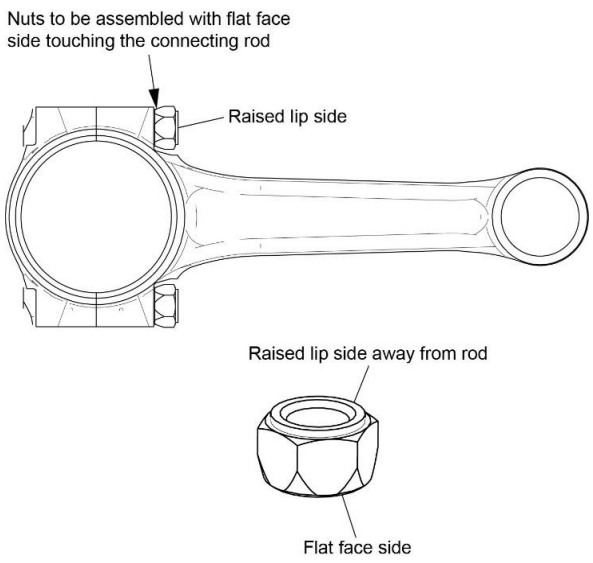

Figure 14
Connecting Rod Nut Installation

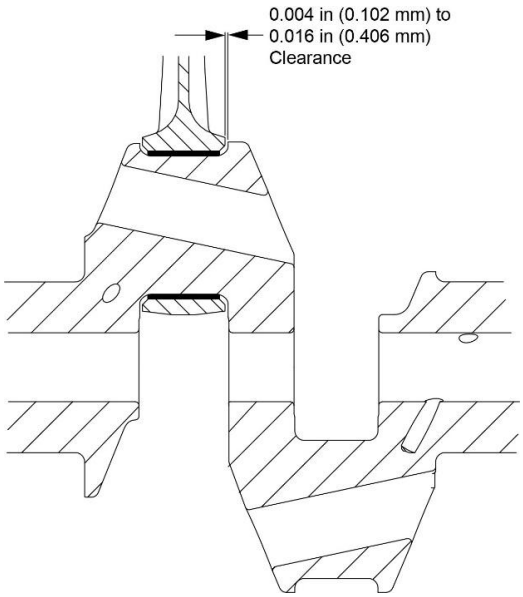

Figure 15
Connecting Rod Clearance

NOTICE: It will be necessary to use an ST-488, Stretch Bolt Micrometer and Set Master to ensure correct connecting rod bolt stretch when applicable.

12. Torque the connecting rod bolts per the torque values in the latest revision of Service Instruction No. SI-1458. (Stretch bolts require an initial torque and are then torqued to the correct stretched length.)
13. Measure the side clearance between the connecting rod and crankshaft with a feeler gage where shown in Figure 15. The clearance is to be 0.004 to 0.016 in (0.102 to 0.406 mm).

Parts Required for Reassembly

Parts Required Table

Top Overhaul Gasket Kit	Refer to the Top Overhaul Gasket Kit table
Replacement connecting rod (includes connecting rod bolts and nuts)	For each connecting rod removed and returned to Lycoming Engines through an Authorized Lycoming Distributor, refer to the Replacement Connecting Rod Assemblies table
Connecting rod bearings	For each connecting rod removed, order the same P/N bearings as removed (refer to Figure 16 for connecting rod bearing P/N location)

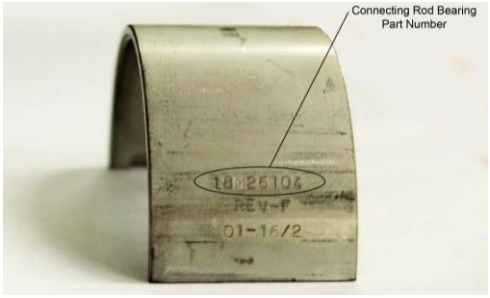

Figure 16
Connecting Rod Bearing Part Number

Replacement Connecting Rod Assemblies

LW-13865-S-85	LW-11750-S-85
78030-S	LW-19332-S-85

Top Overhaul Gasket Kit

Part Number	Applicable Overhaul Gasket Kit
LW-12040	Four Cylinder Parallel Valve Head Engines – O-235 Series
LW-12038	Four Cylinder Parallel Valve Head Engines – O-290; O, IO, LIO-320; AIO, AEIO-320; O-340; O-360-A, -B, -C, -D, -F, -J; IO-360-B, -E, -F, -L; LO-360-A; AEIO-360-B, -H; HO-360-A, -B; HIO-360-B; VO, IVO-360
05K22949	Four Cylinder Parallel Valve Head Engine – IO-360-M1A
LW-12039	Four Cylinder Angle Valve Head Engines – IO-360-A, -C, -D, -J, -K; AIO-360-A, -B; AEIO-360-A; HIO-360-A, -C, -D, -E, -F; LIO-360-C; LHIO-360-C, -F; TO, LTO-360-A; TIO-360-A
LW-15838	Four Cylinder Angle Valve Head Engines – TO, TIO-360-C1A6D, -F1A6D
LW-16916	Four Cylinder "76" Series Engines – O-320-H; O, LO, TO, LTO-360-E
05K26565	Kit – Gasket – Top overhaul IO-390 Series
LW-12032	Six Cylinder Parallel Valve Head Engines – O-540-A, -B, -E, -F, -G, -H, -J, -L, -V; AEIO-540-D; IO-540-C, -D, -J, -N, -R, -T, -W, -V, -AB; TIO-540-C, -E, -G, -H, -K, -AA, -AB, -AF, -AG; LTIO-540-K
LW-12036	Six Cylinder Parallel Valve Head Engine – O-435-A
LW-12033	Six Cylinder Angle Valve Head Top Exhaust Engines – IO-540-B, -E, -M, -U; TIO-540-A, -S, -T; TIO, LTIO-540-F, -J, -N, -R; TIO-541-A; IGO, IGSO-540-B
LW-12034	Six Cylinder Angle Valve Head Down Exhaust Engines – GO, VO, TVO-435; GO, GSO, IGSO-480; IO-540-A, -G, -K, -L, -P, -S, -AA; AEIO-540-L;TIO-540-W, -AE, -AH; TIO, LTIO-540-U, -V, -W; VO, IVO, TVO, TIVO-540; IGO, IGSO-540-A
LW-12035	Six Cylinder Angle Valve Head Engines – IO-540-AC1A5; TIO-540-AJ1A; TIO, TIGO-541-D, -E
LW-12036	Six Cylinder Parallel valve Head engine – O-435-A
LW-12037	Eight Cylinder Angle Valve Head Down Exhaust Engines – IO-720-A, -D
LW-18758	Eight Cylinder Angle Valve Head Top Exhaust Engines – IO-720-B, -C

Table 1 (Cont.)
Affected Lycoming Engines

Engine Model	Serial Number	Engine Model	Serial Number	Engine Model	Serial Number
YIO-540-D4A5	EL-36660-48E	YIO-540-D4A5	EL-36686-48E	YO-540-EXP26	EL-27663-40E
YIO-540-D4A5	EL-36668-48E	YIO-540-D4A5	EL-36715-48E	YTEO-540-B1A	EL-107-84E
YIO-540-D4A5	EL-36671-48E	YIO-540-D4A5	EL-36728-48E	YTEO-540-B1A	EL-108-84E
YIO-540-D4A5	EL-36681-48E	YIO-540-K1A5	EL-36677-48E		
Engine Model	**Serial Number**	**Engine Model**	**Serial Number**	**Engine Model**	**Serial Number**
AEIO-580-B1A	L-463-79E	AEIO-580-B1A	L-481-79E	AEIO-580-B1A	L-493-79E
AEIO-580-B1A	L-464-79E	AEIO-580-B1A	L-482-79E	AEIO-580-B1A	L-494-79E
AEIO-580-B1A	L-466-79E	AEIO-580-B1A	L-483-79E	AEIO-580-B1A	L-495-79E
AEIO-580-B1A	L-467-79E	AEIO-580-B1A	L-484-79E	AEIO-580-B1A	L-496-79E
AEIO-580-B1A	L-468-79E	AEIO-580-B1A	L-485-79E	AEIO-580-B1A	L-497-79E
AEIO-580-B1A	L-470-79E	AEIO-580-B1A	L-486-79E	AEIO-580-B1A	L-498-79E
AEIO-580-B1A	L-471-79E	AEIO-580-B1A	L-487-79E	AEIO-580-EXP	EL-469-79E
AEIO-580-B1A	L-472-79E	AEIO-580-B1A	L-488-79E	AEIO-580-EXP	EL-476-79E
AEIO-580-B1A	L-473-79E	AEIO-580-B1A	L-489-79E	IO-580-B1A	L-477-79E
AEIO-580-B1A	L-474-79E	AEIO-580-B1A	L-490-79E	YIO-580-EXP18	EL-478-79E
AEIO-580-B1A	L-475-79E	AEIO-580-B1A	L-491-79E	YIO-580-EXP18	EL-479-79E
AEIO-580-B1A	L-480-79E	AEIO-580-B1A	L-492-79E		
Engine Model	**Serial Number**				
IO-720-D1C	RL-1019-54A				

Table 2
Part Numbers and Ship Date Ranges of Suspect Connecting Rods and Suspect Connecting Rod Bushings Shipped as Spares

Part Number (P/N)	Description	Shipped from the Factory Between
LW-13923	Connecting Rod Bushing	18 November 2015 and 15 November 2016
LW-11750-S	Connecting Rod Assembly	20 November 2015 and 2 February 2017
78030-S	Connecting Rod Assembly	1 April 2016 and 2 February 2017
LW-19332-S	Connecting Rod Assembly	4 January 2016 and 2 February 2017

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MANDATORY SERVICE BULLETIN

DATE: June 13, 2017

Service Bulletin No. 630A
(Supersedes Service Bulletin No. 630)
Engineering Aspects are
FAA Approved

SUBJECT: Connecting Rod Bushing Inspection After Cylinder Removal

MODELS AFFECTED: All Lycoming Engines

TIME OF COMPLIANCE: At next maintenance event that requires cylinder removal

REASON FOR REVISION: Added more information to examine the following aspects of the connecting rod bushing: 1) looseness/out of place, 2) split line visibility, and 3) wear

NOTICE: Incomplete review of all the information in this document can cause errors. Read the entire Service Bulletin to make sure you have a complete understanding of the requirements.

This Service Bulletin includes a mandatory inspection of the connecting rod bushing (in the smaller end of the connecting rod as shown in Figure 1) that must be done any time a cylinder is removed from a Lycoming engine.

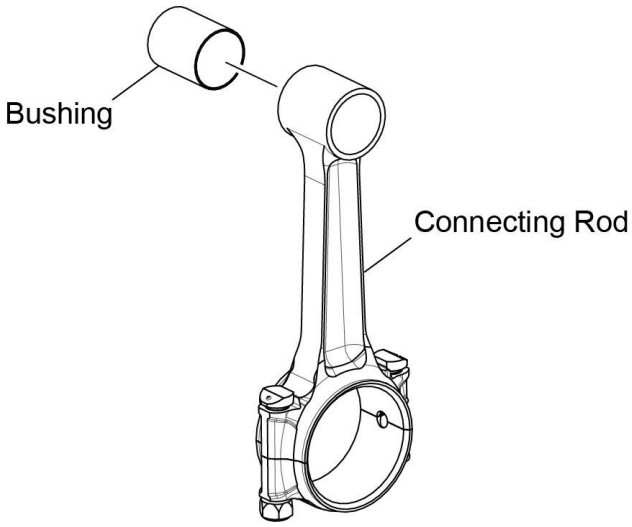

Figure 1
Bushing in Connecting Rod

NOTICE: To accurately and efficiently assist those who could be experiencing connecting rod bushings moving out of the correct installed position, Lycoming Engines must collect certain data and information from you each time you complete this inspection.

If, during the connecting rod bushing inspection, the bushing is found to have moved out of the correct installed position, contact Lycoming Engines' Product Support at +1 (877) 839-7878 (Toll Free) or +1 (570) 327-7222 or email Technicalsupport@lycoming.com.

General Aviation Manufacturers Association

ISSUED			REVISED			PAGE NO.	REVISION
MO	DAY	YEAR	MO	DAY	YEAR	1 of 4	A
04	10	17	06	13	17		

Connecting Rod Bushing Inspection

After cylinder removal, remove the piston and examine the connecting rod bushing for damage. If damaged, remove, discard and replace the connecting rod bushing.

If the connecting rod bushing is not damaged, continue with this progressive inspection for:

- Proper fit in the connecting rod
- Movement of the bushing
- Wear

If any one of the conditions identified above are found in the inspection herein, remove, discard and replace the connecting rod bushing.

For a bushing to be acceptable, the connecting rod bushing must not be damaged and pass all of the steps in the inspection herein.

NOTICE: Some connecting rod bushings have a straight edge (Figure 2) and others have a chamfered edge (Figure 3) on both sides after the bushing is installed at the factory. Some inspection steps apply specifically to the design application.

1. Examine the Connecting Rod Bushing for Looseness or if it has Moved Out of Place:

A. On *straight-edge, non-chamfered bushings (Figure 2)*:

(1) Either apply a straight edge or run your finger around the perimeter of each side of the connecting rod where the connecting rod bushing is installed.

(2) Visually or by touch determine whether the connecting rod bushing is raised above the surface of the connecting rod perimeter.

(3) If the connecting rod bushing is flush with or below the connecting rod perimeter (Figure 4), go to Step1A (5).

(4) If the edge of the connecting rod bushing is raised above the surface of the connecting rod perimeter (Figure 5), the connecting rod bushing is loose or has moved or is out of place. Remove, discard, and replace the connecting rod bushing.

Figure 2
Straight Edge Connecting Rod Bushing

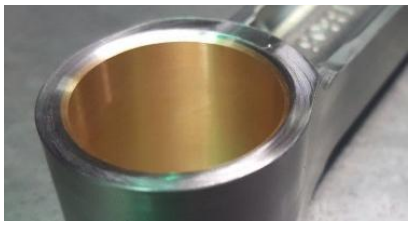

Figure 3
Chamfered Connecting Rod Bushing

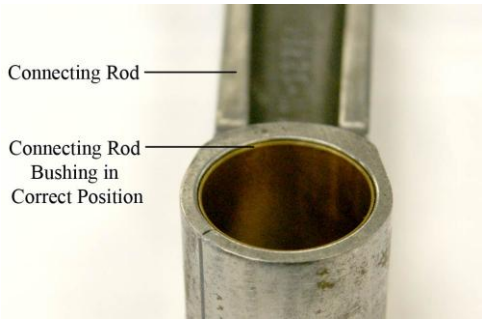

Figure 4
Example of Connecting Rod Bushing in Correct Position

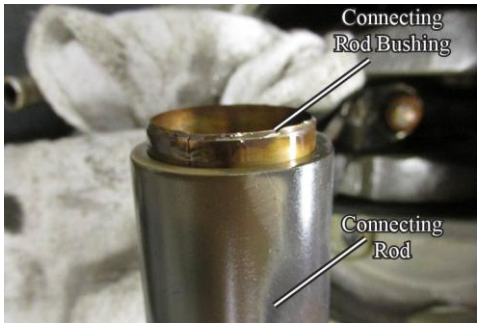

Figure 5
Example of Connecting Rod Bushing Raised Above the Connecting Rod

(5) Measure the distance from the surface of the connecting rod to the edge of the connecting rod bushing installed in the connecting rod (Figure 6) on both sides of the connecting rod.

(a) If the sum total of the measurements from both sides of the connecting rod is 0.038 in. (0.965 mm) or less, this feature is acceptable. Go to Step 2.

(b) If the sum total of the measurements from both sides of the connecting rod is greater than 0.038 in. (0.965 mm) (it is an indication the connecting rod bushing is loose or has moved or is out of place) (Figure 5). Remove, discard, and replace the connecting rod bushing.

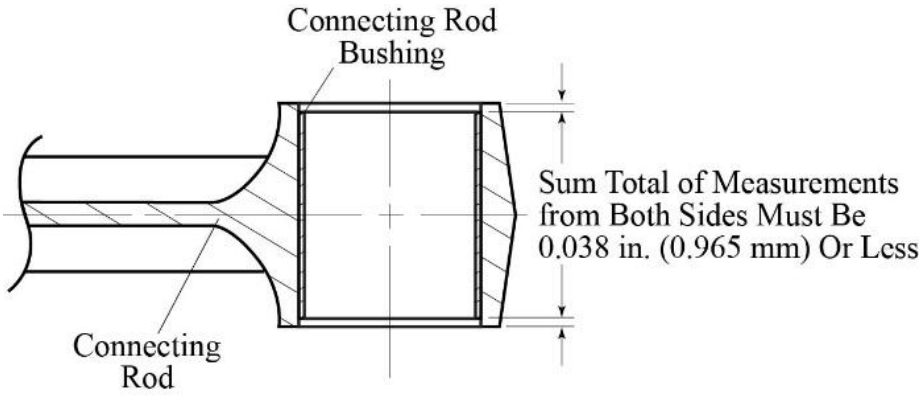

Figure 6
Correct Placement of Connecting Rod Bushing

B. On *chamfered connecting rod bushings (Figure 3),* look at the perimeter edge of the applicable connecting rod bushing within the connecting rod.

(1) If the chamfer of the connecting rod and the chamfer of the connecting rod bushing align (Figure 7), this feature is acceptable. Go to Step 2 on the next page.

(2) If the chamfer of the connecting rod and the chamfer of the connecting rod bushing do not align (Figure 8), the connecting rod bushing has moved within the connecting rod. Remove, discard, and replace the connecting rod bushing. Contact Lycoming Engines' Product Support at +1 (877) 839-7878 (Toll Free) or +1 (570) 327-7222 or email Technicalsupport@lycoming.com.

NOTICE: As the connecting rod bushing moves further out of place, the piston at the piston pin hole could show wear. If the connecting rod bushing is out of position, examine the piston for wear.

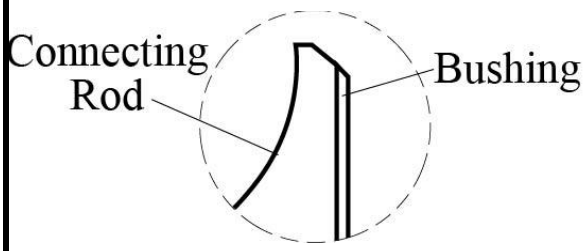

Figure 7
Connecting Rod Bushing in Correct Position

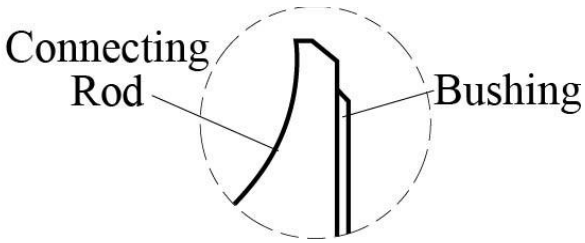

Figure 8
Connecting Rod Bushing Out of Place

2. Examine the Location of the Connecting Rod Bushing Split Line

NOTICE: Connecting rod bushings are manufactured with a split line in the bushing. When installed, the split line of the bushing is positioned approximately at a 45° angle from the center line of the connecting rod as shown in Figure 9.

Some connecting rod bushings have a notch or notches in the edge of the bushing (Figure 10). Do not confuse the notch or notches with the split line in the bushing.

Look for the split line on the inside diameter of the connecting rod bushing.

If the split line is visible at any other location other than approximately at a 45° angle from the center line of the connecting rod, the connecting rod bushing has moved and must be removed, discarded, and replaced.

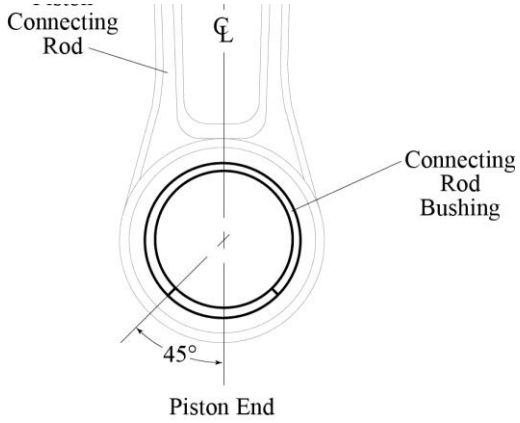

Figure 9
Connecting Rod Bushing Split Line Position

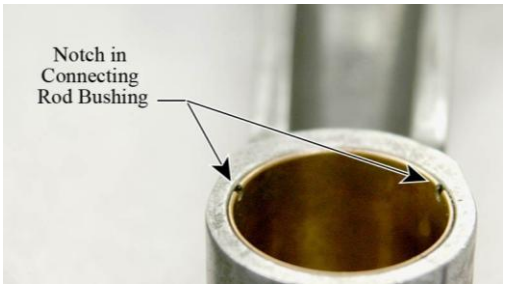

Figure 10
Notches in the Connecting Rod Bushing

3. Examine the Connecting Rod Bushing for Wear:

A. Measure and record the Inside Diameter (ID) of the connecting rod bushing.

B. Measure and record the Outside Diameter (OD) of the piston pin.

C. Calculate and record the clearance by subtracting the OD of the piston pin from the ID of the connecting rod bushing.

- If the clearance is less than or equal to the "Service Max." clearance in the latest revision of the ***Service Table of Limits - SSP-1776***, the connecting rod bushing and piston pin are acceptable with regards to connecting rod bushing wear.
- If the clearance is greater than the "Service Max." clearance in the latest revision of the ***Service Table of Limits - SSP-1776***, remove, discard and replace the component(s) that exceed(s) the manufacturing dimensions according to the latest revision of the ***Service Table of Limits - SSP-1776***.

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SERVICE INSTRUCTION

DATE: January 27, 2016

Service Instruction No. 1059E
(Supersedes Service Instruction No. 1059D)
Engineering Aspects are
FAA Approved

SUBJECT: Pre-Lubrication of Parts Before Assembly

MODELS AFFECTED: All Lycoming opposed series aircraft engines

TIME OF COMPLIANCE: At engine assembly

REASON FOR REVISION: Update lubricants

NOTICE: Incomplete review of all the information in this document can cause errors. Read the entire Service Instruction to make sure you have a complete understanding of the requirements.

This Service Instruction identifies approved factory-tested lubricants for specific engine parts that must be lubricated during engine assembly. Many premature part failures have been caused by incorrect pre-lubrication during engine assembly.

If parts are not correctly lubricated, or if an unapproved lubricant is used, engine parts could become scored before the engine oil has lubricated the engine during the first cycle of operation. This scoring can cause premature part failure, or, in some cases, engine failure.

As preventive action, during engine assembly and individual engine component replacement, apply the approved lubricant for specified components identified in Table 1.

Table 1
Lycoming-Approved Lubricants for Engine Components

Lycoming-Approved Lubricant	Engine Component
Undiluted lubricant - Castrol Contractor's Special NLGI #1 or Lubri-bond (A) - Fulfills MIL-L-23398 Spec. or Tex MOLYTEX EP 0	• Camshaft lobes • Face of tappet body (straight body solid tappet, hydraulic spherical tappet, or hydraulic hyperbolic tappet only) • Rocker arm tips • Valve stems and valve guides • Supercharger bearing (where applicable) • Piston pin plugs • Crankshaft thrust bearing surface • Drive spline of AN-type gear driven fuel pump • Fuel pump plunger for AC-type fuel pump

Table 1 (Cont.)
Lycoming-Approved Lubricants for Engine Components

Undiluted lubricant - Fel-Pro C5-A or Cop-Graf	High crush bearings used with connecting rod assembly P/N LW-13422 (apply as a light coat to the bearing surface of the connecting rod)
Mixture of 15% pre-lubricant (STP or equivalent) and 85% SAE No. 50 mineral base aviation grade lubricating oil	• All other connecting rod bearings • Tappet bores (roller tappet engines only) • Roller tappet rollers • Camshaft lobes (roller tappet engines only) • Cylinder base oil ring • All other engine components

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SERVICE INSTRUCTION

DATE: November 10, 2015

Service Instruction No. 1458G
(Supersedes Service Instruction No. 1458F and
Obsoletes Service Instruction Nos. 1106D, 1311A, and 1318)
Engineering Aspects are
FAA Approved

SUBJECT: Connecting Rod Bolts (Identification and Installation)

MODELS AFFECTED: All supported Lycoming reciprocating aircraft engines

TIME OF COMPLIANCE: Whenever new connecting rods and/or new connecting rod bolts are being installed

REASON FOR REVISION: Clarified connecting rod bolt selection and installation instructions, added new Figure 1, revised part numbers in Table 1, and added information from obsolete Service Instructions

NOTICE: Incomplete review of all the information in this document can cause errors. Read the entire Service Instruction to make sure you have a complete understanding of the requirements.

This Service Instruction identifies currently available connecting rod assemblies, the applicable connecting rod bolt part numbers (P/Ns), specific requirements, and installation instructions for the various connecting rod bolts. Table 1 includes connecting rod bolt P/N LW-12596 which can be used as either a stretch bolt or torque bolt (indicated by the green or blue shading). Table 2 includes connecting rod assemblies no longer available from Lycoming Engines.

Connecting Rod Bolt Selection & Installation Guidelines

⚠ **CAUTION:** CONNECTING ROD ASSEMBLIES IN TABLE 1 HAVE A CORRESPONDING "SERVICE USE ONLY" CONNECTING ROD BOLT P/N. FOR CORRECT ENGINE OPERATION, ONLY INSTALL THE DESGNATED "SERVICE USE ONLY" CONNECTING ROD BOLT ON THE APPLICABLE CONNECTING ROD. DO NOT INSTALL ANY OTHER CONNECTING ROD BOLT.

NOTICE: All current connecting rod bolts are installed with connecting rod nut P/N LW-12186 as a matched set.

1. Any time connecting rod bolts and nuts are removed, discard both of the connecting rod bolts and nuts (Figure 1) and replace them with "Service Use Only" connecting rod bolts and nuts for the corresponding connecting rod assembly in Table 1 or Table 2.
2. To select the correct connecting rod bolt, identify the connecting rod assembly P/N in Table 1 and select the corresponding replacement "Service Use Only" connecting rod bolt P/N.

NOTICE: Connecting rod bolts identified as "Service Use Only" in Tables 1 and 2 are for installation in the field. Connecting rod bolts identified as "Lycoming Use Only" in Table 1 are only installed at the factory and are not for field installation.

⚠ CAUTION: LYCOMING DOES NOT GIVE APPROVAL FOR USE OF PMA PARTS ON ITS ENGINES. LYCOMING INSTALLATION INSTRUCTIONS DO NOT APPLY TO PMA PARTS. EQUIPMENT FAILURE COULD OCCUR IF LYCOMING INSTRUCTIONS ARE USED TO INSTALL PMA PARTS.

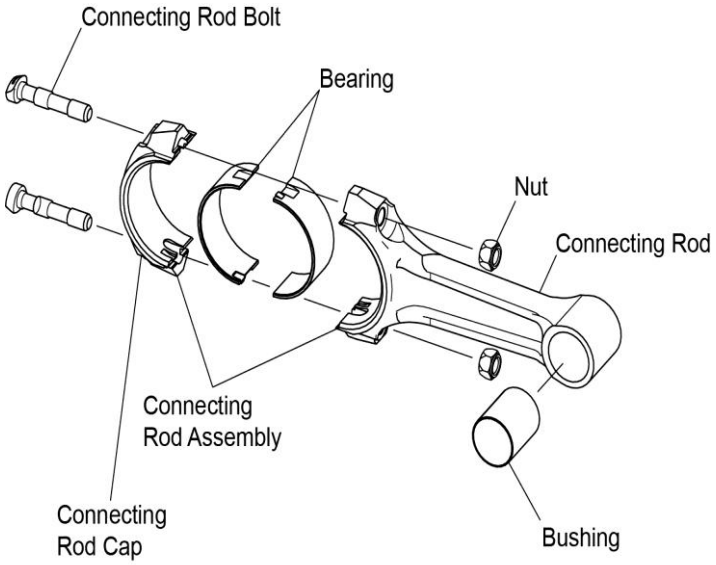

Figure 1
Connecting Rod

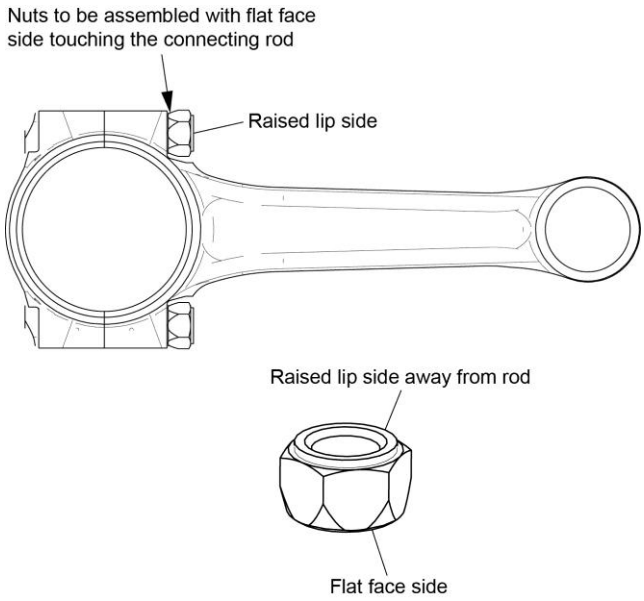

Figure 2
Connecting Rod Nut Installation

⚠ WARNING: *DO NOT ASSEMBLE STANDARD SIZE CONNECTING ROD BOLTS IN RODS THAT HAVE 0.005 IN. (0.127 MM) OVERSIZE BOLT HOLES. REFER TO THE "OVERSIZE CONNECTING ROD BOLTS" SECTION OF THIS SERVICE INSTRUCTION.*

3. Make sure the connecting rod bolt and nut are clean, free of dirt and debris, and that the threads are not damaged.
4. Apply Loctite® Food Grade Anti-Seize Lubricant to the bottom two or three threads of the connecting rod bolt. Wipe away any excess with a clean, lint-free cloth.

⚠ CAUTION: CORRECT INSTALLATION OF THE NEW NUT ON EACH NEW CONNECTING ROD BOLT IS NECESSARY FOR CORRECT CONNECTING ROD ASSEMBLY. EACH CONNECTING ROD NUT HAS TWO DIFFERENT SURFACES, ONE SURFACE IS FLAT AND THE OTHER HAS A RAISED LIP. BE SURE TO INSTALL EACH NUT ON THE CONNECTING ROD BOLT WITH THE FLAT FACE TOUCHING THE ROD AS SHOWN IN FIGURE 2. THE RAISED LIP SURFACE IS AWAY FROM THE ROD. THE CONNECTING ROD BOLT CANNOT BE TIGHTENED CORRECTLY IF THE NUT ON THE CONNECTING ROD IS INSTALLED INCORRECTLY.

5. Install the nut on the connecting rod bolt where the flat face of the nut touches the connecting rod as shown in Figure 2.
6. As shown in Table 1, some connecting rod bolts are either torqued or stretched:
   A. FOR TORQUE BOLTS: Tighten the torque bolts with a calibrated torque wrench. If a torque bolt cannot be installed at the specified torque value, send the bolt to Lycoming Engines. Refer to Tables 1 and 2 in this Service Instruction for the specified torque value.

B. FOR STRETCH BOLTS: Stretch bolts require an initial torque of 35 ft.-lb. (47 Nm). If 35 ft.-lb. (47 Nm) of torque fails to give the correct stretch, between 2.255/2.256 in. (57.2770/57.3024 mm) length measured by gauge 64945 or equivalent, apply additional torque, to a maximum of 55 ft.-lb.(75 Nm), until the bolt is at the correct stretched length. Replace the bolt if the required stretch length cannot be obtained using an applied torque between the minimum and maximum amounts. If 35 ft.-lb. (47 Nm) causes an over-stretched bolt (greater than 2.256 in. (57.3024 mm) length) replace the bolt. Although variables in the joint can increase the torque for the specified stretch, a maximum torque of 55 ft.-lb. (75 Nm) is acceptable for stretch bolts.

Initial Torque: 35 ft.-lb. (47 Nm)

Maximum Torque: 55 ft.-lb. (75 Nm).

NOTICE: If the correct stretched length of 2.255/2.256 in. (57.2770/57.3024 mm) is not achieved with the maximum torque of 55 ft.-lb. (75 Nm), discard and replace the bolt.

Table 1

Lycoming Connecting Rod Assemblies, Bolts, and Bolt Installation

Current Connecting Rod Assembly P/N	Service Use Only* Connecting Rod Bolt P/N	Bolt Type	Lycoming Use Only Connecting Rod Bolt P/N	Features
LW-11750-S**	75061	Torque	14S23890	Torque 40 ft.-lb (54 Nm).
LW-13865-S**	75061	Torque	14S23890	
77450-S	75060	Stretch	14S23890	Stretch length of bolt must be 2.255/2.256 in. (57.2770/57.3024 mm) measured using gage 64945 or equivalent.
78030-S	78027	Torque	----------	Torque 40 ft.-lb (54 Nm). All rod assemblies (connecting rod, bolts, and nuts) must be the same in a case where alternate rods could be approved for a particular engine.
LW-15288-S	78027	Torque	----------	
LW-13422-S**	LW-12596	Stretch	14S23889	High tensile strength bolt. Underside of bolt head must install flush against the boss on the connecting rod. Stretch length of bolt must be 2.255/2.256 in. (57.2770/57.3024 mm) measured using gage 64945 or equivalent.
LW-19332-S**	LW-12596	Stretch	14S23889	
LW-13937-S*	***LW-12596***	***Torque***	***14S23889***	*Torque 40 ft.-lb (54 Nm)*

NOTICE: Any time connecting rod bolts and nuts are removed, discard both of the connecting rod bolts and nuts (Figure 1) and replace them with "Service Use Only" connecting rod bolts and nuts for the corresponding connecting rod assembly

All current connecting rod assemblies use connecting rod nut P/N LW-12186.

Connecting rod bolt P/N LW-12595 is no longer available.

* "Service Use Only" bolts are to be used for installation of the connecting rod in the field.

** This connecting rod assembly can use connecting rod bolt P/N 75060 (stretch bolt) as an alternate to connecting rod bolt P/N 75061 (torque bolt). Either bolt must be used in pairs on the connecting rod assemblies in complete engine sets.

⚠ **CAUTION:** WHEN INSTALLING ANY CONNECTING ROD ASSEMBLY IN TABLE 1, USE THE SPECIFIED CONNECTING ROD BOLT FOR THAT PARTICULAR ASSEMBLY.

Table 2
Lycoming Connecting Rod Assemblies

Connecting Rod Assembly No Longer Available at Lycoming	Service Use Only* Connecting Rod Bolt P/N	Bolt Type	Features
69483	74669**	Crimp	Torque 30 ft.-lb (41 Nm).
74502	74644	Torque	Torque 40 ft.-lb (54 Nm).
LW-11457-S	75061	Torque	Torque 40 ft.-lb (54 Nm).
LW-10776	75060	Stretch	Stretch length of bolt must be 2.255/2.256 in. (57.2770/57.3024 mm) measured using gage 64945 or equivalent.
LW-10725	78027	Torque	Torque 40 ft.-lb (54 Nm) All rod assemblies (connecting rod, bolts, and nuts) must be the same in a case where alternate rods could be approved for a particular engine.
78028-S	78027	Torque	
LW-10726	78027	Torque	
78029-S	78027	Torque	Torque 40 ft.-lb (54 Nm) All rod assemblies (connecting rod, bolts, and nuts) must be the same in a case where alternate rods could be approved for a particular engine.
LW-10718	78027	Torque	
LW-10646	75060	Stretch	Stretch length of bolt must be 2.255/2.256 in. (57.2770/57.3024 mm) measured using gage 64945 or equivalent.

NOTICE: Any time connecting rod bolts and nuts are removed, discard both of the connecting rod bolts and nuts (Figure 1) and replace them with "Service Use Only" connecting rod bolts and nuts for the corresponding connecting rod assembly.

* "Service Use Only" bolts are to be used for installation of the connecting rod in the field.

** No longer available, no replacement available.

⚠ **CAUTION:** WHEN INSTALLING ANY CONNECTING ROD ASSEMBLY IN TABLE 2, USE THE SPECIFIED CONNECTING ROD BOLT FOR THAT PARTICULAR ASSEMBLY.

Oversize Connecting Rod Bolts

Connecting rods with 0.005 in. (0.127 mm) oversize bolt holes, use connecting rod bolts with 0.005 in. (0.127 mm) oversize body diameter are identified as shown in Figures 3 and 4. The oversize connecting rod bolts are identified by the black oxide coating and the characters, "H5" on the truncated surface of the bolt head; connecting rods with 0.005 in. (0.127 mm) oversize bolt holes are stamped with "H5" on both sides of the rod and cap. Also, the part number on the side of connecting rod has the suffix"H5" indicative of the oversize bolt holes. If any doubt exists as to the size of any bolt or bolt hole, measure the diameter with the dimensions shown in Figures 3 and 4.

WARNING *DO NOT, UNDER ANY CIRCUMSTANCE, ASSEMBLE STANDARD SIZE CONNECTING ROD BOLTS IN CONNECTING RODS THAT HAVE .005 0/S HOLES; TO DO SO COULD CAUSE ABRUPT ENGINE FAILURE. USED CONNECTING RODS WITH STANDARD SIZE BOLT HOLES CANNOT BE REWORKED TO ACCOMMODATE OVERSIZE BOLTS.*

Table 3 identifies the part numbers of connecting rods and corresponding attaching bolts that are currently available with 0.005 in. (0.127 mm) oversize bolt holes and 0.005 in. (0.127 mm) oversize body diameters, respectively. During manufacture, connecting rods with 0.005 in. (0.127 mm) oversize bolts and connecting rods with standard size bolts are not intermixed in the same engine. However, during overhaul it is permissible to intermix connecting rod assemblies with oversize bolts and connecting rod assemblies with standard size bolts.

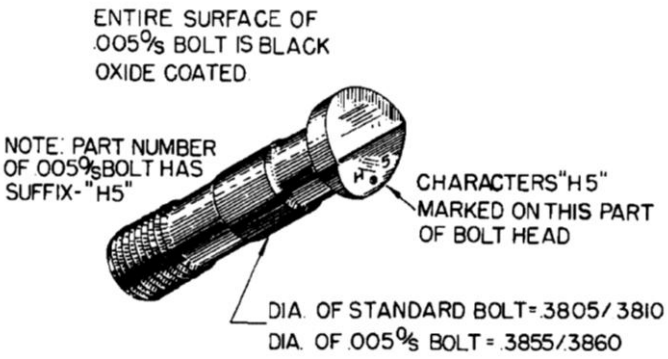

Figure 3
Typical Connecting Rod Bolt Showing Identification Marks on the Head

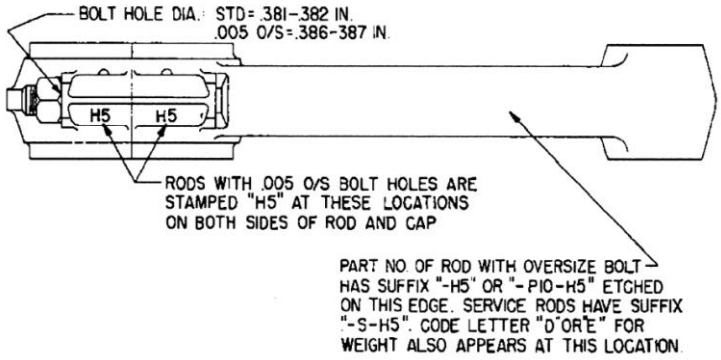

Figure 4
Typical Connecting Rod Assembly Showing Location of Oversize Identification Markings

Table 3
Connecting Rod and Oversize Connecting Rod Bolt Part Numbers

Basic Connecting Rod P/N	Basic Connecting Rod Bolt P/N
77450	75060
78030	78027
LW- 11750	75061
LW-13422*	***LW-12596****
LW-13937*	***LW-12596****
* Refer to Table 1 for connecting rod assembly and stretch or torque bolt application.	

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SERVICE INSTRUCTION

DATE: March 11, 2020

Service Instruction No. 1575
Engineering Aspects are
FAA Approved

SUBJECT: New Connecting Rod Bushing

MODELS AFFECTED: All Lycoming engine models

TIME OF COMPLIANCE: As required

NOTICE: Incomplete review of all the information in this document can cause errors. Read the entire Service Instruction to make sure you have a complete understanding of the requirements.

This Service Instruction announces the release of a new connecting rod bushing P/N 01K28983 replacing connecting rod bushing P/N LW-13923. The connecting rod bushing P/N 01K28983 will be the only bushing installed in connecting rods, in engines, or available as spares from Lycoming Engines once inventory of connecting rod bushing P/N LW-13923 is depleted. This Service Instruction contains installation instructions for the new connecting rod bushing P/N 01K28983.

The new connecting rod bushing P/N 01K28983 does not require burnishing after installation in the connecting rod. Bushing P/N 01K28983 is not affected by any version of Lycoming Mandatory Service Bulletin 632 including any procedures or tools referenced in any version of S.B. 632.

NOTICE: Connecting rod bushing P/N LW-13923 is still approved for use, if available from distributors or in spares inventory. Burnishing the LW-13923 is still required (refer to the applicable overhaul or maintenance manual). The new 01K28983 and superseded LW-13923 bushings may be used together in any combination in an engine.

When installing P/N 01K28983 connecting rod bushing, installation instructions in this Service Instruction supersede installation instructions in any maintenance manual or overhaul manual released by Lycoming Engines prior to release of this Service Instruction. The connecting rod bushing installation procedure in this Service Instruction will be included in engine manuals when revised and in new manuals when released.

Replace the connecting rod bushing if it is damaged or if the inner diameter of the bushing is worn beyond the service limit.

NOTICE: The new connecting rod bushing P/N 01K28983 will have the part number etched on the outside diameter of the bushing (Figure 1). Future versions of this bushing will be marked 01K28983-B or later revision letter, have a different lot code, and be identified with a notch in the edge of the bushing.

Figure 1
Connecting Rod Bushing (P/N 01K28983)

General Aviation Manufacturers Association

ISSUED			REVISED			PAGE NO.	REVISION
MO	DAY	YEAR	MO	DAY	YEAR	1 of 2	--
03	11	20	--	--	--		

Connecting Rod Bushing Replacement Procedure for Bushing P/N 01K28983

A. Clamp the connecting rod on the Connecting Rod Bushing Replacement Block P/N 64597 or equivalent in such a manner that the small bushing in the rod is in alignment with the hole stamped "Remove Bushing".

B. Use the Connecting Rod Bushing Removal Drift P/N 64535 or equivalent to drive the bushing out of the rod.

C. After bushing removal, measure the inside diameter of the connecting rod both parallel and perpendicular to the connecting rod beam (Figure 2). If either inside diameter measurement is not between 1.1833 in. (30.056 mm) and 1.1848 in. (30.094 mm), discard the connecting rod and replace it with a serviceable connecting rod.

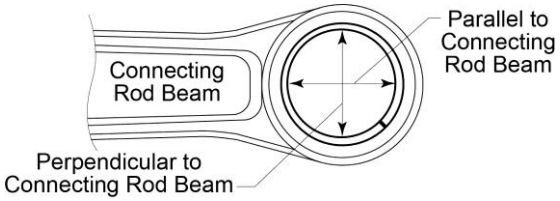


Figure 2
Measure the I.D. of the Connecting Rod

D. Move the connecting rod to the "Install" position on the Connecting Rod Bushing Replacement Block or equivalent and clamp it securely in place.

E. Use the Replacement Drift P/N 64536 or equivalent to install the new connecting rod bushing in the connecting rod.

F. Make sure the split in the bushing is located so that it is toward the piston end of the connecting rod and 45° off the centerline (Figure 3) and press the bushing into the connecting rod until the edge of the bushing is flush with the surface of the connecting rod.

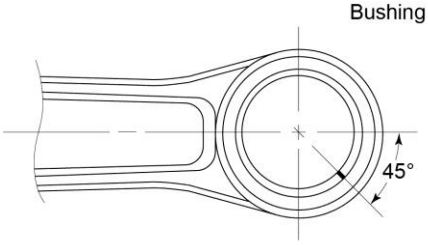


Figure 3
Bushing Installed in the Connecting Rod

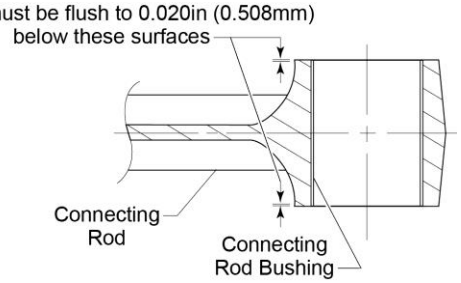


Figure 4
Bushing Installed Flush to 0.020 in.
(0.508 mm) Below Connecting Rod Surface

⚠ **CAUTION** **DO NOT** BURNISH CONNECTING ROD BUSHING P/N 01K28983. THESE BUSHINGS ARE NOT DESIGNED TO BE BURNISHED AFTER INSTALLATION. BURNISHING MAY RESULT IN DAMAGE TO BUSHING P/N 01K28983.

G. Examine the bushing after installation to make sure the bushing is flush to 0.020 in. (0.508 mm) below the connecting rod surface (Figure 4) on both sides of the connecting rod.

H. Remove the connecting rod from the holding block and complete a final bore of the bushing to the inside diameter shown in the latest revision of the ***Service Table of Limits - SSP-1776***.

If using a carbide cutter when final boring the 01K28983 bushing, Lycoming recommends an approximate spindle speed of 730 RPM and a feed rate of .003 in. per revolution.

I. As a check, measure the bushing inner diameter with the Finish ID Gage P/N 64767 or equivalent.

J. Complete the “Connecting Rod Parallelism/Squareness Check” per instructions in the latest revision of the applicable Lycoming Engine Maintenance Manual or Overhaul Manual.

K. If the assembly does not pass this check, replace the connecting rod assembly.

L. Record all maintenance completed, include the P/N of the new bushing, in the engine logbook.

[4910-13-P]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39

[Docket No. FAA-2017-0788; Product Identifier 2017-NE-27-AD; Amendment 39-18988; AD 2017-16-11]

RIN 2120-AA64

Airworthiness Directives; Lycoming Engines Reciprocating Engines

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule; request for comments.

SUMMARY: We are adopting a new airworthiness directive (AD) for certain models of Lycoming Engines reciprocating engines. This AD requires an inspection of connecting rods and replacement of affected connecting rod small end bushings. This AD was prompted by several reports of connecting rod failures resulting in uncontained engine failure and in-flight shutdowns (IFSDs). We are issuing this AD to address the unsafe condition on these products.

DATES: This AD is effective [INSERT DATE 5 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

The Director of the Federal Register approved the incorporation by reference of a certain publication listed in this AD as of [INSERT DATE 5 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

We must receive comments on this AD by [INSERT DATE 45 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

ADDRESSES: You may send comments, using the procedures found in 14 CFR 11.43 and 11.45, by any of the following methods:

• Federal eRulemaking Portal: Go to http://www.regulations.gov. Follow the instructions for submitting comments.

• Fax: 202-493-2251.

• Mail: U.S. Department of Transportation, Docket Operations, M-30, West Building Ground Floor, Room W12-140, 1200 New Jersey Avenue SE., Washington, DC 20590.

• Hand Delivery: U.S. Department of Transportation, Docket Operations, M-30, West Building Ground Floor, Room W12-140, 1200 New Jersey Avenue SE., Washington, DC 20590, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

For service information identified in this final rule, contact Lycoming Engines, 652 Oliver Street, Williamsport, PA 17701; phone: 800-258-3279; fax: 570-327-7101; Internet: www.lycoming.com/Lycoming/SUPPORT/TechnicalPublications/ServiceBulletins.aspx. You may view this service information at the FAA, Engine and Propeller Standards Branch, 1200 District Avenue, Burlington, MA. For information on the availability of this material at the FAA, call 781-238-7125. It is also available on the internet at http://www.regulations.gov by searching for and locating Docket No. FAA-2017-0788.

Examining the AD Docket:

You may examine the AD docket on the Internet at http://www.regulations.gov by searching for and locating Docket No. FAA-2017-0788; or in person at the Docket Management Facility between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays. The AD docket contains this final rule, the regulatory evaluation, any comments received, and other information. The street address for the Docket Office (phone: 800-647-5527) is in the ADDRESSES section. Comments will be available in the AD docket shortly after receipt.

FOR FURTHER INFORMATION CONTACT: Norman Perenson, Aerospace Engineer, New York ACO Branch, FAA, 1600 Stewart Avenue, Suite 410, Westbury, NY 11590; phone: 516-228-7337; fax: 516-794-5531; email: norman.perenson@faa.gov.

SUPPLEMENTARY INFORMATION:

Discussion

We have received 5 reports of uncontained engine failures and IFSDs due to failed connecting rods on various models of Lycoming Engines reciprocating engines listed in Table 1 of Lycoming Engines Mandatory Service Bulletin (MSB) No. 632B, dated August 4, 2017, that were overhauled or repaired using any replacement part listed in Table 2 of Lycoming Engines MSB No. 632B, dated August 4, 2017, which was shipped from Lycoming Engines during the dates listed in Table 2 of Lycoming Engines MSB No. 632B, dated August 4, 2017. This AD requires accomplishing the instructions in Lycoming Engines MSB No. 632B, dated August 4, 2017, except for the instruction to complete the online survey as specified in the MSB. This condition, if not corrected, could result in uncontained engine failure, total engine power loss, IFSD, and possible loss of the airplane. We are issuing this AD to prevent connecting rod failure.

Related Service Information under 1 CFR part 51

Lycoming Engines Mandatory Service Bulletin (MSB) No. 632B, dated August 4, 2017. The MSB describes procedures for inspecting connecting rods and replacing connecting rod small end bushings. This service information is reasonably available because the interested parties have access to it through their normal course of business or by the means identified in the ADDRESSES section.

FAA's Determination

We are issuing this AD because we evaluated all the relevant information and determined the unsafe condition described previously is likely to exist or develop in other products of the same type design.

AD Requirements

This AD requires accomplishing the actions specified in the service information described previously, except as discussed under "Differences Between the AD and the Service Information".

Differences Between this AD and the Service Information

Lycoming Engines MSB No. 632B, dated August 4, 2017 requires you to complete an online survey at www.lycoming.com/SB632, review your inventory of any part listed in Table 2 of the MSB, and sending certain parts to Lycoming Engines. This AD does not include those requirements.

FAA's Justification and Determination of the Effective Date

An unsafe condition exists that requires the immediate adoption of this AD. The FAA has found that the risk to the flying public justifies waiving notice and comment prior to adoption of this rule because compliance is required within 10 operating hours. Therefore, we find that notice and opportunity for prior public comment are impracticable and that good cause exists for making this amendment effective in less than 30 days.

Comments Invited

This AD is a final rule that involves requirements affecting flight safety and was not preceded by notice and an opportunity for public comment. However, we invite you to send any written data, views, or arguments about this final rule. Send your comments to an address listed under the ADDRESSES section. Include the docket number FAA-2017-0788 and Product Identifier 2017-NE-27-AD at the beginning of your comments. We specifically invite comments on the overall regulatory, economic, environmental, and energy aspects of this final rule. We will consider all comments received by the closing date and may amend this final rule because of those comments.

We will post all comments we receive, without change, to http://www.regulations.gov, including any personal information you provide. We will also post a report summarizing each substantive verbal contact we receive about this final rule.

Costs of Compliance

We estimate that this AD affects 778 engines installed on airplanes of U.S. registry.

We estimate the following costs to comply with this AD:

Estimated costs

Action	Labor cost	Parts cost	Cost per product	Cost on U.S. operators
Inspection	15 work-hours X $85 per hour = $1,275 per inspection cycle	$150.00	$1,425	$1,108,650.00 per inspection cycle

We estimate the following costs to do any necessary replacements that would be required based on the results of the inspection. We have no way of determining the number of aircraft that might need these replacements:

On-condition costs

Action	Labor cost	Parts cost	Cost per product
Connecting rod replacement on 4-cylinder engine	12 work-hours X $85 per hour = $1,020.00	$1,150.00	$2,170.00
Connecting rod replacement on 6-cylinder engine	18 work-hours X $85 per hour = $1,530.00	$5,150.00	$6,680.00
Connecting rod replacement on 8-cylinder engine	20 work-hours X $85 per hour = $1,700.00	$5,150.00	$6,850.00

According to the manufacturer, some of the costs of this AD may be covered under warranty, thereby reducing the cost impact on affected individuals. We do not control warranty coverage for affected individuals. As a result, we have included all costs in our cost estimate.

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.

This AD is issued in accordance with authority delegated by the Executive Director, Aircraft Certification Service, as authorized by FAA Order 8000.51C. In accordance with that order, issuance of ADs is normally a function of the Compliance and Airworthiness Division, but during this transition period, the Executive Director has delegated the authority to issue ADs applicable to engines, propellers, and associated appliances to the Manager, Engine and Propeller Standards Branch, Policy and Innovation Division.

Regulatory Findings

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),

(3) Will not affect intrastate aviation in Alaska, and

(4) 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.

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 FAA 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 (AD):

2017-16-11 Lycoming Engines Reciprocating Engines (Type Certificate previously held by Textron Lycoming Division, AVCO Corporation): Amendment 39-18988; Docket No. FAA-2017-0788; Product Identifier 2017-NE-27-AD.

(a) Effective Date

This AD is effective [INSERT DATE 5 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

(b) Affected ADs

None.

(c) Applicability

This AD applies to:

(1) all Lycoming Engines reciprocating engines listed in Table 1 of Lycoming Engines Mandatory Service Bulletin (MSB) No. 632B, dated August 4, 2017, and

(2) all Lycoming Engines reciprocating engines that were overhauled or repaired using any replacement part listed in Table 2 of Lycoming Engines MSB No. 632B, dated August 4, 2017, which was shipped from Lycoming Engines during the dates listed in Table 2 of Lycoming Engines MSB No. 632B, dated August 4, 2017.

(d) Subject

Joint Aircraft System Component (JASC) Code 8520, Reciprocating Engine Power Section.

(e) Unsafe Condition

This AD was prompted by several reports of connecting rod failures resulting in uncontained engine failure and in-flight shutdowns (IFSDs). We are issuing this AD to prevent connecting rod failure. The unsafe condition, if not corrected, could result in uncontained engine failure, total engine power loss, IFSD, and possible loss of the airplane.

(f) Compliance

Comply with this AD within the compliance times specified, unless already done.

(g) Required Actions

(1) For all affected engines, within 10 operating hours after the effective date of this AD, inspect all affected connecting rods as specified in Lycoming Engines MSB No. 632B, dated August 4, 2017, except for the instruction to complete the online survey and the instruction to review your inventory.

(2) Replace all connecting rods that fail the inspection required by paragraph (g)(1) of this AD with parts eligible for installation.

(h) Installation Prohibition

After the effective date of this AD:

(1) do not install any Lycoming Engines reciprocating engine that was overhauled or repaired using any replacement part listed in Table 2 of Lycoming Engines MSB No. 632B, dated August 4, 2017, which was shipped from Lycoming Engines during the dates listed in Table 2 of Lycoming Engines MSB No. 632B, dated August 4, 2017, and

(2) do not install any part listed in Table 2 of Lycoming Engines MSB No. 632B, dated August 4, 2017 into any Lycoming Engines reciprocating engine.

(i) Credit for Previous Actions

You may take credit for the actions required by paragraph (g) of this AD if you performed those actions before the effective date of this AD using Lycoming Engines MSB No. 632A, dated July 23, 2017 or earlier versions.

(j) Alternative Methods of Compliance (AMOCs)

(1) The Manager, New York ACO Branch, FAA, has the authority to approve AMOCs for this AD, if requested using the procedures found in 14 CFR 39.19. In accordance with 14 CFR 39.19, send your request to your principal inspector or local Flight Standards District Office, as appropriate. If sending information directly to the manager of the certification office, send it to the attention of the person identified in paragraph (j) of this AD.

(2) Before using any approved AMOC, notify your appropriate principal inspector, or lacking a principal inspector, the manager of the local flight standards district office/certificate holding district office.

(k) Related Information

For more information about this AD, contact Norman Perenson, Aerospace Engineer, New York ACO Branch, FAA, 1600 Stewart Avenue, Suite 410, Westbury, NY 11590; phone: 516-228-7337; fax: 516-794-5531; email: norman.perenson@faa.gov.

(l) Material Incorporated by Reference

(1) The Director of the Federal Register approved the incorporation by reference (IBR) of the service information listed in this paragraph under 5 U.S.C. 552(a) and 1 CFR part 51.

(2) You must use this service information as applicable to do the actions required by this AD, unless the AD specifies otherwise.

(i) Lycoming Engines Mandatory Service Bulletin No. 632B, dated August 4, 2017.

(ii) Reserved.

(3) For Lycoming Engines service information identified in this AD, contact Lycoming Engines, 652 Oliver Street, Williamsport, PA 17701; phone: 800-258-3279; fax: 570-327-7101; Internet: www.lycoming.com/Lycoming/SUPPORT/TechnicalPublications/ServiceBulletins.aspx.

(4) You may view this service information at FAA, Engine and Propeller Standards Branch. For information on the availability of this material at the FAA, call 781-238-7125.

(5) You may view this service information that is incorporated by reference 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 August 7, 2017.

Robert J. Ganley,
Manager, Engine and Propeller Standards Branch,
Aircraft Certification Service.
[FR Doc. 2017-16968 Filed: 8/9/2017 8:45 am; Publication Date: 8/10/2017]

August 3, 2017

James Delisio
Federal Aviation Administration
Program Manager, Continued Operational Safety
New York Aircraft Certification Office (ACO-170)
1600 Stewart Ave
Westbury, NY 11590

RE: Lycoming Service Bulletin No. 632A

Dear Mr. Delisio,

On July 23, 2017, Lycoming published a Mandatory Service Bulletin No. 632A to identify connecting rods with non-conforming small end bushings. As a result of that publication, as representatives of affected owner groups, we have heard from a number of our members with questions, comments, and concerns.

A corresponding Airworthiness Concern Sheet (ACS) was not, and has not, been transmitted on this issue. An ACS is intended as a means for the FAA to coordinate airworthiness concerns with engine/operators through the Aircraft Owners and Pilots Association (AOPA) and helps in developing a common understanding of the risk and notably quantify the number of failures or incidents that have occurred.

Soon after the service bulletin's publication, we asked the agency if an ACS was forthcoming – a process explored and agreed to at the FAA/Industry Engine Summit. We were disappointed to hear that, due to time restraints, the FAA was unable to go through the standard ACS process but was willing and able to arrange a telecon with stakeholders to discuss.

Yesterday, August 2nd, we were informed that if we were to have that discussion it would have to be that afternoon and a time was quickly established for the undersigned owner's groups, the FAA, and Lycoming to discuss the issue, ask and answer questions, and hopefully come to a common understanding of the risk and means to best manage it.

In the short time before the call, we attempted to outline our specific questions, concerns, and recommendations to both Lycoming and the Agency and have attached them to this letter. We firmly believe that the alternative protocol outlined in our recommendation could serve as an alternative method of compliance (if warranted) and effectively mitigate the risk, if not more so, when compared to SB 632A. Additionally, our recommended method would be accomplished at a fraction of the cost and have a lower risk of maintenance-induced failures. We were, however, disappointed that on the call, neither the FAA or Lycoming were willing to share any data or numbers of failures – a critical and essential element needed to better understand and quantify risk.

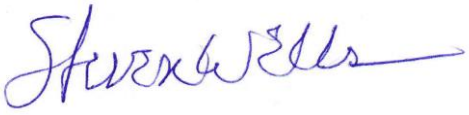
If and when the Agency initiates a Corrective Action Review Board (CARB), we respectfully ask for it to consider the questions, concerns, and, most importantly, our recommended alternative means of compliance. If, after the CARB review and risk assessment, the risk rises above the line to warrant an Airworthiness Directive, given the short compliance time, we respectfully request that a global AMOC be approved simultaneously upon the issuance of the AD. The service bulletin's time of compliance within the next 10 hours of engine operation will simply not afford the time needed to request and approve an AMOC after the issuance of an AD.

Thank you for the opportunity to submit comments and any consideration given to them during the CARB review. Collectively, we stand ready and willing to continued discussions and ways to work together to best mitigate the issue. We share the belief that a strong and trusting relationship between the FAA, manufacturers, and operators will result in a marked improvement in safety.

Sincerely,

David Oord
Aircraft Owners & Pilots Association

Paul New
Cessna Pilots Association
Tennessee Aircraft Services, Inc.



Steve Ells
Ells Aviation LLC

Jonathan Sisk
Malibu/Mirage Owners & Pilots Association

Mike Busch
Savvy Aviation

CC: Christopher J. Richards, FAA
Cesar Gomez, FAA
Norman Perenson, FAA
Aaron Spotts, Lycoming
Jennifer Miller, Lycoming

Questions, Concerns, and Recommendation

Lycoming SB 632A – Identification of Connecting Rods with Non-Conforming Small End Bushings

QUESTIONS

- How many Lycoming-built/rebuilt engines will be affected?
- What is Lycoming's and/or FAA's estimate of how many field-overhauled/repaired engines will be affected? How was this estimate arrived at?
- How many displaced small-end bushings have been reported to date? Over what period of time?
- How many connecting rod failures have been reported to date that were due to bushing displacement? Over what period of time?
- What is the correlation between reported bushing displacement and engine TIS since new/rebuilt/overhauled?
- What is the correlation between connecting rod failure due to bushing displacement and engine TIS since new/rebuilt/overhauled?
- What is the lowest-TIS engine for which bushing displacement has been reported? What is the highest-TIS engine?
- What is the lowest-TIS engine for which connecting rod failure due to bushing displacement has been reported? What is the highest-TIS engine?
- What efforts has Lycoming made to narrow the scope of non-conforming bushings to specific lots or manufacture dates? Is there any way to narrow the scope from the current two full years of bushing production?
- What is the availability of the ST-531 Connecting Rod Bushing Press-Out Verification Tool? What is the cost of this tool? How quickly will Lycoming be able to supply the many thousands of such tools that will be required to equip all the maintenance shops and independent A&Ps who will be called upon to perform SB632A?
- Lycoming states that the ST-531 tool "tests the bushings at a much greater force than they would experience during normal engine operation." Lycoming further states that "approximately 20% of the bushings in the affected population" are expected to flunk the press-out test. These statements imply that the percentage of bushings that would suffer displacement during normal engine operation is far less than 20%. What is Lycoming's estimate of what percentage of bushings in affected engines would suffer displacement in normal engine operation?

CONCERNS

- Although we need the above-requested data to evaluate the severity of risk associated with the issue of non-conforming small end bushings, we are inclined to agree with Lycoming that this issue probably does rise to the level of being an unsafe condition warranting an Airworthiness Directive by the FAA.
- At the same time, we believe that the corrective action proposed by Lycoming in SB632A is so invasive and inherently risky that the corrective action is very likely to create a greater safety risk than the problem that it is intended to mitigate. In other words, we are convinced that the SB632A cure is worse than the disease.
    - Removal/reinstallation of all cylinders of an engine "on the wing" by typical line mechanics has a long, well-documented history of causing catastrophic maintenance-induced engine failures. Mechanics in the field typically do not use torque plates (nor have them) and do not take precautions to prevent main bearing displacement while most of the through-bolts that clamp the main bearing saddles together are simultaneously relieved of torque. Mechanics in the field often fail to provide adequate preload on through-bolts and hold-down studs because they fail to lubricate the fasteners properly prior to torqueing and because they sometimes reuse nuts with worn cadmium plating and sometimes worn or damaged threads. All of these things can lead to fastener failure and cylinder separation.
    - Consequently, we hate to see all cylinders removed simultaneously from an engine by anyone but a qualified engine specialist in a certified engine repair station.
    - Removal/reinstallation of connecting rods "on the wing" by typical line mechanics is a positively terrifying proposition. Rod bolts are the most highly stressed components of the engine, and achieving proper preload on rod bolts is absolutely essential to prevent catastrophic failure. Arguably the majority of line mechanics who will be performing SB632A will never have previously installed connecting rod "stretch bolts." (Unfortunately, the provision of 14 CFR 65.81(a) that says a mechanic may not supervise or approve work "unless he has satisfactorily performed the work concerned at an earlier date" is rarely observed in the real world of piston GA maintenance.)
    - Doing this properly is difficult with the engine installed in the airplane, and really should be done with the engine on an engine stand with unencumbered access, and performed by an experienced engine technician. Unfortunately, that is not what will happen if SB632A is mandated by AD.
    - Consequently, we are convinced that the risk of thrown connecting rods caused by improper removal/reinstallation under "battlefield conditions" would be greater than the risk of thrown connecting rods caused by bushing migration. The cure here would almost certainly be worse than the disease.
    - If Lycoming's estimate is correct that 20% of the connecting rod bushings will fail the press-out test, that means that the overwhelming majority of affected engine will need to have at least one connecting rod removed in the field by typical line mechanics who are marginally qualified to perform this task. This is truly a terrifying prospect.
- We feel strongly that the FAA should ask Lycoming to propose a far less invasive and risky corrective action before it issues an Airworthiness Directive. We are convinced that a minimally invasive approach will detect bushing displacement well before rod failure can occur.

- The small end bushing of the connecting rod cannot displace more than about 1/16" before coming in contact with the piston. A displacement of 1/16" is not nearly sufficient to cause rod failure.
- Once the small end bushing has displaced far enough to come in contact with the piston, further displacement cannot occur unless the exposed portion of the bushing breaks off and falls into the engine sump.
- Once this portion of the busing breaks off, the bushing can continue to be displaced further until it contacts the piston once more and another exposed portion breaks off. This process must repeat several times until the displacement progresses far enough to result in rod failure.
- We wholeheartedly agree with Lycoming's concern "that mechanics may not identify bushing deterioration during oil filter checks at the recommended oil change intervals." Indeed, the portions of bushings that break off are typically too large to pass through the engine's suction screen and reach the oil filter.
- However, we are convinced that an alternative minimally-invasive protocol would be sufficient to detect bushing displacement long before it progresses to the point that rod failure could occur.

RECOMMENDATION

- We propose that the FAA, if warranted, approve an alternate protocol for detecting small end bushing displacement along the following lines:
  - At an appropriate interval (each 25 hours?), remove and inspect the suction screen for evidence of bushing material.
  - At an appropriate interval (each 25 hours?), drain the engine oil hot through a piece of fine window screen or cheesecloth and inspect for evidence of bushing material.
  - At an appropriate interval (each 25 hours?), after the engine oil has been completely drained, remove both oil drain plugs and inspect the bottom of the oil sump using a borescope for evidence of bushing material.
  - If (and only if) any of the three above inspections reveal evidence of bushing material, perform the cylinder removal and press-out tests described in SB 632A.
- We believe that this recommended alternative will drastically reduce the risk of maintenance-induced failure while providing effective mitigation of the risk created by non-conforming small end bushings.