

CONTINENTAL MOTORS® AIRCRAFT ENGINE
CRITICAL SERVICE BULLETIN

COMPLIANCE NECESSARY TO MAINTAIN SAFETY

CATEGORY 2
CSB05-8D

Supersedes CSB05-8C
TECHNICAL PORTIONS
FAA APPROVED

SUBJECT: Camshaft Gear (P/N 656818)

PURPOSE: To eliminate the possibility of camshaft gear tooth fracture, resulting in power loss or in-flight shutdown, and to inspect and remove from service P/Ns 631845, 655430, 655516, or 656031 and replace with camshaft gear, P/N 656818. This Service Document initially announced the release of improved camshaft gear P/N 656818 in 2005. It now clarifies part number superseding action and amplifies camshaft gear replacement instructions.

COMPLIANCE: Inspect at next 100-hour or Annual inspection (whichever is applicable based on type of operation or inspection requirements) or next maintenance event when the camshaft gear is made available (whichever comes first). Continue with recurring inspections every 100-hour/Annual inspection until superseded gears are replaced with camshaft gear, P/N 656818 no later than next overhaul.

MODELS

AFFECTED: Continental Motors (CMI) aviation gasoline (AvGas) engines - O-470-U, IO-470-U, V, VO; IO-520-A, B, BA, BB, C, CB, D, E, F, J, K, L, M, MB, N, NB, P, R; L/TSIO-520-ALL; LIO-520-P; IO-550-A, B, C, D, E, F, G, L, N, P, R; IOF-550-B, C, D, E, F, L, N, P, R; TSIO-550-A, B, C, E; TSIOL-550-A, B, C (see Section II for detail)

I. GENERAL INFORMATION

In 2005, camshaft gear, part number (P/N 656818), was released as a product improvement for the above listed engines. Service Bulletin SB05-8 was written to identify not only the availability of the new part (P/N 656818), but also provided a required Permold crankcase repair to eliminate interference with the new thicker camshaft gear.

Service Document revision CSB05-8D adds the O-470-U engine specification to the MODELS AFFECTED and camshaft gear configuration (reference CMI Service Document SIL18-05, "*O-470-U Camshaft Gear Configuration*").

Service Bulletin SB05-8 (originally issued 09 AUG 2005) and subsequent revision SB05-8A recommended the new camshaft gear (P/N 656818) be incorporated at the next engine overhaul or whenever replacement of the camshaft gear was required. Service Bulletin SB97-6B, "Mandatory Replacement Parts" (revised 18 NOV 2009) listed the camshaft gear (P/Ns 631845, 655430, 655516, or 656031) as a mandatory replacement item at overhaul with P/N 656818. This was also incorporated in the original M-0, "Standard Practice Maintenance Manual" (issued April 2016).

NOTE: Recommended TBO calendar limit for the affected engines is 12 years. Since the original SB05-8 recommending gear replacement was issued in 2005, and the gear was added to the list of MANDATORY REPLACEMENT PARTS in 2009, gear replacement and crankcase repairs should have occurred through attrition.

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II. SCOPE

Inspect the camshaft gear on all engines currently configured with camshaft gear P/Ns 631845, 655430, 655516, or 656031. Inspect at next 100-hour/Annual inspection or next maintenance event when the camshaft gear is made available. Continue with recurring inspections every 100-hour/Annual inspection until superseded gears are replaced with camshaft gear, P/N 656818 no later than next overhaul (see Section VI, “TERMINATING ACTION (PERMOLD CRANKCASE)” or Section VII, “TERMINATING ACTION (SANDCAST CRANKCASE)”). Inspection is required for all engines manufactured prior to 09 August 2005 that have not had the camshaft gear replaced with P/N 656818.

III. SAFETY INTENT

To eliminate the possibility of camshaft gear tooth fracture, resulting in power loss or in-flight shutdown, and to inspect and remove from service P/Ns 631845, 655430, 655516, or 656031 and replace with camshaft gear, P/N 656818.

IV. CONFIGURATION DESCRIPTION

Inspect camshaft gear, P/Ns 631845, 655430, 655516, or 656031 at next 100-hour/Annual inspection or next maintenance event when the camshaft gear is made available. Continue with recurring inspections every 100-hour/Annual inspection until superseded gears are replaced with camshaft gear, P/N 656818 no later than next overhaul.

In order to replace the camshaft gear as a terminating action for the inspection:

1. The crankcase halves may be **split** (as occurs at engine overhaul or major inspection). If this is done, the crankcase for the Permold engine must be modified with the required clearance cut to the 1-3-5 crankcase half in accordance with Section VI, B. or with the crankcase assembly **intact** with the special tools and radial grinder fixture specified in Section VI, C.,

-OR-
2. The camshaft gear may be replaced in a Permold engine **without splitting** the crankcase halves using the methods and techniques in Section VI, C.,

-OR-
3. The camshaft gear may be replaced in a Sandcast engine **without splitting** the crankcase halves using the methods and techniques in Section VII.

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V. RECURRENT GEAR INSPECTION

WARNING

Turn the Ignition Switch OFF and disconnect engine electrical power before commencing maintenance or inspections. Confirm continuity between the magneto capacitor and aircraft ground to prevent accidental engine start during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Remove the starter adapter according to instructions in the primary ICA to gain visual access to identify the camshaft gear.
2. Determine the camshaft gear part number. Manually rotate the crankshaft until the camshaft gear part number becomes clearly visible and the part number can be identified. The camshaft gear part number is visible through the starter adapter mounting pad opening (reference Figure 1).
3. If the camshaft gear part number cannot be determined, measure the gear face width at the circumference. Camshaft gear part number 656818 will measure 0.500". All previous part numbers, measure the gear face width as 0.440" at the circumference. The new camshaft gear face is 0.060" wider at the circumference.
4. If the camshaft gear part number is identified as P/N 656818, record compliance with Service Document CSB05-8D in the engine log book.



Figure 1. Camshaft Gear Part Number Location, typical
(part number is visible through the starter adapter mounting pad opening)

5. If the camshaft gear is identified as P/N 631845, 655430, 655516, or 656031, perform an inspection of the gear and gear teeth through the starter adapter mounting pad opening according to instructions in M-0, "Standard Practice Maintenance Manual", Chapter 11, sections on "Visual Inspection" and "Gear Tooth Inspection". Additionally:

CAUTION: DO NOT contaminate the oil system with excess cleaning solvent. Use a solvent dampened, clean lint free cloth to remove oil from camshaft gear surfaces and gear teeth.

- a. Clean the camshaft gear of all oil and rotate the crankshaft through two complete revolutions while inspecting all visible camshaft gear surfaces for physical damage, fractures, or cracks. Use supplemental lighting and magnification (10X power) as

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required to perform inspection. Pay particular attention to the gear tooth root and fillets (see Figure 2).

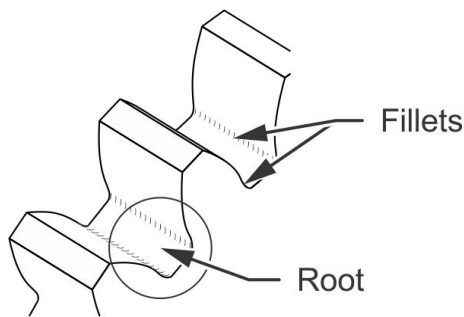


Figure 2. Camshaft Gear Inspection Surfaces, typical

- b. If fractures or cracks are suspect, remove and replace the gear with P/N 656818 according to instructions for either Permold Crankcase (Section VI), Sandcast Crankcase (Section VII), or the standard disassembly and replacement instructions specified in the primary ICA prior to further flight.
- 6. If camshaft gears 631845, 655430, 655516, or 656031 exhibit no evidence of fractures or cracks, document the 100-hour inspection in the engine log book.
- 7. Install the starter adapter (and any parts removed to facilitate inspection) according to instructions in the primary ICA.

VI. TERMINATING ACTION (PERMOLD CRANKCASE)

A. Permold Crankcase Clearance Cut Inspection

Inspect the applicable Permold crankcase according to the following steps below:

1. Inspect the needle bearing boss in the center of the starter adapter mounting pad. If a clearance cut (Figure 3) is present or if a clearance of 0.030" (or greater with the camshaft and gear installed) is provided under all conditions, the crankcase meets the clearance requirement.

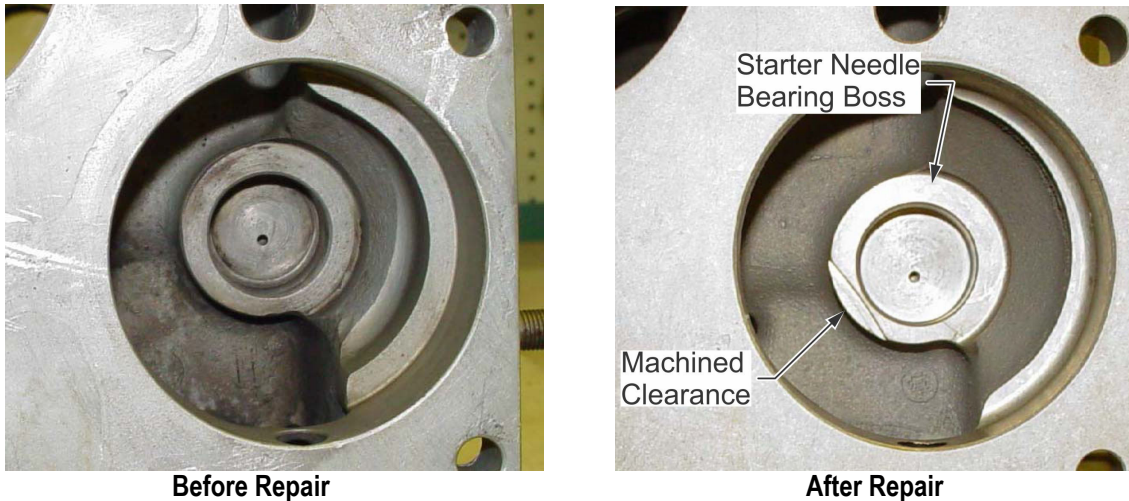


Figure 3. 1-3-5 Permold Crankcase Half, Boss Clearance Cut Repair

2. If no clearance cut is present, or if, (with the camshaft and gear installed) the clearance is less than 0.030" under all conditions, the 1-3-5 crankcase half must be machined according to the following instructions by either:
 - a. sending the 1-3-5 crankcase half to be machined in accordance with instructions in section B. "Option 1, Permold Crankcase Repair, at Overhaul", *or by*
 - b. replacing the camshaft gear in Permold engines without splitting the crankcase (see C. "Option 2, Permold Crankcase Repair, in Service").

B. Option 1, Permold Crankcase Repair, at Overhaul

Instructions below pertain to machining the crankcase and replacing the camshaft gear in Permold engines during engine overhaul.

1. Measure and mark 3.100"- 3.105" from the camshaft bore centerline radius to the starter needle bearing boss (see Figure 4).
2. Cut a radius clearance cut in the outside edge of the starter drive needle bearing boss at a depth of 2.100 - 2.110" (see Figure 5) from the crankcase accessory mounting face.

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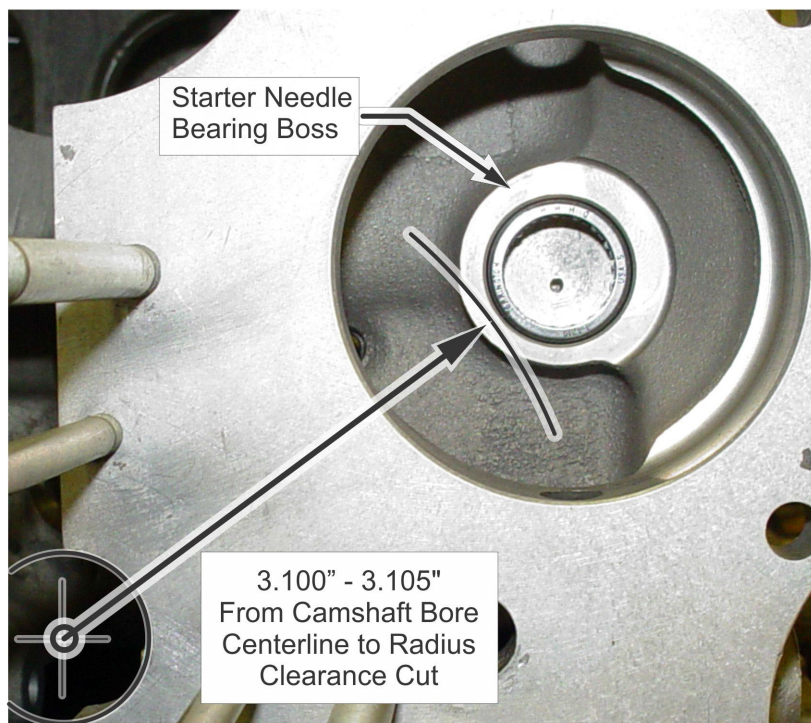


Figure 4. Radius Clearance Cut, Distance from Camshaft Bore Centerline, Permold Crankcase

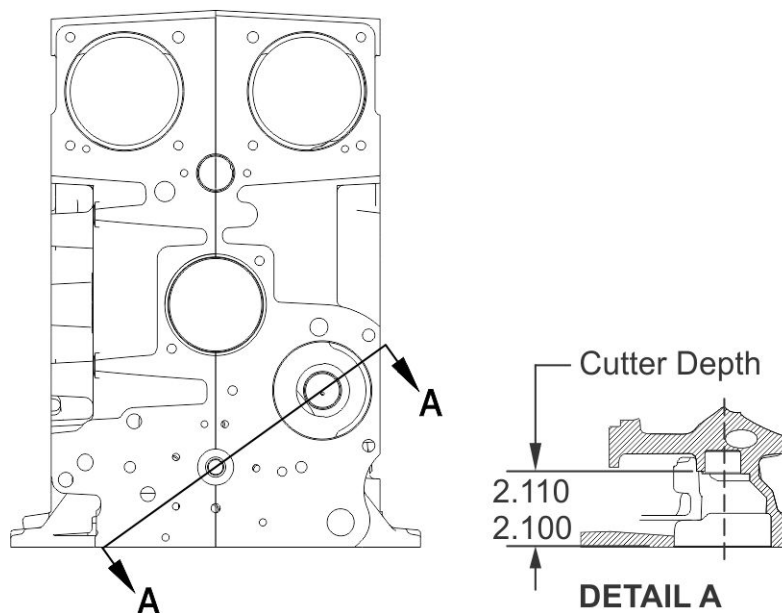


Figure 5. Overhead View of Radius Cut Depth, Permold Crankcase

3. Upon completion of crankcase repair, proceed with overhaul instructions according to the primary ICA, replacing the camshaft gear with P/N 656818.

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C. Option 2, Permold Crankcase Repair, in Service

The instructions below pertain to replacing the camshaft gear in Permold engines without splitting the crankcase.

Special Tools and Supplies

- Continental Motors Radial Grinder Fixture Assembly¹
 - Pencil Die-Grinder (i.e. 5530007545JP)²
 - Carbide Burr Bit (M41209, Cylindrical, Double Cut)²
- 3" x 3" x 8" Open Cell Reticulated Foam Block / Sponge²
- W-9 Cap Plug (P/N 626972-9)²
- De-burring Tool²
- Scotch-Brite® Scuff Pad, Ultra Fine (or equivalent)²

CAUTION: Machine a crankcase radius clearance cut to provide adequate clearance for the new camshaft gear, P/N 656818 (see Section VI, B.1.). Installing the new camshaft gear, (P/N 656818) in an unmodified Permold crankcase may result in damage to the gear and crankcase.

Camshaft gear (P/N 656818), gear face is 0.060" wider at the circumference than the replaced camshaft gear (P/Ns 631845, 655430, 655516, or 656031). Permold crankcases may require repair to the starter adapter bearing boss (needle bearing, see Figure 2). The following procedures were performed by securing the Permold engine to an engine test (nose) stand. Reference the principal ICA for the engine, accessories, and oil sump removal procedures.

1. Remove camshaft gears 631845, 655430, 655516, or 656031, and reassemble the camshaft assembly with camshaft gear P/N 656818 according to the following procedure:

WARNING

Ensure timing marks align throughout the entire camshaft gear replacement procedure.

- a. Rotate the crankshaft until the timing marks on the crankshaft gear and camshaft gear align.
- b. With the crankshaft gear and camshaft gear in the timed position, mark the crankshaft gear and camshaft gear alignment and mark the bolt closest to the starter adapter mount opening to ensure correct alignment of the replacement camshaft gear.

WARNING

Wear eye protection when cutting safety wire to avoid injury from flying debris.

CAUTION: Prevent safety wire, nuts, washers, dirt, etc. from entering the engine.

1. Fabricate locally using supplied drawings
2. Commercially available from AERO Accessories

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- c. Cut and discard safety wire from the four screws securing the camshaft gear to the camshaft.

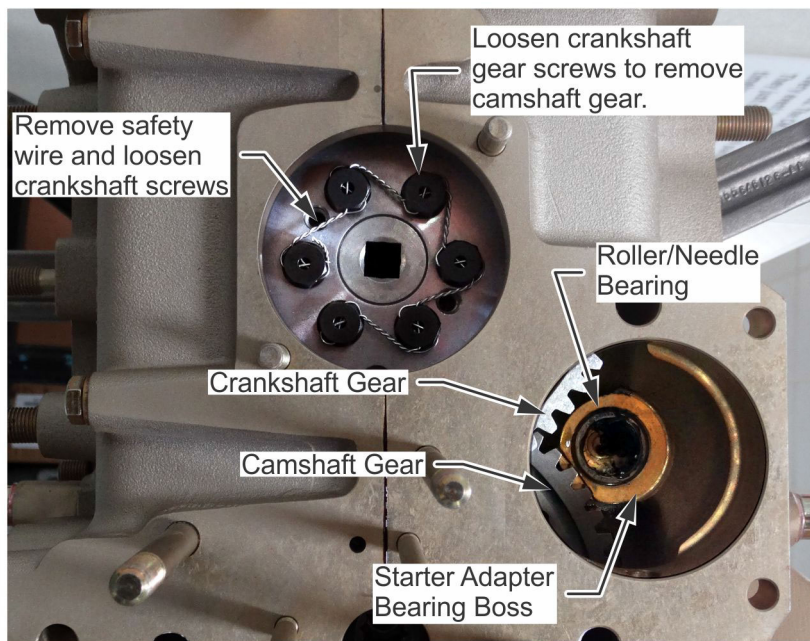


Figure 6. Camshaft Gear Access Locations, Crankcase, typical

- d. Carefully rotate the camshaft and remove the screws securing the camshaft gear to the camshaft. Screws must be removed one at a time. Discard the camshaft gear screws.
- e. Cut and discard safety wire from the crankshaft gear screws (see Figure 6).
- f. Loosen, but do not fully remove, the crankshaft gear screws to allow the large crankshaft gear to be raised in order to remove the camshaft gear through the oil sump area.
- g. Remove the camshaft gear through the oil sump area.

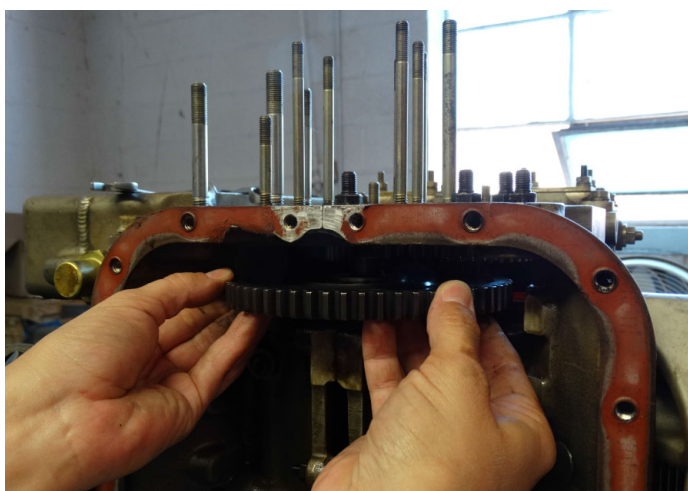


Figure 7. Remove Camshaft Gear through Oil Sump Area

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2. Prepare Permold crankcase for clearance cut repair. Protect the crankcase against contamination from debris and metal shavings:
 - a. Insert a reticulated foam block (or equivalent material) to protect the inner crankcase from debris or metal shavings.
 - b. Use a long, modified-tipped vacuum and thoroughly suction debris or metal shavings from the crankcase gear work area.

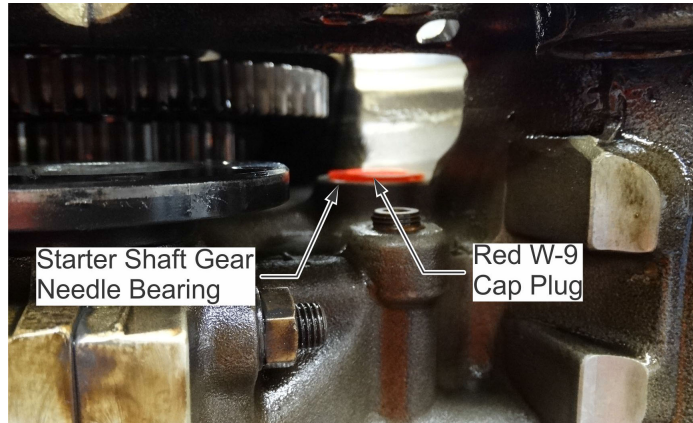


Figure 8. Cap the Starter Shaft Gear Needle Bearing

- c. Place a W-9 Cap Plug (CMI P/N 626972-9) into the starter shaft gear needle bearing (located in the crankcase through the Starter Adapter Mount pad, see Figure 8) to protect the needle bearing from debris or metal shavings. Coat the mating surface of the cap plug with Super Molyshield grease to help capture grinding debris.
- d. Assemble the Radial Grinder Fixture Assembly according to the instructions in Figure 9.

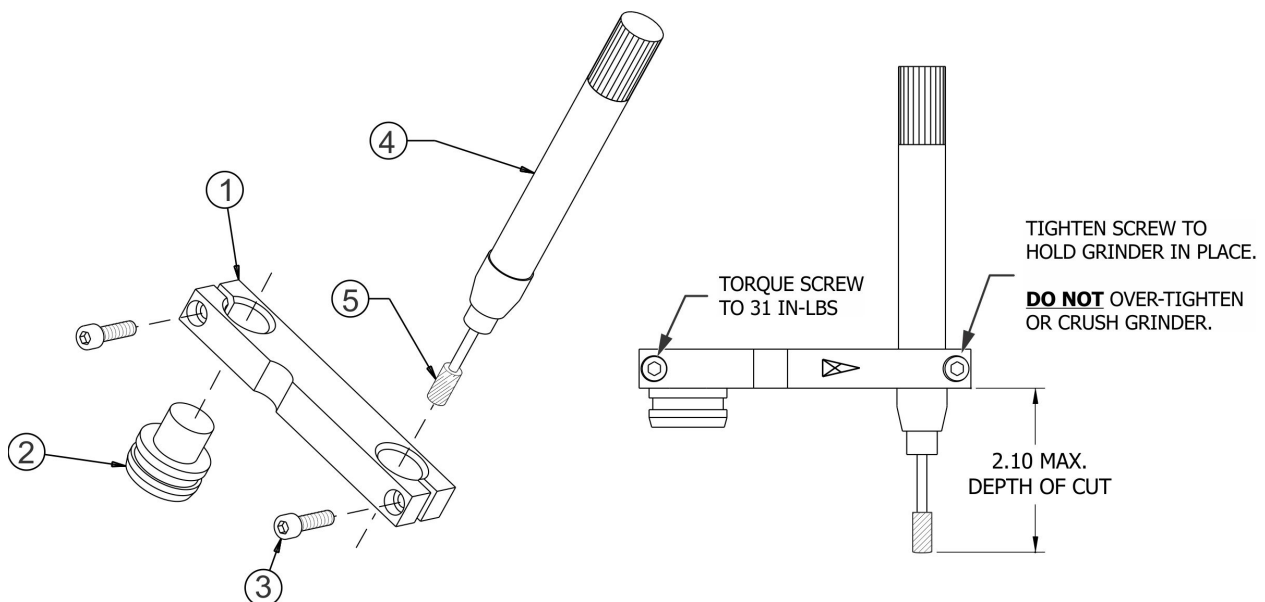


Figure 9. Fixture Assembly, Radial Grinder

- | | |
|---|---|
| 1 Fixture, Radial Grinder | 4 Pencil Die Grinder, with vertical air discharge, Jupiter Pneumatic P/N 5530007545JP |
| 2 Bushing, Radial Grinder Fixture | 5 M41209 Carbide Burr, Cylindrical, Double Cut, SA51EM 1/4HD x 3/16CL x 1/8SD |
| 3 Hexagon Socket Head Cap Screw, ANSI B18.3 - 10-32 UNF-0.75 HS HCS | |

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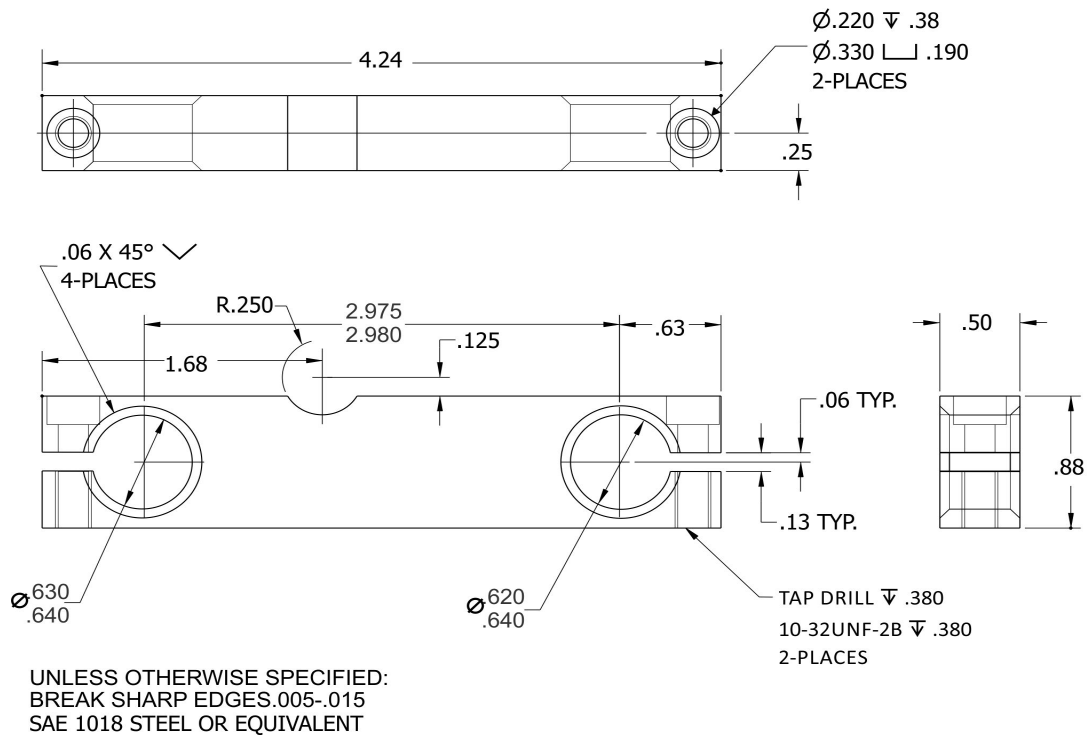


Figure 10. Fixture, Radial Grinder

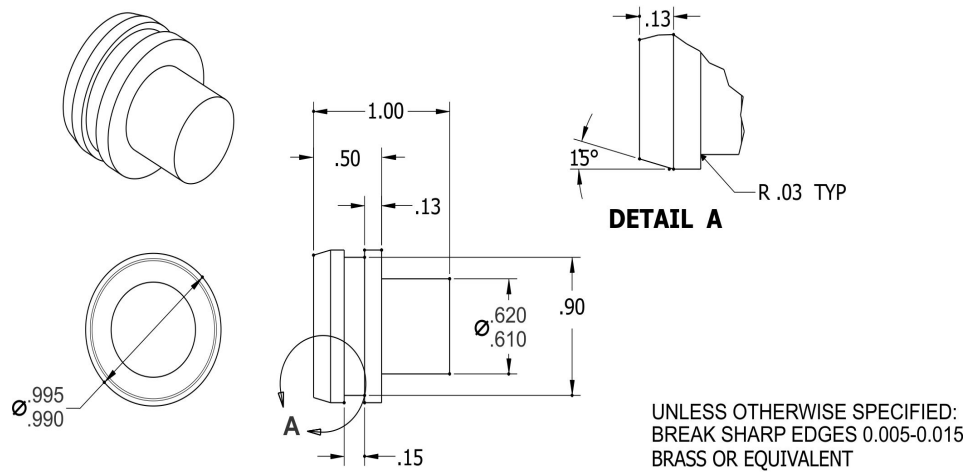


Figure 11. Bushing, Radial Grinder

- e. Insert the radial grinder assembly (bushing) into the camshaft gear boss as shown in Figure 12.

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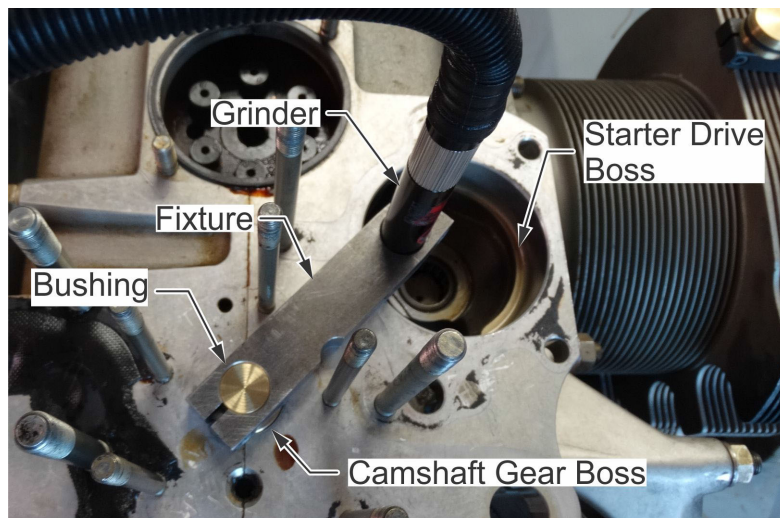


Figure 12. Clearance Cut, Setup

- f. Loosen the screw holding the grinder in place and carefully lower the grinder and burr bit over the clearance cut area (starter drive needle bearing boss).

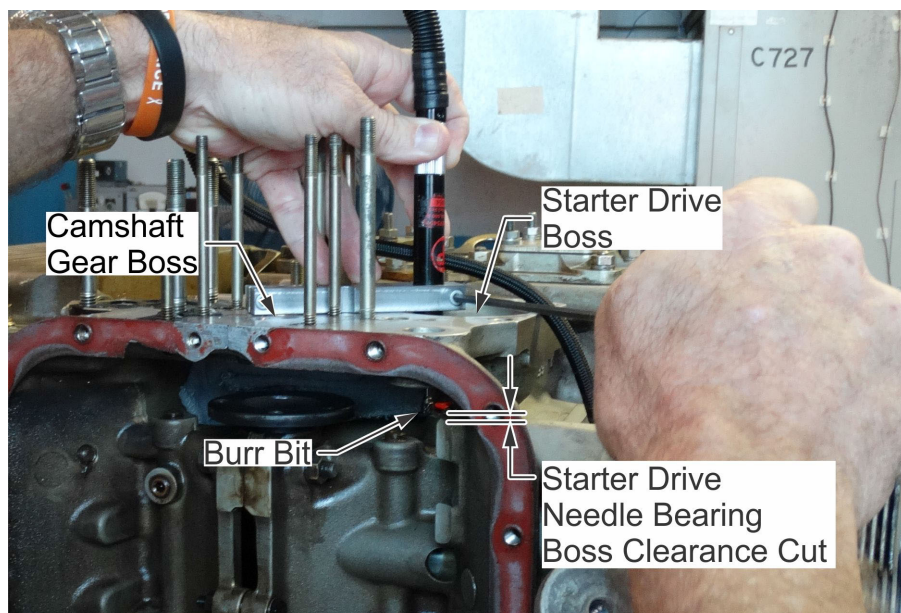


Figure 13. Clearance Cut, Setup (sump view)

CAUTION: DO NOT over-tighten the set screw securing the pencil die grinder to the radial grinder fixture. Damage to the grinder and jamming the grinder motor may occur.

- g. Set the cutting height of the radial grinder fixture assembly flush with the surface of the starter drive needle bearing boss and secure the grinder with the set screw. Cut the bearing boss clearance by removing no more than 0.010" (max.) with each cut.
- h. Continue adjusting cut depth of the pencil die grinder until clearance of 0.030" (or greater with the camshaft and gear installed) is provided under all conditions.

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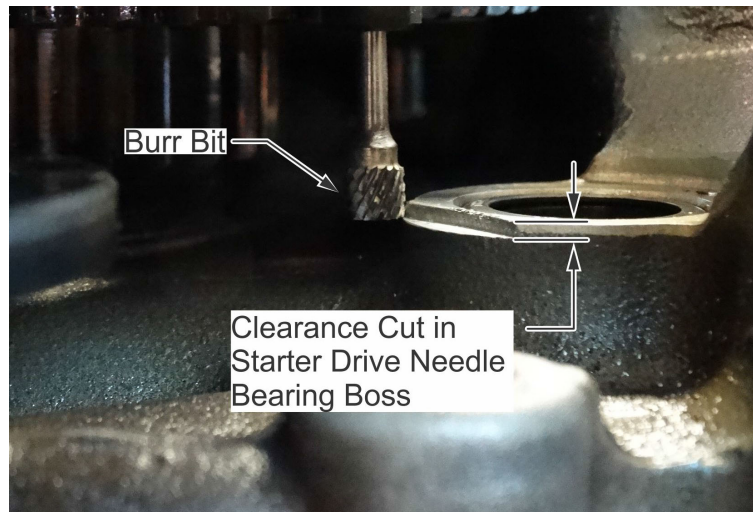


Figure 14. Clearance Cut, Setup

CAUTION: Inspect and ensure there is a minimum 0.030" clearance between the camshaft gear and the starter drive needle bearing boss

- i. Inspect the clearance cut surface and remove all nicks, burrs or sharp edges using a de-burring tool and Scotch-Brite® ultra fine scuff pad.
- j. Vacuum and thoroughly clean all debris or metal shavings from the crankcase gear work area.
- k. Remove cap plug and verify needle bearing has no debris, damage, or contamination.
- l. Transfer the markings from the old camshaft gear to the new camshaft gear to aid in the camshaft gear bolt hole alignment.
- m. Carefully insert camshaft gear P/N 656818 and seat into position over the camshaft.
- n. Ensure camshaft and crankshaft gear timing marks are correctly aligned.

NOTE: Lubricate the threads of all replaced crankshaft gear bolts and camshaft gear screws with clean 50 weight aviation engine oil.

- o. Install new camshaft gear screws in an alternating cross pattern, finger tight.
- p. Remove and install new crankshaft gear bolts (one bolt at a time) in an alternating cross pattern, finger tight.
- q. Verify crankshaft to camshaft timing alignment before torquing screws.
- r. Verify gears are evenly seated before applying torque.
- s. Pre-torque the camshaft and crankshaft gear screws 140 in. lbs. nominal in an alternating cross pattern.
- t. Final torque the camshaft and crankshaft gear screws to the value specified in M-0, "Standard Practice Maintenance Manual, Appendix B."

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WARNING

Wear eye protection when cutting safety wire to avoid injury from flying debris.

CAUTION: Prevent safety wire, nuts, washers, dirt, etc. from entering the engine.

- u. Using 0.032” safety wire, safety wire camshaft gear bolts and crankshaft gear screws according to instructions in M-0, “Standard Practice Maintenance Manual, Table 3-7 (wire size), and Appendix C-3 (method).
3. Proceed with engine assembly and reinstall any engine components that were removed in accordance with the applicable Maintenance or Overhaul Manual.
4. Install engine in aircraft in accordance with the primary ICA.
5. Document compliance with CSB05-8D in the engine log book.
6. Perform a complete engine ground run up in accordance with the aircraft manufacturer’s AFM/POH.

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VII. TERMINATING ACTION (SANDCAST CRANKCASE)

The instructions below pertain to replacing the camshaft gear in Sandcast engines without splitting the crankcase. The following procedures were performed by securing the engine to an engine test (nose) stand. Reference the principal ICA for the engine and sump removal procedures.

CAUTION: Camshaft gear (P/N 656818) is 0.060" wider at the circumference than the replaced camshaft gears (P/Ns 631845, 655430, 655516, or 656031). For engines with a Sandcast crankcase, the assembler must inspect and sustain a minimum clearance (0.030" or greater) between the camshaft gear (P/N 656818) and the oil gallery plug at the rear crankcase below the starter adapter (see step k. and Figure 20)).

1. Replace camshaft gears 631845, 655430, 655516, or 656031, and reassemble the camshaft assembly with camshaft gear P/N 656818 according to the following procedure (typical for cluster gear configuration):
 - a. Rotate the crankshaft until the timing marks on the crankshaft gear and camshaft gear align.
 - b. With the crankshaft gear and camshaft gear (and cluster gear where applicable) in the timed position, mark the crankshaft gear and camshaft gear alignment (see Figure 15) and mark the bolt closest to the starter adapter mount opening to ensure correct alignment of the replacement camshaft gear.



Figure 15. Camshaft Gear Timing Alignment Marked, Sandcast Crankcase

WARNING

Wear eye protection when cutting safety wire to avoid injury from flying debris.

CAUTION: Prevent safety wire, nuts, washers, dirt, etc. from entering the engine.

- c. Cut and remove safety wire from the four screws securing the camshaft gear to the camshaft (or cluster gear where applicable).

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- d. Carefully rotate the camshaft and remove the unmarked screws securing the camshaft gear to the camshaft (and cluster gear where applicable). Screws must be removed (one at a time) through the fuel pump mount opening. Do not remove the last screw (marked) at this time.

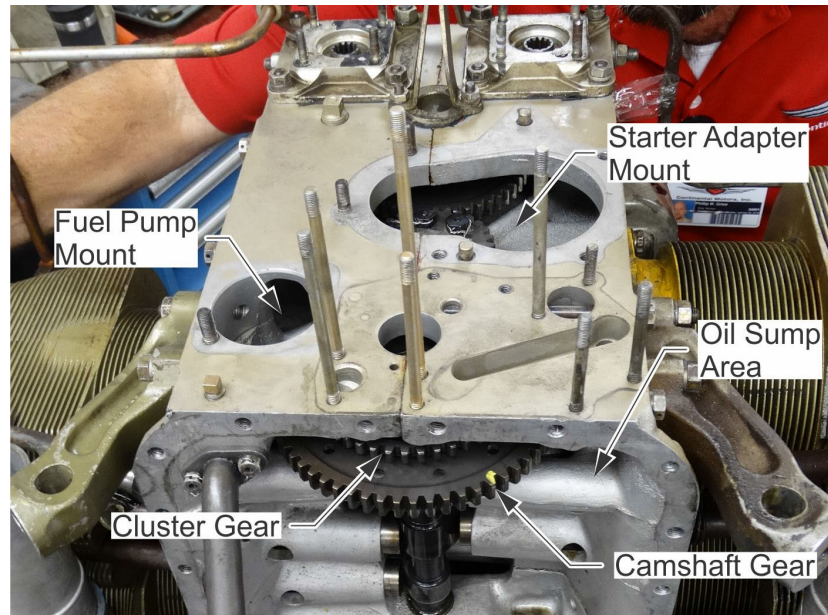


Figure 16. Camshaft Gear Access Points, Sandcast Crankcase

- e. Before removing the last screw (previously marked in step 1.. b.. above), insert and finger tighten a temporary half-height alignment screw, securing the camshaft gear to the camshaft and cluster gear (where applicable). Remove the fourth (marked) camshaft gear screw. Discard and replace all removed screws.
- f. Align and mark the crankshaft gear and camshaft gear 180 degrees from the timing marks (see Figure 18). Remove the half-height alignment screw and remove camshaft gear through the oil sump area.

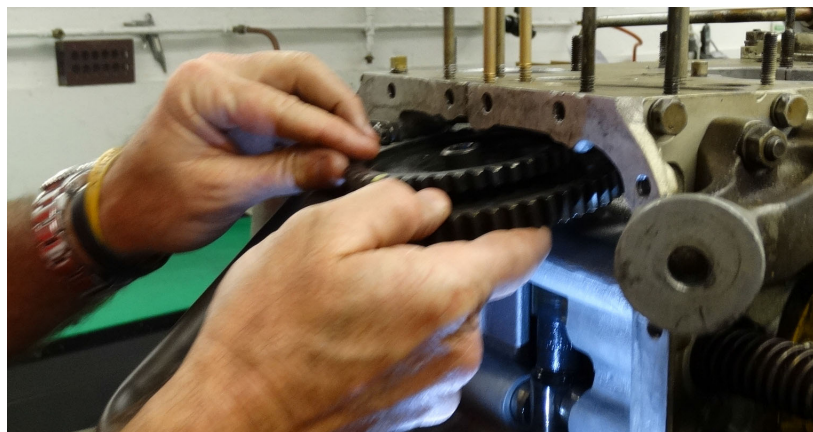


Figure 17. Remove Camshaft Gear and Cluster Gear (where applicable) through Oil Sump Area

CAUTION: Avoid applying direct pressure to the gear teeth.

- g. Carefully separate the two gears (and position for removal) from each other with a soft metal pry-bar (preferable brass). Remove both gears through the oil sump area.

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- h. Transfer the markings from the old camshaft gear to the new camshaft gear to aid in the camshaft gear bolt hole alignment. Clean the cluster gear and fit the new camshaft gear, carefully align the mounting holes on the cluster gear and camshaft gear.

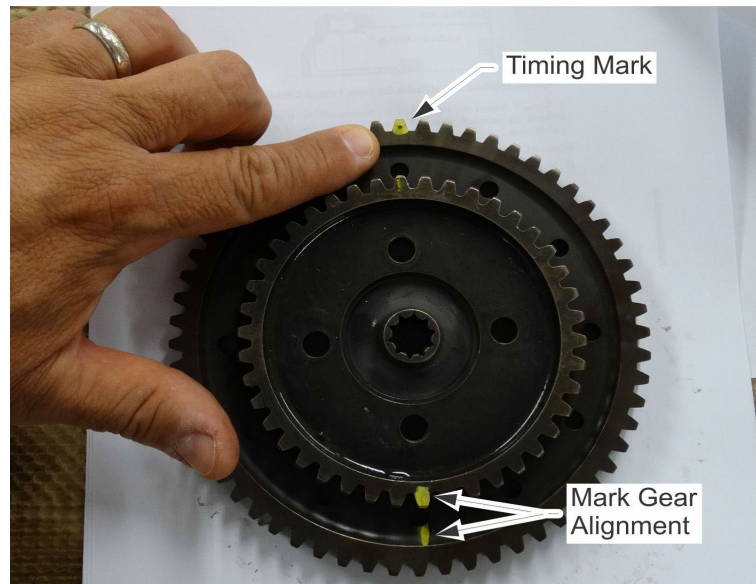


Figure 18. Transfer Gear Alignment Marks

- i. Insert both gears and carefully seat into position on the camshaft. Ensure the marking on both gears remain aligned and timing marks are correctly aligned.
- j. Verify gears mate and seat evenly. Install the half-height alignment screw, finger tight. Do not torque at this time.

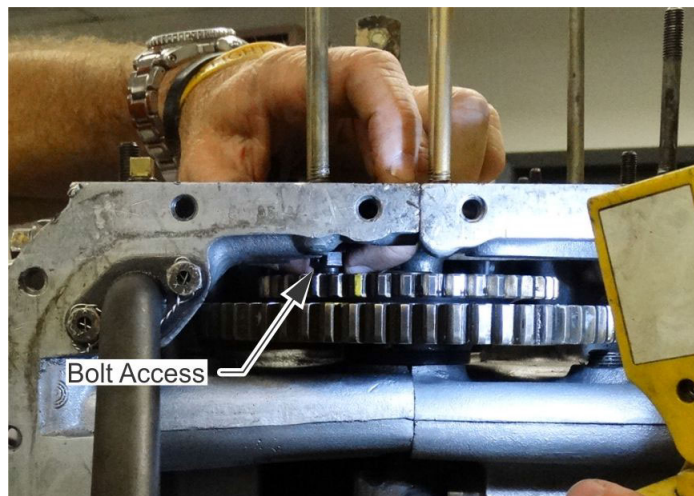


Figure 19. Install Camshaft Screws through the Fuel Pump Mount Opening

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CAUTION: Inspect and ensure there is a minimum 0.030" clearance between the camshaft gear (P/N 656818) and the oil gallery plug.

- k. Measure the clearance between the oil gallery plug and the camshaft gear using a feeler gauge (see Figure 20). Ensure the minimum clearance is 0.030" or greater. If the clearance is less than 0.030":
 - 1) Remove the safety wire and the rear crankcase tie bolt (P/N 627433) according to the instructions in the primary ICA (if it is blocking access to the oil gallery plug).
 - 2) Remove the half-height alignment screw and remove the camshaft gear.
 - 3) Remove the oil gallery plug, clean the sealant residue from the crankcase and plug threads.
 - 4) Install the oil gallery plug (according to the instructions in the primary ICA) to the maximum allowable torque specified in M-0, "Standard Practice Maintenance Manual, Appendix B" and verify required minimum clearance (0.030" or greater) is met.
 - 5) Install and torque the crankcase tie bolt (P/N 627433) according to the instructions in the primary ICA.
 - 6) Reinstall the half-height alignment screw and camshaft gear (step j.. above).

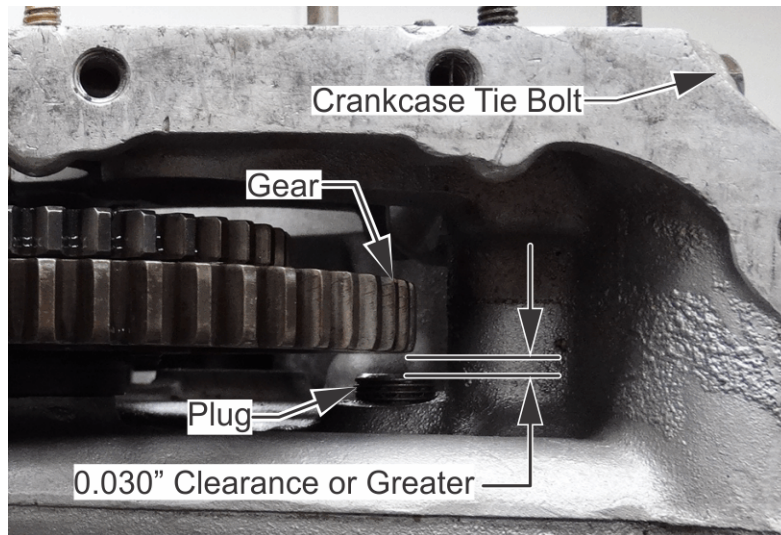


Figure 20. Lower Rear Oil Gallery (Control) Plug, Sandcast 1-3-5 Crankcase Half

NOTE: Lubricate the threads of any removed screws or bolts with clean 50 weight aviation engine oil.

- l. Insert new camshaft gear screws through the fuel pump mount opening and install in an alternating cross pattern, finger tight. Remove the half-height alignment screw and install the last camshaft gear screw, finger tight.
- m. Verify crankshaft to camshaft timing alignment. Verify alignment of the previous gear marks before torquing screws.
- n. Verify gears are evenly seated before applying torque.

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- o. Pre-torque the screws to 140 in. lbs. nominal in an alternating cross pattern.
- p. Apply final torque to the camshaft gear screws according to the value specified in M-0, “Standard Practice Maintenance Manual, Appendix B.”

WARNING

Wear eye protection when cutting safety wire to avoid injury from flying debris.

CAUTION: Prevent safety wire, nuts, washers, dirt, etc. from entering the engine.

2. Using 0.032” safety wire, safety wire crankshaft gear screws according to instructions in M-0, “Standard Practice Maintenance Manual, Table 3-7 (wire size), and Appendix C-3 (method).
3. Proceed with engine assembly and reinstall any engine components that were removed in accordance with the applicable Maintenance or Overhaul Manual.
4. Install engine in aircraft in accordance with the primary ICA.
5. Document replacement of camshaft gear as compliance with CSB05-8D in the engine log book.
6. Perform a complete engine ground run up in accordance with the aircraft manufacturer’s AFM/POH.

VIII. CUSTOMER SERVICE

Visit the Continental Motors web site at www.continentalmotors.aero to obtain copies of Continental Motors Warranty Policies.

Contact Continental Motors Technical Services at one of the numbers listed below if you have any questions concerning the technical content of this Service Document.

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