



STANDARD PRACTICE MAINTENANCE MANUAL

SPARK IGNITED ENGINES

Technical Portions Accepted by the Federal Aviation Administration

10-9.4. Connecting Rod Replacement

WARNING

Never remove material from a connecting rod. The removal of metal from connecting rods, crankshafts or pistons, for the purposes of balancing, is not an approved procedure. Removing material from a connecting rod will destroy the shot peen treatment and may cause stress risers. Connecting rods are matched to limit engine vibration with no more the 1/2 ounce weight variance allowed between connecting rods in opposing cylinder bays.

CAUTION: For dynamic balance, connecting rod assemblies are paired with a maximum weight variation of one-half ounce (14 grams) between opposing bays. For this reason, connecting rods must be replaced in pairs.

NOTE: The allowable weight variation between pistons and connecting rods does not apply to the entire set. Connecting rod and piston weight variations are limited to opposing bays.

1. Remove the connecting rods according to the instructions in the primary Instructions for Continued Airworthiness(Section 1-1.1).
2. Clean the connecting rods with an approved solvent or degreaser. Verify all surfaces are free of varnish, oil, or residue that will affect reliability of visual, dimensional and magnetic particle inspections.

10-9.4.1. Connecting Rod Dimensional Inspection

1. Verify the connecting rod and cap mate marks are aligned and the position numbers stamped on or adjacent to the bolt boss match. Scrap connecting rods and caps with mate marks that do not align.
2. Visually inspect the connecting rods for corrosion, pitting, discoloration (bluing), galling, bending, twisting, impact damage or nicks. Scrap connecting rods with any of these indications.
3. Weigh the connecting rods within opposing cylinder pairs (1 vs. 2, 3 vs. 4, etc.) with a calibrated scale, accurate to one-half ounce, and record the weight variation. Discard connecting rod pairs exceeding 1/2 ounce maximum weight variation.
4. Visually inspect the connecting rod and cap parting surface. Contact signatures resulting from assembly forces are normal and acceptable. Connecting rods exhibiting fretting signatures, indicated by erosion of the original machining marks, either locally or over the entire surface, are not acceptable for continued service. Scrap connecting rods with fretting at the parting surfaces; do not attempt rework.
5. Visually inspect the nut seat area. Excessive fretting signatures indicate material loss. Scrap connecting rods with edge loading under the bolt head surface contact area.
6. Visually inspect dowel surfaces at the rod and cap bolt holes. Scrap connecting rods with fretting at the dowel surface.

7. Align the mate marks on matching position numbers and assemble the connecting rod and cap by installing a bolt through the cap and rod. With the cap seated firmly against the rod, you must be able to install the remaining bolt using hand pressure only. Scrap connecting rods if the bolts cannot be installed by hand.
8. Lubricate the connecting rod bolt and nut threads with clean 50 weight aviation oil.
9. Install and torque the nuts and bolts to Appendix B specifications.
10. Inspect the inside diameter joint of the rod to cap with both bolts and nuts installed and torqued; mismatch (or a step) must be less than 0.001 inch. To check for a mismatch: place the rod on a surface plate with the split line at the 6 and 12 o'clock position; use V-blocks to hold the connecting rod in place. Use a dial indicator mounted on a height gauge, zero out on one side of the split line and move the indicator across the split line; a mismatch (or a step) of more than 0.001 inch is not acceptable.

WARNING

Removing and installing the piston pin bushing with makeshift tools will damage connecting rods.

11. Remove the piston pin bushings from the connecting rod using a Connecting Rod Bushing Removal/Installation Set (Borroughs Part No. 8098, or equivalent) and an arbor press.
12. Inspect the piston pin bushing bore and surrounding area for nicks, gouges and mechanical damage. Scrap connecting rods with any of these indications.
13. Use precision measuring equipment, such as a dial bore gauge or air gauge; verify the connecting rod meets the dimensional specifications in Figure 10-41 and Table 10-39.
14. Measure the inside diameter of the rod and cap within 30° of the rod and cap joint; take a second measurement 90° from the first. Both measurements must meet dimensional specifications in Figure 10-41 and Table 10-39; the difference between these two measurements is an indication of out-of-round and must not exceed 0.0015 inches. Scrap connecting rods and caps which fail to meet dimensional specifications in Figure 10-41 and Table 10-39 or exceed 0.0015" out-of-round. Scrap connecting rods and caps which fail to meet these specifications.
15. Inspect the connecting rod channel rails for nicks, gouges or mechanical damage. Scrap connecting rods with any of these indications.
16. Perform a "Connecting Rod Magnetic Particle Inspection" according to the instructions in Section 11-3.1.

WARNING

Failure to comply with the specifications and instructions depicted in Figure 10-41 will result in engine malfunction and/or stoppage.

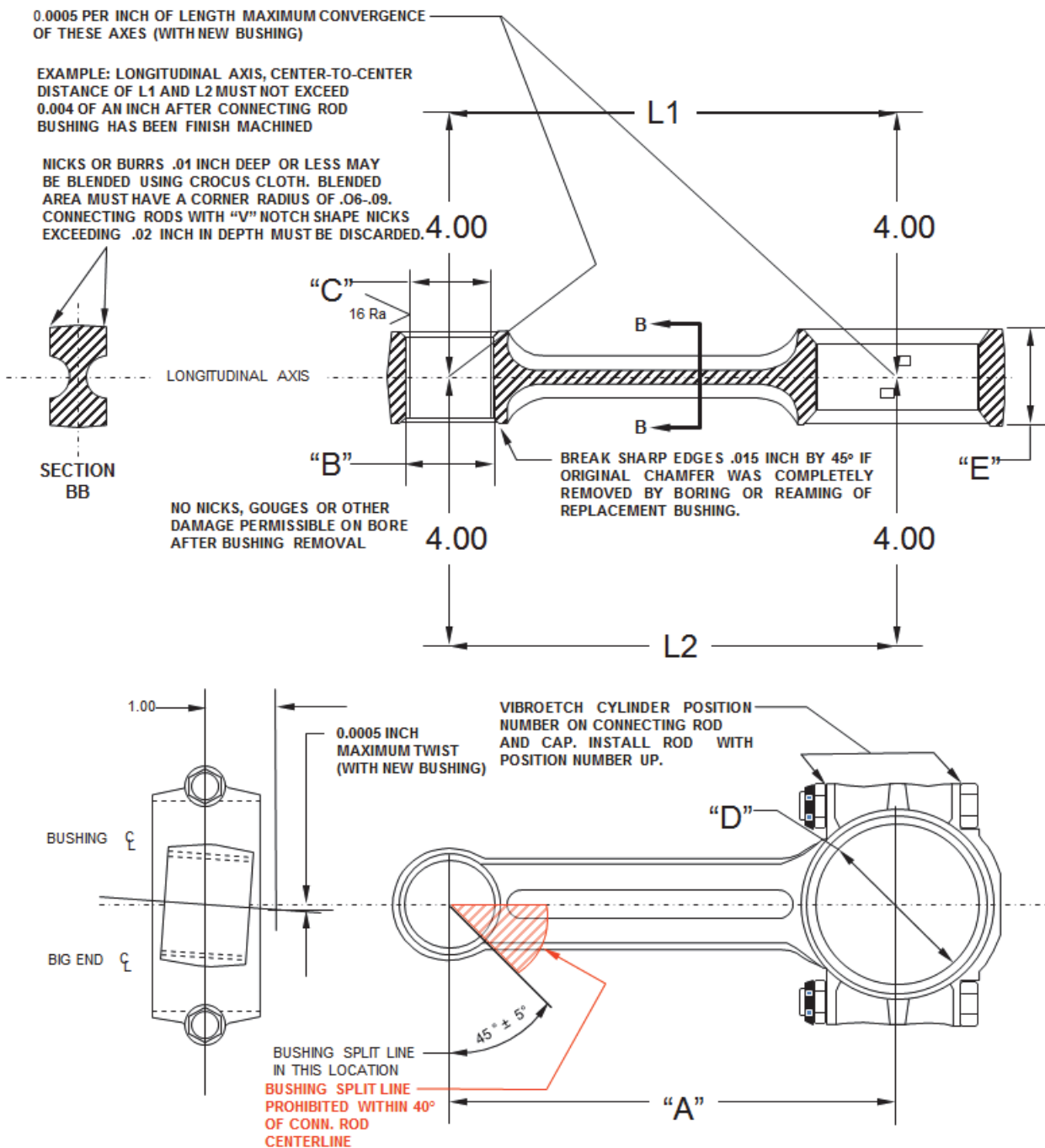


Figure 10-41. Connecting Rod Dimensions

Table 10-39. Connecting Rod Specifications

Engine Model	Connecting Rod Part Number	Forging Part Number	Nut P/N ^{1, 2} Bolt P/N	Connecting Rod Bores Centerline Distance "A"	Piston Pin Bore I.D. (No Bushing) "B"	Piston Pin Bushing I.D. Bushing P/N "C"	Crankpin Bore I.D. "D"	Connecting Rod End Width "E"
WARNING If the Hardware listed in the footnotes at the end of the Table is not available, replace the obsolete connecting rod assembly with replacement (later) configuration listed for the engine model.								
O/O/TSIO-470 Small Bore IO & TSIO-520 IO-346	655910 ³ Superseded 655000 655004 654999 646778	646126 Superseded 632041	654490 Nut 655958 Bolt	6.6230 6.6270	1.2340 1.2350	1.1267 1.1269 530658	2.3755 2.3760	1.521 1.525
E- Series O-470- 2,4,11,13A,15 IO-470- C,G,J,K,P,R	654796 ^{3, 4} Superseded 646478 A36121 ⁵	646126 Superseded 632041	654487 Nut 655960 Bolt	6.6230 6.6270	1.2340 1.2350	1.1263 1.1265 530658	2.3755 2.3760	1.583 1.587
360 Large Bore IO-240 IOF-240	654793 ^{3, 4} Superseded 646320 642268	646116 Superseded 626119	654487 Nut 655959 Bolt	6.3730 6.3770	1.0620 1.0630	1.000 1.0005 538684	2.0615 2.0620	1.2215 1.2255
360 Small Bore GO-300	654794 ^{3, 4} Superseded 646321 626128	646116 Superseded 626119	654487 Nut 655959 Bolt	6.3730 6.3770	1.0620 1.0630	1.000 1.0005 538684	2.0615 2.0620	1.3015 1.3055
O-200 O-300 C-90 C-145	654795 ^{3, 4} Superseded 646322 530184 ⁶ 5561 ⁶	646116 Superseded 626119 530186 ⁶	654487 Nut 655959 Bolt	6.3730 6.3770	1.0620 1.0630	0.9230 - 0.9235 530192	2.0615 2.0620	1.3015 1.3055
IO / TSIO-520 Large Bore TSIO-520-BE	655911 ³ Superseded 655005 ⁴ 646476 646475	646126 Superseded 632041	654490 Nut 655958 Bolt	6.6230 6.6270	1.2340 1.2350	1.1267 1.1269 530658	2.3755 2.3760	1.461 1.465

Table 10-39. Connecting Rod Specifications

Engine Model	Connecting Rod Part Number	Forging Part Number	Nut P/N ^{1, 2} Bolt P/N	Connecting Rod Bores Centerline Distance "A"	Piston Pin Bore I.D. (No Bushing) "B"	Piston Pin Bushing I.D. Bushing P/N "C"	Crankpin Bore I.D. "D"	Connecting Rod End Width "E"
L/TSIO-520-AE	655910 ³ Superseded 655000 ⁴ 646480 643166	646126 Superseded 632041	654490 Nut 655958 Bolt	6.6230 6.6270	1.2340 1.2350	1.1267 1.1269 530658	2.3755 2.3760	1.521 1.525
TSIO-520-CE IO-550 TSIO-550 TSIOL-550	655911 ³ Superseded 655001 646482	646126 Superseded 632041	654490 Nut 655958 Bolt	6.6230 6.6270	1.2340 1.2350	1.1267 1.1269 530658	2.3755 2.3760	1.461 1.465
IO-550-B29, B33, B37, C25, C30 TSIO-520- UB17	655911 ^{3, 7} Superseded 655001 654440	646126 Superseded 632041	654490 Nut 655958 Bolt	6.6230 6.6270	1.2340 1.2350	1.1267 1.1269 530658	2.3755 2.3760	1.461 1.465
GTSIO-520	655910 ³ Superseded 655004	646126 Superseded 632041	654490 Nut 655958 Bolt	6.6230 6.6270	1.2340 1.2350	1.1267 1.1269 530658	2.3755 2.3760	1.521 1.525

1. The most current part number connecting rod nuts and bolts must not be used on or with superseded part number nuts and bolts
2. See Appendix B for Nut and Bolt torque specifications
3. Connecting Rod Assembly must use corresponding Bolt and Nut specified in column 4 of table.
4. Current part number (serviceable) connecting rods must use the most current part number connecting rod new nuts and bolts. The most current connecting rod new nut and bolt part numbers can be used with old (serviceable) connecting rods of the same style. (Hex head rod bolts must replace hex head rod bolts, contour head rod bolts must replace contour head rod bolts.)
5. Part No. A36121 connecting rod assemblies utilizing Part No. 632041 forging must be serviced according to table.
Part No. A36121 connecting rod assemblies utilizing the Part No. 40742 forging must be serviced with Part No. 35972 connecting rod bolt, Part No. 24804 nut and Part No. MS24665-132 cotter pin; torque to the value specified in Appendix B.
6. Part No. A36121 connecting rod (identified by forging number 530186), A35159 (Identified by forging number 5561) and A35160 (Also identified by forging number 5561) must be serviced with Part No. 530213 bolt, Part No. 24804 or Part No. 626140 nut and Part No. 639292 cotter pin, torqued to value specified in Appendix B.
7. Used in Balanced Set Part No. 655913

10-9.4.2. Connecting Rod Piston Pin Bushing Replacement

Replace all connecting rod piston pin bushings at overhaul.

Equipment Required

- Arbor press
- Borroughs Part No. 8098, Connecting Rod Bushing Removal/Installation Set, or equivalent
- Borroughs Part No. 8111A, Connecting Rod Boring and Alignment Fixture, or equivalent
- High speed borer of the correct size
- Borroughs Part No. 8042C Adapter Kit, or equivalent (E-Series, 470, 520 engines) or Part No. 8072C (240, 300, 360 engines), or equivalent
- Vertical mill, or equivalent, capable of maintaining 1750 RPM.
- Federal Dimension D-2500 or D-4000 Air Plug Gauge with a 1.1268 setting ring and 1.1268 air plug, or equivalent)
- Profilometer

WARNING

Use only the special tools listed. Removing and installing connecting rod bushings with makeshift tools can damage the connecting rods.

Verify the piston pin bushing being installed is the correct part number for the application. Use a Connecting Rod Bushing Removal/Installation Set (Borroughs Part No. 8098 or equivalent) and an arbor press to install the piston pin bushing as follows:

1. Press out the old piston pin bushing using the Connecting Rod Bushing Removal/Installation Set and an arbor press. Verify the connecting rod bore is smooth.
2. Verify the new bushing part number. Dip the new piston pin bushing in clean 50 weight aviation engine oil before placing it in position. The bushing may be chilled to aid installation.
3. Visually inspect the piston pin bushing bore to determine acceptability of parts. No nicks or gouges are permissible on the bore after the bushing is removed. Discard the connecting rod if nicks/gouges are found.
4. Position the connecting rod over the pilot so the mate marks and piston pin bore chamfer are facing up.
5. Place the piston pin bushing on the pilot so that the bushing split is located $45^{\circ} \pm 5^{\circ}$ from the center line of the connecting rod, facing the crankpin end. Refer to the Connecting Rod dimensions in Figure 10-41 and Table 10-39.
6. Position the ram onto the pilot.
7. Using the arbor press, carefully press the new piston pin bushing flush with the piston pin bore.

8. Bore the new piston pin bushing to the diameter specified in Figure 10-41 and Table 10-39 according to the “Connecting Rod Piston Pin Bushing Boring” in Section 10-9.4.3.
9. Visually inspect the connecting rod for nicks or damage that may have occurred during bushing installation. Scrap connecting rods exhibiting these conditions.
10. Verify the piston pin bushing split line meets Figure 10-41 specifications.
11. Because of the close tolerances required, inspect the new piston pin bushing; note the bushing bore inner diameter must meet Table 10-39 specifications:
 - a. Use a Federal Dimension Air Gauge (with the appropriate setting ring and air plug) to verify that the piston pin bushing is within the connecting rod minimum and maximum limits specified in Table 10-39.
 - b. Check the piston pin bushing surface finish with a profilometer. The surface finish must not exceed 16 Ra.
 - c. Check the connecting rod bushing for alignment and twist after bushing installation using the Connecting Rod Boring and Alignment Fixture (Borroughs Part No. 8111A or equivalent). To check the connecting rod twist, insert the push-to-fit arbors into the pin and crank end of the rod.
 - d. Place the connecting rod crank pin end onto the V-blocks.
 - e. Place the pin end arbor on the two machined parallel steel blocks spaced equal distance from the center line of the rod, but not less than 6 inches apart.
 - f. Use a flat feeler gauge to detect clearance between the machined steel blocks and the pin end arbor. Refer to the connecting rod dimensions in Table 10-39 for specified limits.
 - g. To check the connecting rod alignment, rotate the pin end of the connecting rod to a vertical position and with the arbor resting against a positive stop.

NOTE: The piston pin bushing must be bored to the proper inside diameter according to the “Connecting Rod Piston Pin Bushing Boring” instructions in Section 10-9.4.3.

- h. Using a dial indicator mounted on a vertical stand resting on the surface plate, measure the vertical distance of the pin end arbor from the surface plate at points of equal distance from the centerline of the connecting rod. Compare the connecting rod measurements to the connecting rod dimensions in Table 10-39. Connecting rods exceeding Table 10-39 limits must have the piston pin bushing replaced and reamed or the connecting rod must be scrapped.

10-9.4.3. Connecting Rod Piston Pin Bushing Boring

Equipment Required

- Borroughs Part No. 8111A, Connecting Rod Boring and Alignment Fixture, or equivalent
- Adapter Kit
- Vertical mill, or equivalent, capable of maintaining 1750 RPM
- Boring tool of the correct sizes

1. Place the connecting rod on the base plate and secure with retainers provided.
2. Select the correct adapter kit and boring tool for the connecting rod.
3. Using a vertical mill, or equivalent, bore the connecting rod bushing to size. Maintain 1750 RPM during the boring process.