



# Service Instruction

ENGINE COMPONENTS, INC.

S.I. No.: 05-9

Page: 1 of 4

Title: **REWORK OF TCM CONNECTING RODS FOR BOLTS WITH CONTOUR HEADS**

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Revision: 0

*Technical Portions are FAA DER Approved.*

- 1.0 **PURPOSE:** To provide customers and owners with part number information and assembly data pertaining to rework of TCM connecting rods for use with bolts having contour (also known as "ellipsoidal") heads, P/N 655239 or 655958, and 12-point nut, P/N 654490, or FAA-PMA equivalent parts.
- 2.0 **MODELS AFFECTED:** Connecting rods reworked by Engine Components, Inc (ECi®) for use of contour head bolts may be used as replacement parts in various TCM engine models of 346, 470, 520 and 550 cubic-inch displacement. See Table 1 and Table 2 below for specific part number and model application. In addition, these connecting rods may also be used in engines that are being converted from 520 cubic-inch to 550 cubic-inch displacement in accordance with a Supplemental Type Certificate (STC).
- 3.0 **APPROVAL BASIS:** ECi performs rework of connecting rods for use of contour head bolts in accordance with proprietary data. FAA engineering approval of these data was granted on October 11, 2002 in conjunction with FAA Certification Project TD2533SE-E. This project included 150 hours of endurance testing in accordance with FAR 33.49, as well as 199 hours of durability and other testing, for a total of 349 hours of total test time under very adverse conditions.
- 4.0 **BACKGROUND:**
- 4.1 **Engines with 4.00" Piston Stroke:** Historically, TCM 346, 470 and 520-series engines were built with connecting rod bolts having hex heads. The threaded ends of these bolts were drilled for installation of cotter pins to secure the castellated nuts. Originally, the rod bolts of 346 and 470-series engines were 3/8" in diameter, while those of 520-series engines were 7/16" diameter. In the early 1980's, TCM standardized production so that new replacement connecting rods for 346 and 470-series engines were upgraded to 7/16" diameter bolts. More recently, TCM eliminated the use of drilled rod bolts, castellated nuts and cotter pins in favor of undrilled bolts and self-locking 12-point nuts in most new production connecting rods.

**IMPORTANT NOTE:** *The 12-point rod nuts have a revised thread pitch and become self-locking only under load. Thus they require an assembly torque value different from castellated hex nuts. See TCM SB96-7C, or subsequent revision.*

- 4.2 **Engines with 4.25" Piston Stroke:** In order to increase engine displacement from 520 to 550 cubic-inches, the piston stroke was increased to 4.25 inches. Increased piston stroke necessitated a reconfiguration of the connecting rod cap and bolt head in order to provide adequate clearance with the camshaft and interior of the engine crankcase at crankshaft angles near bottom dead center (BDC) of the piston stroke. First, the exterior of the connecting rod cap was fully machined to a uniform radius between the bolt bosses. Second, a new connecting rod bolt was designed with a narrow ("ellipsoidal") contour head. Third, the bolt head recess was machined slightly deeper into the cap; and there is a relief at the edge of both bolt bosses.

**NOTE:** *Connecting rod forging changes were not required since reconfiguration of the cap could be accomplished solely by changes in machining. Note also that 550-series engines require different pistons and camshafts with narrower #1, #3 and #5 exhaust lobes in order to clear connecting rods. This camshaft design change was incorporated into all camshaft part numbers superseding the P/N 535661 or 629726 camshafts originally installed in 520-series engines.*

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ENGINE COMPONENTS, INC.

Service Instruction No. 05-9

## REWORK OF TCM CONNECTING RODS FOR BOLTS WITH CONTOUR HEADS

Page 2 of 4

Due to the larger cross-sectional OD of the camshafts, connecting rods with fully machined caps and contour head bolts were also incorporated into the original type design for L/TSIO-520-AE ("lightweight 520") engines. In addition, connecting rods of this type are also used in TSIO-520-CE engines, although not for internal clearance requirements. Fully machined connecting rod caps are much more uniform in weight, thereby simplifying weight matching of the connecting rods for dynamic balance purposes. In addition, these rods are generally somewhat lighter than similar connecting rods with as-forged surfaces on the caps, thereby slightly reducing friction horsepower losses in the assembled engine.

- 4.3 Current Standardized Production:** Recently, TCM standardized manufacturing of connecting rods for most 4.00" and 4.25" stroke engines, which includes all 346, 470, 520 and 550-series engine models. Current rods are all manufactured with fully machined caps and contour head bolts. Although several additional part numbers exist, depending on whether the connecting rods are sold as a matched pair or as a balanced set of six, the connecting rods fall into two basic groups:

- 1) Connecting rods having a big end width of 1.52" for 346 models, narrow-rod 470 models, small-main 520 models and GTSIO-520 models
- 2) Connecting rods having a big end width of 1.46" for large-main 520 ("B-configuration"), TSIO-520-CE and 550-series engine models

- 4.4 ECi Aftermarket Upgrades:** Through careful engineering analysis and extensive testing, ECi has determined that many existing TCM 470 and 520 connecting rods designed for hex head bolts may be reworked to the current design of fully machined caps and contour head bolts. This upgrade offers several advantages, including:

- More uniform big end weights (see NOTE below)
- Faster engine assembly since cotter pin installation and nut swapping are eliminated
- More uniform preloading of rod bolts after torquing of the nuts
- Ease of torquing since there is no need to hold the bolt head with a separate wrench
- Standardization of bolt/nut ordering and inventory
- An economical source of connecting rods for 520 models being converted to 550 models in accordance with an STC

**NOTE:** *Big end weights of connecting rods with fully machined caps are more uniform than those of connecting rods with as-forged caps. However, this rework changes weight distribution and total weight of the finished connecting rods which must be dynamically balanced to ECi's FAA-approved specifications after rework. Therefore, customers should not remove material from connecting rod cores for dynamic balancing purposes prior to the rework of the big ends. In order to minimize material removal and facilitate dynamic balancing after big end rework, ECi recommends that the rework be accomplished in connecting rod lots of 12 or more.*

- 4.5 Forgings Eligible for Rework:** ECi data permit rework of TCM connecting rods originally machined for assembly with 7/16" hex head bolts and manufactured from forging numbers 632041 and 646126 only.
- 4.6 Forgings Not Eligible for Rework:** 632041 forgings machined for assembly with 3/8" hex head bolts are not eligible for rework. Early 520 rods, P/N 629343, made from wide I-beam 40742 forgings are also not eligible for this rework.

**NOTE:** *Forging numbers are those appearing in raised characters on the side of the I-beam section of the connecting rod, not the assembly numbers acid etched onto the exterior surface of the rod cap.*



ENGINE COMPONENTS, INC.

Service Instruction No. 05-9

# REWORK OF TCM CONNECTING RODS FOR BOLTS WITH CONTOUR HEADS

Page 3 of 4

## 5.0 CONFIGURATION DETAILS:

Table 1: For connecting rods having a big end width of 1.52"

Forging No.	P/N Before Rework	P/N After Rework	Eligible for Installation in These Models
632041	632041A1 or A2; 632043; 633403	AEC643166R	IO-346-A O-470-numerical. O-470-A, B, E, G, J, K, L, M, P, R, S, U
646126	646437A1, A2, A3 or A4; 646474; 646778	AEC655000R	IO-470-C, D, E, F, G, H, J, K, L, M, N, P, R, S, U, V, VO TSIO-470-B, C, D IO-520-A, B, BA, C, D, E, F, J, K, L, M, P LIO-520-P TSIO-520-AE, AF, B, C, D, E, G, H, J, K, L, M, N, P, R, T GTSIO-520-C, D, F, H, K, L, M, N LTSIO-520-AE

**IMPORTANT NOTE:** For 470 models, AEC643166R and AEC655000R are eligible for use only on narrow-rod crankshafts. Wide-rod 470 crankshafts require P/N A36121 connecting rod (1.587"-1.585" width) and must continue to use that rod and associated hardware. See TCM service bulletins M78-13 and 00-3A, Table 4.

Table 2: For connecting rods having a big end width of 1.46"

Forging No.	P/N Before Rework	P/N After Rework	Eligible for Installation in These Models
*632041	642397A1; 642399	*AEC643329R	IO-520-BB, CB, MB TSIO-520-BB, BE, CE, DB, EB, JB, KB, LB, NB, UB, VB, WB
*646126	646475A1 or A2; 646476	*AEC655001R	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

**\*SUPERSEDURES:** Some 632041 forgings were reworked and identified as P/N AEC643168R. When overhauled, these rods should be identified as P/N AEC643329R. Some 646126 forgings (1.46" big end width) were reworked and identified as P/N AEC646482R when assembled with 643112 bolts and 643215 hex nuts which have since been superseded. When assembled with P/N 655239 or 655958 bolts and 654490 12-point nuts, or equivalent, AEC646482R rods become P/N AEC655001R.

**6.0 ASSEMBLY DATA:** AEC643166R, AEC643329R, AEC655000R and AEC655001R must be used in complete sets. Assemble w/ P/N 655239 or 655958 bolts and P/N 654490 nuts, or equivalent, lubricate with Grade 50 engine oil and torque nuts to 690-710 in/lb. See TCM SB96-7C, or subsequent revision. Assemble according to the following sequence:

- 6.1 Bearings:** Assemble AEC643166R and AEC655000R connecting rods (1.52" big end width) with AEC630826 bearings. Assemble AEC643329R and AEC655001R connecting rods (1.46" big end width) with AEC642398 bearings. Use bearings in standard size, M005 or M010, as appropriate to crankshaft journal sizes. Equivalent FAA-approved bearings may be substituted.
- 6.2 Lubrication:** DO NOT LUBRICATE BEARINGS AND CRANKPINS WITH GREASE OF ANY TYPE! Use SAE 50 (aviation grade 100) aircraft engine oil at all points. Lightly oil ID of connecting rods and caps and back sides of bearings prior to installation. Lightly oil bolt shanks prior to installation in rod caps. Thoroughly oil ID of bearings, OD and thrust surfaces of crankpins on crankshaft, bolt threads and nut faces.



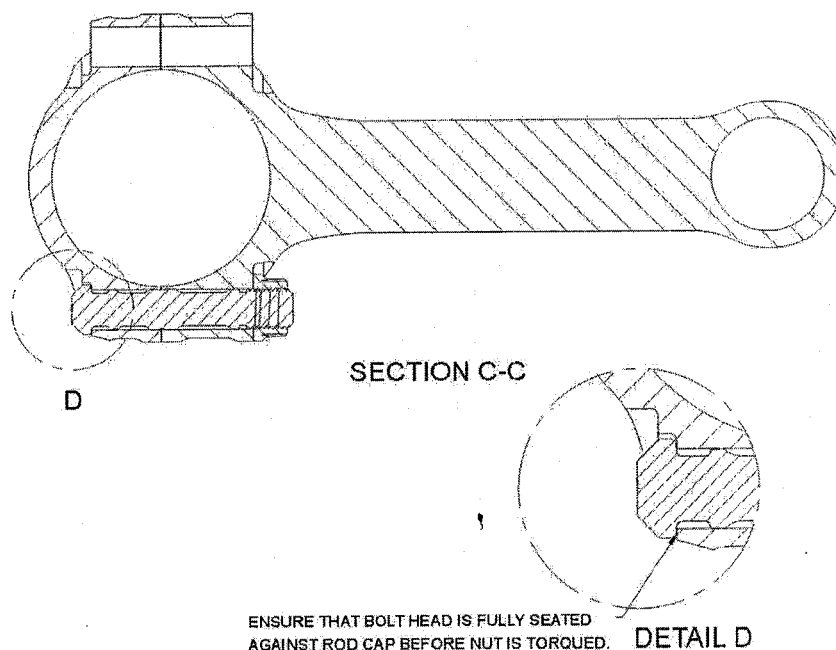
ENGINE COMPONENTS, INC.

Service Instruction No. 05-9

## REWORK OF TCM CONNECTING RODS FOR BOLTS WITH CONTOUR HEADS

Page 4 of 4

- 6.3 **Initial Assembly:** Assemble connecting rods and caps on crankpins so that the numbered side of rods will face away from the camshaft in the assembled engine. Snug both nuts on each rod with a speed handle and 12-point socket wrench.
- 6.4 **Inspect:** Visually inspect each bolt head to ensure that it is fully and properly seated in the machined recess of the connecting rod cap. See Figure 1 below.
- 6.5 **Initial Torque:** Tighten both nuts on each rod to an initial torque value of 350 in/lb (29.2 ft/lb). Again inspect bolt heads for proper seating. See Figure 1 below.
- 6.6 **Final Torque:** Tighten both nuts on each rod to a final torque value of 690-710 in/lb (57.5-59.2 ft/lb). When all nuts are torqued, double check each nut to ensure that all have been tightened to the final torque value.
- 6.7 **Inspect:** Inspect each rod for free rotation on the crankpin. Ensure that side clearance of each connecting rod is within limits established by the appropriate engine overhaul manual. If not, disassemble and correct as required.



Correct Seating of Bolt Head in Connecting Rod Cap

Figure 1

- 7.0 **OVERHAUL REQUIREMENTS:** After rework, AEC643166R, AEC643329R, AEC655000R and AEC655001R connecting rods become functionally interchangeable with TCM connecting rods of equivalent part numbers and may be repaired, overhauled and inspected in accordance with current TCM overhaul manuals for subject engine models.