TEXTRON Lycoming

652 Oliver Street
Williamsport, PA 17701 U.S.A.
717/323-6181

SERVICE INSTRUCTION

DATE: August 15, 1986

Service Instruction No. 1029D
(Supersedes Service Instruction No. 1029C)
Engineering Aspects are
FAA Approved

SUBJECT: Tightening Procedures for Crankcase Thru-Studs and Bolts

MODELS AFFECTED: All Avco Lycoming piston engines.

TIME OF COMPLIANCE: When assembling cylinder(s) to engines.

All Avco Lycoming aircraft engines incorporate bolts and long thru studs that extend through the crankcase halves primarily for holding them together. The studs also secure the cylinders to their mounting decks on the crankcase.

Two basic types of thru studs are used: anchored and free-thru.

The anchored-thru studs are threaded into one of the crankcase halves; the free-thru studs are not. Instead, the free-thru studs extend through both crankcase halves. Because of their interference fit in the main bearing webs, the free-thru studs also serve as dowels to align the crankcase halves.

To insure uniform loading on the main bearings, it is necessary to tighten these studs and bolts in a sequence beginning at the approximate center of the engine and progressing evenly to both front and rear of the engine as described in detail in the following procedures.

Two different procedures are shown. The first procedure, shown in PART I, is to be used when the engine has been completely disassembled, or when all the cylinders have been removed; the second procedure, shown in part II, is used when individual cylinders are replaced on an assembled engine. The procedure shown in PART II is simpler to undertake, because bearing loading is localized.

PART I: TIGHTENING PROCEDURE FOR CRANKCASE THRU-STUDS. (Disassembled engines, or engines on which all cylinders have been removed.)

NOTE

Before installing cylinder hold-down nuts, lubricate crankcase thru stud threads with any one of the following lubricants, or combination of lubricants.

1. 90% SAE 50W engine oil and 10% STP
2. Parker Thread Lube
3. SAE 30W engine oil
4. 60% SAE 30W engine oil and 40% Parker Thread Lube.

1. Before the cylinders are assembled on the crankcase, install torque plate P/N ST-222 over the 1/2 inch thru-studs to simulate the thickness of the cylinder base flange; then install nuts on the free ends of 1/2 inch thru-studs and tighten each to 300 in. lbs. (25 ft. lbs.) Use tightening sequences that follow Figures 1 through 11.

NOTE

On O-235 Series crankcases, install spacers or flat washers over the 3/8 in. or 7/16 in. thru-studs (since torque plate P/N ST-222 does not apply) and torque to 300 in. lb. (25 ft. lb.).

2. Using same sequence as specified in paragraph 1, retorque the 1/2 in. thru-studs to 600 in. lbs. torque (50 ft. lbs). On O-235 model engines using 7/16-inch thru studs, retorque to 420-in. lb. (35 ft. lb.). Where 3/8-inch nuts are used, do not tighten more than 300 in. lb. (25 ft. lb.).

NOTE

Before tightening free-thru studs, make sure that they extend equally from both sides of crankcase.

3. Using sequences shown in figures 1 thru 11, tighten the 3/8-inch and 1/4-inch nuts at the crankcase parting flange. Torque values are:

3/8-inch nuts, 300 in. lb. (25 ft. lb.);
1/4-inch nuts and capscrews, 96-108 in. lb.;
1/4-inch shear nuts, 55-60 in. lb.

NOTE

The tightening sequence procedures following the illustrations are numerically keyed to the legends in the illustrations. As for those crankcase fastenings not specifically covered, use any sequence and tighten to torque values listed in paragraph 3, Part I.

a. Four Cylinder Engines, Wide Cylinder Flange (See Figure 1).

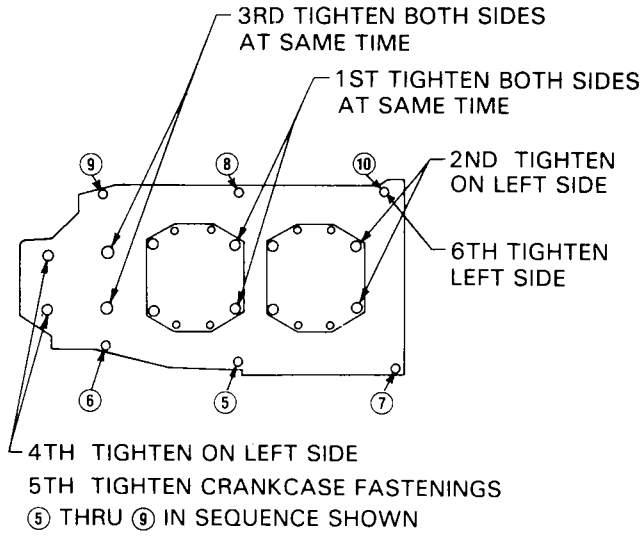

Figure 1. Left Side of Crankcase

1st - Tighten both ends of free-thru studs simultaneously at rear of No. 2 cylinder and at front of No. 3 cylinder.
2nd - Tighten thru studs at rear of No. 4 cylinder.
3rd - Tighten both ends of free-thru studs simultaneously in front of No. 2 cylinder and at front of No. 1 cylinder.
4th - Tighten 3/8-inch nuts at front main bearing (left side) to 300 in. lb. (25 ft. lb.).
5th - Tighten crankcase fastenings 5 thru 9 in sequence shown.
6th - Tighten 3/8-inch nut 10 at camshaft bearing location (left side) to 300 in. lb. (25 ft. lb.).

b. Four Cylinder Engines, Standard Cylinder Flange (See Figure 2).

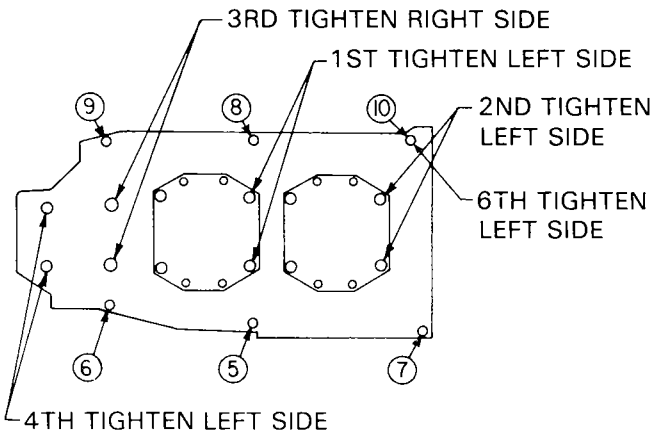

Figure 2. Left Side of Crankcase

1st - Tighten thru studs at rear of No. 2 cylinder.
2nd - Tighten thru studs at rear of No. 4 cylinder.
3rd - Tighten thru studs at front of No. 1 cylinder.
4th - Tighten 3/8 nuts at front main bearing (left side) to 300 in. lb. (25 ft. lb.).
5th - Tighten crankcase fastenings 5 thru 9 in sequence shown.
6th - Tighten 3/8-inch nut and bolt 10 at rear camshaft bearing location (left side) to 300 in. lb. (25 ft. lb.).

c. Four Cylinder Engines, Wide Cylinder Flange — "76" Series (See Figure 3).

NOTE

On 76 series engines, initially torque all 1/2-inch free-thru and anchored-thru studs to 300 in. lb. (25 ft. lb.). Then apply a final torque of 600 in.-lb. (50 ft. lb.). Tighten 3/8-inch nuts at front main bearings to 300 in.-lb. (25 ft. lb.).

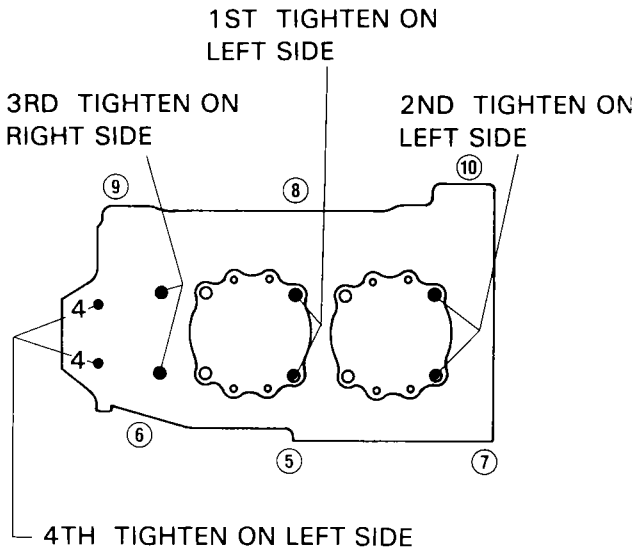

Figure 3. Left Side of Crankcase

1st - Tighten thru studs at rear of No. 2 cylinder.
2nd - Tighten thru studs at rear of No. 4 cylinder.
3rd - Tighten thru studs at front of No. 1 cylinder.
4th - Tighten 3/8-inch nuts at front main bearing (left side) to 300 in. lb. (25 ft. lb.).
5th - Tighten crankcase fastenings 5 thru 10 in sequence shown.

d. Six Cylinder Engines (O-540 Type), Wide Cylinder Flange (See Figure 4).

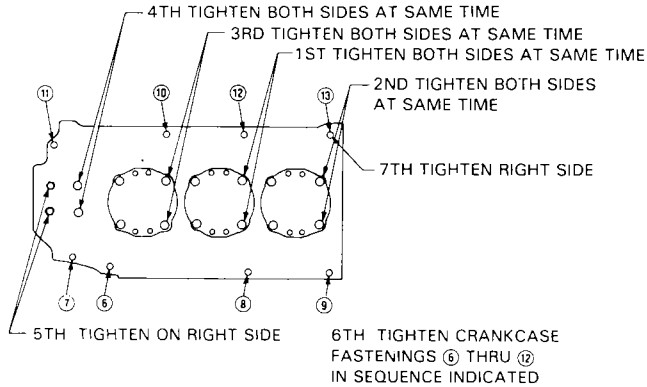

Figure 4. Left Side of Crankcase

1st - Tighten both ends of free-thru studs simultaneously at rear of No. 4 cylinder and at front of No. 5 cylinder.
2nd - Tighten both ends of free-thru studs simultaneously at rear of No. 6 cylinder and behind No. 5 cylinder.
3rd - Tighten both ends of free-thru studs simultaneously at rear of No. 2 cylinder and at front of No. 3 cylinder.
4th - Tighten both ends of free-thru studs simultaneously in front of No. 2 cylinder and at front of No. 1 cylinder.
5th - Tighten 3/8-inch nuts at front main bearing (right side) to 300 in. lb. (25 ft. lb.).
6th - Tighten crankcase fastenings 6 thru 12 in sequence shown.
7th - Tighten 3/8-inch nut 13 at rear camshaft bearing location (right side) to 300 in. lb. (25 ft. lb.).

e. Integral Accessory Drive Engines (TIO-541), Wide Cylinder Flange (See Figure 5).

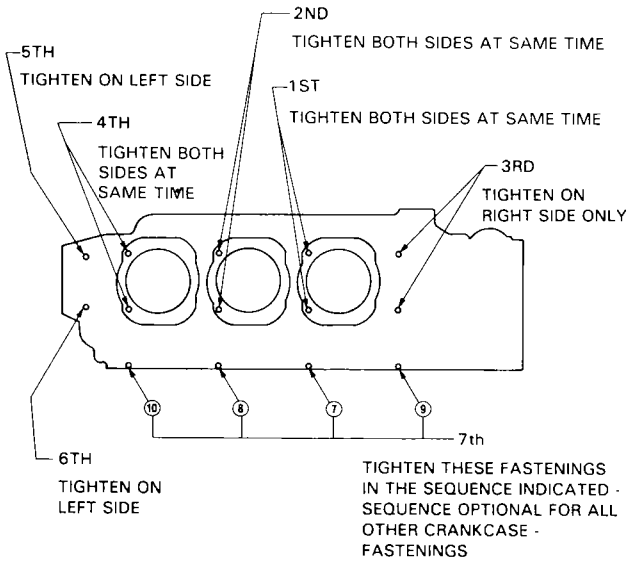

Figure 5. Left Side of Crankcase

1st - Tighten both ends of free-thru studs simultaneously at front of No. 5 cylinder and at rear of No. 4 cylinder.
2nd - Tighten both ends of free-thru studs simultaneously at front of No. 3 cylinder and at rear of No. 2 cylinder.
3rd - Tighten nuts on thru bolts at rear of No. 6 cylinder.
4th - Tighten both ends of free-thru studs simultaneously at front of No. 1 cylinder and in front of No. 2 cylinder.
5th - Tighten 1/2-inch bolt in front of No. 1 cylinder.
6th - Tighten 1/2-inch stud in front of No. 1 cylinder.
7th - Tighten 5/16-inch camshaft bearing nuts 7 thru 10 to 125-170 in. lb. (10-14 ft. lb.).

f. Integral Accessory Drive Engines (TIGO-541), Wide Cylinder Flange (See Figure 6).

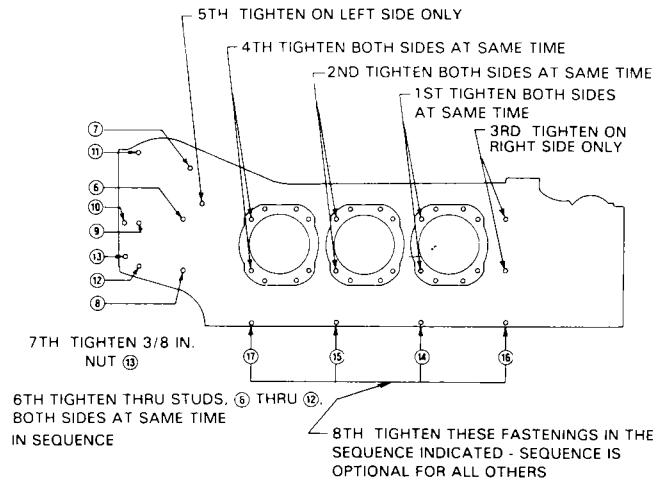

Figure 6. Left Side of Crankcase

1st - Tighten both ends of free-thru studs simultaneously at front of No. 5 cylinder and at rear of No. 4 cylinder.
2nd - Tighten both ends of free-thru studs simultaneously at front of No. 3 cylinder and at rear of No. 2 cylinder.
3rd - Tighten 1/2-inch thru bolts at rear of No. 6 cylinder.

4th - Tighten both ends of free-thru studs simultaneously at front of No. 1 cylinder and in front of No. 2 cylinder.
5th - Tighten 1/2-inch thru stud in front of No. 1 cylinder.
6th - In sequence, tighten both ends simultaneously of free-thru studs, 6 thru 12.
7th - Tighten 3/8-inch nut, 13, at front main bearing to 300-in. lb. (25 ft. lb.).
8th - Tighten 5/16-inch camshaft bearing nuts 14 thru 17 to 125-170 in. lb. (10-14 ft. lb.).

g. Six Cylinder Geared Engines (Wrap-Around Crankcase), Standard Cylinder Flange (See Figure 7).

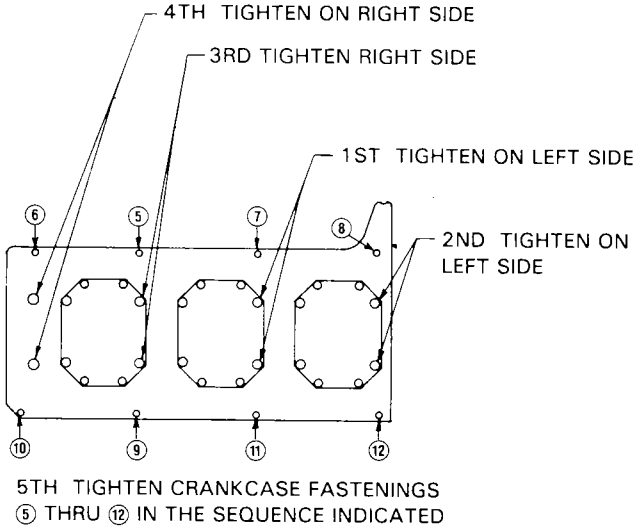

Figure 7. Left Side of Crankcase

1st - Tighten thru studs at rear of No. 4 cylinder.
2nd - Tighten thru studs at rear of No. 6 cylinder.
3rd - Tighten thru studs at front of No. 3 cylinder.
4th - Tighten thru studs at front of No. 1 cylinder.
5th - Tighten 3/8-inch nuts 5 thru 12 in sequence shown (left side) to 300 in. lb. (25 ft. lb.).

h. Six Cylinder Geared Engines (Open Bottom Crankcase), Standard Cylinder Flange (See Figure 8).

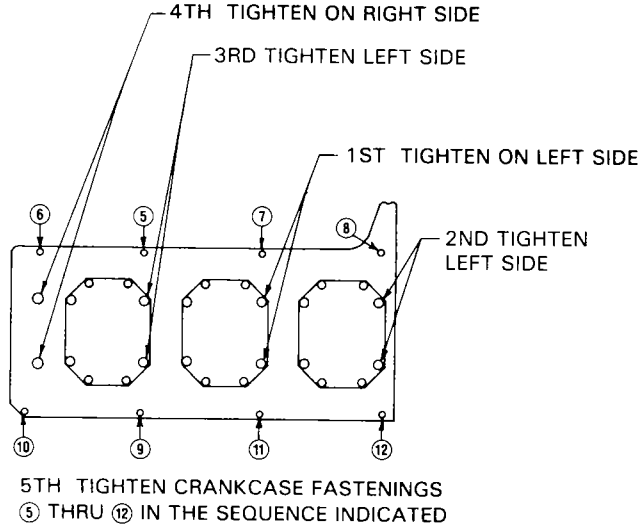

Figure 8. Left Side of Crankcase

1st - Tighten thru studs at rear of No. 4 cylinder.
2nd - Tighten thru studs at rear of No. 6 cylinder.
3rd - Tighten thru studs at rear of No. 2 cylinder.
4th - Tighten thru studs at front of No. 1 cylinder.
5th - Tighten 3/8-inch nuts 5 thru 12 in sequence shown (left side) to 300 in. lb. (25 ft. lb.).

i. Six Cylinder Direct Drive Engines, O-435A/O-540 type, Standard Cylinder Flange (See Figure 9).

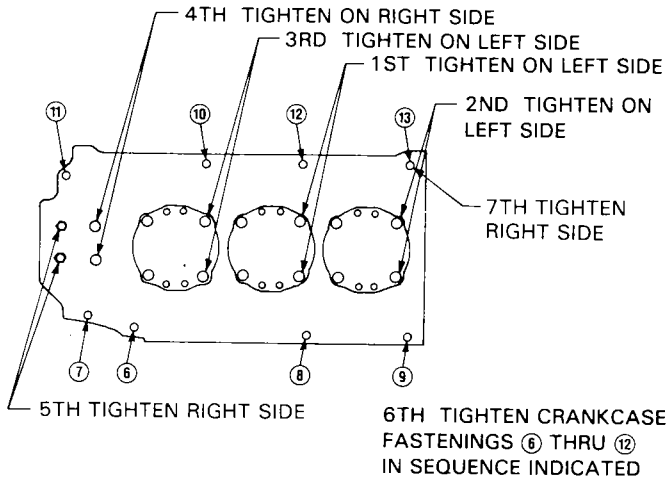

Figure 9. Left Side of Crankcase

1st - Tighten thru studs at rear of No. 4 cylinder.
2nd - Tighten thru studs at rear of No. 6 cylinder.
3rd - Tighten thru studs at rear of No. 2 cylinder.
4th - Tighten thru studs at front of No. 1 cylinder.
5th Tighten 3/8-inch nuts at front main bearing (right side) to 300 in. lb. (25 ft. lb.).
6th - Tighten crankcase fastenings 6 thru 12 in sequence shown.
7th - Tighten 3/8-inch nut 13 at rear camshaft bearing location (right side) to 300 in. lb. (25 ft. lb.).

j. Eight Cylinder Engines, Wide Cylinder Flange (See Figure 10).

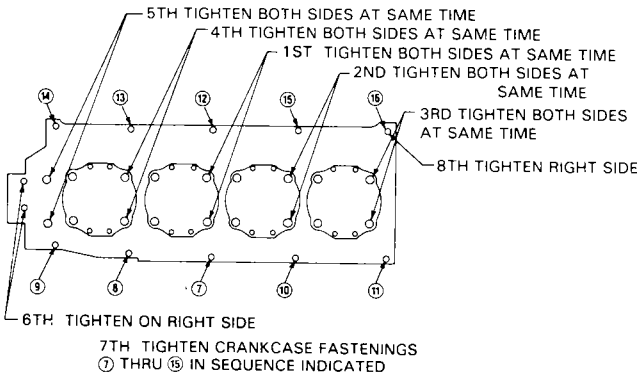

Figure 10. Left Side of Crankcase

1st - Tighten both ends of free-thru studs simultaneously at rear of No. 4 cylinder and at front of No. 5 cylinder.
2nd - Tighten both ends of free-thru studs simultaneously at rear of No. 6 cylinder and at front of No. 7 cylinder.
3rd - Tighten both ends of free-thru studs simultaneously at rear of No. 8 cylinder and in the crankcase behind No. 7 cylinder.
4th - Tighten both ends of free-thru studs simultaneously at rear of No. 2 cylinder and at front of No. 3 cylinder.
5th - Tighten both ends of free-thru studs simultaneously at front of No. 1 cylinder and in the crankcase in front of No. 2 cylinder.
6th - Tighten 3/8-inch nuts at front bearing location (right side) to 300 in. lb. (25 ft. lb.).
7th - Tighten crankcase fastenings 7 thru 15 in sequence shown.
8th - Tighten 3/8-inch nut 16 at right rear camshaft bearing location to 300 in. lb. (25 ft. lb.).

k. Eight Cylinder Engines, Standard Cylinder Flange (See Figure 11).

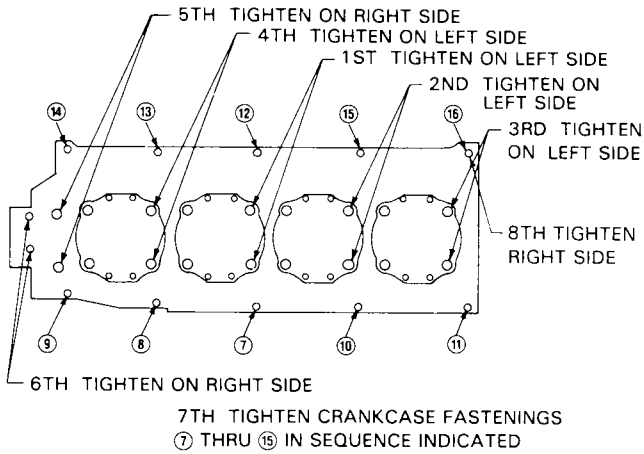

Figure 11. Left Side of Crankcase

1st - Tighten thru studs at rear of No. 4 cylinder.
2nd - Tighten thru studs at rear of No. 6 cylinder.
3rd - Tighten thru studs at rear of No. 8 cylinder.
4th - Tighten thru studs at rear of No. 2 cylinder.
5th - Tighten thru studs at front of No. 1 cylinder.
6th - Tighten 3/8-inch nuts at front main bearing (right side) to 300 in. lb. (25 ft. lb.).
7th - Tighten crankcase fastenings 7 thru 15 in sequence shown.
8th - Tighten 3/8-inch nut 16 at right rear camshaft bearing location to 300 in. lb. (25 ft. lb.).

4. Install sump, accessory housing, reduction gear unit and supercharger where applicable. Remove nuts and torque plate P/N ST-222 from the thru-studs on both rear cylinder mounting pads (cylinders 3 and 4 on four cylinder engines; 5 and 6 on six cylinder engines; and numbers 7 and 8 on eight cylinder engines).

5. Install cylinders on the pads from which the nuts were removed in the previous step. Initially tighten cylinder hold-down nuts, to a torque of 300 in. lb. (25 ft. lb.) in the sequence shown in Fig. 12. On engines with cylinder hold-down plates, follow instructions in Figure 13.

6. Proceed to install the remaining cylinders on the engine in pairs, proceeding toward the front, in the same manner as described in paragraphs 4 and 5.

7. Install 3/8 inch nuts on the remaining cylinder base studs and torque to 300 in. lbs. (25 ft. lbs.). The sequence for tightening these nuts is optional.

8. Using the same sequence as described in paragraphs 5 and 6, and shown in Figure 12, check all 1/2-inch nuts for tightness by bringing torque to 600 in. lb. (25 ft. lb.). Be sure shims are removed before final torquing engines using cylinder hold-down plates. On O-235 engines using 7/16-inch thru studs, retorque to 420-in. lb. (35 ft. lb.). Where 3/8-inch nuts are used, do not tighten more than 300 inches (25 ft. lb.).

9. Check 3/8-inch nuts for tightness on the remaining cylinder base studs by bringing torque up to 300 in. lb. (25 ft. lb.). Sequence is optional.

10. After all cylinder base nuts have been tightened, remove any nicks in cylinder fins by burring or filing.

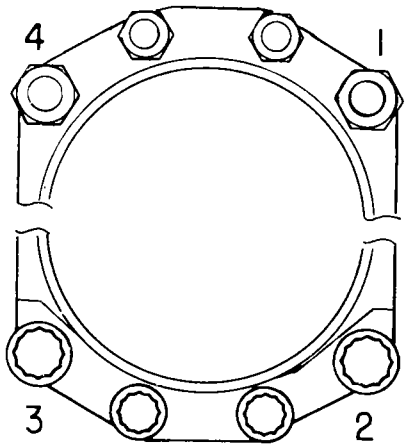

Figure 12. Sequence for Tightening Cylinder Basenuts

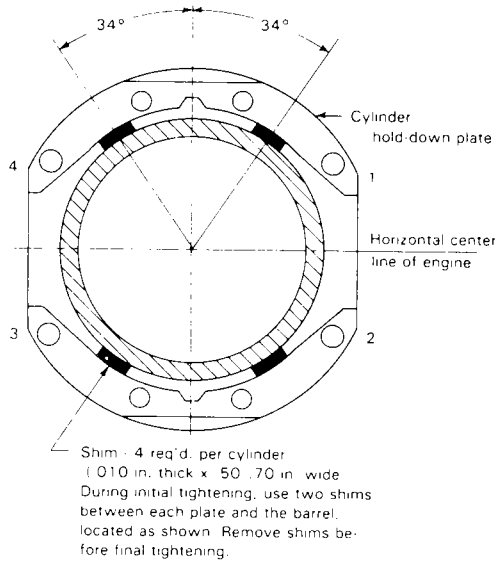

Figure 13. Location of Shims Between Cylinder Barrel and Hold-Down Plates

PART II: TIGHTENING PROCEDURE FOR CYLINDER REPLACEMENT. (Assembled engines.)

NOTE

The tightening procedure for cylinder replacement on all wide cylinder flange engines is the same as the following procedure, except that both ends of free-thru studs must be tightened simultaneously. At any time one or more cylinders are replaced, it is necessary to retorque the thru-studs on the cylinder on the opposite side of the engine; the procedure is as follows:

1. Lubricate the threads of the thru-studs with any of the lubricants listed in the note preceding paragraph 1, Part I.

2. Install the cylinder on its mounting pad. If the engine employs hold-down plates, shim as shown in Figure 13. Initially torque the 1/2-inch thru studs to 300 in. lb. (25 ft. lb.) per sequence in Figure 12.

3. Then remove all shims from hold-down plates, if fitted, and retorque the 1/2-inch thru studs to 600 in. lb. (50 ft. lb.) per Figure 12.

NOTE

For those O-235 model engines using 3/8 inch thru studs, do not exceed torque of 300 in. lb. (25 ft. lb.). And if 7/16-inch studs are used, torque initially to 300 in. lb. (25 ft. lb.); then, following the same sequence in Figure 12, apply final torque of 420 in. lb. (35 ft. lb.).

4. Torque the thru-stud nuts on the opposite cylinder in the same manner as described above.

5. Install 3/8-inch nuts on remaining cylinder base studs and torque to 300 in. lb. (25 ft. lb.). The tightening sequence for these nuts is optional.

6. Recheck all thru studs and 3/8-inch cylinder basenuts on both the installed cylinder and its opposing cylinder by applying maximum torque values given.

NOTE

If thru studs and other cylinder basenuts are tightened properly, it is not necessary to use lockwire or Pal-Nuts for security purposes. However, this is the prerogative of the mechanic.

7. After all cylinder basenuts have been tightened, remove any nicks in cylinder fins by burring or filing.

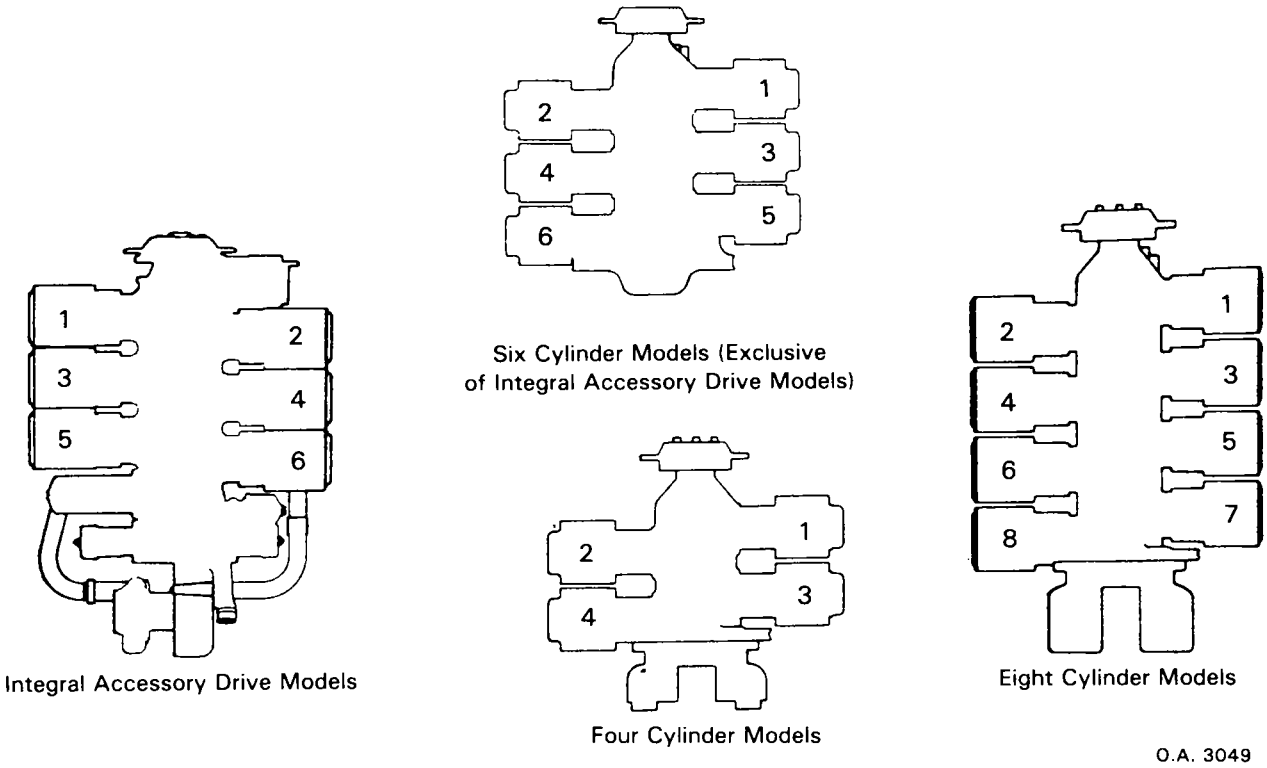

Figure 14. Cylinder Numbering System (Viewed from Top)

TOOL DATA:

CYLINDER BASE NUT PART NUMBER	TYPE	STUD SIZE	WRENCH PART NUMBER
71134	Allen head	3/8	64943 and ST-84 (3/8-inch Allen head)
71133	Allen head	1/2	64942 and ST-83 (1/2-inch Allen head)
383B	Hex head	3/8	ST-374 (9/16-inch Hex head)
STD-2090	Hex head	1/2	STD-375 (3/4-inch Hex head)
STD-2106	Hex head	7/16	ST-322 (5/8-inch Hex head)
68515	Spline head	3/8	64700 (9/16-inch spline head)
68514	Spline head	1/2	64701 (3/4-inch spline head)
Torque Hold Down Plate			ST-222

NOTE: Revision "D" revises text, artwork, format and part numbers; also adds wide cylinder flange 4-, 6-, and 8-cylinder engines.

TEXTRON Lycoming

652 Oliver Street
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717/323-6181

SERVICE INSTRUCTION

March 5, 1993

Supplement No. 1

To

Service Instruction No. 1029D

On page 7 of 9 of Service Instruction No. 1029D, the first sentence of step 8. should read as follows:

8. Using the same sequence as described in paragraphs 5 and 6, and shown in Figure 12, check all 1/2-inch nuts for tightness by bringing torque to 600 in. lb. (50 ft. lb.).

TEXTRON Lycoming

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717/323-6181

SERVICE INSTRUCTION

April 23, 1993

Supplement No. 2

To

Service Instruction No. 1029D

On page 9 of 9 of Service Instruction No. 1029D, the wrench part number STD-375 (3/4 inch Hex head) for cylinder base nut part number STD-2090 should be wrench part number ST-375 (3/4 inch Hex head).