TEXTRON Lycoming

652 Oliver Street
Williamsport, PA 17701 U.S.A.
570/323-6181

SERVICE INSTRUCTION

DATE: January 12, 2001

Service Instruction No. 1009AQ
(Supersedes Service Instruction No. 1009AP and Supplement No. 1 to Service Instruction No. 1009AP)
Engineering Aspects are FAA Approved

SUBJECT: Recommended Time Between Overhaul Periods

MODELS AFFECTED: All Textron Lycoming Piston Aircraft Engines

The following chart shows the established time between overhaul (TBO) for Textron Lycoming piston aircraft engines. TBO's can be established on engines that incorporate GENUINE TEXTRON LYCOMING PARTS only, and are not applicable if the engine contains parts other than those supplied by Textron Lycoming. Service experience, variations in operating conditions, and frequency of operation are some of the factors taken into consideration when a TBO is established. **Because of variations in the manner in which engines are operated and maintained, Textron Lycoming can give no assurance that any individual operator will achieve the recommended TBO.**

Continuous service assumes that the aircraft will not be out of service for any extended period of time. Refer to latest revision of Service Letter No. L180 if the aircraft is to be out of service for a period of time greater than 30 days.

Engine deterioration in the form of corrosion (rust) and the drying out and hardening of composition materials such as gaskets, seals, flexible hoses and fuel pump diaphragms can occur if an engine is out of service for an extended period of time. Due to the loss of a protective oil film after an extended period of inactivity, abnormal wear on soft metal bearing surfaces can occur during engine start. Therefore, all engines that do not accumulate the hourly period of time between overhauls specified in this publication are recommended to be overhauled in the twelfth year.

Engine accessories and propellers may require overhaul prior to engine overhaul and should be accomplished in accordance with the accessory manufacturer's recommendation.

The TBO's in the chart do not apply to engines engaged in crop dusting or other chemical-application flying. These engines should be overhauled at 1500-hour intervals or at recommended TBO, whichever is lower.

Reliability and average service life cannot be predicted when an engine has undergone any modification not approved by Textron Lycoming. The TBO's shown in the table are recommendations for engines as manufactured, without considering any modifications that may alter the life of the engine.

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RECOMMENDED TIME BETWEEN OVERHAUL PERIODS

FIXED WING AIRCRAFT		
Engine Models	See Note	Hours
O-235 Series (except –F, -G, -J	12	2400
O-235-F, -G, -J	13	2000
O-290-D	--------	2000
O-290-D2	--------	1500
O-320 Series (except O-320-H); IO-320-A, -E	1,10,11	2000
O-320-H	11	2000
IO-320-B, -D, -F	4,6,10,11	2000
IO-320-C	2,4,10,11	1800
AIO-320 (160 HP)	6	1600
AEIO-320 Series	6	1600
O-340 Series	1	2000
O-360 Series (except O-360-E, -J2A); IO-360-B, -E, -F, -M1A (180 HP)	1,4,10,11	2000
O-360-E	4,11	2000
IO-360-L2A	11	2000
IO-360-A, -C, -D, -J (200 HP)	4,5,6,10,11	2000
TO-360-C,-F; TIO-360-C	3,11	1800
TO-360-E (180 HP)	3,4,11	1800
AIO-360 (200 HP)	6	1400
TIO-360-A Series	3,11	1200
AEIO-360 Series (180 HP)	6	1600
AEIO-360 Series (200 HP)	6	1400
O-435; GO-435	--------	1200
GO, GSO-480; IGSO-480	1	1400
O-540-A, -B, -E4A5; IO-540-C, -D	1,10	2000
O-540-E4B5, -E4C5	1,11	2000
O-540-G, -H, -J; IO-540-N, -T, -V, -W	10,11	2000
O-540-L3C5D	2,11	2000
IO-540-A, -B (290 HP)	1,10,11	1400
IO-540-E, -G, -P	1,10,11	1600
IO-540-S, -AA	2,10	1800
IO-540-J, -R	2,10	1800
IO-540-AB1A5, -AC1A5	11	2000
IO-540-K, -L, -M	10,11	2000
IO-540-K1B5, -K1G5	10,11	2000
AEIO-540 Series	6	1400
IGO & IGSO-540 Series	--------	1200
TIO-540-V, -W, -AE	3,4,11	2000
TIO-540-C, -AA, -AB, -AF, -AG, -AH, -AJ	3,4,7,11	2000
TIO-540-A, -F, -J, -N, -R, -S, -U	3,4,11,14	1800
TIO-541-A (320 HP)	3	1300
TIO-541-E (380 HP)	3,9	1600
TIGO-541 (425 HP)	3	1200
IO-720 Series	11	1800

RECOMMENDED TIME BETWEEN OVERHAUL PERIODS (CONT.)

ROTARY WING AIRCRAFT		
Engine Models	See Note	Hours
O-320-A2C, -B2C	11	2000
HO-360-C1A	11	2000
O-360-C2B,-C2D; HO-360 (except –C1A); HIO-360-B	--------	1500
O-360-J2A	11	2000
HIO-360-A, -C, -D, -E, -F Series	--------	1500
VO-360-A Series	--------	600
VO-360-B; IVO-360	--------	1000
VO-435-A Series	--------	1200
VO-435-B Series	--------	1200
TVO-435 Series	3	1000
O-540-F1B5	11	2000
VO-540 Series	8	1200
IVO-540 Series	--------	600
TVO, TIVO-540 Series	3,8	1200

NOTES

1. Only engines built with ½ inch dia. exhaust valve stems. Engines of this series with 7/16 inch dia. exhaust valves should not exceed 1200 hours between overhauls regardless of the type of operation. New and remanufactured engines built with ½ inch dia. exhaust valve stems are identified, respectively, by serial numbers and date in the latest revision of Service Instruction No. 1136.
2. These engines are designed to incorporate exhaust turbocharging.
3. Turbochargers may require removal, prior to engine overhaul, for carbon removal and repair.
4. Engines with reverse rotation have same overhaul times as corresponding normal rotation engines.
5. 1200 HOURS: Engines that do not have large main bearing dowels should not be operated more than 1200 hours between overhauls.

1400 HOURS: Engines that have large main bearing dowels may be operated to 1400 hours between overhauls. These include engines with serial numbers L-7100-51A and up, and L-101-67A and up; engines which are in compliance with the latest revision of Service Bulletin No. 326; and remanufactured engines shipped after January 26, 1970.

2000 HOURS: Engines that have large main bearing dowels and redesigned camshafts may be operated to 2000 hours between overhauls. These include engines with serial numbers L-9762-51A and up; IO-360-C1E6 engines with serial numbers L-9723-51A and up; LIO-360-C1E6 engines with serial numbers L-524-67A and up; engines that are in compliance with the latest revision of Service Bulletin No. 326 and Service Instruction No. 1263. Remanufactured engines shipped after October 1, 1972 may be operated to 2000 hours between overhauls except those with serial numbers L-2349-51A and L-7852-51A which do not have the redesigned camshaft and must not exceed 1400 hours of operating time between overhauls.

6. The reliability and service life of engines can be detrimentally affected if they are repeatedly operated at alternating high and low power applications which cause extreme changes in cylinder temperatures. Flight maneuvers which cause engine overspeed also contribute to abnormal wear characteristics that tend to shorten engine life. These factors must be considered to establish TBO of aerobatic engines; therefore it is the responsibility of the operator to determine the percentage of time the engine is used for aerobatics and establish his own TBO. The maximum recommended is the time specified in this instruction.

7. TIO-540-C Series engines with serial numbers L-1754-61 and up, TIO-540-C Series engines that were remanufactured or overhauled at Textron Lycoming, Williamsport, PA after March 1, 1971 and TIO-540-C series engines that have been modified to incorporate large main bearing dowels as described in the latest revision of Service Instruction No. 1225 may be operated to 2000 hours. Engines that do not incorporate this modification must not exceed 1500 hours between overhauls.

8. VO, TVO and TIVO-540 engines built with P/N 77450 connecting rods as described in the latest revision of Service Bulletin No. 371 may be continued in service to 1200 hours. Engines that do not incorporate this new connecting rod are restricted to 1000 hours for VO-540 models and 900 hours for TVO and TIVO-540. See latest revision of Service Bulletin No. 371 for improved connecting rod assembly.

9. TIO-541-E series engines with serial numbers L-804-59 and up, remanufactured engines shipped after March 1, 1976 and all engines that incorporate the improved crankcases and cylinder assemblies described in the latest revision to Service Bulletin Nos. 334 and 353 may be operated for 1600 hours before overhaul. Engines not in compliance with these requirements are limited to 1200 hours recommended time between overhaul.

10. Some engines in the field have been altered to incorporate an inverted oil system in order to perform aerobatic maneuvers. Whenever this modification is done to an engine, the TBO of the engine must be determined in the same manner listed for AEIO engines of the same model series.

11. If an engine is being used in "frequent" type service and accumulates 40 hours or more per month, and has been so operated consistently since being placed in service, add 200 hours to TBO time.

12. To qualify for the 2400 hour TBO, high-compression O-235's must have the increased strength pistons (P/N LW-18729). See latest revision of Service Letter No. L213.

13. The high-compression O-235-F, -G and –J series do not have the increased-strength pistons (P/N LW-18729); therefore, they do not qualify for the 2400 hour TBO.

14. TIO-540-A series engines with serial numbers L-1880-61 and up, TIO-540-A series engines that were remanufactured or overhauled at Textron Lycoming, Williamsport, PA after March 1, 1971 and TIO-540-A series engines that have been modified to incorporate large main bearing dowels as described in the latest revision of Service Instruction No. 1225 may be operated to 1800 hours. Engines that do not incorporate this modification must not exceed 1500 hours between overhauls.

TEXTRON Lycoming

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MANDATORY

SERVICE BULLETIN

DATE: November 10, 1999

Service Bulletin No. 240R
(Supersedes Service Bulletin No. 240Q)
Engineering Aspects are
FAA Approved

SUBJECT: Mandatory Parts Replacement at Normal Overhaul and During Repair or Normal Maintenance

MODELS AFFECTED: All Textron Lycoming reciprocating aircraft engines.

TIME OF COMPLIANCE: As specified below.

AT OVERHAUL OR UPON REMOVAL:

Any time the following parts are removed from any Textron Lycoming reciprocating engine, it is mandatory that the parts be replaced regardless of their apparent condition.

- All circlips, lockplates, retaining rings and laminated shims
- All lockwashers and locknuts
- Stressed bolts and fasteners, such as:
  - Stationary drive gear bolts (reduction gear)
  - Camshaft gear attaching bolts
  - Connecting rod bolts and nuts
  - Crankshaft flange bolts
  - Crankshaft gear bolt

AT OVERHAUL:

During overhaul of any Textron Lycoming reciprocating engine, it is mandatory that the following parts be replaced regardless of their apparent condition.

- All engine hoses
- All engine hose assemblies
- All oil seals
- All cylinder base seals
- All gaskets
- Piston rings
- Piston pins (thin wall)*
- Piston pin plugs*
- Propeller governor oil line elbow (aluminum)**
- Propeller shaft sleeve rings
- Propeller shaft rollers (reduction gear pinion cage)

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- Propeller shaft thrust bearings (all geared drive engines)
- Supercharger bearing oil seal (mechanically supercharged series)
- All exhaust valves (replace with current exhaust valves)
- All intake and exhaust valve guides
- All exhaust valve retaining rings
- Rocker arms and fulcrums (O-320-H, O, LO, TO, LTO-360-E series)
- Aluminum push rod assemblies (O-235 and O-290 series)
- Hydraulic plunger assemblies (Except for P/N 78290, refer to the latest edition of Service Instruction No. 1011.)
- All bearing inserts (main and connecting rod)
- Cylinder fin stabilizers
- Magneto drive cushions
- Thermostatic bypass valves
- Damaged ignition cables
- Crankshaft sludge tubes
- Counterweight bushings in crankshaft and in counterweights (See latest edition of Service Instructions No. 1142 and 1143 for instructions.)
- Accessory drive coupling springs (supercharged and VO-540 engines)
- AC diaphragm fuel pumps
- Oil pump bodies (two-piece)
- Oil pump gears (Reference latest editions of Service Bulletin No. 524 and Service Instruction No. 1164)
- All V-band couplings and gaskets

Requirements for replacement of parts for accessories such as magnetos, carburetors, fuel injectors, AN fuel pumps, and turbochargers are described in the applicable manufacturer's manual.

* - Heavy-wall piston pins P/N LW-14077 and P/N LW-14078 may be reused; all others should not be reused. See latest edition of Service Instruction No. 1340 and No. 1267 for replacement data.

** - P/N MS-20822-6D aluminum propeller governor oil line elbow must be replaced with P/N MS20822-6 steel elbow at overhaul. It is not necessary to replace a steel elbow. (Reference latest edition of Service Instruction no. 1435 and Service Bulletin No. 488.)

Dimensional inspections should be carried out in accordance with measurements and tolerances as listed in "Table of Limits" (SSP-1776) for all parts approved for use.

NOTE: Revision "R" corrects Service Instruction number.

TEXTRON Lycoming

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MANDATORY

SERVICE BULLETIN

December 8, 1998

Supplement No. 1

To

Service Bulletin No. 388B

PART I. REVISE TIME OF COMPLIANCE:

On page 1 of Service Bulletin No. 388B the Time of Compliance should read as follows:

TIME OF COMPLIANCE: Helicopter Engines – 300 hour intervals or earlier if valve sticking suspected. All Other Engines – 400 hour intervals or earlier if valve sticking suspected until exhaust valve guides are replaced with guides made of improved material. (Refer to latest edition of Service Instruction No. 1485.)

PART II. ADD AN OPTIONAL INSPECTION PROCEDURE THAT USES A "GO/NO-GO" GAGE:

1. Remove all spark plugs and exhaust manifold. If compressed air is to be used to hold valve, one spark plug should not be removed.
2. Remove rocker box cover and gasket from cylinder.
3. On all engines except the 76 series, push out rocker shaft to remove exhaust rocker and rotator cap. On 76 series engines, remove rocker box covers, rocker arm retaining nuts, rocker arm fulcrums, spacer washers, and rocker arms.

CAUTION

PHYSICALLY SEPARATE AND IDENTIFY BY CYLINDER AND VALVE LOCATION, THE VALVE TRAIN COMPONENTS AS THEY ARE DISASSEMBLED, SO THAT EACH PART MAY BE REINSTALLED IN EXACTLY THE SAME LOCATION FROM WHICH IT WAS REMOVED. PAY PARTICULAR ATTENTION TO VALVE STEM KEYS. THESE TEND TO WEAR IN UNIFORM DISTINCTIVE PATTERNS, AND SHOULD BE RETURNED TO THE SAME POSITION AS THEY WERE REMOVED.

4. Position crankshaft just after bottom center on the intake stroke.
5. Insert about 8 feet of 3/8 inch nylon rope through the spark plug hole; then turn the crankshaft until the piston moves the rope snuggly against the exhaust valve.

   a. An alternate technique for holding the valve in position is with air pressure using shop air and a compression check fitting.

General Aviation Manufacturers Association

CAUTION

THE PISTON IS HELD AT BOTTOM DEAD CENTER BY FIRMLY HOLDING THE PROPELLER TO PREVENT THE ENGINE FROM TURNING WHEN AIR PRESSURE IS APPLIED THROUGH THE DIFFERENTIAL COMPRESSION DEVICE TO THE COMBUSTION CHAMBER. USE GLOVES OR RAGS TO PROTECT THE HANDS WHILE HOLDING THE PROPELLER BLADE. ALSO, BEFORE ATTACHING THE COMPRESSION TESTER, CHECK THE AIR SUPPLY REGULATOR TO MAKE SURE THE AIR PRESSURE TO THE CYLINDER IS NOT EXCESSIVE. AIR PRESSURE IN THE CYLINDER CAN CAUSE THE PROPELLER TO TURN. KEEP CLEAR OF THE PATH OF THE BLADES.

6. Compress the exhaust valve spring and remove valve keys. (The rope or air pressure inserted in the combustion chamber in the preceding step provides a base to support the valve in the event the keys tend to stick.

7. Remove the nylon rope or bleed off the air pressure and insert light through the upper spark plug hole. Then start pushing the valve from its guide. Before the valve stem is free from the guide, secure it from falling into the cylinder with mechanical pickup fingers, working through the spark plug holes and/or exhaust ports as shown in Figure 1.

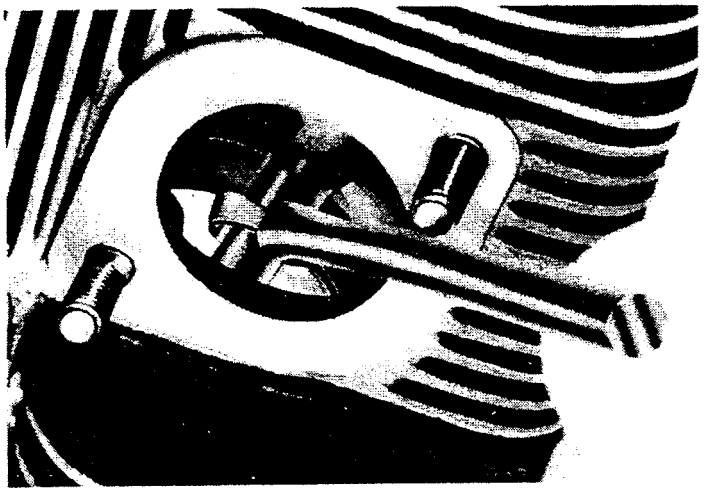

Figure 1. View Through Exhaust Port Showing Mechanical Fingers Holding Valve Stem

8. Move the valve (secured by the mechanical fingers) completely out of the guide and position it away from the guide to avoid interference when using GO/NO-GO gage made in accordance with Table 1.

TABLE 1

Nominal Exhaust Valve Guide ID	GO Gage	NO-GO Gage
.4045	.4040	*
.4375	.4370	*
.4380	.4375	*
.4990	.4985	*
.5000	.4995	*
.5005	.5000	*
* – This gage to be sized in accordance with Table of Limits, SSP1776, for hours on engine.		

9. With the appropriate gage (GO/NO–GO), check the valve guide for either wear or carbon build up.

   a. The NO–GO gage must not enter. If it is does, the valve guide has had too much wear and must be replaced in accordance with the overhaul manual procedure.

   b. The GO gage side must enter totally inside the valve guide; if such is not the case or if there is a friction point, ream the guide in accordance with latest edition of Service Instruction No. 1425.

10. Using a magnetic pencil and flexible mechanical fingers, position tip of valve in guide and very carefully work the valve back into its guide. Extreme caution should be exercised during this operation, making sure the valve is placed within the guide and not cocked, as damage could be done to the guide or valve.

CAUTION

NEVER USE THE PISTON TO PUSH THE VALVE THROUGH THE GUIDE.

11. Install valve springs and valve spring seats in same position as removed. Compress valve spring and install keys in their respective position. In some cases it has been found that when the valve spring is compressed, the valve slides down the guide, making it impossible to install the keys. If this condition exists, reinsert the nylon rope (steps 4. and 5.) to hold valve firmly on its seat while installing valve keys.

12. Remove hydraulic lifter and clean free of all oil, inspect for any malfunction. Clean ID of cam follower. Reinstall hydraulic lifter.

13. Install push rod, then rotating cap, rocker arm and shaft.

14. Check dry tappet clearance in accordance with the Service Table of Limits in the appropriate Textron Lycoming Overhaul Manual.

15. Install rocker box cover and new gasket.

CAUTION

DURING REASSEMBLY, VALVE TRAIN COMPONENTS MUST BE REPLACED IN THEIR ORIGINAL LOCATION. ON 76 SERIES ENGINES, GIVE SPECIAL ATTENTION DURING REASSEMBLY TO ALIGNMENT OF ROCKER ARMS, SPACERS AND ROCKER ARM FULCRUMS WITH THE ROCKER ARM RETAINING STUD. ALL PARTS MUST BE IN PROPER ALIGNMENT TO ASSURE CORRECT DRY TAPPET CLEARANCE. MISALIGNMENT COULD RESULT IN ENGINE DAMAGE.

16. Make sure all flashlights, ropes, etc. have been removed from within the cylinder before proceeding to the next cylinder.

17. Install spark plugs. (Install exhaust manifold after all exhaust valve guides are cleaned.)

18. Make appropriate lobgook entry.

TEXTRON Lycoming

Reciprocating Engine Division/
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MANDATORY

SERVICE BULLETIN

DATE: May 13, 1992

Service Bulletin No. 388B
(Supersedes Service Bulletin No. 388A)
Engineering Aspects are
FAA Approved

SUBJECT: Procedure to Determine Exhaust Valve And Guide Condition

PART 1 — Use of P/N ST-71 and ST-310 Fixtures.

PART 2 — Modification to P/N ST-71 and ST-310 Fixtures to Allow Use of a Dial Indicator.

PART 3 — Example of Alternate Tools That Can Be Locally Manufactured.

TIME OF COMPLIANCE: Helicopter engines should be inspected at 300 hour intervals; all other engines should be inspected at 400 hour intervals, or earlier if valve sticking is suspected.

To insure positive and trouble free valve train operation, the inspection procedure described in this publication should be accomplished as recommended in the Time of Compliance section of this publication. Failure to comply with the provisions of this publication could result in engine failure due to excessive carbon build up between the valve guide and valve stem resulting in sticking exhaust valves or; broken exhaust valves which result from excessive wear (bell-mouthing) of the exhaust valve guide.

This publication describes the approved procedures for checking exhaust valve guide condition.

PART 1

USE OF P/N ST-71 AND ST-310 FIXTURES TO DETERMINE VALVE GUIDE WEAR OR CARBON BUILD UP

The illustrations used in PART 1 are primarily of a parallel valve cylinder and the P/N ST-71 fixture which uses one adjustable self-locking screw to measure valve stem movement on all parallel valve cylinders. The procedure for inspecting angle valve cylinders with the ST-310 Fixture is basically the same. Refer to Figure 2 for Fixture installation. Valve guide wear (bell mouthing) occurs on the inside diameter of the valve guide in a straight line with the centerline of the rocker arm. Valve stem movement must be measured by moving the valve stem along this line. The ST-310 Fixture incorporates two adjustable self-locking screws located at different angles to accomplish this on two differently designed angle valve cylinder head configurations. Refer to Figure 2.

1. All Engines: Remove the rocker box cover and gasket from the cylinder head.

2. All Engines Except 76 Series: Push out the valve rocker shaft and remove the exhaust rocker arm and rotator cap.

3. 76 Series Engines: Remove valve rocker arm retaining nut, fulcrum, rocker arm, spacer washers and rotator cap.

CAUTION

Physically separate and identify by cylinder each valve train part as it is removed, so that each part may be reassembled in exactly the same location from which it was removed.

4. All Engines: Remove push rods, shroud tubes and hydraulic tappet assemblies. Disassemble tappet and clean as described in the applicable overhaul manual.

5. All Engines: Wipe the oil from the top surface of the spring retainer by wiping with a cloth dampened with solvent. This will increase the friction between the valve spring retainer and pressure plate and should eliminate any slippage when the valve stem and spring are moved into position for a measurement.

6. Engines With Sodium Cooled Exhaust Valves: Install the gage adapter over the end of the valve stem and tighten it securely. If the adapter can be rocked on the valve stem by hand, it is not correctly secured. The valve retainer keys do not need to be removed from this type valve stem. Refer to Figure 1.

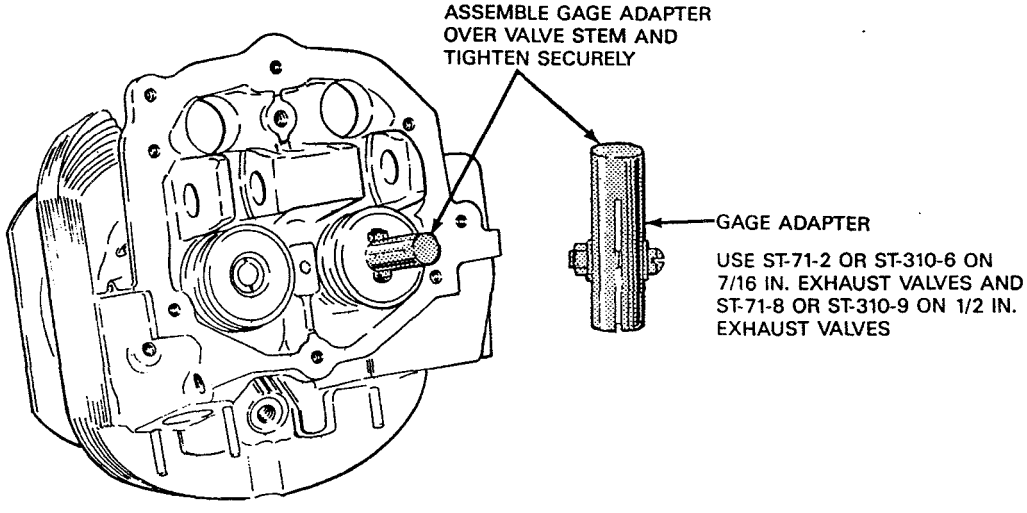


Figure 1. Gage Adapter Assembled on Exhaust Valve Stem

6A. Engines With Solid Stem Nonrotator Type Exhaust Valves: The tapered valve retention keys will not allow installation of the split gage adapter and must be removed. Proceed with installation of the ST-71 or ST-310 fixtures until the valve spring is compressed and the tapered keys can be removed. See step 8 for removal of tapered keys.

7. All Engines: Insure the adjustable self-locking set screws on the ST-71 or ST-310 fixtures are backed out (counterclockwise) to avoid interference with the adapter post attached to the valve stem. See Figure 2.

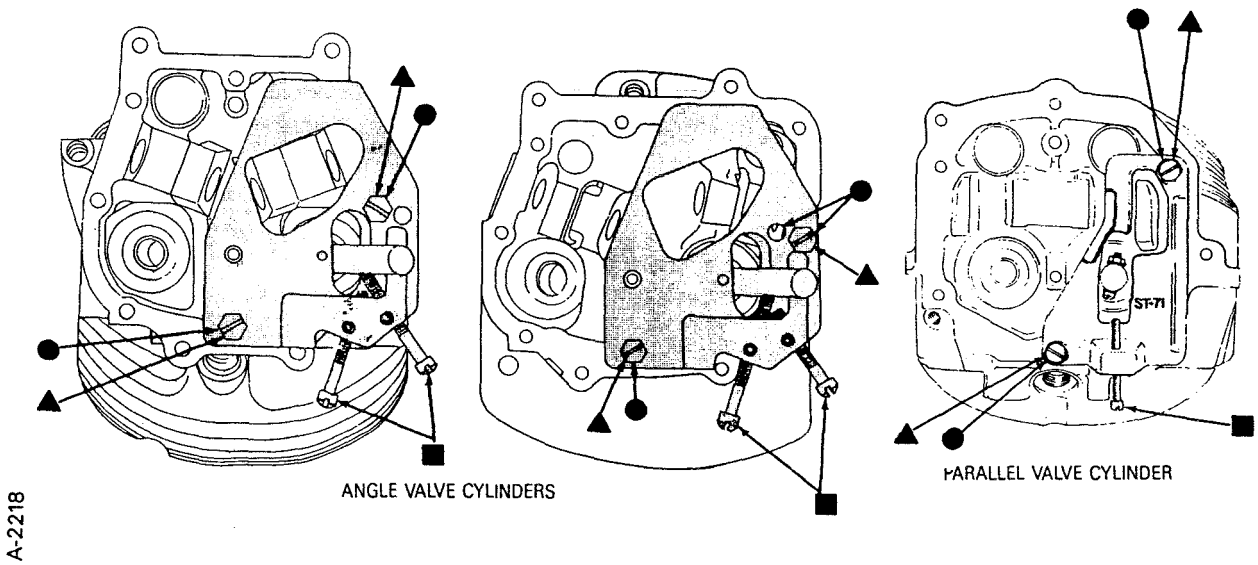


Figure 2. Compressor Plate Installed on Cylinder — Angle and Parallel Valve Cylinders

NOTE

Older P/N ST-71 fixtures may require a modification before being used on 76 series cylinder heads. Refer to Figure 3 for modification dimensions and instructions. Current production P/N ST-71 fixtures include this modification.

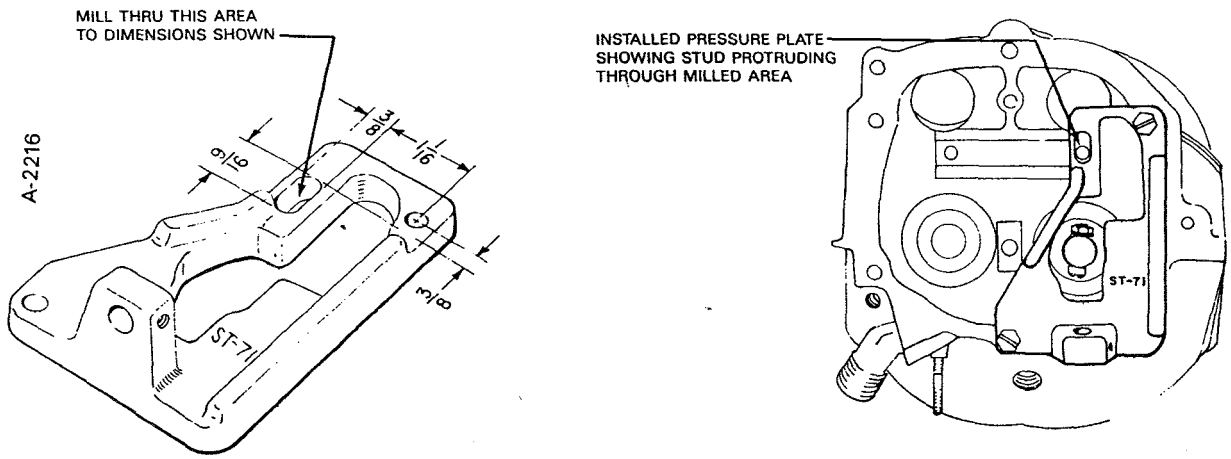


Figure 3. Details for Modifying ST-71 Compressor Plate For Use on "76 Series" Engines

8. Engines Equipped With Solid Stem Exhaust Valves: Remove the tapered valve retaining keys by moving the piston of the cylinder being inspected to near its top end of travel. This will eliminate any chance of the valve sliding into the cylinder after the tapered keys are removed. Fabricate a small hooked tool as shown in Figure 4 and insert it between the valve keys engaging the hook of the tool with the underside of the valve tip as shown in Figure 4. Tap on the fixture with a plastic headed hammer while exerting a steady pull on the valve stem, with the hooked tool, until the valve keys release.

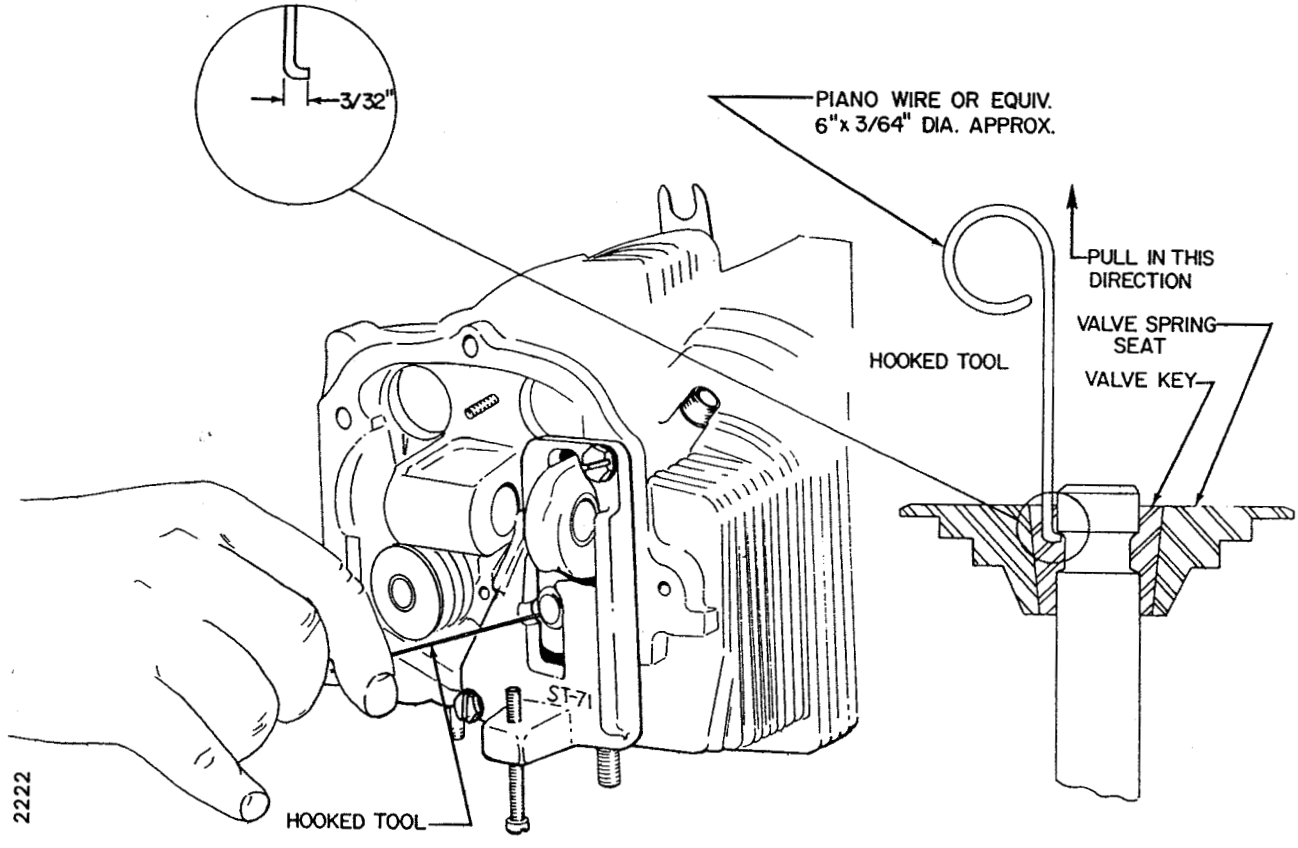


Figure 4. Method of Using Hooked Wire Tool to Pull Valve Into Position For Removal of Tapered Keys

8A. If the valve keys do not readily release, remove the pressure plate and using air pressure or 3/8'' rope, as described in the latest revision to Service Instruction No. 1425, to hold the valve in the closed position, reinstall the fixture, tapping on it as it is drawn on the cylinder head.

8B. Once the valve keys are loosened and removed install the split gage adapter on the end of the valve stem. Release the air pressure or remove the rope and move the piston to near the bottom of its travel.

9. All Engines: Push the assembled valve stem and gage adapter in against the upper spring retainer as far as it will go. This will move the valve off of the seat and eliminate any interference when the valve stem is moved.

NOTE

In the following steps 10 and 12, a screwdriver with a 3/16 inch blade x 4 inch long shank is sufficient to move the valve both ways. Excessive pressure applied to the screwdriver will cause erratic measurements.

10. All Engines: Insert the blade of a screwdriver in the area between the exhaust valve spring and fixture as shown in Figure 5; and using the pressure plate as a fulcrum, press the blade of the screwdriver against the exhaust valve spring, forcing it toward the self-locking set screw as far as it will go. Relax the pressure on the screwdriver. Friction between the fixture and the outer spring retainer should keep the valve stem from returning to its normal position. If the valve stem does have a tendency to move, maintain a slight pressure on the spring with the screwdriver.

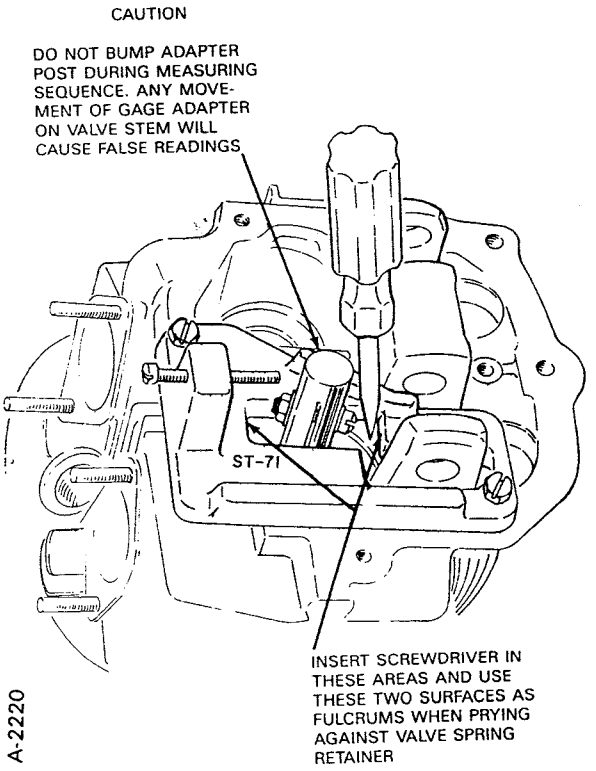


Figure 5. View Showing Screwdriver in Position to Move Exhaust Valve Stem

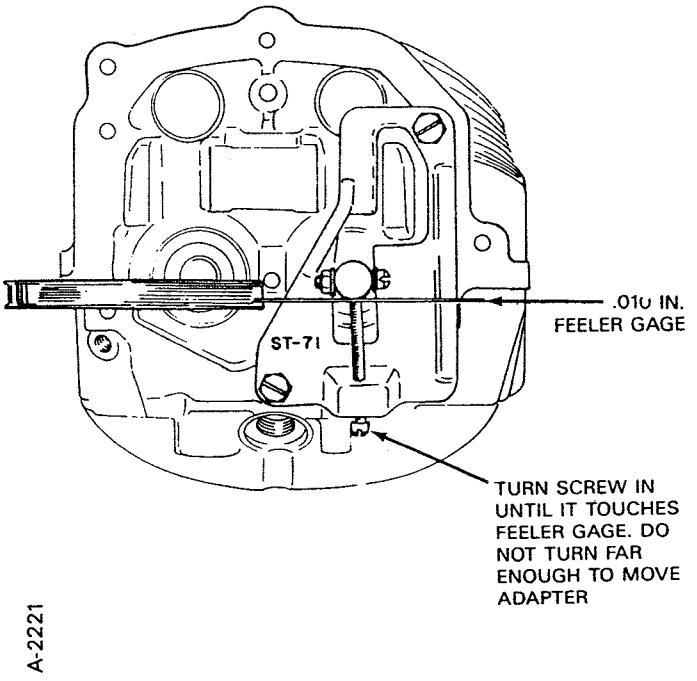


Figure 6. Feeler Gage in Position Between Set Screw and Adapter Post

11. All Engines: Using a .010 inch feeler gage between the set screw and gage adapter as shown in Figure 6, turn the set screw toward the gage until a slight drag is obtained on the feeler gage. Do not turn the screw far enough to move the adapter and valve stem.

12. All Engines: Using the screwdriver, push the valve spring as far away from the set screw as it will go, and using a combination of feeler gage blades determine the gap between the tip of the set screw and the gage adapter. Refer to the following Table for acceptable limits.

Valve Guide I.D.	Recommended Allowable Valve Stem Movement	
	Minimum Clearance	Maximum Clearance
.4040/.4050	.010	.030
.4360/.4370	.010	.030
.4370/.4380	.010	.030
.4375/.4385	.010	.030
.4985/.4995	.015	.030
.4995/.5005	.015	.030
.5000/.5010	.015	.035

12A. The measurement obtained in step 12 includes the .010 inch used in step 11 as a starting dimension. Determine the actual distance the exhaust valve stem has moved in the following manner.

EXAMPLE

.019 = Total thickness of gage required to measure valve movement.
- .010 = Thickness of gage used to establish a starting point.
.009 = Actual amount the valve stem has moved: This indicates insufficient clearance between the valve stem and valve guide which can be corrected by reaming the valve guide I.D. to remove a buildup of carbon deposits. (Refer to the latest revision of Service Instruction No. 1425 for valve guide reaming.) Using the same procedure, if the dimension obtained in step 12 had been .038 inch, the actual amount the valve stem moved would be .028 inch indicating that wear on the inside diameter of the valve guide is below the maximum limit and the valve guide is suitable for further service. If valve stem movement is in excess of the maximum limit listed in the table, the valve and guide must be replaced.

13. All Engines: Rotate the piston to near its top end of travel again and remove the gage adapter from the valve stem. Install any valve keys that were removed in step 8 or 8A and insure they are properly seated on the valve stem.

14. All Engines: Remove the fixture from the cylinder by backing out the capscrews alternately to release pressure on valve springs evenly.

15. Engines Equipped With Solid Stem Exhaust Valves: The stem of an exhaust valve, installed in an engine that is operated on highly leaded fuels, can become damaged by erosion or "necking". In addition to the preceding valve stem and guide clearance check, the exhaust valve stems must be examined for this condition. Remove the exhaust manifold and visually inspect the exposed area of the valve stem, between the exhaust valve seat and guide. Any evidence of erosion is reason to replace the exhaust valve and guide.

16. All Engines: Complete the preceding checks on all cylinders, enter the inspection results and any corrective action accomplished in the engine log book.

17. All Engines Except 76 Series: Using new seals and gaskets, install the hydraulic tappet assemblies, shroud tubes, push rods valve rotator caps (if required), rocker arms and shafts, and check dry tappet clearance. If all parts are returned to their original position, dry tappet clearance will not change. Refer to applicable overhaul manual for dry tappet clearance check.

18. 76 Series Engines: Using new seals and gaskets, install the hydraulic tappet assembly shroud tube, push rod, rocker arm fulcrum and spacers, valve rotator cap, and rocker arm. Check dry tappet clearance as described in the applicable overhaul manual. If all parts are returned to their original position and are aligned properly, the dry tappet clearance will not change.

PART 2

MODIFICATION OF P/N ST-71 AND ST-310 FIXTURES TO ALLOW USE OF A DIAL INDICATOR

The procedure described in the preceding PART 1, utilizes a feeler gage to measure the distance the exhaust valve stem has moved. Although this method is satisfactory, it has been found that it is much easier to measure movement of the valve stem if a dial indicator is used instead of the feeler gage. Refer to Figure 7 for modification of a P/N ST-71 fixture and to Figure 8 for modification of a P/N ST-310 fixture.

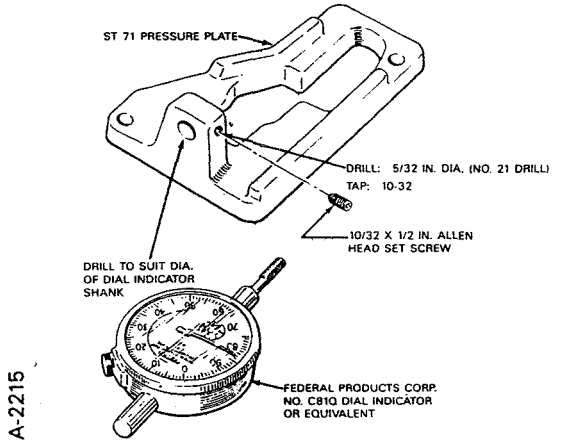


Figure 7. Details for Modifying Tool ST-71 For Use With a Dial Indicator (Parallel Valve Cylinders)

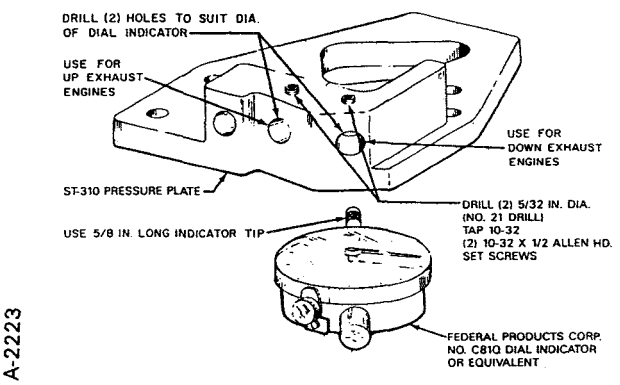


Figure 8. Details for Modifying Tool ST-310 For Use With a Dial Indicator (Angle Valve Cylinders)

NOTE

The dial indicator shown in Figure 7, 8, 9 and 10 is Model C8IQ manufactured by Federal Products Corp., Providence R.I. If a comparable dial indicator is available for use, the adjustment screw holes in the fixtures can be drilled to accommodate the indicator.

1. Install the adapter post and fixture in the same manner as described in PART 1, and push the adapter post and valve stem in against the valve spring retainer as far as it will go.

2. Insert the blade of a screwdriver in the area between the valve spring and fixture and push the valve and adapter post away from the dial indicator as shown in Figure 9.

3. Move the dial indicator toward the adapter post until the indicator is preloaded approximately .010 inch, and lock it in place with the set screw.

4. Adjust the dial of the indicator to read "0" (zero) as shown in Figure 9.

5. Insert the screwdriver between the fixture and valve spring on the opposite side and push the valve spring toward the dial indicator as shown in Figure 10. Relax the screwdriver and record the reading on the dial indicator. The measurement should be within the limits specified in the table with PART 1. If not, perform the required repair procedure as described in PART 1.

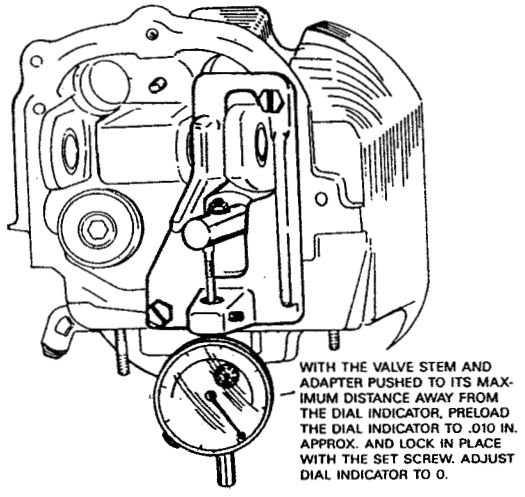


Figure 9. Dial Indicator in Position to Check Valve Guide Clearance

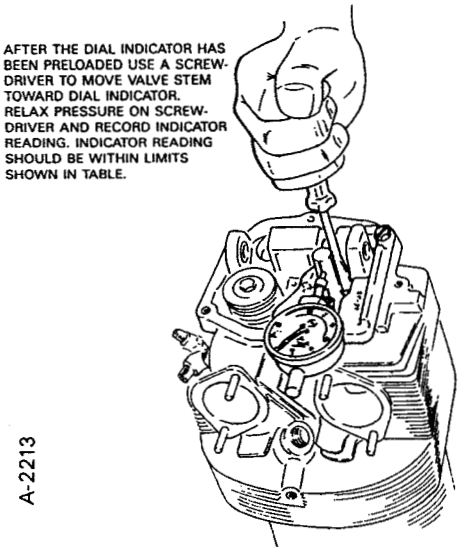


Figure 10. Pushing Valve Stem And Adapter Post Toward Dial Indicator to Establish Valve Guide Condition

PART 3

Figures 11, 13 and 15 are detailed drawings of tools that can be made locally by any machine shop. These tools are not available for purchase.

The tool shown in Figure 11 mounts on the valve rocker shaft, of all engines except 76 series engines, and is secured in place with set screws that lock against a valve rocker shaft bearing boss. 5/8 inch I.D. rocker arm spacer washers are used to hold the fixture against the boss. See Figure 12. Mounting this type fixture on the valve rocker shaft insures that the dial indicator is correctly aligned to measure valve stem movement. Figure 13 is an example of a tool that can be made for use on 76 series cylinder heads. The fixture is attached to the cylinder head on the 5/16-18 stud that secures the rocker arm and related components. Use a standard 5/16-18 nut to secure the fixture on the stud. The 17/32 in. wide x 1/8 in. deep slot that holds the rocker arm components in alignment also aligns the fixture. See Figure 14. An adapter post is also required to extend the length of the valve stem. The post can be made from any suitable size, smooth finish, straight round stock. Refer to Figure 15 for dimensions and Figure 12 and 14 for installation.

To insure an accurate measurement when the inspection procedure is accomplished with either of these tools, or similarly made tools, the exhaust valve springs must be removed before the adapter post is installed on the tip of the valve stem. To insure that the valve seat does not interfere with the valve as it is moved from one

position to the other, the valve must be pushed approximately 1/2 inch into the cylinder. The valve stem can now be pushed in either direction with fingertip pressure.

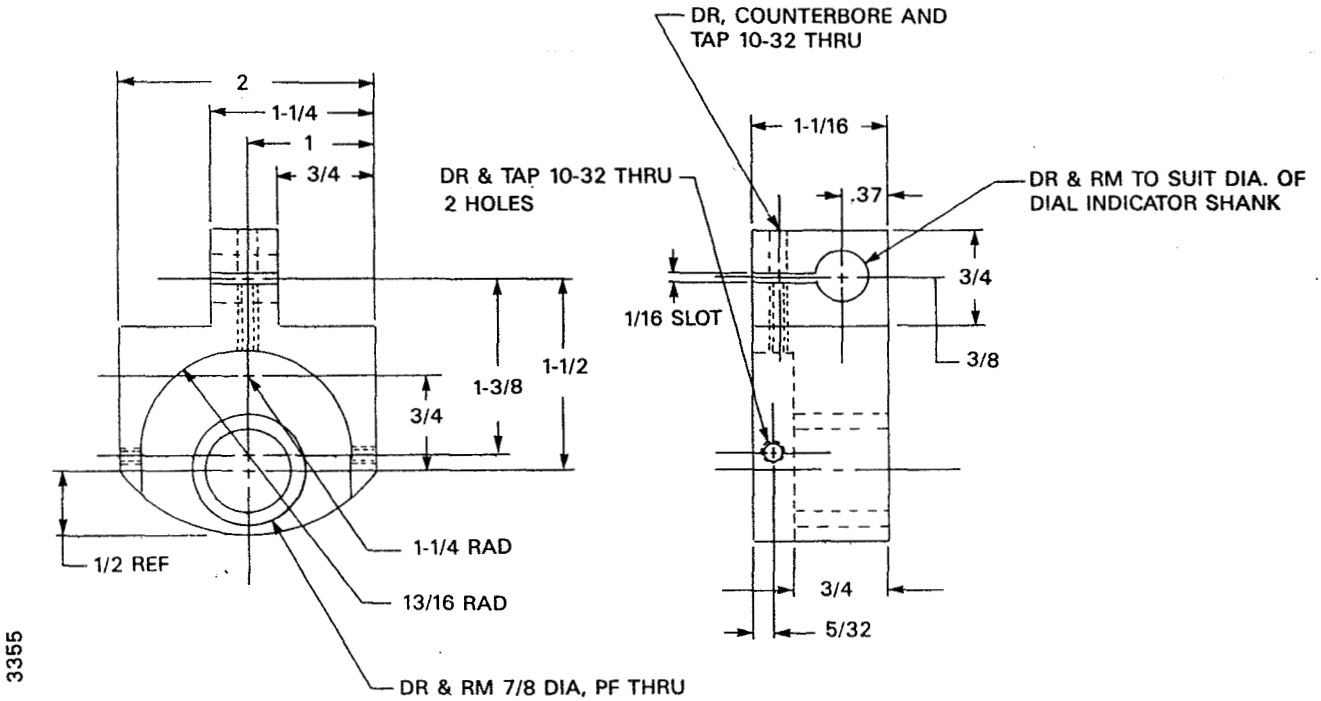


Figure 11. Detail of Tool for Parallel and Angle Valve Cylinders With Rocker Arm Shaft

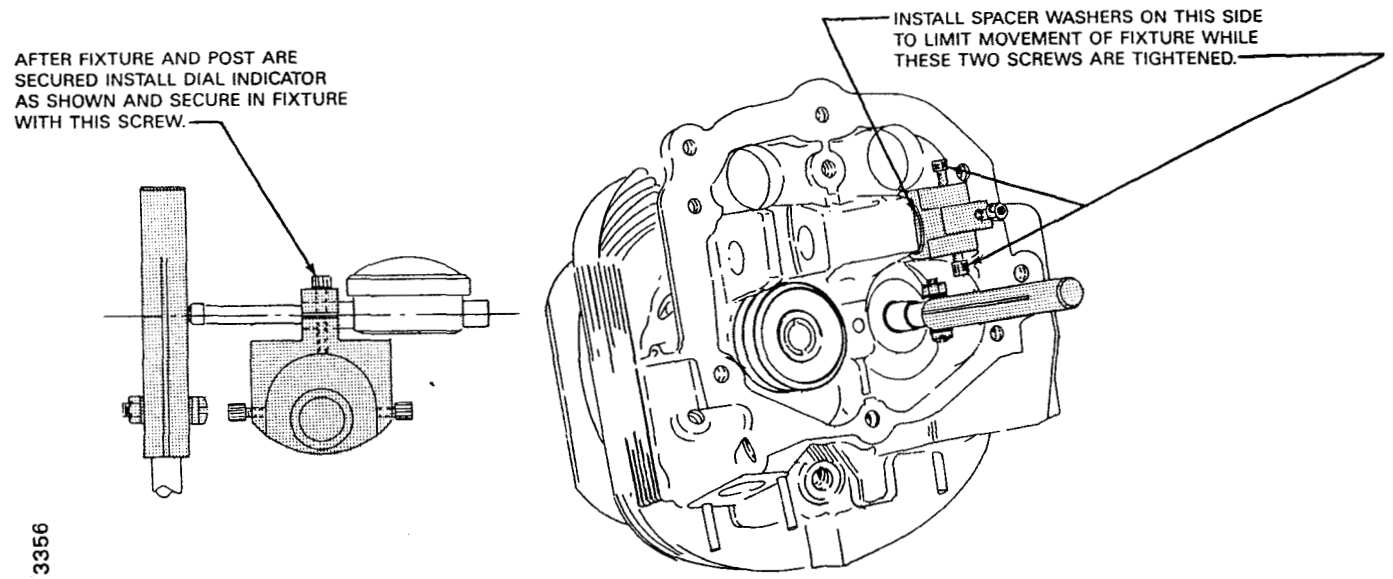


Figure 12. Tool Mounted on Rocker Arm Shaft — Parallel Valve Cylinder

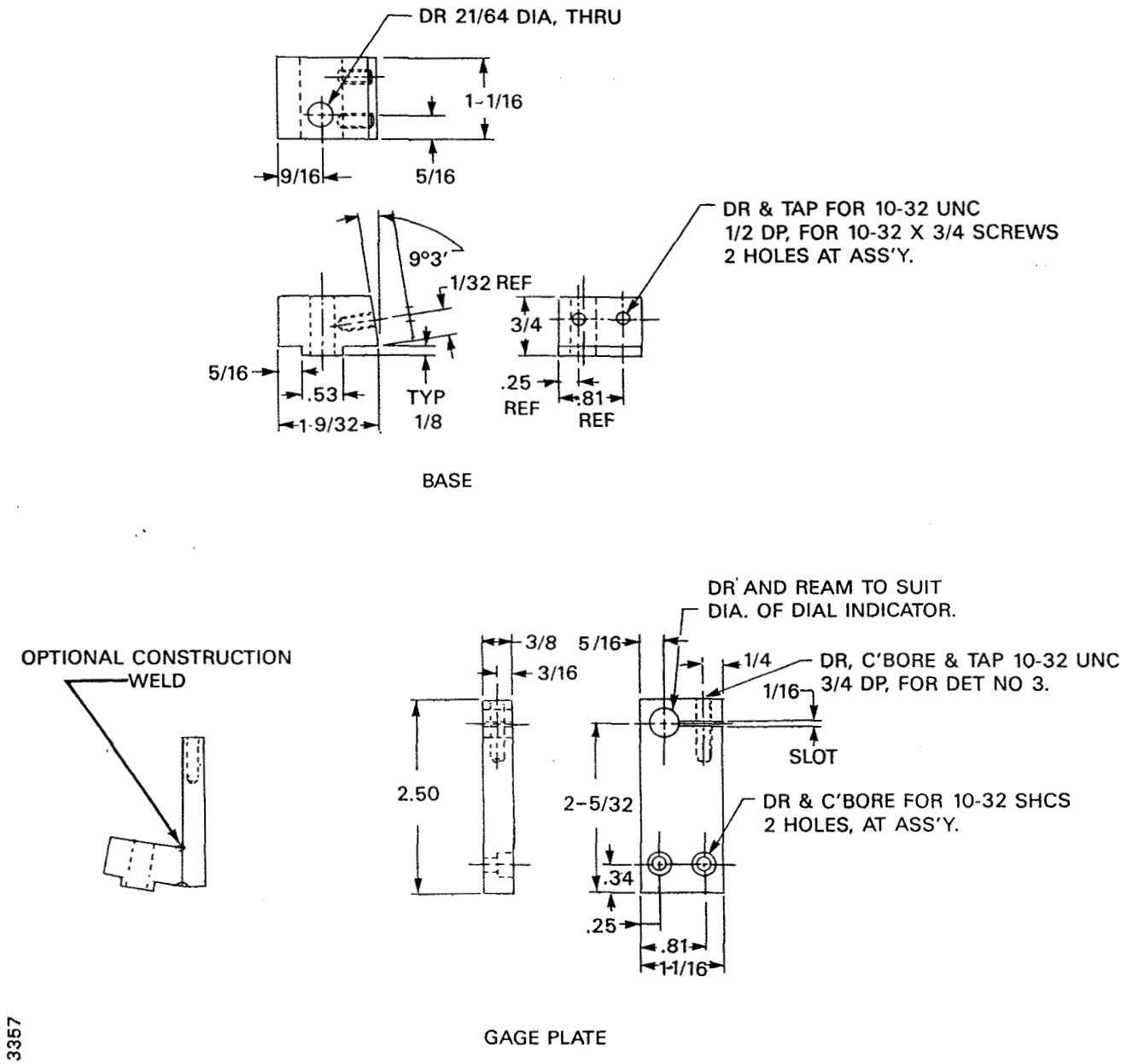


Figure 13. Detail of Tool For "76 Series" Cylinders

The procedure for measuring valve stem movement is the same as described in PART 2, except that a slight fingertip pressure must remain against the valve stem as the dial indicator is preloaded, and again when the valve stem and adapter post are moved toward the dial indicator until the dial indicator reading is recorded.

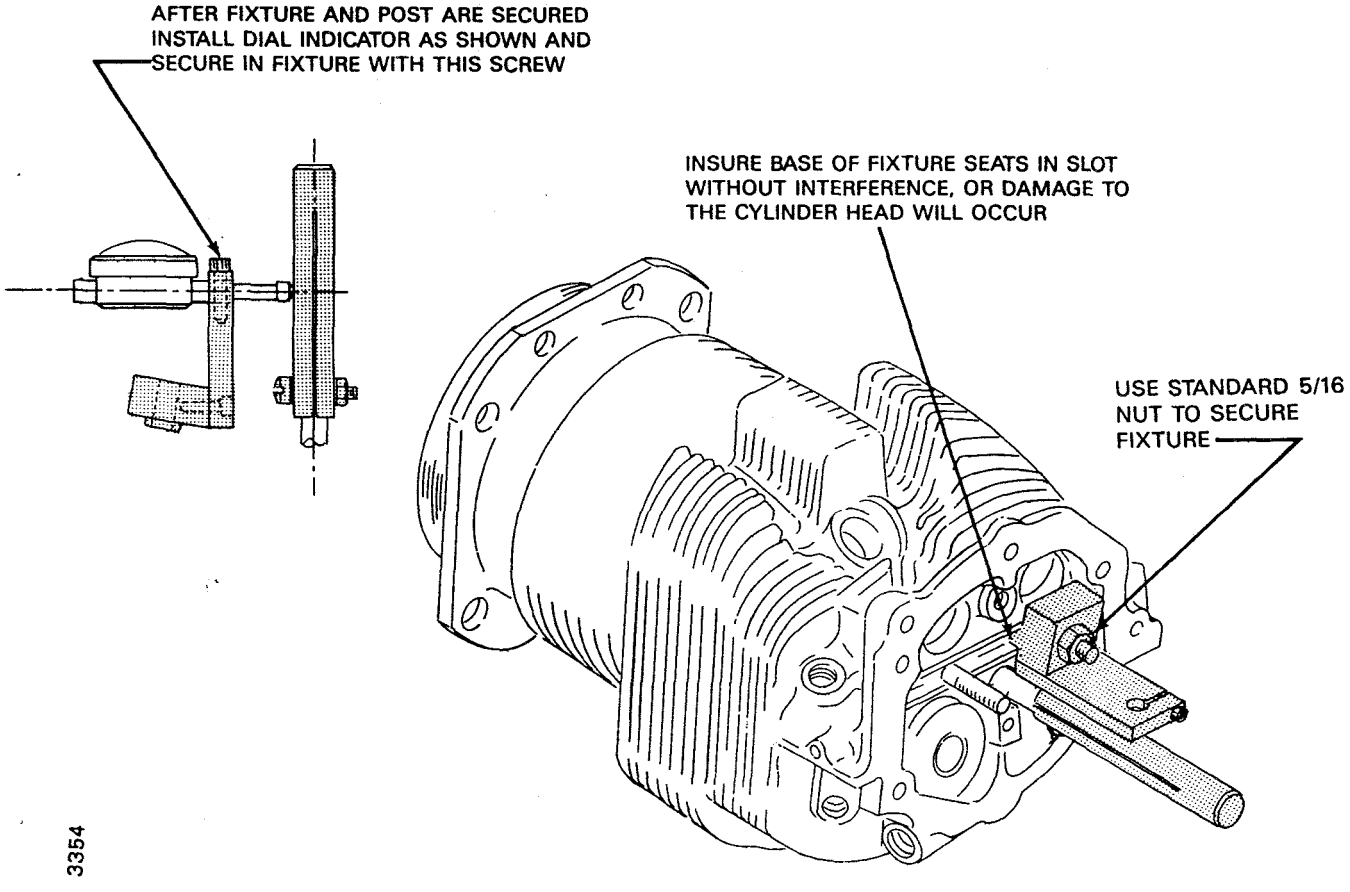
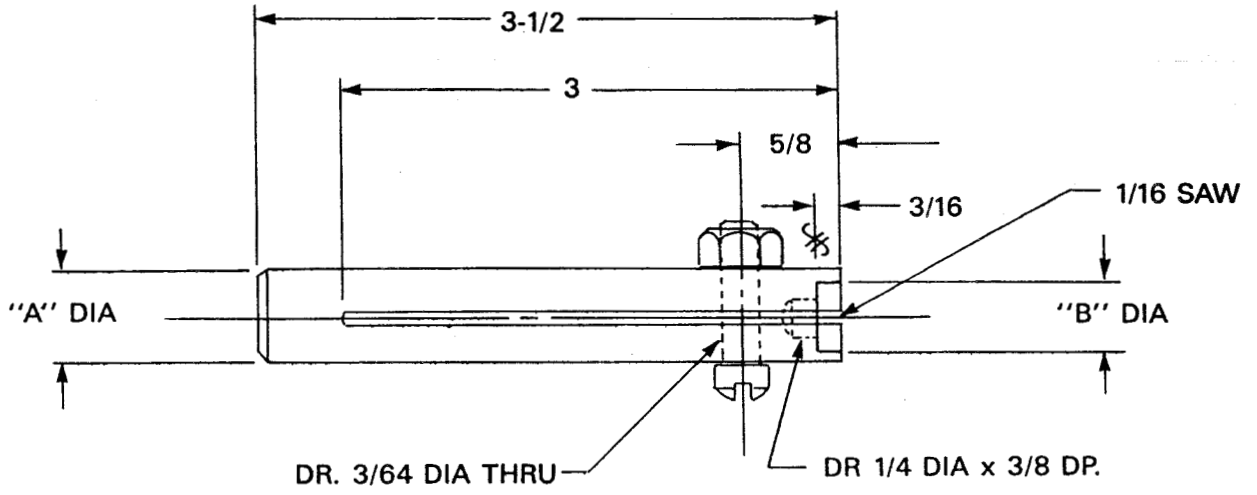


Figure 14. Tool Mounted on "76 Series" Cylinder Head

NOTE

The tools described in this section locate the tip of the measuring instrument 2-1/2 inches from the top of the valve guide. This dimension should be maintained on all locally manufactured tools.



7/16 ASS'Y, 7/16 ASS'Y, A = 9/16, B = .402-.405 RM

1/2 ASS'Y, 1/2 ASS'Y, A = 5/8, B = .498-.496 RM

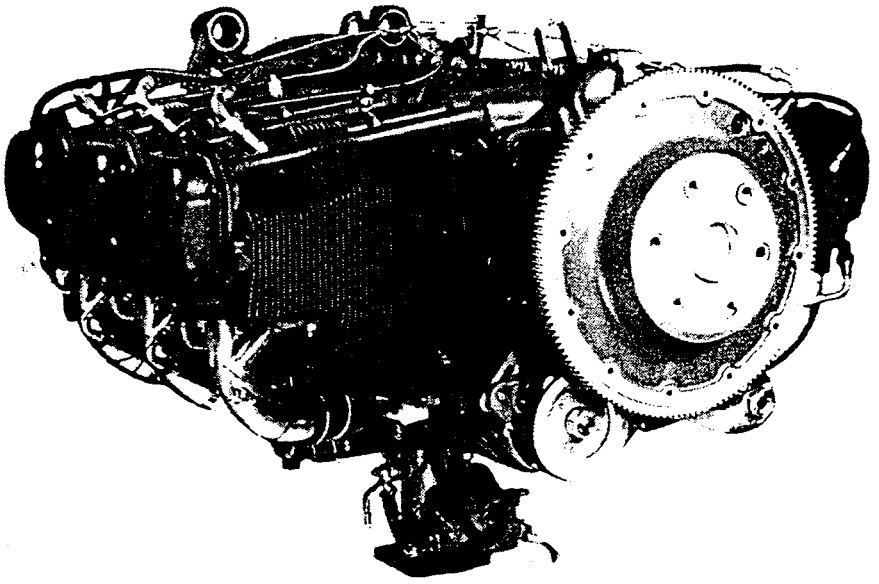
DIAMETERS "A" AND "B" MUST BE CONCENTRIC

3358

Figure 15. Adapter Post — Required With Both Tools

NOTE: Revision "B" changes text, changes Table on Page 3, changes method for calculating valve guide wear, changes art figures and adds PART 3.

Overhaul Manual
Direct Drive Engine



Approved by F.A.A.

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TEXTRON Lycoming

Reciprocating Engine Division/
Subsidiary of Textron Inc.

652 Oliver Street
Williamsport, PA 17701 U.S.A.

TO THE OWNER OF THIS MANUAL

IN ADDITION TO THIS MANUAL AND SUBSEQUENT REVISIONS, ADDITIONAL OVERHAUL AND REPAIR INFORMATION IS PUBLISHED IN THE FORM OF SERVICE BULLETINS AND SERVICE INSTRUCTIONS. THE INFORMATION CONTAINED IN THESE SERVICE BULLETINS AND SERVICE INSTRUCTIONS IS AN INTEGRAL PART OF, AND IS TO BE USED IN CONJUNCTION WITH, THE INFORMATION CONTAINED IN THIS OVERHAUL MANUAL.

THIS OVERHAUL MANUAL AND ALL APPLICABLE SERVICE BULLETINS AND SERVICE INSTRUCTIONS, USED IN CONJUNCTION WITH THE APPROPRIATE OPERATORS MANUAL, CONSTITUTES THE ENGINE MAINTENANCE MANUAL REQUIRED BY FAA-FAR 43.13.

For a period of three (3) years new and revised pages for this manual will be furnished to owners, who fill out the registration card and return it to Textron Lycoming. Registered owners of this manual will be notified of any changes in revision policy or cost of revisions.

Service Bulletins, Service Instructions and Service Letters are available from all Textron Lycoming Distributors or from the factory by subscription. Consult the latest revision to Textron Lycoming Service Letter No. L114. Textron Lycoming also publishes an Index of Service Bulletins, Instructions and Letters that lists all Bulletins, Instructions and Letters in alphabetical order by title and topic as well as a list of Bulletins, Instructions and Letters applicable to each engine series. Consult the Service Publication Section of the latest revision to Service Letter No. L114 for the current part number of the index.

SPECIAL NOTE

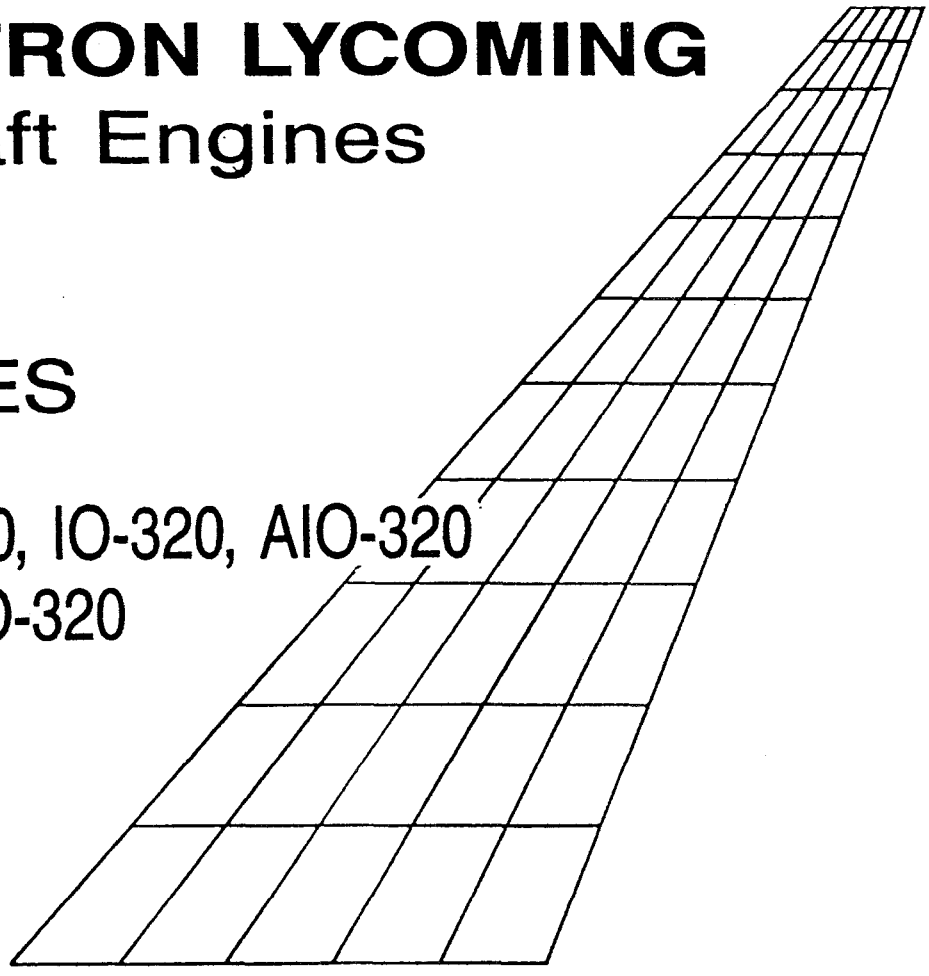
The illustrations, pictures and drawings shown in this publication are typical of the subject matter they portray; in no instance are they to be interpreted as examples of any specific engine, equipment or part thereof:

OPERATOR'S MANUAL

TEXTRON LYCOMING
Aircraft Engines

SERIES

O-320, IO-320, AIO-320 & LIO-320



60297-16

TEXTRON Lycoming

Reciprocating Engine Division/
Subsidiary of Textron Inc.
652 Oliver Street
Williamsport, PA 17701 U.S.A.

ATTENTION

OWNERS, OPERATORS, AND MAINTENANCE PERSONNEL

This operator's manual contains a description of the engine, its specifications, and detailed information on how to operate and maintain it. Such maintenance procedures that may be required in conjunction with periodic inspections are also included. This manual is intended for use by owners, pilots and maintenance personnel responsible for care of Lycoming powered aircraft. Modifications and repair procedures are contained in Lycoming overhaul manuals; maintenance personnel should refer to these for such procedures.

SAFETY WARNING

Neglecting to follow the operating instructions and to carry out periodic maintenance procedures can result in poor engine performance and power loss. Also, if power and speed limitations specified in this manual are exceeded, for any reason; damage to the engine and personal injury can happen. Consult your local FAA approved maintenance facility.

SERVICE BULLETINS, INSTRUCTIONS, AND LETTERS

Although the information contained in this manual is up-to-date at time of publication, users are urged to keep abreast of later information through Lycoming Service Bulletins, Instructions and Service Letters which are available from all Lycoming distributors or from the factory by subscription. Consult the latest edition of Service Letter No. L114 for subscription information.

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TEXTRON LYCOMING OPERATOR'S MANUAL

IMPORTANT SAFETY NOTICE

Proper service and repair is essential to increase the safe, reliable operation of all aircraft engines. The service procedures recommended by Textron Lycoming are effective methods for performing service operations. Some of these service operations require the use of tools specially designed for the task. These special tools must be used when and as recommended.

It is important to note that most Textron Lycoming publications contain various Warnings and Cautions which must be carefully read in order to minimize the risk of personal injury or the use of improper service methods that may damage the engine or render it unsafe.

It is also important to understand that these Warnings and Cautions are not all inclusive. Textron Lycoming could not possibly know, evaluate or advise the service trade of all conceivable ways in which service might be done or of the possible hazardous consequences that may be involved. Acordingly, anyone who uses a service procedure must first satisfy themselves thoroughly that neither their safety nor aircraft safety will be jeopardized by the service procedure they select.

SECTION 4

PERIODIC INSPECTION

NOTE

Perhaps no other factor is quite so important to safety and durability of the aircraft and its components as faithful and diligent attention to regular checks for minor troubles and prompt repair when they are found.

The operator should bear in mind that the items listed in the following pages do not constitute a complete aircraft inspection, but are meant for the engine only. Consult the airframe manufacturer's handbook for additional instructions.

Pre-Starting Inspection - The daily pre-flight inspection is a check of the aircraft prior to the first flight of the day. This inspection is to determine the general condition of the aircraft and engine.

The importance of proper pre-flight inspection cannot be over emphasized. Statistics prove several hundred accidents occur yearly directly responsible to poor pre-flight inspection.

Among the major causes of poor pre-flight inspection are lack of concentration, reluctance to acknowledge the need for a check list, carelessness bred by familiarity and haste.

1. DAILY PRE–FLIGHT.

a. Be sure all switches are in the "Off" position.

b. Be sure magneto ground wires are connected.

c. Check oil level.

d. See that fuel tanks are full.

e. Check fuel and oil line connections, note minor indications for repair at 50 hour inspection. Repair any major leaks before aircraft is flown.

f. Open the fuel drain to remove any accumulation of water and sediment.

g. Make sure all shields and cowling are in place and secure. If any are missing or damaged, repair or replacement should be made before the aircraft is flown.

h. Check controls for general condition, travel and freedom of operation.

i. Induction system air filter should be inspected and serviced in accordance with the airframe manufacturer's recommendations.

2. 25–HOUR INSPECTION. After the first twenty-five hours operating time, new, remanufactured or newly overhauled engines should undergo a 50 hour inspection including draining and renewing lubricating oil.

3. 50–HOUR INSPECTION. In addition to the items listed for daily pre-flight inspection, the following maintenance checks should be made after every 50 hours of operation.

a. Ignition System -

(1) If fouling of spark plugs has been apparent, rotate bottom plugs to upper position.

(2) Examine spark plug leads of cable and ceramics for corrosion and deposits. This condition is evidence of either leaking spark plugs, improper cleaning of the spark plug walls or connector ends. Where this condition is found, clean the cable ends, spark plug walls and ceramics with a dry, clean cloth or a clean cloth moistened with methyl-ethyl ketone. All parts should be clean and dry before reassembly.

(3) Check ignition harness for security of mounting clamps and be sure connections are tight at spark plug and magneto terminals.

b. Fuel and Induction System - Check the primer lines (where applicable) for leaks and security of the clamps. Remove and clean the fuel inlet strainers. Check the mixture control and throttle linkage for travel, freedom of movement, security of the clamps and lubricate if necessary. Check the air intake ducts for leaks, security, filter damage; evidence of dust or other solid material in the ducts is indicative of inadequate filter care or damaged filter. Check vent lines for evidence of fuel or oil seepage; if present, fuel pump may require replacement.

c. Lubrication System -

(1) Remove oil suction and oil pressure screens and check carefully for presence of metal particles that are indicative of internal engine damage. This step is not feasible unless oil is being changed and should be omitted on installations employing an external full flow oil filter.

(2) Replace external full flow oil filter element. Drain and renew lubricating oil on installations not employing full flow filter with replaceable element.

NOTE

Intervals between oil changes can be increased as much as 100% on engines equipped with full flow oil filters - provided the element is replaced each 50 hours of operation.

(3) Check oil lines for leaks, particularly at connections for security of anchorage and for wear due to rubbing or vibration, for dents and cracks.

d. Exhaust System - Check attaching flanges at exhaust ports on cylinder for evidence of leakage. If they are loose, they must be removed and machined flat before they are reassembled and tightened. Examine exhaust manifolds for general condition.

e. Cooling System - Check cowling and baffles for damage and secure anchorage. Any damaged or missing part of the cooling system must be repaired or replaced before the aircraft resumes operation.

f. Cylinders - Check rocker box covers for evidence of oil leaks. If found, replace gasket and tighten screws to specified torque (50 inch lbs.).

Check cylinders for evidence of excessive heat which is indicated by burned paint on the cylinder. This condition is indicative of internal damage to the cylinder and, if found, its cause must be determined and corrected before the aircraft resumes operation.

4. 100–HOUR INSPECTION. In addition to the items listed for daily pre-flight and 50 hour inspection, the following maintenance checks should be made after every one hundred hours of operation.

a. Electrical System -

(1) Check all wiring connected to the engine or accessories. Any shielded cables that are damaged should be replaced. Replace clamps or loose wires and check terminals for security and cleanliness.

(2) Remove spark plugs; test, clean and regap. Replace if necessary.

b. Magnetos - Check breaker points for pitting and minimum gap. Check for excessive oil in the breaker compartment, if found, wipe dry with a clean lint free cloth. The felt located at the breaker points should be lubricated in accordance with the magneto manufacturer's instructions. Check magneto to engine timing. Timing procedure is described in Section 5, 1, b of this manual.

c. Engine Accessories - Engine mounted accessories such as pumps, temperature and pressure sensing units should be checked for secure mounting, tight connections.

d. Cylinders - Check cylinders visually for cracked or broken fins.

e. Engine Mounts - Check engine mounting bolts and bushings for security and excessive wear. Replace any bushings that are excessively worn.

f. Fuel Injector Nozzles and Fuel Lines - Check fuel injector nozzles for looseness. Tighten to 60 inch pounds torque. Check fuel lines for fuel stains which are indicative of fuel leaks. Repair or replacement must be accomplished before the aircraft resumes operation.

5. 400–HOUR INSPECTION. In addition to the items listed for daily pre-flight, 50 hour and 100 hour inspections, the following maintenance check should be made after every 400 hours of operation.

Valve Inspection - Remove rocker box covers and check for freedom of valve rockers when valves are closed. Look for evidence for abnormal wear or broken parts in the area of the valve tips, valve keeper, springs and spring seats. If any indications are found, the cylinder and all of its components should be removed (including the piston and connecting rod assembly) and inspected for further damage. Replace any parts that do not conform with limits shown in the latest edition of Special Service Publication No. SSP2070.

6. NON–SCHEDULED INSPECTIONS. Occasionally, service bulletins or service instructions are issued by Avco Lycoming Division that require inspection procedures that are not listed in this manual. Such publications, usually are limited to specified engine models and become obsolete after corrective modification has been accomplished. All such publications are available from Avco Lycoming distributors, or from the factory by subscription. Consult the latest edition of Service Letter No. L114 for subscription information. Maintenance facilities should have an up-to-date file of these publications available at all times.