Engine Maintenance Manual

YO-233-B2A Engine

February 2021

Part No. MM-YO-233-B2A
(Supersedes Maintenance Manual LM-YO-233, dated June 2012)

YO-233-B2A Engine
Maintenance Manual

Lycoming Part Number: MM-YO-233-B2A

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RECORD OF REVISIONS

Revision	Revision Date	Revised By	Revision Description
Original			Original Release of Maintenance Manual – MM-YO-233-B2A (Supersedes Maintenance Manual LM-YO-233, dated June 2012). MM-YO-233-B2A has been formatted and incorporates changes included in recently released and FAA approved maintenance manuals. This manual contains the same basic information as LM-YO-233 with significant changes to several chapters including 05-00, 05-30, 05-50, 12-10, 72-30, and 74-30. This manual also includes a description and instruction for an approved alternate ignition system.

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SERVICE DOCUMENT LIST

NOTICE: The following is a list of service documents referenced in or incorporated into the information in this manual. Although the YO-233-B2A is not currently certified by the FAA it is recommended that all inspections, procedures, and guidelines in the latest revision of any service document (including any supplements) be followed to maintain continued airworthiness.

Supplements to a service document contain information relevant to the service document but not yet added to the service document.

The latest revision of all service documents in this list can be downloaded from our website https://www.lycoming.com/contact/knowledge-base/publications.

To narrow the search parameters and limit the number of returns, enter only the numerical portion of the service document number in the **Search** box on the website.

Number	Incorporation Date	Subject
S.B. 369	02/21	Engine Inspection after Overspeed
S.B. 388	02/21	Procedure to Determine Exhaust Valve and Guide Condition
S.B. 398	02/21	Recommended Corrective Action for Use of Incorrect Fuel
S.B. 399	02/21	Action to Take If Loss of Oil Pressure
S.B. 401	02/21	Recommendations for Aircraft Struck by Lightning
S.B. 480	02/21	I. Oil Filter Change and Screen Cleaning II. Oil Filter/Screen Content Inspection
S.B. 533	02/21	Recommendations Regarding Accidental Engine Stoppage, Propeller/Rotor Strike or Loss of Propeller/Rotor Blade Tip
S.I. 1014	02/21	Lubricating Oil Recommendations
S.I. 1042	02/21	Approved Spark Plugs
S.I. 1043	02/21	Spark Plug Heli-Coil Insert Replacement
S.I. 1080	02/21	Maintenance Items for Special Attention
S.I. 1191	02/21	Cylinder Compression
S.I. 1409	02/21	Lycoming Engines P/N LW-16702 Oil Additives
S.I. 1425	02/21	Suggested Maintenance Procedures to Reduce the Possibility of Valve Sticking
S.I. 1462	02/21	Propeller Oil Control Leak Test Procedure
S.I. 1530	02/21	Engine Inspection in Particulate-Laden Environments
S.I. 1566	02/21	Lycoming Engines Approves the Use of Safety Cable

SERVICE DOCUMENT LIST (CONT.)

Number	Incorporation Date	Subject
S.L. L162	02/21	Heli-Coil® Service Repair Kit
S.L. L171	02/21	General Aspects of Spectrometric Oil Analysis
S.L. L192	02/21	Spark Plug Fouling
S.L. L197	02/21	Recommendations to Avoid Valve Sticking
S.L. L283	02/21	Alternate Ignition System

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ABBREVIATIONS AND ACRONYMS

B	
BHP	Brake Horsepower (per hour)
C	
C	Celsius
F	
F	Fahrenheit
FAA	Federal Aviation Administration
FAR	Federal Aviation (and Space) Regulation
FOD	Foreign Object Debris
ft.-lb	Foot Pound (torque)
H	
hr	Hour
I	
ID	Inside Diameter
in.-lb	Inch Pound (torque)
in.	Inch, inches
IOM	YO-233-B2A Engine Installation and Operation Manual
M	
Max.	Maximum
MEK	Methyl-Ethyl-Ketone
O	
OEM	Original Equipment Manufacturer
OHM	Direct Drive Overhaul Manual
P	
psi	Pounds per square inch
Q	
Qt	Quart
R	
rpm	Revolutions per Minute
S	
SAE	Society of Automotive Engineers
SB	Service Bulletin
SI	Service Instruction
SL	Service Letter

SMOH	Since Major Overhaul
STC	Supplemental Type Certificate
T	
TBO	Time Between Overhaul
TDC	Top Dead Center
V	
V	Volt, Voltage

INTRODUCTION

Engine Description

The Lycoming YO-233-B2A Series Engine (Figure 1) is an ASTM F2339 compliant direct drive, four cylinder, carbureted, horizontally opposed, wet sump, air cooled engine. Refer to Figure 1.

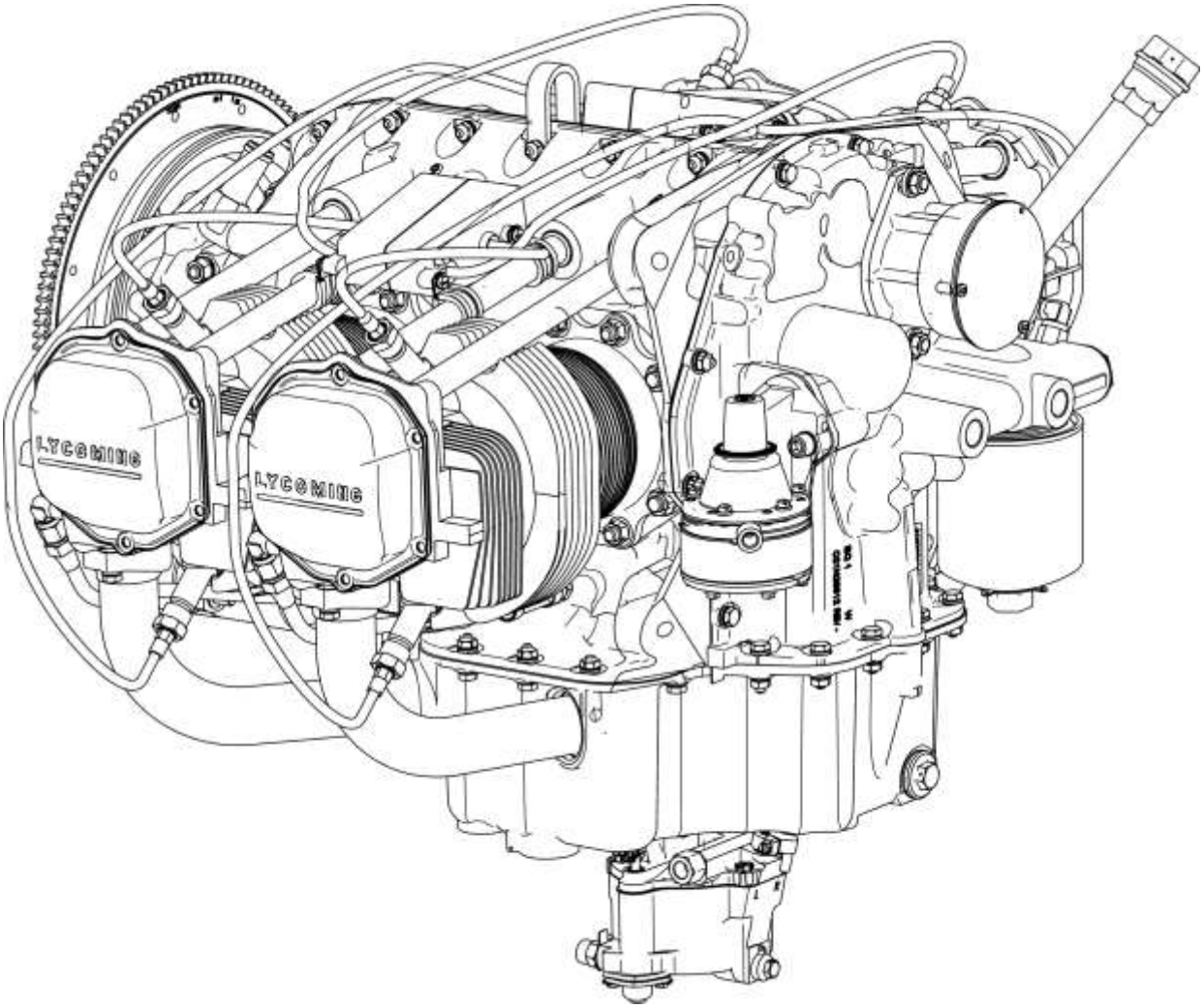

Figure 1
YO-233-B2A Series Engine

Engine Model Nomenclature

This table shows the definition of each letter and number in the basic engine model number.

Model Number	Meaning
Y	Non-Certified
O	Horizontally Opposed
233	Displacement in cubic inches

Engine Serial Number

Every engine sent from the factory is identified by a unique serial number. The engine serial number is identified on the engine data plate (Figure 2). Do not remove the engine data plate.

If a data plate is ever lost or damaged, refer to the latest revision of Service Instruction No. SI-1304 for data plate replacement information.

Figure 2
Engine Data Plate

Cylinder Number Designations

- The propeller is at the front of the engine and the accessories are at the rear of the engine.
- In a top view of the engine, the left side cylinders are 2-4. Cylinder 2 is at the front of the engine. Refer to Figure 3.
- In a top view of the engine, the left side cylinders are 1-3. Cylinder 1 is at the front of the engine. Refer to Figure 3.
- The firing order of the cylinders is 1-3-2-4.

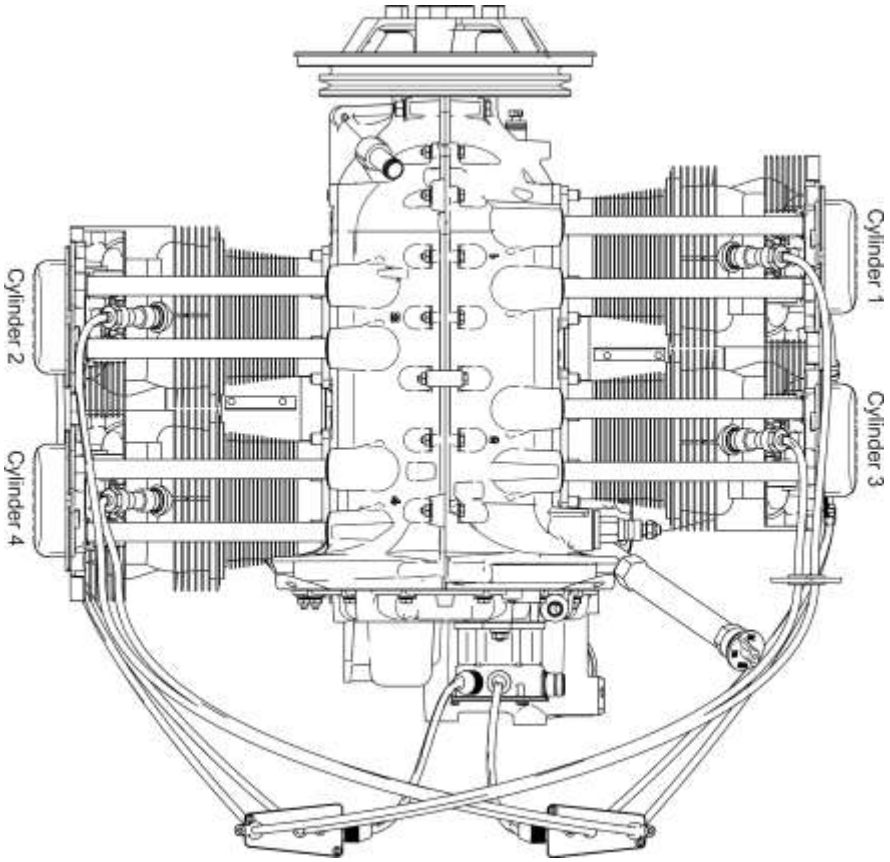

Figure 3
Top View of Engine – Cylinder Number Designations

Scope of this Manual

Although the YO-233-B2A is not certified by the Federal Aviation Administration (FAA), this manual adheres to guidelines set forth by the FAA for certified engines. It is recommended that all inspections, procedures, and guidelines in this manual be followed to maintain continued airworthiness.

This manual supplies instructions for service and maintenance of the Lycoming YO-233-B2A engine. The information includes required maintenance (service information) for oil changes, oil addition, oil filter replacement, routine time-interval inspections, routine service, spark plug replacement/inspection procedures, cylinder inspection, fuel system inspection, scheduled servicing procedures, fault isolation guidelines, and procedures for component replacement. Refer to the ***YO-233-B2A Illustrated Parts Catalog*** to identify spare parts.

Engine Airworthiness

To operate and maintain this engine in safe and airworthy condition, operators and maintenance personnel should have access to this manual, the latest revision of the ***Service Table of Limits - SSP-1776,*** and all service documents applicable to this engine model.

WARNING: FOR CORRECT ENGINE MAINTENANCE, COMPLETE THE NECESSARY MAINTENANCE PROCEDURES IN THIS MANUAL AND APPLICABLE SERVICE DOCUMENTS. LYCOMING ENGINES' SERVICE DOCUMENTS WRITTEN AT A LATER DATE OVERRIDE PROCEDURES IN THIS MANUAL UNLESS OTHERWISE SPECIFIED.

PROCEDURES IN THIS MANUAL MUST BE DONE BY QUALIFIED PERSONNEL WITH THE REQUISITE CERTIFICATIONS.

Before you do maintenance on the YO-233-B2A engine, read this manual in its entirety. Obey all procedures and inspections in this manual.

NOTICE: If you do not obey the maintenance procedures in this manual for this engine, you can void the engine warranty. Please consult your warranty for a full a statement of your rights, limitations and obligations that exist there under.

Refer to the ***YO-233-B2A Engine Installation and Operation Manual*** for engine description, uncrating procedures, acceptance check, engine lift procedure, engine preservation and storage, depreservation, engine installation requirements, engine installation, engine start, operation, and stop procedures, engine initiation, fuels and oil to be used, and operating specifications.

Refer to the latest revision of the ***Service Table of Limits - SSP-1776,*** for dimensions, clearances, measurements, and torque values.

WARNING: OPERATE THIS ENGINE IN ACCORDANCE WITH SPECIFICATIONS IN APPENDIX A OF THE YO-233-B2A ENGINE INSTALLATION AND OPERATION MANUAL. OPERATION OF THE ENGINE OUTSIDE OF THE SPECIFIED OPERATING LIMITS CAN CAUSE PERSONAL INJURY AND/OR DAMAGE TO THE ENGINE.

Environmental Compliance

Lycoming Engines recommends that engine owners and engine service personnel be in compliance with all federal, state, and local environmental regulations when solvents, paint, fuel, oil, chemicals, or other consumables are used in engine service.

Warnings, Cautions, and Notices

Be sure to read and obey the Warnings, Cautions, and Notices in this manual and in service documents. Although Lycoming Engines cannot know all possible hazards or damages, it makes a reasonable effort to supply the best known guidance and recommended practices for safe operation and maintenance of its engines.

The table below defines the four types of safety advisory messages used in this manual as per the American National Standard and ANSI Z535-6-2006.

Safety Advisory Conventions	
Advisory Word	**Definition**
DANGER:	Indicates a hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.
WARNING:	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION:	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury. It also can be used without the safety alert symbol as an alternative to **"NOTICE."**
NOTICE:	The preferred signal word to address practices not related to personal injury.

NOTICE: In this manual, the word "recommend" refers to "best practices."

Service Bulletins, Service Instructions, and Service Letters

As advancements in technological applications on this engine continue, Lycoming will make future revisions to this manual. However, if more timely distribution is necessary, Lycoming supplies up-to-date Service Bulletins (SBs), Service Instructions (SIs) and Service Letters (which are abbreviated with a capital “L” followed by the number, example L180). Special Advisories (SAs) are supplied as necessary.

For additional publication information, look on Lycoming’s website (Lycoming.com) or speak to Lycoming Engines by telephone: U.S. and Canada toll free: +1(800) 258-3279; or Direct: +1 (570) 323-6181.

Applicable information from Lycoming Engines' Service Bulletins, Service Instructions, and Service Letters are included in this manual at the time of publication. Any new service information will be included in the next update of the manual.

Reminder: Unless otherwise specified, Lycoming Engines' service documents (which are dated after this manual’s release date) override procedures in this manual.

For reference, the Service Document List at the front of this manual shows the service documents referenced or included in this manual.

List of Publications

Refer to the latest revision of Service Letter No. L114 for a list of Lycoming Engines' publications.

Instructions for Continued Airworthiness

This manual, together with the Installation and Operation Manual, Overhaul Manual, Service Documents and related publications make up the complete set of Instructions for Continued Airworthiness (ICAs).

Simplified Technical English

The text in the manual is written in the form of Simplified Technical English to make translation into other languages easier.

Format

Chapters in this manual are identified in Air Transport Association (ATA) format.

Figures

Figures in this manual are for illustration purposes only. Figures always start as Figure 1 in each chapter.

Table and Checklists

Tables in this manual are used to display detailed information in an organized format. Tables always start as Table 1 in each chapter. Checklists are used to display a list of tasks to be completed as part of a specific procedure. Checklists are not numbered because they are used as a reference tool contained within the procedure.

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Feedback

To supply comments, suggestions, or corrections to this manual, either email or contact Lycoming Engines Technical Support at the email or phone number in the front of this manual or use the Lycoming.com website.

Manual Revisions

Lycoming Engines constantly examines our manuals to provide our customers the most complete and up-to-date information for operating and maintaining our engines. Revisions to this manual will be published as necessary.

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05-00 - MAINTENANCE - GENERAL

1. General
   A. For continued airworthiness, this manual includes service information for oil changes, oil addition, oil filter replacement, routine time-interval inspections, routine maintenance, mantenance for unusual conditions, spark plug replacement/inspection procedures, cylinder maintenance, fuel maintenance, scheduled and unscheduled servicing procedures, and guidelines for fault isolation.
   B. Engine features, system description, uncrating procedures, acceptance check, engine lift procedure, engine preservation and storage, deinhibition, engine installation requirements, engine installation,engine start, operation, and stop procedures, pre-flight test, operational test, and fuels to be used are included in the ***YO-233-B2A Engine Installation and Operation Manual***.
2. List of Tools for Maintenance
   A. Table 1 identifies tools used for maintenance.

Table 1
Tools for Maintenance

Tool	Purpose
Champion Tool CT-470	Cut open oil filter
Borescope	Cylinder Borescope Inspection
Aviation Mechanic's Tools	
ST-25	Compressor, Valve Spring
ST-131 Tension Gage	Measure belt tension on alternator
ST-71 Valve Guide Gage	Exhaust Valve Guide Inspection/Removal
ST-71-2 Gage Adapter	Exhaust Valve Guide Inspection/Removal
ST-222	Plate, Torque Hold-Down
ST-483 Test Plate	
64530	Connecting Rod Parallelism and Squareness Gage
64535	Connecting Rod Bushing Removal Drift
64536	Replacement Drift
64593	Expanding and Staking Tool, 0.71 in. (18 mm) Spark Plug Heli-Coil® Insert
64594	Inserting Tool, 18 MM Spark Plug Heli-Coil® Insert
64595	Removing Tool, 18 MM Spark Plug Heli-Coil® Insert
64596-1	Tap, 18 mm Heli-Coil® Spark Plug Bottom Tap 0.010 in. (0.254 mm) OS
0.010 in. (0.254 mm) Feeler Gage	

3. Engine Overhaul vs. Engine Rebuild

   Engine overhaul is different from engine rebuild as follows:

   A. Engine overhaul – Completed by an authorized mechanic using technical data provided by Lycoming, overhauled to serviceable limits maintaining the engine total time in service.

   B. Engine rebuild – Completed only by Lycoming Engines at the factory using (design) data, returning a zero time in service engine to the customer.

4. Time Between Overhaul (TBO)

   NOTICE: Lycoming Service Bulletin No. 240 specifies mandatory parts replacement at overhaul and during repair or maintenance for all Lycoming engines. Requirements for replacement of parts for accessories such as magnetos, carburetors, fuel injectors, and AN fuel pumps are described in the applicable manufacturer's manual.

   A. If the engine is operated under usual conditions, overhaul or a factory rebuild is recommended at every 2200 hours of operation or every 12 years (whichever occurs first) from the date of manufacture. (For rebuild, the engine is to be shipped back to the factory.)

   B. However, if the engine is out of service on a usual basis for 30 days or more or it has been flown or stored in humid, dusty, or volcanic ash conditions, overhaul or rebuild could be necessary before the 2200 hours or 12 year TBO.

5. Safety Precautions - Before Engine Maintenance

   WARNING BEFORE THE START OF ANY SERVICE OR MAINTENANCE ON AN INSTALLED ENGINE OR AN ENGINE ON A TEST STAND CONNECTED TO POWER, ENSURE THE IGNITION SWITCH IS TURNED OFF AND DISABLE/DISCONNECT ALL POWER TO THE ENGINE TO PREVENT ACCIDENTAL ENGINE START-UP. FAILURE TO DISABLE POWER COULD CAUSE ACCIDENTAL ENGINE START-UP, INJURY, OR DEATH.

   ENSURE ALL OBJECTS/PERSONNEL ARE CLEAR OF THE PROPELLER'S ROTATIONAL ARC. IF POWER IS ON, A LOOSE OR BROKEN WIRE CAN CAUSE THE ENGINE TO START AND THE PROPELLER TO TURN WHICH CAN LEAD TO DEATH OR SERIOUS INJURY OR A PROPELLER STRIKE.

   IF IT IS NECESSARY TO COMPLETE OPERATIONAL TESTS ON THE ENGINE WITH POWER ON, KEEP ALL PERSONNEL AWAY FROM THE ROTATIONAL RADIUS OF THE PROPELLER TO PREVENT INJURY OR DEATH ON ENGINE START-UP.

   A. Disconnect the battery.

   B. Remove access panel(s), cowling(s) and/or baffles for access to areas.

6. Maintenance Practices

   A. Obey all safety precautions.

   B. Do not reuse a gasket, O-ring, or seal. Install a new gasket, O-ring, or seal during component installation where a gasket, O-ring, or seal was removed.

   C. If maintenance is done that could cause contamination of the internal components of the engine, complete the "Oil Change Procedure" in Chapter 12-10.

D. Remove all traces of dirt, dust, debris and accumulated matter from parts. All parts must be clean before they are installed on the engine. For specific cleaning guidelines, refer to Chapter 05-30.

E. If adhesive tape has been applied to any part, remove the tape and all residue. Clean the part completely.

F. Hardware

(1) All cotter pins that are removed must be discarded and not reused. Install a new cotter pin where a cotter pin was removed.

(2) All safety wire and cotter pins must be made of corrosion-resistant steel and installed as a snug fit in holes in studs and bolts for correct locking.

(3) If safety wire or safety cable was removed during component removal, be sure to install new safety wire or safety cable during component installation.

(4) All safety cable installed on the engine must meet or exceed specifications in the latest revision of AS3510. Safety cable must be installed per the safety cable manufacturer's instructions and in accordance with specifications in the latest revisions of AS4536 and AS567 and the latest revision of Service Instruction No. SI-1566.

(5) The cotter pin head must install as a snug fit into the castellation of the nut. Unless otherwise specified, bend one end of the cotter pin back over the stud or bolt and the other end flat against the nut.

(6) Torque a castellated or slotted nut to the value specified in this manual or the latest revision of the ***Service Table of Limits - SSP-1776***, if necessary, turn the nut up to one additional hex to align the slot in the nut with the hole in the bolt.

(7) If a lockplate is required when installing a bolt, torque the nut to the value specified in this manual or the latest revision of the ***Service Table of Limits - SSP-1776***. If necessary, turn the nut up to one additional hex to align the flat on the nut with the tab on the lockplate. Lockplate tabs must not be bent up on the corner of the nut.

(8) Replace any damaged or unserviceable hardware, fasteners, studs, screws, bolts, nuts, washers, and clamps with new parts.

(9) Always replace lock washers and lock nuts with new lock washers and lock nuts.

(10) Although the latest revision of Service Bulletin No. SB-240 identifies parts which must be replaced after they are removed, in the case where other parts are removed, it is recommended practice, prior to installation, to examine each part for damage or wear and replace the part as needed in accordance with accepted practices and standards to ensure that serviceable parts are installed on the engine.

G. Unless otherwise specified in this manual, refer to the latest revision of the ***Service Table of Limits - SSP-1776*** for:

- Standard torque values for fittings, plugs, and hardware fasteners
- Special torque requirements for fittings, valves, clamps, couplings, plugs, and other hardware fasteners in various locations on the engine
- Dimensions

- Clearances
- Measurements

H. Specific engine parts must be lubricated prior to installation. If parts are not correctly lubricated, or if an unapproved lubricant is used, engine parts could become scored before the engine oil has lubricated the engine during the first cycle of operation. This scoring can cause premature part failure, or, in some cases, engine failure. As preventive action, during engine component replacement, apply the approved lubricant for specified components identified in the latest revision of Service Instruction No. SI-1059.

I. If an engine start is required to complete a maintenance procedure, make sure that if you do not see oil pressure (greater than 0) indication within 10 seconds after engine start or oil pressure does **not** continue to increase above the published minimum pressure in the next 20 seconds, stop the engine. Identify and correct the problem before another engine start.

J. Complete the Operational Ground Check prior to and after each inspection, after maintenance, and engine assembly. Refer to Chapter 72-00.

7. General Engine Inspection Criteria

During visual inspection, replace engine components including the crankcase, oil sump, and accessory housing with:

- Replace the crankcase, oil sump, or accessory housing if there is any raised metal on surfaces
- Replace the crankcase, oil sump, or accessory housing if there is any scratch, ding, dent, or pit, that exceeds 0.050 in. (1.27 mm) depth
- Replace the crankcase if the dowels do not fully seat into the crankcase holes
- Replace any bent, damaged, or stripped studs, refer to Appendix A

8. Requirements for Engine Maintenance

A. These engines must be maintained using Lycoming Engines' approved methods and procedures.

B. Refer to the latest revision of Service Bulletin No. SB-240 for a list of parts must be replaced whenever they are removed.

9. Approved Parts

⚠ **CAUTION:** LYCOMING DOES NOT GIVE APPROVAL FOR USE OF PARTS MANUFACTURER APPROVAL (PMA) PARTS ON ITS ENGINES. LYCOMING INSTALLATION INSTRUCTIONS DO NOT APPLY TO PMA PARTS. EQUIPMENT FAILURE COULD OCCUR IF LYCOMING INSTRUCTIONS ARE USED TO INSTALL PMA PARTS. DAMAGES RELATED TO THE INSTALLATION OF PMA PARTS COULD VOID THE WARRANTY.

Lycoming Engines recommends these engines be maintained using only genuine Lycoming parts (PMA parts have not been approved for use by Lycoming Engines).

Refer to the ***YO-233-B2A Illustrated Parts Catalog*** for genuine Lycoming parts.

Before installing a component, complete a check of the shelf-life of the part as per the latest revision of Service Letter No. L247.

10. Corrosion Prevention

⚠ **CAUTION:** DO NOT USE PLAIN LUBRICATING OIL.

Before assembly of each subassembly, clean all of the parts to remove the preservative oil, grease, and unwanted dirt per instructions in Chapter 05-30.

Specific engine parts must be pre-lubricated prior to installation. Many premature part failures have been caused by incorrect pre-lubrication. If parts are not correctly lubricated, or if an unapproved lubricant is used, engine parts could become scored before the engine oil has lubricated the engine during the first cycle of operation. This scoring can cause premature part failure, or, in some cases, engine failure. As preventive action, during component replacement, apply the approved lubricant for specified components identified in the latest revision of Service Instruction No. SI-1059.

11. Painting the Engine and Engine Components

Lycoming Engines recommends that the basic engine be painted as an assembly (without accessories, intake tubes, fluid lines, wiring harness). However, if it is necessary to paint an individual component:

- Do not get paint on any mating surfaces or under the cylinder hold down nuts.
- There must be metal-to-metal contact to ensure correct torque.
- Mask mating surfaces and the area where the nut will contact the component surface.

Table 2 includes paint stripping and painting guidelines for components.

All paint is to be sprayed; however, if it is necessary to use a brush, use care to prevent an accumulation of pockets of paint. Refer to the paint manufacturer's instructions for drying and curing times.

Parts requiring use of paint for protection or appearance are to be painted in accordance with the recommendations using the following approved materials:

- Thinner - Toluene or equivalent (AMS3180 or equivalent Federal Spec. TT-T-548).
- Primer - Zinc chromate (AMS3110 or equivalent MIL-P-8585).
- Enamel - Phthalate resin type (AMS3125C or equivalent MIL- E-7729).

NOTICE: All machined bosses are to be masked before painting. Do not paint areas under hold-down nuts where torque is required.

Table 2
Paint Stripping and Painting Guidelines for Components

Aluminum and Steel Parts	**NOTICE:** It is not necessary to apply the primer coat if paint has not been removed from the part. (1) Clean and degrease the parts with mineral spirits or equivalent. (2) Apply one coat of zinc chromate primer, thinned with two parts toluene. (3) Air dry. (4) Apply one coat of enamel and bake at 250° F, to 300° F (121 to 149° C), for 1/2-hour.

Table 2 (Cont.)
Paint Stripping and Painting Guidelines for Components

Magnesium Parts	(1) Clean all traces of oil and grease from the part using a neutral, non-corrosive, degreasing medium followed by a rinse. (2) Immerse the part for 45 minutes in a hot dichromate solution (3/4 lb. of sodium dichromate to 1 gallon (3.8 liters) of water at 180° to 200°F (82° to 93°C) (as required). (3) Wash the part thoroughly in cold running water, dipped in hot water, and dried in an air blast. (4) Immediately paint the part with a primer coat and engine enamel, the same as aluminum parts.
Shroud Tubes	(1) Clean and degrease the shroud tube with mineral spirits or equivalent. (2) Dip the shroud tube in zinc chromate primer, thinned to spraying consistency. (3) Let the primer coat dry. (4) Paint the outside of the shroud tube with engine enamel.
Cylinders	**NOTICE:** Paint the cylinder with a Phthalate resin type enamel (AMS3125C or equivalent MIL-E-7729) properly thinned with Toluene or equivalent (AMS3180 or equivalent Federal Spec. TT-T-548). (1) Remove all old paint from the cylinder. Paint strippers are usually organic solvents like MEK or acetone or toluene, etc. and typically will not cause any damage to metals. A vapor degreaser is best suited for this purpose. **NOTICE:** Masking tape, corks, plugs, metal covers, etc. are acceptable for masking purposes. (2) Mask off the following parts of the cylinder: • Rocker box section, including the rocker box flange • Both valve ports and flanges • Thermocouple hole • Spark plug holes • Push rod shroud tube holes All other exposed threaded surfaces in which paint could accumulate (3) Cover the flange area to prevent paint being applied where the cylinder hold-down nuts contact the cylinder flange. **NOTICE:** In the next step, maximum thickness of the paint on the cylinder flange must be 0.0005 in. (0.0127 mm). Measure the thickness of the paint with a thickness gage or equivalent. If a thickness gage is not available, use a micrometer to measure the thickness of the flange before and after painting. If the paint is over 0.0005 in. (0.0127 mm) thick, remove the paint and repaint the cylinder flange.

Table 2 (Cont.)
Paint Stripping and Painting Guidelines for Components

Cylinders (Cont.)	(4) Apply a very light sprayed coat of zinc chromate primer to a maximum thickness of (0.0005 in. (0.0127 mm) on the cylinder flange. If the correct amount of paint has been applied, the color of the paint will be green with a yellowish tint and the metal will show through. If the paint is too thick, the color will be zinc chromate yellow. (5) Use a cloth dipped in paint thinner to remove paint from all surfaces where it could have accidentally accumulated. (6) Air-dry the cylinder or bake the cylinder in an oven until completely dry. Refer to the paint manufacturer's instructions for drying time and oven temperature. (7) Refer to the latest revision of Service Instruction No. 1181 and paint the cylinder fin area appropriately for spark plug identification.

12. Limits and Clearances

Refer to the latest revision of ***Service Table of Limits - SSP-1776***, for the following.

- Backlash and end clearance of gears
- Clearance between mating machined parts
- Clearance between moving parts that touch
- Torque limits for various nuts, screws, and fasteners.

13. Inspections

NOTICE: Inspections in this section refer to reusable items that do not require replacement in accordance with the latest revision of Service Bulletin No. SB-240. Be sure to record part replacement or any corrective action in the engine logbook.

A. Bearing Shell Surface Inspection

(1) Examine all bearing saddle surfaces for damage, scoring, galling, and wear. If any of these conditions are found, identify and correct the cause.

(2) Make sure that the clearance of each bearing agrees with the specification in the latest revision of the ***Service Table of Limits - SSP-1776***.

(3) If a bearing is not in the specified limits in the latest revision of the ***Service Table of Limit - SSP-1776***, discard it and replace it with a new one.

(4) Examine all journal surfaces for galling, scores, misalignment, and out-of-round condition. Replace a scored, galled, misaligned, or out-of-round component.

(5) Examine the shafts and pins for straightness.

B. Gear Inspection

(1) Examine the involutes of the gear teeth for pitting and excessive wear.

(2) If pit marks are found, discard the gear and replace it with a new one.

(3) Examine the bearing surfaces of all gears for deep scratches.

(4) Remove minor abrasions with a fine abrasive cloth.

C. Screwed Fitting Inspection

(1) Examine the condition of the threads on screwed fittings (threaded fastenings or plugs).

(2) Remove small nicks and burrs with a small file, fine abrasive cloth, or stone.

(3) If the part cannot be repaired by polishing it, discard it and replace it with a new one.

(4) If the part has too much distortion, galling, or mutilation (caused by over-tightening or use of an incorrect tool) replace it.

05-10 - TIME LIMITS

1. General
   A. Engine maintenance inspections are based on time intervals as shown in the Engine Inspection Schedule. All inspections must be completed no later than 10 hours after the specified time interval for the inspection.
2. Engine Inspection Schedule
   A. The Engine Inspection Schedule shows the inspections that must be done for engines in this manual. The scope of engine inspections includes visual observations during engine servicing or maintenance as well as inspections based on progressive time intervals after the engine is put into service. Engine inspections start from 10 hours and go to 25, 50, 100, 400, 500, and 1000-hour inspections.

Engine Inspection Schedule	
When to Complete	**Reference**
During engine servicing or maintenance	"Visual Inspection" in Chapter 05-20
Initial 10-hour engine inspection (for new, rebuilt, or overhauled engines)	"10-hour Initial Engine Inspection" in Chapter 05-20
• ***After 25 hours of initial operation*** of new or repaired or rebuilt/overhauled engines or the ***first 6 months*** since the engine was placed back into service (whichever occurs first) • If one or more new engine cylinders and/or piston rings have been installed • If the rate of oil consumption has not stabilized, repeat this inspection after the next 25 hours of operation	"25-hour Initial and Routine Engine Inspection" in Chapter 05-20
• 25 hours after 25-hour Initial Operation Inspection • After every 50 hours of operation or every 4 months (whichever occurs first)	"50-hour Engine Inspection" in Chapter 05-20
After every 100 hours of operation and annually*	"100-hour or Annual Engine Inspection" in Chapter 05-20
After every 400 hours of operation	"400-hour Engine Inspection" in Chapter 05-20
After every 500 hours of operation	"500-hour Engine Inspection" in Chapter 05-20
After every 1000 hours of operation	"1000-hour Engine Inspection" in Chapter 05-20.
Time Between Overhaul (TBO) 2200 hours or 12 years after engine placed in service, rebuilt or overhauled (whichever occurs first).	Direct Drive Overhaul Manual
*More frequent inspections could be necessary for engines operated in particulate-laden or extremely humid, cold, damp environments.	
NOTICE: An operational ground check must be completed prior to and after each inspection, after maintenance, and after engine overhaul. Refer to Chapter 72-00.	

NOTICE: Inspections in this manual apply to the engine and not to the aircraft. Refer to the airframe manufacturer's maintenance manual for inspection information on airframe components.

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05-20 - TIME LIMITS / MAINTENANCE CHECKS – SCHEDULED MAINTENANCE CHECKS

NOTICE: Obey and follow inspection checklists and instructions in this chapter in addition to maintenance guidelines from the airframe manufacturer or component manufacturers.

NOTICE: Do not exceed inspection intervals by more than 10 hours.

1. Visual Inspection

   A. Complete the visual inspection, usually with the engine installed in the aircraft, before each routine 50, 100, 400, 500, and 1000-hour inspection and every time you service or do maintenance on an engine.

   WARNING BEFORE ANY ENGINE INSPECTION OR SERVICE PROCEDURE, MAKE SURE THE IGNITION SWITCH IS SET TO OFF AND THAT ALL POWER TO THE ENGINE IS DISCONNECTED. ENSURE ALL OBJECTS/PERSONNEL ARE CLEAR OF THE PROPELLER'S ROTATIONAL ARC. IF POWER IS ON, A LOOSE OR BROKEN WIRE CAN CAUSE THE ENGINE TO START AND THE PROPELLER TO TURN WHICH CAN LEAD TO DEATH OR SERIOUS INJURY OR A PROPELLER STRIKE.

   B. Required tools:

      — Basic aviation mechanic's tools
      — Flashlight
      — Mirror.

   C. Complete the visual inspection as follows:

      (1) Set all ignition and electrical switches to the OFF position.

      (2) Remove the engine cowling from the aircraft for access to the engine and its compartment.

      CAUTION IF VOLCANIC ASH IS SUSPECTED ON THE ENGINE, DO NOT TOUCH IT WITH BARE HANDS OR GET IT IN YOUR EYES. WEAR PERSONAL PROTECTIVE EQUIPMENT. DO NOT USE WATER TO RINSE IT OFF. THE VOLCANIC ASH CAN CONTAIN ACIDIC COMPOUNDS WHICH MUST NOT BE INHALED OR TOUCHED SINCE IT CAN CAUSE INJURY. REFER TO THE "VOLCANIC ASH REMOVAL" PROCEDURE IN CHAPTER 05-30.

      (3) Look for unwanted dirt, dust, volcanic ash, sand, or particles on the engine and in its compartment. Remove any unwanted materials. The engine and nacelle must be clean and free of all dirt and unwanted materials.

      (4) Examine the cowling, engine and its compartment for evidence of fluid leaks, residues, or discoloration. Identify and correct the cause(s) of any leak or residue before flight and complete all of the necessary repairs to make sure the engine is operating correctly.

WARNING: FUEL AND OIL HOSES MUST BE INTACT AND HELD SECURELY IN PLACE TO PREVENT LEAKS DURING FLIGHT WHICH CAN CAUSE CATASTROPHIC ENGINE FAILURE.

(5) Examine fuel and oil hoses for secure attachment, leaks or wear. Tighten any loose connections. Replace any worn fuel or oil hoses. Refer to the Direct Drive Overhaul Manual.

(6) Examine the following for cracks, pitting and damage:

— External cylinder barrel
— Cylinder barrel fins
— Areas between and adjacent to the fins
— External surface of the cylinder head and fins
— Top and bottom spark plug bosses.

NOTICE: If you find any cracked, pitted or defective cylinders or components, complete the cylinder inspection in accordance with Chapter 72-30.

(7) Examine the external surface of the crankcase for damage, cracks, and defects. If damage, cracks or defects are found, replace the crankcase. Refer to the Direct Drive Overhaul Manual.

(8) Examine the accessory housing and its attached accessories for damage and defects. Repair or replace any damaged, worn, or defective parts.

CAUTION: THE WIRING HARNESS MUST BE INTACT FOR CORRECT ENGINE OPERATION.

(9) Make sure that the wiring harness and its connectors are attached correctly and not damaged.

(10) Examine the wiring harness for correct attachment to the electrical connectors and engine, broken or frayed wire, signs of chafing, deterioration, abrasion or heat-related damage. Replace the wiring harness if a wire is broken, frayed, chafed, abraded, overheated, or damaged. Refer to the Direct Drive Overhaul Manual.

(11) Make sure that the securing straps, and lockwiring are attached correctly and tightly.

(12) Make sure that the ignition system is operating correctly, in accordance with the aircraft manufacturer's instructions.

(13) Make sure that the induction system is in satisfactory condition. Ensure that all clamps, flanges, and hardware are securely fastened and that there is no evidence of leakage or staining.

(14) Make sure that the lubrication system is in satisfactory condition. Ensure that all clamps, flanges, and hardware are securely fastened and that there is no evidence of leakage.

(15) In accordance with the airframe manufacturer's instructions, examine the induction air filter for cleanliness, security, and indications of damage. Replace the air filter if it has holes or is torn in accordance with the aircraft manufacturer's instructions.

NOTICE: After it has been operated in dusty conditions, clean the induction filter. For servicing procedures refer to the airframe manufacturer's instructions.

(16) Examine all engine controls for general condition, full travel, and freedom of operation in accordance with the airframe manufacturer's instructions.

(17) Before flight, make sure that all leaks and problems have been corrected or repaired. Repair or replace all missing or damaged components identified by the airframe manufacturer's instructions.

(18) Install the cowling on the aircraft.

2. 10-Hour Initial Engine Inspection

   A. Complete this inspection after the first 10 hours of initial operation of the engine.

   B. Complete the 10-Hour Initial Engine Inspection Checklist for this inspection.

WARNING BEFORE ANY ENGINE INSPECTION OR SERVICE PROCEDURE, MAKE SURE THE IGNITION SWITCH IS SET TO OFF AND THAT ALL POWER TO THE ENGINE IS DISCONNECTED. ENSURE ALL OBJECTS/PERSONNEL ARE CLEAR OF THE PROPELLER'S ROTATIONAL ARC. IF POWER IS ON, A LOOSE OR BROKEN WIRE CAN CAUSE THE ENGINE TO START AND THE PROPELLER TO TURN WHICH CAN LEAD TO DEATH OR SERIOUS INJURY OR A PROPELLER STRIKE.

NOTICE: Copy the blank checklist and complete this checklist as a record of engine maintenance. Put the completed checklist in the engine logbook.

10-Hour Initial Engine Inspection Checklist			
Engine Model Number_____ **Engine Serial Number:**_____ **Date Inspection Done:**_____ **Inspection done by:**_____ **Aircraft Tachometer:**_____ **Engine Time:**_____			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Complete the operational ground check in accordance with Chapter 72-00.	Look for leaks. Identify and correct the cause of any leak. Correct any problem and repair as necessary to make sure the engine operates correctly to specifications.		

3. 25-Hour Initial and Routine Engine Inspection

   A. The purpose of this inspection is to measure the oil level and oil consumption, and identify any oil leaks.

   B. Complete the 25-Hour Engine Inspection at the following times:

      — After 25 hours of initial operation of a new, repaired, or rebuilt/overhauled engine for the first (engine-break-in) or after the first 6 months since the engine was placed in service (whichever comes first)

      — After one or more new engine cylinders and/or piston rings have been installed

      — If the rate of oil consumption has not stabilized, repeat this inspection after the next 50 hours of operation. Refer to the "Oil Consumption" section in Chapter 12-10.

   C. Complete the 25-hour Initial and Routine Engine Inspection Checklist for this inspection.

⚠ WARNING BEFORE ANY ENGINE INSPECTION OR SERVICE PROCEDURE, MAKE SURE THE IGNITION SWITCH IS SET TO OFF AND THAT ALL POWER TO THE ENGINE IS DISCONNECTED. ENSURE ALL OBJECTS/PERSONNEL ARE CLEAR OF THE PROPELLER'S ROTATIONAL ARC. IF POWER IS ON, A LOOSE OR BROKEN WIRE CAN CAUSE THE ENGINE TO START AND THE PROPELLER TO TURN WHICH CAN LEAD TO DEATH OR SERIOUS INJURY OR A PROPELLER STRIKE.

NOTICE: Copy the blank checklist and complete the checklist as a record of engine maintenance. Put the completed checklist in the engine logbook.

25-Hour Initial and Routine Engine Inspection Checklist

Engine Model Number_____ **Engine Serial Number:**_____

Date Inspection Done: _____ **Inspection done by:**_____

Aircraft Tachometer:_____ **Engine Time:**_____

Inspection Item	Comments	Results/Notes	Done
Complete the Visual Inspection.	Refer to the section "Visual Inspection" in this chapter.		
NOTICE: At 25 hours after the first oil sump suction screen cleaning - complete an oil change, filter replacement and oil sump suction screen check for new, remanufactured or newly overhauled engines and for engines with any newly installed cylinders.			
Measure and record the oil level.	Refer to the section "Oil Level Check" in Chapter 12-10.		

25-Hour Initial and Routine Engine Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Calculate oil consumption.	Refer to the section "Oil Consumption" in Chapter 12-10. If oil consumption has increased, complete the "Cylinder Borescope Inspection Procedure." Refer to Chapter 72-30. Complete this 25-hour Inspection again until oil consumption stabilizes.		
Change the oil.	Refer to the section "Oil Change Procedure" in Chapter 12-10.		
Replace the oil filter.	Refer to the section "Oil Filter Replacement" in Chapter 12-10.		
Examine the oil sump suction screen and oil filter for blockage.	Remove any blockage and clean the oil sump suction screen. Identify the cause of any blockage and correct the problem. Refer to the sections "Oil Suction Screen Removal/Installation" and "Oil Filter/Oil Suction Screen Inspection" in Chapter 12-10.		
WARNING: EXAMINE THE OIL SUMP SUCTION SCREEN AND OIL FILTER ELEMENT FOR UNWANTED METAL PARTICLES. A CLOGGED OIL FILTER AND/OR SUCTION SCREEN CAN CAUSE ENGINE FAILURE.			
WARNING: CORRECT ALL LEAKS. IF FUEL OR OIL LEAKS ARE NOT CORRECTED BEFORE FLIGHT, THE ENGINE CAN HAVE LOSS OF POWER OR ENGINE FAILURE CAN OCCUR.			
NOTICE: During the first hours of service, engines can have some leakage at the cylinder head. This initial leakage is not harmful or detrimental to the engine.			
Examine the engine and nacelle for fuel or oil leaks.	Refer to the section "Oil Leak Check" in Chapter 12-10. If a leak is found, identify and correct the cause of the leak.		

25-Hour Initial and Routine Engine Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Examine the engine and nacelle for dirt, particulate, sand, or other contamination.	Remove any dirt, particulate, sand, or other contamination. Refer to the Direct Drive Overhaul Manual for cleaning instructions		
Correct any discrepancies found before returning the engine to service.			
Complete the operational ground check in accordance with Chapter 72-00.	Look for leaks. Identify and correct the cause of any leak. Correct any problem and repair as necessary to make sure the engine operates correctly to specifications.		
Record all findings and corrective action in the engine logbook			

4. 50-Hour Engine Inspection

   A. The purpose of this inspection is to make sure that the engine operates correctly and agrees with operational specifications.

   B. Complete the 50-Hour Engine Inspection after every 50 hours of engine operation or every 4 months, whichever occurs first.

   C. Complete the 50-hour Engine Inspection Checklist for this inspection.

WARNING BEFORE ANY ENGINE INSPECTION OR SERVICE PROCEDURE, MAKE SURE THE IGNITION SWITCH IS SET TO OFF AND THAT ALL POWER TO THE ENGINE IS DISCONNECTED. ENSURE ALL OBJECTS/PERSONNEL ARE CLEAR OF THE PROPELLER'S ROTATIONAL ARC. IF POWER IS ON, A LOOSE OR BROKEN WIRE CAN CAUSE THE ENGINE TO START AND THE PROPELLER TO TURN WHICH CAN LEAD TO DEATH OR SERIOUS INJURY OR A PROPELLER STRIKE.

NOTICE: Copy the blank checklist and complete the checklist as a record of engine maintenance. Put the completed checklist in the engine logbook.

50-Hour Engine Inspection Checklist			
Engine Model Number_____ **Engine Serial Number:_____** **Date Inspection Done: _____** **Inspection done by:_____** **Aircraft Tachometer:_____** **Engine Time:_____**			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Complete the visual inspection.	Refer to the "Visual Inspection" section in this chapter.		
Measure the oil level and calculate the rate of consumption.	If the rate of oil consumption is not within limits repeat the steps in the 25-Hour Engine Inspection Checklist.		
Do an oil change.	Refer to the "Oil Change Procedure" in Chapter 12-10. Collect an oil sample for analysis. If steel, copper or aluminum particles are found in the oil filter, examine the engine cylinders and other metal components for worn parts or damage. Refer to the sections "Engine Wear and Oil Analysis" and "Guidelines for Results of Oil Analysis" in Chapter 12-10.		

50-Hour Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Look for any fuel or oil leaks before cleaning the engine.			
Clean the engine.			
Engine and Cowling			
Examine all hoses, lines, connections, wiring, fittings, and baffles for loose connections and any damage.	Tighten any loose hardware. Refer to the latest revision of the ***Service Table of Limits - SSP-1776*** for torque values. Replace damaged components as per the Direct Drive Overhaul Manual.		
Examine the cowling and baffles for damage and correct installation.	Replace damaged cowling or baffles. Refer to the aircraft OEM procedures.		
Champion Electronic Ignition System			
Remove spark plug connector nuts and examine spark plug cable leads and ceramics for corrosion and deposits.	Corrosion and deposits are evidence of leaking spark plugs or of improper cleaning of the spark plug walls or connector ends.		
Clean the cable ends, spark plug walls, and ceramics with a clean lint-free cloth moistened with methyl-ethyl-ketone (MEK), acetone, or wood alcohol.			
Rotate or replace spark plugs as necessary.	Refer to Table 2 in Chapter 74-20.		
Replace any broken, cracked, deformed, or corroded parts.			
Dry all parts using compressed air.			
Visually examine the ignition harness for evidence of chafing or deterioration.	Replace the harness assembly if any leads are worn, damaged, or broken.		

50-Hour Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Champion Electronic Ignition System (Cont.)			
Make sure that the ignition harness mounting clamps are tight.			
Examine the Electronic Ignition System for damage. Refer to the Direct Drive Overhaul Manual.			
Light Speed Plasma III and Magneto Ignition System			
Make sure that the P-leads are securely attached to the magneto condenser studs. Torque the P-lead nut to 13 to 15 in. lb (1.5 to 1.7 Nm) as necessary.	Refer to the aircraft manufacturer's recommendations to make sure the ignition switch and P-lead are operating correctly.		
Remove spark plug connector nuts and examine spark plug cable leads and ceramics for corrosion and deposits. Replace spark plugs as necessary per Chapter 74-20.	Corrosion and deposits are evidence of leaking spark plugs or of improper cleaning of the spark plug walls or connector ends. Refer to the section “Spark Plug Cleaning” in Chapter 05-30.		
Clean the cable ends, spark plug walls, and ceramics.	Refer to the section “Spark Plug Cleaning” in Chapter 05-30.		
Make sure that the spark plug and magneto terminal connections are tight.			
Make sure that the spark plug connections are tight.			
Replace any broken, cracked, deformed, or corroded parts.			
Examine each ignition lead for chafing, insulation breakdown, frayed wiring, deterioration, heat damage, wear, and cracking. Examine the ignition lead routing.	Refer to the section “Ignition Lead Inspection” in Chapter 74-20.		
Make sure that the ignition harness mounting clamps are tight.	Tighten any loose clamps.		

50-Hour Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Fuel System			
Complete the Fuel System Inspection.	Refer to the "Fuel System Inspection Procedure" section In Chapter 73-10.		
Induction System			
Complete the Induction System Inspection.	Refer to the "Induction System Inspection Procedure" section in Chapter 72-80.		
Electrical System			
Make sure the wiring harness is routed correctly and attached securely and that there are no broken, chafed or frayed wires or connectors.	Replace the wiring harness if a wire is broken, frayed or chafed or if a connector is broken or damaged. Refer to the Direct Drive Overhaul Manual for replacement procedures.		
Make sure that clamps are installed to keep the wiring harness in place.	Tighten or install any loose or missing clamps to keep the wires securely in place.		
Engine Cylinders			
NOTICE: During the first hours of service, engines can have some leakage at the cylinder head. This initial leakage is not harmful or detrimental to the engine.			
Examine the rocker box covers for oil leaks.	Identify and correct the cause of the oil leak. For possible causes and corrections, refer to the "Fault Isolation" section in Chapter 12-30.		
Examine the gaskets for excessive leaks and damage.	Replace any gasket that is damaged or leaks. Refer to the Direct Drive Overhaul Manual. Tighten gasket screws per torque values in the latest revision of the ***Service Table of Limits - SSP-1776***.		

50-Hour Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Engine Cylinders (Cont.)			
Examine the cylinders for heat damage i.e. burnt paint and damaged fins. (Identify whether the paint has scaled or peeled from discolored and blistered paint appearance. Unburned metallic surfaces appear bright or clean with definite edges.	If you find burnt paint on a cylinder, then you must examine it for internal damage. For possible causes and corrections, refer to the "Fault Isolation" section in Chapter 12-30.		
Examine the exhaust system for leaks in connections between the exhaust system and exhaust ports of cylinder - look for burnt paint around the spark plug and exhaust flange bosses or for light gray deposits near the leaks; look for a warped exhaust flange (which can cause a leak).	Exhaust leaks can cause damage to spark plugs, ignition cables, and the cylinder head.		
Look for unusual discoloration on each engine cylinder.	If discoloration is found, do not allow aircraft to be flown. Identify and correct the cause. For possible causes and corrections, refer to the "Fault Isolation" section in Chapter 12-30.		
Examine the inter-cylinder baffle for damage or looseness.	Replace damaged or loose inter-cylinder baffle. Refer to the Direct Drive Overhaul Manual.		
NOTICE: A cylinder can be discolored because of thread lubricant emission that happens during assembly of the barrel at the factory. This condition is not harmful or detrimental to the engine operation.			

50-Hour Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
General			
Correct any discrepancies found before returning the engine to service.			
Complete the operational ground check in accordance with Chapter 72-00.	Look for leaks. Identify and correct the cause of any leak. Correct any problem and repair as necessary to make sure the engine operates correctly to specifications.		
Record all findings and corrective action in the engine logbook.			

5. 100-Hour or Annual Engine Inspection

   A. The purpose of this inspection is to examine the engine, cylinders, hardware, and components.

   B. Complete the 100-Hour Engine Inspection after the first 100 hours of operation since the engine has been in service and then after every 100 hours of operation or during each annual aircraft inspection (whichever occurs first).

   C. Complete the 100-hour or Annual Engine Inspection Checklist for this inspection.

WARNING BEFORE ANY ENGINE INSPECTION OR SERVICE PROCEDURE, MAKE SURE THE IGNITION SWITCH IS SET TO OFF AND THAT ALL POWER TO THE ENGINE IS DISCONNECTED. ENSURE ALL OBJECTS/PERSONNEL ARE CLEAR OF THE PROPELLER'S ROTATIONAL ARC. IF POWER IS ON, A LOOSE OR BROKEN WIRE CAN CAUSE THE ENGINE TO START AND THE PROPELLER TO TURN WHICH CAN LEAD TO DEATH OR SERIOUS INJURY OR A PROPELLER STRIKE.

NOTICE: Copy the blank checklist and complete this checklist as a record of engine maintenance. Put the completed checklist in the engine logbook.

100-Hour or Annual Engine Inspection Checklist			
Engine Model Number_____ **Engine Serial Number:_____** **Date Inspection Done: _____** **Inspection done by:_____** **Aircraft Tachometer_____** **Engine Time:_____**			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Complete the 50-Hour Engine Inspection.	Refer to the section "50-Hour Engine Inspection" in this chapter.		
Examine all studs and nuts for loose hardware and defects.	Torque loose hardware to the correct specification torque value in the latest revision of the ***Service Table of Limits - SSP-1776***.		
Champion Electronic Ignition System			
Rotate, clean, and re-gap the spark plugs as necessary.	Replace worn spark plugs. Refer to Chapter 74-20.		
Examine each ignition lead for chafing, insulation breakdown, frayed wiring, deterioration, heat damage, wear, and cracking.	Refer to Chapter 74-20.		

100 Hour or Annual Engine Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Ignition System (Cont.)			
Examine each spark plug for chafing, corrosion, wear, and cracking.	Refer to Chapter 74-20.		
Examine the ignition lead routing.	Refer to the “Examine the Ignition Lead Routing” section in Chapter 74-20		
Examine the continuity of the engine group straps.	Refer to the airframe manufacturer’s instructions.		
Light Speed Plasma III and Magneto Ignition System			
Complete the Annual / 100 hour Inspection in accordance with the Light Speed Installation and Operation Manual			
WARNING IF THE P-LEAD IS DISCONNECTED, THE MAGNETO WILL BE ON AND WILL ACTIVATE THE SPARK PLUG IF THE PROPELLER IS TURNED. TO PREVENT INJURY, MAKE SURE THAT THE P-LEAD IS SECURELY ATTACHED TO THE CONDENSER STUD.			
Make sure that the magneto-to-engine timing is correct. Adjust the timing as necessary.	Refer to the "Magneto-to-Engine Timing Check" in Chapter 74-30. The correct advance timing is stamped on the engine data plate.		
Complete a visual inspection of the magneto wiring conditions and connections, vent holes, and P-lead attachment.			
Clean the magneto vents to make sure that there is no obstruction.			
Make sure the magneto clamps securely attach each magneto to the engine.			
If a retard magneto is installed, make sure that the switch wire on the retard (left) breaker connects the retard contact points to the ignition vibrator.			

100-Hour or Annual Engine Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Power			
Make sure the alternator belt support bracket and mounting are tight.	Tighten all loose hardware per torque values in the latest revision of the ***Service Table of Limits - SSP-1776***.		
Electrical System			
Complete the 100 Hour Wiring Inspection	Refer to the "100-Hour Wiring Inspection" section in Chapter 72-70.		
Fuel Distribution System			
Examine carburetor for any evidence of physical damage.	Look for carbon gum deposits and clogging. Remove deposits as per the Direct Drive Overhaul Manual.		
⚠ CAUTION: DO NOT ATTEMPT TO REPAIR A DAMAGED FUEL LINE. REPLACE ANY FUEL LINE THAT IS CRACKED, DENTED, OR KINKED; CRACKS CAN DEVELOP AT THE SIDE OF SHARP BENDS OR KINKS.			
Examine solder joints at the end of fuel lines for cracks.	Replace cracked lines.		
Examine the routing of fuel lines. Make sure that the clamps securely support the fuel line.			
Visually examine the fuel lines and hoses for evidence of damage, chafing, leaking, improper conditions, and looseness.			
Examine the flexible hoses.	Replace any hoses that have become hard.		
Examine hoses, gaskets, and seals for deterioration or leakage.	Replace any hoses, gaskets, or seals that are worn, damaged, or leaking.		
Crankcase			
Complete the Crankcase Inspection.	Refer to the "Crankcase Inspection Procedure" in Chapter 72-20.		

100-Hour or Annual Engine Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Engine Accessories			
Complete the Accessory Drive Inspection	Refer to the "100-Hour Accessory Drive Inspection Procedure" in Chapter 72-60.		
Examine engine controls for security, safety/locking devices, and full range of travel.			
Cowling			
Examine the cowling and baffles for physical damage. Make sure that they are tightly attached.	Repair or replace all of the damaged or missing parts of the cooling system in accordance with the airframe manufacturer's maintenance manual		
Engine Mounts			
Complete the Engine Mount Inspection	Refer to the "100-Hour Engine Mount Inspection Procedure" in Chapter 72-00 of this manual.		

Inspection Item	**Comments**
Cylinders	
Complete the Cylinder Visual Inspection as per the "Visual Cylinder Inspection Procedure" in Chapter 72-30 of this manual	
Cylinder 1	
Cylinder 2	
Cylinder 3	
Cylinder 4	
Complete the Cylinder Compression Check as per the "Cylinder Compression Check Procedure" in Chapter 72-30.	
Cylinder Compression Check	
Cylinder 1	
Cylinder 2	
Cylinder 3	
Cylinder 4	

100-Hour or Annual Engine Inspection Checklist (Cont.)	
Inspection Item	**Comments**
Baffle Inspection	
Complete the Visual Baffle Inspection per instructions in the section "Visual Baffle Inspection Procedure" in Chapter 72-30. Record the results for each cylinder below.	
Cylinder 1	
Cylinder 2	
Cylinder 3	
Cylinder 4	

Inspection Item	Comments	Done
Examine all the rocker box covers for indications of oil leaks.	Identify and correct the cause of any oil leaks. For possible causes and corrections, refer to the "Fault Isolation" section in Chapter 12-30.	
Tighten the gasket screws per the torque values in the latest revision of the ***Service Table of Limits - SSP-1776***.		
Operational Test		
After all inspections and repairs are done, complete the operational check in accordance with Chapter 72-00. Look for leaks. Identify and correct the cause of any leak. Correct any problem and repair as necessary to make sure the engine operates correctly to specifications.	Refer to the section "Operational Ground Check After Maintenance in Chapter 72-00.	
Complete the "Return to Service Procedure."	Refer to the section "Return to Service Procedure" in Chapter 72-00.	
Before you return this engine to service, make sure that you correct all of the causes and complete all of the repairs that are necessary as per in this inspection.		
General		
Correct any discrepancies found before returning the engine to service.		
Record all findings and corrective action in the engine logbook.		

6. 400-Hour Engine Inspection
   A. Complete the 400-Hour Engine Inspection after every 400 hours of operation since the engine has been in service.
   B. Complete the 400-Hour Engine Inspection Checklist for this inspection.

WARNING BEFORE ANY ENGINE INSPECTION OR SERVICE PROCEDURE, MAKE SURE THE IGNITION SWITCH IS SET TO OFF AND THAT ALL POWER TO THE ENGINE IS DISCONNECTED. ENSURE ALL OBJECTS/PERSONNEL ARE CLEAR OF THE PROPELLER'S ROTATIONAL ARC. IF POWER IS ON, A LOOSE OR BROKEN WIRE CAN CAUSE THE ENGINE TO START AND THE PROPELLER TO TURN WHICH CAN LEAD TO DEATH OR SERIOUS INJURY OR A PROPELLER STRIKE.

NOTICE: Copy the blank checklist and complete this checklist as a record of engine maintenance. Put the completed checklist in the engine logbook.

400-Hour Engine Inspection Checklist			
Engine Model Number_____ **Engine Serial Number:_____** **Date Inspection Done: _____** **Inspection done by:_____** **Aircraft Tachometer:_____** **Engine Time:_____**			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Complete the 100-Hour Engine Inspection.	Refer to the section "100-Hour or Annual Inspection" in this chapter.		
Cylinders			
Remove rocker box covers.			
Look for evidence of abnormal wear or broken parts in the area of the valve tips, valve keeper, springs, and spring seats. If any of these indications are found, remove the cylinder and all of its components (including the piston and connecting rod assembly) and examine for further damage.			
Complete the Cylinder Borescope Inspection as per the "Cylinder Borescope Inspection Procedure" in Chapter 72-30 of this manual. Record the results below.			
Cylinder 1			
Cylinder 2			
Cylinder 3			
Cylinder 4			

400-Hour Engine Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
General			
Correct any discrepancies found before returning the engine to service.			
Complete the operational ground check in accordance with Chapter 72-00.	Look for leaks. Identify and correct the cause of any leak. Correct any problem and repair as necessary to make sure the engine operates correctly to specifications.		
Record all findings and corrective action in the engine logbook.			

7. 500-Hour Engine Inspection
   A. Complete the 500-Hour Engine Inspection after every 500 hours of operation since the engine has been in service.
   B. Complete the 500-Hour Engine Inspection Checklist for this inspection.

WARNING BEFORE ANY ENGINE INSPECTION OR SERVICE PROCEDURE, MAKE SURE THE IGNITION SWITCH IS SET TO OFF AND THAT ALL POWER TO THE ENGINE IS DISCONNECTED. ENSURE ALL OBJECTS/PERSONNEL ARE CLEAR OF THE PROPELLER'S ROTATIONAL ARC. IF POWER IS ON, A LOOSE OR BROKEN WIRE CAN CAUSE THE ENGINE TO START AND THE PROPELLER TO TURN WHICH CAN LEAD TO DEATH OR SERIOUS INJURY OR A PROPELLER STRIKE.

NOTICE: Copy the blank checklist and complete this checklist as a record of engine maintenance. Put the completed checklist in the engine logbook.

500-Hour Engine Inspection Checklist

Engine Model Number_____ **Engine Serial Number:**_____

Date Inspection Done: _____ **Inspection done by:**_____

Aircraft Tachometer:_____ **Engine Time:**_____

Inspection Item	Comments	Results/Notes	Done
Complete the 100-Hour Engine Inspection.	Refer to the section "100-Hour or Annual Inspection" in this chapter.		
Light Speed Plasma III and Magneto Ignition System			
Complete the 500-hour Inspection in accordance with the Light Speed Plasma III Installation and Operation Manual			
Examine the magnetos in accordance with the magneto manufacturer's instructions.	If a magneto must be replaced, refer to the "Magneto Replacement Procedure" in Chapter 74-30.		
General			
Correct any discrepancies found before returning the engine to service.			
Complete the operational ground check in accordance with Chapter 72-00.	Look for leaks. Identify and correct the cause of any leak. Correct any problem and repair as necessary to make sure the engine operates correctly to specifications.		
Record all findings and corrective action in the engine logbook.			

8. 1000-Hour Engine Inspection
   A. The purpose of this checklist is to complete the exhaust valve and guide inspection.
   B. Complete the 1000-Hour Engine Inspection after every 1000 hours of operation since the engine has been in service.
   C. Complete the 1000-Hour Engine Inspection Checklist for this inspection.

WARNING BEFORE ANY ENGINE INSPECTION OR SERVICE PROCEDURE, MAKE SURE THE IGNITION SWITCH IS SET TO OFF AND THAT ALL POWER TO THE ENGINE IS DISCONNECTED. ENSURE ALL OBJECTS/PERSONNEL ARE CLEAR OF THE PROPELLER'S ROTATIONAL ARC. IF POWER IS ON, A LOOSE OR BROKEN WIRE CAN CAUSE THE ENGINE TO START AND THE PROPELLER TO TURN WHICH CAN LEAD TO DEATH OR SERIOUS INJURY OR A PROPELLER STRIKE.

NOTICE: Copy the blank checklist and complete this checklist as a record of engine maintenance. Put the completed checklist in the engine logbook.

1000-Hour Engine Inspection Checklist

Engine Model Number_____ **Engine Serial Number:**_____

Date Inspection Done: _____ **Inspection done by:**_____

Aircraft Tachometer_____ **Engine Time:**_____

Inspection Item	Comments	Results/Notes	Done
General			
Examine the starter ring gear support.	Replace the starter ring gear support as necessary. Refer to Chapter 74-30 for replacement instructions.		
Correct any discrepancies found before returning the engine to service.			
Complete the operational ground check in accordance with Chapter 72-00.	Look for leaks. Identify and correct the cause of any leak. Correct any problem and repair as necessary to make sure the engine operates correctly to specifications.		
Record all findings and corrective action in the engine logbook.			

05-30 - CLEANING

1. Cleaning Guidelines

NOTICE: The goal to keep the engine and nacelle clean is to prevent contamination from foreign object debris (FOD) which can adversely affect engine operation.

A. Refer to Table 1 for cleaning guidelines for engine components.

⚠ **CAUTION** IF VOLCANIC ASH IS SUSPECTED ON THE ENGINE, DO NOT INHALE IT OR TOUCH IT WITH BARE HANDS OR GET IT IN YOUR EYES. WEAR PERSONAL PROTECTIVE EQUIPMENT. DO NOT USE WATER TO RINSE IT OFF. THE VOLCANIC ASH CAN CONTAIN ACIDIC COMPOUNDS WHICH MUST NOT BE INHALED OR TOUCHED SINCE IT CAN CAUSE INJURY. REFER TO THE SECTION "VOLCANIC ASH REMOVAL" IN THIS CHAPTER.

NOTICE: Except for parts contaminated with suspect volcanic ash, before cleaning engine parts, complete a visual inspection (per Chapter 05-20) of engine parts to identify any stains and residues and sources thereof.

B. After the initial visual inspection (in Chapter 05-20), clean engine parts thoroughly per instructions in this chapter.

⚠ **CAUTION** DO NOT USE ALKALINE (CAUSTIC) CLEANING SOLUTIONS SUCH AS DETERGENTS ON ENGINE PARTS. ALKALINE SOLUTIONS REMOVE THE FINISH ON ALUMINUM PARTS AND MAGNESIUM PARTS. ALKALINE COMPOUNDS CAN GET INTO THE PORES OF THE METAL WHICH CAN CAUSE OIL FOAMING WHEN THE PART IS PUT BACK INTO SERVICE.
OBEY STANDARD SAFETY PRACTICES REGARDING THE HANDLING OF CLEANING MATERIALS AND THE USE OF PERSONAL PROTECTIVE EQUIPMENT.

NOTICE: YO-233-B2A Series engines can be equipped with aluminum or magnesium oil sump or accessory housing. Be aware of the type of components installed on your engine before cleaning, completing maintenance, or replacing parts.
If you are not sure of the correct cleaning agent or whether the component contains aluminum or magnesium, contact Lycoming Engines Technical Support at the phone numbers in the front of the manual.

C. There are two processes for cleaning: degreasing and decarbonizing.

(1) Degreasing removes dirt and sludge (soft carbon). Soak the component or part in mineral spirits or other degreaser. Refer to the “Soft Carbon Removal” procedure in this chapter.

⚠ **CAUTION** DO NOT USE ANY HEATED DECARBONIZING SOLVENT ON ALUMINUM OR MAGNESIUM PARTS. THE DECARBONIZING SOLVENT CAN DAMAGE OR CORRODE MAGNESIUM AND ALUMINUM PARTS.

(2) Decarbonzing removes hard carbon with an initial soak of the part in a warm or heated decarbonizing solution. After the soak, use a (non-wire) bristle brush, wooden scraper, or grit-blasting (with non-abrasive media as per the “Grit-Blast Procedure” in this chapter) to physically remove the hard carbon. Refer to the “Hard Carbon Removal” procedure in this chapter.

NOTICE: Since decarbonizing can remove most of the enamel from exterior surfaces, remove any remaining enamel by grit-blasting.

Table 1
Cleaning Guidelines for Engine Components

Component or Part	Cleaning Agent*	Guidelines
Accessory Housing		Refer to the "Soft Carbon Removal" procedure in this chapter
Cylinders	Mineral spirits (MIL-PRF-680), kerosene or equivalent degreasing solvent	Refer to the "Cylinder Cleaning" procedure in this chapter.
Deposits in cylinder combustion chamber		Refer to the "Grit-Blasting the Combustion Chamber in an Engine Cylinder" procedure in this chapter.
Connecting Rods	Mineral spirits, MIL-PRF-680 or equivalent	
Interior surfaces of aluminum parts with hard carbon or oil varnish (gum) deposits	Petroleum-based decarbonizing solutions (Gunk®, Penetrol®, or equivalent)	Refer to the "Hard Carbon Removal" procedure in this chapter.
Valve rockers	Mineral spirits (MIL-PRF-680), kerosene or equivalent degreasing agent	Clean with Scotch-Brite™ or equivalent. Remove debris with clean lint-free wipes.
Stabilizers, valve components, starter drive, fuel control inlet screen	Mineral spirits (MIL-PRF-680), kerosene or equivalent degreasing agent	
Piston	Mineral spirits (MIL-PRF-680), Safety Solvent or equivalent degreasing solvent	Refer to the "Piston Cleaning" procedure in this chapter.
Small steel parts	Mineral Spirits Cold Dip Tanks (or closed tank system) and use NALCO 1704	Refer to the "Steel, Aluminum or Magnesium Parts Cleaning" procedure in this chapter.
Large steel parts covered with light oil	Oil-based solvent: mineral spirits or equivalent	Refer to the "Steel, Aluminum or Magnesium Parts Cleaning" procedure in this chapter.
Aluminum or magnesium parts		Refer to the "Steel, Aluminum or Magnesium Parts Cleaning" procedure in this chapter.
Oil sump Oil pump and oil pump housing	Mineral spirits, MIL-PRF-680 or equivalent	
Oil suction screen	Mineral spirits, MIL-PRF-680 or equivalent degreasing solvent	Refer to Chapter 12-10 for additional details.

Table 1 (Cont.)
Cleaning Guidelines for Engine Components

Component or Part	Cleaning Agent*	Guidelines
Oil cooler bypass valve	Mineral spirits, MIL-PRF-680 or equivalent degreasing solvent	⚠ **CAUTION** DO NOT USE RAGS OR ANY LINT CLOTH TO CLEAN THIS VALVE. Soak the oil cooler bypass valve in filtered mineral spirits.
Spark plugs	Commercially available spark plug cleaner.	Refer to the spark plug manufacturer's cleaning instructions, regap spark plugs after cleaning
Spark plug lead connector, cable ends, and ceramics	MEK Acetone Wood Alcohol Naptha or equivalent	Refer to the "Spark Plug Cleaning" procedure in this chapter.
Lead deposits		Refer to the "Lead Deposit Removal" procedure in this chapter.
Removal of gasket material	MEK Acetone Naptha or equivalent	Apply solvent to gasket material Use a wooden scraper to remove gasket material. Wipe away all debris with clean lint-free wipe.
Electrical connectors	CR4 or equivalent	Refer to contact cleaning solvent manufacturer's instructions.
Hartzell Engine Technologies (HET) (formerly Kelly Aerospace) starter		Refer to starter manufacturer's cleaning instructions.
All other parts	Parts washer solvent using Whirlwash-L or equivilant	
Volcanic ash on engine		Refer to the "Volcanic Ash Removal" procedure in this chapter.
*Refer to the manufacturer's instructions for usage, safety data, and disposal of all cleaning agents.		

2. Grit-Blasting

   Do not grit-blast the following:

   - Piston ring grooves and piston skirts
   - Valve stems
   - Valve guides
   - Bearing surfaces
   - Bushings
   - Gears
   - Any machined surface

A. Grit-Blast Media

⚠ **CAUTION** DO NOT USE SAND OR METALLICALLY ABRASIVE MATERIALS TO GRIT-BLAST.

During grit-blasting, for general cleaning of components not subject to Non-Destructive Testing (NDT), only use mildly abrasive blast media such as 17-grit walnut shells or equivalent.

For components subject to NDT, do not use 17-grit walnut shells, use a fine abrasive of 150-grit or finer. Refer to the "Cleaning Methods for Non-Destructive Testing" section in this chapter.

B. Grit-Blast Procedure

⚠ **CAUTION** ALWAYS REMOVE ANY COMPONENT OR PART FROM THE ENGINE BEFORE GRIT-BLASTING THE COMPONENT OR PART.

MASK OR PROTECT ALL MACHINED SURFACES, BEARING SURFACES, BUSHINGS, AND GEARS ON COMPONENTS OR ENGINE PARTS DURING GRIT-BLASTING.

(1) To grit-blast the engine cylinders, refer to the section "Grit-Blasting the Combustion Chamber in an Engine Cylinder" in this chapter.

(2) Hold the grit-blast gun (filled with the correct grit-blast media), a few inches away, but pointed toward the surface to be grit-blasted. Operate the grit-blast gun as per the manufacturer's instructions.

(3) Unless otherwise specified in the manufacturer's instructions, use approximately 35 to 45 psi (241 to 310 kPa) of air pressure during grit-blasting.

(4) Use compressed air and the vacuum cleaner to remove any debris and residue.

(5) After all cleaning is complete:

(a) Rinse the part in a petroleum solvent.

(b) Dry the part with an air blast to remove all loose particles.

(c) Apply a coating of preservative oil to the entire part.

(d) Put cleaned oil and fuel system components in a clean sealed container until ready for assembly.

(e) Install clean plastic caps or covers over each open end of a cleaned hollow tube, hose or line to prevent debris from entering these areas.

(f) Put remaining cleaned parts on clean bench surfaces where there is no particulate, dirt, grit, or other unwanted materials.

3. Soft Carbon Removal

A. Unless otherwise directed, put the component in a bath tank fully immersed in mineral spirits or equivalent for 10 minutes.

B. Remove the component from the bath tank.

C. Remove any remaining soft carbon (dirt or sludge) from the component with a lint-free wipe.

D. Apply a spray coating of preservative oil on the component to prevent corrosion.

E. If the component is not to be installed immediately, put the component in a sealed plastic bag until installation.

4. Hard Carbon Removal

CAUTION DO NOT PUT STEEL AND MAGNESIUM PARTS INTO THE SAME DECARBONIZING SOLUTION, BECAUSE IT CAN CAUSE CORROSION OF THE MAGNESIUM PARTS.

DO NOT USE ANY HEATED DECARBONIZING SOLVENT ON ALUMINUM OR MAGNESIUM PARTS. THE DECARBONIZING SOLVENT CAN DAMAGE OR CORRODE MAGNESIUM AND ALUMINUM PARTS.

NOTICE: If you are not sure if the component is steel or contains magnesium, contact Technical Support at Lycoming Engines at the phone numbers in the front of the manual.

CAUTION DO NOT USE WIRE BRUSHES OR METAL SCRAPERS ON BEARINGS OR CONTACT SURFACES.

NOTICE: Hard carbon can remain on interior surfaces of cylinders and combustion chambers after using a degreasing solvent to clean a part.

A. Put the component with the hard carbon fully immersed into a warm petroleum-based decarbonizing solution (examples: Gunk®, Penetrol®, or equivalent) in a heated bath tank or Paint and Ink Remover in an ultrasonic cleaner.

B. Soak for 10 minutes (to loosen the hard carbon).

C. Remove the component from the bath tank.

D. Use a (non-wire) bristle brush, wooden, plastic, or phenolic scraper, or grit-blasting (per the section “Grit-Blasting” in this chapter) to physically remove the hard carbon.

E. Remove any remaining hard carbon from the component with a lint-free wipe.

F. Apply a spray coating of preservative oil on the component to prevent corrosion.

G. If the component is not to be installed immediately, put the component in a sealed plastic bag until installation.

5. Cylinder Cleaning

A. Clean the internal barrel of the cylinder by flushing it with a hydrocarbon-based solvent (mineral spirits MIL-PRF-680 or equivalent) under air pressure. Use a soft bristle brush in conjunction with flushing to remove abrasive build-up from areas that are otherwise difficult to reach.

B. Make a hooked tool from soft wire and rub the tool back and forth in the recess to loosen any built-up abrasive. Complete this task each time the cylinder is flushed. There must not be any abraded material in this area.

C. Remove all oil accumulation from the external sides of the cylinders by washing with mineral spirits (MIL-PRF-680), kerosene, or equivalent degreasing solvent.

D. Thoroughly dry the cylinder with compressed air.

E. Clean the cylinder head fin areas thoroughly with mineral spirits (MIL-PRF-680), kerosene or equivalent, to remove all traces of grease, dirt, or other foreign matter, and air dry with compressed air.

F. Grit-Blasting the Combustion Chamber in an Engine Cylinder:

(1) Remove the intake and exhaust valves from the cylinder to be cleaned. Refer to Chapter 72-30.

(2) Remove the spark plugs from the cylinder. Refer to the section “Spark Plug Removal” in Chapter 74-20.

(3) Complete the "Grit-Blast Procedure” in this chapter.

(4) Record the cleaning for future reference to identify trends and engine operating time for lead build up to occur.

(5) Wipe the cylinder with a clean, white cloth dipped in SAE 10 engine oil. Examine the cloth under a light for evidence of any abrasive residue remaining in the cylinder. If any residual abrasive is found, repeat the earlier steps in this procedure until there is no abrasive residue.

6. Piston Cleaning

⚠ **CAUTION** DO NOT USE A STEEL BUFFING BRUSH TO CLEAN THE RING LANDS AND SKIRT OF A PISTON. DO NOT GRIT-BLAST PISTON RING GROOVES OR PISTON SKIRTS. THESE METHODS CAN STRETCH THE SIDES OF THE PISTON RING GROOVES AND ROUND OFF THE OUTER CORNER OF THE PISTON RING LANDS, WHICH AFFECTS THE PISTON CONFIGURATION.

A. Remove all oil or preservative oil accumulation from the piston by a soak or wash in a clean bath of mineral spirits, Safety Solvent, or equivalent degreasing solvent in compliance with MIL-PRF-680 specifications.

B. Remove any remaining deposits with a wooden scraper.

C. Gently clean the piston pin bore with a soft bristle non-metallic brush (Figure 2). Use a gentle twist motion to clean each bore.

D. After cleaning one side, turn the piston 180° and repeat the previous step to ensure the entire bore is free of FOD.

E. Soak the piston again in a new clean bath of mineral spirits, Safety Solvent, or equivalent degreasing solvent in compliance with MIL-PRF-680 specifications to remove remaining deposits.

F. Clean the piston ring grooves thoroughly so there is no debris in the grooves.

Figure 2
Cleaning the Piston Pin Bore with a Soft Bristle Non-Metallic Brush

7. Steel, Aluminum, or Magnesium Parts Cleaning

⚠ CAUTION DO NOT PUT STEEL AND MAGNESIUM PARTS INTO THE SAME DECARBONIZING SOLUTION, BECAUSE IT CAN CAUSE CORROSION OF THE MAGNESIUM PARTS.

DO NOT USE ANY HEATED DECARBONIZING SOLVENT ON ALUMINUM OR MAGNESIUM PARTS. THE DECARBONIZING SOLVENT CAN DAMAGE OR CORRODE MAGNESIUM AND ALUMINUM PARTS.

ONLY USE PETROLEUM-BASED DECARBONIZING SOLUTIONS ON ALUMINUM PARTS.

DO NOT USE CHLORINATED SOLVENTS (SUCH AS TRICHLOROETHANE, TRICHLOROETHYLENE, "PERC"-DEGREASER, ETC), TO PREVENT HYDROGEN EMBRITTLEMENT WHICH CAN WEAKEN A METAL PART AND CAUSE IT TO FAIL.

DO NOT USE WATER-MIXED SOLVENTS THAT CONTAIN CAUSTIC COMPOUNDS AND/OR SOAP, BECAUSE THEY CAN CAUSE DAMAGE TO ALUMINUM AND MAGNESIUM PARTS. WHEN THE ENGINE IS RETURNED TO SERVICE, THESE MATERIALS CAN ENTER THE PORES OF THE METAL AND CAUSE OIL FOAMING.

NOTICE: If you are not sure if the component is steel or contains magnesium or aluminum, contact Technical Support at Lycoming Engines at the phone numbers in the front of this manual.

A. Put the component fully immersed in mineral spirits or equivalent in a bath tank.

NOTICE: For small steel parts, cold dip tanks or a closed tank system can be used with NALCO 1704.

B. Remove the component from the bath tank.

C. Remove any remaining soft carbon (dirt or sludge) from the component with a lint-free wipe.

D. Apply a spray coating of preservative oil on the component to prevent corrosion.

E. If the component is not be installed immediately, put the component in a sealed plastic bag to prevent the oil from drying out.

8. Spark Plug Cleaning

A. Remove the spark plug as per the "Spark Plug Removal" procedure in Chapter 74-20.

B. Refer to the spark plug manufacturer's cleaning instructions.

C. Clean the ignition lead, cable ends, spark plug walls, and ceramic of the spark plugs (new or reused) as per the spark plug manufacturer's instructions.

D. Wipe the spark plug lead connector clean using a lint-free cloth moistened with Methyl-Ethyl-Ketone (MEK), acetone, wood alcohol, naptha, or equivalent.

E. Remove all cleaning residue from the spark plug lead connector.

F. Install the spark plug as per the "Spark Plug Installation" procedure in Chapter 74-20.

9. Lead Deposit Removal
   A. Refer to the sections “Grit-Blast Media” and “Grit-Blast Procedure” in this chapter:
      (1) If Non-Destructive Testing is not to be done on the component, grit-blast (the component with lead deposits) with 17 grit walnut shells or equivalent at 35 to 45 psi (241 to 310 kPa).
      (2) If Non-Destructive Testing is to be done on the component, use a fine abrasive of 150-grit or finer.
   B. Remove all debris from the component to prevent problems caused by foreign object debris.
10. Volcanic Ash Removal

⚠ **CAUTION** IF VOLCANIC ASH IS SUSPECTED ON THE ENGINE, DO NOT INHALE IT OR TOUCH IT WITH BARE HANDS OR GET IT IN YOUR EYES. WEAR PERSONAL PROTECTIVE EQUIPMENT. DO NOT USE WATER TO RINSE IT OFF. THE VOLCANIC ASH CAN CONTAIN ACIDIC COMPOUNDS WHICH MUST NOT BE INHALED OR TOUCHED SINCE IT CAN CAUSE INJURY.

   A. Engine exterior and components NOT contaminated with volcanic ash:
      (1) Remove grease, oil, dirt, and soft carbon deposits from the parts.
      (2) Spray or brush the components with a hydrocarbon-base solvent.
   B. To remove volcanic ash:
      (1) Wear personal protective equipment (gloves, respiratory, and eye protection).
      (2) Per the aircraft manufacturer’s instructions, thoroughly remove the ash or particulate from the aircraft by hand brushing or air/vacuuming. Make sure that all ash is removed from the engine and cowling.
   C. Examine the induction filters, induction system, and engine baffles for blockage or damage.
   D. Refer to the section “Volcanic Ash/Particulate Contamination” in Chapter 05-50 for further details.
   E. Refer to the aircraft manufacturer’s instructions for additional information
11. Cleaning Guidelines for a Soaked Engine
   A. Clean the engine, especially all recessed areas where debris and silt can get trapped.
   B. When cleaning parts removed from an engine that was soaked, especially ferrous (iron) metals, do not use hot acidic cleaning agents or electrolytic cleaning methods (such as cathodic cleaning) since they can cause hydrogen embrittlement. This embrittlement can cause a metallic part to weaken and fail.
   C. Additionally, acids can generally attack the metals and cause pitting or other corrosion damage.
   D. Be sure to remove all cleaning agents.
   E. Rinse the part thoroughly.
   F. Dry the part.

G. There must not be any cleaning agent residue on the metal surfaces. Any chemical that could either corrode the metal or create hydrogen gas which can cause hydrogen embrittlement during service.

H. Paint strippers are usually organic solvents like MEK or acetone or toluene, etc. and typically will not cause any damage to metals. Except for chlorinated solvents (such as trichloroethane, trichloroethylene, "perc"-degreaser, etc.), just about any other type of solvent can be used on steel or aluminum parts. Chlorinated solvents can react with moisture and produce some hydrochloric acid which could harm the metal.

12. Cleaning Method for Non-Destructive Testing

A. Remove all traces of:

- Paint
- Corrosion
- Gasket materials
- Smeared metal
- Oil
- Plating
- Grease
- Chemical residues
- Dirt

B. Use any of the following cleaning methods as long as it is not harmful to the component or its intended function:

- Vapor degreasing
- Solvent degreasing
- Ultrasonic cleaning
- Chemical cleaning
- Aqueous-based cleaning
- Mechanical cleaning (such as grit-blasting)

NOTICE: Grit blasting without etching can be an acceptable cleaning method if it can be demonstrated that a sufficiently fine abrasive (150 grit or finer) will not cause peening and can be removed by a detergent or alkaline cleaner.

Etching of the area(s) to be examined is to be done prior to inspection when evidence exists that previous cleaning, surface treatments, or service usage has produced a surface condition that degrades the effectiveness of the penetrant examination.

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05-50 - TIME LIMITS / MAINTENANCE CHECKS – UNSCHEDULED MAINTENANCE

1. Unusual Conditions

   Unscheduled maintenance is necessary when the following conditions occur:

   A. Lightning Strike
   B. Engine Overspeed
   C. Incorrect Fuel or Fuel Contamination
   D. Soaked Engine
   E. Engine on Fire or Near Fire
   F. Hydraulic Lock
   G. Volcanic Ash/ Particulate Contamination
   H. Valve Sticking
   I. Oil Starvation/Sudden Loss of Oil Pressure
   J. Metal Contamination of the Lubrication System
   K. Propeller Strike, Sudden Engine Stoppage, or Loss of Propeller Blade Tip

   A. Lightning Strike

      (1) After a lightning strike:

         (a) Before next flight, examine the engine and compartment. Look at external surfaces and internal parts for discoloration, cracks, and other indications of arcing and heat damage.

         NOTICE: Heat from a lightning strike can cause internal damage to the hardened surfaces of parts such as ball bearings, crankshaft bearing surfaces, camshaft lobes, gear teeth, etc.

         (b) Complete the Magnaflux and degauss procedure on the steel parts of the engine during the inspection.

         (c) Complete the engine overhaul in accordance with the Direct Drive Overhaul Manual. Disassemble and examine the engine. Discard all parts that have damage, discoloration, cracks, etc.

         (d) Examine the crankshaft rod journals, main journals, counterweights, camshaft lobes, bearings, gear teeth, and all other hardened surfaces.

   B. Engine Overspeed

      (1) In *engine overspeed*, the engine operates above its rated (speed) revolutions per minute (rpm). *Momentary overspeed* is an increase of no more than 10% of rated engine rpm for a period not exceeding 3 seconds. If the duration and amount of overspeed is less than 3 seconds, no further maintenance actions are necessary.

      NOTICE: Refer to the engine specifications in the ***YO-233-B2A Engine Installation and Operation Manual*** for rated engine speed.

      NOTICE: All incidents of engine overspeed must be recorded in the engine logbook along with the inspection and any corrective action identified below.

      (2) If any engine is operated at overspeed for more than 3 seconds:

         (a) Identify the category of percent of overspeed based on the three categories of overspeed shown in Table 1.

         (b) Refer to the latest revision of Service Bulletin No. 369.

Table 1
Overspeed Values for YO-233-B2A Series Engines

Overspeed Category	rpm	Corrective Action
Engine overspeed less than 5% in excess of maximum rated rpm for more than 3 seconds	2801 to 2940	a. Identify and correct the cause of the overspeed. b. In the engine logbook, record the overspeed incident and any inspections and corrective action.
Engine overspeed between 5% and 10% in excess of maximum rated engine rpm for more than 3 seconds.	2941 to 3080	a. Identify and correct the cause of the overspeed. b. Complete the "Cylinder Overspeed Inspection" procedure in this chapter. c. Refer to Chapter 12-10: (1)Drain the lubricating system. (2)Remove the suction screen and oil filter. (3)Examine the suction screen and oil filter element for metal contamination. If any unexplained metal accumulation is found, identify and correct the cause before putting the engine back into service. d. Complete the "Valve Train Overspeed Inspection" procedure in this chapter. e. Complete the "EIS Overspeed Inspection" or "Magneto Overspeed Inspection" in this chapter. f. In the engine logbook, record the overspeed incident and any inspection and corrective action.
Engine overspeed more than 10% in excess of maximum rated engine rpm for any duration	3081 or more for any length of time	a. Remove the engine from the aircraft. Refer to the "Engine Removal" procedure in Chapter 72-00. b. It is recommended the engine be sent to Lycoming Engines for customized evaluation. Include a description of the overspeed incident, amount of overspeed, and duration. c. In the engine logbook, record the overspeed incident and any inspections and corrective action. OR Refer to Chapter 72-05 and the latest revision of Service Bulletin No. SB-240 to: • Disassemble the engine • Complete an inspection of the engine • Replace any parts that are damaged or not in compliance • Replace any parts that must be replaced at overhaul or upon removal

(3) Cylinder Overspeed Inspection

(a) Complete the cylinder compression pressure check on all cylinders to complete the check of the sealing quality of the rings and valves. Refer to the section "Cylinder Compression Check Procedure" in Chapter 72-30.

(b) Use a borescope or equivalent instrument to examine the walls of each cylinder for scoring which could be caused by a stuck or broken piston ring. Refer to the "Cylinder Borescope Inspection Procedure" in Chapter 72-30.

(4) Valve Train Overspeed Inspection

(a) Either repeated moments or short periods of operation in the overspeed region increase the rate of wear at an accelerated rated in the parts that make up the valve train and consequently decrease engine reliability. In addition to the checks completed on the engine during a 100-hour maintenance inspection, complete the following steps to examine the valve train before putting the engine back into service.

(b) Use a borescope or equivalent illuminated magnifying optical device to examine the condition of the intake and exhaust valve faces and seat faces. If there is evidence of excessive wear, pounding, or grooving, replace the valve and seat.

(c) Examine the external condition of valve keys, rockers, and exhaust valve guides for damage. Examine valve springs for coil strikes or severe bottoming of the coils. If damage to springs is evident, remove them and complete the check of the compression load as specified in the latest revision of the ***Service Table of Limits - SSP-1776***. Replace any valve spring that is not within limits.

(d) Rotate the crankshaft by hand to see if the valve lift is uniform or equal for all cylinders. See if valve rockers are free when the valves are closed. Unequal valve lift is an indication of bent push rods. Tight rockers, when valves are closed, are an indication of a tuliped valve or a damaged valve lifter. Repair any suspected damage before putting the engine back into service.

(e) Refer to the latest revision of Service Bulletin No. 388 to determine exhaust valve condition and stem-to-valve guide clearance condition.

C. Incorrect Fuel or Fuel Contamination

(1) Actual damage to the engine from incorrect fuel could be in a range from unnoticeable to severe damage or failure. Primary damage to the engine caused by incorrect fuel occurs in the combustion chambers. Tuliped intake valves and burned pistons from excessive cylinder head and oil temperatures are evidence of primary damage. If detonation has been severe enough, further damage will occur to crank pins, main bearings, counterweights, and valve train components. The extent of damage can vary accordingly as the duration of run, engine power level and the type of fuel used.

⚠ WARNING: AVOID FLIGHT IF A LOWER OCTANE OR INCORRECT GRADE OF FUEL OR JET FUEL. (DIFFERENT FROM FUEL IDENTIFIED IN APPENDIX A IN THE YO-233-B2A INSTALLATION & OPERATION MANUAL) IS USED TO OPERATE THE ENGINE. UNUSUAL DETONATION CAN INCREASE ENGINE TEMPERATURE AND PRESSURE WHICH CAN DAMAGE THE ENGINE.

(2) Any mixture of unapproved fuels and additive materials that change the octane rating.

(3) Because of many variables, it is impossible to be sure of the airworthiness of an engine that has been operated with incorrect fuel - except by detailed inspection of the engine by qualified personnel. Therefore, after the engine has been operated with incorrect fuel, regardless of the power setting or time of operation:

(a) Do not continue flight and engine operation with incorrect fuel.

(b) Drain the aircraft fuel system until all fuel tanks are empty in accordance with the aircraft manufacturer's installation.

(c) If the aircraft manufacturer has a procedure for cleaning and/or purging the aircraft fuel system after the use of an incorrect fuel, follow the aircraft manufacturer's procedure. If there is no aircraft cleaning and/or purging procedure, do service on the aircraft fuel tanks in accordance with the aircraft manufacturer's instructions.

(d) Remove the engine in accordance with the "Engine Removal Procedure" section in Chapter 72-00.

(e) At this point, the operator can either:

1 Send the engine to Lycoming for customized evaluation and advisory on whether an engine repair or overhaul is necessary.

or

2 Complete the following in the field:

a Disassemble and clean the engine in accordance with the Direct Drive Overhaul Manual.

b Complete then inspection of the engine in accordance with the Direct Drive Overhaul Manual.

c During inspection of engine components, carefully look for signs of detonation such as tuliped intake valves, burnt pistons, and damage to: crankpins, main bearings, counterweights and drive train components, and other conditions that can cause engine failure.

d Complete the engine repair or overhaul, if necessary, in accordance with the Direct Drive Overhaul Manual.

e Refer to the latest revision of Service Bulletin No. 240 which identifies certain parts that must be replaced on engine reassembly.

f Assemble the engine and complete the operational test in accordance with the Direct Drive Overhaul Manual.

D. Soaked Engine

⚠ **CAUTION:** WHEN AN ENGINE HAS BEEN SOAKED IN WATER, MOISTURE AND UNWANTED MATERIALS CAN CAUSE DAMAGE TO ALL SYSTEMS OF THE ENGINE. DO NOT OPERATE AN ENGINE THAT HAS BEEN IMMERSED. THE ENGINE MUST BE DISASSEMBLED AND EXAMINED.

NOTICE: The composition of the substance that the engine has been exposed to can affect the type and extent of the damage.

Disassemble and examine an engine that has been soaked in water or other liquid. Refer to the Direct Drive Overhaul Manual.

E. Engine on Fire or Near a Fire

(1) Any components exposed to the heat of a fire must be replaced.

(2) Also, disassemble and examine the engine to look for any other damage from heat. Refer to the Direct Drive Overhaul Manual.

F. Hydraulic Lock

⚠ WARNING: DO NOT OPERATE THE ENGINE IF HYDRAULIC LOCK IS SUSPECTED.

Hydraulic lock is caused by liquid accumulation in the Induction System or the cylinder assembly.

(1) The liquid prevents movement of the piston during the compression stroke.

(2) Damage to the engine occurs when the other cylinders fire, which forces the piston in the liquid filled cylinder through the compression stroke.

(3) Damage to an engine from hydraulic lock can be extensive due to the high forces. These forces can damage connecting rods, pistons, cylinder assemblies, piston pins, the crankcase, and the crankshaft.

(4) Hydraulic lock can occur as a result of any of the following:

— Incorrect maintenance of the cylinder fuel drain lines

— Incorrect starting procedures

— Failure to remove preservative oil from an engine that had been in storage.

(5) Examine the engine for hydraulic lock as directed below.

(a) Remove all cylinders and connecting rods in accordance with the Direct Drive Overhaul Manual.

(b) If all connecting rods are in compliance with the specified criteria in the Overhaul Manual, reassemble the engine in accordance with the Direct Drive Overhaul Manual.

(c) If any connecting rod is not in compliance with acceptance criteria, remove and disassemble the engine to examine the crankcase and crankshaft in accordance with instructions in the Direct Drive Overhaul Manual.

G. Volcanic Ash/Particulate Contamination

(1) Given the dynamic conditions of volcanic ash, Lycoming recommends that engines not be operated in areas where volcanic ash is seen in the air or on the ground. Ash on the ground and runways can inadvertently get into the engine compartment and cause engine damage during landing or take-off.

(2) If you know in advance that you could have flight in volcanic or particulate-laden environments, as a precaution, install inlet and exhaust covers to prevent airborne volcanic ash from entry into the static engine.

(3) Inlet air which contains volcanic ash or other particulates can cause damage to piston engines. Solid deposits can collect on engine baffles or other engine surfaces to prevent engine cooling. Accumulation of deposits on the induction air filter can prevent air flow to the engine and decrease engine power.

(4) If deposits get into the engine oil, engine malfunction and/or failure can occur from abrasive wear.

(5) However, if during flight, the engine is in a particulate-laden atmosphere, do the following:

(a) Monitor the engine temperature during flight. (Damaged or blocked cooling baffles or heavy deposits on engine cooling surfaces can decrease cooling efficiency and cause the engine to overheat.)

(b) If the engine is not operating smoothly in flight, make a safe landing as soon as possible. Identify and repair the cause of rough operation.

(6) In the event that the engine has been in particulate-laden atmospheres, especially volcanic ash clouds or with ash on the ground, Lycoming recommends that you complete the standard actions shown in Table 2.

⚠ **CAUTION:** DO NOT USE WATER INITIALLY TO REMOVE VOLCANIC ASH. WHEN VOLCANIC ASH COMES INTO CONTACT WITH WATER IT CAN BECOME A HARDENED, CORROSIVE COMPOUND.

Table 2
Action to Take in Volcanic Ash Conditions

Maintenance after flight…	**Maintenance after 10 hours of operation or the next flight…**
Wear personal protective equipment (gloves, respiratory, and eye protection). Per the airframe manufacturer's instructions, thoroughly remove the ash or particulate from the aircraft by hand brushing or air/vacuum. Make sure that all ash is removed from the engine, nacelle and cowling.	Wear personal protective equipment. Examine the external engine, cowling, and nacelle for any particulate or ash residue. Remove any particulate or ash residue per the airframe manufacturer's instructions.
Complete the post-flight inspection. Particularly, examine the induction filters, induction system, and engine baffles for blockage or damage.	Complete the pre-flight inspection.
Immediately, complete an oil change, collect an oil sample and have a spectrographic analysis done on the oil sample. Compare this analysis with past oil analyses to determine engine wear or contamination.	Complete the oil change and collect another oil sample for spectrographic analysis. Compare the results against the last oil sample to identify engine wear or effects of contamination. As a precaution, complete another oil change and analysis of a sample again, as necessary.
Replace the oil filter and intake air filter to remove any internal contamination that can cause premature wear because of the highly abrasive effects of most solid particles.	Replace the oil filter and intake air filter as a precaution to be sure there are no effects of particulate contamination. Replace these components again after the next flight, as necessary.

Table 2 (Cont.) Action to Take in Volcanic Ash Conditions	
Maintenance after flight…	**Maintenance after 10 hours of operation or the next flight**
Examine the external condition of the engine, all accessories, compressor, external fuel and oil cooling air baffles, oil hoses, and all other components for corrosion or scoring. Identify any possible damage caused by the high speed impact of solid particles and corrosive effects caused by the chemical composition of volcanic ash.	Examine the external condition of the engine, all accessories, compressor, external fuel and oil cooling air baffles, oil hoses, and all other components for corrosion or scoring. Identify any possible damage caused by the high speed impact of solid particles and corrosive effects caused by the chemical composition of the volcanic ash. Do this inspection again as necessary.
Drain all other fuel/fluids from the engine and replace with clean fluids. Replace the disposable fuel filter. Remove and clean the fuel inlet screen.	Remove and examine the fuel filter to identify contamination. Replace the fuel filter if contamination is found.
Examine seals for damage and leaks. Replace damaged or leaky seals.	Monitor oil temperature and pressure for indications of engine problems.
Clean the engine with high pressure air spray. Be sure to clean the cooling fins on the cylinder.	
In volcanic ash fall-out or high sand or dust areas, after the engine cools install inlet and exhaust covers to prevent airborne volcanic ash from entry into the static engine.	

NOTICE: Additional measures may be necessary in specific operating conditions.

H. Valve Sticking

(1) The primary causes of intake or exhaust valve sticking are:

(a) Accumulated contaminants in the oil and oil filter can collect on valve stems to prevent valve movement and cause intermittent engine hesitation or “miss.” If the contamination deposits are not removed, the valve becomes stuck and causes engine damage. In hot ambient temperatures, lead salts from leaded (aviation) fuel can cause oil contamination but the lead salts are removed when the oil and the oil filter are replaced.

(b) Other conditions that can increase oil contamination include:

— High ambient temperature
— Slow flight with reduced cooling
— High lead content in fuel
— Oil and filter changes not done as frequently as necessary. Refer to the section “Oil Change and Oil Filter Replacement Schedule” in Chapter 12-10
— Induction system not sealed - unfiltered air enters engine

— Cooling air baffles and/or baffle strip deterioration
— Sudden cool down of the engine that can occur with a rapid descent with reduced power or engine shutdown without sufficient engine cooling.

(4) If valve sticking is a problem, refer to the section “Corrective Action for Valve Sticking" in Chapter 72-30.

I. Oil Starvation/Sudden Loss of Oil Pressure

(1) To operate correctly at various attitudes, the engine must be supplied with a sufficient quantity of lubricating oil. Unless there is an adequate quantity of lubricating oil at all times during flight, loss of oil pressure can occur.

(2) During various attitudes of flight, the risk of oil not covering the inlet to the oil pump increases as the quantity of oil decreases. In certain attitudes, the oil in the sump cannot be drawn into the oil pickup line which can cause a momentary loss of oil pressure. If there is insufficient oil during flight, oil starvation can occur. Yet, not all low oil pressure incidents result in oil starvation.

(3) Very often a sudden loss of oil pressure is quickly followed by a sudden rise in oil temperature.

(4) As a preventive measure, before every take-off, complete a check of the engine oil level as per instructions in "Oil Level Check" in chapter 12-10. Make sure the oil level is at the specified level shown in the Flight Manual or Pilot Operating Handbook.

NOTICE: Circumstances which cause loss of oil pressure can be different which makes prediction of the extent of damage to the engine or future engine reliability difficult. In case of oil pressure loss or engine operation with oil below the minimum operating level, the most conservative action is to remove the engine, disassemble, and completely examine all engine components. Any decision to operate an engine that had loss of oil pressure without an inspection must be the responsibility of the agency putting the aircraft back into service.

(5) Any time oil pressure falls below the minimum level, identify the root cause as per the following protocol progressive steps:

(a) Complete the check of the oil level in the oil sump. Drain the oil if necessary to measure the oil quantity.

(b) If the oil level is sufficient, complete the check of the oil pressure indication system accuracy. If the oil pressure gage is not operating correctly, replace it.

(c) Examine oil hose connections for leaks. Tighten any loose connections and look for leaks. Replace leaking oil hoses.

(d) Examine the oil suction screen at the oil sump and the oil filter for blockage or metal deposits. If metal or blockage is found, remove the material and identify the origin of material and correct the root cause.

(e) Examine the oil pump for malfunction. Replace the oil pump if it is not operating correctly.

(f) If the oil pressure indication system is operating correctly and there has been confirmation that oil pressure loss/oil starvation has occurred, remove and disassemble the engine and perform a complete inspection.

J. Metal Contamination of the Lubrication System

(1) If metallic particles/residue, metal shavings or metal flakes is found in the engine oil after oil servicing, refer to the "Identification of Metallic Solids After Oil Servicing" section in Chapter 12-10 and complete the recommended corrective action.

K. Propeller Strike, Sudden Engine Stoppage or Loss of a Propeller Blade Tip

(1) This section includes recommendations for aircraft engines that have had propeller/rotor damage as well as any of the following.

— Separation of the propeller/rotor blade from the hub

— Loss of a propeller or rotor blade tip

— Sudden stoppage after accidental propeller/rotor damage.

(2) A propeller strike includes:

— Any incident, whether or not the engine is operating, where repair of the propeller is necessary

— Any incident during engine operation where the propeller has impact on a solid object which causes a decrease in rpm and also makes a structural repair of the propeller necessary. This incident includes propeller strikes against the ground. Although the propeller can continue to rotate, damage to the engine can occur, possibly with progression to engine failure

— Sudden rpm drop on impact to water, tall grass, or similar yielding medium where propeller damage does not usually occur.

(3) A propeller strike can occur at taxi speeds, including instances of touch and go operations with propeller tip ground contact. In addition, propeller strikes also include situations where an aircraft is stationary and a landing gear collapse occurs causing one or more blades to be bent, or where a hangar door (or other object) hits the propeller blade. These instances are cases of sudden engine stoppage because of potentially severe side loading on the crankshaft flange, front bearing, and seal.

⚠ **CAUTION:** BASED UPON THE ACCUMULATED ENGINEERING, TECHNICAL AND HISTORICAL DATA AVAILABLE, LYCOMING ENGINES **PROHIBITS** STRAIGHTENING OR GRINDING OF BENT CRANKSHAFT FLANGES TO RESTORE MAXIMUM RUN-OUT SPECIFICATION AS NOTED IN THE LATEST REVISION OF SSP-1776, TABLE OF LIMITS. IF THE CRANKSHAFT FLANGE IS BENT, REPLACE THE CRANKSHAFT. **DO NOT TRY TO STRAIGHTEN OR GRIND THE CRANKSHAFT FLANGE.**

(4) Recommended Corrective Action for Propeller Strikes

⚠ **CAUTION:** DAMAGE TO A PROPELLER IS SERIOUS AND CAN CAUSE THE ENGINE TO BE UNAIRWORTHY.

(a) Circumstances of a propeller strike cannot always be used as predictors for the extent of engine damage or its future reliability. There can be varying degrees of damage to an engine and propeller from a propeller strike. The initial damage can be hidden but becomes progressive and worsens with time and wear.

(b) Given these possibilities and the fact that there is no identified clear, quantifiable threshold limit or gradient standard to reliably measure the extent of damage to an engine, Lycoming Engines can only recommend BEFORE FURTHER FLIGHT, that you complete the tasks in the sequential order shown in Engine Inspection Checklist After Propeller Strike as the corrective action for a propeller strike.

NOTICE: The agency that return the aircraft to service is responsible for the decision to operate and engine that had a propeller strike. Lycoming Engines does not take responsibility for the decision to return the engine to service after a propeller strike.

(5) Make a copy of this checklist; complete it and keep it as a service record. Record all results and any corrective action taken in the engine logbook.

Engine Inspection Checklist After Propeller Strike for YO-233-B2A Series Engines			
Engine Model Number:		**Engine Serial Number:**	
Date Inspection Started:		**Date Inspection Completed:**	
Sequential Task		**Additional Information**	**Corrective Action Done/Comments**
1.	Examine the propeller for extent of damage; record condition of propeller.	Condition of Propeller/Corrective Action: ☐ Propeller satisfactory ☐ Repair propeller in accordance with propeller manufacturer's instructions ☐ Replace propeller in accordance with the airframe manufacturer's instructions.	
2.	Remove the propeller.	As per airframe and propeller manufacturer’s instructions.	
3.	Remove the engine.	Refer to Chapter 72-00	
CRANKCASE P/N:		**MATCH NO:**	
4.	Disassemble the engine - remove the crankshaft, camshaft, connecting rods, crankshaft gear, and internal steel parts.	Refer to Table 1 - Sequence of Engine Disassembly in Chapter 72-05	
5.	Complete grit-blast cleaning* of the crankcase with fine abrasive (150-grit or finer) remove all coatings on the crankcase and engine mount bosses.	Make sure there is no dirt, debris, sludge, paint, or any other substance that could prevent reliable Fluorescent Penetrant Inspection (FPI) or subsequent oil flow.	

Engine Inspection Checklist After Propeller Strike for YO-233-B2A Series Engines (Cont.)			
Sequential Task		**Additional Information**	**Corrective Action Done/Comments**
6.	Complete grit-blast cleaning* of the oil sump and engine mount bosses with fine abrasive (150-grit or finer).	Make sure there is no dirt, debris, sludge, paint, or any other substance that could prevent reliable FPI or subsequent oil flow.	
7.	Complete grit-blast cleaning* of the engine mount brackets (if used) with fine abrasive (150-grit or finer).	Make sure there is no dirt, debris, sludge, paint, or any other substance that could prevent reliable FPI or subsequent oil flow.	
8.	Complete grit-blast cleaning* of the accessory housing with fine abrasive (150-grit or finer).	Make sure there is no dirt, debris, sludge, paint, or any other substance that could prevent reliable FPI or subsequent oil flow.	
9.	Remove and discard the existing crankshaft gear retaining bolt and lockplate.	Refer to the "Crankshaft Disassembly" procedure in Chapter 72-20.	
10.	Examine the crankshaft.	Refer to the "Crankshaft Inspection" procedure and checklist in Chapter 72-20.	
11.	Examine, the crankshaft counter-bored recess, the alignment dowel especially at the base where it goes into the crankshaft, the bolt hole threads, and the crankshaft gear for wear, galling, corrosion, and fretting.	Refer to the latest revision of Service Bulletin No. 475. If the bolt hole threads are damaged, they cannot be repaired. Replace the crankshaft.	
12.	Clean the crankshaft, camshaft, crankshaft gear, rollers and bushings.	Refer to procedures and guidelines in Chapter 05-30. Make sure there is no dirt, debris, sludge, paint, or any other substance that could prevent reliable magnetic particle inspection or subsequent oil flow.	
13.	Clean the following internal parts made of steel: • Connecting Rods • Piston pins • Rocker shafts • Accessory drive gears • Magneto drive gears • Idler and oil pump shafts • Shaft gears and impellers	Refer to Chapter 05-30.	
* Refer to the "Grit-Blast Procedure" in Chapter 05-30.			

Engine Inspection Checklist After Propeller Strike for YO-233-B2A Series Engines (Cont.)			
Sequential Task		**Additional Information**	**Corrective Action Done/Comments**
⚠ **CAUTION** BASED UPON THE ACCUMULATED ENGINEERING, TECHNICAL, AND HISTORICAL DATA AVAILABLE, LYCOMING ENGINES PROHIBITS STRAIGHTENING OR GRINDING OF BENT CRANKSHAFT PROPELLER FLANGES TO RESTORE MAXIMUM RUN-OUT SPECIFICATION. IF THE CRANKSHAFT PROPELLER FLANGE IS BENT, REPLACE THE CRANKSHAFT. DO NOT TRY TO STRAIGHTEN OR GRIND THE CRANKSHAFT PROPELLER FLANGE. REFER TO THE LATEST REVISION OF SERVICE BULLETIN NO. SB-201.			
CRANKSHAFT P/N:		**S/N:**	
14.	Measure the flange run-out on the crankshaft.	Refer to the latest revisions of both Service Bulletin SB-240 and Part I of the ***Service Table of Limits - SSP-1776*** for crankshaft flange run-out tolerance. Record the crankshaft flange run-out measurement.*	☐ Flange run-out within acceptable limits - use crankshaft ☐ Replace crankshaft
15.	Measure the main bearing run-out on the crankshaft.	Refer to the latest revision of Part I of the ***Service Table of Limits - SSP-1776*** for the main bearing run-out tolerance Record the main bearing run-out measurement.*	☐ Main bearing run-out within acceptable limits - use crankshaft ☐ Replace crankshaft
16.	Measure the polished dimensions on the main journals.	Refer to the latest revision of Part I of the ***Service Table of Limits - SSP-1776*** for the dimensions on the main journals Record the dimensions of the main journals.*	☐ Main journals within acceptable limits - use crankshaft ☐ Replace crankshaft
17.	Measure the polished dimensions on the pin journals.	Refer to the latest revision of Part I of the ***Service Table of Limits - SSP-1776*** for the dimensions on the pin journals Record the dimensions of the pin journals.* Dimension:_____	☐ Pin journals within acceptable limits - use crankshaft ☐ Replace crankshaft
* If the measurement or dimension is out of tolerance, discard the crankshaft and replace it with a serviceable crankshaft. Install the crankshaft per "Crankshaft Installation" procedure in Chapter 72-20.			

Engine Inspection Checklist After Propeller Strike for YO-233-B2A Series Engines (Cont.)				
Sequential Task		**Additional Information**	**Corrective Action Done/Comments**	
18.	Complete a check of the connecting rods parallelism.	Refer to the "Connecting Rod/Parallelism/Squareness Check" in Chapter 72-20 for measurement instructions. Record the parallelism measurement for each connecting rod. Replace all connecting rods not in compliance with measurements in the latest revision of Part I of the ***Service Table of Limits - SSP-1776*** (Reference 503).	Parallelism Measurement	
			Connecting Rod 1	
			Connecting Rod 2	
			Connecting Rod 3	
			Connecting Rod 4	
19.	Complete a check of connecting rod squareness.	Refer to the section "Connecting Rod Parallelism/Squareness Check" in Chapter 72-20. Record the squareness measurement for each connecting rod. Replace all connecting rods not in compliance with measurements in the latest revision of the ***Service Table of Limits, SSP-1776*** (Reference 504).	Squareness Measurement	
			Connecting Rod 1	
			Connecting Rod 2	
			Connecting Rod 3	
			Connecting Rod 4	
NOTICE: The magnetic particle inspection must be done by a certified technician as per the latest revision of Service Instruction No. 1285.				
20.	Complete a magnetic particle inspection on the crankshaft.†	Record test results.	☐ Magnetic particle test results acceptable ☐ Replace crankshaft	
21.	Complete a magnetic particle inspection on the camshaft.†	Record test results.	☐ Use camshaft ☐ Replace camshaft	
22.	Complete a magnetic particle inspection on the connecting rods.†	Record test results.	Replace connecting rod bolts and nuts - regardless of condition. Refer to the latest revision of Service Instruction 1458 for assembly instructions.	
23.	Complete a magnetic particle inspection on the crankshaft gear.† Examine the gear end as per the latest revision of Service Bulletin No. 475.	Record test results.	☐ Use crankshaft gear ☐ Replace crankshaft gear	
† Refer to the section "Non-Destructive Testing" in this chapter.				

Engine Inspection Checklist After Propeller Strike for YO-233-B2A Series Engines (Cont.)			
Sequential Task		**Additional Information**	**Corrective Action Done/Comments**
24.	Complete a magnetic particle inspection† on the following internal parts made of steel: • Accessory drive gears • Magneto drive gears • Idler and oil pump shafts • Shaft gears and impellers • Piston pins • Connecting rods	Record test results.	Use Replace ☐ ☐ Accessory drive gears ☐ ☐ Magneto drive gears ☐ ☐ Idler and oil pump shafts ☐ ☐ Shaft gears and impellers ☐ ☐ Piston pins ☐ ☐ Connecting Rods
† Refer to the section "Non-Destructive Testing" in this chapter.			
25.	Complete the visual inspection and Fluorescent Penetrant Inspection (FPI) on the crankcase. Closely examine the forward crankcase bearing support and adjacent structure.	Record test results.	☐ Use crankcase ☐ Replace crankcase
26.	Complete the visual inspection and FPI on the oil sump.	Record test results.	☐ Use oil sump ☐ Replace oil sump
27.	Complete the visual inspection and FPI on the engine mounts.	Record test results.	☐ Use engine mounts ☐ Replace engine mounts
28.	Complete the visual inspection and FPI on the accessory housing.	Record test results.	☐ Use accessory housing ☐ Replace accessory housing
29.	Complete the visual inspection and FPI on the oil pump impeller.	Record test results.	☐ Use impeller ☐ Replace impeller
30.	For Lycoming EIS, remove the unit and reinstall per instructions in Chapter 74-30. If the unit does not function correctly, replace the EIS. OR Examine the magneto in accordance with the magneto manufacturer's instructions.	Record test results.	☐ Use EIS ☐ Replace EIS ☐ Use magneto ☐ Replace magneto
31.	Examine the pistons per instructions in Chapter 72-30 and the latest revision of the ***Service Table of Limits - SSP-1776.***	Record test results.	☐ Pistons acceptable ☐ Replace pistons
32.	Refer to the latest revision of Service Bulletin No. 240 to identify any parts that must be replaced during engine assembly.	Record parts that must be replaced.	
33.	Install a new crankshaft gear bolt and new lockplate.	Refer to the "Crankshaft Gear Installation" procedure in Chapter 72-20.	

Engine Inspection Checklist After Propeller Strike for YO-233-B2A Series Engines (Cont.)			
Sequential Task		**Additional Information**	**Corrective Action Done/Comments**
34.	Replace all of the roller tappets with new or serviceable roller tappets.	Refer to Chapter 72-20 in this manual.	
35.	Review the documents of all engine-mounted accessories including the propeller governor (if installed), etc. for continued airworthiness instruction.		
36.	Assemble and install the engine. Install the propeller and test the engine. Complete an Operational Ground Check of the engine.	In accordance with instructions in Chapters 72-00 and 72-10.	
37.	Complete "Field Run-In" (if applicable) and "Engine Initiation".	Refer to the "Field Run-In" and "Engine Initiation" chapters in the ***YO-233-B2A Engine Installation and Operation Manual.***	
38.	Record maintenance findings and any corrective action.		
UNAIRWORTHY PARTS:			
ADDITIONAL WORK/INSPECTIONS NECESSARY:			
OUTCOME OF INSPECTION- SUMMARY NOTES:			

2. Non-Destructive Testing (Magnetic Particle Inspection and Fluorescent Penetrant Inspection)

   Refer to the latest revision of Service Instruction No. SI-1285 for additional details.

   A. Non-destructive testing (NDT) that can be done on engine components includes Magnetic Particle Inspection (MPI) and Fluorescent Penetrant Inspection (FPI). The purpose of the NDT is to identify the presence or potential of structural failures in an engine component.

      The MPI is used for detection of discontinuities on the surface and/or sub-surface of ferroelectric materials such as iron, nickel, cobalt, and some of their alloys.

      The FPI is used to identify casting, forging and welding surface defects such as hairline cracks, surface porosity, leaks in new products, and fatigue cracks on in-service components.

   B. Penetrant Materials Used for NDT

      Do not use visible dye for MPIs or FPIs because visible dye penetrant materials have an adverse effect on future penetrant inspections which can cause indications to be tightly closed and therefore missed during future inspections.

   C. Requirements for NDT Personnel

      Personnel who complete the Magnetic Particle and Fluorescent Penetrant Inspections on Lycoming engine components must be qualified and certified to a written procedure in accordance with *NAS-410, Certification and Qualification of NDT personnel.* Also, personnel who make the "accept" or "reject" decisions during the inspections must be qualified and certified to at least Level II in accordance with NAS-410.

   D. NDT Inspection Procedure Requirements and Guidelines

      There must be written procedures for the Magnetic Particle Inspection and the Fluorescent Penetrant Inspection that have been approved by someone who is qualified and certified to Level III in accordance with NAS-410.

   E. Before NDT, clean the components per the “Cleaning Method for Non-Destructive Testing” in Chapter 05-30.

   F. Inspection Guidelines

      (1) The inspections must be done per established acceptance criteria to ensure component conformance.

      (2) A 3 power to 10 power magnifying glass must be used to evaluate indications.

      (3) If a Magnetic Particle Inspection is difficult to do on an odd-shaped part, the Fluorescent Penetrant Inspection can be used if the acceptance criteria are concerned about surface indications only.

12-10 - SERVICING – REPLENISHING

1. Refueling
   A. Refer to Appendix A of the ***YO-233-B2A Engine Installation and Operation Manual*** for approved fuel.
   B. To prevent refueling with incorrect fuel:
      (1) Know what fuel grades are specified for your engine and their color code.
      (2) Do not accept any fuel that has a lower octane rating than the fuel specified for your engine.
   C. Refer to the airframe manufacturer's manual for fuel capacity.
2. Oil Level Check

⚠ WARNING: DURING ENGINE OPERATION, THERE ALWAYS MUST BE A SUFFICIENT SUPPLY OF OIL IN THE ENGINE FOR CORRECT ENGINE OPERATION. IF YOU OPERATE AN ENGINE WITH INSUFFICIENT OIL, ENGINE FAILURE CAN OCCUR. REFER TO APPENDIX A OF THE YO-233-B2A ENGINE INSTALLATION AND OPERATION MANUAL FOR MINIMUM QUANTITY OF OIL IN FLIGHT.

   A. The oil in the engine must be kept at the correct level for the engine to operate correctly.
   B. Measure the oil level of an engine before every flight as follows:
      (1) Make sure the engine is warm or cool to touch.
      (2) Pull out the oil level gauge dipstick rod (Figure 1).

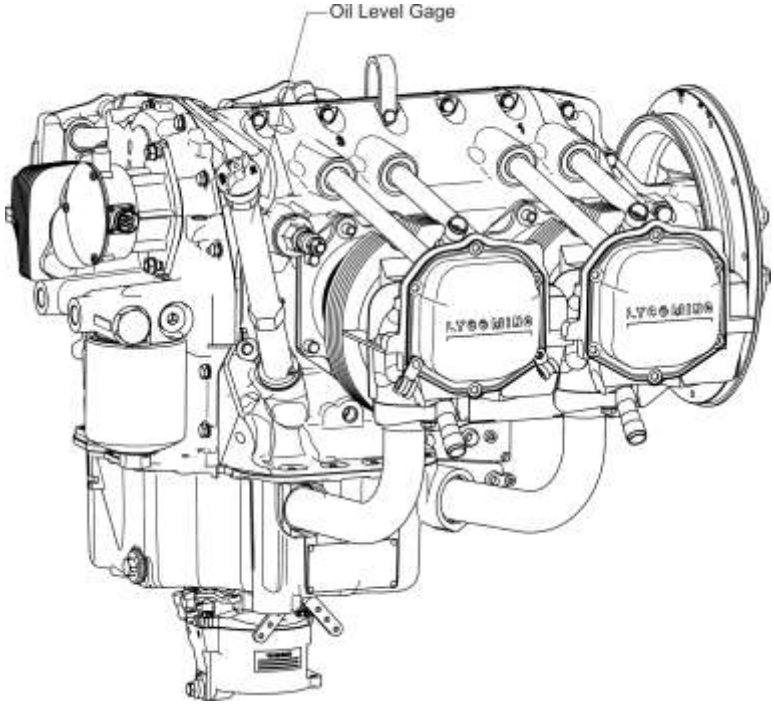

Figure 1
Oil Level Gauge (Dipstick Rod)

(3) Wipe all oil from the rod with a clean, lint-free cloth. Do not let any lint or dirt get in the oil fill port.

(4) Put the oil level gauge dipstick rod fully back into the oil sump and pull the rod out again.

(5) Look at the oil level indication on the dipstick rod.

(6) If the oil level is not sufficient add the correct oil through the fill port. Refer to the section "Add Oil to the Engine" in this chapter.

C. The oil sump capacity and the minimum quantity for flight and on the ground are identified in Appendix A of the ***YO-233-B2A Engine Installation and Operation Manual***.

WARNING: DO NOT FLY THE AIRCRAFT IF THE OIL LEVEL IS LESS THAN THE MINIMUM OIL LEVEL. IF THE ENGINE IS OPERATED ON A LOW OIL LEVEL, ENGINE DAMAGE CAN OCCUR.

3. Oil Consumption

WARNING: IF OIL CONSUMPTION IS MORE THAN THE CONSUMPTION RATES SHOWN IN TABLE 1, THE AIRCRAFT IS NOT TO BE IN FLIGHT. UNUSUAL OIL CONSUMPTION IS INDICATION OF A PROBLEM, SUCH AS OIL LEAKS OR CYLINDER MALFUNCTION. IDENTIFY AND CORRECT THE CAUSE(S) OF THE INCREASED OIL CONSUMPTION.

A. The maximum rate of oil consumption in quarts per hour is:

$$\frac{0.006 \times BHP \times 4}{7.4}$$

B. Usual oil consumption rates in quarts per hour are shown in Table 1.

Table 1
Oil Consumption

Performance (75% Rated)	0.84 Max Qt/Hr
Economy	0.67 Max Qt/Hr

C. Unusual oil consumption rates are:

1 quart (0.9 liter) for every 3 hours of operation – start of too much consumption

1/2 quart (0.5 liter) of oil consumed for every hour during usual engine operation

D. If the engine oil level is less than the minimum oil level or oil consumption has increased or is unusual, look for oil leaks and examine the engine cylinders. Identify and correct the cause of the increased oil consumption or overhaul the engine, if necessary, before the next flight.

4. Oils Type and Viscosity

A. The correct oils to be used in the YO-233-B2A series engines are in Appendix A of the ***YO-233-B2A Engine Installation and Operation Manual***.

WARNING: DO NOT USE AUTOMOTIVE LUBRICANTS IN LYCOMING ENGINES BECAUSE THEY MAY CAUSE ENGINE FAILURE.

B. Ashless dispersant oil contains additives, one of which has a viscosity stabilizing effect, which removes the tendency of the oil to thin out at high oil temperatures and thicken at low oil temperatures. The additives in these oils extend operating temperature range, improve cold engine starting and lubrication of the engine during the critical warm-up period, thus permitting flight through wider ranges of climatic changes without the necessity of changing oil. The ashless dispersant grades are recommended for aircraft engines subjected to wide variations of ambient temperature. It must not be presumed however, that these oils will remove all of the problems encountered in extremely cold environments (below +10°F (-12°C)). At these temperatures preheating of the engine and oil supply tank will be necessary regardless of the type of oil used.

5. Add Oil to the Engine

   A. Make sure the engine is warm or cool to touch.

   B. Remove the oil level gauge/dipstick assembly.

   ⚠ **CAUTION:** DO NOT OVER-FILL THE ENGINE WITH OIL. IT CAN CAUSE ENGINE DAMAGE.

   C. Measure the oil level. Refer to the section “Oil Level Check” in this chapter.

   D. Add oil as necessary and measure the oil level until the oil level check shows that there is sufficient oil in the engine for the flight conditions.

   E. Install the oil level gauge/dipstick rod securely.

   F. Lubricant Additives

   ⚠ **CAUTION:** DO NOT ADD TOP CYLINDER LUBRICANT, DOPES, OR CARBON REMOVERS TO THE ENGINE. THESE PRODUCTS CAN DAMAGE THE ENGINE (PISTONS, ENGINE RINGS, ETC.). IF YOU ADD THESE PRODUCTS TO THE ENGINE, YOU WILL VOID THE WARRANTY.

      (1) Anti-scuffing agent oil additive (P/N LW-16702) to decrease engine wear can be added to the oil sump during an oil change.

6. Oil Leak Check

   A. Examine the engine nacelle, engine compartment, and adjacent area for oil leaks.

   B. Examine the engine cylinders for leaks.

   C. If leaks are found, identify and correct the cause.

   D. After the cause of the oil leak is corrected, measure the oil level. Refer to “Oil Level Check” in this chapter.

   E. Add oil as necessary. Refer to the procedure “Add Oil to the Engine” in this chapter.

7. Oil Servicing Schedule

   A. Oil changes and oil filter replacement are recommended as shown in the schedule in Table 2.

Table 2 Recommended Engine Oil Change and Oil Filter Replacement Schedule
Before an engine is put in for short-term storage
For engine preservation
To put an engine into service after storage
Before installation of a new or rebuilt engine
To return an overhauled or stored engine to service
After 25 hours of operation after first start-up of any overhauled, rebuilt, new engine, or engine returned to service after storage
After the first replacement/oil suction screen cleaning
After every 50 hours of operation or every 4 months*
After overhaul of any engine cylinder

***NOTICE:** Oil change intervals must not exceed four (4) months regardless of operating hours and especially if the aircraft has not been flown for at least 25 hours in a 4-month period. More frequent oil changes are recommended if the engine has been exposed to volcanic ash, particulate, sand, dust debris or extreme weather conditions.

8. Oil Change Procedure

WARNING: ENGINE OIL IS FLAMMABLE. OBEY ALL FIRE HAZARD PRECAUTIONS DURING THE OIL CHANGE PROCEDURE.

NOTICE: An oil sample must be collected during the oil change. The oil change and oil sample collection must be done within 30 minutes after engine shutdown to get an accurate sample.

NOTICE: An anti-scuffing oil additive can be added to the oil sump during an oil change. Refer to "Lubricant Additives" in this chapter.

A. Operate the engine until the oil temperature stabilizes and then shut down the engine.

B. Let the engine cool for up to 25 minutes after shutdown.

C. Drain oil from the engine as follows:

(1) Place a 15-quart capacity container under the drain plug of the oil sump.

(2) Have a clean oil sample vial prepared to collect oil after a few ounces of oil have drained.

(3) Remove the safety from the oil drain plug.

(4) Remove the oil drain plug (Figure 2).

(5) Connect oil drain hose if available.

(6) Allow a few ounces of oil to drain and collect an oil sample. Refer to the "Oil Sample Collection" procedure.

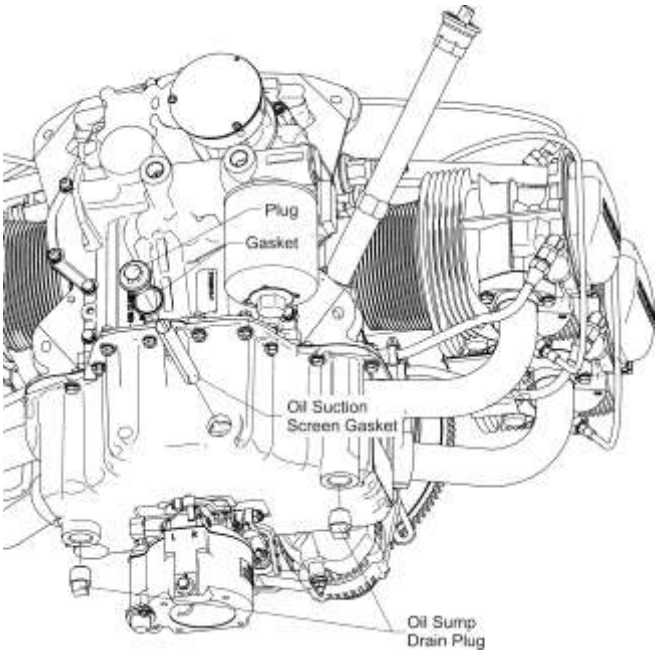

Figure 2
Oil Sump Drain Plug

D. Oil Sample Collection

NOTICE: During the first three oil changes on a new, rebuilt, or overhauled engine, collect 1 to 2 oz. (30 to 60 ml) of oil while the oil drains. Use a sampling tube, funnel, and sample vial that is clean and free of any particulate, debris, foreign material or residue. Do not take an oil sample from the bottom of the oil sump since it may give false-positive readings.

(1) After 1/3 of the oil has been drained from the engine's oil sump, collect 1 to 2 oz. (30 to 60 ml) of oil into the clean sample vial.

(2) Identify the oil sample vial with a mark or label.

(3) Send the oil sample in the vial to the same laboratory (that has been used in the past) for spectrographical analysis to compare past results and identify a wear trend pattern.

E. Let the remainder of the oil drain from the engine.

F. Dispose of the oil in the container in accordance with environmental safety laws.

G. Remove the suction screen from the oil sump. Refer to the "Oil Suction Screen Removal/Installation" procedure in this chapter.

H. Install the oil drain plug with a 135° angle of turn for the copper gasket. Torque the oil drain plug as per the torque values in the latest revision of the ***Service Table of Limits - SSP-1776***.

⚠ **CAUTION:** MAKE SURE THAT THE OIL DRAIN PLUG IS INSTALLED TIGHTLY. IF THE DRAIN PLUG IS NOT TIGHTLY INSTALLED AND LEAKS, ENGINE FAILURE WILL OCCUR.

I. Safety the oil drain plug and screen in accordance with the best standard practices described in the latest revision of AC43.13-1B.

J. Replace the oil filter. Refer to "Oil Filter Replacement" procedure in this chapter.

K. Add oil to the engine. Refer to the "Add Oil to the Engine" procedure in this chapter.

L. Operate the engine under usual conditions until the oil has reached the "Desired Oil Temperature" listed in Appendix A of the ***YO-233-B2A Engine Installation and Operation Manual.***

M. Allow the engine to cool for 15 minutes.

N. Examine the engine and nacelle for oil leaks. Refer to the "Oil Leak Check" procedure in this chapter.

⚠ **CAUTION:** DISPOSE OF THE USED OIL AND CLEAN UP ANY SPILLED OIL OR FUEL IN COMPLIANCE WITH FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

O. Clean up any oil spilled on the engine and nacelle.

P. Send oil for analysis.

Q. Refer to the sections "Engine Wear and Oil Analysis" and "Guidelines for Results of Oil Analysis" in this chapter.

9. Oil Filter Replacement

A. Remove the oil filter (Figure 3) from the engine.

B. Examine the oil filter for metal particles, shavings or flakes. Refer to the "Oil Filter/Suction Screen Inspection" procedure in this chapter.

C. Install a new oil filter.

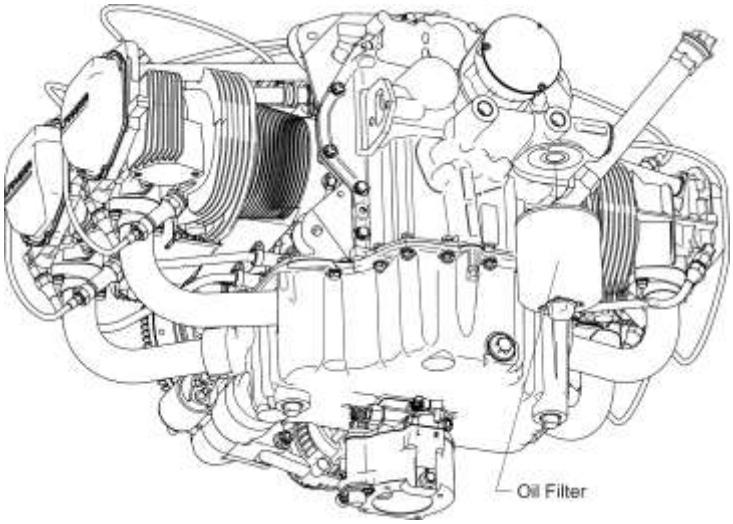

Figure 3
Oil Filter Assembly

10. Oil Suction Screen Removal/Installation
    A. Remove the suction screen from the oil sump.
    B. Discard the gasket.
    C. Before you clean the suction screen, examine the suction screen for metal particles, shavings or flakes. Refer to "Oil Filter/Suction Screen Inspection" procedure in this chapter.
    D. Clean the suction screen.
    E. Install the suction screen with a new crush type gasket.
11. Oil Filter/Oil Suction Screen Inspection
    A. Cut open the removed oil filter canister with an approved tool (e.g., for full-flow filters, use Champion Tool CT-470) per the tool manufacturer's instructions.
    B. Remove the paper element from the oil filter.
    C. Carefully cut the paper element at each end of the body.
    D. Carefully unfold the paper element to prevent loss of collected particles which can compromise the integrity of this inspection.
    E. Examine the material trapped in the filter. Look for shiny metallic particles/residue, shavings or flakes. Refer to the sections: "Identification of Metallic Solids After Oil Servicing" and "Visual Inspection of the Oil Filter Element and Oil Suction Screen" in this chapter.
    F. Record all inspection findings and any corrective action in the engine logbook.
12. Identification of Metallic Solids After Oil Servicing
    A. Metallic particles in the oil will require further examination since the metallic particles can be an early indication of wear or damage to engine components such as cylinders, bushings, piston pins, etc. ("Metallic particles" herein include metal particulates and/or chips, flake, hair-like strands, shavings, etc.)
    B. Identification of the nature of the metallic particles found in an oil filter element or oil suction screen during an oil change is helpful as a diagnostic method.
    C. Identification of the metallic particles is a progressive approach that begins with a "Visual Inspection of the Oil Filter Element and Oil Suction Screen" in this chapter that can be followed with basic chemical analysis or more in-depth analysis (such as spectrometric oil analysis or directly with component examination and subsequent corrective action.
    D. Through spectrometric oil analysis for metal content, the metallic concentrations can be identified and corrective action taken. Refer to the latest revision of Service Letter No. L171 for additional details.

    NOTICE: For spectrometric oil analysis to be an effective diagnostic tool, Lycoming Engines recommends that oil samples must be taken and analyzed at each oil change.

    Contact Lycoming Engines' Technical Support at the phone numbers at the front of this manual, if:

    - The cause of the metal contamination cannot be found
    - If the next two oil analyses show progressive increases in aluminum or iron content, complete a "Visual Cylinder Inspection," and/or "Cylinder Borescope Inspection" on each engine cylinder per Chapter 72-30.

13. Visual Inspection of the Oil Filter Element and Oil Suction Screen

When metallic particles are found on a filter element or screen, a visual inspection of the metallic particles on the filter element or oil suction screen is to be done to help identify and narrow the root source of affected engine components subject to wear or damage. The visual inspection includes four attributes:

Size - "Chunks" are metallic particles larger than 3/16-inch in size; chips are smaller than chunks. Chunks and chips require immediate analysis. Yet metallic particles can be small dust-size particulates - that is where quantity becomes more of the issue in this case.

Quantity – If more than five small particulates are on almost every panel in the oil filter element or if there is a 1/4 teaspoon full of metallic particles from an oil suction screen, these metallic particles require immediate analysis because they can be an indication of an engine component being worn or damaged.

Color – Metallic particles can vary in color: black, shiny silver or gray metal, bronze or brass – all of which can be an indicator toward the affected engine component.

Magnetic/Not Magnetic – Most ferrous alloy materials can be picked up by a magnet. However, some stainless steel and non-ferrous materials such as aluminum, magnesium, tin, cadmium, zinc, etc. cannot be picked up with a magnet.

The visual inspection procedure is slightly different for oil filter elements and screens:

Visual inspection for oil filter element:	**Visual inspection for oil pressure screen or oil suction screen:**
Remove the oil filter element from the oil filter canister.	Drain all fluid oil through a strainer cloth or paper to remove oil from either the oil pressure screen or oil suction screen as much as possible to enable better visibility of the metallic particles and prevent loss of metallic particles. Since quantity matters, try not to lose particles. Loss of metallic particles can compromise the integrity of this inspection.
Drain all fluid oil through a strainer cloth or paper to remove oil from the oil filter, and oil suction screen as much as possible to enable better visibility of the metallic particles and prevent loss of metallic particles. Since quantity matters, try not to lose particles. Loss of metallic particles can compromise the integrity of this inspection.	Scrape all of the remaining metallic particles onto a clean teaspoon, paper or cloth.
Open up and unravel the oil filter element on a clean sheet of white paper or cloth.	Look at metallic particles for any shiny metallic solids.
Use bright light illumination to look at the panels and folds on the filter element for any shiny metallic solids.	Look for any copper-colored metallic particles.
Look for any copper-colored metallic particles.	Use non-metallic tweezers or a pick to sort chips and particles that look different.
Estimate the size and number of metallic particles.	Estimate the size and number of metallic particles.

It is important to know if this is the initial oil change of a new, rebuilt, or overhauled engine. Typically, small metallic particles, chips, and chunks on either the oil filter element or oil suction screen during the first oil change of a new, rebuilt, or overhauled engine, are acceptable. After an initial break-in period, metal content is likely to decrease rapidly to a level that remains essentially constant.

However, on subsequent oil changes, an increased quantity of chunks, chips, and/or small metal particles in the oil can be evidence of engine part wear. This wear can increase over a period of time until premature loss of form, fit, or function occurs.

NOTICE: If the engine has been operated in dust, sand storms, volcanic ash, wildfires, etc. more particulates could be found.

Table 3 identifies field tests and guidelines for identifying types of metals as well as possible sources and the next step in the process.

Table 4 identifies the size and amount of material and the recommended corrective action.

Table 5 identifies specific corrective action for the various findings.

The type of material (Table 3), regardless of quantity, and/or the quantity and size of metallic particles (Table 4) can help determine the corrective action (Table 5) to be taken.

NOTICE: Table 3 only applies to engines that use genuine Lycoming Parts.

Table 3
Guidelines for Identification of Metal Particulates and Chips & Corrective Action

Metals/ Alloys	Tests & Characteristics	Possible Source of Origin on Lycoming Engine	Next Step
Steel or cast iron	Picked up by magnet or, will move when a magnet is placed on the opposite surface of the filter element or strainer cloth – which will prevent chips from sticking to the magnet	Camshaft lobes Gears Tappets Push rods Rockers Shafts Impellers Piston rings Cylinder barrels	Refer to Table 4 for the quantity and size of the particles
Bronze	When placed in nitric acid, turns bright green	Connecting rod bushings Rocker bushings Crankshaft bearings Intake valve guide Piston pin plug Idler gear bushing	Refer to Table 4 for the quantity and size of the particles
Nickel	Not picked up by magnet	Exhaust flange V-band coupling Gasket	Refer to Table 4 for the quantity and size of the particles
Stainless steel		Valves Exhaust components Valve seats Oil bypass valve spring Safety wire	Refer to Table 4 for the quantity and size of the particles

Table 3 (Continued)
Guidelines for Identification of Metal Particulates and Chips & Corrective Action

Metals/ Alloys	Tests & Characteristics	Possible Source of Origin on Lycoming Engine	Next Step
Chrome		Piston rings Exhaust valve stems	Refer to Table 4 for the quantity and size of the particles
Copper	When placed in nitric acid, turns bright green	Platings	Refer to Table 4 for the quantity and size of the particles
Brass	When placed in nitric acid, turns bright green	Oil suction screen Pressure relief valve spacer	Refer to Table 4 for the quantity and size of the particles
Lead		Bearings	If lead chips, chunks, or balls are found, complete Corrective Action 4 in Table 5.
Aluminum flakes	When placed in 50% solution of nitric acid and muriatic acid (approximately 30% hydrochloric acid and water), or a sodium hydroxide solution, the aluminum particles bubble and fizz and form a black residue	Crankcase Accessory housing Oil pump body Cylinder head Pistons Piston pin plugs Oil sump baffle Turbocharger inlet housing Sleeve bearings	Refer to Table 4 for the quantity and size of the particles
Magnesium		Oil sump	Refer to Table 4 for the quantity and size of the particles
Tin	Soft, malleable Not picked up by magnet When dropped onto a hot (500◦F) soldering iron, tin particle will melt and fuse with 50/50 solder	Tin-plated parts	Refer to Table 4 for the quantity and size of the particles
Cadmium		Plating	Refer to Table 4 for the quantity and size of the particles
Zinc		Plating	Refer to Table 4 for the quantity and size of the particles

Table 4
Guidelines for Particle Quantity and Size on Oil Filter or Oil Suction Screen

Condition	Corrective Action (Table 5)
1 to 9 pieces of metal (1/16 in. (1.2 mm)) diameter or less)	Continue to operate the engine until the next scheduled oil change
10 to 20 pieces of shiny flake-like, non-magnetic metal (1/16 in. (1.2 mm)) diameter or less)	Corrective Action 1
10 or fewer short hair-like pieces of magnetic metal	Corrective Action 1
20 to 40 pieces of shiny flake-like non-magnetic metal	Corrective Action 2
45 to 60 small pieces of shiny flake-like, nonmagnetic metal	Corrective Action 3
Pieces of metal that are chunks, greater than 3/16 in. (4.8 mm) or chips smaller than chunks **NOTICE:** A mixture of magnetic and nonmagnetic material can indicate valve or ring and piston failure. **NOTICE:** Remove the bottom spark plugs to identify a non-conforming cylinder.	Corrective Action 4
1/4 teaspoonful or more of nonmagnetic plating with or without a copper tint, could vary in sizes	Corrective Action 2
1/4 teaspoonful or more of nonmagnetic plating with or without a copper tint, 1/16-inch or larger size could indicate bearing damage	Corrective Action 4
Pieces of shiny flake-like, nonmagnetic metal (larger than 1/16 inch in diameter) with no copper tint. (Possible indication of incorrect propeller operation.)	Corrective Action 4
1/4 teaspoonful of nonmagnetic brass or copper colored metal that appears coarse like sand	Corrective Action 4
1/2 teaspoonful of more of metal	Corrective Action 4

Table 4 (Continued)
Guidelines for Particle Quantity and Size on Oil or Oil Suction Screen

Condition	Source of Particles	Corrective Action (Table 5)
Chunks (3/16-inch or larger) in oil suction screen	Valve Tappet Ring Piston Bearing Machining chips	Corrective Action 3 and contact Lycoming Product Support
Bronze chips in the oil suction screen	Connecting rod bushing	Corrective Action 6
More than five bronze chips found in the oil filter or oil suction screen	Connecting rod bushing	Corrective Action 6
More than three bronze chips AND more than three aluminum chips found in the oil filter or oil suction screen	Connecting rod bushing and piston	Corrective Action 7
1/4 teaspoon or more of metallic particles and metal has gotten past the oil filter	Cylinders Bearings Piston Piston pin plugs	Corrective Action 4
1/4 teaspoon or more of metallic particles and metal has **not** gotten past the oil filter	Possibly only one engine cylinder is damaged or spark plug is worn or damaged	Corrective Action 5

If the cause of the metal contamination cannot be identified, speak with the Lycoming Engines Product Support.

If there is unusual aluminum, bronze, or iron contamination in the oil, make sure you have a full description of the engine model, serial number, history, oil temperatures, oil pressure, unusual performance, and properties of the metal contamination (color, size, metallic/nonmetallic, shape, etc.). This information will help Product Support identify the cause of the contamination.

Coordinate with an appropriate oil analysis laboratory to have the material analyzed. For factory new, factory rebuilt or factory overhauled Lycoming engines within their hourly or 12 year required TBO cycle, if directed, send the oil filter element and metallic material to Lycoming Engines for analyses.

A change in the usual wear rate of a part is not necessarily an indication of imminent failure. It is an indication that a borescope examination, cylinder compression pressure check, etc. are necessary to identify the cause for unusual wear.

14. Recommended Corrective Action Options

Table 5
Recommended Corrective Action Options

1	a. Per sections in this chapter complete: • Oil Change Procedure • Oil Filter Replacement • Oil Suction Screen Removal/Inspection/Cleaning/Installation. b. Operate the engine in flight for 25 hours. c. Complete the "Oil Change Procedure" again. d. Remove and examine the oil filter. e. If the oil filter is clean, resume the routine oil servicing schedule. If chunks or more than 45 metallic particles are found, ground the aircraft and proceed to Corrective Action 3.
2	a. Per sections in this chapter complete: • Oil Change Procedure • Oil Filter Replacement • Oil Suction Screen Removal/Inspection/Cleaning/Installation. b. Operate the engine **on the ground** for 20 to 30 minutes. Refer to the aircraft POH. c. Remove and examine the oil filter. d. If the oil filter is clean, install a new oil filter. e. Operate the engine in flight for 10 hours. f. Remove and examine the oil filter. g. If either the oil filter is clean, resume the routine oil servicing schedule. If chunks or more than 45 metallic particles are found, ground the aircraft and proceed to Corrective Action 3.
3	a. Per sections in this chapter complete: • Oil Change Procedure • Oil Suction Screen Removal/Inspection/Cleaning/Installation – look for chunks in this screen. b. If one or more chunks are found, complete the "Oil Sump Removal" procedure in Chapter 72-50. c. Look for chunks and metallic particles in the oil sump. d. If one or more chunks are found in the oil sump, examine the exhaust and intake valves, pistons, and piston rings per procedures in Chapter 72-30.
4	Complete the "Engine Removal" procedure in Chapter 72-00 and send the engine to Lycoming Engines or an authorized repair facility for customized evaluation. or Complete the "Engine Disassembly" procedure in Chapter 72-05 and examine engine components per the applicable chapters in this manual to identify and correct the cause.

Table 5 (Continued)
Recommended Corrective Action Options

5	Per Chapter 74-20, remove and examine the spark plugs. Per Chapter 72-30, complete a "Cylinder Borescope Inspection" on the cylinders. Remove the propeller governor to determine if metallic particles have spread to other parts of the engine. If the contamination has spread to other parts of the engine, proceed to Corrective Action 4.
6	a. Complete these procedures in Chapter 72-30: • Cylinder Removal • Piston Removal b. Per the Connecting Rod Inspection Checklist in Chapter 72-20, examine the connecting rod bushing
7	c. Complete these procedures in Chapter 72-30: • Cylinder Removal • Piston Removal a. Per the Connecting Rod Inspection Checklist in Chapter 72-20, examine the connecting rod bushing b. Complete the "Piston Inspection" procedure in Chapter 72-30. Examine the pistons for wear or damage.

12-30 - UNSCHEDULED SERVICING

FAULT ISOLATION

1. General
   A. Fault Isolation:
      (1) Refer to the section “Fault Isolation Guide” in this chapter.
      (2) Review maintenance logs and use applicable indicators to eliminate simple and inexpensive solutions. A quick visual inspection of the engine can show indications of obvious problems, such as intake and exhaust valve leaks, physical damage to ignition wires and wiring harness, blocked breathers, gas and oil stains, etc
      (3) Discuss the problem with the pilot for more details.
2. Fault Isolation Guide
   1. The Fault Isolation Guide in Table 1 shows the more common and recurring problems, causes, and corrective actions. Continue from the simplest to the most complex possible causes.

      NOTICE: The "Ref." column includes reference to "IOM" for the ***YO-233-B2A Engine Installation and Operation Manual***, "OHM" refers to the Direct Drive Overhaul Manual. A numeric entry such as "72-00" refers to a chapter in this manual.

Table 1
Fault Isolation Guide

Problem	Cause	Corrective Action	Ref.
Engine will not start or starts with difficulty	Inactive battery	Replace with a charged battery in accordance with airframe manufacturer’s instructions.	
	Incorrect starting procedure	Obey starting procedures or the Airframe Flight Manual.	
	Insufficient prime (could be accompanied by backfire	Increase prime. Examine priming system for leaks.	
	Flooded engine (overpriming)	1. Turn ignition switch "on" and put the mixture control in IDLE CUT-OFF. 2. Fully open throttle and start the engine. 3. When the engine starts, decrease throttle and advance the mixture control slowly to FULL RICH.	
	Faulty starter	Replace the starter.	OHM
	Low fuel level	Complete the check of the fuel supply. Service as required.	

Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
Engine will not start or starts with difficulty (Cont.)	No fuel flow Blockage in fuel hose	1. Disconnect the fuel hose. 2. Complete the check of the fuel flow. 3. Examine for evidence of leaks and correct as required. 4. Clean the filters, strainers, lines, or fuel valves.	OHM
	Water in fuel system	Drain the fuel hoses.	
	Throttle valve open too far	Set throttle control approximately 1/4 inch open for about 800 rpm.	
	Flooded engine (overpriming)	1. Turn ignition switch "on" and put the mixture control in IDLE CUT-OFF. 2. Fully open throttle and start the engine. 3. If the engine does not start in 5 seconds, shut down and do not try to start until the starter cools down. 4. When the engine starts, decrease throttle and advance the mixture control slowly to FULL RICH.	
	Faulty ignition wire	1. Examine the ignition harness for breaks and cracks. 2. Replace faulty wires.	
	Incorrect crankshaft-to-camshaft timing	Make sure that the crankshaft-to-camshaft timing is correct	OHM
	Faulty spark plug	1. Remove the spark plugs. 2. Examine, clean, gap, test, and replace as necessary.	74-20
	Faulty harness	Remove and replace the harness as necessary.	
	Cylinder compression problem	1. Complete the cylinder compression check. 2. Complete the borescope inspection of low cylinder(s) to determine if further disassembly and repairs are necessary.	72-30

Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
Poor idle cut-off	Incorrect rigging of mixture control linkage	Adjust in accordance with airframe manufacturer's instructions.	
	Mixture control valve is scored or not seating properly or O-ring on mixture jet is broken or deformed Leaky valve	Send carburetor to the manufacturer or repair center for inspection or repair.	
Rough Idle	Incorrect idle mixture	1. Adjust the idler mixture per instructions in the section "Idle Speed Mixture Adjustment" in Chapter 72-00. 2. Readjust idler speed	72-00
	Found only as follows: —High ambient temperatures —Engine operating for a long time at low or idle rpm	1. Operate with cowl flaps in the full open position. 2. Keep ground operation to a minimum. 3. Operate with boost pump on as necessary. 4. Complete the check of the vent return line for blockage. Clean if necessary.	
	Leak in induction system	1. Examine the flanges, gaskets and O-rings for leaks. Tighten or replace as necessary. 2. Examine for cracked intake pipes. Replace as necessary. 3. Examine for loose flange bolts or loose plugs in intake port of cylinders. Torque as required. 4. Examine for fuel stain evidence of leaking gaskets. Replace when found. 5. Examine for fuel drain valve not properly seating.	OHM

Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
Rough Idle (Cont.)	Cracked engine mounts or defective mount bushings	Replace in accordance with airframe and part manufacturer's instructions.	
	Engine mount bushing incorrectly installed	Install in accordance with manufacturer's instructions.	
	Engine mount bushing incorrectly installed	Install in accordance with manufacturer's instructions.	
	Low fuel pressure	Replace fuel pump or fuel pressure regulator.	OHM
	Uneven cylinder compression	1. Complete the cylinder compression check. 2. Complete the borescope inspection of low cylinder(s) to determine if further disassembly and repairs are necessary.	72-30
	Ignition leads	Make sure all ignition leads are secure.	
	Fault in the ignition system	1. Remove the distributor block and examine leads using a high-tension lead tester. 2. Repair or replace components as necessary. 3. Remove spark plugs, examine, clean, gap, test, and replace as necessary.	IOM
Engine will not idle unless the boost pump is on	Fuel vaporizing in lines	1. Operate with cowl flaps in the FULL OPEN position and keep ground operation to a minimum. 2. Operate with boost pump on as necessary. 3. Complete the check of the vent return line for blockage. Clean if necessary.	

Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
Engine will not idle unless the boost pump is on (Cont.)	Low fuel pressure	Replace fuel pump.	OHM
	Very lean idle mixture	1. Enrich idle mixture. Refer to instructions in the section "Idle Speed Mixture Adjustment" in Chapter 72-00. 2. Readjust idle speed.	72-00
	Pressure too low at idle speed (engine could also lose fuel pressure as the aircraft climbs)	Look for loose fuel fitting. Tighten loose fuel fitting.	
	Idle mixture is extremely rich (evident by excess black exhaust)	1. Lean idle mixture. Refer to instructions in the section "Idle Speed Mixture Adjustment" in Chapter 72-00. 2. Readjust idle speed.	72-00
	Fuel pressure is set too high	Adjust engine fuel pump.	
	Broken fuel pump drive	Replace the fuel pump in accordance with airframe manufacturer’s instructions.	OHM
Engine will not shut off	Faulty power switches	Replace the switches.	
	Faulty wiring in the harness	Replace the harness.	
	Ignition switch faulty	Check for faults on the ignition switch circuits. Repair as necessary.	
Low fuel flow	Dirty fuel filter	Remove and replace the fuel filter.	
Carburetor shut-off	Faulty power switches	Replace the switches.	
	Faulty wiring in the harness	Replace the harness.	
	Ignition switch faulty	Check for faults on the ignition switch circuits. Repair as necessary.	

Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
Mixture control not working	Faulty power switches	Replace the switches.	
	Faulty wiring in the harness	Replace the harness.	
	Ignition Switch faulty	Check for faults on the ignition switch circuits. Repair as necessary.	
Engine will not turn static rpm or will not develop rated rpm	Tachometer reading is incorrect	1. Make sure that the tachometer operates correctly. 2. Replace the tachometer.	OHM
	Decreased air flow in the air induction system	1. Examine the system and remove all blockages. 2. Make sure that the airbox is installed in accordance with the airframe manufacturer's specifications.	
	Propeller is out of adjustment (not reaching specified low pitch)	Adjust in accordance with propeller or airframe manufacturer's instructions.	
	Muffler's internal baffles are broken and blocking the exhaust outlet **NOTICE:** Broken baffles can move around freely in the muffler. The engine may turn static rpm's intermittently.	1. Hit the muffler with a rubber mallet or soft object. 2. Listen for a rattle which is indication of loose baffles. 3. Remove the muffler and complete the thorough inspection. 4. Replace muffler as necessary, in accordance with airframe manufacturer's instructions.	
	Air filter dirty	Replace air filter in accordance with airframe manufacturer's instructions.	
	Too much air dropped through a new air filter. Defective air filter	1. Put the engine on test stand, in a dust-free area. 2. Remove the air filter. 3. Operate the engine to full throttle. 4. If the engine operates at full rpm, replace the air filter with a new air filter.	

Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
Engine will not turn static rpm or will not develop rated rpm (Cont.)	Fouled spark plugs	Remove and clean spark plugs	
	Incorrect fuel flow	Look for blocked fuel filters.	
	Blockage in air inlet or manifold.	1. Make sure that the air filters are clean. 2. Examine the induction system for breaks in the ducts. Breaks can let foreign material or heated air enter the induction system. 3. Repair or replace air inlet or manifold if necessary.	OHM
	Incorrect type of fuel	1. Replace fuel with correct fuel. 2. Also refer to "Incorrect Fuel or Fuel Contamination" in Chapter 05-50.	IOM Appendix A
	Throttle lever is incorrectly adjusted	Adjust the throttle lever in accordance with airframe manufacturer’s instructions.	
	Insufficient combustion	1. Complete the cylinder compression check. 2. Complete the borescope inspection to look for excessive wear on the cylinders or damaged valve and valve seats. 3. Complete the top overhaul.	72-30 OHM
	Incorrect crankshaft to camshaft timing **NOTICE:** This could also cause the engine not to start.	Make sure that the crankshaft-to-camshaft timing is correct.	OHM
Engine will not supply the rated power	Blockage in manifold system	Clear all ducting.	
	Leak in intake or exhaust	Tighten loose connections or replace manifold gaskets as necessary.	

Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
Engine will not supply the rated power (Cont.)	Oil pressure too low	1. Tighten fittings. 2. Replace oil lines, or hoses. 3. Increase oil pressure as necessary.	
Engine smokes excessively **NOTICE:** An engine regularly smokes if it is idling for an extended period.	Breather is clogged	Make sure that nothing is blocking the air flow.	
Engine hesitates, misses	Valve sticking	Refer to "Valve Sticking"	05-50
Engine surges	Low engine oil level	Complete the check of the oil level.	12-10
	Faulty governor	Leak test propeller governor. Replace the propeller governor.	72-20 OHM
	Incorrect propeller governor	Make sure that the propeller governor isthe correct part number.	
	Breather is blocked	Examine the breather for obstructions. Remove all obstructions.	
	Faulty oil pump	Repair or replace the oil.	OHM
	Propeller blades are intermittently sticking in hub	Remove and overhaul the propeller.	Propeller manufacturer's instructions
	Front main bearing has too much clearance	Complete the leak test. Refer to the latest revision of Service Instruction No. 1462.	OHM

Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
Irregular or low oil pressure	Low engine oil level	Complete a check of the oil level. Add oil.	12-10
	Air leaks	Look for air leaks at the oil sump gasket.	
	Pressure relief is out of adjustment	Increase the oil pressure by turning the adjusting screw counterclockwise.	72-50
	Dirt or metal chips under the oil pressure relief valve	Remove, disassemble, and clean the oil pressure relief valve	OHM
	Damaged oil pressure relief seat	Replace or repair the oil pressure relief seat	OHM
	Blockage at inlet side of oil pump	Remove and clean the oil suction screen and oil passage to the inlet side of the oil pump.	12-10
	Too much internal oil spill-off	Examine these area: — Loose or missing plugs in oil galley — Piston cooling squirts are blocked open (at idle rpm) — Too much bearing clearance — Cracked crankcase in the oil galley area	OHM
	Air leak on suction side	1. Examine the conditions of these components: — Oil suction screen — Oil sump gasket — Oil pump mating surface to accessory housing 2. Replace cracked or damaged parts.	OHM

Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
Irregular or low oil pressure (Cont.)	Failed or failing bearings **NOTICE:** Metal in the oil suction screen or oil filter is a sign of excessive bearing wear	Disassemble the engine for bearing inspection and replacement.	OHM
High oil consumption	Incorrect grade of oil	Use correct grade of oil.	IOM Appendix A
	New rings are incorrectly seated.	For break-in, operate the engine at 65% - 75% power for the first 50 – 100 hours.	
	Piston rings are worn or incorrectly installed OR Cylinder barrels are glazed or worn too much	1. Complete the cylinder compression check. 2. Complete the borescope inspection. **NOTICE:** Listen for a hissing sound around the rings which is an indication of air leaks at the breather entrance of the crankcase. 3. Remove the cylinders, replace the piston rings, and deglaze the cylinder barrels	72-30 OHM
	Worn valve guides	1. Remove the cylinders from the engine. 2. Remove the valves. 3. Measure the guides for wear. 4. Replace the guides that are worn or out of limits.	OHM
	Oil leaks	Examine the external area of the engine for leaks, identify and correct the cause of any leak.	
	Oil siphoned from engine during flight	1. Verify that the oil filter cap is secure, and the oil access door closes correctly. 2. Make sure that the breather hose is accurately cut and installed to prevent siphoning.	

Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
High oil consumption (Cont.)	Crankcase ventilation system	Examine the plumbing and positive breather tube.	
	Oil level too high	Do not fill above the maximum oil sump capacity.	12-10
High cylinder temperature	Spark plugs have incorrect heat rating	Install approved spark plugs.	74-20
	Cooling baffles and seals are missing, broken, or incorrectly installed	Verify that all baffles are installed correctly and none are broken. Replace as necessary. **NOTICE:** Never modify, relocate, or eliminate any cooling baffles.	OHM
	Engine is operating excessively lean	1. Refer to Appendix C in the ***YO-233-B2A Engine Installation and Operation Manual*** for minimum fuel flows for various power settings and never lean below minimum fuel flows. 2. Examine the combustion chamber for carbon deposits. The absence of carbon deposits is evidence of operating the engine too lean.	IOM Appendix C OHM
	Mixture control is incorrectly installed	Make sure that full travel of the cockpit mixture control lever is calibrated to the correct FULL RICH and IDLE CUT-OFF stops.	
High oil temperature	Defective oil temperature gage	1. Install the master temperature gage and operate the engine to compare gages. 2. Replace the faulty gage if necessary.	
	Oil level is too low	Complete the check of the oil level at regular intervals. Keep oil at the specified level.	12-10

Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Correction Steps**	**Ref.**
High oil temperature (Cont.)	Insufficient cooling air	1. Make sure the air inlet and outlet ducting to the oil cooler are operating correctly. 2. Repair or replace parts in accordance with the airframe manufacturer's manual as necessary.	
	Incorrect grade of oil	Use only correct oil grade.	IOM Appendix A
	Oil cooler or oil cooler lines are fully or partially blocked	1. Remove the oil cooler and oil cooler lines. 2. Flush out in accordance with airframe manufacturer's manual.	
	Thermostatic bypass valve is not operating correctly or seating accurately	1. Replace thermostatic bypass valve. 2. Replace the filter base if valve is not seating properly.	OHM
	Too much blow-by	1. Complete the differential compression check in accordance with Chapter 72-30. 2. Complete the top overhaul	72-30 OHM
	Leaks in engine induction system	Look for leaks; repair leaks.	
High manifold pressure at idler	Air leak in induction system	Examine the induction system for leaks and repair as necessary. **NOTICE:** If the induction system has leaks, the engine will idle rough.	

Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Correction Steps**	**Ref.**
High manifold pressure at idler (Cont.)	Incorrect hydraulic lifters were installed	Replace hydraulic lifters with the correct part number for lifters. Refer to the latest revisions of Service Instruction Nos. 1529 and No. 1011. **NOTICE:** Keep the cylinders and plungers together as an assembly when you remove hydraulic lifters from the engine. If they become separated, replace with new ones. Incorrectly assembled body and plunger assemblies will change the leak-down rate.	OHM
High oil pressure	Oil pressure incorrectly adjusted	1. Increase the oil pressure by turning the adjusting screw clockwise. 2. Decrease the oil pressure by turning the adjusting screw counterclockwise.	72-50
	Incorrect weight of oil used	Use the recommended viscosity of oil for the ambient temperature.	IOM Appendix A
	Oil passage is blocked from the pressure relief valve to the sump	1. Remove the pressure relief valve from the engine. 2. Push a soft copper wire through the oil passage to the sump to remove blockage. **NOTICE:** If blockage continues, remove sump and clean passage.	OHM
	Relocated oil pressure take-off point on the engine	Use only the approved oil pressure take-off point. **NOTICE:** If the oil pressure take-off point on the engine is moved closer to the oil pump discharge, oil pressure will increase.	
	Oil temperature is too cold	Before increasing the throttle, allow the oil temperature to increase.	

Table 1 (Cont.)
Fault Isolation Guide

Problem	Cause	Correction Steps	Ref.
Too much noise or vibration	Insufficient bearing lubrication	1. Supply the required oil. 2. Clean or replace the oil hose; clean the oil strainer.	
	Leak in engine intake or exhaust manifold	Tighten loose connections or replace manifold gaskets as necessary.	

72-00 - RECIPROCATING ENGINE – REMOVAL/OPERATIONAL GROUND CHECK

1. Engine Removal Prerequisites

⚠ WARNING: BEFORE ENGINE REMOVAL, BE SURE TO DISCONNECT ALL POWER TO THE ENGINE. IF THE POWER IS NOT TURNED **OFF**, A LOOSE OR BROKEN WIRE COULD CAUSE THE ENGINE TO START AND THE PROPELLER TO ROTATE. AS A PRECAUTION, DO NOT STAND OR ALLOW ANYONE ELSE TO STAND WITHIN THE ARC RADIUS OF THE PROPELLER.

   A. Before engine removal from the airframe:

      — Disconnect electrical power to the engine.

      — Remove the propeller in accordance with the airframe manufacturer's instructions.

2. Engine Removal Procedure

   A. Remove the engine as follows:

      (1) Complete the prerequisites in the section "Engine Removal Prerequisites."

      (2) If the engine is to be put back into service at a later date, complete the engine preservation procedure before engine removal. Refer to instructions in the ***YO-233-B2A Engine Installation and Operation Manual***.

      (3) Make sure that all electrical switches, circuit breakers, Ignition Switch, and the Fuel Selector Valve are in the OFF position.

      (4) In accordance with the airframe manufacturer's instructions, remove all cowling, baffling and nacelle access panels that prevent engine removal.

⚠ CAUTION: USE CARE TO PREVENT DUST, DIRT, LOCKWIRE, NUTS, WASHERS OR OTHER FOREIGN MATTER FROM ENTERING THE ENGINE. DURING ENGINE REMOVAL, IF ITEMS ACCIDENTALLY FALL INTO THE ENGINE, STOP UNTIL THE DROPPED ARTICLES ARE FOUND AND REMOVED. USE CORRECT PLUGS, CAPS, AND OTHER COVERING TO COVER EXPOSED OPENINGS. DUST CAPS MUST BE INSTALLED OVER, NOT IN, TUBE ENDS.

      (5) Apply a cap to lines and connections to prevent fuel spillage and debris from entering the engine.

      (6) Apply tags and identify ports, clips, tubes, wires, etc. for reference to make correct connections during engine installation. Identify the location of each part during removal. Tag unserviceable parts and units for investigation and possible repair.

      (7) Disconnect any relays, gages, or other indicating devices following the airframe manufacturer's procedure.

      (8) During removal of tubes or engine parts, look for indications of scoring, burning or other unacceptable conditions.

      (9) Disconnect the ground terminal of the battery.

(10) Disconnect the positive terminal of the battery.

(11) Disconnect the engine from the alternator.

(12) Remove the baffling as required.

(13) Drain the oil as described in the “Oil Change Procedure” in Chapter 12-10.

(14) Remove all wiring bundle attaching clamps and hardware.

(15) Install and torque the oil sump drain plug in accordance with the latest revision of the ***Service Table of Limits - SSP-1776***. Safety the drain plug

(16) Disconnect the throttle control in accordance with the airframe manufacturer’s instructions.

(17) Remove the manifold pressure gage line and airframe fuel supply hoses in accordance with the airframe manufacturer’s instructions.

(18) Refer to the airframe manufacturer's instructions to disconnect any accessory connections or to remove any external accessories to enable removal of the engine from the airframe.

(19) Make sure that all wires, lines, and hoses and attachments between the engine and airframe are disconnected.

(20) Attach an engine-lifting cable (with a minimum capacity of 250 to 300 lb (114 to 136 kg) to the lifting lugs on the engine in accordance with Figure 1.

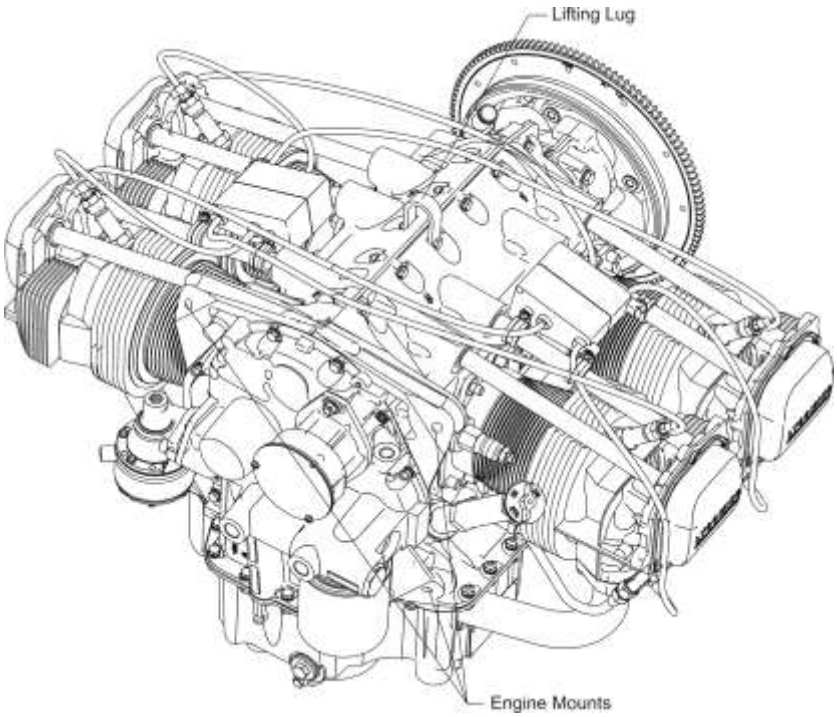

Figure 1
Lifting Lugs and Engine Mounts

(21) Use a crane or overhead hoist (with a minimum load of 750 lb (340 kg)) to increase the tension in the lifting cable until there is enough tension to hold the weight of the engine.

(22) Remove the nuts and bolts from the engine mounts that are supplied by the airframe manufacturer.

NOTICE: Do not remove the engine-mounting brackets. They are crating and packing tie-down points for shipping. Also, an overhaul facility will use the brackets to mount the engine in an overhaul stand.

(23) Lift the engine from the airframe.

⚠ **CAUTION:** MAKE SURE THE AREA IS CLEAR WHEN LIFTING THE ENGINE. DO NOT ALLOW THE FRONT, REAR, SIDES OR BOTTOM OF THE ENGINE TO BUMP OR STRIKE ANY OBJECTS TO PREVENT DAMAGE TO THE ENGINE OR ITS COMPONENTS.

(24) Carefully lift the engine slowly out of the airframe.

(25) Put the engine on an engine stand, transport dolly, or engine shipping container base.

⚠ **CAUTION:** DO NOT PUT TAPE OR INSERT PLUGS INSIDE OPEN LINES OR FITTINGS.

(26) Install protective covers over any open lines.

(27) To prevent delays on engine re-installation, have materials and new spare parts on hand. Refer to the YO-233-B2A Series Engine Illustrated Parts Catalog.

3. Engine Installation Preparation Requirements

To prevent delays on engine re-installation, have the following materials and new spare parts available (YO-233-B2A Series Engine Illustrated Parts Catalog) to replace any of these parts:

A. Gaskets, seals, and packing - make sure the new parts are not brittle, torn, cut, or cracked and do not have flashings, deterioration/wear or deformities.

B. Before installing a part, complete a check of the shelf-life of a part as per the latest revision of Service Letter No. L247.

C. Any parts that were found damaged and cannot be repaired.

⚠ **CAUTION:** LOCKWIRE (SAFETY WIRE), LOCK WASHERS, LOCK NUTS, TAB LOCKS, TAB WASHERS, AND COTTER PINS ARE TO BE DISCARDED, NEVER TO BE RE-USED OR RE-INSTALLED ON AN ENGINE. DURING ENGINE INSTALLATION, ALWAYS USE NEW LOCKWIRE, LOCK WASHERS, LOCK NUTS, TAB LOCKS, TAB WASHERS, AND COTTER PINS.

D. Lockwire.

E. Lock washers, lock nuts, tab locks, tab washers, and cotter pins.

F. Oil per specifications in Appendix A of the ***YO-233-B2A Engine Installation and Operation Manual***.

G. Fuel per specifications in Appendix A of the ***YO-233-B2A Engine Installation and Operation Manual***.

H. Cleaning materials.

4. Engine Installation
   A. During engine re-installation:
      (1) Refer to and follow the "Maintenance Practices" in Chapter 05-00.
      (2) Replace any gaskets, seals or packing that was removed with new parts.
      (3) Replace any part that was damaged or that could not be repaired with a new part.
      (4) Install external accessories as per the airframe manufacturer's instructions.
      (5) Examine the engine mounts to make sure they are not damaged or bent.
   B. Install the engine after all inspections and maintenance tasks are complete. Refer to the ***YO-233-B2A Engine Installation and Operation Manual***.
5. Operational Ground Check After Maintenance

NOTICE: The purpose of this check is to make sure the engine operates according to specifications in Appendix A of the YO-233-B2A Series Engines Installation and Operation Manual.

   A. Per the component manufacturer's instructions, calibrate the cylinder head temperature gage, oil temperature gage, oil pressure gage, manifold pressure gage, and tachometer prior to testing.
   B. Make sure that all of the engine gages operate correctly.
   C. Make sure that the vent and breather lines are correctly installed and secured in accordance with the airframe maintenance manual.
   D. Install the cowling and all of the intercylinder baffles and airframe baffles.

⚠ **CAUTION:** IF YOU CANNOT GET A TEST CLUB, YOU CAN USE THE REGULAR FLIGHT PROPELLER. IF YOU USE THE FLIGHT PROPELLER, MONITOR THE CYLINDER HEAD TEMPERATURE.

   E. Use a test club during the ground tests.
   F. Put the aircraft in a position against the wind.
   G. Start the engine and complete the Pre-Flight Test. Refer to the ***YO-233-B2A Engine Installation and Operation Manual***
6. Idle Speed Mixture Adjustment
   A. The goal of this procedure is to adjust the idle speed mixture to an optimum level for maximum rpm with minimum manifold pressure.
      (1) Start the engine and operate until the oil and cylinder head temperatures are in the specified operating range shown in Appendix A of the ***YO-233-B2A Engine Installation and Operation Manual***.
      (2) Set the throttle stop screw to let the engine idle at the aircraft manufacturer's recommended idling rpm speed.
      (3) When the idle speed is stable, move the cockpit mixture control level with a very slow, steady pull toward the IDLE CUT-OFF position - but do not let the engine stop. Steadily move the mixture control lever to the FULL RICH position - while monitoring the tachometer.

(4) An increase of more than 35 rpm during leaning is an indication of excessively rich idle mixture. An immediate decrease in rpm (without an initial momentary increase) is an indication that the idle mixture is too lean.

(5) Rotate the Idle Mixture Adjustment knob in the applicable direction to lean out or enrich the fuel/air mixture.

NOTICE: You must run-up the engine to 2000 rpm to clear the engine each time you turn the Idle Mixture Adjustment knob to adjust the idle speed mixture.

(6) After the adjustment, run up the engine again to 2000 rpm. Complete the previous steps until the idle speed mixture check shows a momentary increase of approximately 10 to 25 rpm.

(7) Make the final idle speed adjustment for the desired idling rpm with a closed throttle.

(8) If the idle speed mixture setting is not stable after repeated attempts, complete a check of the idle linkage, and look for loose connections which could cause erratic idling. Also take into account weather conditions and field altitude which could affect the idle speed mixture adjustment.

7. Engine Mount Inspection Procedure

   A. Examine the engine mounts for cracks.

   B. Examine the engine mounts for looseness of the engine and mounting. Tighten any loose hardware. Refer to the airframe manufacturer's instructions.

   C. Examine the rubber engine mounts and mounting hardware for signs of deterioration or damage. Replace engine mounts or hardware in accordance with airframe manufacturer's instructions.

   D. After the first 100 hours of operation, make sure that the engine mounting bracket-attaching nuts and bolts are torqued correctly. For torque values, refer to the airframe manufacturer's instructions.

8. Return to Service Procedure

   Before you return a reciprocating engine-powered aircraft to service, operate the engine to make sure that it operates in accordance with specifications in Appendix A of the ***YO-233-B2A Engine Installation and Operation Manual***.

   — Power output (static and idle rpm)
   — Fuel and oil pressure
   — Cylinder and oil temperatures

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72-20 - RECIPROCATING ENGINE – CRANKCASE

1. Crankcase System Description

   A. Refer to the ***YO-233-B2A Engine Installation and Operation Manual***.

2. Crankcase Maintenance

   A. Table 1 shows the crankcase maintenance schedule of inspection and section reference.

Table 1
Crankcase Maintenance Items

Maintenance Item	Usual Maintenance Necessary	Referenced Chapter
Crankcase Inspection	Every 100 hours of engine operation	"Crankcase Inspection Procedure" in this Chapter 72-20

3. Crankcase Inspection Procedure

   A. The crankcase inspection is done every 100 hours of engine operation to make sure that hardware fasteners are torqued correctly and to identify any oil leaks, cracks, and mechanical damage on the crankcase that must be corrected before putting the engine back into service.

   WARNING: IF A CRACKED CRANKCASE IS NOT REPLACED, OIL CAN LEAK OUT OF THE CRANKCASE AND CAUSE ENGINE FAILURE.

   B. Examine the exterior surface of the crankcase for cracks and damage. A crankcase with one or more cracks must be replaced. Refer to the Direct Drive Overhaul Manual.

   C. Examine the crankcase breather for cracks, dents, and damage. Replace a cracked, dented or damaged breather. Refer to the Direct Drive Overhaul Manual.

   D. Examine the ends of the breather tube for scoring and out of roundness.

   E. Examine the crankcase through bolts to make sure the threads are not striped and the bolts are torqued correctly. Replace any hardware that is distorted or has stripped threads. Refer to the latest revision of the ***Service Table of Limits - SSP-1776***, for torque values.

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72-30 - RECIPROCATING ENGINE – CYLINDER INSPECTIONS

1. General

   A. Cylinder inspections include the regularly scheduled procedures in Table 1, and in this chapter. Complete the Inspection Checklists in Chapter 05-20 of this manual.

Table 1
Regularly Scheduled Cylinder Inspections

Procedure	Frequency
Visual Cylinder Inspection	After every 100 hours of engine operation
Cylinder Compression Check	After every 100 hours of engine operation
Visual Baffle Inspection	After every 100 hours of engine operation
Cylinder Borescope Inspection	After every 400 hours of engine operation

NOTICE: For cylinder barrel inspection, refer to the Direct Drive Overhaul Manual.

   B. Refer to Table 4 for an analysis of cylinder inspection results and corrective action. Record all findings on a copy of the 100-Hour, and 400-Hour Engine Inspection Checklists as records of inspection and any corrective action in the engine logbook.

2. Visual Cylinder Inspection

   A. Examine the cylinder and cylinder head (Figure 1) thoroughly for cracks, leaks, rust, pitting and/or damage. Replace a damaged, rusted, pitted, leaky or cracked cylinder per instructions in this chapter.

   B. Look for loose or damaged crankcase thru-studs and cylinder hold-down studs. Replace with appropriate oversize studs per Appendix A.

   C. Look for loose or damaged spark plug Heli-Coil® inserts. If a loose or damaged Heli-Coil® is found, replace the Heli-Coil® per the "Heli-Coil® Replacement" procedure in this chapter.

   D. Look for cracked or broken fins and baffles (Figure 1). If a cooling fin adjacent to the exhaust port flange is cracked, a 3/16 in. diameter hole can be drilled as a stop, under the following conditions:

   - The end of the crack is at least 1/4 in. (6.35 mm) from the base of the metal; or
   - The cracked area can be removed from the fin, provided the maximum removal is no more than one-half the total fin width; or
   - No burrs or sharp edges are in evidence; or
   - The minimum fillet at the root of the removed portion of the fin has a 1/4 in. (6.35 mm) radius, and the minimum corner at the top of the fin adjacent to the removed portion has a 1/2 in. (12.7 mm) radius; or
   - There is no more than one crack per fin and its depth is not more than 1/4 in. (6.35 mm) from the base of the metal, and a fin stabilizer is used to reduce vibration and prevent further deepening of the crack.

- If a cooling fin is damaged, broken or bent, the bent area must not exceed 3/8 in. (9.53 mm) nor the break be 3/8 in. (9.53 mm) deep, or:
  (1) There cannot be more than four blended fins on the push rod side of the head, or
  (2) No more than six blended fins on the anti-push rod side of the head.
- If a radial fin crack extends to the root of the fin, replace the cylinder.

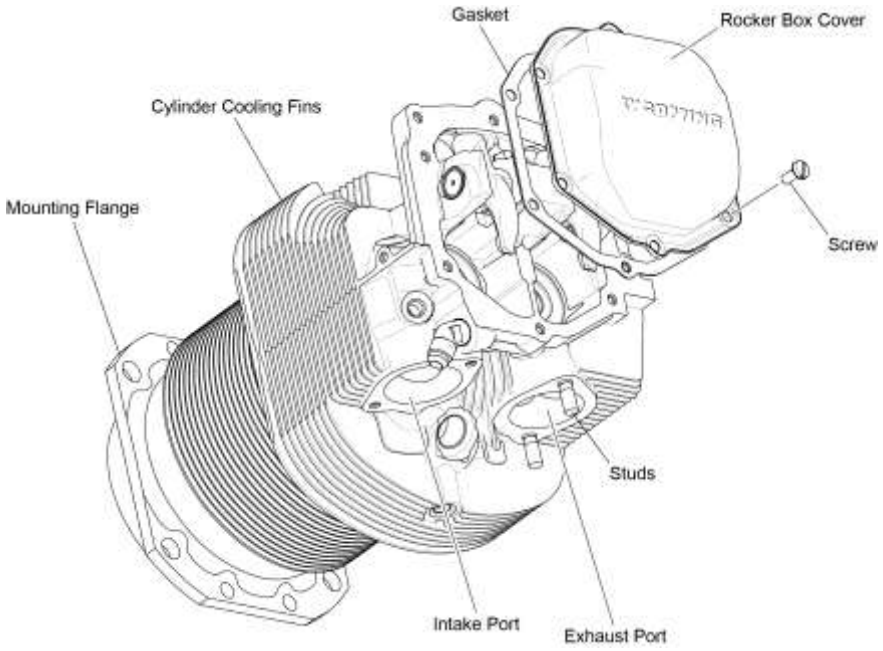


Figure 1
Engine Cylinder on YO-233-B2A Engines

3. Cylinder Compression Check

   A. The Cylinder Compression Check is done on an installed engine and measures pressure leakage through the combustion chamber using a regulated pressure source and tester. It is essentially a cylinder leak-check procedure as an initial inspection of the condition of the engine cylinders. This procedure compares the static leak rate of the cylinder with the leak rate through an orifice of a specified range.

   B. The Cylinder Compression Check on the engine cylinders must be done at the following times or if the engine has any of these conditions:

   - After every 100 hours of engine operation or annual inspection
   - Loss of power or unsteady power
   - Difficulty starting
   - Increased oil consumption
   - Other indications of unusual operation.

   A differential compression tester (Figure 2), attached to pressure gages, is used for the Cylinder Compression Check. This tester operates with a given airflow through a fixed orifice and measures constant pressure drop across that orifice. This Cylinder Compression Check identifies leaks caused by incorrect valve seating, worn piston rings, damaged pistons or damaged cylinders. The static leak rate can indicate the condition of the parts in the combustion chamber. The leak rate is measured when pressure drops.

NOTICE: The orifice size of the differential compression tester is critical for consistent and meaningful cylinder analysis. A specific orifice size of 0.040 in. diameter (No. 60 drill) x 0.250 in. long, with entrance angle of 59°/60° supplies an acceptable calibrated leak rate. Larger orifice sizes can decrease the effectiveness of identifying problems.

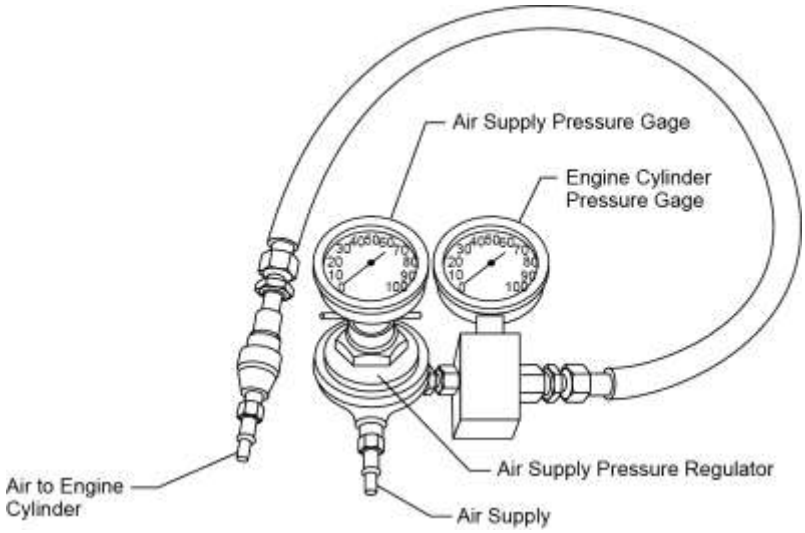


Figure 2
Example of a Differential Compression Tester

(1) All differential compression testers must be in compliance with these specifications:

- 0.250 in. long restrictor orifice
- 0.040 in. ID (No. 61 drill) orifice diameter
- 60° entrance angle

(2) Make sure that all of the gages to be connected to the differential compression tester are calibrated in accordance with the differential compression tester's manufacturer's specifications.

(3) Refer to the differential compression tester's manufacturer's instructions to ensure the tester operates correctly.

C. Cylinder Compression Check Procedure

NOTICE: Make sure the differential compression tester has been calibrated and the equipment check is complete per previous steps before this cylinder compression check.

This check is to be done on an engine installed in the airframe or test stand without interruption while the cylinder is still warm.

(1) Immediately before the Cylinder Compression Check:

(a) Operate the engine at usual cylinder head and oil temperatures (specified in Appendix A of the ***YO-233-B2A Engine Installation and Operation Manual***).

(b) Move the throttle to the CLOSED position and the mixture control to the IDLE-CUT-OFF position to shut down the engine.

(c) Move the Ignition switch to the OFF position.

(d) Make sure that the aircraft master switch and fuel supply switches are all in the OFF position.

(e) After the engine is shut down, complete the Cylinder Compression Check immediately to get an accurate measurement.

(f) Set the aircraft brakes and install the wheel chocks.

⚠ **CAUTION** TAKE ALL NECESSARY PRECAUTIONS AGAINST ACCIDENTAL ROTATION OF THE CRANKSHAFT/PROPELLER TO PREVENT INJURY.

(2) Disable power to the engine.

⚠ **CAUTION** IGNTION LEADS AND SPARK PLUGS ARE VERY HOT. IN THE NEXT STEP, WEAR PERSONAL PROTECTIVE GEAR TO PREVENT BURNS.

(3) Disconnect all of the spark plugs leads per the "Spark Plug Removal" procedure in Chapter 74-20.

(4) Remove a spark plug from each cylinder. Discard the spark plug gasket.

⚠ **CAUTION** USE GLOVES OR RAGS TO PROTECT HANDS WHILE HOLDING THE PROPELLER BLADE.

(5) Turn the crankshaft by hand in the direction of propeller rotation to put the piston in a position as close to Top Dead Center (TDC) on the compression stroke as possible.

(6) Install the threaded end of an adapter with a coupling end in the spark plug hole of the cylinder to be tested.

(7) Make sure that the air valve on the differential compression tester is in the CLOSED position.

⚠ **CAUTION** BEFORE CONNECTION OF THE COMPRESSION TESTER, MAKE SURE THAT THE AIR SUPPLY REGULATOR DOES NOT SHOW MORE THAN 80 PSI (552 KPA) OF AIR PRESSURE. EXCESSIVE AIR PRESSURE CAN CAUSE THE PROPELLER TO TURN. KEEP CLEAR OF THE ROTATIONAL RADIUS OF THE PROPELLER.

NOTICE: Operate the differential compression tester per the manufacturer's instructions.

(8) Connect the differential compression tester to a clean source of compressed air.

(9) Adjust the regulator of the compression tester to 0 psi (0 kPa) on the regulated pressure gage.

(10) Connect the differential compression tester to the adapter in the spark plug hole of the cylinder to be tested.

(11) One mechanic holds the propeller firmly in place, to prevent crankshaft rotation, while the other mechanic opens the cylinder pressure valve in the next step.

WARNING IN THE NEXT STEP, HOLD THE PROPELLER FIRMLY WHEN OPENING THE AIR VALVE ON THE DIFFERENTIAL COMPRESSION TESTER. PENT-UP AIR PRESSURE IN THE CYLINDER COULD CAUSE THE CRANKSHAFT TO TURN.

(12) Slowly open the air valve on the differential compression tester and increase the pressure to the cylinder to 15 to 20 psi (103 to 138 kPa).

(13) Listen for escaping air. If escaping air is heard, refer to Table 2 to identify and correct the cause.

(14) Continue to turn the propeller in the usual direction of rotation against the 15 to 20 psi (103 to 138 kPa) pressure until the piston reaches TDC evident by a sudden decrease in the force necessary to turn the propeller.

NOTICE: If you turn the propeller past TDC, back up the rotation at least one revolution and repeat the previous step to prevent backlash and to keep the piston rings in position.

(15) With the piston at TDC, one mechanic holds the propeller securely while the other mechanic opens the air valve slowly and completely. Gradually increase the air supply pressure up to 80 psi (552 kPa). As the pressure increases, the other mechanic must move the propeller back and forth slightly with a rocking motion to make sure that the piston rings are seated.

(16) Record the pressure reading on the engine cylinder pressure gage. The difference between the engine cylinder pressure gage reading and the pressure shown on the air supply pressure gage reading is the amount of leakage through the cylinder.

(17) The minimum approved engine cylinder pressure reading is 60 psi (414 kPa). Maximum approved leakage is 25% (20 psi (138 kPa) of the 80 psi (552 kPa) regulated pressure).

(18) Close the air valve and disconnect the differential compression tester from the engine cylinder and connect it to the spark plug hole of the next engine cylinder to be tested.

NOTICE: Pressure readings for all of the engine cylinders are to be nearly equal. Refer to Table 2.

(19) Complete the previous steps for each of the remaining engine cylinders.

(20) Refer to Table 2 for a summary of the Cylinder Compression Check results and corrective action. Corrective action in Table 2 applies to procedures in this chapter.

D. Review and analyze the results. Take any necessary corrective action.

E. Record the results of the Cylinder Compression Check for each cylinder on the 100-Hour or Annual Engine Inspection Checklist (in Chapter 05-20).

F. After all service is complete, examine and install the spark plugs with a new gasket and connect the ignition leads to the spark plugs per the following procedures in Chapter 74-20.

- Spark Plug Inspection
- Ignition Lead Inspection
- Spark Plug Gap Setting
- Spark Plug Rotation
- Spark Plug Installation
- Ignition Harness Installation

Table 2
Summary of Cylinder Compression Check Results and Corrective Action

Results	Indication	Corrective Action
Differential pressure of **70 psi (483 kPa) or more** for an engine cylinder	Satisfactory	No corrective action necessary.
Differential pressure of **60 to 69 psi** (**414 to 441 kPa**) for an engine cylinder	Wear has occurred	Complete the Cylinder Compression Check again after the next 100-hour engine operating interval - record results. Monitor the differential pressure.
Differential pressure of less than **60 psi (413 kPa)** for an engine cylinder	Cylinder worn or not in conformance	Either manually turn the crankshaft three times or start the engine and operate for 3 minutes, stop the engine, and repeat the Cylinder Compression Check. If the results of the second Cylinder Compression Check are too low, listen for airflow at the exhaust and intake ports. Identify all of the causes and complete the necessary corrective action.
Difference of **5 psi (34 kPa)** or less between engine cylinders (Pressure readings for all engine cylinders must be nearly equal.)	Satisfactory	No corrective action necessary.
Difference of **6 to 15 psi (41 to 103 kPa)** between engine cylinders		Repeat the Cylinder Compression Check after the next 10 hours of engine operation. A valve can reseat itself and show satisfactory compression again. If the difference remains between **6 to 15 psi (41 to 103 kPa)** after the second Cylinder Compression Check, identify all of the causes and complete the necessary corrective action.
Difference of more than **15 psi (104 kPa)** between engine cylinders		Start and operate the engine for 3 minutes, stop the engine, and repeat the Cylinder Compression Check. If the differential pressure between engine cylinders is still more than **15 psi (104 kPa),** complete the necessary corrective action for each individual cylinder.
Air escaping at spark plug spot face	Fluorescent Penetrant Inspection of area shows cracks	Replace the cylinder with a cylinder kit.
Leak check at the spark plug port seals (using a soap solution) shows bubbling around spark plug port seal.	Heli-Coil® insert requires replacement	Complete the "Heli-Coil® Replacement" procedure in this chapter.

Table 2 (Cont.)
Summary of Cylinder Compression Check Results and Corrective Action

Results	Indication	Corrective Action
Air discharge at cylinder head-to-barrel juncture or between barrel fins.		Replace the cylinder with a cylinder kit.
Air discharged through the breather or oil level gage tube	Leakage in the area of the piston and rings.	Complete the "Piston Inspection" in this chapter.
Air discharged through the intake system	Cracked cylinder	Replace the cylinder with a cylinder kit.
	Intake valve and/or seat worn or burnt Leakage at the intake valve	Examine the intake valve and valve seat for wear or burns.* Replace worn or burnt intake valve or intake valve seat.*
Air discharged through the exhaust system	Cracked cylinder	Replace the cylinder with a cylinder kit.
	Exhaust valve and/or seat worn or burnt Leakage at the exhaust valve	Examine the exhaust valve and valve seat for wear or burns.* Replace worn or burnt exhaust valve or exhaust valve seat.*
* Either replace the cylinder or send the engine cylinder to an authorized vendor to replace the valve seat.		

4. Intercylinder Baffle Inspection

NOTICE: This inspection can be done while the intercylinder baffles are installed on the engine.

A. This inspection is done during the visual inspection to look for premature cylinder deterioration and make sure that intercylinder baffles are correctly fitted and installed. The intercylinder baffles are necessary to prevent rapid deterioration of the cylinders and other engine components because they transfer heat in piston engines. To ensure this cooling, the intercylinder baffles must be installed intact and operating correctly.

B. Intercylinder Baffle Inspection Procedure

(1) Examine the intercylinder baffle (Figure 3) and surrounding components for damage, holes, cracks, wear, deterioration, and incorrect position. Replace a damaged, worn, cracked or deteriorated intercylinder baffle per the "Intercylinder Baffle Removal" and Intercylinder Baffle Installation" procedures in this chapter.

(2) Tighten any loose intercylinder baffle fasteners per the latest revision of the ***Service Table of Limits SSP-1776***.

(3) Correct the intercylinder baffle position as necessary.

(4) Record results of this inspection and any corrective action taken on the Visual Inspection Checklist in Chapter 05-20.

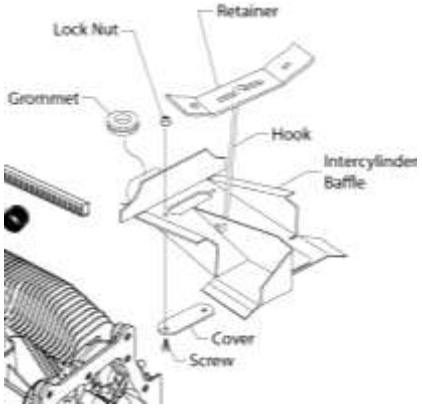


Figure 3
Intercylinder Baffle

5. Cylinder Borescope Inspection

WARNING DURING A CYLINDER BORESCOPE INSPECTION, MAKE SURE THAT THE IGNITION SWITCH IS TURNED OFF AND THAT POWER TO THE ENGINE IS DISCONNECTED.

AS A PRECAUTION, DO NOT STAND OR ALLOW ANYONE TO STAND WITHIN THE ROTATIONAL ARC RADIUS OF THE PROPELLER. MAKE SURE THE ENGINE IS COOL.

A. The cylinder borescope inspection is done to examine the inner walls of the engine cylinders for rust, deposits and unusual wear patterns of the combustion chamber, valve, piston top, and the cylinder barrel without removing the engine cylinder.

B. When to complete the Cylinder Borescope Inspection:

(1) Repeatedly high oil consumption is excessive

(2) 400-hour inspection

(3) After an engine overspeed

(4) Low cylinder compression

(5) If valve sticking is suspected (refer to the "Corrective Action for Valve Sticking" section in this chapter)

(6) Worn piston rings or worn cylinder barrel

(7) Insufficient combustion

C. Cylinder Borescope Inspection Procedure

(1) Remove a top spark plug from each cylinder per the "Spark Plug Removal" procedure in Chapter 74-20.

(2) Put the piston at bottom dead center on the power stroke.

(3) Install the borescope through the vacant top spark plug hole on the engine cylinder and examine the combustion chamber, the top of the piston, the internal surfaces of each cylinder, including the exhaust valve and exhaust valve seat. Complete inspection steps in Table 3.

(4) Remove the borescope from the cylinder.

(5) Put the piston at bottom dead center at the end of the intake stroke.

(6) Install the borescope through the vacant spark plug hole and examine the intake valve and intake valve seat. Complete inspection steps in Table 3. Unless otherwise shown, corrective action in Table 3 applies to procedures in this chapter.

(7) Reinstall the spark plug in the cylinder per the "Spark Plug Installation" procedure in Chapter 74-20.

(8) Record all results and corrective action in the 400-Hour Engine Inspection Checklist in Chapter 05-20 or the engine logbook.

Table 3
Borescope Inspection Steps, Results and Corrective Action

Inspection Step	If these are the results…	Take this corrective action…
Examine valve seat inserts for scoring, pitting, erosion, burning or damage	Eroded, scored, burnt, pitted or damaged valve seats	Replace the cylinder or send the engine cylinder to an authorized vendor to replace the valve seat.
Examine spark plug Heli-Coils® for protrusion into the combustion chamber	Spark plug Heli-Coil® protrudes into combustion chamber	Replace the Heli-Coil® per the "Heli-Coil® Replacement" procedure in this chapter.
Look for discoloration on the circumference of the exhaust valve face	Discoloration on the circumference of the exhaust valve face	Remove and examine the exhaust valve.
Look for cracks and erosion on the exhaust valve face	Cracks or erosion on the exhaust valve face	Replace the exhaust valve.
Look for discoloration on the circumference of the intake valve face	Discoloration on the circumference of the intake valve face	Remove and examine the intake valve.
Look for cracks and erosion on the intake valve face	Cracks or erosion on the intake valve face	Replace the intake valve.
Examine the cylinder bore for scoring, rubbing, or corrosion	Scoring or piston rub or corrosion on cylinder bore	Remove and examine the engine cylinder.
Look for excessive oil in the cylinder	Excessive oil in the cylinder	Remove and examine the engine cylinder. Remove and examine the oil suction screen and the oil filter per instructions in Chapter 12-10.
Examine the piston crown for erosion or damage	Erosion or damage on piston crown	Remove the engine cylinder and examine the piston.

6. Exhaust Valve and Guide Inspection

   On YO-233-B2A engines, this inspection is to be done after every 1000 hours of engine operation or earlier if valve sticking is suspected.

   NOTICE: If valve sticking is a problem, this inspection must be done every 400 hours. Refer to "Corrective Action for Valve Sticking" in this chapter.

   Sticking between the valve stem and guide (on intake and exhaust valves) can substantially change valve opening and closing. If the valve cannot open or close correctly, incomplete combustion will occur, which can cause formation of more deposits and increased valve sticking. Because a correctly-timed sequence of valve opening and closing is essential to efficient and reliable engine operation, the cause of valve sticking must be identified and corrected.

WARNING A STUCK VALVE CAN CAUSE ENGINE DAMAGE.

NOTICE: If one valve is sticking, examine all intake and exhaust valves on all of the engine cylinders.

The exhaust valve and guide must be examined to measure valve stem movement to identify excessive wear (bell-mouthing) of the exhaust valve guide and carbon build-up between the valve guide and valve stem which can cause valve sticking.

Refer to the latest revision of Service Bulletin No. SB-388, Service Instruction No. SI-1485, and Service Letter L197 for additional details.

NOTICE: The Gage (ST-71) is used to examine parallel-type valves on engine cylinders. Although the Gage (ST-71) and a feeler gage can be used to measure valve stem movement, a modified ST-71 (Figure 4) and a dial indicator are a faster and easier means to measure valve stem movement, valve guide wear, and carbon build-up per this procedure.

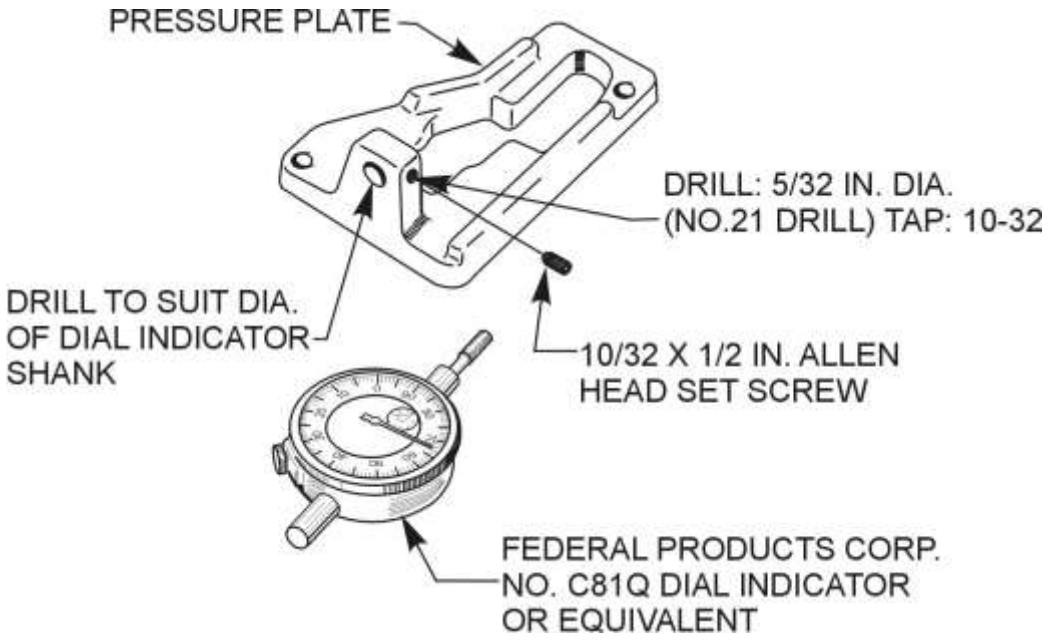


Figure 4
Details for Modifying Tool P/N ST-71
for Use with a Dial Indicator

NOTICE: Do not intermix valve and cylinder components between cylinders. Re-install serviceable parts in the same cylinder.

A. Examine the exhaust valve and guide on each cylinder as follows:

(1) Disconnect power to the engine.

(2) Make sure the engine is cool.

(3) Remove one of the spark plugs from the cylinder per the “Spark Plug Removal” procedure in Chapter 74-20.

(4) Turn the crankshaft to position the piston at Top Dead Center (TDC) of the compression stroke.

(5) Remove the screws, rocker box cover (Figure 1) and gasket from the cylinder head. Discard the gasket.

(6) Remove the thrust button from the exhaust side of the valve rocker shaft (Figure 5) and push the valve rocker shaft toward the intake side enough to remove the exhaust rocker assembly.

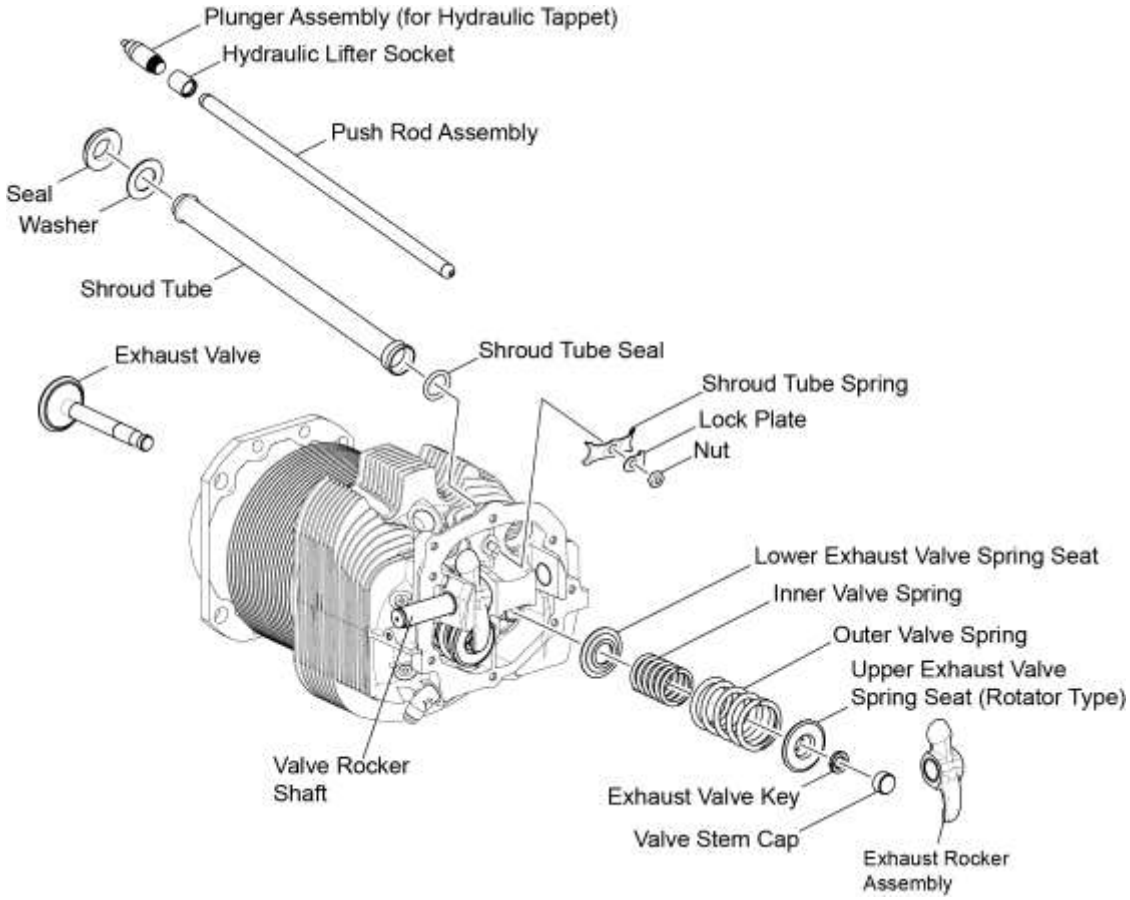


Figure 5
YO-233-B2A Engine Valve Components

(7) Remove the exhaust rocker assembly.

(8) Remove the valve stem cap from the exhaust valve.

(9) Turn the crankshaft to position the piston at the bottom of the compression stroke.

(10) Insert about 8 ft. (2.4 m) of 3/8-inch nylon rope through the spark plug hole; turn the crankshaft until the piston moves the rope snuggly against the exhaust valve.

(11) Use a Valve Spring Compressor (ST-25) to compress the exhaust valve springs and remove the exhaust valve key. (The rope inserted in the combustion chamber in the preceding step provides a base to support the valve.)

(12) Examine the exhaust valve key which tends to wear in uniform distinctive patterns. Replace a worn or damaged valve key. If the key does not need to be replaced, use a Valve Spring Compressor (ST-25) to compress the exhaust valve springs and install it in the same position from where it was removed.

(13) Turn the crankshaft to position the piston at the bottom of the compression stroke and remove the rope from the cylinder.

⚠ **CAUTION** DO NOT MIX PLUNGER ASSEMBLIES WITH DIFFERENT PART NUMBERS IN THE SAME ENGINE. DIFFERENT PLUNGERS HAVE VARYING LEAK DOWN RATES WHICH CAN CAUSE INCORRECT ENGINE OPERATION.

(14) Remove the nut, lockplate, and shroud tube spring (Figure 5). Discard the lockplate.

(15) Remove the exhaust side push rod assembly, shroud tube, hydraulic lifter socket, and plunger assembly.

(16) Remove the washer and seal from the cup in the exhaust side tappet bore of the crankcase, and shroud tube seal from the engine cylinder. Discard the seals.

NOTICE: Do not confuse "valve spring seats" with "valve seats," valve spring seats (Figure 5) are metal disks installed on the ends of the valve springs in the rocker box and are field replaceable. Valve seats (Figure 15) are installed inside the cylinder at the surface where the intake or exhaust valve rests during engine operation when that valve is closed. Valve seats only can be replaced by an authorized vendor.

(17) Use a cloth dampened with mineral spirits to wipe the oil from the top surface of the upper exhaust valve spring seat (Figure 5).

(18) Loosen the screws identified in Figure 6 to prevent the screw from touching the Gage Adapter (ST-71-8) when installed on the valve stem.

(19) Install the Gage (ST-71) on the valve on the cylinder head as shown in Figure 6.

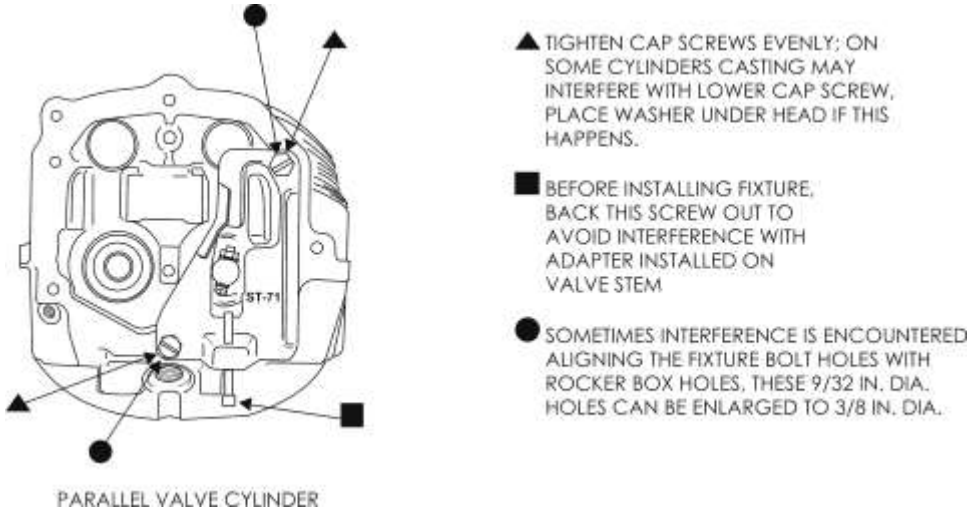


Figure 6
Gage ST-71 Installation on the Cylinder Head

(20) Install the Gage Adapter (ST-71-8) over the top of the exhaust valve stem (Figure 7). Make sure it is tight.

NOTICE: If you can move the Gage Adapter (ST-71-8) on the exhaust valve stem with your hand, it is incorrectly installed.

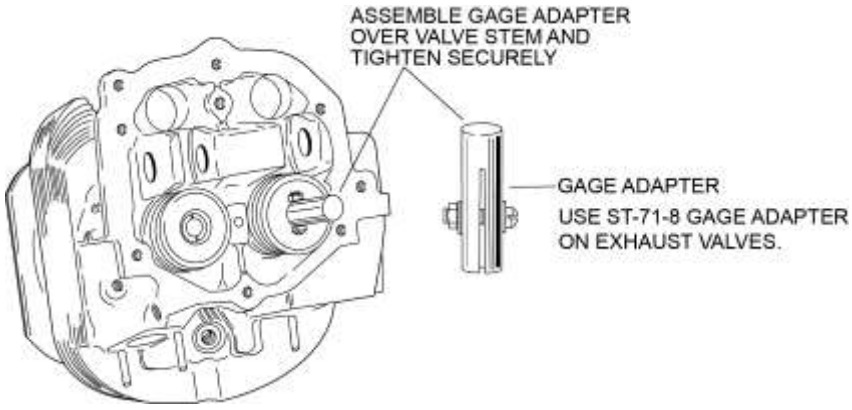


Figure 7
Gage Adapter (ST-71-8) Assembled on Exhaust Valve

(21) Push the exhaust valve stem and Gage Adapter (ST-71-8), against the upper exhaust valve spring seat as far as they will go.

(22) Put the blade of a screwdriver in the area between the exhaust valve spring and Gage (ST-71).

(23) Use the screwdriver to push the valve the maximum distance away from the dial indicator as shown in Figure 8.

(24) Move the dial indicator toward the adapter post until the indicator is preloaded approximately 0.010 in. (0.254 mm), and lock it in place with the set screw (Figure 8).

(25) Adjust the dial of the indicator to read "0" (zero) as shown in Figure 8.

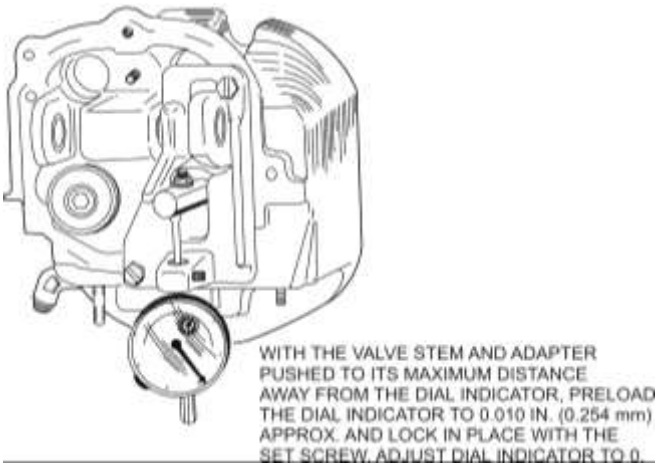


Figure 8
Dial Indicator

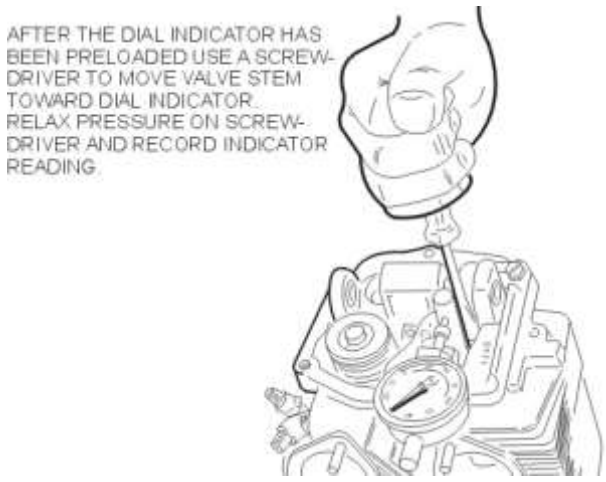


Figure 9
Pushing Valve Stem and Adapter Post Toward Dial Indicator

(26) Insert the screwdriver between the Gage (ST-71) and valve spring on the opposite side and push the valve spring toward the dial indicator as shown in Figure 9.

(27) Relax the screwdriver and record the reading on the dial indicator. For the exhaust valve guide to be acceptable, the measurement must be within the specified limits in the latest revision of the ***Service Table of Limits - SSP-1776.***

- If the measurement is greater than the specified limit, either replace the cylinder or send the cylinder to an authorized vendor who can replace the valve guide.
- If the measurement is less than the specified limit, ream the valve guide per instructions in the latest revision of Service Instruction No. SI-1425.

(28) Move the piston to near its top end of travel.

(29) Remove the Gage Adapter (ST-71-8) from the valve stem.

(30) Loosen each cap screw in the Gage (ST-71) (Figure 6) in small equal increments to decrease pressure on the valve spring slowly and equally.

(31) Remove the Gage (ST-71) from the cylinder.

NOTICE: Make sure the plunger assembly is clean and dry. There must be no oil in the plunger assembly.

(32) Examine and install an acceptable plunger assembly and hydraulic lifter socket (Figure 5) in the exhaust side tappet bore of the crankcase. Refer to the latest revision of Service Instruction SI-1011 for plunger assembly inspection guidelines.

(33) Apply engine oil mixture (15% pre-lubricant (STP or equivalent) and 85% SAE No. 50 mineral base aviation grade lubricating oil) to the new seal and shroud tube seal (Figure 5).

(34) Install a new seal and the washer into the cup in the exhaust side tappet bore of the crankcase.

(35) Assemble the new shroud tube seal over the outer end of the shroud tube.

(36) Insert the shroud tube through the hole in the rocker box and seat the end firmly into the crankcase.

(37) Install the shroud tube spring, new lockplate, and nut. Torque the nut to 96 in.-lb. (11 Nm).

NOTICE: If necessary, turn the nut up to one additional hex to align the flat on the nut with the tab on the lockplate.

(38) Ensure the flat on the nut aligns with the lockplate tab and bend the tab up. Lockplate tabs must not be bent up on the corner of the nut.

(39) Make sure that the valves are closed with the piston at TDC of the compression stroke.

(40) Use a brush and apply a mixture of 15% STP or equivalent and 85% SAE No. 50 mineral-based aviation-grade lubricating oil to 1-inch (2.54 cm) of both ends of the push rods. Refer to the latest revision of Service Instruction No. SI-1059 for any new details.

(41) Install the push rod assembly into the full length of the shroud tube.

(42) Press the push rod tightly from the outer end of the shroud tube to test the spring tension and free travel of the unloaded or dry hydraulic tappet plungers. Make sure the springs compress and return.

NOTICE: The valve stem cap (Figure 5) is only on the exhaust valve stem.

(43) Install the valve stem cap (Figure 10) on the exhaust valve stem.

(44) Install the exhaust rocker assembly (Figure 5).

(45) Push the valve rocker shaft through the exhaust valve rocker assembly (Figure 5) and install the thrust button on the exhaust side of the valve rocker shaft.

(46) Complete a dry tappet clearance check per the "Push Rod Installation" section in this chapter.

(47) Install the screws, rocker box cover with a new gasket on the cylinder head (Figure 1). Torque the screws per the Special Torque Requirements Table in the latest revision of the ***Service Table of Limits - SSP-1776.***

Figure 10
Exhaust Valve Stem Cap

(48) Repeat this exhaust valve and guide inspection for all cylinders, beginning with step (3) through this step.

(49) Enable power to the engine.

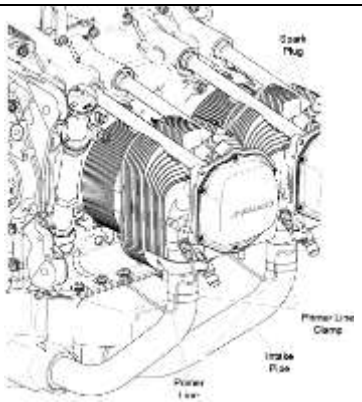
(50) Complete the "Operational Ground Check" in Chapter 72-00

(51) Record all of the results in the 1000-Hour Inspection Checklist for YO-233-B2A Engines in Chapter 05-20.

7. Cylinder Removal

A. Disable all power to the engine and disconnect the engine wiring harness from the airframe.

B. If not already done:

• Remove airframe components to enable cylinder removal	Airframe Maintenance Manual
• Drain the oil from the oil sump. • Disconnect the ignition leads to the spark plugs. Remove the top and bottom spark plugs from the cylinder.	"Oil Change Procedure" in Chapter 12-10 "Spark Plug Removal" procedure in Chapter 74-20.
• Remove the clamps that attach the primer line to the intake pipe, disconnect the primer line from the primer nipple assembly (Figure 11), put a cap on the end of the primer line and the primer nipple assembly.	 **Figure 11** **Spark Plugs, Intake Pipes, and Primer Lines**
• Remove the intake and exhaust pipes from the cylinder to be removed.	"Intake Pipe Removal" procedure in Chapter 72-80 and the airframe manufacturer's instructions.

C. Oil Drain Tube Removal

NOTICE: There are different part numbers for some of the oil drain tube assemblies. Apply a label to identify the location of each oil drain tube, in case the drain tube is to be replaced. Refer to the ***YO-233-B2A Illustrated Parts Catalog*** for the correct part number for the oil drain tube.

(1) Remove the hose clamps (Figure 12) from the hose attached to the oil drain tube assembly.
(2) Disconnect the hose from the nipple.
(3) Disconnect the drain tube fitting from the engine cylinder.
(4) Remove and discard the hose.
(5) Remove the oil drain tube assembly from the cylinder.
(6) Examine the oil drain tube for cracks or damage.
(7) Replace a cracked or damaged drain tube assembly.

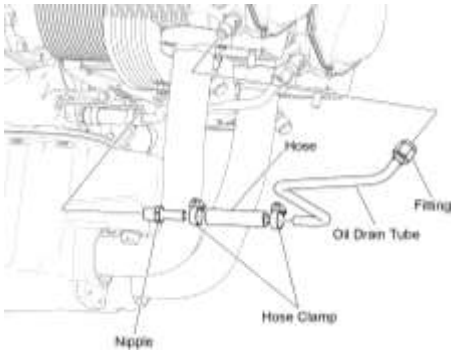


Figure 12
Oil Drain Tube

NOTICE: Remove the cylinders by firing order 1-3-2-4 (Figure 13). Remove each cylinder as an assembly.

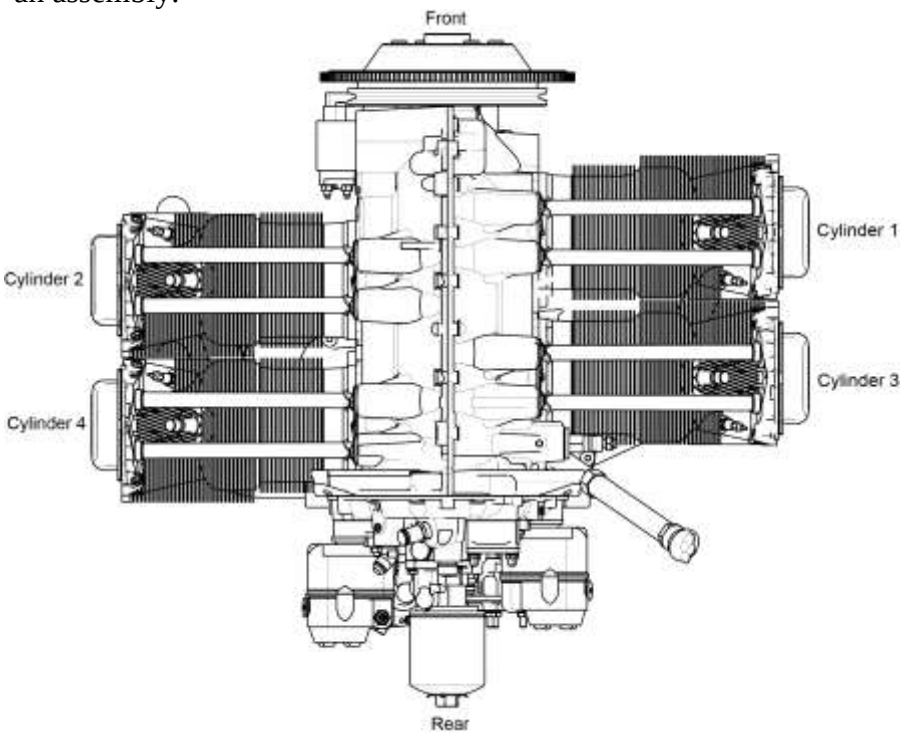


Figure 13
Engine Cylinder Firing Order

NOTICE: During cylinder removal, identify and label the cylinder, piston, and other parts by location (i.e., cylinder number) as they are removed for reference on assembly (to ensure that each serviceable part is installed in the same location from which it was removed).

D. Intercylinder Baffle Removal

(1) Turn the baffle retainer hook to disengage the retainer on the intercylinder baffle (Figure 14).

(2) Remove the intercylinder baffle and hook from between the cylinders.

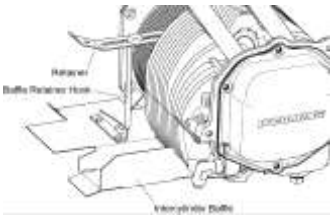


Figure 14
Intercylinder Baffles

NOTICE: Do not intermix valve and cylinder components between cylinders. Re-install serviceable parts in the same cylinder.

E. Remove the screws from the rocker box cover (Figure 1).

NOTICE: A silicone rocker box cover gasket can be reused if it is not damaged.

F. Remove the rocker box cover and gasket. Discard a cork gasket.

G. Turn the crankshaft to put the piston at TDC of the compression stroke of the cylinder to be removed. (With the piston in this position, both intake and exhaust valves are closed and the piston is extended away from the crankcase to prevent damage when the cylinder is removed.)

H. Remove both thrust buttons from the ends of the valve rocker shaft (Figure 15).

I. Remove the valve rocker shaft and valve rocker assemblies.

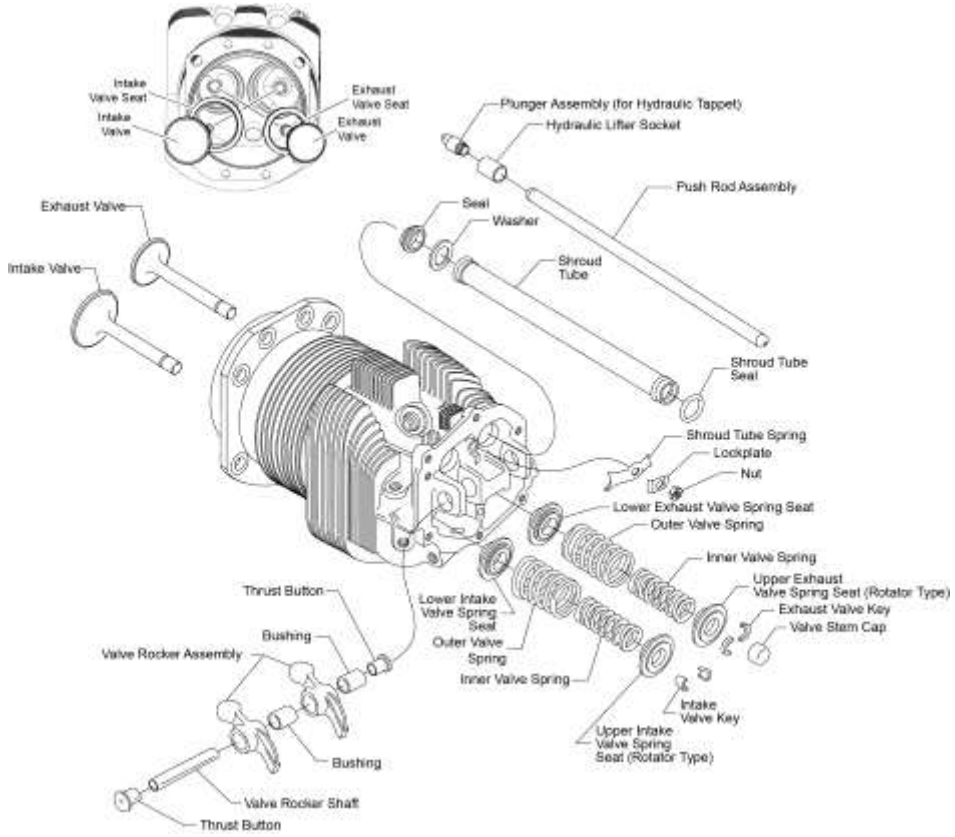


Figure 15
YO-233-B2A Engine Valve Components

J. Remove push rods and the valve stem cap from the exhaust valve.
K. Remove the nut, lockplate, and shroud tube spring (Figure 15). Discard the lockplate.
L. Remove the shroud tubes through the rocker box.
M. Remove the shroud tube seals from the ends of the shroud tubes. Discard the seals.
N. Remove the washers, seals, hydraulic lifter sockets, and plunger assemblies from the crankcase. Discard the seals.
O. Remove the cylinder base hold-down nuts (Figure 16).

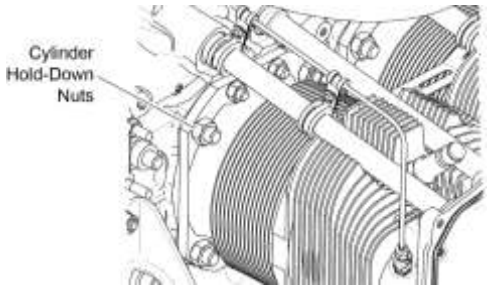


Figure 16
Cylinder Base Hold-Down Nuts

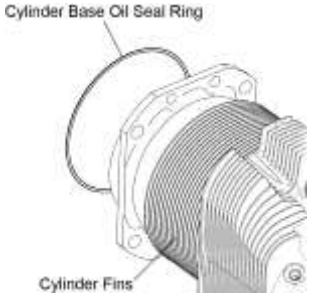


Figure 17
Cylinder Base Oil Ring and Cylinder Fins

⚠ **CAUTION** AS EACH CYLINDER IS SEPARATED FROM THE CRANKCASE, CATCH AND HOLD THE PISTON TO PREVENT IT FROM FALLING AGAINST THE CRANKCASE AND BEING DAMAGED.

P. Remove the cylinder.
Q. Remove and discard the cylinder base oil seal ring from the cylinder (Figure 17).

⚠ **CAUTION** IF A CYLINDER IS NOT TO BE IMMEDIATELY INSTALLED ON THE CRANKCASE, INSTALL TORQUE HOLD-DOWN PLATES (ST-222) TO MAINTAIN THE PRE-LOAD ON THE MAIN BEARINGS.

R. After piston removal, examine the connecting rod bushing for damage, wear, or distortion per the "Connecting Rod Inspection Checklist for YO-233-B2A Engines" in Chapter 72-20.

8. Piston Removal

NOTICE: During removal of each piston pin (Figure 18), the piston will disconnect from the connecting rod.

A. Support the piston and remove the two piston pin plugs (Figure 18) and piston pin from the piston.

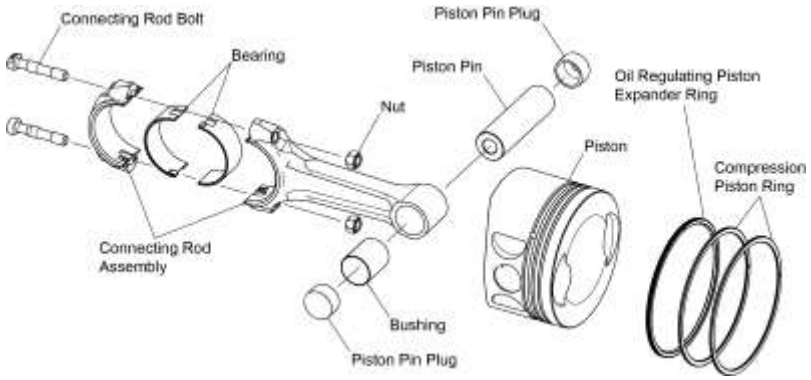


Figure 18
Piston Assembly

⚠ **CAUTION** ANYTIME A CYLINDER IS REMOVED, INSTALL TORQUE HOLD-DOWN PLATES OR EQUIVALENT TO ENSURE A UNIFORM LOAD ON THE MAIN BEARINGS IN THE CRANKCASE.

NOTICE: During piston removal, support the connecting rod to prevent damage to the connecting rods and crankcase:

B. Remove the piston from the connecting rod.

C. Install Torque Hold-Down Plates (ST-222) (Figure 19) or equivalent as shown in Figure 20.

Figure 19
Torque Hold-Down Plate (ST-222)

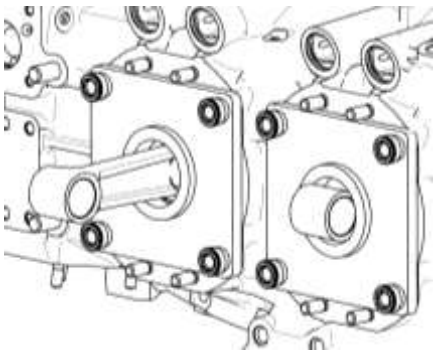


Figure 20
Installed Torque Hold-Down Plates

⚠ **CAUTION** DURING REMOVAL OF THE THREE PISTON RINGS IN THE NEXT STEP, USE CARE NOT TO SCRATCH THE PISTON.

D. Start from the top down, use the Piston Ring Expander (P/N 64713) to remove the two top compression rings and the oil regulating piston expander ring (Figure 18).

9. Connecting Rod Removal

⚠ **CAUTION:** DO NOT RE-USE THE CONNECTING ROD BEARINGS, BOLTS, AND NUTS.

NOTICE: If the two nuts in the connecting rod cap cannot easily be removed, use a soft (plastic head) mallet and gently tap on the end of the two bolts to remove the nuts and the bolts.

A. Remove and discard the two nuts (Figure 21) and the two bolts that attach the connecting rod cap to the connecting rod.

B. Remove the connecting rod cap and connecting rod; keep them together, apply a label to identify the throw position of the connecting rod for reference on assembly.

C. Remove and discard the two connecting rod bearings.

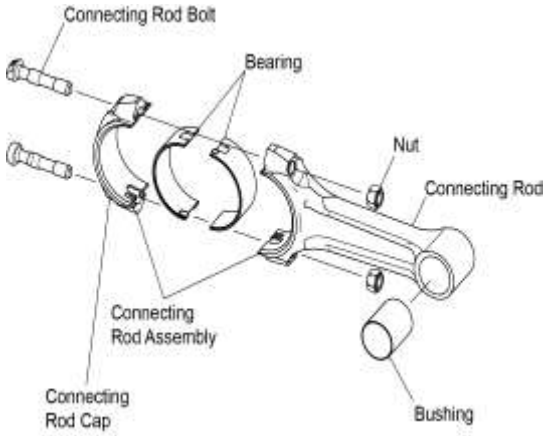


Figure 21
Connecting Rod Parts

10. Cylinder Assembly Inspection

Copy and complete the Cylinder Assembly Inspection Checklist for YO-233-B2A Engine Models.

Cylinder Assembly Inspection Checklist for YO-233-B2A Engine Models

Engine Serial Number:_____ Engine Hours: _____

Inspection Date:_____Inspected by:_____

Item to Examine and Corrective Action	Cylinder No.	Findings / Corrective Action
Look for wear or broken parts in the area of the valve, springs, and spring seats. **Corrective Action:** Replace any broken or worn parts. (Figure 5).	Cylinder 1	
	Cylinder 2	
	Cylinder 3	
	Cylinder 4	
Examine the intake and exhaust valve seats for looseness, scoring, pitting damage or non-conformities. Look for cracked or eroded valve seat bores. **Corrective Action:** If a valve seat is loose, scored, pitted, defective, or damaged valve seats, either replace the cylinder or send the engine cylinder to an authorized vendor to replace the valve seat.	Cylinder 1	
	Cylinder 2	
	Cylinder 3	
	Cylinder 4	
Examine intake and exhaust valve guides for looseness, cracks or scoring. **Corrective Action:** If any valve guide is loose, scored, pitted, defective, or damaged valve either replace the cylinder or send the engine cylinder to an authorized vendor to replace the valve guide.	Cylinder 1	
	Cylinder 2	
	Cylinder 3	
	Cylinder 4	

Cylinder Assembly Inspection Checklist for YO-233-B2A Engine Models (Cont.)

Item to Examine and Corrective Action	Cylinder No.	Findings / Corrective Action
Look for rust/pitting on: • Cylinder barrel fins and fin tips in power stroke areas • Cylinder barrel and base flange **Corrective Action:** Replace the cylinder if rust/pitting is found **<u>Do not grind the cylinder bore</u>** to remove pitting or damage caused by overheating.	Cylinder 1	
	Cylinder 2	
	Cylinder 3	
	Cylinder 4	
Look for discolored/burnt paint or scored cylinder barrel bores. Look for blistered paint on the cylinder barrel. **Corrective Action:** Replace the cylinder if the cylinder barrel bores are scored or the paint is discolored/burnt/ blistered.	Cylinder 1	
	Cylinder 2	
	Cylinder 3	
	Cylinder 4	
Examine the threads in all threaded holes in the cylinder for debris or damage. **Corrective Action:** Use the correct size bottoming tap to clean the threads. If thread damage cannot be corrected with the tap, replace the cylinder.	Cylinder 1	
	Cylinder 2	
	Cylinder 3	
	Cylinder 4	
Examine the exhaust flange for damage or warping. **Corrective Action:** Replace the cylinder if the exhaust flange is warped or damaged. **<u>Do not grind or repair the exhaust flange</u>** to correct a bent or warped flange.	Cylinder 1	
	Cylinder 2	
	Cylinder 3	
	Cylinder 4	

Cylinder Assembly Inspection Checklist for YO-233-B2A Engine Models (Cont.)

Item to Examine and Corrective Action	Cylinder No.	Findings / Corrective Action
Look for any radial fin crack extending to the root of a fin. **Corrective Action:** Replace the cylinder if there is a radial fin crack extending to the root of the fin.	Cylinder 1	
	Cylinder 2	
	Cylinder 3	
	Cylinder 4	
Look for broken, bent or straightened, or pitted cylinder head fins. Refer to the "Visual Cylinder Inspection" in this chapter. **Corrective Action:** Replace any cylinder that has unacceptable cylinder head fins.	Cylinder 1	
	Cylinder 2	
	Cylinder 3	
	Cylinder 4	
Look for cracks in the cylinder head. Measure the diameter of the cylinder head at several points to identify any out-of-roundness. Refer to the latest revision of the ***Service Table of Limits - SSP-1776*** for measurements. **Corrective Action:** Replace any cylinder that has a crack in the cylinder head or if the cylinder head is out-of-round.	Cylinder 1	
	Cylinder 2	
	Cylinder 3	
	Cylinder 4	

Cylinder Assembly Inspection Checklist for YO-233-B2A Engine Models (Cont.)

Item to Examine and Corrective Action	Cylinder No.	Findings / Corrective Action
Look for static seal leakage or leakage from the head-to-barrel seal or crack in the head or barrel. **Corrective Action:** Replace any cylinder that has leakage at the cylinder head or barrel.	Cylinder 1	
	Cylinder 2	
	Cylinder 3	
	Cylinder 4	
Look for scratches in the honed surface of the cylinder wall or cylinder bore. **Corrective Action:** Hone the cylinder to remove the scratches. Refer to the latest revision of the ***Service Table of Limits - SSP-1776*** for dimensions and limits.	Cylinder 1	
	Cylinder 2	
	Cylinder 3	
	Cylinder 4	
Make sure there is not any cylinder head-to-barrel flange movement. **Corrective Action:** Replace any cylinder that has any cylinder head-to-barrel flange movement.	Cylinder 1	
	Cylinder 2	
	Cylinder 3	
	Cylinder 4	
Examine mounting pads (for intake and exhaust ports) for nicks, scoring or dents. **Corrective Action:** Replace all nicked, scored, or dented mounting pads for intake and exhaust ports.	Cylinder 1	
	Cylinder 2	
	Cylinder 3	
	Cylinder 4	

Cylinder Assembly Inspection Checklist for YO-233-B2A Engine Models (Cont.)

Examine mounting pads for rocker box covers for nicks, scoring or dents. **Corrective Action:** Replace all nicked, scored, or dented mounting pads for rocker box covers.	Cylinder 1	
	Cylinder 2	
	Cylinder 3	
	Cylinder 4	
Examine the spark plug Heli-Coil® inserts for looseness or damage. **Corrective Action:** Replace all loose or damaged spark plug Heli-Coil® inserts with oversize inserts per the "Heli-Coil® Replacement" procedure in this chapter.	Cylinder 1	
	Cylinder 2	
	Cylinder 3	
	Cylinder 4	
Examine studs on the cylinder head for looseness of damage. **Corrective Action:** Replace all loose or damaged studs with the next higher applicable oversize studs.	Cylinder 1	
	Cylinder 2	
	Cylinder 3	
	Cylinder 4	
Measure the inside diameter of the rocker shaft bushings. Refer to the latest revision of the ***Service Table of Limits - SSP-1776*** for dimensions. **Corrective Action:** Replace the rocker shaft bushings if they are not in accordance with specifications.	Cylinder 1	
	Cylinder 2	
	Cylinder 3	
	Cylinder 4	

11. Piston Inspection

A. Copy and complete the Piston Inspection Checklist for YO-233-B2A Engine Models.

Piston Inspection Checklist for YO-233-B2A Engine Models

Engine Serial Number:_____ Engine Hours: _____

Inspection Date:_____Inspected by:_____

Inspection Item	Findings/Corrective Action	
Before cleaning the piston examine the following areas on the piston for pitting, cavities and surface distortion (which can be an indication of detonation or pre-ignition): • Top of the piston • Piston ring lands and grooves • Piston pin holes • Piston pin whole bosses • Look for deposits or damage • Complete the "Piston Cleaning" procedure in Chapter 05-30. **NOTICE:** Surface distortion can be an indication of detonation or pre-ignition.	Cylinder 1	
	Cylinder 2	
	Cylinder 3	
	Cylinder 4	
After Cleaning: • Look for cracks on the piston head or skirt. Replace the piston if a crack is found. • Look for bent or broken lands. Replace the piston if the land is broken or bent. • Look for scoring on the piston skirt, damage or discoloration from burns. Replace the piston if scoring, damage or discoloration found. Identify and correct the cause. • Examine the piston grooves for wear. Replace the piston if high ridges are on the lower lands.*	Cylinder 1	
	Cylinder 2	
	Cylinder 3	
	Cylinder 4	

* High ridges of displaced metal can interfere with operation of new piston rings. The displaced metal can cause excessive piston ring clearance in the valleys.

Piston Inspection Checklist for YO-233-B2A Engine Models (Cont.)

NOTICE: Lycoming manufactures pistons with a taper that extends from the top to the bottom of the skirt with the smaller diameter at the top.

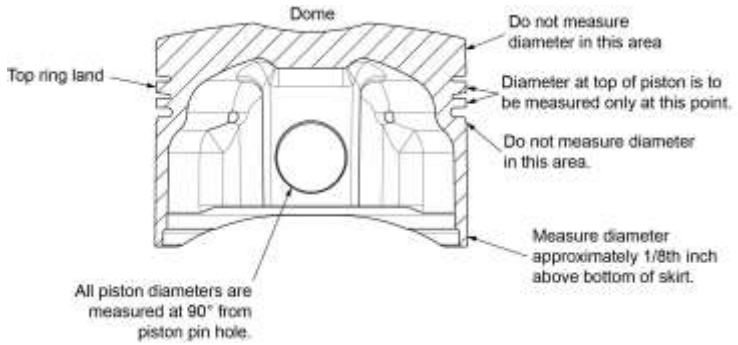


Figure 22
Section Through Piston Showing Points for Measuring Diameter

Inspection Item		Findings/Corrective Action			
		Cylinder 1	Cylinder 2	Cylinder 3	Cylinder 4
Measure the inside diameter of the piston pin hole (Figure 22).	Actual Measurement**				
	SSP-1776				
Measure the piston diameter at the top ring land of the piston between the top and second compression ring grooves (at a right angle to the piston pin hole) (Figure 22).	Actual Measurement**				
	SSP-1776				
Measure the diameter approximately 1/8 in. above the bottom of the piston skirt. (at a right angle to the piston pin hole) (Figure 22).	Actual Measurement**				
	SSP-1776				
Subtract the diameter approximately 1/8 in. above the bottom of the piston skirt from the Average Cylinder Diameter (from the Cylinder Assembly Inspection Checklist) and compare to the acceptable clearance in the latest revision of the ***Service Table of Limits - SSP-1776.***					
Piston skirt and cylinder clearance.					
Measure the piston ring clearance.	Actual Measurement**				
	SSP-1776				

Compare the actual measurement against the limits in the latest revision of the ***Service Table of Limits - SSP-1776*. Replace the piston if any of the measurements are out of tolerance.

Piston Inspection Checklist for YO-233-B2A Engine Models (Cont.)

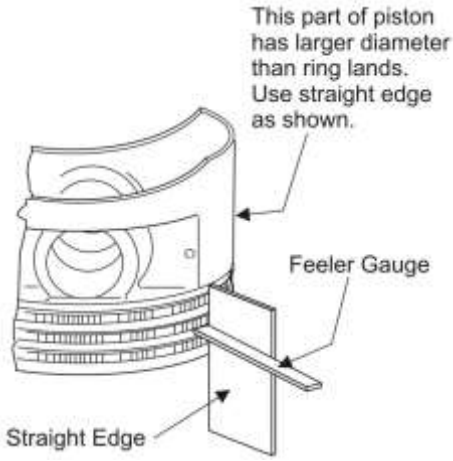


Figure 23
Checking Piston Ring Side Clearance

Inspection Item			Findings/Corrective Action			
			Cylinder 1	Cylinder 2	Cylinder 3	Cylinder 4
Measure the side clearance between the piston rings and piston with a feeler gauge and straight edge (Figure 23).	Top piston compression ring	Actual Measurement**				
		SSP-1776				
	Second piston compression ring	Actual Measurement**				
		SSP-1776				
	Piston oil ring	Actual Measurement**				
		SSP-1776				
Measure the piston ring end-gap with feeler gauges. Complete the "Piston Ring End Gap Check" in this chapter.	Top piston compression ring	Actual Measurement**				
		SSP-1776				
	Second piston compression ring	Actual Measurement**				
		SSP-1776				
	Piston oil ring	Actual Measurement**				
		SSP-1776				

Compare the actual measurement against the limits in the latest revision of the ***Service Table of Limits - SSP-177*6. Replace the piston if any of the measurements are out of tolerance.

Piston Inspection Checklist for YO-233-B2A Engine Models (Cont.)

Comments:
If inspection of the piston shows the original ground surface of the piston skirt to be undamaged, the piston is acceptable and can be re-installed. If any of the following conditions are found on the piston, replace the piston. • Damage or pitting, cavities, surface distortion, scoring, or discoloration • Cracked, bent, or broken lands, scored skirts or any out-of-tolerance dimensional limits • Piston grooves worn to the extent that high ridges are on the lower lands • Excessive side clearance of piston rings in grooves **NOTICE:** Refer to the ***YO-233-B2A Illustrated Parts Catalog*** to identify a replacement piston and associated rings.

B. Piston Ring End-Gap Check

⚠ **CAUTION** DURING THE PISTON RING END-GAP CHECK, USE CARE NOT TO SCRATCH OR SCORE THE PISTON OR CYLINDER BORE.

(1) Lubricate the piston ring, piston, and cylinder bore with a light coating of a mixture of 15% pre-lubricant (STP or equivalent) and 85% SAE 50 mineral-base aviation-grade lubricating oil (unless otherwise directed per the latest revision of Service Instruction No. SI-1059).

(2) Put one of the piston rings in the cylinder in which it will be used.

(3) To square the piston ring in the cylinder bore, install the piston in the cylinder (per the "Piston Installation" procedure in this chapter) and use a soft mallet to tap the dome end of the piston on the inside, until the bottom of the piston skirt is flush with the end of the cylinder barrel. Remove the piston from the cylinder per the "Piston Removal" procedure in this chapter.

(4) Measure the piston ring end-gap with feeler gauges. Record the measurement in the Piston Inspection Checklist. Compare the measurement with the ring end gap measurement in the latest revision of the ***Service Table of Limits - SSP-1776***.

(5) If necessary to increase the end-gap, carefully file the ends of the piston ring.

(6) Repeat this check for each piston ring to be used in each cylinder.

12. Connecting Rod Inspection

Copy and complete the Connecting Rod Inspection Checklist is used to record the condition of all of the connecting rods and any corrective action.

Connecting Rod Inspection Checklist for YO-233-B2A Engine Models

Engine Serial Number:_____ Engine Time:_____

Date Inspection Done: _____ Inspection done by:_____

Task or Inspection	Measurements, Findings and/or Corrective Action	
Disassemble the connecting rod; clean the rod and its cap thoroughly. Visually examine the connecting rod for damage.		
Examine the connecting rod bore for wear.	If the rod bore is worn, replace the connecting rod assembly.	
	o Rod bore not worn	o Worn rod bore/connecting rod replaced
Examine the mating face of the connecting rod and its cap face for fretting (Figure 24).	If fretting is found, replace the connecting rod assembly.	
	o No fretting	o Fretting found/connecting rod replaced
Use a 6-power magnifying glass (minimum) or bench microscope to examine the critical areas on the connecting rod identified in Figure 24 for galling.*	If galling is found, replace the connecting rod assembly.	
	o No galling	o Galling found/connecting rod replaced

* Do not mistake stains or discoloration for galling. Surface blemishes are easily removed with a fine abrasive cloth, chemical cleaner or steel wool. Whereas, galling cannot be removed. If galling is found in the bearing bore, replace the connecting rod. If surface blemishes cannot be removed with a fine abrasive cloth, chemical cleaner or steel wool, there is evidence of galling. Gall marks vary in size and shape. Some gall marks can be as small as pin heads. Other gall marks can be circular, oval, or thin, or look like rods.

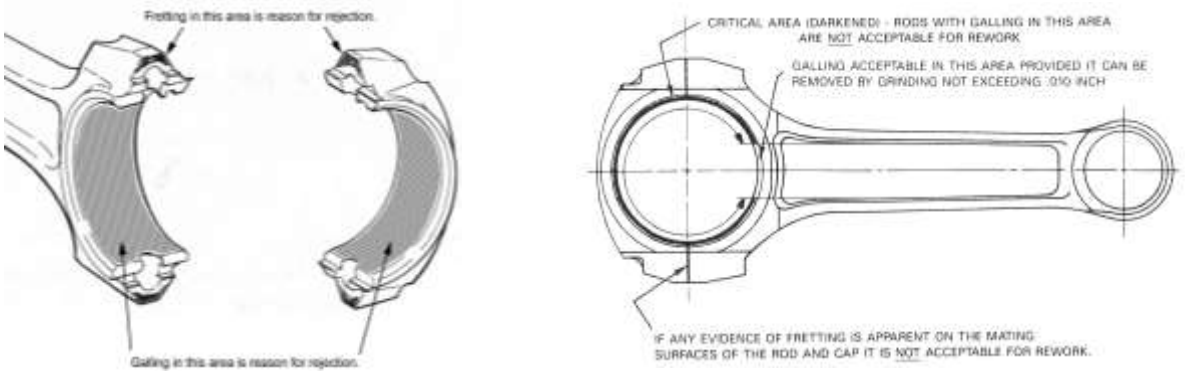


Figure 24
Areas on Connecting Rod to Examine for Fretting and Galling

Connecting Rod Inspection Checklist for YO-233-B2A Engine Models (Cont.)

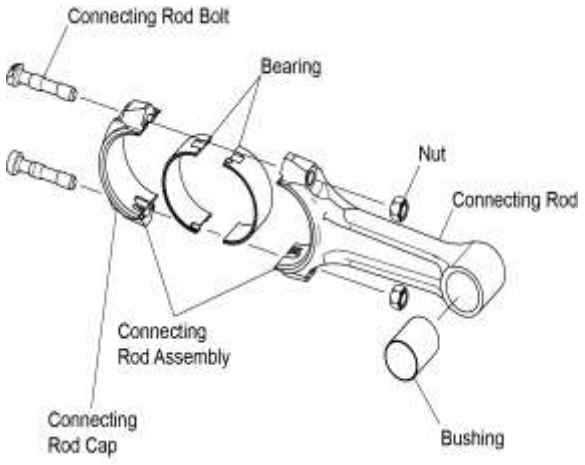
<table>
<tr><th>Item</th><th>Comments</th><th colspan="2">Findings/Corrective Action</th><th>Done</th></tr>
<tr><td rowspan="5">Measure the Inner Diameter (ID) of the connecting rod bushing using a micrometer (Figure 25)</td><td rowspan="5">If the connecting rod bushing is worn beyond service limits per the latest revision of the Service Table of Limits - SSP-1776, replace the bushing per the “Connecting Rod Bushing Replacement” procedure in this chapter.</td><td colspan="2">Bushing ID Measurement</td><td></td></tr>
<tr><td>Connecting Rod 1</td><td></td><td></td></tr>
<tr><td>Connecting Rod 2</td><td></td><td></td></tr>
<tr><td>Connecting Rod 3</td><td></td><td></td></tr>
<tr><td>Connecting Rod 4</td><td></td><td></td></tr>
<tr><td rowspan="4">Measure the distance from the surface of the connecting rod to the edge of the connecting rod bushing installed in the connecting rod on both sides of the connecting rod. Examine the ID of the connecting rod bushing for a visible split line.</td><td rowspan="4">Refer to the latest revision of Service Bulletin No. SB-630 for inspection instructions and any additional details. Replace the bushing as necessary per the “Connecting Rod Bushing Replacement” procedure in this chapter.</td><td>Connecting Rod 1</td><td>Acceptable
Replace</td><td></td></tr>
<tr><td>Connecting Rod 2</td><td>Acceptable
Replace</td><td></td></tr>
<tr><td>Connecting Rod 3</td><td>Acceptable
Replace</td><td></td></tr>
<tr><td>Connecting Rod 4</td><td>Acceptable
Replace</td><td></td></tr>
<tr><td colspan="2" rowspan="6"> 

Figure 25
Connecting Rod</td><td colspan="3">For connecting rods that pass the Visual Inspection herein, complete a Magnetic Particle Inspection on all connecting rods as per the “Non-Destructive Testing” section in Chapter 05-50.</td></tr>
<tr><td colspan="2">Findings/ Corrective Action of Magnetic Particle Inspection</td><td>Done</td></tr>
<tr><td>Connecting Rod 1</td><td>Acceptable
Replace</td><td></td></tr>
<tr><td>Connecting Rod 2</td><td>Acceptable
Replace</td><td></td></tr>
<tr><td>Connecting Rod 3</td><td>Acceptable
Replace</td><td></td></tr>
<tr><td>Connecting Rod 4</td><td>Acceptable
Replace</td><td></td></tr>
</table>

Connecting Rod Inspection Checklist for YO-233-B2A Engine Models (Cont.)

<table>
<tr><th>Item</th><th colspan="3">Findings</th></tr>
<tr><td rowspan="5">Refer to the “Connecting Rods - Parallelism / Squareness Check” in this chapter.
Measure the distance between arbors (Figure 29). For exact parallelism or alignment, the distances measured on both sides are to be the same.
Measure clearance at the points where the arbors rest on the parallel blocks (Figure 30) using a feeler gage. Compare the clearance between each arbor and the parallel blocks against the values in the latest revision of the Service Table of Limits - SSP-1776.</td><td></td><td>Parallelism Measurement</td><td>Squareness Measurement</td></tr>
<tr><td>Connecting Rod 1</td><td></td><td></td></tr>
<tr><td>Connecting Rod 2</td><td></td><td></td></tr>
<tr><td>Connecting Rod 3</td><td></td><td></td></tr>
<tr><td>Connecting Rod 4</td><td></td><td></td></tr>
<tr><td colspan="4">Connecting Rod Bearing and Crankshaft Clearance</td></tr>
<tr><td colspan="4">To complete this inspection:
<u>NOTICE:</u> For this inspection, the connecting rods, bearings, connecting rod bolts, and nuts (Figure 25) are assembled, but not installed on the crankshaft.
All of the connecting rods installed on the crankshaft must be of the same weight class, except “S” weight rods (service rods) can be used with either “A” or “E” weight rods depending on parts availability. Record the weight code of each connecting rod in this checklist.
1. Assemble and torque each connecting rod with acceptable bearings per instructions in the “Connecting Rod Installation” section in this chapter.
2. Measure the inside diameter of the bearing in each connecting rod and record the measurement below.
3. Measure the crankshaft diameter at the crank pin journal for each connecting rod and record the measurement below.
4. Subtract the crankshaft diameter at the crank pin journal from the inside diameter of the bearings for each connecting rod to calculate the connecting rod bearing and crankshaft clearance. Record the measurement below.
5. Compare the connecting rod bearing and crankshaft clearance to the acceptable clearance measurement in the latest revision of the Service Table of Limits - SSP-1776.
6. Remove and discard the connecting rod bolts and nuts from the connecting rod assembly.
7. If the connecting rod bearing and crankshaft clearance is within limits, the connecting rod bearings are acceptable.
8. If the connecting rod bearing and crankshaft clearance is not within limits, replace the connecting rod bearings with oversize bearings to bring the clearance within acceptable limits.</td></tr>
</table>

Connecting Rod Inspection Checklist for YO-233-B2A Engine Models (Cont.)

Connecting Rod	Connecting Rod Weight Code	Inside Diameter of the Bearings	Crankshaft Diameter at the Crank Pin Journal	Connecting Rod Bearing and Crankshaft Clearance	Outcome
Connecting Rod 1					Acceptable Replace
Connecting Rod 2					Acceptable Replace
Connecting Rod 3					Acceptable Replace
Connecting Rod 4					Acceptable Replace

13. Connecting Rod Bushing Replacement

NOTICE: Replace the connecting rod bushing if it is damaged or if the inner diameter of the bushing is worn beyond service limit per the Connecting Rod Inspection Checklist for TEO-540-EXP22 Engines.

If replacement bushing is Lycoming P/N LW-13923 which must be burnished after installation, refer to the latest revision of Service Instruction No. 1575.

A. Clamp the connecting rod on the Connecting Rod Bushing Replacement Block (P/N 64597) in such a manner that the small bushing in the rod is in alignment with the hole stamped "Remove Bushing".

B. Use the Connecting Rod Bushing Removal Drift (P/N 64535) or equivalent to drive the bushing out of the rod.

C. After bushing removal, measure the inside diameter of the connecting rod both parallel and perpendicular to the connecting rod beam (Figure 26). If either inside diameter measurement is not between 1.1833 in. (30.056 mm) and 1.1848 in. (30.094 mm), discard the connecting rod and replace it with a serviceable connecting rod.

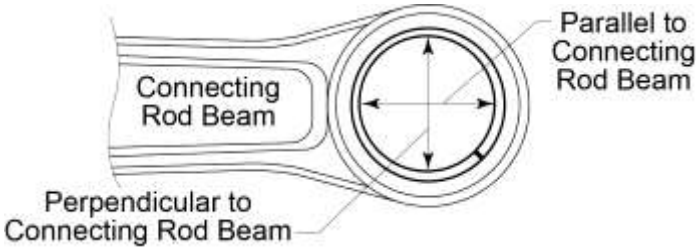


Figure 26
Measure the I.D. of the Connecting Rod

D. Move the connecting rod to the "Install" position on the Connecting Rod Bushing Replacement Block or equivalent and clamp it securely in place.

E. Use the Replacement Drift P/N 64536 or equivalent to install the new connecting rod bushing in the connecting rod.

F. Make sure the split in the bushing is located so that it is toward the piston end of the connecting rod and 45° off the centerline (Figure 27) and press the bushing into the connecting rod until the edge of the bushing is flush with the surface of the connecting rod.

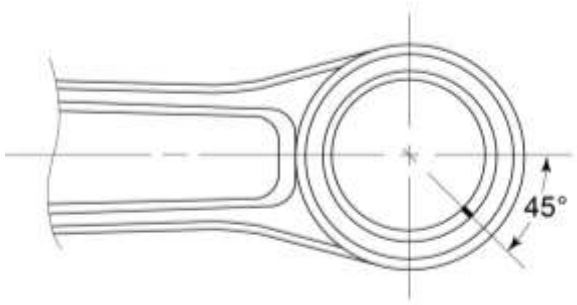


Figure 27
Bushing Installed in the Connecting Rod

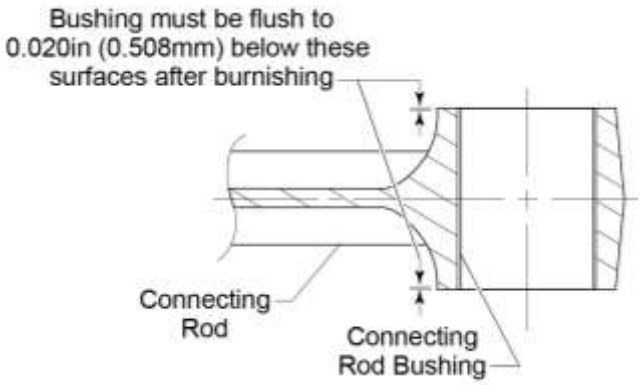


Figure 28
Bushing Burnished Flush to 0.020 in. (0.508 mm) Below Connecting Rod Surface

⚠ **CAUTION** **DO NOT** BURNISH CONNECTING ROD BUSHING P/N 01K28983. THESE BUSHINGS ARE NOT DESIGNED TO BE BURNISHED AFTER INSTALLATION. BURNISHING MAY RESULT IN DAMAGE TO BUSHING P/N 01K28983.

G. Examine the bushing after installation to make sure the bushing is flush to 0.020 in. (0.508 mm) below the connecting rod surface (Figure 28) on both sides of the connecting rod.

H. Remove the connecting rod from the holding block and complete a final bore of the bushing to the diameter shown in the latest revision of the ***Service Table of Limits - SSP-1776***.

If using a carbide cutter when final boring the 01K28983 bushing, Lycoming recommends an approximate spindle speed of 730 RPM and a feed rate of .003 in. per revolution.

I. As a check, measure the bushing inner diameter with the Finish ID Gage P/N 64767 or equivalent.

J. Complete the “Connecting Rod Parallelism/Squareness Check” in this chapter.

K. If the assembly does not pass this check, replace the connecting rod assembly.

L. Record all maintenance completed, include the P/N of the new bushing, in the engine logbook.

14. Connecting Rods - Parallelism / Squareness Check

NOTICE: The Connecting Rod Parallelism and Squareness Gage P/N 64530 (Figure 29) is necessary for this check.

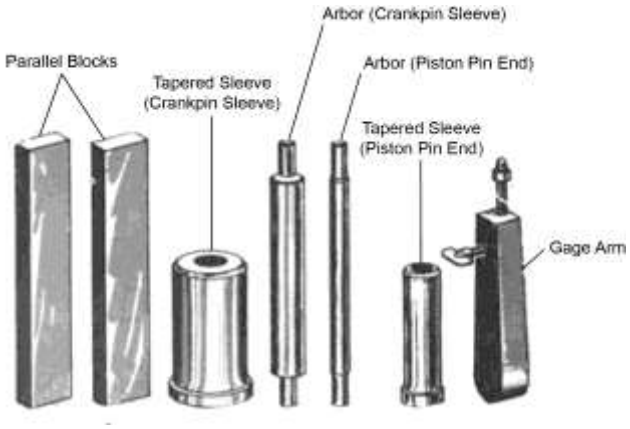


Figure 29
Connecting Rod Parallelism and Squareness Gage P/N 64530

A. Make sure that the bearing cap is assembled correctly and is tightened securely.
B. Insert the tapered sleeves (Figure 30) of the Connecting Rod Parallelism and Squareness Gage P/N 64530 in the bearing holes in the connecting rod.
C. Pull the arbors through the sleeves.
D. Install the gage arm on the arbor as shown in Figure 30.
E. Turn the adjusting screw on the gage arm until it just touches the arbor.
F. Use the wing nut to lock the adjusting screw.
G. Make sure the adjusting screw just touches the arbor.

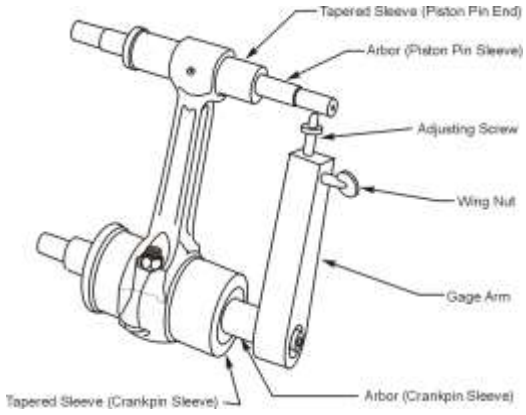


Figure 30
Parallelism Check of Connecting Rods

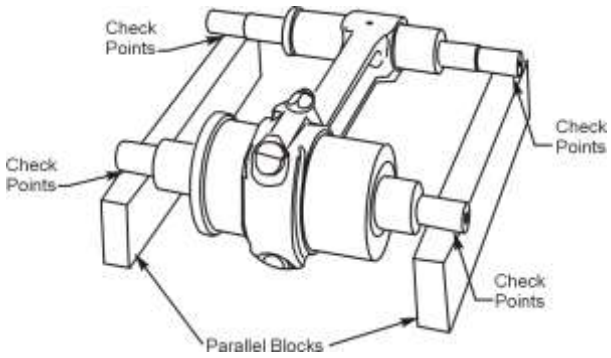


Figure 31
Squareness Check of Connecting Rods

H. Remove the gage arm and install it on the other end of the arbor.
I. Measure the distance between arbors. For exact parallelism or alignment, the distances measured on both sides must be the same. Record the parallelism measurement in the Connecting Rod Inspection Checklist for YO-233-B2A Engines earlier in this chapter.
J. Remove the gage arm.

K. Keep the sleeves and arbors in place.

L. Put the parallel blocks (Figure 31) of the Connecting Rod Parallelism and Squareness Gage on the surface plate.

M. Put the ends of the arbors on the parallel blocks.

N. For the squareness check, use a feeler gage to measure the clearance at the four check points where the arbors rest on the parallel blocks (Figure 31). Record the measurement in the Connecting Rod Inspection Checklist for YO-233-B2A Engines earlier in this chapter

O. Compare the clearance between each arbor and the parallel blocks against the values in the latest revision of the Service Table of Limits - SSP-1776. If out of tolerance, replace the connecting rod and examine the crankshaft to make sure the crankshaft is not damaged.

15. Connecting Rod Installation

NOTICE: Each connecting rod is identified by a letter (A, E, S, etc.) as a designation for weight class. All of the connecting rods installed on the crankshaft must be of the same weight class, except "S" weight rods (service rods) can be used with either "A" or "E" weight rods depending on parts availability.

A. Ensure that all of the connecting rods have the same weight class letter.

B. Apply specified lubricant to the connecting rod and bearing inserts per the latest revision of Service Instruction No. SI-1059 where shown in Figure 32. Different lubricants are used on the various areas on the connecting rod and bearing surfaces.

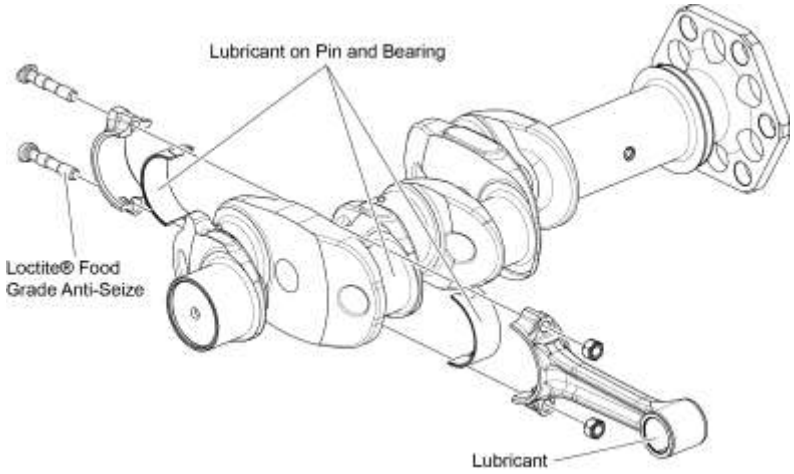


Figure 32
Connecting Rod Assembly Lubrication

NOTICE: Anytime either the connecting rod bolt and/or nut pairs are removed from a Lycoming engine, replace **both** the bolt and nut pairs with new "Service Use Only" hardware regardless of apparent condition.

C. Refer to the***YO-233-B2A Illustrated Parts Catalog*** to identify the correct P/Ns for the new connecting rods bolts.

D. Make sure the new connecting rod bolt and new nut pairs are clean, free of dirt and debris and that the threads are not damaged.

E. Install the new lubricated matched set bearing pair on each connecting rod, one bearing on the connecting rod and the other bearing on the connecting rod cap. Ensure that the tang of each bearing fits and seats within the slot of the connecting rod as well as the connecting rod cap.

NOTICE: Do not install standardized connecting rod bolts in connecting rods with oversize bolt holes. Refer to the latest revision of Service Instruction No. SI-1458 for details.

F. Apply Loctite® Food-Grade Anti-Seize Lubricant to the bottom two or three threads of the new connecting rod bolts (Figure 32). Wipe away excess lubricant with a clean, lint-free cloth.

G. Install each connecting rod pair (with the bearing inserts installed) on their respective crank pins on the crankshaft (where the numbers on the connecting rods and caps point down - toward the oil sump.)

⚠ **CAUTION:** CORRECT INSTALLATION OF THE NEW NUT ON EACH NEW CONNECTING ROD BOLT IS NECESSARY FOR CORRECT CONNECTING ROD ASSEMBLY. EACH CONNECTING ROD NUT HAS TWO DIFFERENT SURFACES, ONE SURFACE IS FLAT AND THE OTHER HAS A RAISED LIP. BE SURE TO INSTALL EACH NUT ON THE CONNECTING ROD BOLT WITH THE FLAT FACE TOUCHING THE ROD. THE RAISED LIP SURFACE IS AWAY FROM THE ROD. THE CONNECTING ROD BOLT CANNOT BE TIGHTENED CORRECTLY IF THE NUT ON THE CONNECTING ROD IS INSTALLED INCORRECTLY.

H. Install a new nut on each new connecting rod bolt where the flat face of the nut touches the connecting rod as shown in Figure 33.

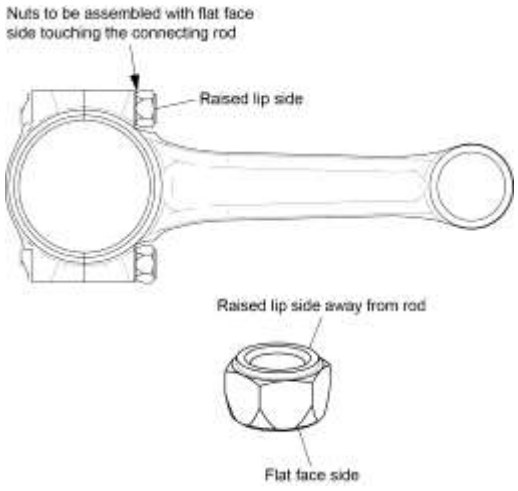


Figure 33
Connecting Rod Nut Installation

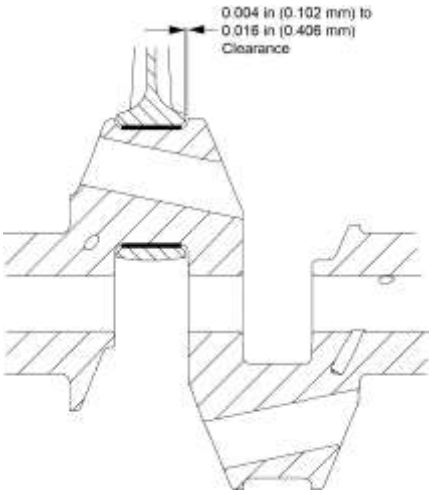


Figure 34
Connecting Rod Clearance

I. Torque the connecting rod bolts per the torque values in the latest revision of Service Instruction No. SI-1458. (Stretch bolts require an initial torque and are then torqued to the correct stretched length.)

J. Measure the side clearance between the connecting rod and crankshaft with a feeler gage where shown in Figure 34. The clearance is to be 0.004 to 0.016 in (0.102 to 0.406 mm).

16. Piston Ring Replacement

⚠ **CAUTION** DO NOT ***UNDER ANY CIRCUMSTANCES*** INSTALL CHROME-PLATED PISTON RINGS IN AN ENGINE HAVING CHROME-PLATED CYLINDER BARRELS. IF YOU ARE UNSURE OF THE CORRECT COMBINATION OF PISTON RINGS TO BE USED, REFER TO THE LATEST REVISION OF SERVICE INSTRUCTION NO. SI-1037.

DURING REMOVAL OF THE THREE PISTON RINGS IN THE NEXT STEP, USE CARE NOT TO SCRATCH OR SCORE THE PISTON. REPLACE A SCRATCHED OR SCORED PISTON.

A. Start from the top down, use the commercially available piston ring expander tool to remove the two top piston compression rings, the piston oil ring, and the inner expander ring (with the piston oil ring) (Figure 35).

NOTICE: New cylinders made by Lycoming Engines will have the correct piston ring finish and do not need further honing. Otherwise, hone the cylinder per the latest revision of Service Instruction No. SI-1047 to ensure correct seating of the new piston rings.

For new piston rings, refer to the ***YO-233-B2A Illustrated Parts Catalog*** to identify the correct new piston rings to be installed on the piston.

New piston rings are shipped from Lycoming with the piston oil ring and the inner expander ring assembled. The inner expander ring must be separated from the piston oil ring before installing them on the piston.

B. Apply a generous coating of a mixture of 15% pre-lubricant (STP or equivalent) and 85% SAE 50 mineral-base aviation-grade lubricating oil (unless otherwise directed per the latest revision of Service Instruction No. SI-1059) to the piston rings.

C. With the piston top side up on a workbench, install the inner expander ring with the part number facing toward the top of the piston in the first groove above the piston pin hole (Figure 35).

D. Assemble the piston oil ring over the inner expander ring with its gap 180° opposite the inner expander ring gap. Orient the gaps in the inner expander ring and piston oil ring perpendicular to the piston pin hole. Compress the assembly several times with the fingers to ensure that the ring lies free and loose in the groove. Both the piston oil ring and the inner expander ring are symmetrical.

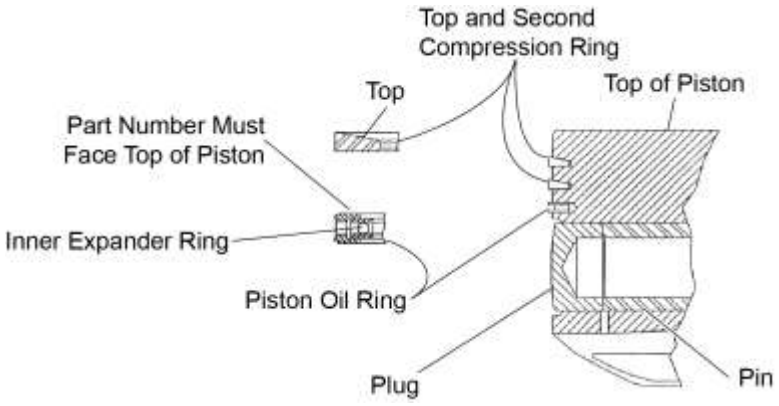


Figure 35
Piston Ring Positions

E. Install the two top compression rings (Figure 35) with the word "Top" toward the top of the piston in the remaining top grooves. Orient the gaps in the two compression rings 180° from each other parallel with the piston pin hole.

F. Compress each of the two top compression piston rings several times with your fingers to make sure the rings are situated freely and loosely in the groove.

G. To ensure correct installation, measure the side clearance of the rings in the grooves with a feeler gage and a straight edge (Figure 23). If the actual measurement is greater than the maximum allowable side clearance, per the latest revision of the ***Service Table of Limits - SSP-1776***, replace the piston.

NOTICE: Engine break-in must be completed to seat newly installed piston rings. Refer to the latest revision of Service Instruction No. SI-1427 and the "Engine Initiation" chapter of the ***YO-233-B2A Engine Installation and Operation Manual.***

17. Piston Installation

NOTICE: If more than one piston is being installed, make sure you are installing the correct piston on the designated connecting rod in the engine.

A. Clean the pistons as per instructions in the "Piston Cleaning" procedure in Chapter 5-30.

NOTICE: If the original piston pin is tighter than a palm push fit, look for burrs or slight carbon in the pin bore of the piston. Remove any burrs with a stone. Remove carbon deposits as per instructions in Chapter 05-30. If a new piston or piston pin is installed, use a pin that will give a palm push fit at 60º to 70ºF (15º to 20ºC).

B. Apply lubricant specified in the latest revision of Service Instruction No. SI-1059 to the inside diameter of the connecting rod bushing, the outer diameter of the piston pin, and the inside diameter of the piston pin hole.

⚠ **CAUTION** DO NOT ATTEMPT TO TURN THE CRANKSHAFT UNLESS THE CONNECTING RODS ARE SUPPORTED.

C. Turn the crankshaft so that when the Number 1 piston is inserted, it will be at TDC of its firing stroke, with both tappets on the base circle of the camshaft lobes.

D. Remove the Torque Hold-Down Plates (ST-222) from the crankcase.

E. Install the piston on the connecting rod where the number stamped on the bottom of the piston head is upright and readable (not upside-down.)

F. Insert the piston pin into the piston and through the connecting rod (Figure 18) to ensure the entire length of the piston pin is lubricated, move the piston pin back and forth until it is centered.

G. Insert a piston pin plug at each end of the piston pin.

H. Complete a check of the clearance between the piston and each piston pin plug. Refer to the latest revision of the ***Service Table of Limits - SSP-1776*** for acceptable clearance limits.

I. Install the piston rings on the piston per the "Piston Ring Replacement" procedure.

J. Apply a generous coating of a mixture of 15% pre-lubricant (STP or equivalent) and 85% SAE 50 mineral-base aviation-grade lubricating oil (unless otherwise directed per the latest revision of Service Instruction No. SI-1059) to the piston rings, working the mixture into the ring grooves.

K. Apply lubricant specified in the latest revision of Service Instruction No. SI-1059 to the piston pin plug faces.

18. Intake Valve Replacement

A. Intake Valve Removal

(1) Remove the cylinder from the engine per the "Cylinder Removal" procedure in this chapter.

(2) Put the cylinder on a Cylinder Block P/N 64526-2 or equivalent.

(3) Compress the intake valve springs with a Valve Spring Compressor Tool (ST-25) and remove the intake valve keys.

(4) Remove the valve spring seats and valve springs from the intake valve (Figure 15).

(5) Remove the cylinder from the Cylinder Block.

NOTICE: Use care not to scratch the inside of the cylinder barrel when removing the intake valve.

(6) Remove the intake valve from the valve guide, through the cylinder barrel.

B. Intake Valve Installation

NOTICE: Use care not to scratch the inside of the cylinder barrel when installing the intake valve (Figure 15).

(1) Apply a coating of Castrol® Contractor Special NLGI#1 to the intake valve stem (or other lubricant identified in the latest revision of Service Instruction No. SI-1059.)

(2) Install a serviceable intake valve in the valve guide (Figure 15), through the cylinder barrel.

(3) Put the cylinder on a Cylinder Block P/N 64526-2 or equivalent.

(4) Install the valve spring seats and valve springs (Figure 15).

(5) Compress the intake valve springs with a Valve Spring Compressor Tool (ST-25) and install the intake valve keys.

(6) Remove the cylinder from the Cylinder Block and install the cylinder on the engine per the "Cylinder Installation" procedure in this chapter.

19. Exhaust Valve Replacement

A. Exhaust Valve Removal

(1) Remove the cylinder from the engine per the "Cylinder Removal" procedure in this chapter.

(2) Put the cylinder on a Cylinder Block P/N 64526-2 or equivalent.

(3) Remove the exhaust valve stem cap (Figure 36) from the exhaust valve.

(4) Compress the exhaust valve springs (Figure 15) with a Valve Spring Compressor Tool (ST-25) and remove the exhaust valve keys.

(5) Remove the valve spring seats and valve springs from the exhaust valve.

Figure 36
Exhaust Valve Stem Cap

(6) Remove the cylinder from the Cylinder Block.

NOTICE: Use care not to scratch the inside of the cylinder barrel when removing the exhaust valve.

(7) Remove the exhaust valve from the valve guide, through the cylinder barrel.

B. Exhaust Valve Installation

NOTICE: Use care not to scratch the inside of the cylinder barrel when installing the exhaust valve.

(1) Apply a coating of Castrol® Contractor Special NLGI#1 to the exhaust valve stem (or other lubricant identified in the latest revision of Service Instruction No. SI-1059.)

(2) Install a serviceable exhaust valve in the valve guide (Figure 15), through the cylinder barrel.

(3) Put the cylinder on a Cylinder Block P/N 64526-2 or equivalent.

(4) Install the valve spring seats and valve springs.

(5) Use a Valve Spring Compressor Tool (ST-25) to compress the exhaust valve springs and install the exhaust valve keys.

(6) Install the exhaust valve stem cap (Figure 24) on the exhaust valve.

(7) Remove the cylinder from the Cylinder Block and install the cylinder on the engine per the "Cylinder Installation" procedure in this chapter.

20. Cylinder Installation

NOTICE: Before cylinder installation, make sure that the connecting rod bushing was examined per the "Connecting Rod Inspection Checklist for YO-233-B2A Engines" in Chapter 72-20.

Use a cylinder kit when installing a new cylinder. When installing a removed cylinder be sure you are installing the correct cylinder in the designated position on the engine.

If all cylinders are to be installed, install them by their firing order 1-3-2-4.

⚠ **CAUTION** INSTALL ONLY THE NEW CYLINDER BASE OIL SEAL RING (FIGURE 17) AROUND THE CYLINDER BASE. DO NOT USE ANY ADDITIONAL SEALANT OR GASKET MATERIAL WHICH COULD DETERIORATE AND CAUSE A REDUCED TORQUE ON THE CYLINDER BASE STUDS.

NOTICE: Do not re-install the cylinder base oil seal ring which had been removed during cylinder removal. Use a new cylinder base oil seal ring.

A. Apply a light coat of engine oil mixture to the cylinder base oil seal ring.

B. Install a new cylinder base oil seal ring around the cylinder base over the pilot diameter on each engine cylinder.

C. Lubricate the inside diameter of the cylinder barrel with engine oil mixture (15% pre-lubricant (STP or equivalent) and 85% SAE No. 50 mineral base aviation grade lubricating oil) to the depth of the piston rings, approximately 2 in. (5 cm).

D. Apply one or a combination of any of the following lubricants to the outer three threads (Figure 37A) on all of the crankcase thru-studs and cylinder hold-down studs (Figure 37B):

- Parker Thread Lube
- SAE 30W engine oil
- Mixture of 60% SAE 30W engine oil and 40% Parker Thread Lube
- Mixture of 90% SAE 50W engine oil and 10% STP

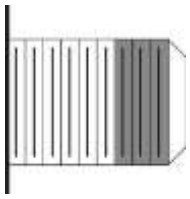


Figure 37A
Stud Thread Location for Lubricant

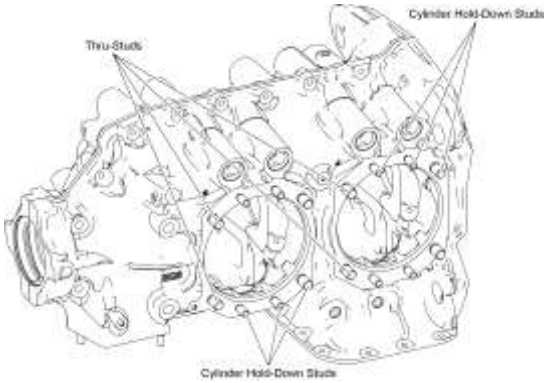


Figure 37B
Crankcase Thru-Studs and Cylinder Hold-Down Studs

E. Use the Piston Ring Compressor (64559) to install the cylinders (Figure 38) as follows:

(1) Assemble the Piston Ring Compressor (64559) over the top piston rings and install the correct cylinder over the piston on the corresponding connecting rod, pushing the Piston Ring Compressor ahead with the cylinder barrel (Figure 39).

(2) As the cylinder barrel approaches the crankcase, catch the Piston Ring Compressor (64559) as it drops off the piston skirt.

(3) As the cylinder assembly pilot is entering the crankcase, align the cylinder hold-down studs with the holes in the cylinder flange.

(4) Push the cylinder until the cylinder flange makes contact with the crankcase.

(5) Install a vented plug in each spark plug hole on the cylinder to prevent the entrance of foreign materials.

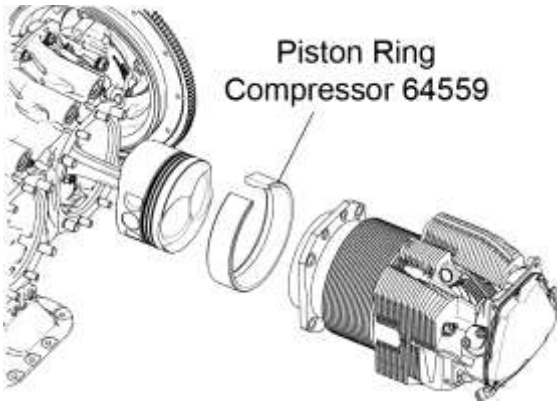


Figure 38
Piston Ring Compressor (64559)

Figure 39
Install the Cylinder

F. Install the cylinder base hold-down nuts (Figures 16 and 40) on the thru-studs and cylinder hold-down studs.

⚠ **CAUTION** TORQUE THE CYLINDER NUTS IN A SPECIFIC SEQUENCE.

G. Torque the cylinder base hold-down nuts as follows:

(1) Torque the 1/2 in. nuts to 25 ft.-lb (34 Nm) in the sequence shown in Figure 40.

(2) Torque the 1/2 in. nuts to 50 ft.-lb (68 Nm) in the sequence shown in Figure 40.

(3) Torque all 3/8 in. nuts to 25 ft.-lb (34 Nm) in the sequence shown in Figure 40. The torque sequence for these nuts is optional.

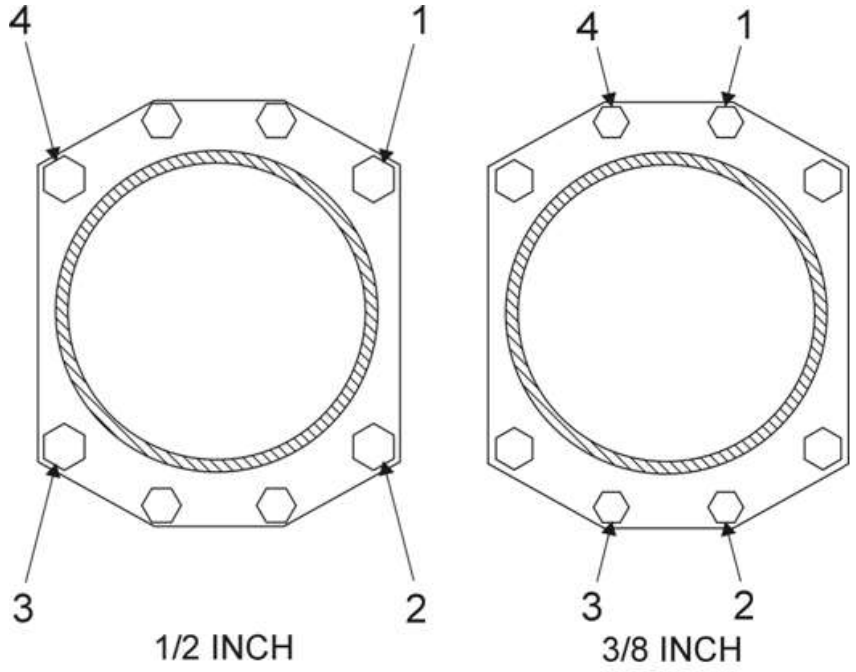


Figure 40
Sequence of Tightening Cylinder Base Hold-Down Nuts

(4) Use the same sequence shown in Figure 40, complete a torque check to 50 ft.-lb. (68 Nm) for all 1/2-in. nuts on the cylinder base studs.

(5) Tighten both ends of the free thru-studs at the same time at the all locations. Make sure all thru-studs have at least 1-1/2 threads above attaching nuts at both ends.

(6) Make sure all cylinder base hold-down nuts are torqued. Complete a torque check of all nuts on the cylinder base using the torque wrench to apply the appropriate torque on each nut for 5 seconds. If the nut does not turn, it is correctly torqued.

(7) Apply torque seal to all cylinder base hold-down nuts where the nut contacts the barrel.

⚠ **CAUTION** MAKE SURE ALL CYLINDER FASTENERS ON THE CRANKCASE ARE TORQUED CORRECTLY AND NONE ARE LOOSE.

H. Shroud Tube Installation

⚠ **CAUTION** BE SURE THERE IS NO OIL INSIDE THE TAPPET BODIES AND THAT THE PLUNGER ASSEMBLY AND CYLINDER ASSEMBLY ARE THOROUGHLY CLEAN AND DRY. WASH ANY LUBRICATING OR PRESERVATIVE OIL (MINERAL SPIRITS, STODDARD SOLUTION, OR EQUIVALENT) FROM THESE PARTS, SINCE PLUNGER ASSEMBLIES MUST BE COMPLETELY DRY FOR THE TAPPET CLEARANCE CHECK.

NOTICE: Install the lower shroud tube seals (Figure 15) in the crankcase first.

One shroud tube installs on the exhaust port of the cylinder and another shroud tube installs on the intake port.

The tappet plunger must be the one for the applicable tappet socket on the applicable cylinder.

(1) For each of the two shroud tubes, install the plunger assembly and hydraulic socket in the tappet bore in the crankcase (Figure 41).

(2) Rotate the crankshaft to move both installed plunger assemblies and hydraulic sockets to their lowest position in the tappet bores in the crankcase.

(3) Apply engine oil mixture (15% pre-lubricant (STP or equivalent) and 85% SAE No. 50 mineral base aviation grade lubricating oil) to all four of the shroud tube seals, two for each shroud tube.

(4) Install one shroud tube seal and the washer into the cups in the tappet bores of the crankcase (Figures 42 and 43).

(5) On each shroud tube, assemble the other shroud tube seal over the outer end of the shroud tube (Figure 43).

(6) Insert each shroud tube through the hole in the rocker box and seat the end firmly into the crankcase.

(7) Install the shroud tube spring, new lockplate, and nut (Figure 44). Torque the nut to 96 in.-lb. (11 Nm).

NOTICE: If necessary, turn the nut up to one additional hex to align the flat on the nut with the tab on the lockplate. Lockplate tabs must not be bent up on the corner of the nut.

(8) Ensure the flat on the nut aligns with the lockplate tab and bend the tab up.

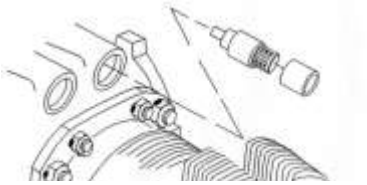


Figure 41
Tappet Plunger and Socket

Figure 42
Shroud Tube Oil Seals in Crankcase

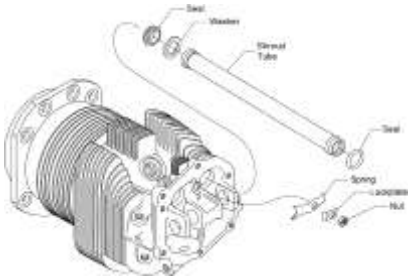


Figure 43
Insert the Shroud Tube

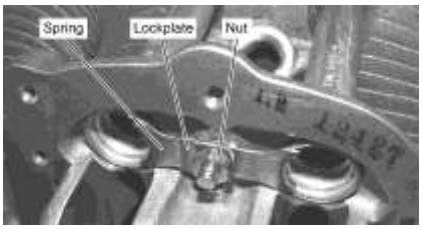


Figure 44
Shroud Tube Spring, Lockplate, and Nut

I. Push Rod Installation

(1) Use a brush and apply a mixture of 15% STP or equivalent and 85% SAE No. 50 mineral-based aviation-grade lubricating oil to 1 in. (2.54 cm) of both ends of the push rod. Refer to the latest revision of Service Instruction No. SI-1059 for any new details.

(2) Install the push rods into the full length of the shroud tube (Figure 15).

(3) Press the push rods tightly from the outer end of the shroud tube to test the spring tension and free travel of the unloaded or dry hydraulic tappet plungers. Make sure the springs compress and return.

(4) Install the rockers with the cupped end on the push rod.

(5) Align the valve rocker assemblies with the rocker shaft.

(6) Slide the rocker shaft through the valve rocker assemblies and bushings to seat the valve rockers in place.

(7) Install the thrust buttons, one on each end of the valve rocker shaft.

(8) Make sure the valve rocker assemblies are in the correct position on the intake and exhaust valves.

(9) Measure the clearance between the valve rocker and cylinder head. Refer to the latest revision of the ***Service Table of Limits - SSP-1776.***

NOTICE: If more than one cylinder is being installed on the engine, complete the procedure to measure dry tappet clearance on each cylinder before installing the next cylinder. The procedure to measure dry tappet clearance is the same for intake or exhaust valves.

To measure the dry tappet clearance:

(a) Push in on the push rod end of the valve rocker.

(b) Use a Valve Clearance Gage (ST-23) (Figure 45) to measure the distance between the end of the valve rocker assembly and the valve stem cap (Figure 47).

Figure 45
Valve Clearance Gage (ST-23)

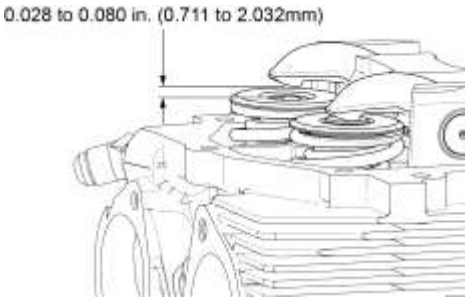


Figure 46
Dry Tappet Clearance

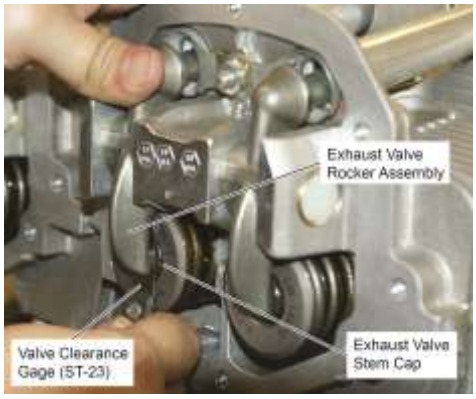


Figure 47
Measuring Dry Tappet Clearance

- Insert the 0.028 end of the Valve Clearance Gage (ST-23) between the valve rocker assembly and the valve stem cap. If it cannot be inserted, remove the current push rod and use a shorter push rod.
- Try to insert the 0.080 end of the Valve Clearance Gage (ST-23) between the valve rocker assembly and the valve stem cap. If it can be inserted, remove the current push rod and use a longer push rod.

(c) The distance must be between 0.028 and 0.080 in. (0.711 to 2.032 mm) (Figure 46).

NOTICE: If the clearance is not within the prescribed limit, insert a longer or shorter push rod to obtain the correct clearance. Refer to the latest revision of Service Instruction No. SI-1060 or the ***YO-233-B2A Illustrated Parts Catalog*** for available push rods.

J. Lubricate the valve rocker contact surfaces (Figure 48) with Modoc® Oil 175.

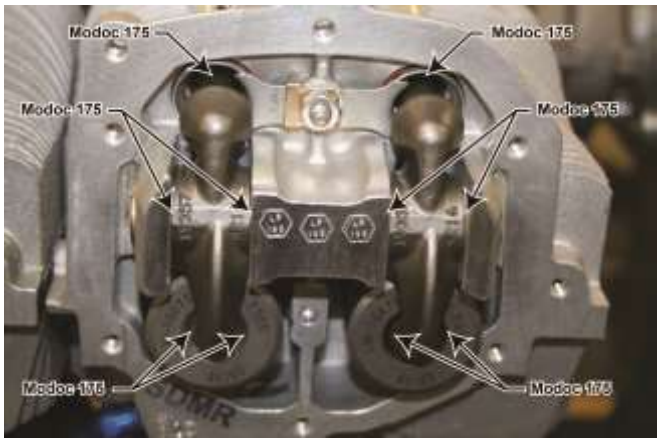


Figure 48
Valve Rocker Lubrication

NOTICE: If a cork rocker box cover gasket is installed, torque the rocker box cover screws to 50 in.-lb. (5.6 Nm). Do not reuse cork gaskets.

K. Examine the silicone rocker box cover gasket to make sure it is intact and not deformed or damaged. Replace as necessary.

L. Install the silicone rocker box cover gasket and rocker box cover with screws on each rocker box. Torque the screws to 35 in.-lb. (4.0 Nm).

M. Remove the vented plug from each spark plug hole.

N. Install the top and bottom spark plugs as per the section “Spark Plug Installation” in Chapter 74-20.

O. Remove the caps from the primer line and primer nipple assembly (Figure 11) and reconnect the primer line to the primer nipple assembly. Refer to the “Primer Line Installation” and “Primer Nipple Assembly Installation” procedures in Chapter 73-10 for primer line and primer nipple assembly installation.

P. Install the applicable intake pipe on the cylinder per the “Intake Pipe Installation” procedure in Chapter 72-80. Install the applicable exhaust pipe on the cylinder per the airframe manufacturer’s instructions.

Q. Be sure to install the cushioned clamps to attach the primer line to the intake pipe.

R. Complete the oil change, add oil to the engine per instructions in Chapter 12-10.

R. Intercylinder Baffle Installation

(1) Engage the "S-Type" retaining hook (Figure 3) through the hole in the in the intercylinder baffle.

(2) Put the baffle in position beneath and between the cylinders on the bottom of the engine as shown in Figure 49 and turn the hook up between the cylinder barrels.

Figure 49
Placement of Intercylinder Baffle on Down Exhaust Engines

Figure 50
Intercylinder Baffle Installed on Three Fins

(3) Put a baffle retainer in place between the cylinders and use a cotter pin puller to pull the retainer hook through the slot in the retainer. The retainer is forced down until the hook comes above the surface of the retainer far enough to be engaged over the bridge between the slots in the retainer.

(4) Ensure the intercylinder baffles are installed on three fins as shown in Figure 50 as a “tight fit” (as shown in Figure 51) and not loose (Figure 52). It could be necessary to bend the angles of the intercylinder baffle to ensure a tight fit.

Figure 51
Correct Tight Fit of Intercylinder Baffle

Figure 52
Loose Fit of Intercylinder Baffle

S. Oil Drain Tube Installation

NOTICE: Since there are different oil drain tube assemblies for the engine cylinders, refer to the ***YO-233-B2A Illustrated Parts Catalog*** for the correct part number for the oil drain tube assembly to ensure the correct oil drain tube assembly is installed on the corresponding engine cylinder.

(1) If a new nipple (Figure 53) is to be installed on the crankcase, apply Loctite® 564 to the threads of the nipple. Torque the nipple to 85 in.-lb. (9.6 Nm).

(2) Connect a new hose to the nipple in the crankcase.

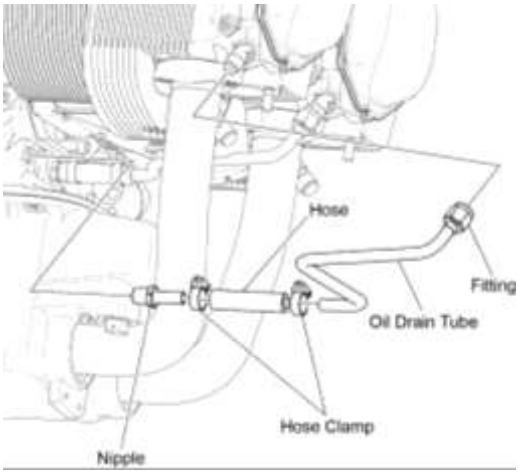


Figure 53
Oil Drain Tube

Figure 54
Oil Drain Tubes, Clamps, and Fittings

(3) Install and tighten a hose clamp on the hose as follows: for Cylinder Nos. 1 and 2, face towards the front of the engine; for the remaining cylinders, install the hose clamp face towards the rear of the engine (Figure 54).

(4) Connect the oil drain tube to the elbow fitting at the cylinder with a flange nut. Torque the nut per instructions in the latest revision of the ***Service Table of Limits - SSP-1776***.

(5) Connect the oil drain tube to the installed new hose and install a hose clamp.

(6) Torque both hose clamps per instructions in the latest revision of the ***Service Table of Limits - SSP-1776***

(7) Tighten the drain tube coupling to the fitting finger tight, plus ½ to ¾ turn. Adjust the cylinder head drain fitting as necessary for alignment. Make sure the oil drain tubes are not touching the intercylinder baffles or cylinders.

21. Corrective Action for Valve Sticking

NOTICE: If valve sticking is a problem, complete the 1000-hour Engine Inspection Checklist in Chapter 05-20 (regardless of the number of engine operating hours) (Figure 15). After correcting the cause of valve sticking, complete the 1000-hour inspection after the next 1000 hours of engine operation, unless valve sticking occurs again.

Sticking between the valve stem and guide (on intake and exhaust valves) can substantially change valve opening and closing. If the valve cannot open or close correctly, incomplete combustion will occur, which can cause formation of more deposits and increased valve sticking. Because a correctly-timed sequence of valve opening and closing is essential to efficient and reliable engine operation, the cause of valve sticking must be identified and corrected.

WARNING A STUCK VALVE CAN CAUSE ENGINE FAILURE.

NOTICE: If one valve is sticking, examine all other valves on all of the engine cylinders as a precaution.

A. Per Chapter 12-10 complete an oil and filter change and have an analysis done on the metallic solids in the oil filter to identify the contamination and find the source to correct the problem. Refer to the latest revision of Service Bulletin No. SB-480 for any additional details.

B. If the source of the oil contamination cannot be found or corrected, complete the following procedures in Chapter 12-10:

(1) Replace the oil filter (more often) after every 25 hours of operation (instead of after every 50 hours of engine operation.)

(2) Complete an oil change after every 25 hours of operation (instead of after every 50 hours of engine operation.)

C. Complete an air filter change at more frequent intervals.

D. Examine the cooling air baffles and baffle strips for contamination. Remove any contamination.

E. Identify with a tag and remove the top spark plugs from the engine cylinders per the “Spark Plug Removal” procedure in Chapter 74-20.

F. Identify the location of each cylinder and valve train component for reference on assembly and remove the cylinder and valve train components per the “Cylinder Removal” section in this chapter.

G. Remove the intake and exhaust valves per the “Intake Valve Removal” and “Exhaust Valve Removal” sections in this chapter.

H. Examine the valve stem keys/caps (Figure 15) for wear. Look for any distinct, uniform patterns. Replace worn valve stem keys or caps.

NOTICE: Refer to the latest revision of the ***Service Table of Limits - SSP-1776*** for valve guide dimensions to use the correct reamer.

Use reamer tools to remove hardened carbon from the valve guides.

I. Apply ordinary cup grease on the flutes of the reamer to remove the deposits on the reamer.

J. Ream the valve guide as follows:

(1) Apply force on the reamer to ensure the reamer has gone through the full length of the valve guide. The 1-in. (2.54 cm) pilot must be visible through the exhaust port or through the spark plug hole using an angled mirror.

(2) Clean the valve guide per the "Hard Carbon Removal" procedure in Chapter 05-30.

(3) Measure the inner diameter of the valve guide using the correct plug gage.

(4) Examine the reamed hole to see if the reamer has cut all the way to the exhaust port end of the guide. If it has not, and the exhaust port end of the hole looks dark, the valve guide is bell-mouthed and must be replaced. Send the engine cylinder to an authorized vendor who can complete this replacement.

(5) If the valve guide is acceptable, apply lubricant to the valve guide.

⚠ **CAUTION** NEVER USE THE PISTON TO PUSH THE VALVE THROUGH THE GUIDE.

K. Install the valves that are satisfactory, in the corresponding position from where valves were removed. Refer to the "Intake Valve Installation" and "Exhaust Valve Installation" procedures in this chapter.

L. Install the valve springs and valve spring seats (Figure 15).

M. Remove and clean the hydraulic lifter and remove all oil.

N. Examine the lifter for any malfunction.

O. Clean the inner diameter of the tappet body.

P. Install the hydraulic lifter.

Q. Install the cylinder in the same position as removed. Refer to the "Cylinder Installation" procedure in this chapter.

R. Examine, rotate (as needed), and install serviceable spark plugs per the "Spark Plug Inspection," "Spark Plug Rotation," and "Spark Plug Installation" procedures in Chapter 74-20.

22. Intake and Exhaust Valve Guide Replacement

Any time a valve guide (Figure 15) is to be replaced, send the engine cylinder to an authorized vendor who can complete this replacement.

23. Intake and Exhaust Valve Seat Replacement

If an intake or exhaust valve seat (Figure 55) is damaged or must be replaced, send the engine cylinder to an authorized vendor who can complete this replacement.

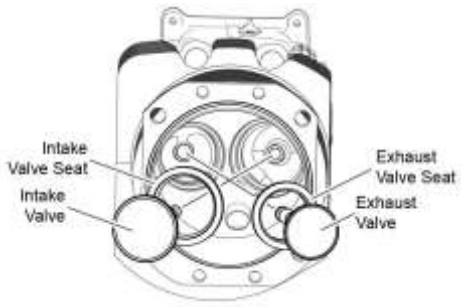


Figure 55
Intake and Exhaust Valve Seats

24. Barrel Glaze and Varnish Removal from Interior Cylinder Barrel
    A. Use a self-centering, self-bottoming hone that follows a choke located in the top of the cylinder barrel.
    B. Use kerosene or light engine oil for lubrication while honing.
    C. Put the deglazing hone in a low-speed drill.
    D. Surface hone each cylinder barrel with a minimum of six to eight passes over the glazed surface, using a smooth up and down motion of the hone to achieve a good cross-hatch pattern on the cylinder barrel wall.
    E. Thoroughly clean the hone.
    F. Wipe as much of the abrasive build-up from the cylinder walls and recesses as possible, especially the recesses formed by the top of the cylinder barrel and the bottom of the cylinder head.
    G. Make a hooked tool from soft wire and rub the tool back and forth in the recess to loosen any built-up abrasive. Complete this task each time the cylinder is flushed. There must not be any abrasive material in this area.
    H. Complete the "Cylinder Cleaning" procedure in Chapter 05-30.
    I. Lubricate the internal cylinder barrel thoroughly with SAE 50 engine oil or a rust preventative oil that conforms with MIL-C-6529.

NOTICE: If step wear is found inside the cylinder barrel, measure it using the dial bore gage used to measure cylinder diameter. If the depth of the step wear is less than 0.0025 in. (0.0635 mm), remove the step as per the previous steps to remove cylinder barrel glaze. If the barrel contains a wear step exceeding 0.0025 in. (0.0635 mm), replace the cylinder. Record the condition and corrective action in the engine logbook.

In some cylinders, a small rough area can be found at either end of the barrel extending less than 0.250 in. (6.35 mm) from the end. This condition is a result of the manufacturing process and has no effect on the quality or condition of the barrel.

25. Heli-Coil® Replacement

NOTICE: The YO-233-B2A has short reach spark plugs.

A. Replace the spark plug Heli-Coil® insert (Figure 56) in the cylinder head if the threads in the spark plug hole in the cylinder are damaged (usually occurs when hard carbon on the end of the spark plug causes the insert to unwind during spark plug removal).

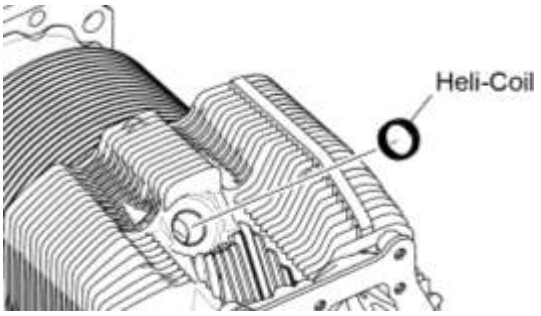


Figure 56
Heli-Coils®

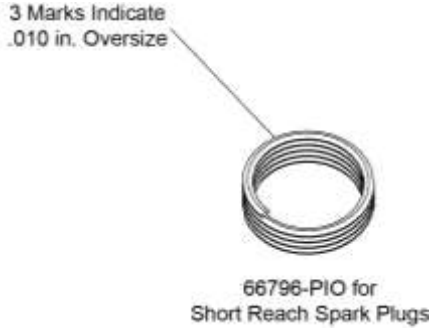


Figure 57
Heli-Coil® Inserts for Short Reach Spark Plugs

NOTICE: Always install a larger 0.010 in. oversized Heli-Coil® insert in the spark plug hole on the cylinder head to replace a standard sized Heli-Coil® insert. Never replace a standard sized Heli-Coil® insert with another standard sized Heli-Coil® insert. The oversize Heli-Coil® inserts are identified by three marks on the tang of the Heli-Coil® insert as shown Figure 57.

(1) Disable all power to the engine to prevent propeller rotation and engine start. Disconnect ignition leads from all spark plugs.

(2) If not already done, remove the Heli-Coil® insert from the spark plug hole as follows:

(a) Insert the T-shaped Removing Tool P/N 64595 (Figure 58) in the spark plug hole. Press the tool down firmly for the edge of the tool to cut into the top thread of the insert.

(b) Turn the tool counterclockwise to the remove the insert.

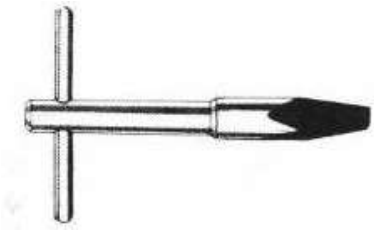


Figure 58
Removing Tool P/N 64595

(3) Examine the removed Heli-Coil® to make sure it is not 0.010 in. oversized (Figure 57). If the removed Heli-Coil® is 0.010 in. oversized, replace the cylinder.

(4) Apply of coat of grease liberally to the Bottom Tap 64596-1 (Figure 59).

(5) If the Heli-Coil® insert is replaced while the cylinder is installed on the engine, take precautions to prevent metal shavings from falling into the combustion chamber.

⚠ **CAUTION** IF METAL SHAVINGS FALL INTO THE COMBUSTION CHAMBER OF THE CYLINDER, STOP AND REMOVE ALL SHAVINGS AND DEBRIS. THE COMBUSTION CHAMBER MUST BE CLEAN WITHOUT DEBRIS.

(6) Turn the crankshaft to the start of the compression stroke.

(7) Put 8 ft. (2.4 m) of 3/8 in. (9.5 mm) nylon rope through the opposite spark plug hole.

(8) Turn the crankshaft to force the rope against the bottom of the spark plug hole that is to be tapped.

(9) Use the 0.010 in. oversized Bottom Tap 64596-1 (Figure 59), to tap an oversize hole for the new 0.010 in. oversized Heli-Coil® insert.

(10) Remove all chips and shavings to prevent contamination from foreign object debris.

(11) Remove the rope from the spark plug hole.

Figure 59
0.010-Inch Bottom Tap 64596-1

Figure 60
Inserting Tool P/N 64594

(12) Install the new 0.010 in. oversized Heli-Coil® insert into the spark plug hole as follows:

(a) Use the T-shaped Inserting Tool P/N 64594 (Figure 60) and withdraw the mandrel portion of this tool beyond the recessed section of its sleeve.

(b) Put the new 0.010 in. oversized Heli-Coil® insert into the recess on the tool.

(c) Push the mandrel to engage its slotted end with the tang of the new 0.010 in. oversized Heli-Coil® insert.

(d) Turn the mandrel clockwise and press it forward slightly to engage the threaded end of the new 0.010 in. oversized Heli-Coil® insert.

(e) While holding the sleeve of the tool, turn the mandrel where adjacent turns of the new 0.010 in. oversized Heli-Coil® insert are in contact with each other to prevent crossed threads and the insert is firmly on the Inserting Tool P/N 64594. Keep the new 0.010 in. oversized Heli-Coil® insert securely on the tool to enable installation of the insert on the threads of the cylinder head.

(f) Turn the threaded portion of the sleeve on the tool within a half-turn from the end of the coil on the new 0.010 in. oversized Heli-Coil® insert.

(g) Use the Inserting Tool P/N 64594 (Figure 60) to install the new 0.010 in. oversized Heli-Coil® insert into the spark plug hole on the cylinder head. Be sure that the first coil engages with the first thread.

(h) Continue to turn the Inserting Tool P/N 64594. When the face of the sleeve on the tool is 1/16-inch away from the face of the boss, be sure to hold the Inserting Tool P/N 64594 tightly with one hand. Use your other hand to simultaneously turn the sleeve counter-clockwise to free the left half-turn of the new insert.

(i) Slide the sleeve toward the top of the mandrel. The new 0.010 in. oversized Heli-Coil® insert is installed correctly at this point if the end of the insert is visible projecting above the boss.

(j) Continue to turn the mandrel clockwise until the insert is no longer visible above the boss.

(k) When the top of the insert is approximately a half turn from the face of the boss, remove the Inserting Tool P/N 64594.

(l) Use the Expanding and Staking Tool P/N 64593 (Figure 61) to stake the new installed 0.010 in. oversized Heli-Coil® insert securely in the spark plug hole as follows:

1 Fix the stop nut/adjusting screw on the Expanding and Staking Tool P/N 64593 to limit expansion of the mandrel to within the thread gage.

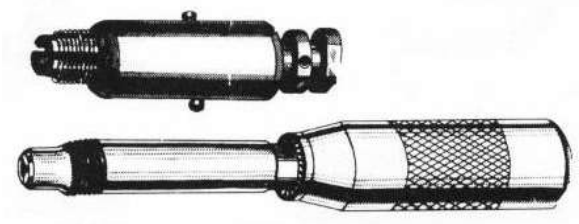


Figure 61
Expanding and Staking Tool P/N 64593

2 Assemble the staking sleeve of the Expanding and Staking Tool P/N 64593 over the mandrel until the sleeve meets the boss.

3 Gently tap the top of the staking sleeve with a plastic mallet to make a slight chamfered edge around the periphery of the tapped hole.

4 Remove the adjusting screw/stop nut on the Expanding and Staking Tool P/N 64593 and remove this tool and its expanding mandrel

5 Use needle-nose pliers to break off the tang at the notch of the newly installed 0.010 in. oversized Heli-Coil® insert.

(13) In the engine logbook, record replacement of the standard sized Heli-Coil® insert with a new oversized Heli-Coil® insert for the applicable cylinder number.

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72-50 - RECIPROCATING ENGINE – LUBRICATION

1. System Description
   A. Refer to the ***YO-233-B2A Engine Installation and Operation Manual***
2. Lubrication Maintenance
   A. Oil Pressure Adjustment

NOTICE: There is an adjustment screw (Figure 1) on the oil pressure relief valve housing. Rotation of this screw used to either increase or decrease the oil pressure to keep it within the specified operational limits in Appendix A of the ***YO-233-B2A Engine Installation and Operation Manual***.

Tools: A screwdriver is necessary for this procedure.

(1) The engine must be installed in the airframe or on a test stand to complete this procedure.

(2) Start and operate the engine as per instructions in the ***YO-233-B2A Engine Installation and Operation Manual***.

(3) Run-up the engine to 2000 rpm.

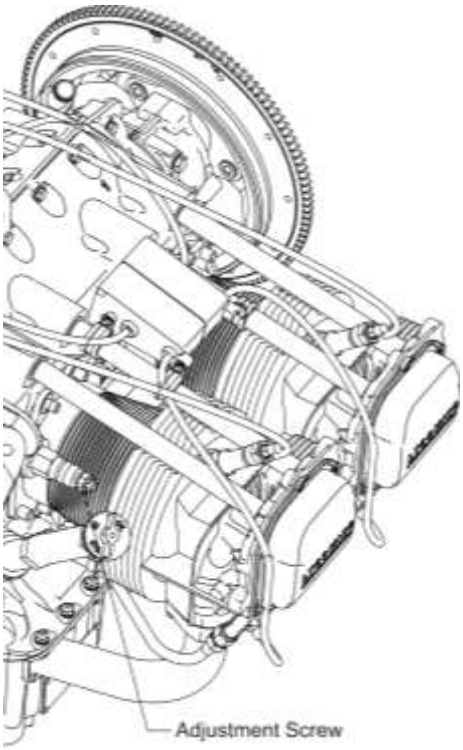
(4) Record the oil pressure reading.

(5) If the oil pressure is out of tolerance, turn off the engine.

(6) To ***increase*** oil pressure, use a screwdriver in the screw slot to turn the oil pressure adjustment screw on the oil pressure relief valve ***clockwise*** (Figure 1).

(7) To ***decrease*** oil pressure, use a screwdriver in the screw slot to turn the oil pressure adjustment screw on the oil pressure relief valve ***counterclockwise.***

(8) Start the engine and repeat the previous steps until the oil pressure is within specified limits.



Adjustment Screw on the Oil Pressure Relief Valve
Figure 1

NOTICE: Usual oil pressure can be expected to vary from 115 psi, during engine starting and warm-up, to

B. Oil System Inspection

(1) If there are indications of leaking around the oil seals and gaskets, identify the source of the leak and repair as necessary.

(2) Replace leaky oil seals and gaskets.

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72-60 - RECIPROCATING ENGINE – ACCESSORY DRIVES

1. 100-Hour Accessory Drive Inspection Procedure
   A. Look for defects in engine-mounted accessories such as pumps.
   B. Make sure the fuel pump and any attached accessories are attached securely at the correct torque. Refer to the latest revision of the ***Service Table of Limits - SSP-1776***.
   C. Make sure that the alternator support bracket and mounting are tight.
   D. Refer to the latest revision of the ***Service Table of Limits - SSP-1776*** for torque values and tighten hardware as necessary.

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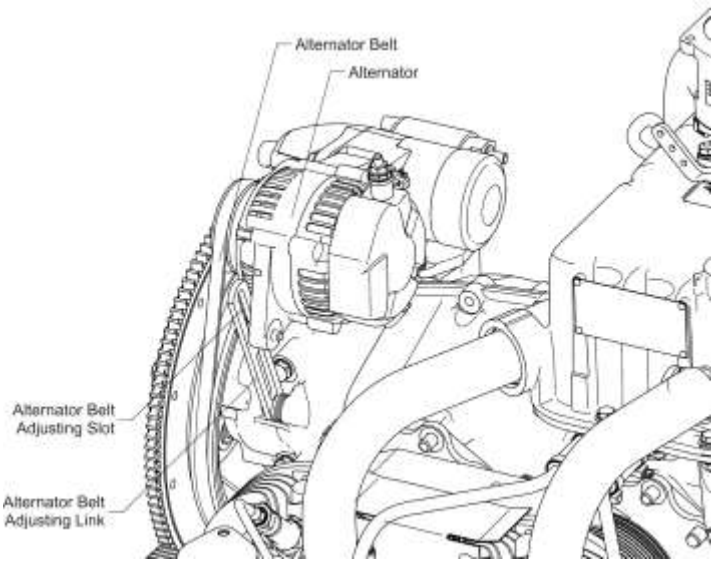
72-70 - RECIPROCATING ENGINE – ELECTRICAL SYSTEM

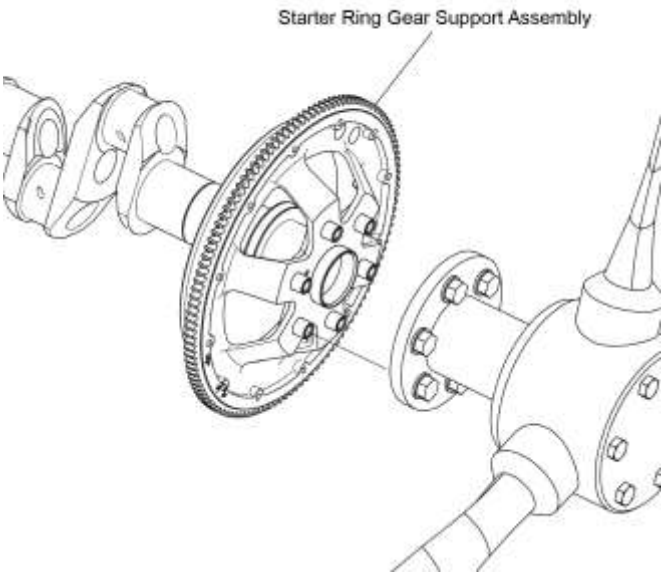
1. General
   A. The Electrical System includes the wiring harness.
2. 100-Hour Wiring Inspection
   A. Examine the airframe electrical wiring for correct routing, security, clamping, deterioration, and chafing in accordance with the airframe manufacturer's instructions.
   B. Record any worn or frayed airframe wiring. Replace worn or frayed wires.
   C. Make sure the wiring connections are tight. Tighten any loose wiring connections.
   D. Examine all of the wiring connections and accessories for physical damage and security.
   E. If any wire is broken, chafed, worn or degraded on the wiring harness, the complete harness must be replaced. Refer to the Direct Drive Overhaul Manual. Wiring degradation includes the following:
      (1) Degraded wire repairs or slices.
      (2) Heat damaged or burn wire.
      (3) Vibration damage or chafing.
      (4) Cracked insulation.
      (5) Arcing.
      (6) Insulation delamination.
   F. To replace damaged cables or clamps refer to the aircraft manufacturer's instructions.
   G. Examine the terminals for correct installation, tightness, and cleanliness. Clean any dirty terminal; tighten terminals as per the torque values in the latest revision of the ***Service Table of Limits - SSP-1776***.
3. Wiring Inspection
   A. Look for damage on all wiring that can come in contact with chemicals and fluids such as:
      (1) Hydraulic fluid
      (2) Battery electrolytes
      (3) Fuel corrosion inhibiting compounds
      (4) Waste system chemicals
      (5) Cleaning agents
      (6) Deicing fluids
      (7) Paint
      (8) Soft drinks.
   B. Closely examine wiring that could have been exposed to hydraulic fluid during wiring inspection.
   C. Look for heat damage on the wiring and on the engine in galleys, and behind lights.
   D. Though a visual inspection of the wiring harness can identify heat damage, burnt wire, vibration damage, or chafing, a more detailed inspection is necessary to identify cracked insulation, arcing, insulation delamination, and degraded repairs or splices.

4. Alternator Belt Inspection
   A. Examine the alternator belt for any cracks, damage, or wear.
   B. Replace worn, cracked or damaged alternator as per instruction in the Direct Drive Overhaul Manual.
   C. Tighten any loose hardware on the alternator belt support bracket and mounting as per torque values in the latest revision of the ***Service Table of Limits - SSP-1776***.
5. Alternator Belt Tension Adjustment
   A. On the adjusting link, use the slot (Figure 1) to adjust the alternator belt tension.



Alternator Belt
Figure 1

6. Starter Ring Gear Support Replacement Procedure
   A. Remove the propeller from the engine in accordance with the airframe manufacturer's instructions.
   B. Remove the starter ring gear support assembly (Figure 2).
   C. Install a new starter ring gear support assembly on the propeller shaft.
   D. Install the propeller in accordance with the propeller manufacturer's instructions.
   E. Torque the fasteners per the specified torque as per the propeller manufacturer's instructions.



Starter Ring Gear Support Assembly
Figure 2

72-80 - INDUCTION SYSTEM

1. System Description
   A. Refer to the ***YO-233-B2A Engine Installation and Operation Manual***.
2. Induction System Inspection Procedure
   A. Examine the air intake ducts for leaks, security, and filter damage.
   B. Service in accordance with the manufacturer's maintenance procedure. Evidence of dust or other solid material in the ducts is indicative of inadequate filter care or of a damaged filter.

   NOTICE: If there is volcanic ash dust, do not touch with bare hands; do not clean with water. Refer to the section "Volcanic Ash/Particulate Contamination" in Chapter 05-50 of this manual.

   C. If there is dust or other solid material in the air ducts, remove the dust and contaminant, examine the air filter and replace the air filter if necessary. Identify the cause of the problem as per the aircraft OEM procedure.
   D. Identify and correct the cause of the problem as per the aircraft OEM procedure.

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73-00 - ENGINE FUEL AND CONTROL – GENERAL

1. System Description
   A. Refer to the ***YO-233-B2A Engine Installation and Operation Manual***.

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73-10 - ENGINE FUEL AND CONTROL – DISTRIBUTION

1. Fuel System Inspection Procedure

⚠ **CAUTION:** DO NOT SMOKE OR HAVE AN OPEN FIRE/FLAME OR USE ANY DEVICES THAT CAN MAKE SPARKS DURING THIS REPLACEMENT PROCEDURE. SMOKING, FLAMES, OR SPARKS CAN IGNITION THE FUEL WHICH CAN CAUSE SERIOUS INJURY OR DEATH.

— Visually examine all fuel lines and fuel fittings for evidence of damage or leaks.

— Replace any fuel lines that are crimped or kinked. (Cracks can develop at the site of bends or kinks.)

— Make sure that all fuel lines are secure and have clamps attached securely.

— Ensure the security of the clamps.

— Examine the carburetor and connections.

— Remove and clean the fuel inlet strainers. Always remove from the inlet side.

⚠ **CAUTION:** DO NOT RETURN THE ENGINE TO SERVICE UNLESS THE ENGINE IS OEPRATING CORRECTLY AND DOES NOT HAVE ANY LEAKS.

— Look for any fuel leaks. Identify and correct the cause of any fuel leak.

— Operate the engine and look for leaks. Identify and correct the cause of any leak or malfunction. If leaks or malfunctions were found and corrected, operate the engine again to make sure it is operating correctly and there is no leak anywhere.

— Make sure the mixture control and throttle linkage have full travel, freedom of movement, and that the clamps are tight.

— Lubricate the linkage as per the aircraft manufacturer's instruction.

2. Fuel Filter Inspection Procedure

A. Remove the fuel filter.

B. Examine the fuel filter for dents, damage, dirt, and contamination.

(1) If metal particles are found, identify the source and correct the cause of the problem.

(2) If the fuel filter is damaged, replace the fuel filter.

C. Install the clean fuel filter on the engine.

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74-00 - IGNITION SYSTEM MAINTENANCE

1. Ignition System Description

   A. Refer to the ***YO-233-B2A Engine Installation and Operation Manual***.

2. Ignition System Maintenance

   A. Table 1 shows the maintenance schedule and section references for ignition system components.

Table 1
Ignition System Maintenance Items

Maintenance Item	Usual Maintenance Necessary	Referenced Chapter
Examine the ignition lead routing	Every 100 hours of engine operation	Refer to Chapter 74-20
Replace the spark plugs (remove and install)	As needed	Refer to Chapter 74-20
Examine spark plugs and ignition leads	As needed	Refer to Chapter 74-20
Examine the spark plug port seals to Complete the check of the Heli-coils	As needed	Refer to Chapter 74-20
Clean the spark plugs	Every 100 hours of engine operation	Refer to Chapter 74-20
Reset the spark plug gap	Every 100 hours of engine operation	Refer to Chapter 74-20
Rotate the spark plugs	Every 100 hours of engine operation	Refer to Chapter 74-20
Light Speed Plasma III and Magneto Ignition System	Every 500 hours of engine operation	• Complete the 500-hour Inspection in accordance with the Light Speed Installation and Operation Manual • Examine the magneto in accordance with the magneto manufacturer's instructions

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74-20 - IGNITION SYSTEM - SPARK PLUG MAINTENANCE

WARNING: FAILURE TO MAINTAIN THE SPARK PLUGS AND IGNITION LEADS CAN CAUSE ENGINE DAMAGE OR FAILURE.

The ignition leads are an all-weather, shielded wire constructed with over braid.

1. Examine the Ignition Lead Routing
   A. Examine the ignition leads for signs of chafing, cracks in the all-weather shielding, or worn leads. Replace the harness if any leads show chafing, cracks, or wear.
   B. Examine the ignition lead connections. Make sure the ignition lead connections are secure.
   C. Tighten the leads if any connections are loose.
   D. Make sure the ignition lead mounting clamps are tight.
2. Remove the Spark Plug
   A. Make sure that the power is disconnected from the engine.
   B. Make sure that the engine is cool to the touch.
   C. Identify and tag the location of all the spark plugs (Figure 1).
   D. Hold the ferrule and loosen the spark plug nut.

CAUTION: HOLD FERRULES WHILE LOOSENING THE SPARK PLUG COUPLING NUT TO PREVENT TWISTING CONDUIT OR CABLE.

   E. Use a 6-point deep recess socket on top of the spark plug and rotate the socket to remove the spark plug from the engine cylinder head.
   F. Remove and discard the spark plug and gasket.

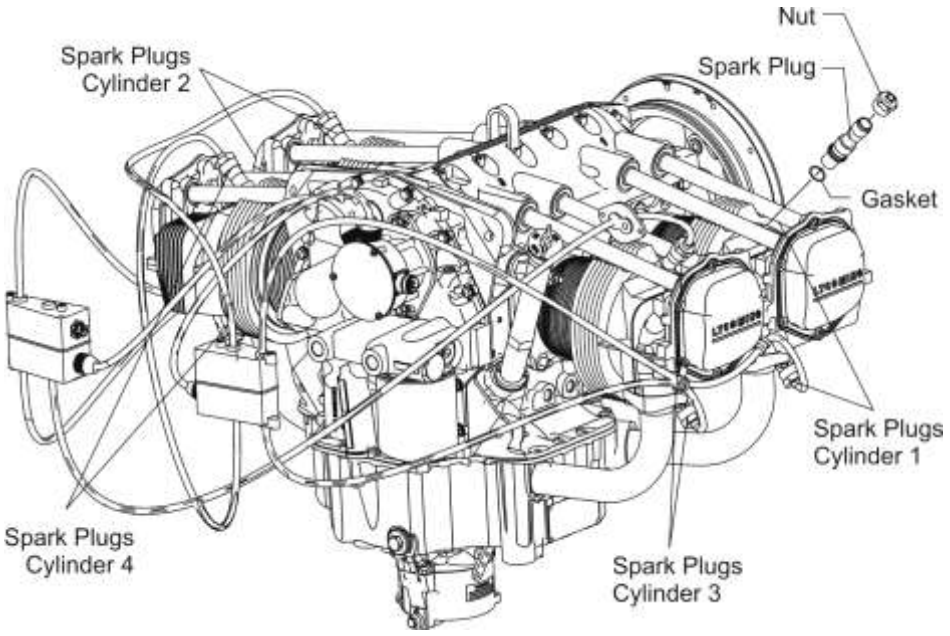

Figure 1
Champion Electronic Ignition System

3. Examine Spark Plugs and Ignition Leads
   A. Remove the spark plug connector nuts.
   B. Examine spark plug cable leads and ceramics for corrosion and deposits.
   C. Examine each ignition lead for chafing, insulation breakdown, frayed wiring, deterioration, heat damage, wear, and cracking during every 100-hour inspection.
   D. Make sure that the lead nuts are attached tightly.

   NOTICE: Corrosion and deposits are evidence of leaking spark plugs or incorrect cleaning of the spark plugs walls or connector ends.

   E. Examine each spark plug for chafing, corrosion, wear, and cracking during every 100-hour inspection. Replace any worn, cracked or corroded spark plug with a new spark plug. Refer to the guidelines in Table 1 to identify acceptable and unacceptable spark plugs. The condition of the fine wire ground and center electrodes as shown in figures in Table 1 show the level of wear indication and condition of the spark plug. Under usual conditions, the electrode wear is caused by high voltage sparking and corrosive gases formed during combustion.

Table 1
General Spark Plug Wear/Replacement Guidelines

Spark Plug	Findings	Condition of Fine Wire Ground Electrode on Spark Plug	Condition of Center Electrode on Spark plug	What to do
Acceptable Spark Plugs	Insulator tip gray, tan or light brown No ash deposits Electrodes intact, not burnt or eroded			Clean, set the spark plug gap and install the spark plug per applicable sections in this chapter and in Chapter 05-30.
Partially Worn Spark Plugs	Ash deposits Electrode burnt and/or eroded to less than half of the original thickness More voltage has been necessary to fire the spark plugs			Discard the spark plug and replace with a serviceable spark plug.
Worn Spark Plugs	Erosion of center and ground electrode Extensive necking of the fine wire ground electrode			Look for excessive heat sources. Discard the spark plug and replace with a serviceable spark plug.

F. To be acceptable, the spark plug must not have any of the following defects:

(1) Fine wire plugs with loose center or ground electrodes.

(2) Electrodes show signs of metal or impact change.

(3) Massive electrode plugs with copper run-out of center electrode.

(4) Ceramic core nose with a cracked or crazed surface.

G. Measure the spark plug gap to make sure it is at correct tolerance. Reset the spark plug gap if it is not correct. Refer to the "Set Spark Plug Gap" procedure in this chapter.

4. Spark Plug Fouling

A. Spark plug fouling can be caused by lead in fuel. Lead deposits can collect on the spark plug electrodes when the engine operates at lower-than-specified temperatures with fuel rich mixtures which does not enable vaporization of lead in the aviation gas. These deposits can cause misfiring.

B. Recommendations to prevent spark plug fouling:

— Rotate top and bottom spark plugs every 50 operating hours

— Operate the engine between 1000 and 1200 rpm after engine start and during warm-up. (At these speeds the spark plug core temperatures are sufficiently hot to activate the lead scavenging agents to prevent lead deposits on the spark plugs and exhaust valve stems.)

— Operate the engine at the specified operating temperature to prevent low temperature operation.

— Use oil cooler baffles to keep the oil temperature from decreasing during winter flight.

— Do not do low power altitude changes or low power landing approaches to prevent rapid engine cool down.

— Do not stop the engine immediately after landing to prevent rapid engine cooling.

— Before engine shutdown, operate the engine between 1000 and 1200 rpm until operating temperatures are stable. Then increase engine speed to 1800 rpm for 15 to 20 seconds. Then decrease engine speed between 1000 and 1200 RPM before engine shutdown.

5. Spark Plug Port Seal Inspection

NOTICE: This inspection is usually done to complete the check of the Heli-coil.

A. Apply a soap solution to the seating area of the cylinder head.

B. Look for bubbles. If bubbles are seen, replace the Heli-coils. Replace all loose or damaged spark plug Heli-coil inserts with oversize inserts.

C. Examine the spark plugs (if not already done). Refer to the section “Examine Spark Plug and Ignition Leads” procedure in this chapter.

D. Examine the surface of the cylinder (covered with soap) for cracks. Refer to the “Visual Cylinder Inspection Procedure" in Chapter 72-30.

6. Clean the Spark Plugs

   A. Clean the ignition lead, cable ends, spark plug walls, and ceramic of the spark plugs (new or reused) as per the spark plug manufacturer's instructions.

   B. Wipe the spark plug lead connector clean using a lint-free cloth moistened with MEK, acetone, wood alcohol or naphtha.

   C. Remove all cleaning residue from the spark plug.

   D. Dry all parts using compressed air.

7. Set Spark Plug Gap

   A. The spark plug must be clean before the gap can be reset.

   B. Make sure that the inside of the spark plug barrel is clean and dry and does not have any residue from cleaning.

   C. Reset and test the spark plugs in accordance with the spark plug manufacturer's instructions.

8. Spark Plug Rotation

   NOTICE: Rotate spark plug locations when the operational ground check indicates evidence of spark plug fouling.

   A. Remove all of the spark plugs. Refer to the "Remove the Spark Plug" procedure in this chapter.

   B. Examine each spark plug and ignition lead. Refer to the "Examine Spark Plugs and Ignition Leads" procedure in this chapter.

   C. Clean acceptable spark plugs. Refer to the "Clean the Spark Plugs" procedure in this chapter.

   D. Rotate the spark plugs by moving the bottom plugs to the upper position.

   E. Install acceptable spark plugs in new locations as per the rotation scheme identified in Table 2 below. Refer to the "Spark Plug Installation" procedure in this chapter.

Table 2
Spark Plug Rotation Scheme

#1 Top	with	#4 Bottom
#2 Top	with	#3 Bottom
#3 Top	with	#2 Bottom
#4 Top	with	#1 Bottom

9. Spark Plug Installation

   Refer to the latest revision of Service Instruction No. 1042 to identify the correct long-reach spark plug for this engine.

   A. Sparingly apply Anti-seize to all spark plug threads, **except the first thread**.

   B. Set the spark plug gage at 0.016 to 0.022 in. (0.406 to -0.559 mm).

C. Use a 6-point deep recess socket to install the spark plug in the engine cylinder head with a new gasket. A new gasket must be installed whether the spark plug is new or is acceptable and being reused.

⚠ **CAUTION:** FAILURE TO INSTALL A NEW SPARK PLUG GASKET ANY TIME A SPARK PLUG IS INSTALLED CAN RESULT IN INCOMPLETE SEALING OF THE COMBUSTION CHAMBER, LOSS OF SPARK PLUG HEAT TRANS, SPARK PLUG OVERHEATING, POSSIBLE REIGNITION/DETONATION AND INTERNAL ENGINE DAMAGE. NEVER INSTALL A SPARK PLUG THAT HAS DROPPED ON THE FLOOR.

D. Thread the spark plug by hand into the engine cylinder head within one to two threads of the gasket. If the spark plug cannot be screwed in this far, clean the cylinder or spark plug threads.

E. Rotate the socket to tighten the spark plug in place.

F. When the B-nut thread makes contact with the spark plug threads, push the ferrule against the spark plug while turning the B-nut clockwise.

G. Continue rotating the B-nut until it seats and is finger-tight.

H. While holding the spark plug lead ferrule stationary, tighten the B-nut an additional 1/8 turn with the correct size open end wrench.

⚠ **CAUTION:** HOLD FERRULES WHILE TORQUING THE SPARK PLUG COUPLING NUT TO PREVENT TWISTING CONDUIT OR CABLE.

J. Torque the spark plug to 35 ft.-lb (47 Nm).

K. Torque to 5/8-24 head nuts to 80 to 90 in.-lb (9.2 to 10.4 Nm).

L. Torque the 3/4-20 head nuts to 110 to 120 in.-lb (12.7 to 13.9 Nm).

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74-30 - ELECTRONIC IGNITION SYSTEM

Champion EIS Ignition System

EIS Replacement and Timing Procedure

NOTICE: The Champion EIS includes the Ignition Module, two coil packs, and attaching cables.

1. Remove the EIS from the engine as follows:
   A. Disconnect the coil packs from the EIS.
   B. Disconnect the cables from the spark plugs.
   C. Remove the coil packs from the engine.
   D. Disconnect the wiring harness from the EIS.
   E. Remove EIS hardware fasteners from the EIS; discard the lock washers. Remove the EIS.
   F. Remove and discard the cotter pin.
   G. Remove the drive gear.

   NOTICE: This procedure can be done on an engine that is installed in the airframe. This procedure is to be done for initial installation as follows:

2. Install the EIS per the latest edition of the Champion Instruction CH42PR20A.

Light Speed Plasma III and Magneto Ignition System

Lycoming has approved an alternate ignition system for the YO-233-B2A. This system consists of a single magneto P/N 66GP-0RANN, ignition harness P/N 67P20440, and a single Light Speed Engineering, LLC Plasma III kit P/N 66K29678-Y. Refer to the latest revision of Service Letter No. L283 for additional information.

Convert the Engine from the Champion EIS Ignition System to the Light Speed Plasma III and Magneto Ignition System:

1. Remove the Champion coil packs and integral high-tension harness, low-tension harness, ignition module, and any other hardware or wiring used for installation of the Champion ignition system.
2. Remove the drive gear from the Champion ignition module and install it on the magneto. Torque the drive gear nut to 10 to 26 ft.-lb. (14 to 35 Nm) and install a new cotter pin.
3. Install a P-lead for connection from the ignition switch to the magneto in accordance with standard aviation wiring practices.
4. Refer to the Light Speed Installation and Operation Manual for instructions to install, test, inspect, maintain, and troubleshoot the Plasma III CDI (Capacitance Discharge Ignition). The manual is available to download at http://lightspeed-aero.com/Manuals/Ignition.htm
5. Install the magneto per the “Magneto Installation” section in this chapter.

Instructions for Magneto Inspection, Magneto-to-Engine Timing Check, Magneto-to-Engine Timing Adjustment Procedure, Magneto Replacement Procedure, are as follows:

1. Magneto Inspection

   Examine the magneto in accordance with the magneto manufacturer's instructions after every 500 hours of engine operation.

2. Magneto-to-Engine Timing Check

   A. Disconnect the ignition leads from all spark plugs.

   B. Remove the nut and lock washer from the condenser terminal on the magneto. Disconnect the P-Leads from the magneto. Discard the lock washer.

   C. Remove one of the spark plugs from Cylinder No. 1 per the “Spark Plug Removal” procedure in Chapter 74-20.

   D. Turn the crankshaft in the direction of normal rotation until Cylinder No. 1 is on the compression stroke, approximately 35° before TDC.

   E. Put your thumb over the spark plug hole and turn the crankshaft in the direction of normal rotation until there is pushback pressure at the spark plug hole.

   NOTICE: Some timing lights operate in the reverse manner than identified herein. The light comes on when the contact points open. Refer to your timing light instructions.

   F. Connect the timing light leads to the appropriate magneto condenser terminals and the ground lead to any unpainted portion of the engine.

   NOTICE: There are two reference points on the engine to be used when aligning the timing marks on the starter ring gear support:

   - When viewing the starter ring gear support assembly from the crankcase side, the reference point is the crankcase parting flange (Figure 1).
   - When viewing the starter ring gear support assembly from the propeller side, the reference point is the timing mark on the starter (Figure 2).

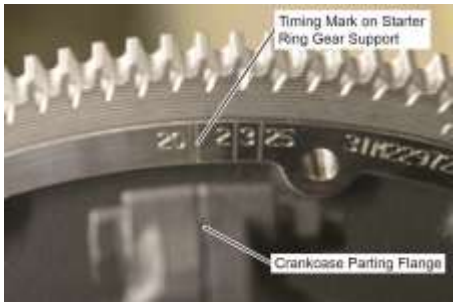

Figure 1
Timing Marks on the Crankcase Side of the Starter Ring Gear Support Assembly Aligned with the Crankcase Parting Flange

Figure 2
Timing Marks on the Propeller Side of the Starter Ring Gear Support Assembly Aligned with the Timing Mark on the Starter

NOTICE: The advance timing specification in degrees is stamped on the engine data plate.

G. Turn the crankshaft in the direction of normal rotation until the correct advance timing mark on the starter ring gear support assembly aligns with the reference point on the engine (Figure 1 or 2).

H. The timing light is to indicate the magneto is firing when the timing mark on the starter ring gear support assembly aligns with the reference point on the engine (Figures 1 or 2) to ensure that the magneto is correctly timed with the engine.

NOTICE: If there is interference from another engine component or an airframe component that prevents correct adjustment of the magneto, remove the magneto and re-position the drive gear in the accessory housing. Use care not to drop the dampers (if installed) into the engine while repositioning the drive gear.

I. The magneto position is typically 15º to 30º above horizontal centerline.

NOTICE: If the magneto-to-engine timing is out of tolerance by more than 5° refer to the magneto manufacturer's instructions for internal adjustment and then complete the "Magneto-to-Engine Timing Adjustment Procedure" in this chapter.

If the magneto-to-engine timing is out of tolerance by less than 5°, complete the "Magneto-to-Engine Timing Adjustment Procedure" in this chapter.

J. If the magneto-to engine timing is within tolerance or after the "Magneto-to-Engine Timing Adjustment Procedure" has been completed:

(1) Remove the timing light leads from the magnetos and grounding source.

(2) Attach the P-Leads to the condenser terminal of each magneto with the nut and a new lock washer. Torque the nut to 13 to 15 in.-lb (1.5 to 1.7 Nm).

K. Install the spark plug in cylinder No. 1 per the "Spark Plug Installation" procedure in Chapter 74-20.

L. Connect the applicable ignition leads to all spark plugs per instructions in the "Ignition Harness Installation" procedure in Chapter 74-20.

M. Enable power to the engine.

N. Complete the "Operational Ground Check" in Chapter 72-00 of the engine to make sure the magnetos are operating correctly.

3. Magneto-to-Engine Timing Adjustment Procedure

A. Turn the crankshaft in the direction of normal rotation until the correct advance timing mark on the starter ring gear support assembly aligns with the reference point on the engine (Figure 1 or 2).

B. Loosen the hold-down nuts on the clamps of the magneto that is not timed with the engine.

C. Manually and slowly turn the magneto in its mounting flange in the direction opposite its normal rotation until the timing light indicates the magneto is not firing.

D. Turn the magneto in the direction of normal rotation until the timing light indicates the magneto is firing.

E. Torque the hold-down nuts on the magneto clamps 48 in.-lb. (5 Nm) increments, alternating between the two nuts until both nuts are torqued to 15 to 18 ft.-lb. (20 to 24 Nm).

F. Apply torque seal to the torqued hold-down nuts on the magneto clamps.

G. Turn the crankshaft a few degrees in the direction opposite normal rotation. The timing lights are to indicate the magneto is not firing.

H. Slowly turn the crankshaft in the direction of normal rotation until the correct advance timing mark on the starter ring gear support assembly (Figure 1) aligns with the reference point on the engine (Figure 1 or 2). Both lights on the timing light are to indicate the magnetos are firing.

I. Adjust the magneto-to-engine timing until repeat checks by the "Magneto-to-Engine Timing Check" in this chapter are within tolerance.

4. Magneto Replacement Procedure

WARNING BEFORE THIS PROCEDURE, MAKE SURE ALL POWER IS DISABLED TO THE ENGINE TO PREVENT ELECTRICAL SHOCK AND INJUIRY.

NOTICE: Magneto configurations are different between magneto suppliers. This procedure applies to Slick magnetos only. Refer to the manufacturer's instructions for other types of magnetos.

A. Magneto Removal

(1) Disconnect the ignition harness cap from the magneto per the "Ignition Harness Removal" procedure in Chapter 74-20.

(2) Disconnect any other wires connected to the magneto.

(3) Hold the magneto and remove the nuts, lock washers, washers, clamps, cotter pin, gear nut, and magneto gear from the magneto. Discard the lock washers.

(4) Remove the magneto.

(5) Remove and discard the gasket.

B. Magneto Installation

A new or serviceable magneto, new magneto gasket, and two new lock washers are necessary to install the magneto. Refer to the applicable parts catalog.

(1) Apply a light coat of C5-A Copper-Based Anti-Seize compound to the tapered section of the magneto driveshaft (Figure 3).

(2) Install the magneto gear on the magneto driveshaft.

(3) Remove excess C5-A Copper-Based Anti-Seize compound from the magneto driveshaft.

(4) Install the gear nut and washer on the magneto gear. Torque the gear nut per the magneto manufacturer's instructions.

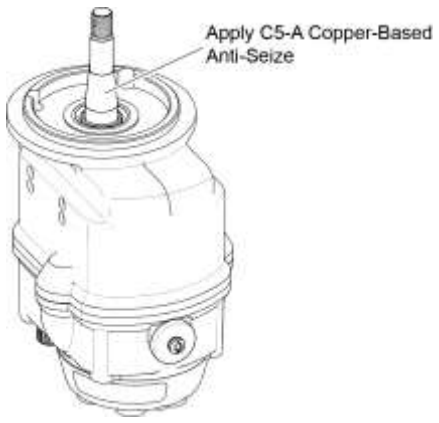

Figure 3
C5-A Copper-Based Anti-Seize Application

(5) Install a new cotter pin through the gear nut and magneto driveshaft. Bend the top prong on the cotter pin over the stud and bend the bottom prong of the cotter pin down.

(6) Verify the magneto direction of rotation as per the magneto data plate.

(7) Install a timing pin (Figure 4) in the hole marked Left on the face of the distributor block based on the magneto rotation requirements.

Figure 4
Timing Pin

(8) Apply a slight inward pressure to the pin and slowly turn the magneto drive shaft in the direction of normal rotation until the shoulder of the pin seats against the distributor block. When correctly engaged, the timing pin will be inserted 7/8 in. (22 mm) into the distributor block.

(9) If not already done, turn the crankshaft in the direction of normal rotation until the correct advance timing mark on the starter ring gear support assembly aligns with the reference point on the engine (Figures 1 or 2).

(10) Apply Lubriko® grease to the mating flange and install a new gasket on the mating flange of the magneto.

(11) Remove the timing pin (Figure 4) and install the magneto on the engine with the clamp, nuts, and new lock washers.

(12) Torque the two nuts on the magneto clamps to 48 in.-lb. (5 Nm) in increments, alternating between the two nuts until both nuts are torqued to 15 to 18 ft.-lb. (20 to 24 Nm).

(13) Complete the "Magneto-to-Engine Timing Check" in this chapter again. Install the timing pin back into the hole again to ensure the impulse coupling did not snap and to verify the magneto position.

(14) Once the correct magneto-to-engine timing is complete, recording the timing.

(15) Apply Torque Seal to the magneto nuts in the locations shown in Figures 5A and B.

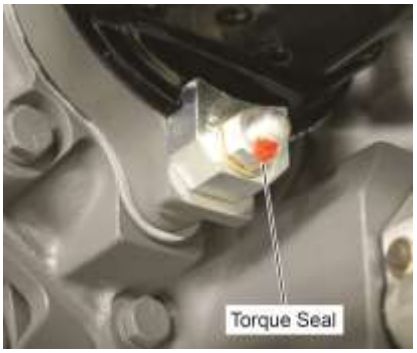

Figure 5A **Figure 5B**
Torque Seal on the Magneto Nuts

(16) Spray mold release compound on rubber coated leads of the magneto harness.

(17) Connect the harness cap to the respective magneto with three screws shown in Figure 6. Tighten the three screws until all screws are touching the harness cap to ensure that there is an even gap around the cap.

(18) Torque the three screws to 18 to 20 in.-lb. (2.0 to 2.3 Nm) in the sequence shown in Figure 7 as a final torque.

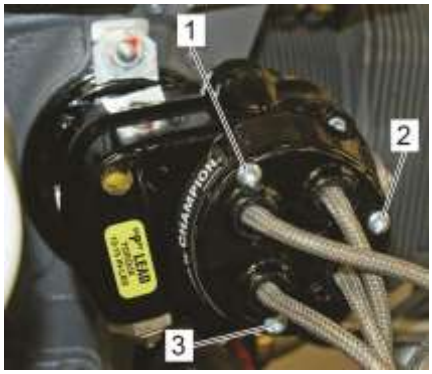

Figure 6
Torque Sequence for Screws on Magneto Harness Cap