IO-540-AG1A5 Series Engine Maintenance Manual

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652 Oliver Street
Williamsport, PA 17701

Part No. LM-IO-540-AG1A5

IO-540-AG1A5 Series Engine Maintenance Manual

Lycoming Part Number: LM-IO-540-AG1A5

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TRANSMITTAL LETTER

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Current Revision: _____
Current Revision Date: _____
Original Issue Date: _____

To: Recipients of IO-540-AG1A5 Series Engine Maintenance Manual

Subject: Release of the current manual revision

This page section transmits the initial edition of the IO-540-AG1A5 Series Engine Maintenance Manual. Please replace any previous revisions of this manual with this current edition. See Record of Revisions for a complete list of dates and numbers of all released revisions of this manual.

The following Table of Revision Highlights is a compilation of all Revisions incorporated, plus any more currently approved information. The table will identify the pages that have been removed and/or replaced, a concise description of changes, and a list of the supporting documentation (Service Bulletins, etc.).

HIGHLIGHTS

Page(s) Removed	Page(s) Added	Description of Change	Reference Docs	Doc Date

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RECORD OF REVISIONS

Rev. No	Issue Date	Initials	Insertion Date

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SERVICE DOCUMENT LIST

NOTICE: The "Incorporation Date" column indicates the latest revision date of this report, due to a Service Document, or Service Document revision. The words "No Effect" indicate that the Service Document caused no changes within this report.

Number	Revision Number	Incorporation Date	Subject
S.B. 240	W	11/12	Mandatory Parts Replacement a Overhaul and During Repair or Maintenance
S.B. 369	L	11/12	Engine Inspection after Overspeed
S.B. 388	C	11/12	PART I. Use of P/N ST-71 and P/N ST-310 Fixture PART 2. A. Modification to P/N ST-71 and P/N ST-310 Fixtures to Allow Use of a Dial Indicator PART 2. B. Optional Inspection Procedure Using a Go/No-Go" Gage PART 3. Example of Alternate Tools That Can Be Locally Manufactured
S.B. 398	B	11/12	Recommended Corrective Action for Use of Incorrect Fuel
S.B. 399	A	11/12	Action to Take If Loss of Oil Pressure
S.B. 401	---	11/12	Recommendations for Aircraft Struck by Lightning
S.B. 475	D	11/12	Crankshaft Gear and Crankshaft Gear End Inspection and Corrective Action
S.B. 480	E	11/12	I. Oil Filter Change and Screen Cleaning II. Oil Filter/Screen Content Inspection
S.B. 533	B	11/12	Recommended Action for Sudden Engine Stoppage, Propeller/Rotor Strike or Loss of Propeller/Rotor Blade or Tip
S.I. 1009	AV	11/12	Recommended Time Between Overhaul Periods
S.I. 1011	J	11/12	Table of Current Tappet Bodies, Plunger Assemblies and Hydraulic Lifter Assemblies
S.I. 1014	M	11/12	Lubricating Oil Recommendations
S.I. 1042	Z	11/12	Approved Spark Plugs
S.I. 1043	A	11/12	Spark Plug Heli-Coil Insert Replacement
S.I. 1070	S	11/12	Specified Fuels
S.I. 1080	C	11/12	Maintenance Items for Special Attention

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SERVICE DOCUMENT LIST (CONT.)

Number	Revision Number	Incorporation Date	Subject
S.I. 1140		11/12	Salvage Repair of Magneto Bearing Recess in Crankcase
S.I. 1191	A	11/12	Cylinder Compression
S.I. 1285	D	11/12	Non-Destructive Testing of Lycoming Engine Parts
S.I. 1301	A	11/12	Identification of Primer and Fuel Injector Lines
S.I. 1409	C	11/12	Lycoming Engines P/N LW-16702 Oil Additives
S.I. 1425	A	11/12	Suggested Maintenance Procedures to Reduce the Possibility of Valve Sticking
S.I. 1427	C	11/12	Lycoming Reciprocating Engine Break-In and Oil Consumption
S.I. 1458	F	11/12	Connecting Rod Bolts (Identification and Installation)`
S.I. 1462	A	11/12	Propeller Oil Control Leak Test Procedure
S.I. 1485	A	11/12	Exhaust Valve and Guide Identification Procedure
S.I. 1529	C	11/12	Hydraulic Lifter and Tappet Body Part Numbers
S.I. 1530	---	11/12	Engine Inspection in Particulate-Laden Environments
S.L. L114	AU	11/12	Reciprocating Engine and Accessory Maintenance Publications
S.L. L162	B	11/12	®Heli-Coil Service Repair Kit
S.L. L171	---	11/12	General Aspects of Spectrometric Oil Analysis
S.L. L192	B	11/12	Spark Plug Fouling
S.L. L197	A	11/12	Recommendations to Avoid Valve Sticking
S.L. L247	A	11/12	Shelf Life Requirements

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ABBREVIATIONS AND ACRONYMS

B	
BTDC	Before Top Dead Center
C	
C	Celsius
D	
DPI	Dye Penetrant Inspection
F	
F	Fahrenheit
FAA	Federal Aviation Administration
FPI	Fluorescent Penetrant Inspection
FAR	Federal Aviation (and Space) Regulation
ft.-lb	Foot Pound (torque)
H	
HET	Hartzell Engine Technologies
I	
ID	Inside Diameter
in.-lb	Inch Pound (torque)
in.	Inch, inches
IOM	IO-540-AG1A5 Series Engine Installation and Operation Manual
M	
Max.	Maximum
MEK	Methyl-Ethyl-Ketone
O	
OEM	Original Equipment Manufacturer
P	
psi	Pounds per square inch
Q	
Qt	Quart
R	
rpm	Revolutions per Minute
S	
SB	Service Bulletin
SI	Service Instruction
SL	Service Letter
SMOH	Since Major Overhaul
STC	Supplemental Type Certificate

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T	
TBO	Time Between Overhaul
TDC	Top Dead Center

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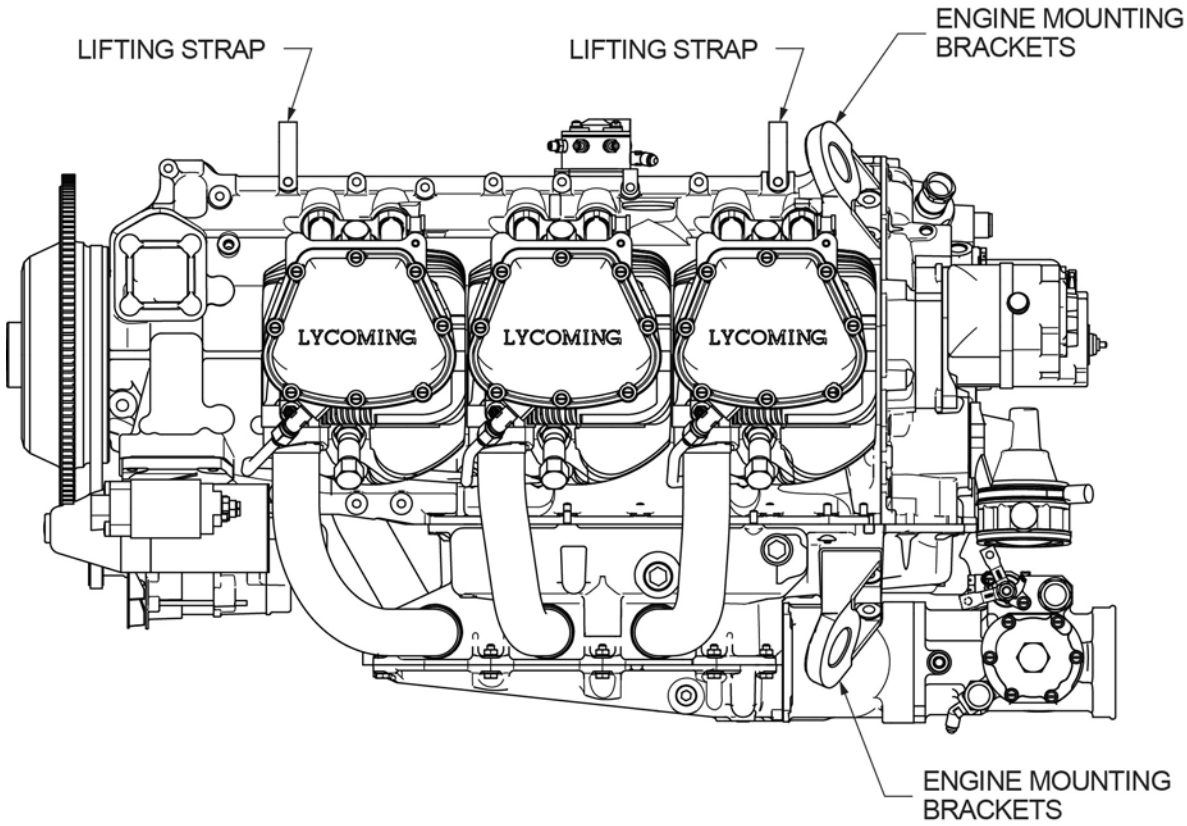
INTRODUCTION

Engine Description

The Lycoming IO-540-AG1A5 Series Engine is a direct-drive, six-cylinder, horizontally opposed, air-cooled engine with a down exhaust. This engine has an automotive type alternator and starter, two AN-type accessory drives, one pad for a diaphragm-type fuel pump, and a drive for a propeller governor. Refer to Figure 1.



IO-540-AG1A5 Series Engine
Figure 1

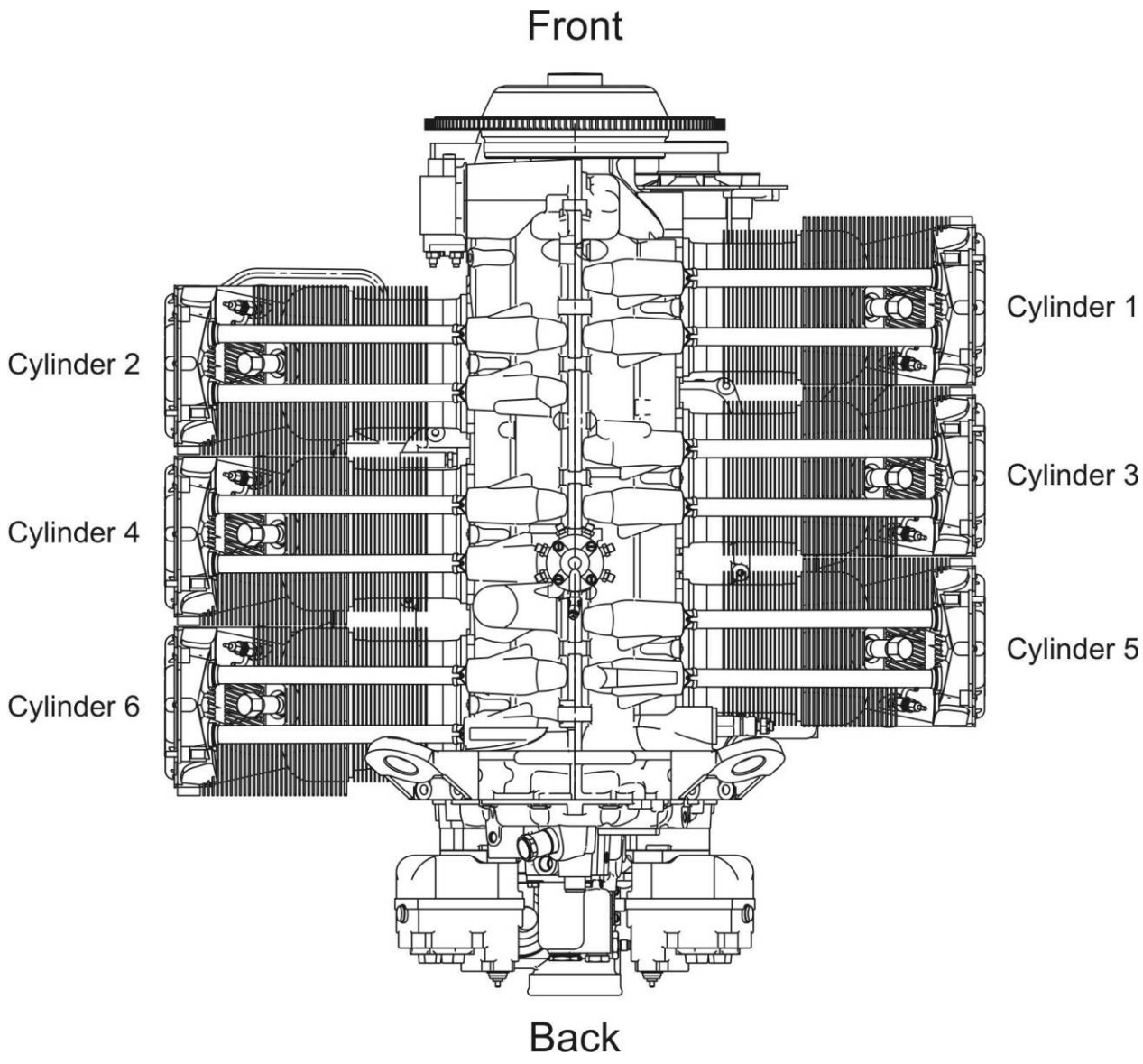
Engine Model Nomenclature

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

Model Number	Meaning
I	Fuel Injected
O	Horizontally Opposed
540	Displacement in cubic inches

Cylinder Number Designations

- The propeller is at the front of the engine and the accessories are at the rear of the engine.
- When viewed from the top of the engine, the left side cylinders are 2-4-6. Cylinder 2 is at the front of the engine. Refer to Figure 2.
- When viewed from the top of the engine, the cylinders on the right are 1-3-5. Cylinder 1 is at the front of the engine. Refer to Figure 2.
- The firing order of the cylinders is 1-4-5-2-3-6.



Top View of Engine – Cylinder Number Designations
Figure 2

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Scope of this Manual

This manual supplies instructions (in compliance with FAR 33.4) for maintenance of the IO-540-AG1A5 Series Lycoming aircraft engines. The information includes inspection, service procedures, fault isolation, repair, and replacement of engine parts. Refer to the Direct Drive Overhaul Manual for overhaul procedures which includes disassembly and assembly procedures and overhaul checklists. Refer to the IO-540-AG1A5 Series Engine Parts Catalog to identify spare parts.

Compliance Requirements

⚠ WARNING: FOR CORRECT ENGINE MAINTENANCE, COMPLETE THE NECESSARY MAINTENANCE PROCEDURES IN THIS MANUAL AND APPLICABLE SERVICE DOCUMENTS. YOU ALSO MUST COMPLETE THE REQUISITE OVERHAUL PROCEDURES IDENTIFIED IN THE RESPECTIVE OVERHAUL MANUAL. LYCOMING ENGINES' SERVICE DOCUMENTS OVERRIDE PROCEDURES IN THIS MANUAL UNLESS OTHERWISE SPECIFIED.

⚠ WARNING: PROCEDURES IN THESE MANUALS MUST BE DONE BY QUALIFIED PERSONNEL WITH THE REQUISITE CERTIFICATIONS.

Before you do maintenance on the IO-540-AG1A5 Series 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 on this engine, you can void the engine warranty.

Refer to the IO-540-AG1A5 Series Engine Installation & Operation Manual for operating specifications, operating limits, installation instructions, drawings, starting tests, and engine operation instructions.

⚠ WARNING: OPERATE THIS ENGINE IN ACCORDANCE WITH SPECIFICATIONS IN APPENDIX A OF THE IO-540-AG1A5 SERIES ENGINE INSTALLATION AND OPERATION MANUAL. OPERATING THE ENGINE OUTSIDE OF THE SPECIFIED OPERATING LIMITS CAN CAUSE PERSONAL INJURY AND/OR DAMAGE TO THE ENGINE.

Environmental Compliance

Lycoming recommends that engine owners and repair/overhaul 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 does its best to make a reasonable effort to supply the best guidance and recommended practices for safe operation of its engines.

The table below defines the four types of safety advisory message used in this manual as per the American National Standard and ANSI 2535-6-2006.

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 can also 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 subscribers with up-to-date Service Bulletins (SBs), Service Instructions (SIs) and Service Letters (SLs).

For subscription information, look on Lycoming's website or speak to Lycoming by telephone: U.S. and Canada toll free: 1-800-258-3279; International Customers: 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 override procedures in this manual.

For reference and future updates, the Service Document List at the front of this manual shows the editions of the service documents included in this manual.

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Supplemental Service Information

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

Instructions for Continued Airworthiness

This manual, together with the Installation & Operation Manual, Overhaul Manual, Service Bulletins and related publications make up the complete set of Instructions for Continued Airworthiness (ICAs). The ICAs are prepared by Lycoming Engines and are approved by the Federal Aviation Administration (FAA).

Simplified Technical English

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

Format

Chapters in this manual are written as modules 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.

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Feedback

To supply comments, suggestions, or corrections to this manual, either make a call to customer service or use the Lycoming.com website.

Customer Service

Additionally, Lycoming has a Customer Service Hot Line to supply information and assistance to owners, operators, and maintenance personnel servicing Lycoming engines.

Call **Field Service - +1(877) 839-7878**
U.S. and Canada Toll Free - +1(800) 258-3279
Direct - +1(570) 323-6181

8:00 A.M. – 5:00 P.M. EST (-5 GMT)
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Change of Address Notification

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AIRWORTHINESS LIMITATIONS

1. General

   This Airworthiness Limitations chapter sets forth each mandatory replacement time, inspection interval, and related procedure required for type certification. The Airworthiness Limitations section is FAA Approved and specifies maintenance required under §§ 43.16 and 91.403 of the Federal Aviation Regulations unless an alternative program has been FAA approved.

2. Mandatory Inspection - Fuel Injector Lines

   At every 100 hours of operation, at each overhaul, and after any maintenance has been done where fuel injector lines have been disconnected, moved or loosened, examine the fuel lines as per the "Fuel System Inspection Procedure" in Chapter 73-10 in this manual.

3. Mandatory Inspection

   At every 500 hours of operation, examine the magnetos in accordance with the applicable magneto manufacturer's instructions.

4. Mandatory Inspection - Exhaust Valve and Guide

   At every 1000 hours of operation, examine the exhaust valve and guide conditions. Refer to the section "Exhaust Valve and Guide Inspection" in Chapter 72-30 of this manual.

Approved by: _____

Gaetano Sciortino
Manager, New York Aircraft Certification Office
Federal Aviation Administration

Date: 11/13/12

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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, oil suction screen cleaning, 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 IO-540-AG1A5 Series Engine Installation and Operation Manual.

   C. 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
Airwolf Cutter AFC-470	Cut open oil filter
AUTOSCOPE™ Lenox Instrument Company	Cylinder Borescope Inspection
Wrench Sets	
Mirror and Flashlight	
Aviation Mechanic's Tools	
ST-310 Fixture	Exhaust Valve Guide Inspection/Removal
ST-310-9 Gage Adapter	Exhaust Valve Guide Inspection/Removal
ST-483 Test Plate	
0.010 in. (0.254 mm) Feeler Gage	

2. Engine Overhaul vs. Engine Rebuild

   A. *Engine overhaul* - the engine is disassembled to enable inspection of each part to identify its condition. If a part is damaged or worn and is within specified tolerances or limits, it is repaired or replaced. Acceptable parts are cleaned and assembled and an operational test is done on the engine to make sure it is operating correctly. An engine in compliance with operational standards is returned to service. The engine will be set at zero time since major overhaul (SMOH). The total time of the previous operating hours must continue in sequence and be carried forward in the engine logbook.

B. *Engine rebuild* - can only be done by the engine manufacturer or an agent approved by the engine manufacturer - during an engine rebuild, a used engine is completely disassembled, examined, repaired as necessary, assembled, and approved in the same manner and to the same tolerances and limits as a new engine, using either new or serviceable parts. The parts used in a rebuilt engine must agree with all production drawings, tolerances and limits for new parts or be of approved oversize or undersize dimensions as on a new engine. A rebuilt engine is considered not to have a previous operating history and can be issued a zero-time logbook. Only the engine manufacturer or an agent approved by the engine manufacturer can issue a zero-time record.

3. Time Between Overhaul (TBO)

NOTICE: Refer to the latest revision of Service Bulletin No. 240 which identifies parts that must be replaced during overhaul or upon removal. Refer to the manufacturer's instructions for replacement criteria and guidelines for "on condition" parts.

A. If the engine is operated under usual conditions, overhaul or a factory rebuild is recommended at every 1800 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.) Refer to the latest revision of Service Instruction No. 1009 for any change to the recommended TBO.

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 1800 hours or 12 year TBO.

4. Safety Precautions

⚠ WARNING: TURN OFF THE IGNITION SWITCH AND DISABLE ALL POWER TO THE ENGINE TO PREVENT ACCIDENTAL ENGINE START-UP WHILE WORKING ON THE ENGINE. FAILURE TO DISABLE POWER COULD CAUSE ACCIDENTAL ENGINE START-UP, INJURY, OR DEATH. 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.

⚠ WARNING: IF WORK IS DONE AROUND FUEL LINES, FUEL SOURCES, DO NOT SMOKE OR HAVE AN OPEN FIRE FLAME OR ANY DEVICE THAT CAN MAKE SPARKS. SMOKE, FLAMES, OR SPARKS CAN CAUSE FUEL IGNITION WHICH CAN CAUSE SERIOUS BURNS, INJURY OR DEATH.

5. Maintenance Practices

A. Obey all safety precautions.

B. Do not reuse a gasket. You must install a new gasket.

C. Remove all traces of dirt, dust, debris and accumulated matter from parts. All parts must be clean before they are installed on the engine.

D. If adhesive tape has been applied to any part, remove the tape and clean the part completely. Remove all tape and residue.

E. If it is necessary to use a hammer to install a part, use only a plastic or rawhide hammer.

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F. Hardware

(1) All lock wire and cotter pins that are removed must be discarded and not reused. A new cotter pin must be installed.

(2) All lock 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) 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.

G. Heli-Coil Repair

(1) The Heli-Coil thread insert is the recommended method for repair of many types of thread damage especially where threaded parts are removed and where corrosion could be a factor.

(2) These Heli-Coil threaded inserts are included in the Heli-Coil Service Repair Kits identified in the latest revision of Lycoming Service Letter No. L162. Each kit contains a Heli-Coil tap and mandrel which are used to install the Heli-Coil insert.

⚠ **CAUTION:** TO PREVENT METAL PARTICLES FROM ENTERING THE ENGINE, DO NOT INSTALL HELI-COIL INSERTS IN ANY THROUGH-HOLE ON AN ASSEMBLED ENGINE.

NOTICE: Any time that a cylinder hold-down stud hole thread is repaired by installation of a Heli-Coil insert, the limits for stud driving torque must be maintained. Refer to the latest revision of the Table of Limits, SSP-1776.

(3) To install a Heli-Coil insert:

⚠ **CAUTION:** DO NOT DRILL TOO FAR INTO THE MATERIAL TO PREVENT A "BREAKTHROUGH" INTO OIL PASSAGES OR INTERNAL CAVITIES OF THE ENGINE OR COMBUSTION AREAS.

(a) Drill hole to a sufficient depth using the drill size shown in Table 2.

Table 2
Thread Inserts and Drill Size Specifications

THREAD SIZE	DRILL SIZE	DRILLED HOLE DIAMETER	
		in.	mm
1/4-20 NC	H	0.2640 to 0.2710	6.7056 to 6.8834
5/16-18 NC	Q	0.3300 to 0.3370	8.3820 to 8.5598
3/8-16 NC	X	0.3940 to 0.4020	10.0076 to 10.2108
1/2-13 NC	33/64	0.5236 to 0.5206	13.0454 to 13.2232
1/8-27 NPT	U	0.3660 to 0.3730	9.2964 to 9.4742
10-24 NC	13/64	0.2011 to 0.2071	5.1079 to 5.2603
10-32NF	8	0.1990 to 0.2050	5.0546 to 5.2070
1/16-27 NPT	9/32	0.2790 to 0.2860	7.0866 to 7.2644

(b) Use the Heli-Coil tap supplied with the repair pack.

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1 Make sure the thread size on the shank is the correct size. Do not attempt to use any other tap.

2 On pipe threads, make the drill to the depth of the copper wire around the tap.

3 For shallow holes it could be necessary to complete the grind-off and re-chamfer of the end of the pipe tap.

(c) For coarse thread series Heli-Coil thread inserts:

1 Install the thread insert on the mandrel of the installation tool.

2 Be sure the tang of the insert is fully engaged in the slot of the mandrel.

(d) For pipe thread inserts and fine thread series:

1 Put the insert in the well of the mandrel, tang end forward.

2 Rotate the mandrel through the insert until the driving tang is fully engaged in the slot of the mandrel. Continue to rotate the mandrel until the insert is engaged on one or two threads in the mandrel body.

(e) Install the insert into the tapped hole until the top of the insert is 1/4 to 1/2 turn below the top surface of the hole.

⚠ WARNING: TO PREVENT FOD, BE SURE TO RECOVER THE TANG WHEN IT BREAKS OFF.

(f) Break off the tang from the insert with a rod that has a diameter that fits into the assembled insert.

1 Hit the rod sharply with a hammer.

NOTICE: The tang is notched and it will break off easily.

2 Tangs on the pipe thread and large diameter inserts can be removed with long-nosed pliers.

(4) Heli-Coil Replacement

To remove a Heli-Coil insert:

(a) With a small triangular file, cut a notch in the top coil of the insert about 1/4 turn from the end of the wire.

⚠ CAUTION: PREVENT DAMAGE TO THE THREADS IN THE TAPPED HOLE.

(b) Put one edge of a three-edge scraper in the notch.

(c) While applying a steady downward pressure, turn the scraper counterclockwise until the Heli-Coil is out.

(d) Discard the insert and use the drill to make sure the hole is clean.

(e) Install a new insert.

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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 Perform	**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 Engine Inspection" in Chapter 05-20
— 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) 1800 hours or 12 years after engine placed in service, rebuilt or overhauled (whichever occurs first). Refer to the latest revision of Service Instruction No. 1009 for any change to the recommended TBO.	Direct Drive Overhaul Manual

Engine Inspection Schedule (Cont.)	
When to Perform	**Reference**
*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. For all engine accessory inspections, refer to the individual service requirements from each manufacturer and Supplementary Type Certificates (STCs).

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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 that have a Supplemental Type Certificate (STC).

NOTICE: Do not exceed inspection intervals by more than 10 hours. Refer to FAR 91-409 for additional requirements.

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 MAINTENANCE INSPECTION IN THE AREA OF THE PROPELLER RADIUS, MAKE SURE THE IGNITION SWITCH IS SET TO OFF AND THAT ALL POWER TO THE ENGINE IS DISCONNECTED. DO NOT STAND (OR ALLOW ANYONE ELSE TO STAND) CLOSE TO THE ARC OF THE PROPELLER BLADE. IF POWER IS ON, A LOOSE OR BROKEN WIRE CAN CAUSE THE ENGINE TO START AND THE PROPELLER TO ROTATE WHICH CAN LEAD TO DEATH OR SERIOUS INJURY.

   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 THERE IS SUSPECTED VOLCANIC ASH ON THE ENGINE, DO NOT TOUCH IT WITH BARE HANDS. **DO NOT USE WATER** TO RINSE IT OFF. THE VOLCANIC ASH CAN CONTAIN ACIDIC COMPOUNDS WHICH MUST NOT BE INHALED OR TOUCHED. REFER TO THE SECTION "VOLCANIC ASH/PARTICULATE CONTAMINATION" IN CHAPTER 05-50.

      (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.

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⚠ 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.

⚠ CAUTION: IF SUPPORT CLAMPS ARE NOT INSTALLED ON THE FUEL LINES, THE FUEL WILL BE SUBJECTED TO VIBRATIONAL FORCES AND/OR RUBBING AGAINST OTHER ENGINE PARTS, BECOME DAMAGED, EVENTUALLY BREAK AND LEAK FUEL ON THE ENGINE.

(a) Clamps (preferably with cushions) must be installed on all fuel lines. If a fuel line had been in service and clamps were not installed, these fuel lines must be replaced with new fuel lines.

1 Do NOT use plastic tie straps.

2 On engines that used metal clamps with no cushion, use the P/N LW-12598 fuel line sleeve at each of those clamping locations. The fuel line sleeve is not used with the cushioned clamps.

3 If the clamps are to have a cushion, make sure the cushion is not missing and is intact.

4 Make sure the clamps are tightly attached to support the fuel line and to prevent movement from vibration or motion frequencies.

(b) Make sure that the fuel lines are securely connected (to prevent line movement during flight) with the necessary clamps and hardware.

(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.

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(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 lock wiring 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 components are secure on their respective mountings, all hose connections are secure 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.

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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 THIS INSPECTION, MAKE SURE THAT THE IGNITION SWITCH IS 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.

NOTICE: Copy the blank checklist and complete this checklist as a record of engine maintenance. Record the engine hours. 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:**_____			
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.		

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3. 25-Hour Initial Engine Inspection

   A. The purpose of this inspection is to measure the oil level and oil consumption, do an oil change, replace the oil filter, and identify any oil leaks.

      NOTICE: On new or rebuilt engines, during the first 50 hours of engine operation, it is recommended that this engine be operated on mineral oil until oil consumption has stabilized.

   B. Complete this 25-Hour Initial 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 4 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 Engine Inspection Checklist for this inspection.

⚠ WARNING: BEFORE THIS INSPECTION, MAKE SURE THAT THE IGNITION SWITCH IS 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.

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

25-Hour Initial Engine Inspection Checklist

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

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

Inspection Item	Comments	Results/Notes	Done
Complete the Visual Inspection.	Refer to the section “Visual Inspection” in this chapter.		
Measure and record the oil level.	Refer to the section “Oil Level Check” in Chapter 12-10.		
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.		

25-Hour Initial Engine Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Change the oil.	Refer to the section “Oil Change Procedure” in Chapter 12-10.		
NOTICE: On new or rebuilt engines, during the first 50 hours of engine operation, it is recommended that this engine be operated on mineral oil until oil consumption has stabilized.			
Replace the oil filter.	Refer to the section “Oil Filter Replacement” in Chapter 12-10.		
WARNING: EXAMINE THE OIL SUMP SUCTION SCREEN AND OIIL FILTER ELEMENT FOR UNWANTED METAL PARTICLES. A CLOGGED OIL FILTER AND/OR SUCTION SCREEN CAN CAUSE ENGINE FAILURE.			
Remove, examine, clean and install the oil suction screen at the oil sump; install the oil suction screen if it is intact.	Refer to the section in Chapter 12-10; "Oil Suction Screen Removal/Inspection/ Installation		
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.		
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		
General			
Correct any discrepancies found before returning the engine to service.			

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25-Hour Initial Engine Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Obey all applicable Airworthiness Directives.			
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 do an oil change and 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.

      NOTICE: On new or rebuilt engines, during the first 50 hours of engine operation, it is recommended that this engine by operated on mineral oil until oil consumption has stabilized.

⚠WARNING: BEFORE THIS INSPECTION, MAKE SURE THAT THE IGNITION SWITCH IS 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.

NOTICE: Copy the blank checklist and complete the checklist as a record of engine maintenance. Record the engine hours. 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:**_____			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Complete the visual inspection.	Refer to the “Visual Inspection” section in this chapter.		
Do an oil change. **NOTICE:** On new or rebuilt engines, during the first 50 hours of engine operation, it is recommended that this engine be operated on mineral oil until oil consumption is stabilized.	Refer to the "Oil Change Procedure" in Chapter 12-10. Collect 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.		
Look for any fuel or oil leaks before cleaning the engine.			
Clean the engine.			

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50-Hour Engine Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
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 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.		
Starter			
On a Hartzell Engine Technologies (HET) (formerly Kelly Aerospace) starter, clean corrosion from electrical terminals. Clean the starter drive and shaft with mineral spirits. Lubricate with Silicon spray.			
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.			
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.	Refer to the spark plug manufacturer for any additional information.		
Rotate or replace spark plugs as necessary.	Refer to Table 2 in Chapter 74-20.		

50-Hour Engine Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Ignition System (Cont.)			
Make sure that the spark plug and magneto terminal connections are tight.			
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.		
Make sure that the ignition harness mounting clamps are tight.			
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.			

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50-Hour Engine Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Engine Cylinders (Cont.)			
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 Table of Limits, SSP-1776.		
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 burnt paint is found on a cylinder, examine it for internal damage. For possible causes and corrections, refer to the "Fault Isolation" section in Chapter 12-30.		
Examine the exhaust system, exhaust flange and port connections for leaks in connections between the exhaust system and exhaust ports of cylinders - 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 the leak).	Exhaust leaks can cause damage to spark plugs, ignition cables, and the cylinder head. Exhaust gas leakage between the exhaust flange and exhaust port pad can quickly erode the cylinder head. If the cylinder head is eroded, resurface the cylinder port as per the Direct Drive Overhaul Manual. Replace any blown gaskets. Tighten any loose gasket flange assemblies in accordance with the latest revision of the Table of Limits, SSP-1776.		

50-Hour Engine Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Engine Cylinders (Cont.)			
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.			
General			
Correct any discrepancies found before returning the engine to service.			
Obey all applicable Airworthiness Directives.			
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.			

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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 THIS INSPECTION, MAKE SURE THAT THE IGNITION SWITCH IS 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.

NOTICE: Copy the blank checklist and complete this checklist as a record of engine maintenance. Record the engine hours. 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:**_____			
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 Table of Limits, SSP-1776.		
Ignition System			
Make sure that the magneto-to-engine timing is 20º before top dead center. Adjust the timing as necessary.	Refer to the "Magneto-to-Engine Timing" procedure in Chapter 74-30.		
Examine the magnetos in accordance with the magneto manufacturer's instructions.			
Clean the magneto vents to make sure that there is no obstruction.			
Make sure the magneto clamps securely attach the magneto to the engine.			

100-Hour or Annual Engine Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Ignition System (Cont.)			
Examine the P-lead attachment on the magneto. The correct torque for the P-lead attachment is 13-15 in.-lbs. Refer to the airframe manufacturer's recommendations to make sure the ignition switch and P-lead are operating correctly.			
⚠ **WARNING:** IF THE P-LEAD IS DISCONNECTED, THE MAGNETO WILL BE **ON** AND WILL ACTIVATE THE SPARK PLUG IF THE PROPELLER IS ROTATED. TO PREVENT INJURY, MAKE SURE THAT THE P-LEAD IS SECURELY ATTACHED TO THE CONDENSER STUD.			
Make sure that the switch wire on the retard (left) breaker connects the retard contact points to the ignition vibrator.			
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.		
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 ground straps.	Refer to the airframe manufacturer’s instructions.		
Power			
Complete the 100 Hour Wiring Inspection.	Refer to the “100-Hour Wiring Inspection” section in Chapter 72-70.		

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100-Hour or Annual Engine Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Electrical System			
Complete the 100 Hour Wiring Inspection.	Refer to the “100-Hour Wiring Inspection” section in Chapter 72-70.		
Fuel System			
Complete the fuel system inspection.	Refer to the "Fuel System Inspection Procedure" in Chapter 73-10.		
⚠ **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 fuel lines for damage, leaks, dents, pits, nicks, kinks, stains caused by fuel leaks, cracked, brittleness, or chafing.	Refer to "Fuel Line Inspection and Corrective Action" section in Chapter 73-10.	Fuel Line 1	
		Fuel Line 2	
		Fuel Line 3	
		Fuel Line 4	
		Fuel Line 5	
		Fuel Line 6	
Make sure fuel lines are held securely in place with clamps in position approximately 8 in. (20 cm) apart.	Refer to "Fuel Line Inspection and Corrective Action" section in Chapter 73-10. If no clamps are attached to fuel line that was in service, the fuel line must be replaced. If cushions are deteriorated or missing, replace the clamps. If the clamps are loose, the fuel line must be replaced. **NOTICE:** Plastic tie straps are not an acceptable substitute for clamps.		
Examine the fuel injector for leaks and correct installation.	Refer to Chapter 73-10		
Examine the fuel injector nozzle line attachments for secure connection.	Tighten any loose connections per torque values in the latest revision of the Table of Limits, SSP-1776.		

100-Hour or Annual Engine Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Fuel System (Cont.)			
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.		
Lubrication System			
Examine oil line routing and connections.	Refer to the section "Oil Hose Line Inspection" in Chapter 72-50.		
Crankcase			
Complete the Crankcase Inspection.	Refer to the “Crankcase Inspection Procedure” in Chapter 72-20.		
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 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.		

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100-Hour or Annual Engine Inspection Checklist (Cont.)	
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	
Cylinder 5	
Cylinder 6	
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	
Cylinder 5	
Cylinder 6	
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	
Cylinder 5	
Cylinder 6	

100 Hour or Annual Engine Inspection Checklist (Cont.)		
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 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.		
Obey all applicable Airworthiness Directives.		
Record all findings and corrective action in the engine logbook.		

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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 THIS INSPECTION, MAKE SURE THAT THE IGNITION SWITCH IS 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.

NOTICE: Copy the blank checklist and complete this checklist as a record of engine maintenance. Record the engine hours. 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:_____

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	
Cylinder 5	
Cylinder 6	

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400-Hour Engine Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
General			
Correct any discrepancies found before returning the engine to service.			
Obey all Airworthiness Directives.			
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.			

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7. 500-Hour Engine Inspection
   A. The purpose of this inspection is to examine the magnetos.
   B. Complete the 500-Hour Engine Inspection after every 500 hours of operation since the engine has been in service.
   C. Complete the 500-Hour Engine Inspection Checklist for this inspection.

⚠WARNING: BEFORE THIS INSPECTION, MAKE SURE THAT THE IGNITION SWITCH IS 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.

NOTICE: Copy the blank checklist and complete this checklist as a record of engine maintenance. Record the engine hours. 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:**_____			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Complete the 100-Hour Engine Inspection.	Refer to the section "100-Hour or Annual Engine Inspection" in this chapter.		
Ignition System			
Examine the magnetos in accordance with the magneto manufacturer's instructions.	If the magnetos must be replaced, refer to the "Magneto Replacement Procedure" in Chapter 74-30 of this manual.		
General			
Correct any discrepancies found before returning the engine to service.			
Obey all applicable Airworthiness Directives.			
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 inspection is to examine the exhaust valves and guides on the engine cylinders.
   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 THIS INSPECTION, MAKE SURE THAT THE IGNITION SWITCH IS 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.

NOTICE: Copy the blank checklist and complete this checklist as a record of engine maintenance. Record the engine hours. 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:**_____			
Inspection Item	**Comments**	**Results/Notes**	**Done**
Complete the 500-Hour Engine Inspection.	Refer to the section "500-Hour or Annual Inspection" in this chapter.		
Complete the Exhaust Valve and Guide Inspection per instructions in the section "Exhaust Valve and Guide Inspection" in Chapter 72-30, record the results for each cylinder below.			
Exhaust Valve and Guide Inspection			
Cylinder 1			
Cylinder 2			
Cylinder 3			
Cylinder 4			
Cylinder 5			
Cylinder 6			
General			
Correct any discrepancies found before returning the engine to service.			
Obey all Airworthiness Directives.			

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1000-Hour Engine Inspection Checklist (Cont.)			
Inspection Item	**Comments**	**Results/Notes**	**Done**
General (Cont.)			
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.			

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

1. Unusual Conditions

Unscheduled maintenance is necessary when the following conditions occur:

- Lightning strike
- Engine overspeed
- Incorrect fuel or fuel contamination
- Soaked engine
- Engine on fire or near fire
- Hydraulic lock
- Volcanic ash/particulate contamination
- Valve sticking
- Oil starvation/sudden loss of oil pressure
- Propeller strike, sudden engine stoppage or loss of 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.

NOTICE: Refer to the engine specifications in the IO-540-AG1A5 Series 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 IO-540-AG1A5 Series Engines

Overspeed Category	rpm	Corrective Action
Engine overspeed in excess of max. rated rpm or less than 5% of rated engine speed for 3 seconds or less	2426 to 2545	a. Identify and correct the cause of the overspeed. b. In the engine logbook, make a record of the overspeed incident and any inspections and corrective action.
Between 5 and 10% or rated engine speed (5 and up to 10% overspeed) for 3 seconds or less	2546 to 2667	a. Identify and correct the cause of the overspeed. b. Complete the “Cylinder Overspeed Inspection” procedure in this chapter. c. Drain the lubricating system. d. Remove oil screens and filters. e. Examine all screens and filters in the lubrication system for metal contamination. If any unexplained metal accumulation is found, identify and correct the cause before putting the engine back into service. f. Complete the “Valve Train Overspeed Inspection” procedure in this chapter. g. Complete the Magneto Overspeed Inspection" in this chapter. h. In the engine logbook, make a record of the overspeed incident and any inspection and corrective action.
More than 10% of rated speed (10% or more overspeed)	Over 2667 for any length of time	a. Remove the engine from the aircraft. Refer to the “Engine Removal Procedure” in Chapter 72-00. b. Disassemble the engine in accordance with the Direct Drive Overhaul Manual. c. Examine the engine and components in accordance with the Direct Drive Overhaul Manual. d. Replace any parts that are damaged or not in agreement with the latest revision of the Table of Limits, SSP-1776. e. In engines with dynamic counterweights, replace the bushings in both the counterweight and the crankshaft in accordance with the Direct Drive Overhaul Manual. f. In the engine logbook, make a record of the overspeed incident and any inspections and corrective action.

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(3) Cylinder Overspeed Inspection

(a) Complete the cylinder compression pressure check on all cylinders as a 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) Magneto Overspeed Inspection

(a) Disassemble the magnetos and examine all components for damage; recondition or replace parts as necessary. Refer to Chapter 74-30.

(b) Assemble and test the magnetos in accordance with the applicable magneto overhaul instructions.

(c) Examine the magneto drive gears for looseness which is an indication that the supporting idler shafts are loose due to failure of safety attachments.

⚠ **CAUTION:** EARLIER SLICK MAGNETOS ARE NON-REPAIRABLE. REFER TO THE APPLICABLE SLICK PUBLICATION.

(d) If applicable, examine the magneto bearing recess in the crankcase for excessive wear. Repair as necessary in accordance with the latest revision of Service Instruction No. 1140.

(5) 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 performed 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 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 section "Exhaust Valve and Guide Inspection" in Chapter 72-30 and 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 based on the duration of operation, 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 THE LATEST REVISION OF SERVICE INSTRUCTION NO. 1070) 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 from the specifications in the latest revision of Service Instruction No. 1070 could be harmful to the engine. Refer to the latest revision of Service Instruction No. 1070 for a list of approved fuels, octane ratings, and the use of a higher grade fuel for this engine.

(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.

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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, examine and overhaul 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 Direct Drive 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.

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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 from most solid particles.	Replace the oil filter and intake air filter as a precaution to be sure there are no effects from particulate contamination. Replace these components again after the next flight, as necessary.
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 from 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 from 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.

Table 2 (Cont.) Action to Take in Volcanic Ash Conditions	
Maintenance after flight…	**Maintenance after 10 hours of operation or the next flight**
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 could 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.

(2) 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.

NOTICE: Refer to Appendix A of the IO-540-AG1A5 Series Engine Installation and Operation Manual for the minimum oil quantity.

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(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 do a complete inspection.

J. 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 THE TABLE OF LIMITS, SSP-1776. 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. Also, refer to any new future revision to Service Bulletin No. 533.

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.

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Engine Inspection Checklist After Propeller Strike			
Engine Model:		**Engine Serial Number:**	
Date Inspection Started:		**Date Inspection Completed:**	
Sequential Task		**Additional Information**	**Corrective Action Done/Comments**
1.	Remove the propeller.		
2.	Examine the propeller for extent of damage; record condition of propeller.	Condition of Propeller/Corrective Action: ☐ Propeller satisfactory ☐ Replace propeller in accordance with propeller manufacturer's instructions ☐ Replace propeller in accordance with the airframe manufacturer's instructions.	
3	Remove the engine.	In accordance with the airframe manufacturer's instructions.	
CRANKCASE P/N:		**MATCH NO:**	
NOTICE: When the engine is disassembled because of a propeller strike, refer to the latest revision of Service Bulletin No. 240 for a list of parts that must be replaced.			
4.	Disassemble the engine where the crankshaft counterweights, camshaft, connecting rods, crankshaft gears, and internal steel parts are removed.	In accordance with the Direct Drive Overhaul Manual.	
5	Complete blast cleaning of the crankcase with 17 grit walnut shells at 35 to 45 psi (241 to 310 kPa); remove all coatings on the crankcase and engine mount bosses.	Make sure there is not dirt, debris, sludge, paint, or any other substance that could prevent reliable fluorescent (FPI) or dye penetrant inspection (DPI) or subsequent oil flow.	
6.	Complete blast cleaning of the oil sump and engine mount bosses with 17 grit walnut shells at 35 to 45 psi (241 to 310 kPa).	Make sure there is no dirt, debris, sludge, paint, or any other substance that could prevent reliable fluorescent or dye penetrant inspection or subsequent oil flow.	
7.	Complete blast cleaning of the engine mount brackets with 17 grit walnut shells at 35 to 45 psi (241 to 310 kPa).	Make sure there is no dirt, debris, sludge, paint, or any other substance that could prevent reliable fluorescent or dye penetrant inspection or subsequent oil flow.	
8.	Complete blast cleaning of the accessory housing with 17 grit walnut shells at 35 to 45 psi (241 to 310 kPa).	Make sure there is no dirt, debris, sludge, paint, or any other substance that could prevent reliable fluorescent or dye penetrant inspection or subsequent oil flow.	

Engine Inspection Checklist After Propeller Strike (Cont.)			
Sequential Task		**Additional Information**	**Corrective Action Done/Comments**
CRANKSHAFT P/N:		**S/N:**	
NOTICE: Examine the crankshaft counter-bored recess, the alignment dowel, the bolt hole threads, and the crankshaft gear for wear, galling, corrosion, and fretting. Refer to the latest revision of Service Bulletin No. 475 and the Direct Drive Overhaul Manual. If the bolt hole threads are damaged, they cannot be repaired. **NOTICE:** Remove and discard the existing gear retaining bolt and Lockplate, and install a new bolt and lockplate.			
9.	Disassemble and examine the crankshaft.	Refer to the Direct Drive Overhaul Manual for the crankshaft disassembly and inspection procedures.	
10.	Clean the crankshaft, camshaft, crankshaft gears, counterweights, rollers and bushings.	Make sure there is no dirt, debris, sludge, paint, or any other substance that could prevent reliable magnetic particle inspection or subsequent oil flow.	
11.	Clean the following internal parts made of steel: — Flat tappets — Piston pins — Rocker shafts — Accessory drive gears — Magneto gears — Idle and oil pump shafts — Shaft gears and impellers		
12.	Measure the flange run-out on the crankshaft	Record measurement. Refer to the Direct Drive Overhaul Manual for measurement instructions.	☐ Use crankshaft ☐ Replace crankshaft
⚠ **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 THE TABLE OF LIMITS, SSP-1776. IF THE CRANKSHAFT FLANGE IS BENT, REPLACE THE CRANKSHAFT. **DO NOT TRY TO STRAIGHTEN OR GRIND THE CRANKSHAFT FLANGE.**			
13.	Measure the bearing run-out on the crankshaft.	Record measurement. Refer to the Direct Drive Overhaul Manual for measurement instructions.	☐ Repair crankshaft ☐ Use crankshaft ☐ Replace crankshaft

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Engine Inspection Checklist After Propeller Strike (Cont.)			
Sequential Task		**Additional Information**	**Corrective Action Done/Comments**
CRANKSHAFT P/N:		**S/N:**	
14.	Measure the polished dimensions on the main journals.	Record measurement. Refer to the Direct Drive Overhaul Manual for measurement instructions. Refer to the latest revision of the Table of Limits, SSP-1776.	
15.	Measure the polished dimensions on the pin journals.	Record measurement. Refer to the Direct Drive Overhaul Manual for measurement instructions. Refer to the latest revision of the Table of Limits. SSP-1776.	
16.	Do a check of the connecting rod parallelism.	Record measurement. Refer to the Direct Drive Overhaul Manual for measurement instructions.	
NOTICE: The magnetic particle inspection must be done by a qualified and certified technician as per the latest revision of Service Instruction No. 1285.			
17.	Complete a magnetic particle inspection of the crankshaft.	Record test results.	☐ Repair crankshaft ☐ Use crankshaft ☐ Replace crankshaft
18.	Complete a magnetic particle inspection on the crankshaft counterweights. Examine the counterweight bushing bores in both counterweights and the crankshaft.	Record test results.	Replace all counterweight pins, bushings, end plates and snap rings - regardless of this condition.
19.	Complete a magnetic particle inspection on the camshaft.	Record test results.	☐ Use camshaft ☐ Replace camshaft
20.	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 No. 1458 for assembly instructions.
21.	Complete a magnetic particle inspection on the crankshaft gears; examine the gear end as per the latest revision of Service Bulletin No. 475.	Record test results.	☐ Use crankshaft gears ☐ Replace crankshaft gears

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Engine Inspection Checklist After Propeller Strike (Cont.)			
Sequential Task		**Additional Information**	**Corrective Action Done/Comments**
22.	Complete a magnetic particle inspection on the following internal parts made of steel: — Accessory drive gears — Magneto gears — Idler and oil pump shaft — Shaft gears and impellers — Piston pins.	Record test results.	Use Replace ☐ ☐ Accessory drive gears ☐ ☐ Magneto gears ☐ ☐ Idler and oil pump shafts ☐ ☐ Shaft gears and impellers ☐ ☐ Piston pins
NOTICE:	Complete the visual inspection and fluorescent (FEP) or dye penetrant (DPI) inspection in the next five steps.		
23.	If the engine has flat tappets, complete a fluorescent penetrant inspection on the flat tappets.	Record test results	
24.	Complete either a fluorescent or dye penetrant inspection on the crankcase. Refer to the latest revision of Service Instruction No. 1285. Closely examine the forward crankcase bearing support and adjacent structure.	Record test results.	☐ Use crankshaft ☐ Replace crankshaft
25.	Complete either fluorescent or dye penetrant inspection on the oil sump.	Record test results.	☐ Use oil sump ☐ Replace oil sump
26.	On six cylinder engines, complete a fluorescent or dye penetrant inspection on the engine mounts and lower mount rings (if present).	Record test results.	☐ Use engine mounts ☐ Replace engine mounts
27.	Complete either a fluorescent or dye penetrant inspection on the accessory housing.	Record test results.	☐ Use accessory housing ☐ Replace accessory housing
28.	Complete either a fluorescent or dye penetrant inspection on the aluminum oil pump impeller.	Record test results.	☐ Use impeller ☐ Replace impeller
29.	Examine the magneto in accordance with the magneto manufacturer's instructions.	Record results.	☐ Replace magneto ☐ Overhaul magneto
30	Examine the pistons as per the Direct Drive Overhaul Manual.	Record results.	☐ Pistons acceptable ☐ Replace pistons
NOTICE:	Roller tappets, counterweight rollers, and bushings must be replaced.		
31.	Refer to the latest revision of Service Bulletin No. 240 to identify any parts that must be replaced.	Record parts that must be replaced.	

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Engine Inspection Checklist After Propeller Strike (Cont.)			
Sequential Task		**Additional Information**	**Corrective Action Done/Comments**
32.	Assemble and install the engine. Install the propeller and test the engine. Complete the procedure as per the Section "Operational Ground Check After Maintenance" in Chapter 72-00.	In accordance with instructions in the Direct Drive Overhaul Manual and the latest revision of Service Instruction No. 1427.	
33.	Review the documents of all the rotating components on the engine, propeller governor, magnetos, etc. for instructions on what to do for components exposed to sudden engine stoppage.		
UNAIRWORTHY PARTS:			
ADDITIONAL WORK/INSPECTIONS NECESSARY:			
OUTCOME OF INSPECTION SUMMARY NOTES:			

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12-10 - SERVICING – REPLENISHING

1. Refueling

   A. Refer to the latest revision of Service Instruction No. 1070 for a list of approved fuels, octane ratings, and the use of a higher grade fuel for this engine.

   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.

   D. Storage Recommendations for Engines That Use Automotive Fuel

      (1) If an engine that has been operating on automotive fuel and the engine is to be stored for 6 or more consecutive months do the following:

         (a) Either operate the engine or drain the aircraft fuel system per the aircraft manufacturer's instruction until the tank contains less than 50% of automotive fuel.

         (b) Add the specified aviation fuel until the aircraft fuel tanks are full.

            NOTICE: The aviation fuel can be mixed with the automotive fuel. The goal is to have more than 50% aviation fuel in the fuel tanks during storage to prevent fuel system clogging.

         (c) Operate the engine for a minimum of 45 minutes with the oil temperature at 180ºF (80ºC) to work the aviation and automotive fuel mixture through the engine and fuel lines.

            ⚠ WARNING: IF THE 45-MINUTE ENGINE OPERATION IS DONE ON THE GROUND, DO NOT OPERATE THE ENGINE AT FULL-STATIC FOR MORE THAN 10 SECONDS.

         (d) Add more aviation fuel to make sure that the aircraft fuel tanks are full.

         (e) Obey the storage preservation recommendations in the IO-540-AG1A5 Series Engine Installation and Operation Manual.

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 IO-540-AG1A5 SERIES 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 fill port cap attached to the dipstick rod.

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(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) Insert the dipstick rod fully back into the oil fill tube down to the oil sump and pull the dipstick rod out again.

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

NOTICE: The oil sump capacity and the minimum quantity for flight and on the ground are identified in Appendix A of the IO-540-AG1A5 Series Engine Installation and Operation Manual.

(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.

⚠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

A. Oil consumption rates are identified in Appendix A of the IO-540-AG1A5 Series Engine Installation and Operation Manual.

⚠WARNING: IF OIL CONSUMPTION IS MORE THAN THE CONSUMPTION RATES SHOWN IN APPENDIX A OF THE IO-540-AG1A5 SERIES ENGINE INSTALLATION AND OPERATION MANUAL, 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.

B. 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 to Be Used for Oil Fill

NOTICE: On new or rebuilt engines, during the first 50 hours of engine operation, it is recommended that this engine be operated on mineral oil until oil consumption has stabilized.

A. The correct oils to be used in the IO-540-AG1A5 series engines are in Appendix A of the IO-540-AG1A5 Series Engine Installation and Operation Manual.

⚠WARNING: DO NOT USE AUTOMOTIVE LUBRICANTS IN LYCOMING ENGINES BECAUSE THEY COULD 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.

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5. Add Oil to the Engine

⚠ **CAUTION:** OIL IN THE CORRECT QUANTITY AND OF THE CORRECT VISOCITY FOR THE CORRESPONDING AMBIENT TEMPERATURE MUST BE ADDED TO THE ENGINE FOR CORRECT LUBRICATION ESSENTIAL TO ENGINE OPERATION. REFER TO APPENDIX A IN THE IO-540-AG1A5 SERIES ENGINE INSTALLATION AND OPERATION MANUAL FOR OIL TYPES AND OIL SUMP CAPACITY TO HAVE THE CORRECT QUANTITY AND TYPE OIL TO ADD TO THE ENGINE.

NOTICE: On new or rebuilt engines, during the first 50 hours of engine operation, it is recommended that the engine be operated with mineral oil until oil consumption has stabilized. After the first 50 hours of engine operation, refer to Appendix A in the IO-540-AG1A5 Series Engine Installation and Operation Manual, to identify oil of the correct viscosity for the corresponding ambient temperature.

NOTICE: The correct oils to be used in the IO-540-AG1A5 series engines are in Appendix A of the IO-540-AG1A5 Series Engine Installation and Operation Manual.

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

B. Remove the oil fill port cap and dipstick rod (Figure 1).

⚠ **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.

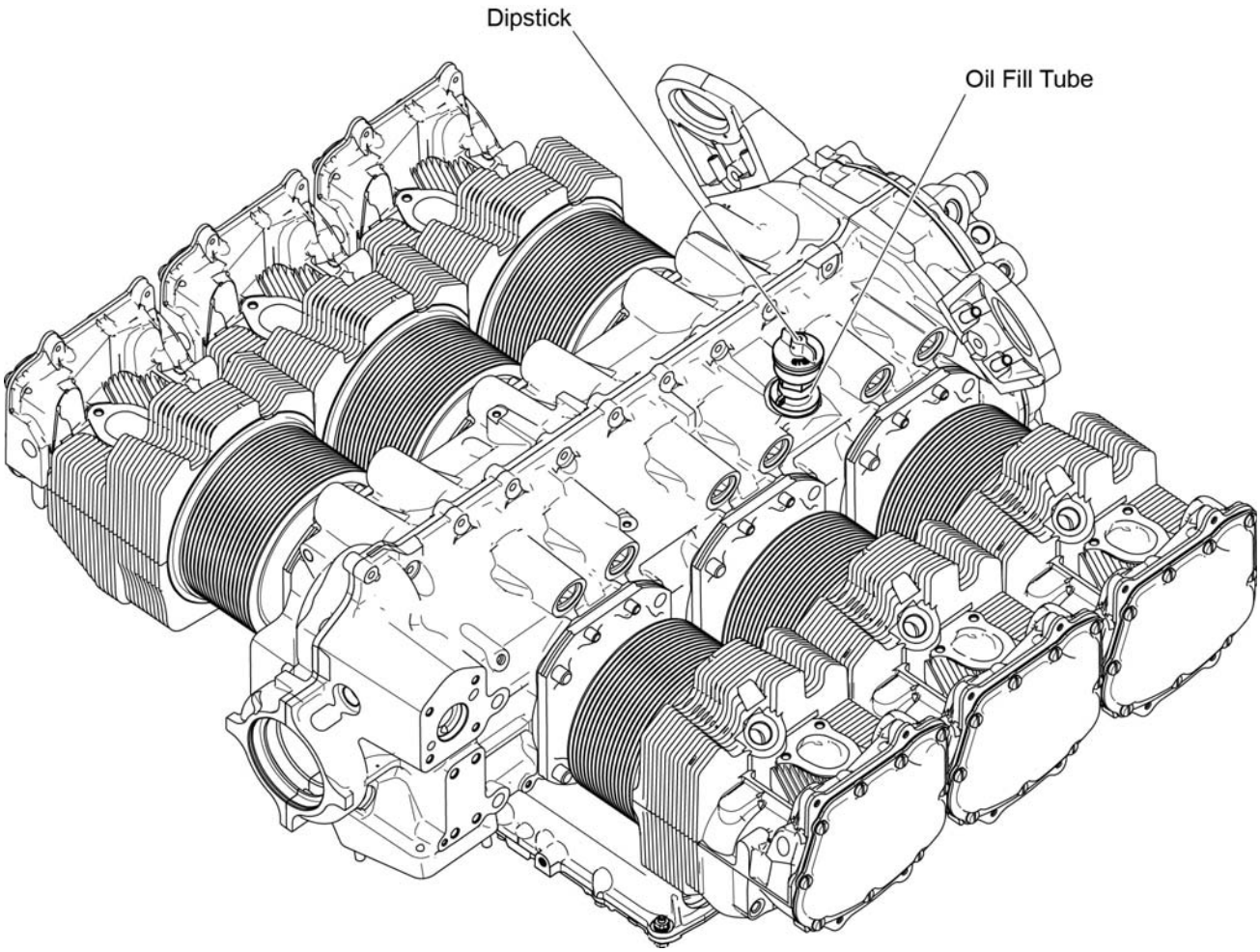
D. Add oil as necessary and measure the oil level until the oil level check shows that there is sufficient oil in the engine for the flight conditions.

E. Install the dipstick rod and oil fill port cap 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 THESE PRODUCTS ARE ADDED TO THE ENGINE, THE ENGINE WARRANTY IS VOID

(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.



Oil Fill Tube
Figure 1

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 Change and Oil Filter Replacement Schedule
   A. Oil changes and oil filter replacement are recommended as shown in the schedule in Table 1.

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Table 1 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.

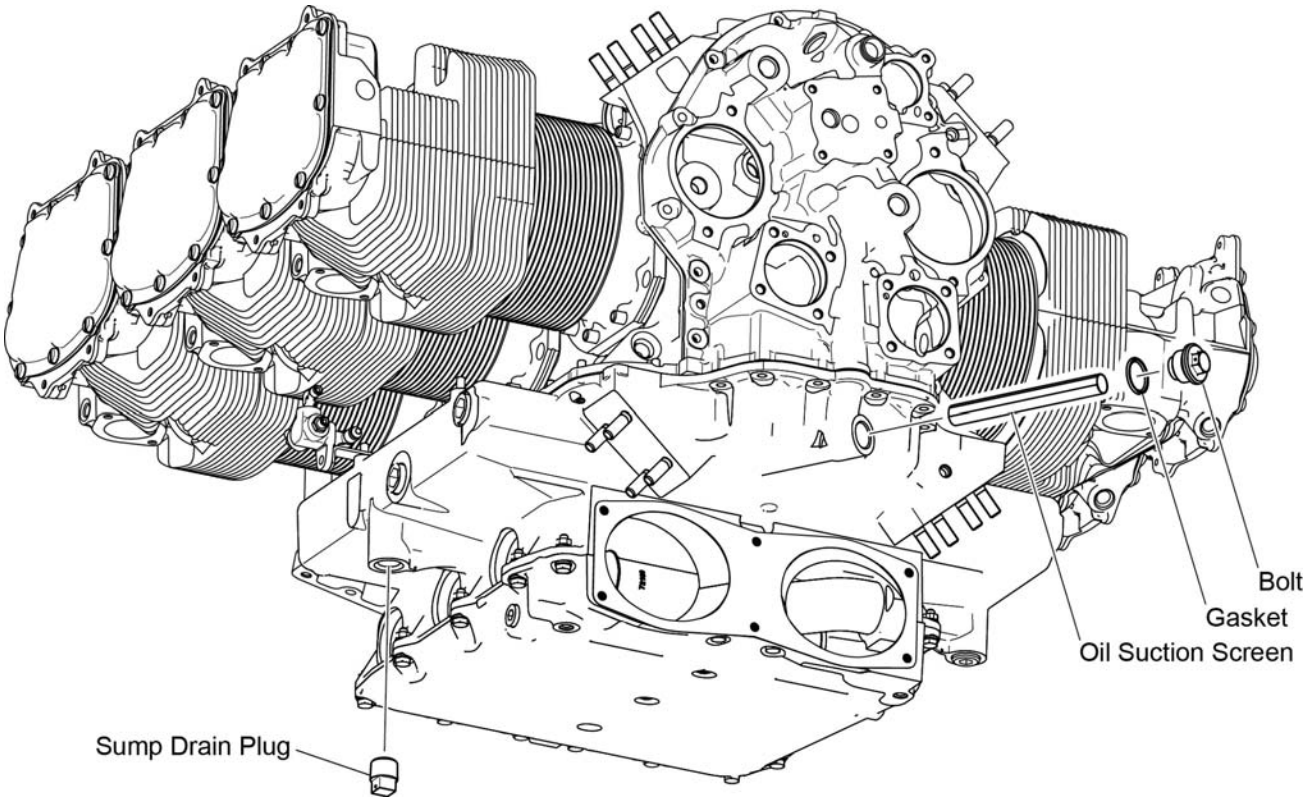
(2) Have a clean oil sample vial prepared to collect oil after a few ounces of oil have drained.

(3) Remove the safety from the oil sump drain plug (Figure 2) (in the rear of the oil sump, at the scavenger oil chamber).

(4) Remove the oil sump drain plug.

(5) Connect the 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.



Oil Sump, Drain Plug, and Oil Suction Screen
Figure 2

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 screen plug, oil suction screen and gasket. Discard the gasket. Clean the oil suction screen with a hydrocarbon-based solvent such as mineral spirits or equivalent.

H. Apply one to two drops of Food Grade Anti-Seize to the plug on the oil suction screen. Install the oil suction screen (do not flare the ends of the suction screen) with a new gasket. Tighten plug until the sealing surfaces are in contact, then turn an additional 135 degrees.

I. Apply one to two drops of Loctite 564 to the threads of the drain plug and install the drain plug.

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⚠ **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.

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

K. Replace the oil filter. Refer to “Oil Filter Replacement” procedure in this chapter.

L. Add oil. Refer to the “Add Oil to the Engine” procedure in this chapter.

M. Operate the engine under usual conditions for 30 minutes.

N. Allow the engine to cool for 15 minutes.

O. 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. After the Oil Change

⚠ **CAUTION:** DO NOT ENERGIZE THE STARTER FOR PERIODS OVER 10 SECONDS. LET THE STARTER COOL FOR 30 SECONDS AFTER EACH ENERGIZATION. IF THE STARTER FAILS TO ENERGIZE AFTER TWO ATTEMPTS, IDENTIFY AND CORRECT THE CAUSE.

A. Pre-oil start cycle: Energize the starter for 10 seconds and look for evidence of oil pressure of at least 20 psi (138 kPa) within 10 seconds.

If there is no oil pressure within 10 seconds, stop energizing the starter. Wait at least 30 seconds and repeat the pre-oil start cycle.

Up to six consecutive pre-oil start cycles can be done. Afterwards let the starter cool for 30 minutes. If stable, oil pressure is not achieved, stop pre-oiling, identify and correct the cause.

NOTICE: Unstable oil pressure or oil pressure less than 20 psi (138 kPa) could be an indication of obstructed or interrupted oil flow or air in the oil lines. In this case, stop the pre-oiling, identify and correct the cause.

B. If oil pressure of at least 20 psi (138 kPa) was sustained in the previous step, repeat the pre-oil start cycle to make sure oil pressure holds stable and that there is no sudden drop in oil pressure. If oil pressure is not stable or drops suddenly, stop pre-oiling, identify and correct the cause.

C. Once the minimum oil pressure of 20 psi (138 kPa) is shown on the oil pressure gauge, reinstall the spark plug in each engine cylinder.

D. Proceed with normal starting within the next 3 hours.

E. Start and operate the engine for 3 minutes at approximately 1000 rpm.

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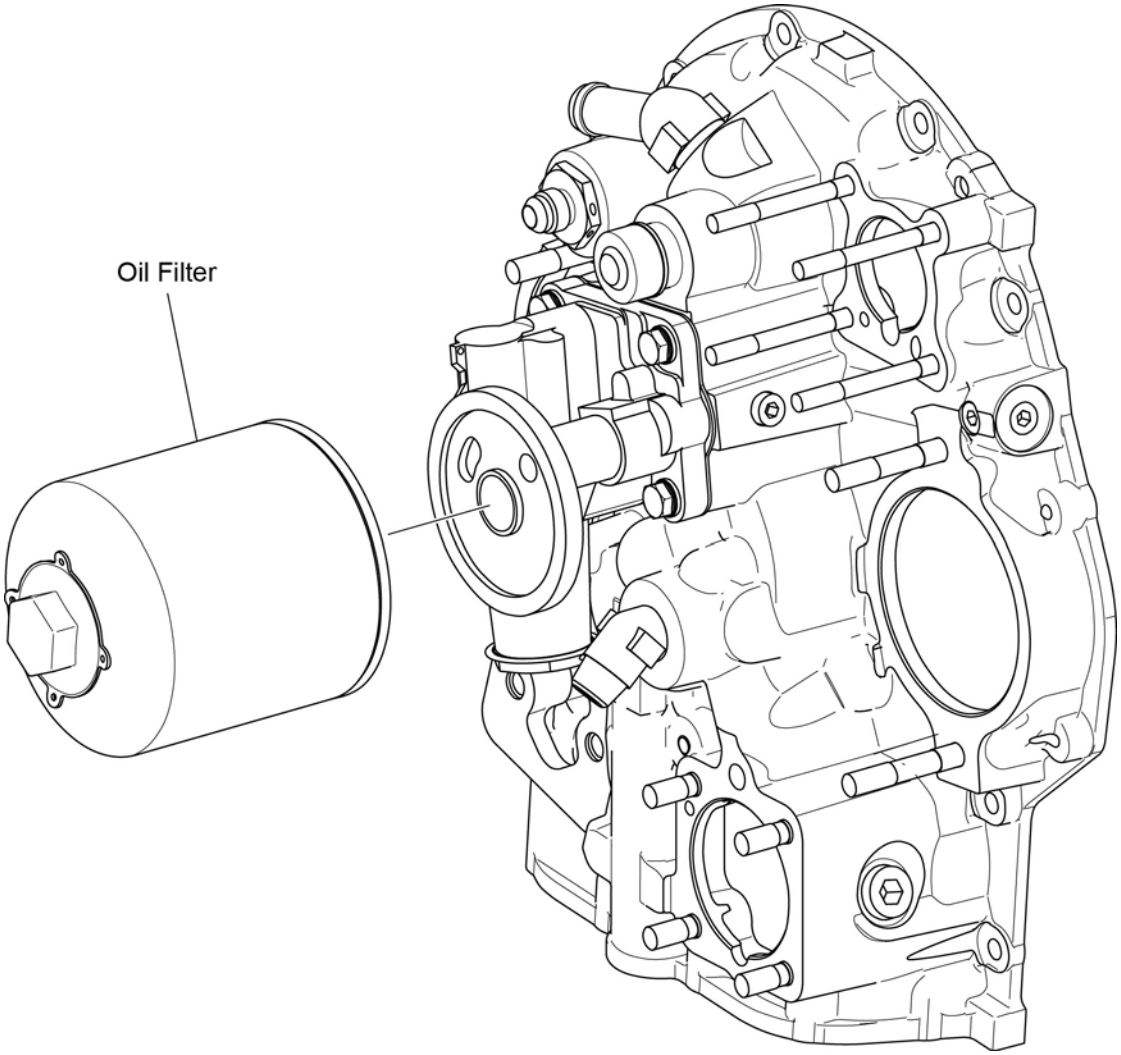
10. Oil Filter Replacement

    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.



Oil Filter
Figure 3

11. Oil Suction Screen Removal/Inspection/Installation

    A. Put a container under the oil sump.

    B. If not already done, remove the oil drain plug (Figure 2) and drain the oil from the oil sump.

    C. Remove the oil suction screen from the oil sump.

    D. Remove and discard the gasket.

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E. Before cleaning the oil suction screen, examine the oil suction screen for metal particles, shavings or flakes as follows:

(1) Examine the oil suction screen for distortion, deformation or openings in the mesh and/or metallic particles (which is an indication of possible excessive internal wear on the engine).

⚠ **CAUTION:** IF STEEL COPPER OR ALUMINUM PARTICLES ARE FOUND ON THE OIL SUCTION SCREEN, EXAMINE THE CYLINDERS AND OTHER METAL COMPONENTS FOR WEAR OR DAMAGE.

(2) Examine the material trapped in the oil suction screen. Examine the condition of the oil and particles on the oil suction screen. Look for shining, metallic residue which is an indication of a high concentration of aluminum. Refer to Table 2.

(3) If possible, count the approximate number of particles on the oil suction screen. Refer to guidelines in Table 3 for the next step in accordance with the quantity of particles.

F. Clean the oil suction screen with a hydrocarbon-based solvent such as mineral spirits or equivalent solvent.

G. Apply one to two drops of Food Grade Anti-Seize to the plug on the oil suction screen. Install the oil suction screen (do not flare the ends of the suction screen) with a new gasket. Tighten plug until the sealing surfaces are in contact, then turn an additional 135 degrees.

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

H. Apply one to two drops of Loctite 564 to the threads of the oil drain plug and install the oil drain plug in the threaded hole of the oil sump. Torque the oil drain plug as per the torque value in the latest revision of the Table of Limits, SSP-1776.

I. Safety the oil drain plug and oil suction screen bolt-plug.

J. If not already done, add oil. Refer to "Add Oil to the Engine" procedure in this chapter.

12. Oil Filter Inspection

A. Open the oil filter with an approved method (e.g., for full-flow, spin-on filters, use Champion Tool CT-470 or Airwolf Cutter AFC-470).

⚠ **CAUTION:** IF STEEL, COPPER OR ALUMINUM PARTICLES ARE FOUND IN THE OIL FILTER, EXAMINE THE CYLINDERS AND OTHER METAL COMPONENTS FOR WEAR OR DAMAGE.

B. Remove the paper element from the oil filter.

C. Carefully unfold the paper element and examine the material trapped in the filter.

D. Examine the condition of the oil and particles on the filter. Look for shining, metallic residue which is an indication of a high concentration of aluminum. Refer to Table 2.

E. If possible, count the approximate number of particles in the oil filter. Refer to guidelines in Table 4 for the next step in accordance with the quantity of particles.

12. Engine Wear and Oil Analysis:

A. Worn engine parts can cause minute particles of metal in the oil. If a part is worn more than usual, excessively high concentrations of its metal deposits are found in the oil. This wear can increase over a period of time until premature failure occurs. Through oil analysis for metal content, the increasing concentrations can be identified and corrective action taken.

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B. The most important aspect of monitoring engine wear by oil analysis is safety. The amount of metal in engine oil is most often high in either a new engine or is caused by new parts mating together.

C. After approximately 25 hours of initial operating time, the metal content decreases rapidly to a level that essentially stays constant unless abnormal wear occurs due to dirt in the induction system or other causes.

D. A “break” in the normal wear rate is not necessarily an indication of imminent failure. It is an indication that an investigation (filter checked, borescope examination, compression pressure check, etc.) is necessary to identify the cause for unusual wear.

E. Results from examination of the oil filter and suction screen on the first oil change of a new, rebuilt or newly overhauled engine usually will show small metallic particles shavings which are acceptable. Refer to “Guidelines for Results of Oil Analysis” in this chapter.

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

Table 2
Characteristics of Various Wear Materials on Oil Filter or Suction Screen

Material	Characteristics	Possible Source
Ferrous particles	Attracted to magnet	
Tin	Soft malleable, not attracted to magnet	
Iron and Chrome		Dirt (change oil filter)
Nickel	Not attracted to magnet	
Aluminum flakes	When placed in a 50% solution of muriatic acid, bubbles	Machining chips, Piston pin plugs, Sleeve bearings
Bronze or Copper particles	When placed in nitric acid; turns bright green	Bushings, Camshaft, Crankshaft
Carbon	When rubbed between fingers, crumbles	
Sand	When pressure applied, does not crumble, can scratch glass	
Steel		Camshaft and Followers

⚠ **CAUTION:** IF THE CUMULATIVE AMOUNT OF METAL IN THE OIL FILTER IS LESS THAN 0.5 IN. (12.7 MM), FLIGHT FOR 10 MORE ENGINE OPERATING HOURS CAN BE DONE FOLLOWED BY AN IMMEDIATE OIL CHANGE AND CHECK OF THE OIL FILTER. REFER TO TABLE 3 FOR FURTHER ACTION. IF THE CUMULATIVE AMOUNT OF METAL IN THE OIL FILTER IS 0.5 IN. (12.7 MM) OR MORE, GROUND THE AIRCRAFT. IDENTIFY AND CORRECT THE CAUSE OF THE METALLIC PARTICLES. REFER TO THE FAULT ISOLATION GUIDELINES IN CHAPTER 12-30 OF THIS MANUAL. REFER TO THE DIRECT DRIVE OVERHAUL MANUAL.

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Table 3
Guidelines for Particle Quantity on Oil Filter or Suction Screen

Condition	Next Step
(1) 1 to 9 pieces of metal (1/16 in. (1.2 mm)) diameter or less).	(a) Operate the aircraft in its usual conditions. (b) At the next regularly scheduled oil change/filter replacement, examine the oil filter or suction screen.
(2) 10 to 20 pieces of shiny flake-like, non-magnetic metal (1/16 in. (1.2 mm)) diameter of less).	(a) Operate the aircraft in its usual conditions. (b) At 25 more hours of usual operation, examine the oil filter or screen.
(3) 10 or less short hair-like pieces of magnetic metal.	(a) Operate the aircraft in its usual conditions. (b) At 25 more hours of usual operation, examine the oil filter or screen.
(4) 20 to 40 pieces of shiny flake-like non-magnetic metal.	(a) At 10 more hours of usual operation, examine the oil filter or screen.
(5) 45 to 60 small pieces of shiny flake-like, nonmagnetic metal.	(a) Change the oil filter or clean the screen, drain the oil, and refill the sump. (b) Operate the engine on the ground for 20 to 30 minutes within Appendix A of the IO-540-AG1A5 Series Engine Installation and Operation Manual. (c) Examine the oil filter/suction screen. If the oil filter/screen does not have metal particles, examine the engine after 10 or more hours of usual operation.
⚠ **CAUTION:** IF AN ENGINE HAS THE CONDITION(S) OF ANY ITEMS (6) THROUGH (11) THAT FOLLOW, DO NOT OPERATE AN ENGINE UNTIL ALL OF THE CAUSES ARE IDENTIFIED AND ALL OF THE REPAIRS ARE COMPLETED.	
(6) Pieces of metal that are larger than 0.078 in. (2.00 mm). **NOTICE:** A mixture of magnetic and nonmagnetic material can be evidence of valve or ring and piston failure. **NOTICE:** If the bottom spark plugs are removed, the defective cylinder can be identified.	(a) Ground the aircraft until you identify all of the causes and complete all of the repairs. (b) Remove the oil suction screen from the sump. (c) Examine the oil sump for pieces of metal.
(7) 1/4 teaspoonful or more of nonmagnetic plating. Nonmagnetic plating is approximately 1/16 in. (1.6 mm) in diameter and can have a copper tint.	Ground the aircraft until all of the causes are identified and all of the repairs are completed.

Table 3 (Cont.) Guidelines for Particle Quantity on Oil Filter or Suction Screen	
Condition	**Next Step**
(8) Pieces of shiny flake-like, nonmagnetic metal (larger than 1/16 in. (1.6 mm) in diameter) with no copper tint. (Possible indication of incorrect propeller operation.)	Ground the aircraft until all of the causes are identified and all of the repairs are completed.
(9) 1/4 teaspoonful of nonmagnetic brass or copper colored metal that appears coarse like sand.	Ground the aircraft until all of the causes are identified and all of the repairs are completed.
(10) 1/2 teaspoonful of more of metal.	Remove and disassemble the engine. Refer to the Direct Drive Overhaul Manual.

F. If the cause of the metal contamination cannot be found, speak with the Lycoming Product Support Department.

G. If there is unusual aluminum 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.) and then speak with the Lycoming Product Support Department. This information will help Lycoming identify the cause of the contamination.

13. Guidelines for Results of Oil Analysis

A. Typically, the first oil analysis of a new, rebuilt or newly overhauled engine will show high concentrations of metal. After an initial break-in period, metal content is to decrease to a constant level.

B. If an oil analysis report shows a level of **aluminum** above **30 PPM** or **iron** content above **100 PPM**, speak with a Technical Representative at the Lycoming Product Support Department.

C. If the next two oil analyses show progressive increases in aluminum or iron content, examine the engine cylinders. Refer to Chapter 72-30.

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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
   A. 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 IO-540-AG1A5 Series 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.	
	Power control open too far	Set power control approximately 1/4 in. open for approximately 800 rpm.	
	Non-conforming starter	Replace the starter.	OHM
	No fuel or low fuel level	Complete the check of the fuel supply. Service as required.	
	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 injector	Drain the fuel injector and fuel lines.	
	Throttle valve open too far	Set throttle control approximately 1/4 inch open for about 800 rpm.	

Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
Engines will not start or starts with difficulty (Cont.)	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
	Non-conforming ignition wire	1. Examine the ignition harness for breaks and cracks. 2. Remove distributor cap from magneto and test leads. 3. Replace non-conforming wires.	
	Magneto incorrectly timed to engine.	Complete the magneto-to-engine timing inspection in Chapter 74-30.	74-30
	Magneto internal timing not adjusted correctly or "E" gap drifting because of point or follower wear	1. Replace the magneto with a serviceable unit as per instructions in Chapter 74-30. 2. Complete the magneto-to-engine timing procedure in Chapter 74-30.	74-30
	Incorrect crankshaft-to-camshaft timing	Make sure that the crankshaft-to-camshaft timing is correct	72-20
	Non-conforming spark plug	1. Remove the spark plugs. 2. Examine, clean, gap, test, and replace spark plugs as necessary.	74-20
	Non-conforming harness	Remove and replace the harness as necessary.	
Poor idle cut-off	Incorrect rigging of mixture control linkage	Adjust in accordance with airframe manufacturer's instructions.	

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Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
Poor idle cut-off (Cont.)	Mixture control valve is scored or not seating properly or O-ring on mixture nozzle is broken or deformed Leaky valve	1. Remove the mixture control assembly. Refer to the Direct Drive Overhaul Manual. 2. Repair the idle cut-off jet and valve assembly using a mild abrasive, until all scores and burrs are removed. 3. Clean thoroughly and re-assemble. 4. Examine the condition of the O-ring on mixture control nozzle. Replace the O-ring if broken or deformed. 5. Look for fuel leaks. 6. Put the throttle mixture in the OFF position and turn the boost pump ON. 7. Look for little or no fuel flow. If fuel flow is leaking more than 5 ml per minute, a valve is leaking.	OHM
	Valve sticking in fuel manifold	1. Remove the fuel manifold from engine and disassemble. **NOTICE:** Do not damage diaphragm during disassembly or assembly of the fuel manifold. 2. Flush out foreign debris. 3. Use a mild abrasive to remove any burrs on the fuel manifold valve seat. **NOTICE:** Do not interchange fuel manifold parts during re-assembly. 4. Reassemble the fuel manifold.	OHM
	Fuel vaporizing in line and fuel manifold during: — High ambient temperatures — Engine operating for prolonged 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.	

Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
Poor idle cut-off (Cont.)	Dirt in the air bleed hole of fuel injector nozzle	Remove fuel injector nozzle and clean.	OHM
	Fuel injector nozzle is not in the correct location	Replace the fuel injector nozzle.	
	Loose fuel line at the fuel manifold or nozzle	1. Make sure the main fuel line at the fuel manifold and fuel injectors are tight. 2. Make sure that all fuel injector nozzles are tightly secured at the cylinders and not cross-threaded.	
Rough Idle	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 leaking gaskets. 5. Examine for fuel drain valve not properly seating.	OHM
	Internal fuel injector leak	Complete the check for a fuel injector leak. Refer to the section "Fuel Injector Leak Check Procedure" in Chapter 73-10.	
	Plugged fuel injector nozzles.	1. The cylinder with the plugged fuel injector nozzle will be cold after 2 minutes of engine operation. 2. Complete a fuel flow check - refer to Chapter 72-00. 3. Clean or replace the fuel nozzle.	OHM
	Fuel injector nozzle screen and shroud are non-conforming and could be blocking the air bleed hole	Replace the fuel injector nozzle.	OHM

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Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
Rough Idle (Cont.)	Valve sticking in fuel manifold	1. Remove the fuel manifold from engine and disassemble. **NOTICE:** Do not damage diaphragm during disassembly or assembly of the fuel manifold. 2. Flush out foreign debris. 3. Use a mild abrasive to remove any burrs on the fuel manifold valve seat. **NOTICE:** Do not interchange fuel manifold parts during re-assembly. 4. Reassemble the fuel manifold.	
	Fuel vaporizing in lines Found only as follows: — High ambient temperatures — Engine operating for prolonged 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.	
	Fault in the ignition system	1. Set the engine power to 50 to 65% with the propeller in low pitch. 2. Monitor both magnetos for excessive drop-off. 3. Ensure that not more that a 50 rpm difference exists between magnetos. **NOTICE:** A smooth drop-off could be an indication of a lean or rich fuel injector. 4. Visually examine the harness for physical damage. 5. Remove the distributor block and examine leads using a high-tension lead tester. 6. Repair or replace components as necessary. 7. Remove spark plugs, examine, clean, gap, test, and replace as necessary.	IOM & OHM 74-20

Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
Rough Idle (Cont.)	Lean idle mixture	1. Adjust the idle mixture per instructions in the section "Idle Speed Mixture Adjustment". 2. Readjust idle speed.	72-00
	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.	
	Low fuel pressure	1. Examine the fuel filter for plugs. Refer to Chapter 73-10. 2. Adjust the fuel pressure. 3. Replace fuel pump or fuel pressure regulator. Refer to the Direct Drive Overhaul Manual.	
	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.	
Engine will not idle unless the boost pump is on	Low fuel pressure	1. Examine the fuel filter for plugs. Refer to Chapter 73-10. 2. Adjust the fuel pressure. 3. Replace fuel pump or fuel pressure regulator. Refer to the Direct Drive Overhaul Manual.	OHM
	Very lean idle mixture	1. Enrich idle mixture. Refer to instructions in the section "Idle Speed Mixture Adjustment". 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.	

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Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
Engine will not idle unless the boost pump is on (Cont.)	Idle mixture is extremely rich (evident by excess black exhaust)	1. Lean idle mixture. Refer to instructions in the section "Idle Speed Mixture Adjustment." 2. Readjust idle speed.	72-00
	Fuel pressure is set too high	Adjust engine fuel pump. If necessary replace the fuel pump.	OHM
	Boost pump pressure is set too high	Adjust boost pump pressure. If necessary, replace the boost pump in accordance with airframe manufacturer's instructions.	
	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.	
	Broken fuel pump drive	Replace the fuel pump in accordance with airframe manufacturer’s instructions.	OHM
Engine will not shut off	Non-conforming power switches	Replace the switches.	
	Non-conforming wiring in the harness	Replace the harness.	OHM
	Non-conforming ignition switch	Check for faults on the ignition switch circuits. Repair as necessary.	
High fuel flow	Plugged fuel injector nozzles evident by high flow reading on nozzle	1. Flow-Check nozzles in containers of equal size to identify plugged nozzles (Chapter 72-00). 2. Clean plugged nozzles with Hoppe's #9 gun cleaning solvent and blow out with compressed air.	72-00
	Non-conforming flow gage	1. Install master fuel flow gage and operate the engine to compare gages. 2. Replace non-conforming fuel flow gage.	OHM

Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
High fuel flow (Cont.)	Inside diameter of fuel lines is too small indicated by high flow velocity on nozzle. Pressure type gage only. Not valid for direct flow type gage	Measure inside diameter of fuel line with a gage to verify that the fuel line is between 0.085 to 0.090 in. (2.159 to 2.286 mm). Do not mark the inside of the fuel line.	
	Injector rich	Recalibrate and/or overhaul the fuel injectors that are running rich.	OHM
Low fuel flow	Dirty fuel filter screen	Remove and clean the fuel filter in acetone or MEK. Blow out with compressed air.	
	Non-conforming flow gage	1. Install master fuel flow gage and operate the engine to compare gages. 2. Replace non-conforming fuel flow gage.	OHM
	Fuel manifold does not open all the way at times	1. Remove the fuel manifold from engine and disassemble. **NOTICE:** Do not damage diaphragm during disassembly or assembly of the fuel manifold. 2. Flush out foreign debris. 3. Use a mild abrasive to remove any burrs on the fuel manifold valve seat. **NOTICE:** Do not interchange fuel manifold parts during re-assembly. 4. Reassemble the fuel manifold.	OHM
	Fuel line to fuel flow gage is broken, loose, or plugged	To identify broken or loose fuel lines, look for fuel dye stains. To identify a plugged fuel line, disconnect the line at the fuel flow gage and injector and blow it out with compressed air. Repair or replace fuel lines as necessary.	
	Low fuel pressure	1. Examine the fuel filter for plugs. Refer to Chapter 73-10. 2. Adjust the fuel pressure. 3. Replace fuel pump or fuel pressure regulator. Refer to the Direct Drive Overhaul Manual.	

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Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
Low fuel flow (Cont.)	Injector lean: Increases in cylinder head temperature, EGT, or oil temperature are indications of a lean mixture	Operate the engine at power setting "FULL RICH. Recalibrate or overhaul fuel injectors that are running lean at an approved facility.	OHM
Engine will not turn static rpm or will not develop rated rpm	Decreased air flow in the air induction system	1. Examine the system and remove all blockages. 2. Make sure that the air box is installed in accordance with the airframe manufacturer's specifications.	
	Propeller or propeller governor is out of adjustment (not rat specified low pitch)	Adjust in accordance with 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 an indication of loose baffles. 3. Remove the muffler and complete a thorough inspection. 4. Replace muffler as necessary, in accordance with the airframe manufacturer's instructions.	
	Air filter dirty	Replace the air filter in accordance with airframe manufacturer's instructions. **NOTICE**: Occasionally new filters will have an excessive air drop through them. If this condition is suspected, remove filter and operate the engine to full throttle on a hard surface in a dust-free area.	
	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
	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

Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
Engine will not turn static rpm or will not develop rated power (Cont.)	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.	
	Incorrect magneto-to-engine timing	Complete the "Magneto-to-Engine Timing" procedure in Chapter 74-30.	74-30
	Fouled spark plugs	Remove and clean spark plugs	
	Injector rich or lean	1. Operate the engine at a given power setting FULL RICH. 2. Recalibrate and/or overhaul fuel injectors that are out of specification.	OHM
	Incorrect fuel flow	1. Look for blocked fuel filters. 2. Remove screens and flush out with acetone or MEK. Blow out with compressed air. 3. Disconnect the fuel flow gage and install a master fuel flow gage to make sure the aircraft fuel flow gage is accurate. 4. Replace the fuel injector as necessary.	OHM
	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.	Latest revision of Service Instruction No. 1070
	Throttle lever is incorrectly adjusted	Adjust the throttle lever in accordance with airframe manufacturer's instructions.	

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Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
Engine will not supply the rated power	Blockage in manifold system	Clear all ducting.	
	Blockage in compressor impeller	Disassemble and clean the compressor impeller.	
	Compressor is too dirty	1. Thoroughly clean the compressor assembly. 2. Service the air cleaner and check for leakage.	
	Leak in intake or exhaust	Tighten loose connections or replace manifold gaskets as necessary.	
	Oil pressure too low	1. Tighten fittings. 2. Replace oil lines, or hoses. 3. Increase oil pressure as necessary.	
	Piston seal in actuator is leaking **NOTICE:** Usually accompanied by oil leakage at drain line.	Remove and replace the actuator or disassemble and replace packing.	OHM
Engine smokes excessively **NOTICE:** An engine regularly smokes if it is idling for an extended period.	Air in oil hoses or actuator	Bleed the system	
	Breather is clogged	Make sure that nothing is blocking the air flow.	
	Exhaust bypass valve is not opening correctly	Examine the exhaust bypass valve to make sure that the shut - off valve in the return line is operating correctly.	
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
	Dirty fuel injector nozzle	Clean fuel injector nozzle with solvent. Blow out with compressed air.	
	Non-conforming propeller governor circuit	Test propeller governor circuit.	
	Non-conforming propeller governor	Leak test propeller governor. Replace the propeller governor.	72-20 OHM
	Incorrect propeller governor	Make sure that the propeller governor is the correct part number.	
	Non-conforming oil pump	Repair or replace the oil pump.	OHM
	Propeller blades are intermittently sticking in hub	Remove and overhaul the propeller.	Propeller manu-facturer's instructions

Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
Engine surges (Cont.)	Unserviceable propeller control solenoid valve	Replace the solenoid valve.	OHM
	Front main bearing has too much clearance	Complete the leak test.	OHM
Irregular oil pressure	Oil pump is sucking air	Repair or replace the oil pump.	OHM
Low oil pressure or excessive oil pressure delay during start-up	Oil not of the correct viscosity for ambient temperature	Make sure oil of the correct viscosity for the ambient temperature is used.	IOM Appendix A
	Low engine oil level	Complete a check of the oil level. Add oil if necessary.	12-10
	Oil pressure relief valve is out of adjustment	Increase the oil pressure by turning the adjusting screw counterclockwise; decrease the oil pressure by turning the screw counterclockwise.	72-50
	Dirt of 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
	High oil temperature	Examine the engine for these conditions: 1. Low oil level 2. Correct grade and weight of oil 3. Thermostatic bypass valve is accurately seated and operating correctly 4. Oil cooler lines are blocked (partially or fully) 5. Too much blow-by 6. The air duct cooler is blocked (partially or fully) 7. Non-conforming temperature gage.	IOM Appendix A
	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
	Air leak on suction side	1. Examine the conditions of these components: — Oil suction screen gasket — Oil sump gasket — Oil pump mating surface to accessory housing 2. Replace cracked or damaged parts.	OHM

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Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
Low oil pressure or excessive oil pressure delay during start-up (Cont.)	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.	
	Failed or failing bearings **NOTICE:** Metal in the oil pressure screen or oil suction screen 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.	On new and rebuilt engines, use mineral oil until oil consumption stabilizes (usually between 50 to 100 hours) then if desired, change to ashless dispersant oil. For best ring seating, always use full throttle take-off wherever the application applies. Also use a high cruise power setting for break-in. Climb to cruise altitude at full power, then operate a 75% power for break-in.	
	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.	

Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Corrective Action**	**Ref.**
High oil consumption (Cont.)	Oil siphoned from engine during flight	1. Verify that the oil fill 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.	
	Crankcase ventilation system	Examine the plumbing.	
	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. Refer to the latest revision of Service Instruction No. 1042.	74-20
	Cooling baffles 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.	IOM Appendix A
	Partially plugged fuel nozzles	Remove and clean fuel nozzles.	OHM
	Incorrect magneto-to-engine timing	Complete the magneto-to-engine timing (Chapter 74-30) is synchronized at 25ºBTDC. **NOTICE:** Timing more than 25º BTDC will cause the engine to operate at high temperature.	74-30
	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	Non-conforming oil temperature gage	1. Install the master temperature gage and operate the engine to compare gages. 2. Replace the non-conforming gage if necessary.	OHM
	Oil level is too low	Complete the check of the oil level at regular intervals. Keep oil at the specified level.	12-10
	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.	

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Table 1 (Cont.) Fault Isolation Guide			
Problem	**Cause**	**Correction Steps**	**Ref.**
High manifold oil temperature	Incorrect grade of oil	Use only correct oil grade.	IOM Appendix A
	Oil cooler or oil cooler lines are fully or partially blocked	3. Remove the oil cooler and oil cooler lines. 4. 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
	Excessive blow-by	1. Complete the differential compression check in accordance with Chapter 72-30. 2. If there are indications of worn or broken rings, complete a borescope inspection. 3. Complete the top overhaul.	72-30 OHM
	Leaks in engine induction system	1. Look for leaks; identify and correct the cause of leaks.	
High manifold pressure at idle	Improperly adjusted	1. Adjust idle mixture to get a 25-50 rpm rise when moving mixture control from FULL RICH to IDLE CUT-OFF. 2. Adjust idle speed after making mixture adjustments. Refer to the section "Idle Speed Mixture Adjustment."	72-00
	Incorrect hydraulic lifters were installed	Replace hydraulic lifters with the correct part number for lifters. Refer to the latest revision s 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
	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**	**Corrective Action**	**Ref.**
High oil pressure	Oil pressure incorrectly adjusted	1. Increase the oil pressure by turning the adjusting screw on the oil pressure relief valve clockwise. 2. Decrease the oil pressure by turning the adjusting screw on the pressure relief valve 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 oil 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.	
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.	
	Dirty impeller blades	Disassemble and clean the impeller.	
Sluggish propeller operation	Propeller oil control leak	Complete "Oil Control Leak Test Procedure" in chapter 72-20.	72-20
Engine does not hold rpm during cruise, climb, or descent	Propeller oil control leak	Complete "Oil Control Leak Test Procedure" in chapter 72-20.	72-20
Engine goes into feather during landing rollout with decreased power control setting	Propeller oil control leak	Complete "Oil Control Leak Test Procedure" in chapter 72-20.	72-20

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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.

— Disconnect the ground terminal battery.

— Disconnect the positive terminal of the battery.

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 IO-540-AG1A5 Series 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 WORK 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.

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

(5) Apply a cap to oil and fuel lines and connections to prevent 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.

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(9) Disconnect the engine from the alternator.

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

(11) Remove the baffling as required.

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

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

(13) Apply one to two drops of Loctite 564 to the threads of the oil drain plug and install the oil drain plug in threaded hole of the oil sump. Torque the oil drain plug as per the torque value in the latest revision of the Table of Limits, SSP-1776. Safety the oil drain plug.

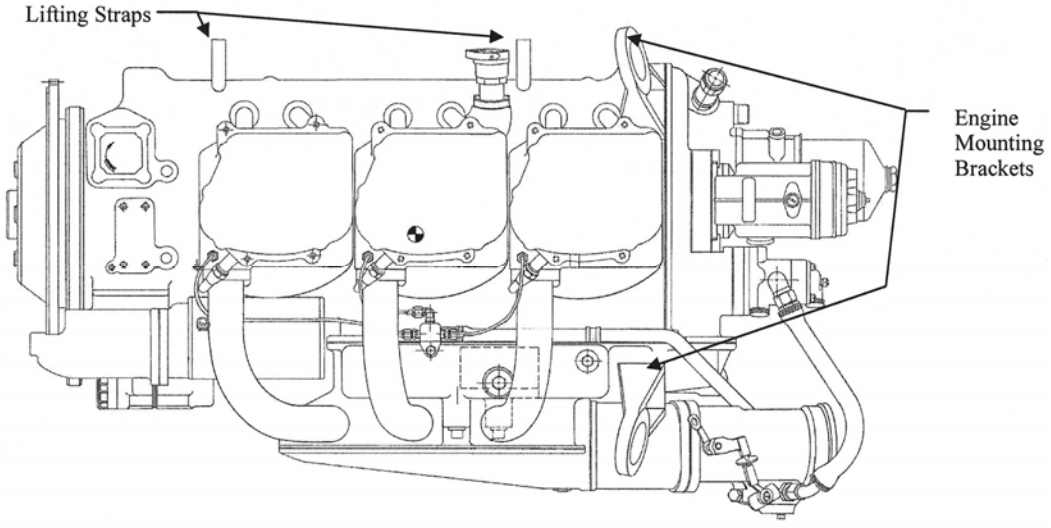
NOTICE: If the engine is to be stored, add preservative oil. Refer to the IO-540-AG1A5 Series Engine Installation and Operation Manual for preservation and storage instructions.

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

(15) 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.

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

(17) Attach an engine-lifting strap (with a minimum capacity of 750 lb (340 kg)) to the lifting lugs on the engine in accordance with Figure 1.



Lifting Lugs and Engine Mounts
Figure 1

(18) Use a crane or overhead hoist (with a minimum load of 750 lb (340 kg)) to take up slack on the lifting cable until there is enough tension to hold the weight of the engine.

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⚠ **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.

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

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

3. Engine Installation Preparation Requirements

To prevent delays on engine re-installation, have the following materials and new spare parts available (IO-540-AG1A5 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. Lock wire.

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

F. Oil per specifications in Appendix A of the IO-540-AG1A5 Series Engine Installation and Operation Manual.

G. Fuel per specifications in the latest revision of Service Instruction No. 1070.

H. Cleaning materials:

(1) Methyl-ethyl-ketone (MEK)

(2) Acetone

(3) Wood alcohol

(4) Naptha

(5) Hoppes #9 gun cleaning solvent

(6) Lint-free wipes

(7) Mineral spirits or equivalent.

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. After all inspections and maintenance tasks are complete, install the engine. Refer to the IO-540-AG1A5 Series 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 IO-540-AG1A5 Series Engine 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 A TEST CLUB IS NOT AVAILABLE, USE THE REGULAR FLIGHT PROPELLER. IF THE FLIGHT PROPELLER IS USED, MONITOR THE CYLINDER HEAD TEMPERATURE.

E. Use a test club during the operational ground check.

F. Put the aircraft in a position against the wind.

G. Start the engine and complete the Pre-Flight Test. Refer to the IO-540-AG1A5 Series Engine Installation and Operation Manual

6. Idle Speed Mixture Adjustment

NOTICE: The fuel injectors have an adjustment knob to adjust the idle speed. There is also an idle mixture adjustment knob and air bleed adjustment kob on the throttle body to adjust the idle speed. Refer to Figure 2.

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 IO-540-AG1A5 Series Engine Installation and Operation Manual.

(2) Complete the magneto drop check on engine start-up in accordance with instructions in the IO-540-AG1A5 Series Engine Installation and Operation Manual.

(3) Set the throttle stop screw to let the engine idle at the aircraft manufacturer's recommended idling rpm speed.

NOTICE: New, rebuilt of overhauled engines or fuel controls must be set to 50 to 100 rpm higher than normal for the first 25 hours of operation - then adjusted to normal after the first 25 hours of operation.

(4) To adjust the idling speed to the desired rpm:

(a) 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

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stop. Steadily move the mixture control lever to the FULL RICH position - while monitoring the tachometer.

(b) An increase of more than 50 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.

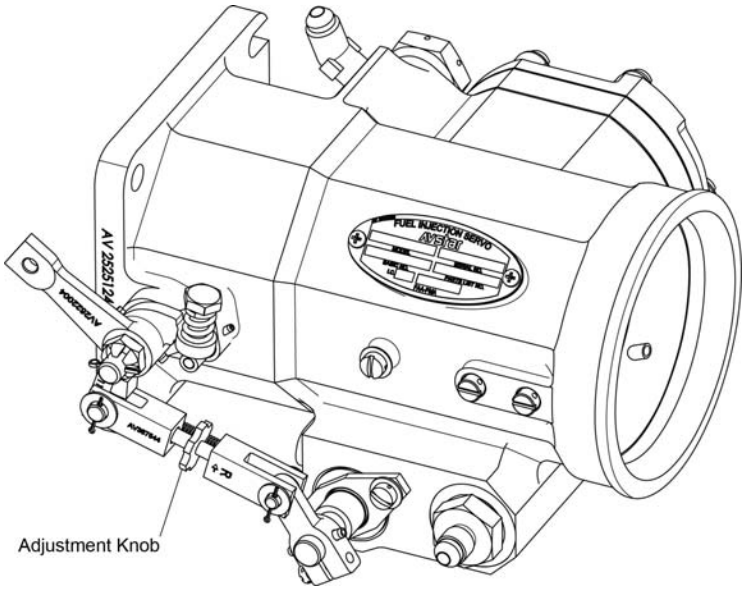
If the idle mixture is too lean:	If the idle mixture is too rich:
Turn the scalloped wheel (Figure 2) at the side of the fuel injector toward ***"R"*** for ***Rich***.	Turn the scalloped wheel at the side of the fuel injector (Figure 2) toward ***"L"*** for ***Lean***.
Turn the idle mixture adjustment knob on the throttle body in the direction to ***enrich*** the fuel mixture.	Turn the idler mixture adjustment knob on the throttle body in the direction ***lean*** the fuel mixture.
Turn the idle air bleed adjustment knob ***clockwise***.	Turn the idle air bleed adjustment knob ***counterclockwise***.

NOTICE: Run-up the engine to 2000 rpm to clear the engine each time you turn any of the idle mixture adjustment knobs to adjust the idle speed mixture.

(5) 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 50 rpm.

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

(7) 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.



Idle Speed Adjustment Knob on the Fuel Injector
Figure 2

7. Fuel Flow Check

   A. Disconnect the fuel lines and remove the nozzles from the cylinders.

   B. Attach the nozzles to the fuel lines and direct the nozzles into six clear containers of equal size.

   C. Put all six containers on a flat surface.

   D. Turn the boost pump on and move the throttle and mixture control full forward.

   E. Let approximately 4 to 6 oz. (120 to 180 ml) of fuel to flow into each container. Close the throttle and mixture control and turn off the boost pump.

   F. Measure the level of the fuel. All containers must have the same amount of fuel. A container with less fuel is an indication of a restriction.

8. 100-Hour 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 worn or damaged 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.

9. Return to Service Procedure

   Before returning 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 IO-540-AG1A5 Series 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 IO-540-AG1A5 Series 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 stripped and the bolts are torqued correctly. Replace any hardware that is distorted or has stripped threads. Refer to the latest revision of the Table of Limits, SSP-1776 for torque values.

4. Propeller Oil Control Leak Test Procedure

   A. The purpose of this air pressure leak test is to identify any leaks, blockages (tight clearance) or openings (excessive clearance) of the propeller governor oil passages.

   B. Complete this leak test procedure (with the propeller installed on the engine) if any of the following conditions occur:

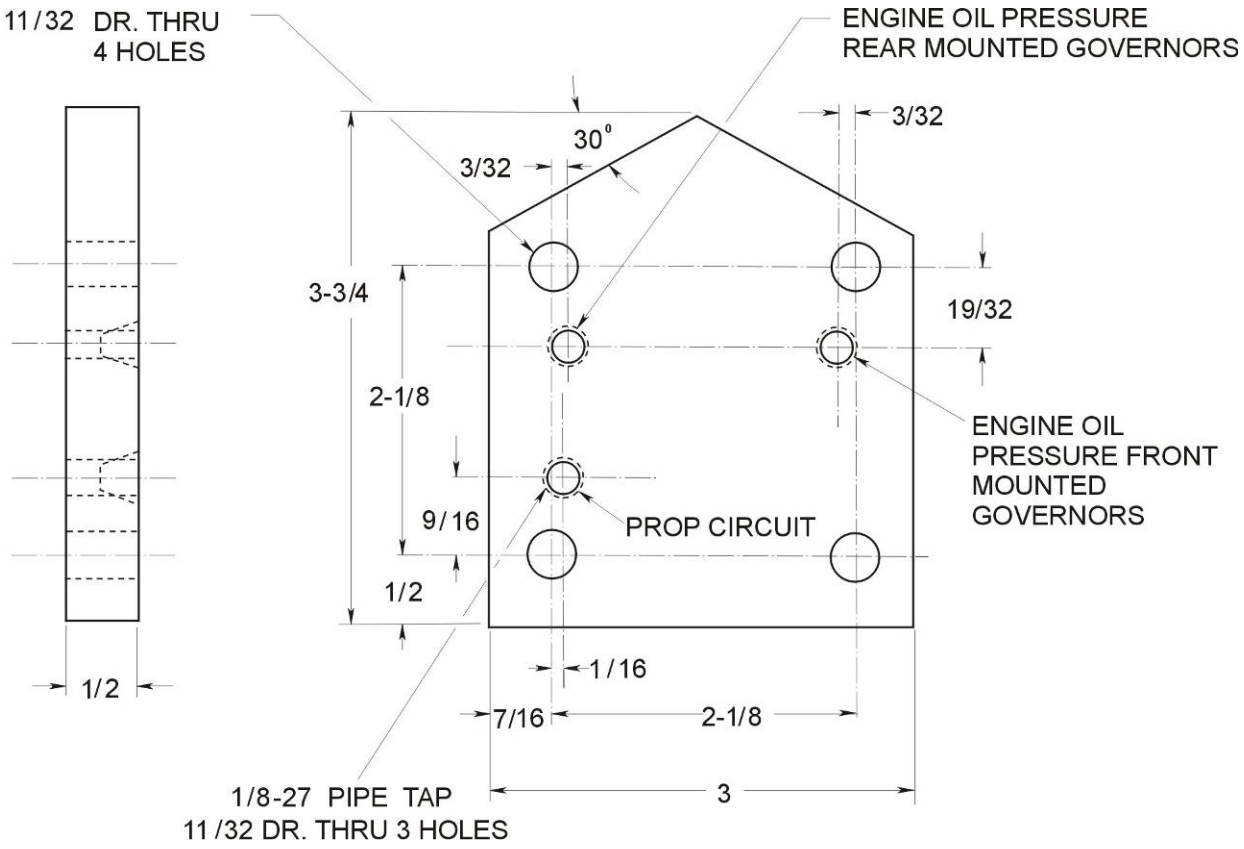
      — Sluggish propeller operation
      — Engine does not hold rpm during cruise, climb, or descent
      — Engine goes into feather during landing rollout with decreased power control setting.

      (1) Remove the propeller governor from the engine.

NOTICE: In the following steps, to prevent an air leak, use governor gasket P/N 72053 with test plate P/N ST-483. Refer to the latest revision of Service Instruction No. 1462 for any updates.

(2) Front mounted governors: Install the gasket and the test plate P/N ST-483, or equivalent on the governor pad with the air fitting in alignment with the governor oil passage that goes to the front bearing (forward hole) or left side of the mounting facing the pad. Refer to Figure 1.

(3) Rear mounted governors: Install the test plate with the left side bottom hole on the test plate at the front bearing and crankshaft transfer tube. Refer to Figure 1.



ST-483 Test Plate
Figure 1

(4) Connect a calibrated oil pressure gauge (0 to 100 psi) (0 to 689 kPa) to the engine oil pressure port on the test plate. Install a plug as a cap on the propeller circuit port.

(5) Start and warm-up the engine until the oil temperature is in the green.

NOTICE: The oil pressure must not be more than 5 psi (34 kPa) below the green arc when the engine rpm is in the usual operating range.

(6) With the engine OFF, remove the plug from the propeller circuit port and install a differential pressure measuring device at the propeller circuit fitting on the test plate.

(7) Apply shop air to the differential pressure regulator and adjust it to 40 psi (276 kPa) on the first gauge. With the engine at operating temperature, the pressure reading on the second gauge should read 6 to 35 psi (41 to 241 kPa), if the system is operating correctly. Refer to Figure 2.

C. Upon completion of the test, assemble in accordance with the aircraft manufacturer's instructions.

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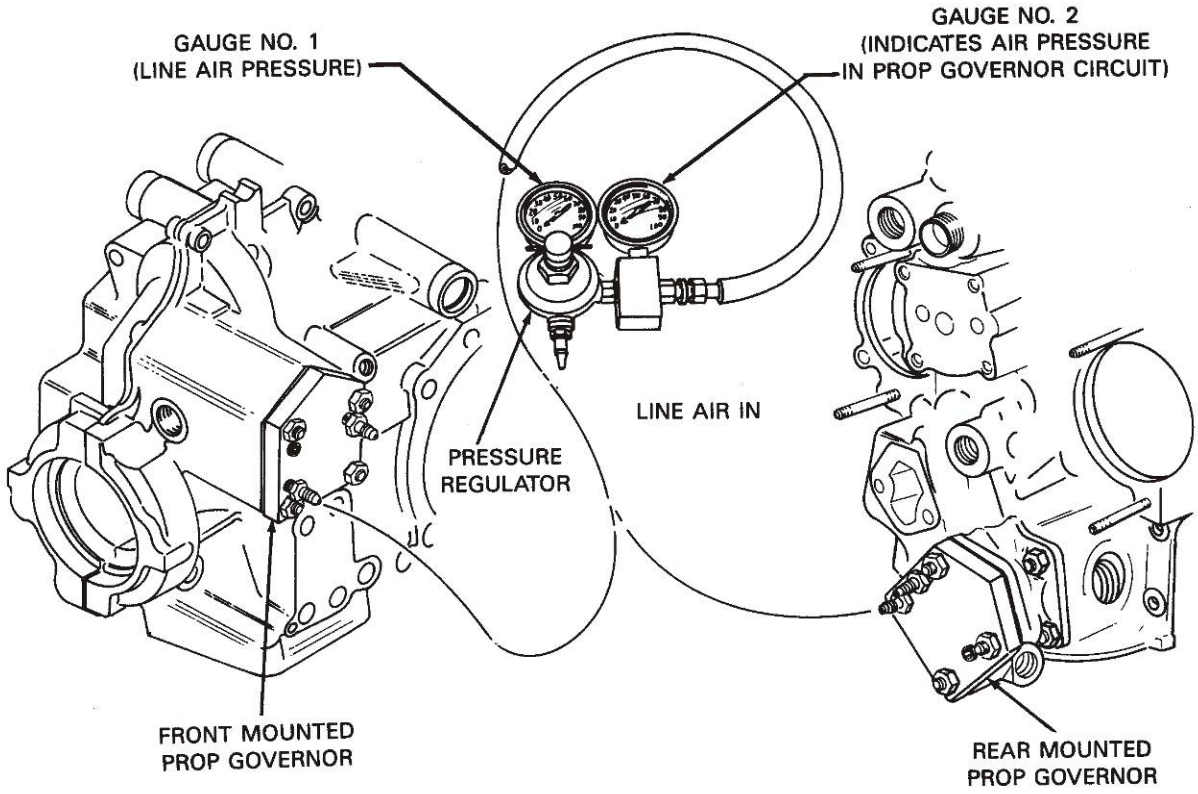
NO. 1 GAUGE	40 psi in. (276 kPa)	
NO. 2 GAUGE	6 psi to 35 psi (41 to 241 kPa)	ACCEPTABLE
	Above 35 psi (241 kPa)	NOT ACCEPTABLE
	Below 6 psi (41 kPa)	NOT ACCEPTABLE



Propeller Governor Circuit Testing
Figure 2

5. Crankshaft-to-Camshaft Timing Check
   A. Make sure the ignition and all electrical switches are OFF.
   B. Disconnect all spark plug leads.
   C. Disconnect the starter.
   D. Remove the top spark plug on Cylinder 1.
   E. Remove the rocker box cover on Cylinder 2.
   F. Turn the engine to Top Dead Center (TDC) on the compression stroke on Cylinder 1.
   G. Monitor the movement of the intake and exhaust valves in Cylinder 2 as you turn the engine just past TDC.
   H. The crankshaft-to-camshaft timing is correct if the intake valve and the exhaust valve in Cylinder 2 must begins to close as the intake valve starts to open as the piston in Cylinder 1 goes over TDC on compression. If the simultaneous opening and closing of the intake and exhaust valves just past TDC does not occur, the crankshaft-to-camshaft timing must be corrected. Remove the accessory housing and correct the timing.

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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
Exhaust Valve and Guide Inspection	After every 1000 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, 400-Hour, and 1000-Hour Engine Inspection Checklists as records of inspection and any corrective action in the engine logbook.

2. Visual Cylinder Inspection Procedure

   A. Examine the cylinder and cylinder head thoroughly for cracks, leaks, rust, pitting and/or damage. Replace a damaged, rusted, pitted, leaky or cracked cylinder. Refer to the Direct Drive Overhaul Manual.

   B. Look for loose or damaged studs. Replace with 0.003, 0.005,.0.007, or 0.012 in. (0.076, 0.127, 0.178, or 0.305 mm).

   C. Look for loose or damaged spark plug Heli-coil inserts. Replace with oversize insert.

   D. Look for cracked or broken fins and baffles. If a cooling fin adjacent to the exhaust port flange is cracked, a 3/16 in. (4.76 mm) diameter hole can be drilled as a stop, providing:

      — 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

      — Refer to the Direct Drive Overhaul Manual for the maximum removal.

      — 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. (12.70 mm) radius; or

      — There is no more than one crack per fin and its depth is not longer 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.

      (1) If a cooling fin is damaged, broken or bent, the bent area must not exceed 3/8 in. (9.53 mm) nor be 3/8 in. (9.53 mm) deep, or:

         (a) There cannot be more than four blended fins on the push rod side of the head, or

         (b) No more than six blended fins on the anti-push rod side of the head.

3. Cylinder Compression Check Procedure

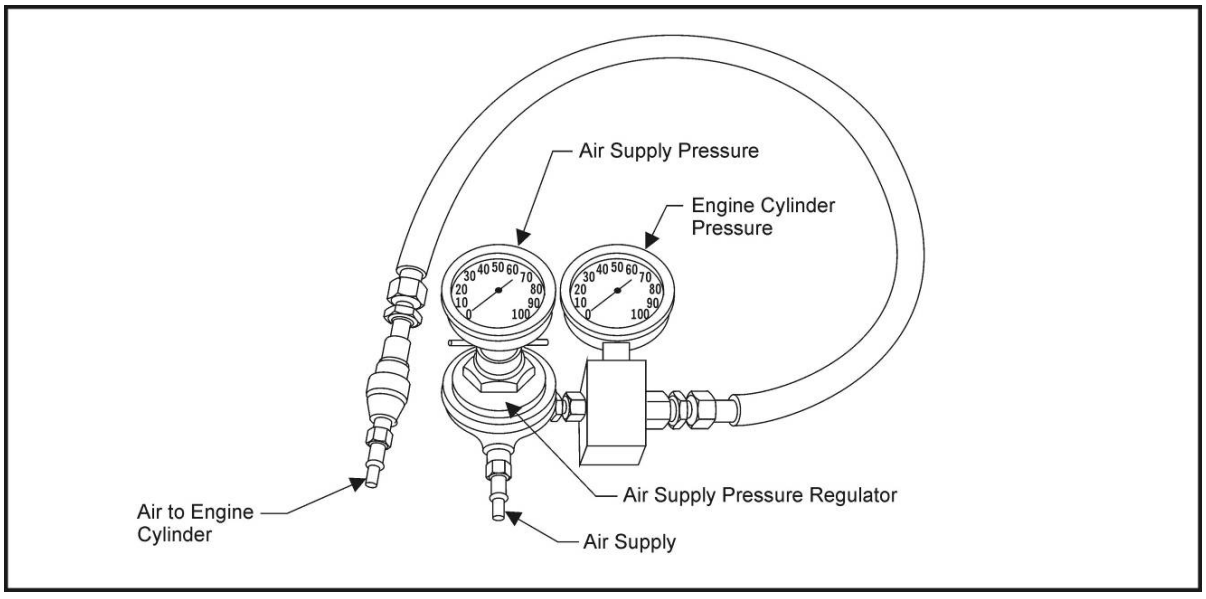
   A. The Cylinder Compression Check is done on an installed engine and measures pressure leakage through the combustion chamber using a regulated pressure source and tester. It is essentially a cylinder leak-check procedure as an initial inspection of the condition of the engine cylinders. This procedure 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 if the engine has any of these conditions:

      — 100 hours of engine operation or annual inspection (whichever occurs first)
      — Loss of power or unsteady power
      — Difficulty starting
      — Increased oil consumption
      — Other indications of unusual operation.

   C. A differential compression tester (Figure 1) 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 setting, worn piston rings, damaged pistons or damaged cylinders. The static leak rate give indication of the condition of the parts in the combustion chamber. The leak rate is measured when pressure is dropped.

      NOTICE: The orifice size of the differential compression tester is critical for consistent and accurate cylinder analysis. A specific orifice size of 0.040 in. (1.016 mm) dia. (No. 60 drill) x 0.250 in. (6.35 mm) long, with entrance angle of 59°/60° supplies an acceptable calibrated leak rate. Larger orifice sizes can decrease the ability to identify problems.



Example of a Differential Compression Tester
Figure 1

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(1) All differential compression testers must agree with these specifications:
— 0.250 in. (6.35 mm) long restrictor orifice
— 0.040 in. (1.016 mm) ID (No. 61 drill) orifice diameter
— 60° entrance angle.

(2) Regularly clean and complete a check of the differential compression tester for accuracy.

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

(4) Differential Compression Test Equipment Check:

(a) Close the shut-off valve.

(b) Make sure the regulated pressure is 80 psi (552 kPa).

(c) Make sure that the cylinder pressure gage shows 80 psi (± 2 psi) (552 kPa (± 14 kPa)), while it keeps the regulated pressure at 80 psi (552 kPa) for at least 5 seconds.

(d) If the differential compression tester fails this check, replace the tester.

D. Procedure

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

NOTICE: This check must be done while the cylinder is still warm and done without interruption.

(1) Immediately before the Cylinder Compression Check:

(a) Operate the engine until the engine is at operating cylinder head and oil temperatures.

(b) Make sure the magneto switches are operating correctly as per the airframe manufacturer's operating instructions.

(c) Close the throttle and put the power control in the IDLE CUT-OFF position.

(d) Move the ignition switch to the OFF position to shut down the engine.

(e) Make sure that the magneto switches and fuel supply switches are all in the OFF position.

(f) Make sure the "P" lead connections are secure.

(g) Make sure the throttle is in the CLOSED position and that the mixture control is in the IDLE-CUT-OFF position.

(h) After the engine is shut down, complete the compression check immediately to get an accurate measurement.

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

⚠ **CAUTION:** TAKE ALL NECESSARY PRECAUTIONS AGAINST ACCIDENTAL FIRING OR ROTATION OF THE CRANKSHAFT.

(2) Disable power to the engine.

⚠ **CAUTION:** IGNTION LEADS AND SPARK PLUGS ARE VERY HOT. WEAR PERSONAL PROTECTIVE GEAR. USE CARE TO PREVENT BURNS.

(3) Disconnect all of the spark plugs leads. Refer to Chapter 74-20.

(4) Remove the top spark plug from each cylinder. Refer to Chapter 74-20.

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

(5) Rotate the crankshaft by hand in the direction of propeller rotation to put the piston in a position as close to top dead center 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 CONNECTING 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 ROTATE. KEEP CLEAR OF THE ROTATIONAL RADIUS OF THE PROPELLER.

(8) Connect the differential compression tester to the adapter in the spark plug hole of the engine cylinder.

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

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

(9) Adjust the regulator of the compression tester to 80 psi ± 2 (552 kPa ± 14 kPa) on the regulated pressure gage. The cylinder pressure gage must also show 80 psi ± 2 (552 kPa ± 4 kPa) for at least 5 seconds.

(10) While one mechanic holds the propeller stationary, the other mechanic applies pressure in the next step to the engine cylinder.

⚠ **WARNING:** WEAR PROTECTIVE GEAR AND HOLD THE PROPELLER FIRMLY TO PREVENT CRANKSHAFT ROTATION WHEN AIR PRESSURE IS APPLIED THROUGH THE DIFFERENTIAL COMPRESSION TESTER TO THE COMBUSTION CHAMBER.

⚠ **WARNING:** IN THE NEXT STEP, USE CARE WHEN OPENING THE CYLINDER PRESSURE VALVE ON THE DIFFERENTIAL COMPRESSION TESTER. PENT-UP AIR PRESSURE IN THE CYLINDER COULD CAUSE THE CRANKSHAFT TO ROTATE.

⚠ **WARNING:** AS A PRECAUTION, DO NOT STAND OR ALLOW ANYONE TO STAND IN THE ROTATIONAL RADIUS ARC OF THE PROPELLER.

(11) 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).

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(12) Listen for escaping air. If escaping air heard, refer to Table 4 to identify and correct the cause.

(13) Continue to rotate 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 rotate the propeller.

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

(14) With the piston at TDC, secure the propeller blades; slowly open the cylinder pressure valve completely. Gradually increase the 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 until the cylinder pressure is at 80 psi (552 kPa).

(15) Record the pressure value on the cylinder pressure gage. The difference between the cylinder pressure and the pressure shown on the regulator pressure gage is the amount of leakage through the cylinder.

(16) Calculate the difference between the pressure on the cylinder pressure gage and the regulator pressure gage. The maximum approved leakage is 60/80, which is 25% of the 80 psi (552 kPa) regulated pressure.

(17) Turn off the air pressure 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.

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

(19) Refer to the section “Cylinder Inspection Results Analysis and Corrective Action” in this chapter. Review and analyze the results, identify and take any necessary corrective action.

(20) Record the results of the Cylinder Compression Check for each cylinder and any corrective action taken in the engine logbook and on the 100-Hour Inspection Checklist.

(21) After all maintenance is complete, install the spark plugs. Refer to Chapter 74-20.

4. Visual Baffle Inspection

A. This inspection is done during the 100-hour or annual inspection to look for premature cylinder deterioration and to make sure that baffles are correctly fitted and installed. The baffles decrease heat transfer. Efficient and reliable operation of cooling baffles is necessary to prevent rapid deterioration of the cylinders and other engine components because of the heat transfer in piston engines. That is why it is important to make sure that the baffles are installed, intact, and operating correctly.

B. Visual Baffle Inspection Procedure

(1) Examine the baffle and surrounding components for holes, cracks, wear, deterioration, and incorrect position.

(2) Repair or replace worn, cracked or deteriorated baffles.

(3) Correct the baffle position if necessary.

5. Cylinder Borescope Inspection Procedure

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

⚠WARNING: 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 TO THE TOUCH.

NOTICE: The cylinder borescope inspection must be done before cylinder removal as confirmation of conditions found during the visual, physical and dimensional inspection.

A. The cylinder borescope inspection is done to examine the inner walls of cylinders for rust, deposits and unusual wear patterns of the combustion chamber, valve, piston top, and the cylinder barrel. The cylinder walls and rings usually show wear in the high pressure and high temperature combustion portions of the cylinder.

B. The AUTOSCOPE™ is used for the borescope inspection.

C. When to complete the cylinder borescope inspection:

(1) Before cylinder removal

(2) If oil consumption is excessive

(3) 400-hour inspection

(4) After an engine overspeed.

D. Cylinder Borescope Inspection

(1) Remove the upper spark plug from each cylinder. Refer to Chapter 74-20.

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

(3) Put the borescope through the upper vacant 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.

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

(5) Put the borescope probe through the upper spark plug hole and examine the intake valve and intake valve seat in accordance with Table 2 which includes inspection steps, borescope results and corrective action.

(6) Record all results and corrective action in the engine logbook and the 400-Hour Inspection Checklist.

Table 2
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	Remove the engine cylinder for repair*

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Table 2 (Cont.) Borescope Inspection Steps, Results and Corrective Action		
Inspection Step	**If these are the results…**	**Take this corrective action…**
Examine spark plug Heli-coils for protrusion into the combustion chamber	Spark plug Heli-coil protrudes into combustion chamber	Remove the engine cylinder for repair*
Look for carbon deposits and excess oil	Heavy carbon deposits and excessive oil	Remove the engine cylinder for repair*
Look for discoloration on the circumference of the exhaust valve face	Discoloration on the circumference of the exhaust valve face	Remove the engine cylinder for repair or replace the engine cylinder*
Look for cracks and erosion on the exhaust valve face	Cracks on the exhaust valve face Erosion on the exhaust valve face	Remove the engine cylinder for repair or replace the engine cylinder*
Look for discoloration on the circumference of the intake valve face	Discoloration on the circumference of the intake valve face	Remove the engine cylinder for repair or replace the engine cylinder*
Look for cracks and erosion on the intake valve face	Cracks on the intake valve face Erosion on the intake valve face	Remove the engine cylinder for repair or replace the engine cylinder*
Examine the cylinder bore for scoring, rubbing, or corrosion	Scoring or piston rub or corrosion on cylinder bore	Remove the engine cylinder for repair or replace the engine cylinder*
Look for excessive oil in the cylinder	Excessive oil in the cylinder	Remove the engine cylinder for repair*
Look for deposits in the cylinder	Deposits in the cylinder	Remove the engine cylinder for repair*
Examine the piston crown for erosion or damage	Erosion or damage on piston crown	Remove the engine cylinder for repair*
* Refer to the Direct Drive Overhaul Manual.		

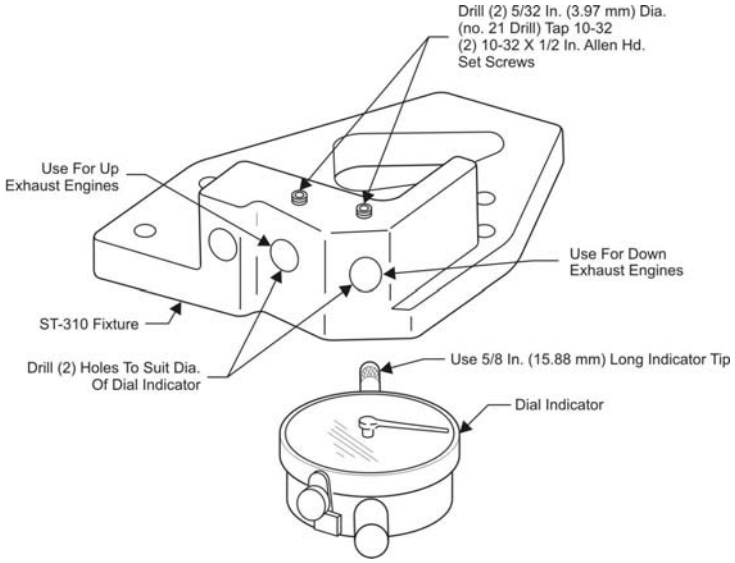
6. Exhaust Valve and Guide Inspection

   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. 388 and Service Instruction No. 1485 for additional details.

NOTICE: The ST-310 fixture is available from Lycoming Engines and is used to examine angular-type valves on engine cylinder. Although the ST-310 fixture and a feeler gage can be used to measure valve stem movement, a modified ST-310 fixture (Figure 2) and a dial indicator are a faster and easier means to measure valve stem movement, valve guide wear, and carbon build-up as per the procedure below. Figure 2 shows how to modify the ST-310 fixture for use with a dial indicator.

NOTICE: A GO/NO-GO gage also can be used for exhaust valve inspection. Refer to the section "Exhaust Valve Inspection Using a GO/NO-GO Gage" in this chapter.



Details for Modification of ST-310 Fixture for Use with a Dial Indicator (Angle Valve Cylinders)
Figure 2

A. Examine the exhaust valve and guide as follows:

(1) Disconnect power to the engine.

(2) Make sure the engine is cool to the touch.

(3) Remove the rocker box cover and gasket from the cylinder head. Discard the gasket.

(4) Identify each valve train part by cylinder for reference on assembly.

(5) Push out the valve rocker shaft.

(6) Remove the exhaust rocker arm and rotator cap.

⚠ **CAUTION:** DO NOT MIX PLUNGER OR LIFTER ASSEMBLIES WITH DIFFERENT PART NUMBERS IN THE SAME ENGINE. THE DIFFERENT LEAK DOWN RATES WILL CAUSE INCORRECT ENGINE OPERATION.

NOTICE: Identify the location of each tappet assembly that is removed for reference on assembly. Refer to the latest revision of Service Instruction No. 1011 for details on tappets and inspections.

(7) Refer to the Direct Drive Overhaul Manual.

(a) Remove all of the push rods, shroud tubes and hydraulic tappet assemblies (Figure 3).

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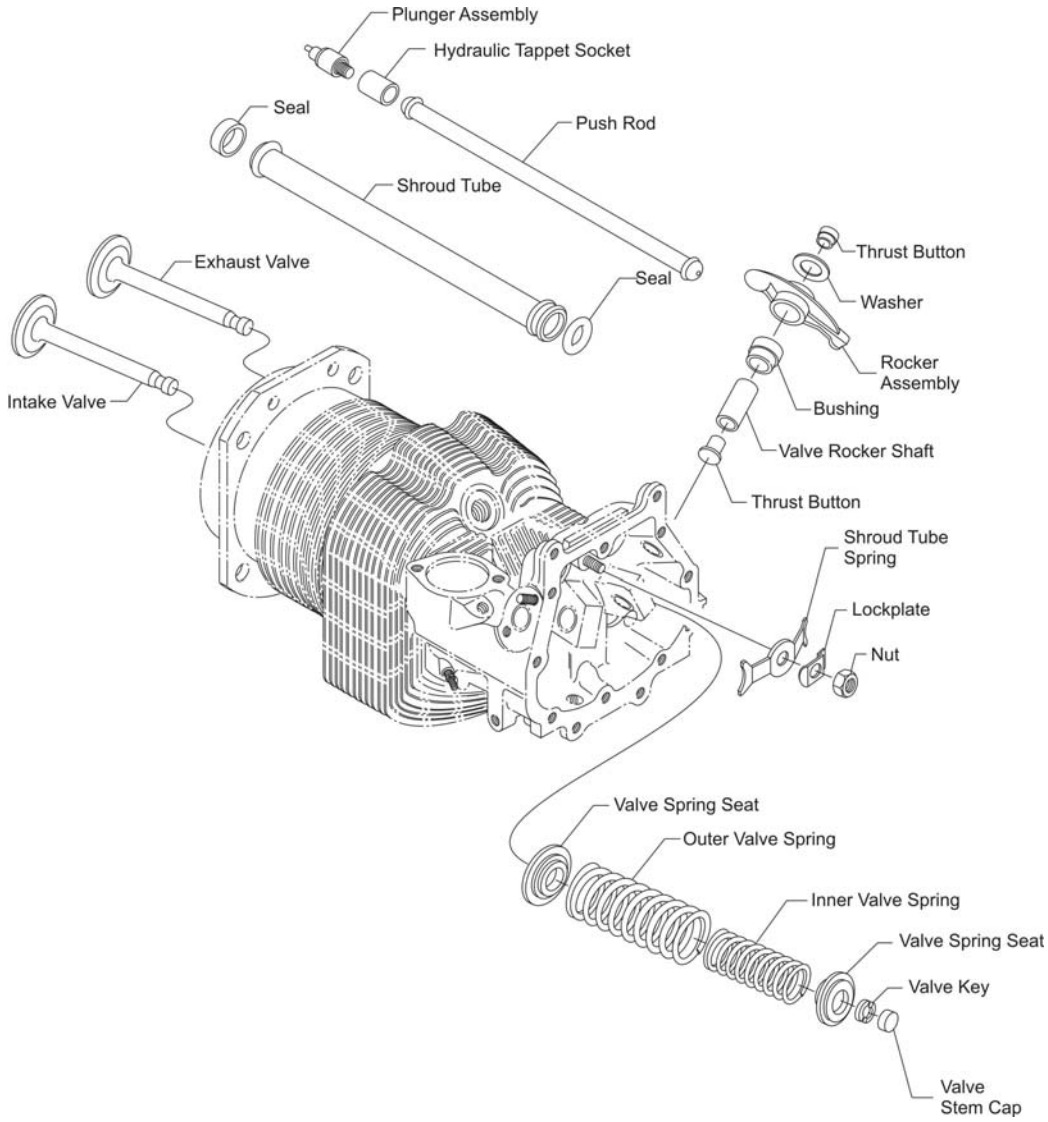
(b) If tappet assemblies are not to be replaced, disassemble each tappet assembly and clean it.



Valve Components
Figure 3

(8) Use a cloth dampened with mineral spirits solvent to wipe the oil from the top surface of the spring retainer.

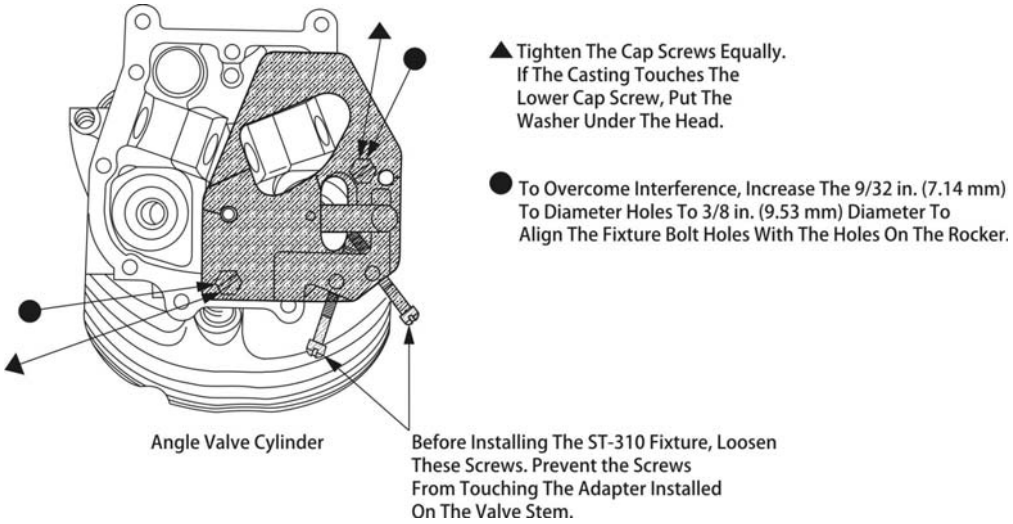
NOTICE: It is not necessary to remove the valve retainer keys from this type of valve stem.

(9) Loosen screws shown in Figure 4 to prevent the screws from touching the adapter installed on the valve stem.

(10) Install the ST-310 fixture on the valve on the cylinder head. Refer to Figure 4 for fixture installation.

(11) Tighten the cap screws equally. If the casting touches the lower cap screw, put the washer under the head,

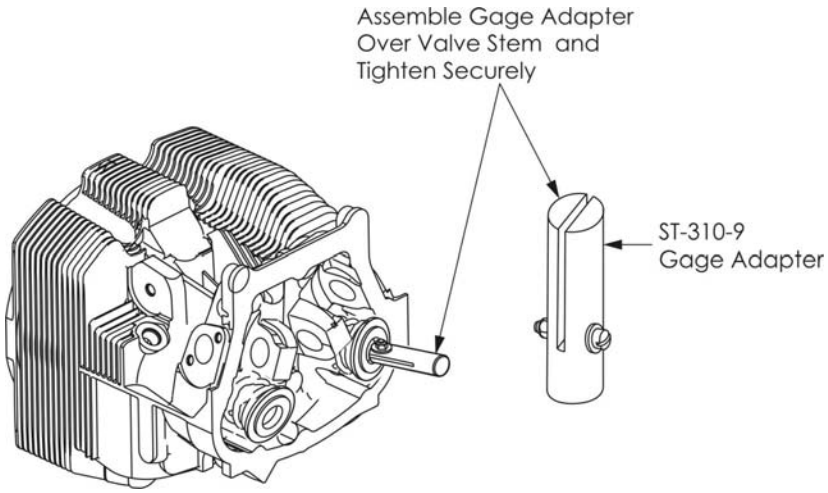
(12) Measure stem movements by moving the valve stem along the valve guide wear line (inside diameter of the valve guide, parallel to the centerline of the rocker arm).



Compressor Plate Installed on Cylinder
Figure 4

(13) Install the gage adapter, ST-310-9, over the top of the valve stem (Figure 5). Make sure it is tight.

NOTICE: If you can move the adapter on the valve stem with your hand, it is incorrectly attached.



Gage Adapter Assembled on Exhaust System
Figure 5

(14) Loosen the adjustable self-locking set screws (on the ST-310 fixture) counterclockwise to prevent the screws from touching the adapter post attached to the valve stem.

(15) After assembly of the valve stem and adapter, push them against the upper spring retainer as far as they will go.

(16) Put the blade of a screwdriver in the area between the exhaust valve spring and ST-310 fixture as shown in Figure 6

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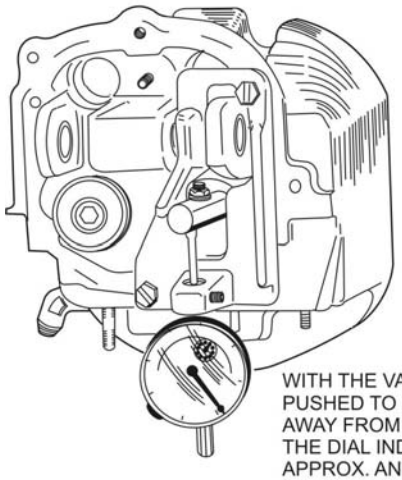
(17) Push the valve and adapter at the maximum distance away from the dial indicator as shown in Figure 6.



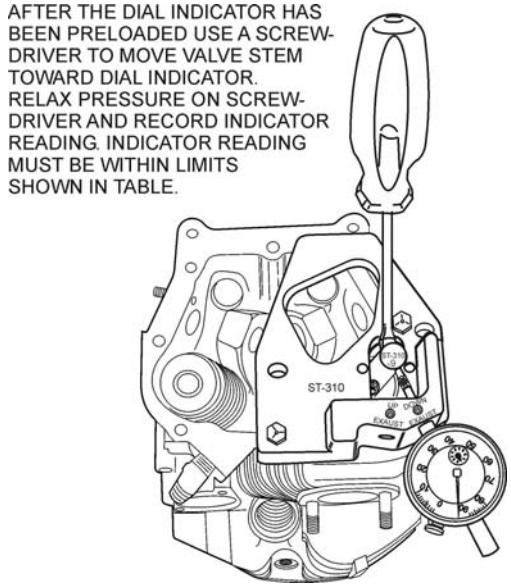
Dial Indicator in Position to Check Valve Guide Clearance
Figure 6

(18) 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.

(19) Adjust the dial of the indicator to read "0" (zero) as shown in Figure 6.

(20) Insert the screwdriver between the ST-310 fixture and valve spring on the opposite side and push the valve spring toward the dial indicator as shown in Figure 7.

(21) Relax pressure on the screwdriver and record the reading on the dial indicator. The measurement must be within the specified limits in Table 3.



Pushing Valve Stem and Adapter Post Toward Dial Indicator to Establish Valve Guide Condition
Figure 7

Table 3 Acceptable Valve Clearance Limits					
Valve Guide Inner Diameter		Recommended Permitted Stem Movement			
		Minimum Clearance		Maximum Clearance	
in.	mm	in.	mm	in.	mm
0.4995/.5005	(12.687/12.713)	0.015	0.381	0.030	0.762

(22) If the valve stem movement is more than the maximum distance in Table 3, replace the valve and guide. Refer to the Direct Drive Overhaul Manual.

EXAMPLE 1:

0.019 in. (0.483 mm) = Total thickness of gages to measure valve movement.

-0.010 in. (0.254 mm) = Thickness of gage used as a starting dimension.

0.009 in. (0.229 mm) = Amount the valve stem has moved and is an indication of insufficient clearance between the valve stem and valve guide. This clearance can be corrected by reaming the inner diameter of the valve guide to remove carbon deposit build-up.

EXAMPLE 2:

If 0.038 in. (0.965 mm) clearance is measured, then the valve stem movement is 0.028 in. (0.711 mm).

0.038 in. (0.965 mm)

-0.010 in. (0.254 mm)

0.028 in. (0.711 mm)

This measurement in Example 2 is an indication that wear on the inside diameter of the valve guide is below the maximum limit and the valve guide is acceptable for further service.

NOTICE: If valve stem movement is more than the maximum clearance in Table 3, replace the valve and guide. Refer to the Direct Drive Overhaul Manual.

(23) Rotate the piston to near its top end of travel.

(24) Remove the gage adapter from the valve stem.

(25) Loosen each of the cap screws (Figure 4) in small equal increments to decrease pressure on the valve spring slowly and equally.

(26) Remove the ST-310 fixture from the cylinder.

(27) Install the push rod (Figure 3) into the shroud tube.

(28) Install the shroud tube and hydraulic tappet assembly.

(29) Install the exhaust rocker arm and rotator cap.

(30) Install the valve rocker shaft.

(31) Install the rocker box cover and gasket on the cylinder head.

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

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(33) Refer to the Direct Drive Overhaul Manual.

(a) Install the tappet assemblies, shroud tubes, push rods, valve rotator caps (if required), rocker arms and shafts with new seats and gaskets (Figure 3).

(b) Measure the dry tappet clearance as follows:

1 Press in on the push rod end of valve rocker.

2 Measure the clearance between the end of the valve rocker and valve stem tip, using a valve clearance gage.

3 Refer to the latest revision of the Table of Limits, SSP-1776 for dry or unleaded clearance limits.

NOTICE: If all parts are installed correctly, the dry tappet clearance will not change.

(34) Record all of the results and repairs in the engine logbook and the 100-Hour Inspection Checklist.

(35) Refer to Table 4 in the section "Cylinder Inspection Results Analysis and Corrective Action" in this chapter to identify any necessary corrective action.

7. Exhaust Valve Inspection Using a GO/NO-GO Gage

NOTICE: Use a GO/NO-GO Gage either with a "GO" Gage end of 0.4995 in. (12.6873 mm) or sized in accordance to the latest revision of the Table of Limits, SSP-1776 in proportion to hours on the engine.

A. Complete these initial tasks:

(1) Disconnect all power to the engine.

(2) Make sure the engine is cool to the touch.

(3) Remove the top spark plugs (or if compressed air is going to be used to hold the exhaust valve, remove only one spark plug from the cylinder head).

(4) Remove the exhaust manifold in accordance with instructions in the Direct Drive Overhaul Manual.

NOTICE: Complete the proceeding steps on one engine cylinder at a time.

(5) Remove the rocker box cover and gasket from the engine cylinder. Discard the gasket.

⚠ **CAUTION:** IDENTIFY BY CYLINDER AND VALVE LOCATION THE EXHAUST VALVE COMPONENTS AS THEY ARE DISASSEMBLED FOR REFERENCE ON ASSEMBLY TO MAKE SURE THAT EACH PART IS INSTALLED IN EXACTLY THE SAME LOCATION FROM WHICH IT WAS REMOVED. EXAMINE THE VALVE STEM KEYS WHICH TEND TO WEAR IN UNIFORM DISTINCTIVE PATTERNS. REPLACE WORN OR DAMAGED VALVE STEM KEYS. IF THE KEYS DO NOT NEED TO BE REPLACED, THEY MUST BE INSTALLED IN THE SAME POSITION AS THEY WERE REMOVED.

B. Remove the rocker shaft, rocker arm, valve stem cap, push rod, shroud tube, and tappet socket (Figure 3). Remove and discard the shroud seals. Refer to the Direct Drive Overhaul Manual.

C. Rotate the propeller to position the piston at the bottom center.

D. To hold the exhaust valve in position:

(1) Put approximately 8 feet (2.4 m) of 3/8 in. (9.5 mm) nylon rope through the spark plug hole. As an alternate technique for holding the valve in position, use shop air pressure and a compression check fitting.

(2) Turn the crankshaft until the piston moves the rope snuggly against the exhaust valve.

⚠ **CAUTION:** THE PISTON IS HELD AT BOTTOM DEAD CENTER BY FIRMLY HOLDING THE PROPELLER TO PREVENT THE ENGINE FROM TURNING WHEN AIR PRESSURE IS APPLIED TO THE COMBUSTION CHAMBER.

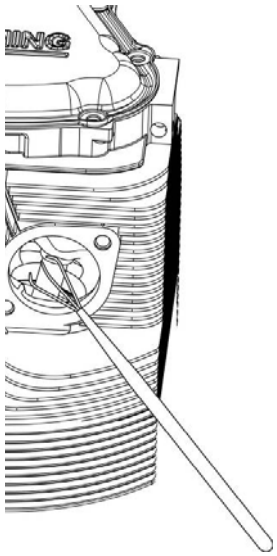
⚠ **CAUTION:** USE GLOVES OR RAGS TO PROTECT YOUR HANDS WHILE HOLDING THE PROPELLER BLADE.

⚠ **CAUTION:** ALSO, BEFORE ATTACHING THE COMPRESSED AIR, MAKE SURE THE AIR PRESSURE TO THE CYLINDER IS NOT EXCESSIVE. AIR PRESSURE IN THE CYLINDER CAN CAUSE THE PROPELLER TO TURN. KEEP CLEAR OF THE ARC RADIUS OF THE PROPELLER BLADES.

E. Compress the exhaust valve spring and remove the valve keys. (The rope or air pressure that had been in the combustion chamber is a base to support the exhaust valve in the event the valve keys tend to stick.)

F. Either remove the nylon rope or bleed off air.

G. Start to push the exhaust valve from its guide. Just as the valve stem is nearly free from the guide, use mechanical pick-up fingers through the spark plug holes and/or exhaust ports as shown in Figure 8 to prevent the valve stem for falling into the cylinder.



Mechanical Fingers Holding Valve Stem
Figure 8

H. Use the applicable GO/NO-GO Gage to examine the valve guide for wear or carbon build-up as follows:

(1) If the valve guide is acceptable, the GO/NO-GO Gage will not enter the valve guide at all. The inner diameter of the exhaust valve guide is 0.5000 in. (12.7000 mm); the gage size of the "GO" end of the GO/NO-GO Gage is 0.4995 in. (12.6873 mm).

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(2) If the GO/NO-GO Gage partially enters the valve guide or if there is a friction rub, ream the guide to the dimensions in the latest revision of the Table of Limits, SSP-1776.

(3) If the GO/NO-GO Gage completely enters inside the valve guide, the valve guide is worn and must be replaced in accordance with the Direct Drive Overhaul Manual.

⚠ **CAUTION:** USE CARE IN THE NEXT STEP TO INSTALL THE EXHAUST VALVE INTO THE VALVE GUIDE. DO NOT USE THE CYLINDER PISTON TO PUSH THE EXHAUST VALVE THROUGH THE VALVE GUIDE. MAKE SURE THAT THE EXHAUST VALVE IS INSTALLED WITHIN THE VALVE GUIDE STRAIGHT AND NOT IN A COCKED POSITION. INCORRECT POSITIONING OF THE EXHAUST VALVE CAN CAUSE DAMAGE TO THE VALVE AND/OR THE GUIDE. ONLY INSTALL AN ACCEPTABLE EXHAUST VALVE INTO AN ACCEPTABLE VALVE GUIDE.

I. Use a magnetic pencil and flexible mechanical fingers to install the tip of the exhaust valve in the valve guide.

NOTICE: Make sure the valve spring and valve spring seats are acceptable. If these parts are not acceptable, replace them in accordance with the Direct Drive Overhaul Manual.

J. Install the exhaust valve spring and valve spring seats in the same position as when they were removed.

NOTICE: Make sure the valve keys are acceptable. If the valve keys are not acceptable, replace the valve keys in accordance with the Direct Drive Overhaul Manual.

NOTICE: If the exhaust valve slides down the valve guide when the valve spring is compressed, install the nylon rope or use the compressed air as in previous steps to hold the exhaust valve in place.

K. Compress the valve spring and install the valve keys in their respective position.

L. Remove the hydraulic lifter. Clean and examine the hydraulic lifter in accordance with the Direct Drive Overhaul Manual and/or the latest revision of Service Instruction No. 1011.

M. Clean the inside diameter of the tappet body and install the hydraulic lifter.

⚠ **CAUTION:** DURING REASSEMBLY, THE VALVE TRAIN COMPONENTS MUST BE INSTALLED IN THEIR ORIGINAL LOCATION. ALL PARTS MUST BE IN ALIGNMENT FOR CORRECT DRY TAPPET CLEARANCE. MISALIGNMENT OF COMPONENTS CAN CAUSE ENGINE DAMAGE.

N. Install the tappet socket, shroud tube with new shroud seals, push rod, valve stem cap, rocker arm and rocker (Figure 3) shaft on the engine cylinder with fastening hardware in accordance with the Direct Drive Overhaul Manual.

O. Set the dry tappet clearance in accordance with the latest revision of the Table of Limits, SSP-1776.

P. Install the rocker box cover with a new gasket.

Q. Remove the nylon rope from within the cylinder before proceeding to the next cylinder.

R. Continue to examine the remaining engine cylinders as per the previous steps.

S. After all engine cylinders have been examined and assembled, examine the removed spark plug(s). Refer to Chapter 74-20.

T. Install spark plug(s) as per the section "Spark Plug Installation" in Chapter 74-20.

U. Clean the exhaust valve guides.

V. Install the exhaust manifold.

W. Record this inspection and any corrective action in the engine logbook and in the 1000-Hour Inspection Checklist.

8. Cylinder Inspection Results Analysis and Corrective Action

A. Refer to Table 4 for guidelines for corrective action on results from the cylinder inspection.

Table 4
Summary of Cylinder Inspection Results and Corrective Action

Results	Indication	Corrective Action
Differential pressure of **70 psi (483 kPa) or more** for an engine cylinder	Satisfactory	Record the results on the 100-Hour Inspection Checklist. No corrective action necessary.
Differential pressure of **65 to 69 psi (448 to 476 kPa)** for an engine cylinder	Cylinder wear could have started	Record the results on the 100-Hour Inspection Checklist and in engine logbook. Complete the Cylinder Compression Check again after the next 100-hour engine operation interval - record results.
Differential pressure of **61 to 64 psi** (421 to 441 kPa) for an engine cylinder	Wear has occurred	Record the results on the 100-Hour Inspection Checklist; and in the engine logbook. Complete the Cylinder Compression Check again after the next 100-hour engine operating interval - record results. Monitor the differential pressure.
Differential pressure of **60 psi (414 kPa) or less** for an engine cylinder	Cylinder worn or not in conformance	Record the results on the 100-Hour Inspection Checklist and in the engine logbook; Start and operate the engine for 3 minutes and repeat the Cylinder Compression Check again. Or Rotate the crankshaft three times (for the engine rings to seal with oil) and complete the Cylinder Compression Check again. If the results of the second Cylinder Compression Check are too low, listen for airflow at the exhaust and intake ports. Complete the “Visual Cylinder Inspection” procedure in this chapter and look for cracks. Remove and overhaul the cylinder.*

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Table 4 (Cont.) Summary of Cylinder Inspection Results and Corrective Action		
Results	**Indication**	**Corrective Action**
Difference **of 5 psi (34 kPa) or less)** between engine cylinders Pressure readings for all engine cylinder must be nearly equal	Satisfactory	Record the results on the 100-Hour Inspection Checklist and in the engine logbook. No corrective action necessary.
Difference between **6 to 15 psi (41 to 103 kPa)**		Repeat the Cylinder Compression Check after the next 10 hours of engine operation. A valve can reseat itself and show satisfactory compression again. Record results for the second Cylinder Compression Check in the engine logbook. 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 all of the repairs.*
Difference of **15 psi (103 kPa) or more** between engine cylinders		Remove and overhaul all of the engine cylinders.*
Bubbling seen after soapy solution application between the fins and the cylinder head and barrel	Leaky cylinder head-to-barrel seal	Replace the cylinder.*
Low pressure reading during two consecutive Cylinder Compression Checks	Piston ring gap alignment incorrect	Correct the piston ring gap alignment.*
Low pressure in a single cylinder	Air is passing by the piston or valve	Examine the piston.*
- Air released from the breather or oil filler tube - Cylinder Compression measurement **above** leakage limit - Borescope inspection acceptable - Oil consumption stable, no excessive oil discharge from engine breather	Leakage in the area of the piston rings Piston ring gear increasing	Examine the piston.* If the piston is acceptable, let the engine remain in service. If the piston is not acceptable, replace the piston rings and set the ring gaps.*

Table 4 (Cont.) Summary of Cylinder Inspection Results and Corrective Action		
Results	**Indication**	**Corrective Action**
- Air discharge at oil filler/crankcase breather - Cylinder compression measurement **below** leakage limit - Borescope inspection acceptable - Oil consumption stable, no excessive oil discharge from engine breather	Leakage in the area of the piston and rings Piston ring gap increasing	Operate the aircraft at Cruise Power setting and repeat Cylinder Compression Check. If the Cylinder compression measurement is still **below** the leakage limit, remove the cylinder for repair.* Replace piston rings and set the ring gaps.*
- Air discharge at oil filler/crankcase breather - Cylinder compression measurement **above or below leakage limit** - Oil consumption unusual, with oil discharge from engine breather - Borescope inspection shows heavy carbon deposits in combustion chamber and on piston crown with excessive oil in cylinder barrel	Cylinder in need of repair or replacement	Remove the cylinder for repair or replacement.*
- Little to no air discharge at oil filler/crankcase breather - Cylinder compression measurement unusually high - Increased oil consumption with oil discharge out engine breather - Borescope inspection shows heavy carbon deposits in combustion chamber and on piston crown with excessive oil in cylinder barrel	Cylinder in need of repair or replacement	Remove the cylinder for repair or replacement.*
Test gage below tolerance of piston ring gap	Piston cracked or out of limits	Replace the piston.*
	Worn piston rings	Replace the piston rings.*

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Table 4 (Cont.)
Summary of Cylinder Inspection Results and Corrective Action

Results	Indication	Corrective Action
Test gage below tolerance of piston ring gap (Cont.)	Cylinder wall dimensions out of limits	Replace the cylinder.*
Audible air flow in the intake port	Cracked cylinder	Replace the cylinder.*
	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.* Grind or replace worn or burnt valve seat; examine the valve seat for conformity.*
- Air discharge into Induction System - Cylinder compression measurement **above** leakage limit		Continue engine in service.
- Air discharge into Induction System - Cylinder compression measurement **below** leakage limit - Cylinder borescope inspection acceptable		Operate the aircraft at Cruise Power setting and repeat the Cylinder Compression Check. If Cylinder Compression measurement still **below** leakage limit, remove cylinder for repair.*
Audible air flow in the exhaust port	Cracked cylinder	Replace the cylinder.*
	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.* Grind or replace worn or burnt valve seat; examine the valve seat for conformity.*
- Air discharge at cylinder head to barrel juncture or between barrel fins - Cylinder compression measurement **above** leakage limit - Cylinder head fin above cylinder barrel wet with oil or has baked on oil residue		Replace the cylinder.*

Table 4 (Cont.) Summary of Cylinder Inspection Results and Corrective Action		
Results	**Indication**	**Corrective Action**
Bubbling seen after soapy solution application around spark plug port seal (per procedure in “Spark Plug Port Seal Inspection” in Chapter 74-20	Loose helical coil	Replace the helical coil. Refer to "Helical Coil Replacement" in Chapter 05-00.
- Air escaping at spark plug spot face - Cylinder compression measurement not applicable	Dye check of area shows cracks	Replace cylinder.*
* Refer to the Direct Drive Overhaul Manual for instructions.		

8. Recommended Corrective Action after Cylinder Inspection and Tests

   Refer to the Direct Drive Overhaul Manual for instructions.

   A. Replace all loose or damaged studs with 0.003, 0.005, 0.007 or 0.012 in. (0.076, 0.127, 0.178 or 0.305 mm) oversize studs.

   B. Replace all loose, cracked, or scored valve guides.

   C. Replace all nicked, scored, or dented mounting pads for intake and exhaust ports or for rocker box covers.

9. Corrective Action for Valve Sticking

   NOTICE: Sticking between the valve stem and guide (on intake and exhaust valves) can severely 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, valve sticking is a serious problem any time those valves stick for any reason.

WARNING: A STUCK VALVE CAN CAUSE ENGINE FAILURE.

NOTICE: If one valve is sticking, examine all other valves.

A. Complete an oil and filter change and have an analysis done on the oil and filter to identify the contamination and find the source to correct the problem.

B. If the source of the oil contamination cannot be found or corrected:

   (1) Clean the oil screen every 25 hours of operation.

   (2) Change the oil and filter every 25 hours of operation.

C. Change the air filter and seal the induction system to keep dirt out of the oil supply.

D. Examine the cooling air baffles and baffle strips for contamination. Remove any contamination.

E. Tag, identify and remove the top spark plugs from the engine cylinders.

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NOTICE: A nylon rope or shop air can be used to hold a valve in position.

E. If compressed air is NOT to be used, remove the exhaust manifold.

F. Remove the rocker box cover and gasket from each engine cylinder.

G. Push out the rocker shaft to remove the exhaust rocker and rotator cap.

H. Identify the location of each cylinder and valve train component for reference on assembly and remove the cylinder and valve train components.

I. Examine the valve stem keys (Figure 3) for wear. Look for any distinct, uniform patterns. Replace worn valve stems.

J. Install the valve stems that are satisfactory or new, in the same position as they were.

K. Position the crankshaft just after the bottom center on the intake stroke.

M. To hold the exhaust valve in position:

(1) Put approximately 8 feet (2.4 m) of 3/8 in. (9.5 mm) nylon rope through the spark plug hole. As an alternate technique for holding the valve in position, use shop air pressure and a compression check fitting.

(2) Turn the crankshaft until the piston moves the rope snuggly against the exhaust valve.

⚠ **CAUTION:** THE PISTON IS HELD AT BOTTOM DEAD CENTER BY FIRMLY HOLDING THE PROPELLER TO PREVENT THE ENGINE FROM TURNING WHEN AIR PRESSURE IS APPLIED TO THE COMBUSTION CHAMBER.

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

⚠ **CAUTION:** ALSO, BEFORE ATTACHING THE COMPRESSED AIR, MAKE SURE THE AIR PRESSURE TO THE CYLINDER IS NOT EXCESSIVE. AIR PRESSURE IN THE CYLINDER CAN CAUSE THE PROPELLER TO TURN. KEEP CLEAR OF THE ARC RADIUS OF THE PROPELLER BLADES.

N. Compress the exhaust valve spring and remove the valve keys. (The rope or air pressure that had been in the combustion chamber is a base to support the exhaust valve in the event the valve keys tend to stick.)

O. Move the valve (secured by the mechanical fingers) completely out of the guide and position it away from the guide to avoid interference during guide reaming.

NOTICE: Refer to the latest revision of the Table of Limits, SSP-1776 for valve guide dimensions to use the correct reamer.

NOTICE: Reamers are manufactured with cutting tips made from various materials to ream valve guides made from different material.

Q. Apply ordinary cup grease on the flutes of the reamer to remove the deposits on the reamer.

R. Ream the valve as follows:

(1) Use force on the reamer by hand to make sure the cutting position has gone through the full length of the guide. The 1 in. (2.54 cm) pilot must be visible through the exhaust port or through spark plug hole using an angled mirror.

(2) Clean the guide with mineral spirits or equivalent solvent and blow compressed air through the valve.

(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 guide is bell-mouthed and must be replaced.

(5) If the valve is acceptable, apply lubricant to the valve guide.

⚠ **CAUTION:** NEVER USE THE PISTON TO PUSH THE VALVE THROUGH THE GUIDE.

S. Use a magnetic pencil and flexible mechanical fingers to position the tip of the valve in the guide. Carefully install the valve back into its guide. Make sure the valve is installed within the guide and not in a cocked position which can cause damage to the guide and valve.

T. Install the valve springs and valve spring seats in the same position as removed.

U. Compress the valve spring and install keys in their respective position. While the valve spring is compressed and if the valve slides down the guide, use the nylon rope to hold the valve firmly on its seat while installing the valve keys.

NOTICE: Identify the location of each tappet assembly that is removed for reference on assembly. Refer to the latest revision of Service Instruction No. 1011 for details on tappets and inspections

⚠ **CAUTION:** DO NOT MIX PLUNGER OR LIFTER ASSEMBLIES WITH DIFFERENT PART NUMBERS IN THE SAME ENGINE. THE DIFFERENT LEAK DOWN RATES WILL CAUSE INCORRECT ENGINE OPERATION.

V. Refer to the Direct Drive Overhaul Manual to:

(1) Remove and clean the hydraulic lifter and remove all oil.

(2) Examine the lifter for any malfunction.

(3) Clean the inner diameter of the cam follower.

(4) Install the hydraulic lifter.

(5) Install the tappet socket, shroud tube (Figure 3) with new shroud seals, push rod, valve stem cap, rocker arm and rocker shaft on the engine cylinder with fastening hardware.

(6) Install the rocker box cover with a new gasket.

⚠ **CAUTION:** DURING REASSEMBLY, VALVE TRAIN COMPONENTS MUST BE INSTALLED IN THEIR ORIGINAL LOCATION. ALL PARTS MUST BE IN CORRECT ALIGNMENT FOR CORRECT DRY TAPPET CLEARANCE. MISALIGNMENT CAN CAUSE ENGINE DAMAGE.

W. Make sure all flashlights, ropes, etc. have been removed from within the cylinder before starting work on the next cylinder.

X. Examine spark plugs as per the section "Spark Plug Inspection" in Chapter 74-20. Install spark plugs as per spark plug instructions.

Y. Install the exhaust manifold after all exhaust valve guides are cleaned. Refer to the Direct Drive Overhaul Manual.

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72-50 - RECIPROCATING ENGINE – LUBRICATION

1. System Description
   A. Refer to the IO-540-AG1A5 Series Engine Installation and Operation Manual
2. Lubrication Maintenance
   A. Oil Pressure Adjustment

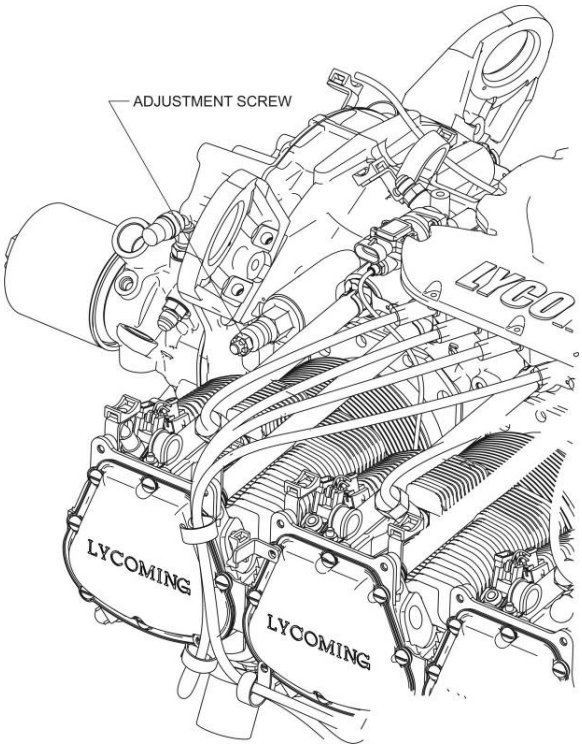
NOTICE: On the majority of these engines, there is an adjustment screw (Figure 1) on the oil pressure relief valve housing. Rotation of this screw used to either increase or decrease the oil pressure to keep it within the specified operational limits in Appendix A of the IO-540-AG1A5 Series Engine Installation and Operation Manual.

On older engines, there are stacked washers (up to nine total) that control the oil pressure. Pressure is increased or decreased by adding or removing washers.

This oil pressure adjustment procedure, applies to the adjustment screw.

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 IO-540-AG1A5 Series 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. While the engine is still warm, ***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. While the engine is still warm, ***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 (793 kPa), when cold during engine starting and warm-up, to 25 psi (172 kPa) at idle.

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.

C. Oil Hose Line Inspection

(1) Examine oil hose line for cracks, kinks, brittleness, wear, damage or loose connections. Replace any worn, cracked, kinked. damaged, or brittle oil line with a new oil line.

(2) Tighten any loose connection at an oil hose line in accordance with the torque values in the latest revision of the Table of Limits, SSP-1776.

⚠ **CAUTION:** MAKE SURE THERE ARE NO SHARP BENDS OR KINKS IN THE OIL HOSE ROUTING TO PREVENT INTERRUPTIONS TO OIL FLOW. DO NOT ROUTE OIL LINES CLOSE TO HEAT SOURCES.

(3) Make sure the oil hose line routing is not sharply bent or kinked which could interrupt or block oil flow.

(4) Also, make sure that oil line hose is not touching or close to a heat source that could damage the line and cause oil loss which could cause engine failure.

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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 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 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. 50-Hour Maintenance for Starters from Hartzell Engine Technologies (formerly Kelly Aerospace)
   A. This maintenance is to be done after every 50 hours of engine operation on Lycoming engines with starters manufactured by Hartzell Engine Technologies (formerly Kelly Aerospace).
      (1) Clean corrosion from electrical terminals.
      (2) Clean the starter drive and shaft with mineral spirits.
      (3) Lubricate the starter drive and shaft with silicon spray.
3. 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. Make sure the wiring connections are tight. Tighten any loose wiring connections.
   C. Examine all of the wiring connections and accessories for physical damage and security.
   D. 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 burnt wire.
      (3) Vibration damage or chafing.
      (4) Cracked insulation.
      (5) Arcing.
      (6) Insulation delamination.
   E. To replace damaged cables or clamps refer to the aircraft manufacturer's instructions.
   F. 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 Table of Limits, SSP-1776.
   G. 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.

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H. Closely examine wiring that could have been exposed to hydraulic fluid during wiring inspection.

I. Look for heat damage on the wiring and on the engine in galleys, and behind lights.

J. 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.

K. Record all findings and corrective action for this wiring inspection in the engine logbook.

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72-80 - INDUCTION SYSTEM

1. System Description
   A. Refer to the IO-540-AG1A5 Series 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 air filter care or of a damaged air 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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73-10 - ENGINE FUEL AND CONTROL – DISTRIBUTION

1. Refer to the IO-540-AG1A5 Series Engine Installation and Operation Manual for the fuel system description.
2. 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 IGNITE THE FUEL WHICH CAN CAUSE SERIOUS INJURY OR DEATH.

   A. Visually examine all fuel lines for evidence of damage or leaks. Refer to the section "Fuel Line Inspection and Corrective Action" in this chapter.
   B. Examine fuel fittings for damage or leaks. Make sure all fuel line fittings and connections are secure and correctly torqued as per the latest revision of the Table of Limits, SSP-1776.
   C. Examine solder joints at the end of fuel lines for cracks.
   D. Examine the routing of fuel lines. Make sure the clamps securely support the fuel line.
   E. Visually examine the fuel lines and hoses for evidence of damage, chafing, leaking, improper conditions, and looseness.
   F. Examine the flexible hoses.
   G. Examine hoses, gaskets, and seals for deterioration or leakage.
   H. Examine the fuel nozzles for damage or wear. If the nozzles are worn or damaged, replace the nozzles. Refer to the Direct Drive Overhaul Manual

⚠ CAUTION: NEVER USE A SHARP TOOL SUCH AS A WIRE OR PIN TO CLEAN OUT A NOZZLE. DAMAGE TO THE INLET AND OUTLET FUEL RESTRICTORS COULD RESULT WHICH WOULD CHANGE THE FUEL FLOW.

   I. 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 OPERATING CORRECTLY AND DOES NOT HAVE ANY LEAKS.

   J. Look for any fuel leaks. Identify and correct the cause of any fuel leaks.
   K. 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.
   L. Make sure the mixture control and throttle linkage have full travel, freedom of movement, and that the clamps are tight..
   M. Lubricate the linkage as per the aircraft manufacturer's instructions.

3. Fuel Line Inspection and Corrective Action

   NOTICE: This fuel line inspection is to be done every 100 hours of engine operation.

   A. Examine all fuel lines for damage, leaks, dents, pits, nicks, kinks, stains (from fuel leaks), cracks, brittleness or chafing.
      (1) Make sure that the fuel line configuration and routing generally agree with the conceptual approximately Figure 1.
   B. Replace any fuel lines that are crimped or kinked. (Cracks can develop at the side of bends or kinks.)

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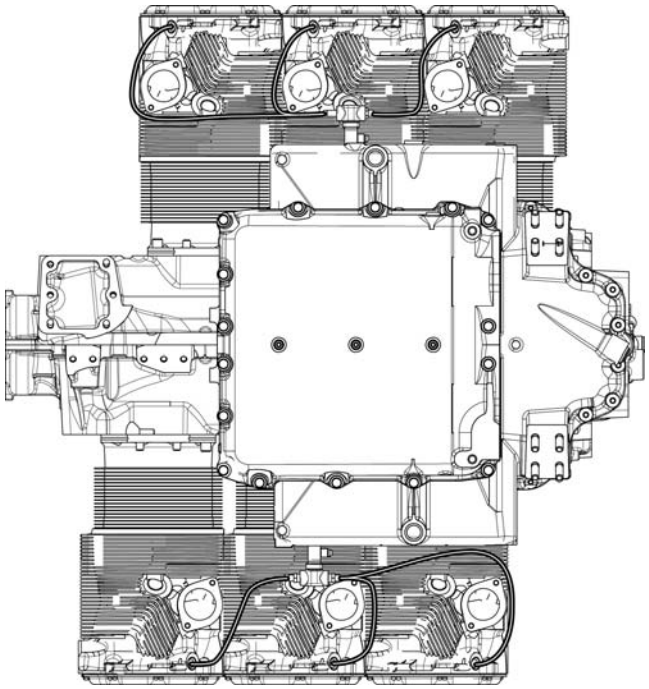
⚠ **CAUTION:** DO NOT ATTEMPT TO REPAIR A DAMAGED FUEL LINE. REPLACE ANY FUEL LINE THAT IS CRACKED, DENTED, OR KINKED; CRACKS CAN DEVELOP AT THE SIDE OF SHARP BENDS OR KINKS.

NOTICE: The fuel line configuration diagram is conceptual and for reference only. Fuel line routing on your engine could have slightly different configurations.



IO-540-AG1A5 Fuel Line Routing and Configuration
Figure 1

C. Make sure that the fuel lines are securely connected (to dampen vibration during flight) with the necessary cushioned clamps and hardware.

⚠ **CAUTION:** IF BY OMISSION DURING FIELD REPAIR, SUPPORT CLAMPS ARE NOT INSTALLED ON THE FUEL LINES, THE FUEL LINES CAN BREAK, LEAK OR BECOME DAMAGED FROM THE IMPACT OF VIBRATIONAL FORCES OR FROM KINKS BETWEEN THE FUEL INJECTOR MANIFOLD AND NOZZLES.

(1) Do NOT use plastic tie straps.

(2) On engines that used metal clamps with no cushion, use the P/N LW-12598 fuel line sleeve at each of those clamping locations. The fuel line sleeve is not used with the cushioned clamps.

(3) If the clamps are to have a cushion, make sure the cushion is not missing and is intact.

(4) Make sure the clamps are tightly attached to support the fuel line and to prevent movement from vibration or motion frequencies.

D. Clamps (preferably with cushions) must be installed on all fuel lines. If a fuel line had been in service and clamps were not installed, the fuel lines are suspect and must be replaced with new fuel lines with cushioned clamps installed.

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E. Fuel lines must be held in place securely using clamps with cushions. The clamps must be approximately 8 in. (20 cm) apart. Make sure the clamps are tightly attached to support the fuel line and to prevent movement from vibration or motion frequencies. Do NOT use plastic straps in place of cushioned clamps.

⚠WARNING: DO NOT ROUTE FUEL LINES CLOSE TO HEAT SOURCES. HEAT CAN CAUSE FUEL VAPORIZATION IN THE FUEL LINES OR CAN DAMAGE THE FUEL LINE AND CAUSE A FUEL LEAK WHICH COULD LEAD TO CATASTROPHIC ENGINE FAILURE.

F. Do not let fuel lines touch the engine or airframe baffle hardware. There must be a minimum clearance of 3/16 in. (4.76 mm) between a fuel line and any engine or airframe surface.

G. Keep a minimum clearance of 3/16 in. (4.76 mm) for the fuel lines.

H. After the inspection, refer to Table 1 for corrective action.

I. Record findings in the 50-Hour Inspection Checklist in Chapter 05-20.

Table 1
Corrective Action for Fuel Lines

Condition	Corrective Action
Leaky, cracked, brittle, worn, chafed, fuel line Bent (non-kinked) stainless steel or metallic fuel lines that has an inside radius less than 5/8 in. (15.88 mm)	Replace fuel line with a new fuel line.♦ Do NOT repair any fuel line that leaks or is cracked.
Damaged, pitted, nicked, dented, crimped or kinked fuel line	Replace fuel line with a new fuel line.♦ Do NOT reuse any fuel line that has a dent. Dents can cause cracks to form.
No clamps installed on fuel line that had been in service	Replace the fuel line with a new fuel line and install clamps.
Loose clamps	Replace fuel line with a new fuel line.♦ Either tighten or replace clamps and make sure they are securely attached to the fuel line to the engine
Deteriorated cushion on clamp or missing cushion (On engines that used metal clamps with no cushion, use the P/N LW-12598 fuel line sleeve at each of those clamping locations. The fuel line sleeve is not used with the cushioned clamps.	Replace the clamp with a new clamp
Trouble with fuel injector clip installation caused by obstructive baffling	Install the clips to enable clearance
♦ Refer to the latest revision of Service Instruction No. 1301 for superseded fuel line identification, bending requirements and replacement information.	

4. Fuel Injector Leak Check Procedure

   NOTICE: Complete this procedure at each suspect leaky fuel injector.

   A. Disconnect the induction system at the fuel injector inlet to monitor the impact tubes.

   B. Put the throttle in the FULL FORWARD position.

   C. Put the mixture control in the FULL RICH position.

   D. Cap the fuel line to the fuel manifold.

   E. Turn ON the fuel boost pump.

   F. If fuel flows out of the impact tubes, the fuel injector has an internal leak and must be replaced.

5. 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.

6. Fuel Control Unit Maintenance

   A. Maintenance for the fuel control unit removal, cleaning, and replacement of the 74 micron inlet screen and the strainer O-ring.

   B. Use a wrench on the hex fitting to disconnect the fuel supply line from the fuel inlet port of the fuel control unit.

   C. Install a plug into the fuel supply line to prevent fuel spills and contamination of the fuel supply system.

      NOTICE: Always remove the screen from the inlet side only. Otherwise dirt could enter the fuel control unit or fuel injector.

   D. Remove the inlet screen from the housing and examine it for distortions or holes. If either condition is found, replace the inlet screen.

   E. If the inlet screen is intact, remove and discard the O-ring from the end of the inlet screen.

   F. Clean the screen by soaking it in unleaded gasoline or mineral spirits or equivalent solvent.

   G. Remove the inlet screen from the solvent and dry with clean, compressed air.

   H. Install a new O-ring on the end of the inlet screen.

   I. Install the inlet screen into the housing of the fuel control unit.

   J. Torque to 60 to 70 in.-lb (7 to 8 Nm).

   K. Remove the plug from the fuel supply line.

   L. Connect the fuel supply line to the fitting on the fuel control unit.

   M. If any gasoline or solvent has been spilled, clean it up in accordance with Federal, State, and Local regulations.

   N. Record maintenance, corrective action and replaced items in the engine logbook.

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73-20 - ENGINE FUEL AND CONTROL – CONTROLLLING

1. Throttle
   A. The throttle body cannot be repaired only replaced.
2. Throttle Body Inspection
   A. Examine throttle body and linkages for any visual damage.
   B. Make sure the throttle is connected and has the correct range of travel.
   C. Move throttle controls for a fluid movement.
   D. If the throttle body is damaged, it must be replaced.
3. Throttle Body Removal
   A. Remove all lines and control cables to throttle body.
   B. Remove the fastening hardware that holds the throttle body to the induction system.
4. Throttle Body Installation
   A. Install the throttle body on the airframe with fastening hardware.
   B. Torque the fastening hardware as per torque values in the latest revision of the Table of Limits, SSP-1776.
   C. Connect the lines and control cables to the throttle body.
5. Operational Test of Throttle Body
   A. Move throttle controls for a fluid movement.
   B. Make sure that the linkage has the correct amount of play for movement.

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74-00 - IGNITION SYSTEM MAINTENANCE

1. Ignition System Description

   A. Refer to the IO-540-AG1A5 Series 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 Section and Chapter
Examine the ignition lead routing	Every 100 hours of engine operation	"Ignition Lead Routing Inspection" in Chapter 74-20
Replace the spark plugs (remove and install)	As needed	"Spark Plug Removal, "Set the Spark Plug Gap," and "Spark Plug Installation" in Chapter 74-20
Examine spark plugs and ignition leads	As needed	"Spark Plug and Ignition Lead Inspection" in Chapter 74-20
Examine the spark plug port seals to complete the check of the Heli-coils	As needed	"Spark Plug Port Seal Inspection" in Chapter 74-20
Clean the spark plugs	Every 100 hours of engine operation	"Spark Plug Cleaning" in 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
Magneto inspection	Every 500 hours of engine operation	"Magneto Inspection" in Chapter 74-30
Magneto-to-engine timing	Every 100 hours of engine operation	"Magneto-to-Engine Timing Procedure" in Chapter 74-30

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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.

1. The ignition leads are an all-weather, shielded wire constructed with over braid.
2. Ignition Lead Routing Inspection
   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.
3. Spark Plug Removal
   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.
   D. Hold the ferrule and loosen the spark plug nut and disconnect it from the ignition lead.

⚠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 the spark plug gasket. Discard the gasket.
4. Spark Plug and Ignition Lead Inspection
   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.

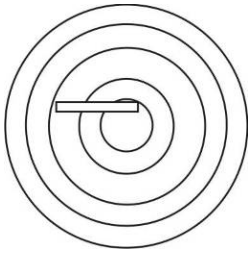
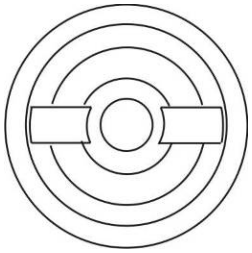
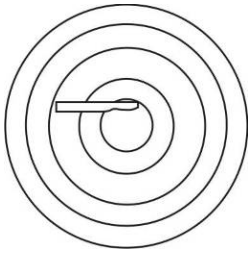
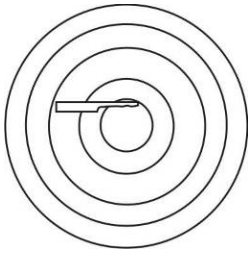
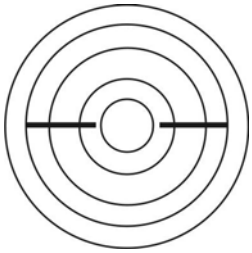
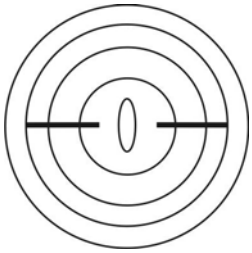
   E. Examine each spark plug for chafing, corrosion, wear, and cracking during every 100-hour inspection. Replace any worn, cracked or corroded spark plug with a new spark plug. Refer to the guidelines in Table 1 to identify acceptable and unacceptable spark plugs. The condition of the fine wire ground 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.
   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 the Spark Plug Gap" procedure in this chapter.

Table 1
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 - see figures in next two columns			Clean, set gap and install spark plug
Partially Worn Spark Plugs:	Ash deposits Electrode burnt and/or eroded to less than half of the original thickness - see figures in next two columns More voltage has been necessary to fire the spark plugs			Discard spark plug and replace with new spark plug
Worn Spark Plugs:	Erosion of center and ground electrode - see figures in next two columns Extensive necking of the fine wire ground electrode			Look for excessive heat sources and measure heat range if possible Discard spark plug and replace with new spark plug

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5. 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.

6. 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 “Spark Plug and Ignition Lead Inspection” 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.

7. Spark Plug Cleaning

   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.

8. Set the 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.

9. 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 "Spark Plug Removal" procedure in this chapter.

B. Examine each spark plug and ignition lead. Refer to the "Spark Plug and Ignition Lead Inspection" procedure in this chapter.

C. Clean acceptable spark plugs. Refer to the "Spark Plug Cleaning" 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	#6 Bottom
#2 Top	with	#5 Bottom
#3 Top	with	#4 Bottom
#4 Top	with	#3 Bottom
#5 Top	with	#2 Bottom
#6 Top	with	#1 Bottom

10. 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. Set the spark plug gage at 0.016 to 0.022 in. (0.406 to 0.559 mm).

⚠ **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 HEAD TRANSFER, SPARK PLUG OVERHEATING, POSSIBLE REIGNITION/DETONATION, AND INTERNAL ENGINE DAMAGE. NEVER INSTALL A SPARK PLUG THAT HAS DROPPED ON THE FLOOR.

B. Install a new spark plug gasket. A new gasket must be installed whether the spark plug is new or is acceptable and being reused.

NOTICE: It is not necessary to apply Anti-seize to threads on Champion spark plugs because Anti-seize was applied at the spark plug factory. Engine oil can be applied to Champion spark plug threads for spark plugs that are installed in engine cylinders with heli-coils.

C. On non-Champion spark plugs, sparingly apply Anti-seize to all spark plug threads, **except the first thread**.

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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. Torque the spark plug to 35 ft.-lb (47 Nm).

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.

I. Torque to 5/8-24 head nuts to 80 to 90 in.-lb (9.2 to 10.4 Nm).

J. Torque the 3/4-20 head nuts to 110 to 120 in.-lb (12.7 to 13.9 Nm).

K. Connect the spark plug to the ignition lead.

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74-30 - MAGNETO MAINTENANCE

1. Magneto Inspection

   A. Examine the magneto in accordance with the magneto manufacturer's instructions.

2. Magneto Replacement Procedure

⚠ WARNING: BEFORE THIS PROCEDURE, MAKE SURE ALL POWER IS DISABLED TO THE ENGINE TO PREVENT ELECTRICAL SHOCK AND INJUIRY.

   A. Magneto Removal

      (1) Disconnect the harness (Figure 1) from the magneto to be removed.

      (2) Hold the magneto and remove the cotter pin, two nuts, two lock washers and two clamps from the magneto. Discard the lock washers and cotter pin.

      (3) Remove and discard the magneto and gasket.

      (4) Remove the drive cushion and gear assembly from the drive pad.

   B. Magneto Installation

      A new or serviceable magneto, new magneto gasket, new cotter pins, new adapter gasket and two new lock washers are necessary to install the magneto. Refer to the IO-540-AG1A5 Series Engine Parts Catalog.

      (1) Begin the "Magneto-to-Engine Timing Procedure" in this chapter.

      (2) Install the adapter (Figure 1) with a new gasket on the drive pad on the accessory housing.

      (3) Engage the marked tooth of the gear assembly between the two marked teeth on the crankshaft idler gear.

      (4) Install the drive cushion on the gear assembly and coupling.

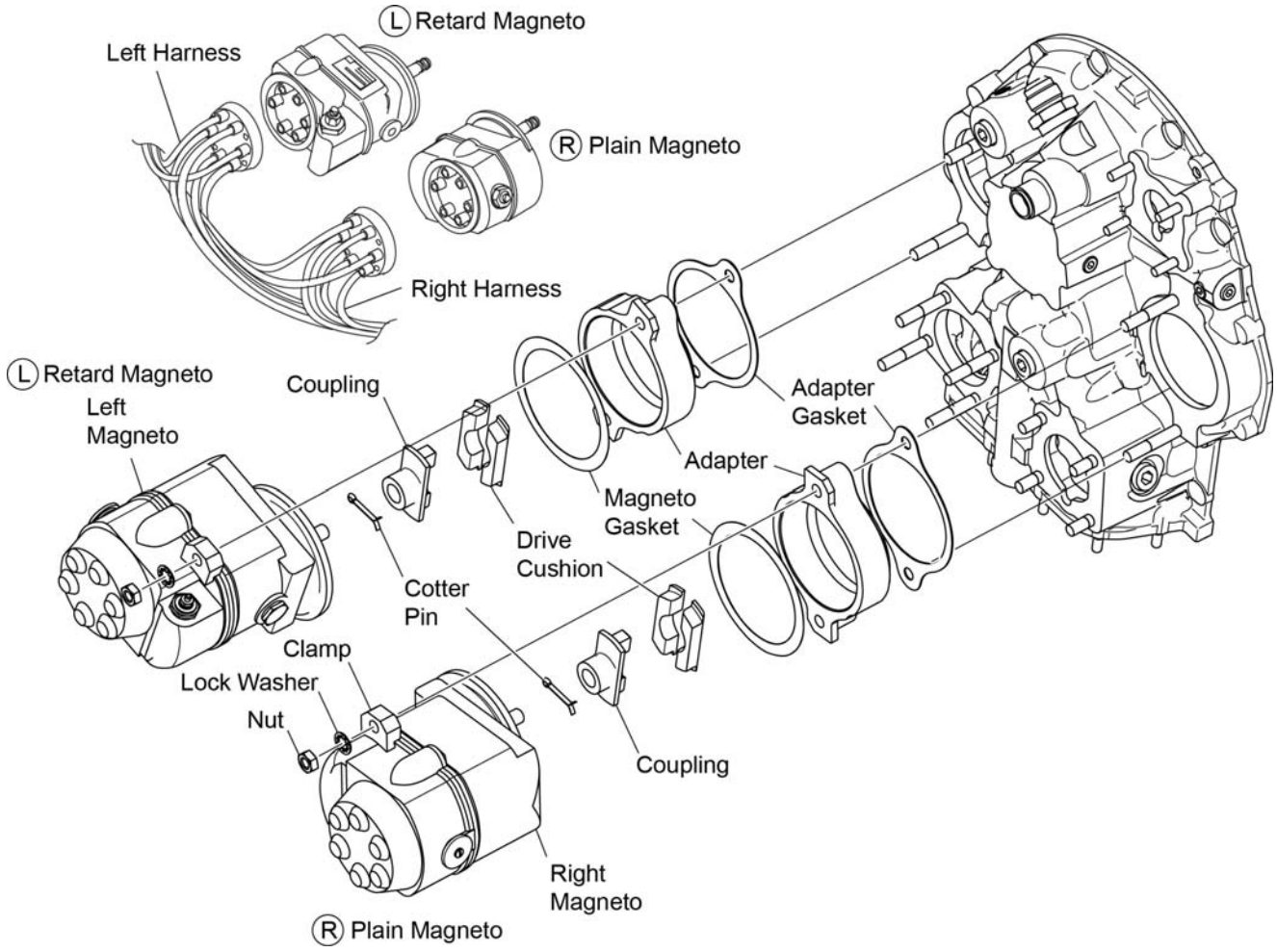
      (5) Install the magneto with the two clamps, two nuts and two new lock washers and a new cotter pin. Torque the nuts in accordance with the torque values in the latest revision of the Table of Limits, SSP-1776.

      (6) Complete the remainder of the "Magneto-to-Engine Timing Procedure" in this chapter.

      (7) When all maintenance is complete:

         (a) Enable power to the engine.

         (b) Complete a ground operation check of the engine as per the "Operational Ground Check Maintenance" procedure in Chapter 72-00.



Magneto
Figure 1

2. Magneto-to-Engine Timing Procedure

NOTICE The magneto-to-engine timing is to be synchronized at 20º BTDC. Timing more than 20º BTDC will cause the engine to operate at high temperature.

A. Before the left magneto installation:

(1) Remove a spark plug from No. 1 cylinder (Figure 2).

(2) Put thumb over the spark plug hole.

(3) Rotate the crankshaft in direction of normal rotation until the compression stroke is indicated by feeling pushback pressure at the spark plug hole.

(4) Continue to rotate the crankshaft until the advance timing mark on the front face of the starter ring gear is aligned with the small hole at the two o'clock position on the front face of the starter housing.

(5) If installed, remove the ignition harness from the magneto.

(6) Install a timing pin in the hole marked "L" (for Left magneto) "R" (for Right magneto) on the face of the distributor block.

(7) Apply a slight inward pressure to the pin and slowly rotate the magneto drive shaft clockwise 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.

(8) Remove the timing pin from the distributor block.

NOTICE: If the magneto shaft cannot be rotated and if the timing pin is not seated 7/8 in. (22 mm) into the distributor block, remove the pin, rotate the drive shaft 1/8 turn and repeat the insertion procedure.

B. Assemble and install the magneto as per instruction sin the "Magneto Installation Procedure" in this chapter.

⚠ **CAUTION:** DO NOT ROTATE THE MAGNETO ROTOR SHAFT WITH THE TIMING PIN INSERTED INTO THE DISTRIBUTOR BLOCK. THIS COULD DAMAGE THE INTERNAL COMPONENTS OF THE MAGNETO.

C. Examine the left magneto accessory housing mounting pad to ensure that the magneto drive dampers, adapter, and gaskets are installed correctly. Position the magneto on its side with the top of the magneto located outboard away from the accessory housing vertical centerline. Install the magneto onto the mounting pad. Be sure the drive dampers remain in place when the magneto drive is inserted into the drive gear. Secure the magneto to the accessory housing with the proper clamps, washers, and nuts. Tighten nuts only finger tight.

⚠ **CAUTION:** DO NOT ROTATE THE MAGNETO OR ENGINE WITH THE TIMING PIN INSERTED INTO THE MAGNETO DISTRIBUTOR BLOCK. THIS COULD CAUSE DAMAGE TO THE INTERNAL COMPONENTS OF THE MAGNETO.

D. Repeat the previous steps. for the right (plain) magneto.

⚠ **WARNING:** DO NOT ATTACH HARNESS SPARK PLUG ENDS TO THE SPARK PLUGS UNTIL ALL MAGNETO-TO-ENGINE TIMING PROCEDURES AND MAGNETO-TO-SWITCH CONNECTIONS ARE ENTIRELY COMPLETED.

E. Attach a timing light to the magneto condenser stud according to the timing light manufacturer's instructions.

F. Rotate the magneto assembly in the direction of rotor rotation until the timing light comes on. If the light is on initially, rotation of the magneto is not necessary because the breaker points are closed.

G. Slowly rotate the magneto assembly in the opposite direction, until the light goes out or the breaker points open.

H. Alternately tighten the magneto mounting nut clamps 96 in.-lb (10.8 Nm) torque. Continue to tighten both nuts alternately, in several steps, to 17 ft.-lb (23.1 Nm) torque.

I. Repeat the previous steps for the right magneto.

J. Rotate the engine approximately 10º opposite to the normal rotational direction. The timing lights should light. Slowly (bump) rotate the engine in the normal direction until the timing lights go out. Both lights should go out within ± 1º of the designated timing mark on ring gear with the dot on the starter housing as referenced in step A.

K. Repeat until the condition in step J. is satisfied.

L. If the magneto position (± 15º from the mounting pad horizontal centerline allowed) interference is encountered, which is unlikely, the magneto must be removed and the drive gear in the accessory housing repositioned. Care must be taken not to drop the dampers into the engine during the repositioning of the drive gear.

M. Remove timing light leads from the magnetos.

N. Attach the appropriate switch or P-Leads to the condenser terminal of each magneto using a lock washer and nut. Torque nut to 13 to 15 in.-lb (1.5 to 1.7 Nm).

O. Retard Breaker

(1) Attach one positive lead of the timing light to retard breaker terminal and the negative lead to ground.

(2) Set the engine required number of degrees before top center on the compression stroke of the number 1 cylinder.

(3) The timing light is to be on, which is an indication that the retard breaker points are closed.

(4) Slowly rotate the engine in the usual direction until the timing light goes out indicating the points opened.

(5) The TC #1 timing mark on the ring gear must be aligned with the dot on the starter housing within ± 3º.

(6) If the timing of these points is incorrect, refer to the Slick Maintenance Manual for the procedure to adjust the contact points.

P. Attach the switch retard breaker lead to the retard post on the magneto (left magneto only) using a lock washer and nut. Torque nut to 13 to 15 in.-lb (1.5 to 1.7 Nm).

Q. Install ignition harness assemblies on the magnetos. The left magneto harness is marked "left" and the right magneto harness is marked "right. Check for proper installation of the O-ring seal in the wire cap. Torque cap-mounting screws to 18 to 20 in.-lb (2.1 to 2.3 Nm).

NOTICE: Some timing lights operate in the reverse manner as described. The light comes on when the breaker points open. Refer to your timing light instructions.

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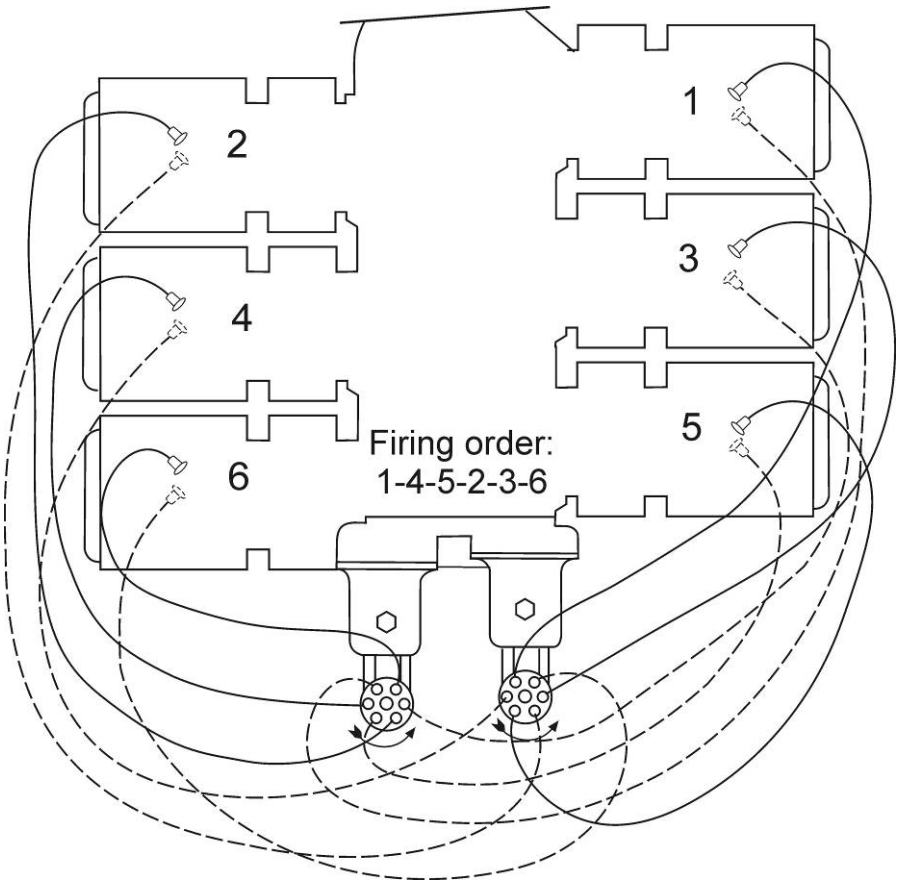

Ignition Wiring Diagram
Figure 2

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