IO-540-AG1A5 Series Engine Installation and Operation Manual

November 2012

LYCOMING

Part No. 60297-45

IO-540-AG1A5 Series Engine Installation and Operation Manual

Lycoming Part Number: 60297-45

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

To: Recipients of IO-540-AG1A5 Series Engine Installation and Operation Manual

Subject: Release of the current manual revision

This page section transmits the initial edition of the IO-540-AG1A5 Series Engine Installation and Operation 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 manual, due to a Service Document, or Service Document revision. The words "No Effect" indicate that the Service Document caused no changes within this manual.

Number	Revision Number	Incorporation Date	Subject
S.B. 369	L	11/12	Engine Inspection after Overspeed
S.B. 480	E	11/12	I. Oil and Filter Change and Screen Cleaning II. Oil Filter Screen Content Inspection
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. 1070	R	11/12	Specified Fuels
S.I. 1132	B	11/12	Magneto Drop-off
S.I. 1154	P	11/12	FAA Approved Starter and Alternators
S.I. 1241	C	11/12	Pre-oil the Engine Prior to Initial Start
S.I. 1443	H	11/12	Approved Slick Magnetos on Lycoming Engines.
S.I. 1472		11/12	Removal of Preservative Oil from Engine
S.I. 1481	B	11/12	Factory Engine Preservation
S.I. 1505		11/12	Cold Weather Starting
S.I. 1528		11/12	Aircraft Engine Starter Recommendations
S.I. 1530		11/12	Engine Inspection in a Particulate Laden Environment (Volcanic Ash, Sand, Dust, Airborne Debris)
S.L. L180	B	11/12	Engine Preservation for Active and Stored Aircraft

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LIST OF EFFECTIVE PAGES

Section	Pages	Date
System Description	1 — 4	11/12
Engine Reception and Lift	5 — 8	11/12
Requirements for Engine Installation	9 — 16	11/12
Engine Installation	17 — 22	11/12
Engine Start and Operation	23 — 30	11/12
Unusual Conditions	31 — 36	11/12
Flight Test	37 — 38	11/12
Engine Preservation and Storage	39 — 44	11/12
Appendix A	45 — 48	11/12
Appendix B	49 — 50	11/12
Appendix C	51 — 52	11/12

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TABLE OF CONTENTS

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LIST OF FIGURES

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LIST OF TABLES

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ABBREVIATIONS AND ACRONYMS

A	
Amp	Ampere
B	
BHP	Brake Horsepower
BSFC	Brake Specific Fuel Consumption
Btu	British Thermal Unit
C	
C	Celsius
CHT	Cylinder Head Temperature
cm	Centimeter
E	
EGT	Exhaust Gas Temperature
EPA	Environmental Protection Agency
F	
F	Fahrenheit
FAA	Federal Aviation Administration
FAR	Federal Aviation (and Space) Regulation
FOD	Foreign Object Debris
Ft.-lb	Foot Pound (torque)
H	
HET	Hartzell Engine Technologies
Hg	Mercury
HP	Horsepower
I	
ICA	Instructions for Continued Airworthiness
in.-lb	Inch Pound (torque)
in.	Inch, inches
In-Hg	Inches of Mercury
L	
lb	Pound
LL	Low Lead (fuel)
M	
mm	Millimeter
MSB	Mandatory Service Bulletin
N	
Nm	Newton Meter

P	
P/N	Part Number
POH	Pilot Operating Handbook
ppm	Particles per Million
psi	Pounds per Square Inch
R	
rpm	Revolutions per Minute
S	
SAE	Society of Automotive Engineers (oil viscosity)
SB	Service Bulletin
SI	Service Instruction
SL	Service Letter
STC	Supplemental Type Certificate
T	
TR	Temporary Revision
V	
V	Volt, Voltage

INTRODUCTION

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 cubic inches

Scope of this Manual

This manual supplies instructions (in compliance with FAR 33.5) for engine preparation, airframe manufacturer installation requirements, installation and operation of the IO-540-AG1A5 Series Lycoming aircraft engines. For maintenance schedules, inspections, and procedures, refer to the IO-540-AG1A5 Series Engine Maintenance Manual. For overhaul requirements, inspections and procedures, refer to the Direct Drive Overhaul Manual. For spare parts information refer to the IO-540-AG1A5 Series Engine Illustrated Parts Catalog.

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 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.

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.

Change Update Distribution

Lycoming Engines supplies changes in the form of revised pages or manuals (depending upon the extent of the changes) to customer subscribers.

Instructions for Continued Airworthiness

This manual, together with the Maintenance 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).

Compliance Requirements

⚠WARNING: OPERATE THIS ENGINE IN ACCORDANCE WITH SPECIFICATIONS IN APPENDIX A OF THIS MANUAL. OPERATING THE ENGINE BEYOND SPECIFIED OPERATING LIMITS CAN CAUSE PERSONAL INJURY AND/OR DAMAGE TO THE ENGINE.

⚠WARNING: YOU ALSO MUST COMPLETE THE NECESSARY MAINTENANCE AND OVERHAUL PROCEDURES IDENTIFIED IN LYCOMING ENGINES' MAINTENANCE AND OVERHAUL MANUALS FOR THIS ENGINE SERIES AS WELL AS ANY APPLICABLE SERVICE DOCUMENTS. LYCOMING ENGINES' SERVICE DOCUMENTS OVERRIDE PROCEDURES IN THIS MANUAL.

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

Warning, Cautions, and Notices

Be sure to read and obey the Warnings and Cautions in this manual and in service documents. Although Lycoming 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 "recommended" refers to "best practices."

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.

Figures

Figures in this manual are for illustration purposes only.

Copyright

Environmental Compliance

Lycoming Engines 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.

Supplemental Service Information

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

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: 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)
Monday – Friday

Change of Address Notification

The owner of the manual is responsible to supply of a change of address to Lycoming Engines.

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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 chapter is FAA approved and specifies maintenance required under §§ 43.16 and 91.403 of the Federal Aviation Regulations (FAR) 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 of the IO-540-AG1A5 Series Engine Maintenance 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 Guide and Inspection" in Chapter 72-30 in the IO-540-AG1A5 Series Engine Maintenance Manual.

Approved by: _____

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

Date: 11/13/12

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SYSTEM DESCRIPTION

The Lycoming IO-540-AG1A5 Series engine (Figure 1) is a direct-drive six-cylinder, horizontally opposed, fuel-injected air-cooled engine with an up exhaust. This engine has tuned induction, dual magnetos, and an automotive type alternator and starter. The engine has the AN-type fuel pump, a vacuum pump, hydraulic pump, and a propeller governor. Refer to Appendix C for engine performance data.

NOTICE: This engine is not to be used for continuous negative or zero "G" operation.

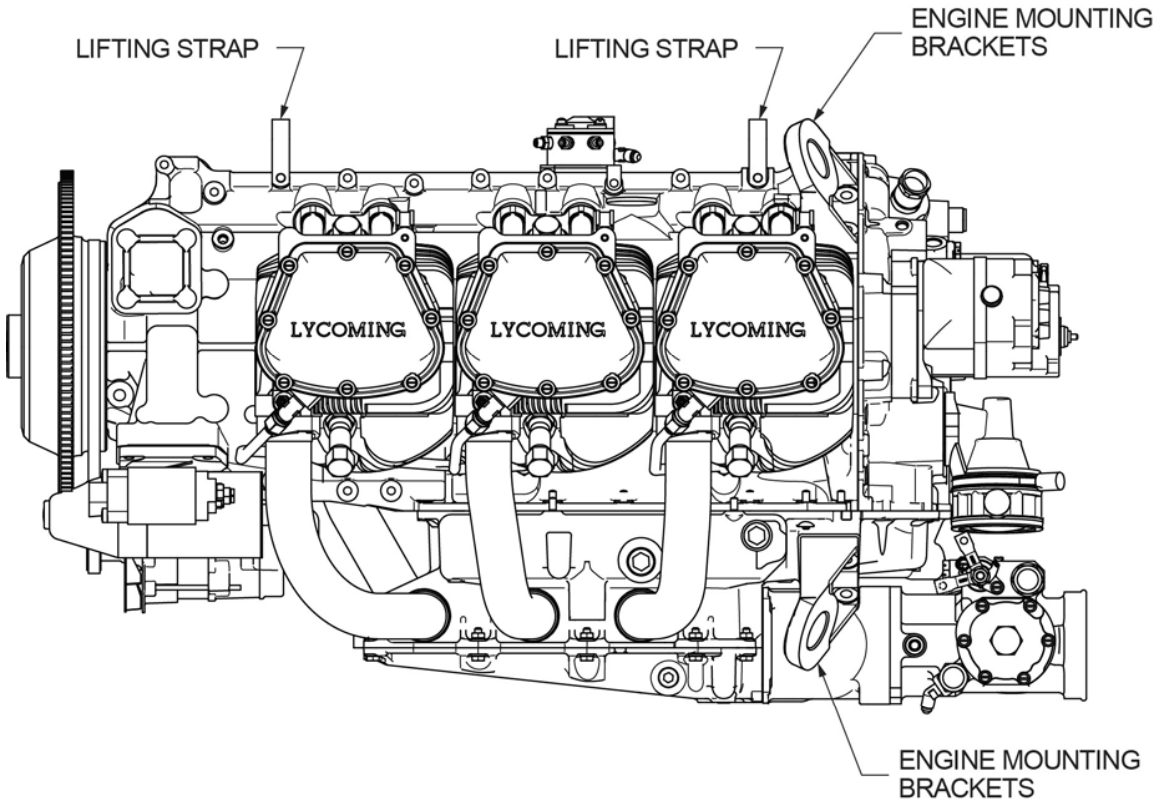

Figure 1 - IO-540-AG1A5 Series Engine

Cylinders

Each of the six nitrided air-cooled engine cylinders (identified by blue paint) between the shroud tubes has rings, pistons, push rods, valves, valve springs, and hydraulic flat tappets. The cylinder head and barrel are screwed and shrunk together.

The valve-operating mechanism uses a conventional camshaft located above and parallel to the crankshaft. The camshaft operates the hydraulic flat tappets. These tappets adjust for expansion or contraction that occurs in the valve train.

A bayonet-type thermocouple can be installed on the cylinder head.

Fuel and air enter the cylinder through the cylinder head for mixing and combustion within the cylinder.

The connecting rods have replaceable bearing inserts in the crankshaft ends. Two bolts/nuts attach the bearing caps to the crankshaft end of each rod.

The engine has intercylinder cooling baffles. Six oil nozzles supply oil for internal piston cooling.

Crankcase

The crankcase is made up of two reinforced castings divided at the centerline of the engine. The castings are attached by a series of through-studs, bolts and nuts. The mating surfaces of the two castings are joined without a gasket.

The crankcase forms the bearings for the camshaft. The camshaft operates the flat tappets which control opening and closing of the intake and exhaust valves. The camshaft has an integral spur gear that drives the propeller governor output shaft.

The main bearing bores are machined for precision-type main bearing inserts. The crankshaft main-bearings are pairs of inserts installed in the crankcase at each journal.

The crankshaft is within the crankcase. The crankshaft has journals and counterweights. The counterweights decrease torsional vibrations as the crankshaft turns to operate the propeller.

The propeller flange is an integral part of the crankshaft in accordance with specification AS127, Type 2. Oil is supplied through the propeller flange for a single-acting controllable pitch propeller.

Ignition System

The ignition system includes:

- All weather-shield ignition system
- Twelve radio-shielded long reach spark plugs, two for each cylinder
- Weather-shielded ignition harness
- Two magnetos.

Magnetos

The left magneto has a retard breaker which supplies a fixed retard and long duration boosted spark for starting. The right magneto is a plain magneto and is grounding during the start cycle. The shafts in both magnetos rotate clockwise (when facing the drive pad).

Electrical System

The electrical system includes:

- 24 V, 70 amp alternator
- 24 V geared starter
- Wiring harness.

Fuel Injection System

The IO-540-AG1A5 engine has fuel injectors, the AN-type fuel pump, and a rear mounted Lycoming servo regulator continuous flow type FM250 or 2549038 fuel control which controls fuel flow in proportion to air flow with injection. The fuel control meters fuel to the nozzles at each individual cylinder and intake port in proportion to induction airflow. The fuel pump operates the fuel control. Fuel mixing and idle cut-off are manual. The fuel injectors supply fuel priming. A separate fuel priming system is not necessary.

NOTICE: For accurate fuel flow indication, the gage must be equal to the ambient pressure surrounding the fuel injector nozzles. If fuel pressures differ by more than 4 in. (10 cm) of water, the gauge must be vented to ambient pressure surrounding the nozzles.

External fuel filtering requirements are 150 micron maximum.

Cooling System

Engine cooling is by air pressure built up on one side of the cylinder and then discharged through the cylinder fins for engine cooling. Baffles build sufficient pressure to push air through the cylinder fins. Air exhaust flows to the atmosphere through gills or augmenter tubes at the rear of the cowling.

Lubrication System

The lubrication system includes a wet sump, oil pump, oil fill/dipstick, oil suction screen, oil pressure screen, oil filter, and oil lines. The oil fill/oil dipstick is on top of the engine. Two filler extensions are available.

There are two drain plugs on each side of the bottom of the oil sump. Another plug at the rear of the oil sump is for removal of the oil suction screen (which is on the side of the oil sump).

Oil flow is as follows:

1. The oil pump, in the accessory housing, pulls oil through a drilled passage leading from the oil suction screen in the oil sump.
2. The oil enters a drilled passage in the accessory housing, where oil flows through a flexible line to the external oil cooler. (An oil cooler bypass valve opens if there is a restriction in oil flow of oil to the cooler.)
3. Pressurized oil from the oil cooler flows to a threaded connection on the accessory housing through a drilled passage to the oil pressure screen, in a chamber below the tachometer drive.
4. Oil flows through a drilled passage to the oil relief valve, in the upper right side of the crankcase in the front of the accessory housing.
5. This relief valve controls engine oil pressure. This valve lets excessive oil flow return to the oil sump, while the balance of the pressurized oil flows to the main oil gallery.
6. Oil distribution is through separate drilled passages to the main bearings of the rod journals.
7. Oil from the main oil gallery also flows to the camshaft and the valve gear passages, and then through branch passages to the tappets and the camshaft bearings.
8. Oil enters the tappet through indexing holes and travels out through the hollow push rods to the valve mechanism to lubricate the valve rocker bearings and the valve stems.
9. Residual oil from the bearings, accessory drives and the rocker boxes flows by gravity to the oil sump.

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.

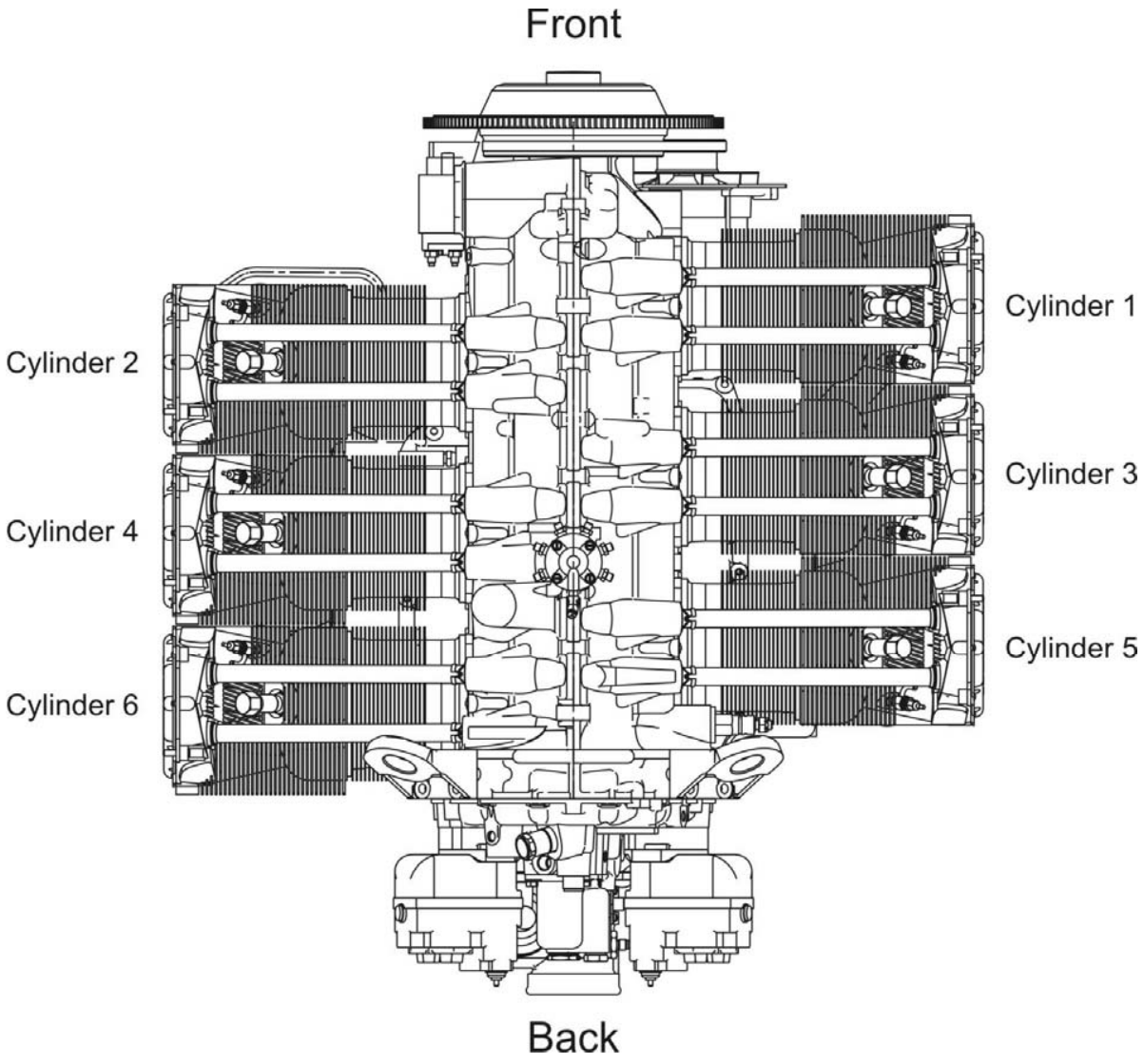

Figure 2 - Cylinder Number Designation

ENGINE RECEPTION AND LIFT

Uncrate Procedure for a New or Rebuilt Engine

NOTICE: If the engine is to be stowed, refer to the chapter "Engine Preservation and Storage" in this manual.

1. When the engine is received, make sure that the crating is not damaged. If the engine crate is damaged, speak to Lycoming's Service Department and the freight shipper. If the crate is acceptable, remove the engine from the crate.
   A. These engines are usually sent in a box where the engine is in a crate within the box. The engine can be in a plastic bag or wrapped and it could have a top foam pillow.

⚠ WARNING: URETHANE FOAM IS FLAMMABLE! DO NOT PUT URETHANE FOAM NEAR OPEN FLAMES OR ANY OTHER DIRECT OR INDIRECT HIGH TEMPERATURE SOURCE OF IGNITION SUCH AS WELDING, BURNING CIGARETTES, SPACE HEATERS, OR HOT LIGHTS.

⚠ WARNING: URETHANE FOAM WILL BURN RAPIDLY AND RELEASE A LOT OF HEAT. IN AN ENCLOSED SPACE, THE DEFICIENCY OF OXYGEN WILL CAUSE A DANGER OF SUFFOCATION TO THE OCCUPANTS. IF HUMANS BREATHE HAZARDOUS GASES SUCH AS CARBON MONOXIDE AND CARBON DIOXIDE RELEASED BY THE BURNING FOAM, THE NOXIOUS FUMES CAN BE HARMFUL OR FATAL.

2. To uncrate the engine:
   A. Cut the bands on the box.
   B. If there are staples at the bottom perimeter around the box, remove the staples and lift away the box. If there are no staples on the bottom perimeter of the box, cut the tape at the top of the box with a knife and open the box.
   C. Remove a few top slats of the crate and then remove the top pillow.
   D. Look for any fluid (oil or fuel) on the skid or below the engine. If fluid is found, identify the source.
   E. If the leaked fluid is preservative oil, examine each engine cylinder as per the "60 to 180-Day Engine Preservation" section in the "Engine Preservation and Storage" chapter in this manual

Acceptance Check

1. Make sure that the engine serial number and model number on the engine data plate are the same as specified in the engine logbook and on the packing slip.
2. Examine the engine for damage or corrosion before lifting. If the engine is damaged or has corrosion, identify the areas of damage and corrosion. Speak to Lycoming's Service Department and the Freight Shipper.

⚠ CAUTION: DO NOT LIFT, INSTALL OR STORE A DAMAGED OR CORRODED ENGINE (PRIOR TO RECEIVING INSTRUCTIONS FROM LYCOMING ENGINES OR THE FREIGHT SHIPPER).

3. If the engine is not damaged and is without corrosion, it can be installed or stored. If the engine is to be installed within 5 days after uncrating, refer to the section "Step 1. Prepare the Engine" in the "Requirements for Engine Installation" chapter.

4. Refer to the section “Lift the Engine” in this chapter and lift the engine.

Engine Deinhibition

The engine is sent with preservative oil in the cylinder and preservative oil in the crankcase. Refer to the “Prepare a New or Rebuilt Engine for Installation” section in the “Requirements for Engine Installation” chapter in this manual.

Lift the Engine (Includes center of gravity)

⚠ **CAUTION:** THE HOIST MUST HAVE A CAPACITY TO LIFT A MINIMUM OF 750 LB (340 KG).

⚠ **CAUTION:** BEFORE SHIPMENT, THE ENGINE CYLINDERS AND CRANKCASE HAVE BEEN FILLED WITH PRESERVATIVE OIL. WHEN LIFTING THE ENGINE, USE CARE TO PREVENT THE PRESERVATIVE OIL FROM SPLASHING ON OTHER ENGINE PARTS.

NOTICE: The center of gravity for this engine (including the starter and alternator) is 0.88 in. (22 - 35 mm) below the centerline of the crankshaft, 0.16 in. (4.06 mm) to the right of the center line of the crankshaft, and 18.25 in. (46.4 cm) from the front face of the propeller mounting flange.

NOTICE: Moment of inertia (including starter and alternator). All axes pass through the center of gravity. At the axis parallel to the crankshaft centerline (Iyg) 87.22 in.-lb sec^2. At the vertical axis (Izg) 161.84 in.-lb sec^2. At the axis parallel to the centerline of the cylinders (Iyg) 106.88 in.-lb sec^2.

1. Connect the hoist and chains to the lifting lug on the engine as shown in Figure 1.

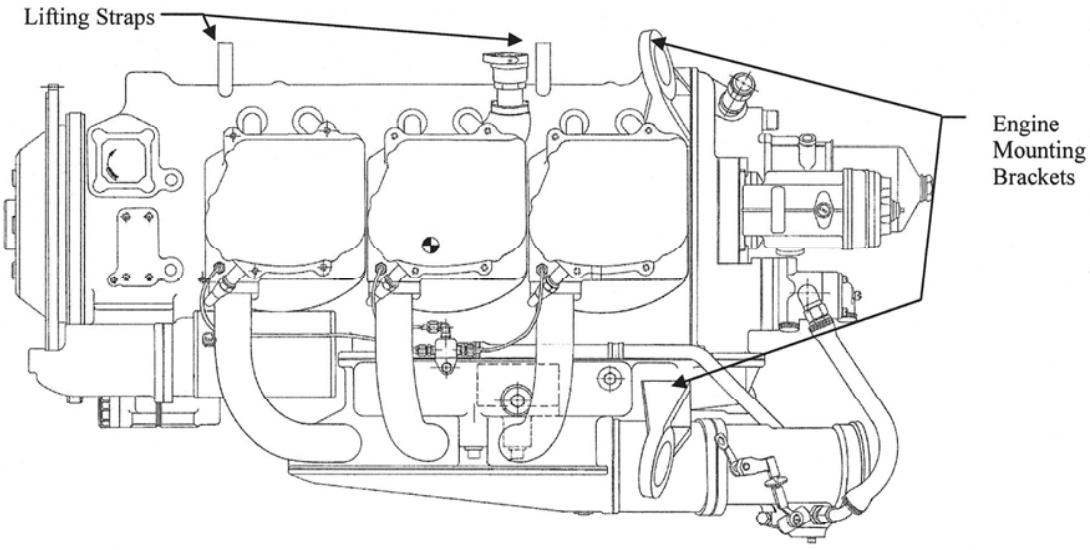

Figure 1 - Engine Lift

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

2. Lift the engine slowly and vertically.

3. When the engine has preservative oil, do the deinhibition procedure now while the engine is lifted. Refer to the section “Prepare a New or Rebuilt Engine for Installation” section or “Prepare a Stored Engine for Installation” in the “Requirements for Engine Installation” chapter in this manual.

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REQUIREMENTS FOR ENGINE INSTALLATION

Overview

NOTICE: All requirements identified in this chapter must be completed before the engine can be installed. These requirements are for a new, rebuilt or stored engine to be placed into service.

Table 1 identifies the necessary steps that must be done before the engine can be installed.

TABLE 1. PREREQUISITES FOR ENGINE INSTALLATION

Step	Section References in This Chapter
1	Prepare the Engine
2	Supply Interface Items
3	Measure Engine Dimensions
4	Remove Components
5	Install Aircraft-Supplied Engine Mounts
6	Make the Aircraft Engine Harness
7	Make Electrical Interface Connections

Step 1. Prepare the Engine

To prepare a new or rebuilt engine	Refer to the section “Prepare a New or Rebuilt Engine for Installation” in this chapter.
To prepare an engine that has been in storage	Refer to the section “Prepare a Stored Engine for Installation” in this chapter.

Prepare a New or Rebuilt Engine for Installation

If the engine has been stored in temperatures below 50°F (10°C), 24 hours before the engine is to be installed and operated, move the engine to an environment where the temperature is at least 70°F (21°C). If the engine cannot be moved to a warmer environment, apply heat to the cylinders with heat lamps before draining the preservative oil from the engine. Refer to the section “Apply Heat to a Cold Engine” in the “Unusual Conditions” chapter in this manual.

NOTICE: The engine is sent from the factory with preservative oil in the cylinders and in the crankcase. A preservation date stamp (usually on the engine box) identifies the date this oil was added and preservation is good for 60 days afterward. If an intake valve was open, the preservative oil can get into the induction system of the engine. This preservative oil must be removed as per this procedure.

To prepare the new or rebuilt engine for installation in the airframe:

⚠ **CAUTION:** DO NOT ROTATE THE CRANKSHAFT OF AN ENGINE WITH PRESERVATIVE OIL BEFORE REMOVAL OF THE BOTTOM SHIPPING OR SPARK PLUGS. OTHERWISE, ENGINE DAMAGE, CAUSED BY HYDRAULIC LOCK, CAN OCCUR.

1. Lift the engine. Refer to the section “Lift the Engine” in the “Engine Reception and Lift” chapter in this manual.

2. Complete the deinhibition procedure as follows:
   A. If any of the dehydrator plugs (which contain crystals of silica gel) break and the crystals fall into the engine, do the following.
      — Disassemble the affected portion of the engine (per the Direct Drive Overhaul Manual).
      — Clean the engine (per the Direct Drive Overhaul Manual).
   B. Remove desiccant bags.
   C. Remove the shipping plugs installed in the lower spark plug holes.
   D. Remove the desiccant plugs from the upper spark plugs holes.
   E. Put a container under the engine to collect the cylinder preservative oil.
   F. Turn the crankshaft through three or four complete revolutions to remove the cylinder preservative oil from the cylinders.
   G. Collect the cylinder preservative oil as it drains out of the lower spark plug holes.
   H. Tilt the engine to one side until the spark plug holes on that side are vertical.
   I. Rotate the crankshaft two revolutions and let the oil drain out through the spark plug holes.
   J. Tilt the engine to the other side until the spark plug holes on that side are vertical.
   K. Rotate the crankshaft two revolutions and let the oil drain out through the spark plug holes.
3. Examine the cylinder bores with a borescope for rust and contamination. Refer to the IO-540-AG1A5 Series Maintenance Manual.
4. If any corrosion or unusual conditions are found, speak to Lycoming Engine's Service Department.
5. Drain oil from the oil sump:
   A. Put a container under the oil sump.
   B. Remove the safety wire and oil sump drain plug. Discard the safety wire.
   C. Drain the remaining preservative oil from the oil sump into the container.

      NOTICE: If some preservative oil stays in the engine, it will not damage the engine. The preservative oil will be removed after the first 25 hours of operation during the oil change. The oil must be drained while hot to remove any remaining preservative oil.

   D. 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.
   E. 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.
   F. Apply one to two drops of Loctite 564 to the threads of the drain plug and install the drain plug.

⚠ **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.

   G. Torque the drain plug in accordance with the latest revision of the Table of Limits, SSP-1776 for torque values.

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

I. Add oil.

6. Drain the fuel pump:
   A. Put a collection container underneath the fuel pump.
   B. Remove the shipping cap installed on the inlet fitting of the fuel pump.
   C. Disconnect the outlet hose from the outlet fitting on the fuel pump.
   D. Let the preservative fluid drain from the fuel pump and outlet hose into a collection container.
   E. Connect the outlet hose to the outlet fitting on the fuel pump.
   F. Install the shipping cap.
7. Make sure that the induction riser is clean and dry. If you find more than 1/2 quart (0.47 liter) of preservative oil is in the induction riser:
   A. Tilt the engine to one side until the spark plug holes on that side are vertical.
   B. Rotate the crankshaft two revolutions and let the oil drain out through the spark plug holes.
   C. Tilt the engine to the other side until the spark plug holes on that side are vertical.
   D. Rotate the crankshaft two revolutions and let the oil drain out through the spark plug holes.
8. Examine the spark plugs. Refer to the IO-540-AG1A5 Series Engine Maintenance Manual for the spark plug inspection procedure.
9. If spark plugs are acceptable, install them. If the spark plugs are dirty, clean them. If the spark plugs are not acceptable, install new spark plugs and connect them to the ignition leads.
10. If a constant speed propeller is used:
    A. Use a pointed punch tool to make a 1/8 in. (3.18 mm) to 3/16 in. (4.76 mm) hole in the center of the front crankshaft plug.
    B. Remove and discard the expansion plug from the crankshaft.
    C. Look for and remove any foreign object contamination (sometimes a little piece of expansion plug falls off).
11. Remove the fuel inlet strainer and clean it with a hydrocarbon-based solvent such as mineral spirits or equivalent.
12. Examine the fuel supply lines, fuel manifold, throttle body, and "bullet nose" venturi to make sure they are clean and dry.

    NOTICE: During the first 50 hours of engine operation of new or rebuilt engines, it is recommended that this engine br operated with mineral oil until oil consumption has stabilized.

13. Add mineral oil to a new or rebuilt engine. Refer to the IO-540-AG1A5 Series Engine Maintenance Manual.
14. Use the correct disposal procedure for collected oil in accordance with local regulations and environmental protection policy.

Prepare a Stored Engine for Installation

This procedure is for an engine that has been in storage. An engine in storage has preservative oil.

If the engine has been stored in temperatures below 50°F (10°C), move the engine to an environment of at least 70°F (21°C) for 24 hours before preservative oil is drained from the cylinders. If the engine cannot be moved to a warmer environment, apply heat to the cylinders with

heat lamps before draining the preservative oil from the engine. Refer to the section “Apply Heat to a Cold Engine” in the “Unusual Conditions” chapter of this manual.

Promptly, prepare the stored engine for installation into the airframe as follows:

1. Lift the engine. Refer to the section “Lift the Engine” in the “Engine Reception and Lift” chapter in this manual.
2. Put a container under the engine to collect the cylinder preservative oil.

⚠ **CAUTION:** DO NOT ROTATE THE CRANKSHAFT OF AN ENGINE WITH PRESERVATIVE OIL BEFORE REMOVAL OF THE BOTTOM SPARK PLUGS. ENGINE DAMAGE CAUSED BY HYDRAULC LOCK CAN OCCUR.

3. If an engine has been in long-term storage or preservation, remove the seals, tape, dehydrator plugs, and desiccant bags. (Use solvent to remove tape residue).
4. Examine the engine for any damage.
5. If the engine is not damaged, go to the next step. If damage is found, identify and correct or repair the problem. Record findings and corrective action in the engine logbook.
6. Remove the spark plugs or protective plugs from the bottom spark plug holes.
7. Remove any other moisture-prevention seals and covers from the engine.

⚠ **CAUTION:** IF PRESERVATIVE OIL TOUCHES PAINTED SURFACES, REMOVE THE OIL IMMEDIATELY TO PREVENT DAMAGE TO THE PAINT.

8. Complete the deinhibition procedure as follows:
   A. If any of the dehydrator plugs (which contain crystals of silica gel) break and the crystals fall into the engine, do the following.
      — Disassemble the affected portion of the engine (as per the Direct Drive Overhaul Manual).
      — Clean the engine (per the Direct Drive Overhaul Manual).
   B. Put a container under the engine to collect the cylinder preservative oil.
   C. Turn the crankshaft through three or four revolutions to remove the cylinder preservative oil from the cylinders.
   D. Collect the cylinder preservative oil as it drains out of the lower spark plug holes.
   E. Tilt the engine to one side, until the spark plug holes on that side are vertical.
   F. Rotate the crankshaft two revolutions and let the oil drain out through the spark plug holes.
   G. Tilt the engine to the other side until the spark plug holes on that side are vertical.
   H. Rotate the crankshaft two revolutions and let the oil drain out through the spark plug holes.
9. Examine the cylinder bores with a borescope for rust and contamination. Refer to the IO-540-AG1A5 Series Engine Maintenance Manual.
10. If any corrosion or unusual conditions are found, speak to Lycoming Engine’s Service Department.
11. Drain oil from the oil sump:
    A. Put a container under the oil sump.
    B. Remove the safety wire and oil sump drain plug. Discard the safety wire.
    C. Drain the preservative oil from the oil sump into the container.

NOTICE: If some preservative oil stays in the engine, it will not damage the engine. The preservative oil will be removed after the first 25 hours of operation during the oil change. The oil must be drained while hot to be sure to remove any remainder of preservative oil.

D. Remove 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.

E. 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.

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

⚠ **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.

G. Torque the drain plug in accordance with the latest revision of Table of Limits, SSP-1776 for torque values.

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

I. Add oil.

12. Remove the oil filter and install a new oil filter. Refer to the IO-540-AG1A5 Series Engine Maintenance Manual.
13. If a constant speed propeller is to be used:
    A. Use a pointed punch tool to make a 1/8 in. (3.18 mm) to 3/16 in. (4.76 mm) hole in the center of the front crankshaft plug.
    B. Remove and discard the expansion plug from the crankshaft.
    C. Look for and remove any foreign object contamination (sometimes a little piece of expansion plug falls off).
14. Examine the spark plugs. Refer to the IO-540-AG1A5 Series Engine Maintenance Manual for the spark plug inspection procedure.
    A. If spark plugs are acceptable, install them. If the spark plugs are dirty, clean them in petroleum solvent. If the spark plugs are not acceptable, install new spark plugs. Refer to the IO-540-AG1A5 Series Engine Maintenance Manual.
    B. Remove the protectors on the ignition lead ends.
    C. Connect the ignition lead ends.
15. Remove the fuel inlet strainer and clean it with a hydrocarbon-based solvent such as mineral spirits or equivalent.
16. Examine the fuel supply lines, fuel manifold, throttle body, and "bullet nose" venturi to make sure they are clean and dry.

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

17. Add mineral oil to a new or rebuilt engine, otherwise add specified oil in Appendix A. Refer to the IO-540-AG1A5 Series Engine Maintenance Manual.

18. Use the correct procedure for disposal of drained oil and fuel in accordance with local, state, federal, and environmental protection regulations.

Step 2. Supply Interface Items

Table 2 contains available equipment options, recommendations and requirements for the airframe manufacturer to prepare for engine installation.

TABLE 2. OPTIONAL EQUIPMENT, RECOMMENDATIONS, AND REQUIREMENTS TO PREPARE THE ENGINE FOR INSTALLATION

Issue	Recommendation/Requirement
Installation drawings and wiring diagrams	Installation drawings are available for purchase from Lycoming Engines. Contact the Publications clerk at Lycoming Engines at 570-327-7274
DC power source	
Starting vibrator	
Magnetos	Refer to the magneto manufacturer's documentation for information on various vibrator and switching arrangements.
	If a different magneto is necessary, refer to the latest revision of Service Instruction No. 1443.
Alternators	If a different alternator is necessary, refer to the latest revision of Service Instruction No. 1154. If an alternator blast tube is used, connect the blast tube to a source of cooling air.
Propeller	This engine design is for a single-acting controllable pitch propeller. However, the heavier counterweights enable the use of the Hartzell compact propeller. Please speak with Lycoming Engines to be sure that the propeller to be installed is approved for use on this engine.
Cylinder head temperature measurement	Airframe manufacturer supplied bayonet thermocouples with AN-4076 fittings for installation on each cylinder head.
Oil Cooler	Provision is made for airframe manufacturer-supplied full flow oil cooler. Oil flow through the cooler system will be approximately 9.5 gallons per minute (36.0 liters minute) and heat rejection will not exceed 1800 Btu per minute. The oil cooler must withstand continuous pressure of 150 psi (1034 kPa).). A thermostatic bypass and pressure relief valve are supplied as standard equipment. The valve closes at 185ºF (85ºC) routing all engine oil flow through the cooler. If pressure drop across the oil cooler system is more than +75 psi (517 kPa) ±15 psi (103 kPa), the pressure relief valve opens to bypass the cooler.
Wiring harness	Connection point to attach wiring harness to the airframe.
Oil pressure gage	There is a tapped hole for installation of an oil pressure gage connection (see installation drawing). The airframe manufacturer supplies the oil pressure gage with a restricted fitting. **NOTICE:** Installation drawings for this engine are available for purchase. Refer to Appendix B.

TABLE 2. OPTIONAL EQUIPMENT, RECOMMENDATIONS, AND REQUIREMENTS TO PREPARE THE ENGINE FOR INSTALLATION (CONT.)

Issue	Recommendation/Requirement
Fuel supply hose (airframe-supplied)	Correctly-sized hose for the fuel pump supply and return vent line back to the airframe.
Fuel selector switch	
Fuel inlet connection	
Independent fuel shut-off valve	To meet engine shutdown requirements.
Air cleaner	Air cleaner air flow at sea level rated power is 2000 lb of air.
Aircraft battery	Two, 12-volt, 25 amp batteries connected in series or one 24-volt, 25 amp battery.
Starter wiring and controls	
Airframe engine mount ground straps	
Whistle slot	To prevent icing of the breather tube.
Exhaust collector	There is a provision for installation of an exhaust collector.

Step 3. Measure Engine Dimensions

Figures 1 and 2 show the approximate physical dimensions of the engine.

1. Measure the length, width, and height of the engine.
2. Measure the length, width, and depth of the engine compartment.

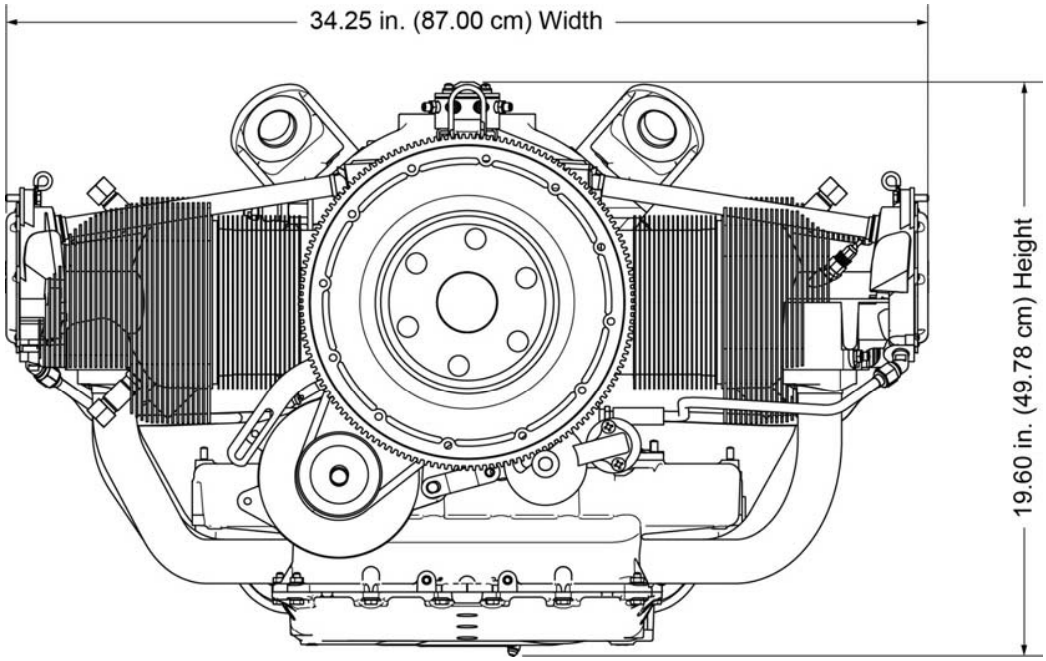

Figure 1. Physical Dimensions of the Engine (Front)

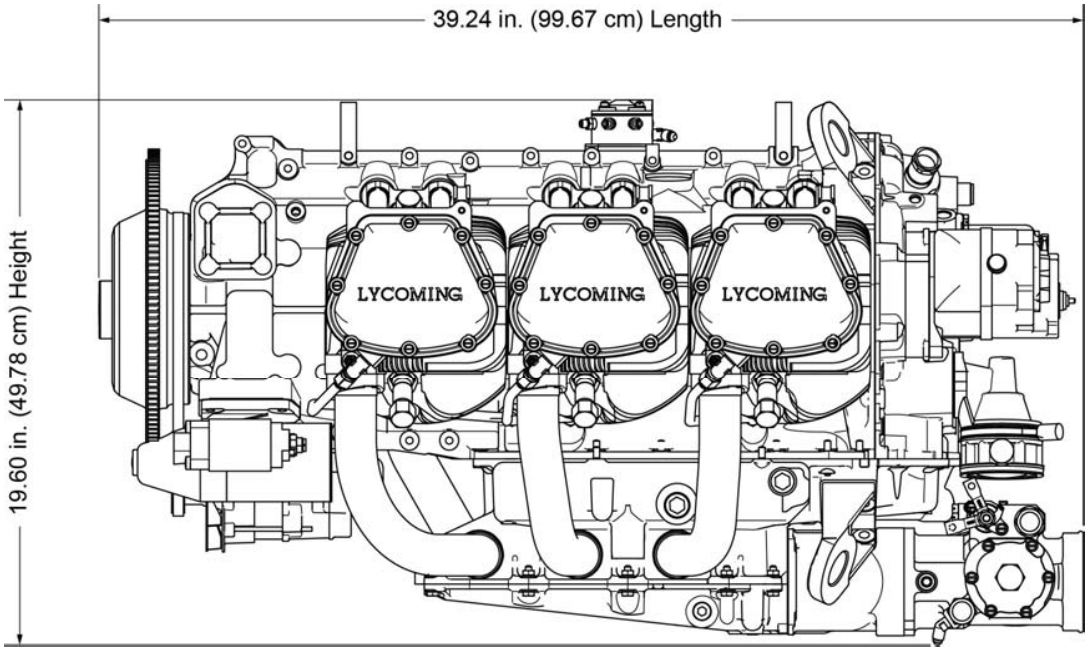

Figure 2. Physical Dimensions of the Engine (Side)

Step 4. Remove Components

It could be necessary to temporarily remove a component, such as an exhaust pipe, to install the engine in its compartment on the aircraft.

Remove only the components necessary to enable engine installation.

The component(s) will be installed on the engine after the engine is installed.

Step 5. Install Aircraft-Supplied Engine Mounts

Provision is made for rear-type dynafocal mounts by means of four mounting brackets, two at the top rear of the crankcase section and two at the rear of the oil sump.

The airframe manufacturer is to supply bonded rubber mounts and bolts for attachment to the Type 1 Dynafocal engine mounts. There are four mounting bosses integral to the crankcase. Refer to the installation drawing.

Maximum Allowable Load for the Mounting Attachment and Structure

The Type 1 Dynafocal mounts can withstand a 10g load per FAA FAR requirements.

Step 6. Make the Aircraft Engine Harness

A wiring diagram will be supplied to the airframe manufacturer which identifies the necessary wires and configurations that must be used to make the aircraft engine harness. This harness is not to be confused with the wiring harness that is already attached to the engine.

All wires must be in compliance with aviation standards wiring.

Step 7. Make Electrical Interface Connections

The electrical interface includes wiring, lighting indication, and switches.

Grounding Requirements

Install grounding jumpers from the engine case to the engine mounting frame. (The engine mount must also be grounded to the airframe).

ENGINE INSTALLATION

Engine Installation Overview

NOTICE: All requirements identified in the chapter "Requirements for Engine Installation" must be completed before engine installation.

NOTICE: This engine can be installed in aircraft in Table 1.

TABLE 1. AIRCRAFT WHERE IO-540-AG1A5 ENGINES CAN BE INSTALLED

FAR Part 23 normal and utility category aircraft up to Class III

NOTICE: This engine cannot be installed in aircraft in Table 2.

TABLE 2. AIRCRAFT WHERE IO-540-AG1A5 ENGINES CANNOT BE INSTALLED

Any FAR part 25 aircraft
Any FAR Part 27 rotorcraft
Any FAR Part 29 rotorcraft

NOTICE: Installation drawings for this engine are available for purchase from Lycoming Engines. Refer to Appendix B for ordering information.

To install the engine, refer to the section reference in this chapter for each step in Table 3.

TABLE 3. ENGINE INSTALLATION STEPS AND REFERENCES

Step	Section References in This Chapter
1	Install the Engine on Mounts
2	Connect the Wiring Harness
3	Connect the Throttle Linkage
4	Install External Accessories (as necessary)
5	Install Baffling
6	Install the Compressor Belt (as necessary)
7	Install the Propeller
8	Connect Fuel Lines
9	Connect Oil Lines
10	Install Components That Had Been Removed Before Engine Installation
11	Make Remaining Engine Connections
12	Add Oil
13	Add Fuel (to aircraft as necessary)
14	Engine Pre-Oil Procedure
15	Final Installation Inspection
16	Close the Engine Compartment

Step 1. Install the Engine on Mounts

⚠ **CAUTION:** MAKE SURE THAT THE ENGINE MOUNTS ARE ALIGNED AND NOT BENT OR DEFORMED. IF THE ENGINE IS INSTALLED ON DEFORMED ENGINE MOUNTS OR MISALIGNED, THE ENGINE CAN BE PUT UNDER UNUSUAL STRESS WHICH CAN CAUSE MALFUNCTION.

1. Lift the engine and put it into the airframe. Refer to the “Lift the Engine” section in the “Engine Reception and Lift” chapter in this manual.
2. Install hardware to securely attach the engine to the airframe and isolation mounts.
3. Torque the mounting hardware as per the airframe manufacturer’s maintenance manual.
4. Disconnect the hoist from the lifting eyes.
5. Make sure the airframe ground straps are connected to the engine mounts.

Step 2. Connect the Wiring Harnesses

1. Connect the airframe engine wiring harness as necessary. Refer to the airframe manufacturer’s wiring diagram, specifications and drawings.
2. Connect wiring to the starter.

Step 3. Connect the Throttle Linkage

Connect the throttle mixture, and propeller (if constant speed) as necessary in accordance with the airframe manufacturer's specifications and drawings.

Step 4. Install External Accessories (as necessary)

1. Remove the accessory drive cover plate and gasket.
2. Install the accessory on the supplied pad in accordance with the airframe manufacturer’s instructions. Refer to Table 3 in Appendix A.
3. If necessary, install the propeller governor; use the manufacturer’s supplied gasket and hardware. Refer to Table 3 in Appendix A.

Step 5. Install Baffling

Install baffling around the engine compartment.

Step 6. Install the Compressor Belt (as necessary)

Install the compressor belt (which will drive an aircraft-supplied air conditioning unit) in accordance with airframe and compressor manufacturer's instructions.

Step 7. Install the Propeller

Install the propeller in accordance with the propeller and airframe manufacturer's instructions.

Step 8. Connect Fuel Lines

1. Remove unwanted material from the aircraft fuel strainer. Let a minimum of 1 gallon (3.8 liters) of fuel flow through the strainer, aircraft fuel filter and fuel supply line.

⚠WARNING: REMOVE ANY CONTAMINATION FROM AIRCRAFT FUEL TANKS AND FUEL LINES. FAILURE TO REMOVE ALL CONTAMINATION CAN CAUSE PREMATURE FUEL FILTER REPLACEMENT OR INCORRECT FUEL SYSTEM OPERATION.

2. Before connection of the main fuel inlet line to the fuel pump, remove all contaminants from aircraft fuel tanks and fuel lines.
3. Make sure that the airframe manufacturer has a fuel filter installed on the airframe.
4. Remove protective caps from the main fuel inlet.
5. Connect the main fuel inlet line to the fuel pump. Torque the connections as per the airframe manufacturer's instructions.
6. Required guidelines for making fuel line connections:
   A. Make sure that each fuel line is intact. Not bent or damaged, and does not have any kinks or dents. The fuel line must be intact.

      NOTICE: Refer to the IO-540-AG1A5 Series Engine Maintenance Manual for suggested routing and configuration arrangement diagrams for fuel lines on this engine. The fuel line configuration diagram is conceptual and for reference only. Fuel line routing on your engine could have slightly different configurations. Fuel lines must be examined every 100 hours as per the IO-540-AG1A5 Series Engine Maintenance Manual.

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

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

Step 9. Connect Oil Lines

⚠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.

1. Connect the oil line to the airframe-supplied oil cooler.
2. Clean each hose section and install it in the respective areas. Make sure the hose routing is smooth, without sharp bends, kinks or helical twists.
3. When making the following oil hose connections:
   A. Align the oil hose with the fitting for best orientation (without kinks or sharp bends).
   B. Torque the fitting to the torque value in the latest revision of the Table of Limits, SSP-1776.

Step 10. Install Components That Had Been Removed Before Engine Installation

Install any component that was removed to enable the engine to be installed.

Step 11. Make Remaining Engine Connections

1. Make engine connections to accessories. Refer to Table 3 in Appendix A.
2. Make engine connections to wires and cables.
3. Make engine connections to ducts and cowling.
4. Make engine connections to breather, hoses and pipes.
5. In accordance with the airframe manufacturer's instructions, install all cowling and nacelle access panels.

Step 12. Add Oil

⚠ **CAUTION:** OIL IN THE CORRECT QUANTITY AND OF THE CORRECT VISCOSITY FOR THE CORRESPONDING AMBIENT TEMPERATURE MUST BE ADDED TO THE ENGINE FOR CORRECT LUBRICATION ESSENTIAL TO ENGINE OPERATION. REFER TO APPENDIX A FOR OIL TYPES AND OIL SUMP CAPACITY TO HAVE THE CORRECT QUANTITY AND TYPE OF OIL TO ADD TO THE ENGINE.

NOTICE: During the first 50 hours of engine operation of new or rebuilt engines, it is recommended that this engine be operated with mineral oil until oil consumption has stabilized. Otherwise, add oil specified in Appendix A.

Add mineral oil to a new or rebuilt engine, otherwise add oil specified in Appendix A. Refer to the IO-540-AG1A5 Series Engine Maintenance Manual for the procedure to add oil.

Step 13. Add Fuel

⚠ **WARNING:** DETONATION CAN OCCUR IF THE INCORRECT FUEL IS USED. DETONATION CAN INCREASE ENGINE CYLINDER TEMPERAURE AND PRESSURE AND CAUSE DAMAGE TO THE ENGINE.

Add the correct fuel to the aircraft. Refer to Appendix A or the latest revision of Service Instruction No. 1070 for fuel specifications.

Step 14. Engine Pre-Oil Procedure

⚠ **WARNING:** IF THE PRE-OIL PROCEDURE IS NOT DONE, HIGH-SPEED BEARING FAILURE CAN OCCUR.

Complete the engine pre-oil procedure on the engine at the following times:

- Before the initial start of a new, overhauled, rebuilt or stored engine
- After oil cooler replacement-draining
- After any prolonged period of inactivity
- After an oil line has been disconnected.

To complete the pre-oil procedure:

1. Make sure that the mixture control lever is in the IDLE CUT-OFF position.
2. Make sure the ignition switch is OFF and magneto P leads are grounded.
3. Make sure the fuel selector and fuel pump switches are in the OFF position.

4. Disconnect the inlet lines.
5. Remove one spark plug from each cylinder of the engine as per instructions in the IO-540-AG1A5 Series Engine Maintenance Manual.
6. Remove and discard the spark plug gasket
7. Enable power to the engine.

⚠ **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.

8. 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.

9. 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.

⚠ **CAUTION:** FAILURE TO INSTALL A NEW SPARK PLUG GASKET ANY TIME A SPARK PLUG IS INSTALLED MAY RESULT IN INCOMPLETE SEALING OF THE COMBUSTION CHAMBER, LOSS OF SPARK PLUG HEAT TRANSFER, SPARK PLUG OVERHEATING, POSSIBLE REIGNITION/DETONATION, AND INTERNAL ENGINE DAMAGE.

NOTICE: A new spark plug gasket must be installed whether a new or acceptable re-used spark plug is to be installed.

10. Once the minimum oil pressure of 20 psi (138 kPa) is shown on the oil pressure gauge, re-install the spark plug each with a new gasket as per instruction in the IO-540-AG1A5 Series Engine Maintenance Manual.
11. Connect the inlet lines.
12. Within the next 3 hours, start and operate the engine for 3 minutes at approximately 1000 rpm.

Step 15. Final Installation Inspection

Complete the Engine Installation Checklist at the end of this chapter.

Step 16. Close the Engine Compartment

1. Make sure that there are no tools or unwanted materials in the engine, in the engine nacelle or compartment.
2. Install all cowling and nacelle access panels to close the engine compartment securely. Refer to the airframe manufacturer's instructions and specified torque values.

Engine Installation Checklist

ENGINE INSTALLATION CHECKLIST

Requirement	Done		Comment
Make sure the engine is securely installed on the engine mounts. Make sure that the hardware that attaches the engine to the engine mounts is torqued as per the airframe manufacturer's specified torque values.	Yes	No	
Make sure the airframe ground straps are connected to the engine mounts.	Yes	No	
Make sure all spark plugs are installed.	Yes	No	
Make sure all harness and wiring connections have been made.	Yes	No	
Make sure the wiring harness is attached to the engine.	Yes	No	
Make sure baffles have been installed.	Yes	No	
Make sure oil has been added to engine.	Yes	No	
Make sure the engine pre-oil procedure has been completed.	Yes	No	
Make sure fuel has been added to aircraft fuel tanks.	Yes	No	
WARNING: TO PREVENT CATASTROPHIC FAILURE FROM FOREIGN OBJECT DEBRIS (FOD), MAKE SURE THAT THERE ARE NO TOOLS IN THE ENGINE NACELLE AND COMPARTMENT.			
Remove any tools or unwanted materials from the engine compartment.	Yes	No	

ENGINE START AND OPERATION

Warranty Requirement

⚠WARNING: AS ONE OF THE CONDITIONS FOR THE ENGINE WARRANTY, YOU MUST OPERATE THIS ENGINE IN ACCORDANCE WITH SPECIFICATIONS IN THIS MANUAL. YOU ALSO MUST DO THE RECOMMENDED MAINTENANCE AND OVERHAUL PROCEDURES IN ACCORDANCE WITH THE IO-540-AG1A5 SERIES ENGINE MAINTENANCE MANUAL AND OVERHAUL MANUAL.

Before Engine Start

Before a newly installed/rebuilt/repaired/overhauled or stored engine can be used for flight, all of the steps shown in Table 1 must be done in the sequence shown. Otherwise, just do steps 2, 3, 4, 5, and 6 in Table 1. Refer to sections in this chapter.

⚠WARNING: THE SEQUENCE OF STEPS IN TABLE 1 MUST BE COMPLETED IN THE ORDER SHOWN ON AN ENGINE THAT HAS BEEN NEWLY INSTALLED AND/OR ROUTINELY INSPECTED, REBUILT, REPAIRED, OR OVERHAULED BEFORE THE AIRCRAFT IS PUT BACK INTO SERVICE.

TABLE 1. PREREQUISITE REQUIREMENTS FOR ENGINE OPERATION

Step	Section References in This Chapter
1	Prepare an Engine for First-Time Operation
2	Daily Pre-Flight Inspection
3	Start the Engine
4	Complete the Engine Run-Up
5	Operate the Engine
6	Stop the Engine

Step 1. Prepare an Engine for First-Time Operation

1. After any of the following actions, complete a pre-flight inspection (which includes this procedure) of the engine, propeller, cowl, and aircraft to make sure that the engine is operating correctly:
   - — Engine installation
   - — Fault isolation
   - — Maintenance or Overhaul
2. Make sure that all switches are **OFF.**
3. Make sure that the throttle, mixture, propeller, and alternate air controls are free to move in the full range of travel.
4. Examine the propeller and propeller hub for cracks, oil leaks, and security. Tighten if loose. Remove and replace if cracks are found. Identify and correct the cause of oil leak(s).
5. Make sure the magneto ground wires are connected.
6. As necessary, add fuel (specified in Appendix A) to the aircraft in accordance with the airframe manufacturer's instructions.

⚠ WARNING: DURING ENGINE OPERATION, THERE ALWAYS MUST BE A SUFFICIENT SUPPLY OF OIL IN THE ENGINE FOR CORRECT ENGINE OPERATION. IF ANY ENGINE IS OPERATED WITH INSUFFICIENT OIL, ENGINE FAILURE CAN OCCUR. REFER TO APPENDIX A FOR MINIMUM QUANTITY OF OIL IN FLIGHT.

NOTICE: The oil in the engine must be kept at the correct level for the engine to operate correctly.

7. Measure the engine oil level (quantity in Appendix A) before every flight to make sure there is sufficient oil in the engine. If the oil level is too low, add the correct specified grade or oil as necessary. Refer to the IO-540-AG1A5 Series Engine Maintenance Manual.

   NOTICE: During the first 50 hours of engine operation of a new or rebuilt engine, it is recommended that this engine by operated with mineral oil until oil consumption has stabilized.

   NOTICE: The oil sump capacity and the minimum quantity for flight and on the ground are identified in Appendix A.

8. Make sure that the engine crankcase breather is attached tightly and that there are no blockages to the breather air flow. Remove any blockage to the air flow. Identify and correct the cause of any blockage.
9. If the engine is newly installed or is to be put back into service after long-term storage, make sure that the pre-oil procedure was done. Refer to Section "Step 14. Engine Pre-Oil Procedure" in the "Engine Installation" chapter in this manual.
10. Make sure that the induction air filter is clean and securely in place.
11. Make sure the alternate air supply operates correctly.
12. Examine the engine, propeller hub area, and cowl for indication of fuel and engine oil leaks. Identify and correct the cause of any leaks.
13. Look in the engine and cowling for unwanted material, loose, missing fittings, clamps and connections. Examine for restrictions to cooling airflow. Remove any unwanted material. Tighten any loose connections per torque values supplied by the airframe manufacturer.

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

14. Make sure that the fuel and lubrication lines are securely connected (to prevent line movement during flight) with the necessary clamps and hardware. Fuel lines must be held in place securely with clamps in position approximately 8 in. (20 cm) apart. Refer to the IO-540-AG1A5 Series Engine Maintenance Manual for fuel line routing and guidelines.
15. Make sure that all baffles and baffle seals are installed in the correct position and are serviceable.

    NOTICE: Record any maintenance-significant events and corrective action taken in the engine logbook. Record the magnitude and duration of a problem and any out-of-tolerance values.

16. Correct all problems before engine start. Refer to the "Unusual Conditions" chapter in this manual.

Step 2. Daily Pre-Flight Inspection

1. Be sure all switches are in the OFF position.
2. Make sure the magneto ground wires are connected.
3. Measure the engine oil level to make sure there is enough oil in the engine before flight.

⚠ **CAUTION:** THE AIRCRAFT MUST HAVE A FULLY CHARGED BATTERY (AND HAVE AT LEAST 1 AMP HOUR OF RESERVE) BEFORE FLIGHT.

4. Make sure the aircraft battery has a full charge, especially in sub-freezing temperatures.
5. Always examine the fuel hoses, fittings, and oil line connections for leakage. Identify and correct the cause of any leaks before the aircraft is flown.
6. Make sure the fuel tanks are full.
7. Open the fuel drain to remove any accumulation of water and sediment.
8. Make sure all shields and cowling are in place and secure. If any are missing or damaged, repair or replace before the aircraft is flown.
9. Examine controls for general condition, correct travel and correct freedom of operation.
10. Examine the induction system air filter and complete service in accordance with the airframe manufacturer's recommendations.
11. Look for any leaks in the fuel, oil, induction and exhaust systems. Identify and correct the cause of any leaks before flight. Make sure there are no leaks before flight.

Step 3. Start the Engine

⚠ **WARNING:** MAKE SURE THAT THE AREA IN THE ROTATIONAL ARC RADIUS OF THE PROPELLER IS CLEAR OF PERSONNEL OR ANY OBSTRUCTION BEFORE STARTING THE ENGINE.

NOTICE: If the engine is to be started in an environment at temperatures less than 10°F (-12°C), refer to the section "Apply Heat to a Cold Engine" in the "Unusual Conditions" chapter in this manual. If the engine is to be operated at temperatures over 90°F (32°C), refer to "Engine Operation in Hot Weather" in the "Unusual Conditions" chapter in this manual.

1. If the engine is newly installed or is to be put back into service after long-term storage, make sure the pre-oil procedure was done. Refer to section "Step 14. Engine Pre-Oil Procedure" in the "Engine Installation" chapter in this manual.
2. Complete specified steps for engine start recommended by the aircraft Pilot Operating Handbook (POH), aircraft manufacturer, or Supplemental Type Certificate (STC) holder's instructions.

⚠ WARNING: EXAMINE THE ENGINE FOR HYDRAULIC LOCK. REFER TO THE IO-540-AG1A5 SERIES ENGINE MAINTENANCE MANUAL. DO NOT OPERATE THE ENGINE IF HYDRAULIC LOCK IS POSSIBLE. HYDRAULIC LOCK IS A CONDITION WHERE FLUID ACCUMULATES IN THE INDUCTION SYSTEM OR THE CYLINDER ASSEMBLY. HYDRAULIC LOCK CAN CAUSE ENGINE DAMAGE.

⚠ WARNING: DO NOT CONTINUE TO OPERATE A MALFUNCTIONING ENGINE. OPERATION OF A MALFUNCTIONING ENGINE CAN RESULT IN ADDITIONAL DAMAGE TO THE ENGINE, POSSIBLE BODILY INJURY OR DEATH.

3. Refer to the aircraft POH for the engine start settings and start procedure.
4. Set the alternate air control to the OFF position.
5. Set the propeller governor to FULL RPM.
6. Turn the fuel valve to the ON position.
7. Open the throttle approximately to 1/4 travel.
8. Turn the boost pump ON.
9. Move the mixture control to FULL RICH until a slight but steady flow is indicated.
10. Return mixture control to the IDLE-CUT-OFF position
11. Set the magneto select switch as per the aircraft manufacturer's instructions.

    NOTICE: For switch information, refer to the airframe manufacturer's handbook

⚠ 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. DO NOT TRY MORE THAN FIVE ENGINE STARTS WITHIN A 2-MINUTE PERIOD.

NOTICE: A low battery, engine speed less than 50 rpm, or sub-zero temperatures can prevent engine start. Refer to the section "Apply Heat to a Cold Engine" in the "Unusual Conditions" chapter.

12. Energize the starter (not to exceed 10 seconds) until the engine starts.
13. When the engine starts, move the mixture control slowly and smoothly to FULL RICH.
14. Put the magneto switch in the BOTH position.

⚠ CAUTION: DO NOT EXCEED THE IDLE RPM (SET BY THE AIRFRAME MANUFACTURER) UNTIL THE OIL PRESSURE IS STABLE ABOVE THE MINIMUM IDLING RANGE. IF THE OIL PRESSURE DOES NOT INCREASE TO THE MINIMUM PRESSURE WITHIN 10 SECONDS, STOP THE ENGINE. IDENTIFY AND CORRECT THE CAUSE. REFER TO THE "UNUSUAL CONDITIONS" CHAPTER IN THIS MANUAL.

15. Move the throttle slowly and smoothly to the IDLE rpm.
16. Look at the oil pressure gage for indicated pressure. If there is no oil pressure indication within 10 seconds, stop the engine. Identify and correct the problems.

    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, identify and correct the cause.

⚠ **CAUTION:** DO NOT OPERATE THE ENGINE AT SPEEDS ABOVE 2500 RPM UNLESS THE OIL TEMPERATURE IS AT A MINIMUM OF 100ºF (38ºC) AND THE OIL PRESSURE IS AT 115 PSI FOR INITIAL START. ENGINE DAMAGE CAN OCCUR IF THE OIL TEMEPRATURE OR OIL PRESSURE IS NOT AT THE SPECIFIED MINIMUM LEVELS.

NOTICE: Upon engine start, if smoke comes from a newly installed engine, after the first start, there could have been some preservative oil in the cylinders, induction system, and/or fuel nozzles/lines. If oil pressure is normal and the engine operates smoothly, continue to operate the engine until the smoke clears. Otherwise, stop the engine and identify the cause.

17. Operate the engine at 750 rpm for 1 minute; slowly increase the speed to 1000 rpm.
18. Let the engine operate at 1000 rpm for approximately 3 minutes.
19. Complete a magneto drop-off check as follows for all three cycles RIGHT/LEFT/BOTH.
    A. Move the propeller control through its complete range as a check for operation and return to the full low pitch position. Full feathering check (twin engine) on the ground is not recommended but a check of the feathering action can be done by operating the engine between 1000 to 1500 rpm, then momentarily pulling the propeller control into the feathering position. Do not allow the rpm to drop more than 500 rpm.
    B. With the propeller in minimum pitch angle, set the engine to produce 50 to 65% power as per the manifold pressure gage unless otherwise specified in the aircraft manufacturer's manual. At these settings, the ignition system and spark plugs must work harder because of the greater pressure within the cylinders. Under these conditions, ignition problems can occur. Magneto checks at low power settings will only indicate fuel/air distribution quality.

       NOTICE: To prevent spark plug fouling, do not operate on a single magneto for too long a period. A few seconds is usually sufficient for the magneto drop-off check.

    C. Switch from BOTH magnetos to one magneto and note the drop-off; return to BOTH until the engine regains speed and switch to the other magneto and note the drop-off, then return to BOTH. Drop-off must not exceed 175 rpm and must not exceed 50 rpm between magnetos.
    D. If the rpm drop exceeds 175 rpm, slowly lean the mixture until the rpm peaks. Then retard the throttle to the rpm specified in step 19A. for the magneto drop-off check and repeat the check. If the drop-off does not exceed 175 rpm and the difference between the drop-off values for both magnetos does not exceed 50 rpm, and the engine is running smoothly, the ignition system is operating properly.
    E. Smooth operation of the engine with a drop-off that exceeds the normal specification of 175 rpm is usually an indication of a propeller load condition at a rich mixture.
20. Look for any illuminated caution or warning lights in the cockpit.
21. Stop the engine and allow it to cool until the CHT temperature is 100ºf (38ºC).

Step 4. Complete the Engine Run-Up

⚠ **WARNING:** IF DURING ENGINE RUN-UP OR ENGINE IDLE, ANY OPERATIONAL PROBLEMS OCCUR, DO NOT TAKE-OFF. IDENTIFY AND CORRECT THE CAUSE OF THE PROBLEM AND COMPLETE THE OPERATIONAL TEST AGAIN.

Complete the engine run-up as follows:

1. With the engine running, turn the Fuel Selector to FULLEST or BOTH.
2. Make sure the oil temperature is above the specified minimum (Appendix A).
3. Operate the engine on the ground (with the propeller at minimum blade angle setting).

WARNING: IF THE ENGINE IS OPERATED AT LOW OIL PRESSURE OR LOW OIL LEVEL, THE ENGINE CAN MALFUNCTION OR STOP.

5. Make sure the oil pressure and oil temperatures are within the specified operating range in Appendix A.

CAUTION: AVOID PROLONGED IDLING AND DO NOT EXCEED 2200 RPM ON THE GROUND. THE ENGINE IS WARM ENOUGH FOR TAKE-OFF WHEN THE THROTTLE CAN BE OPENED WITHOUT THE ENGINE FALTERING.

6. With the mixture control at FULL RICH, increase the throttle to 1000 to 1200 rpm.

Step 5. Operate the Engine

CAUTION: DO NOT TAKE-OFF IF ANY OF THE FOLLOWING CONDITIONS ARE FOUND:

1. ENGINE ROUGHNESS
2. LOW, HIGH OR SURGING RPM OR FLUCTUATIONS
3. HIGH, LOW, OR FLUCTUATING OIL PRESSURE
4. HIGH OR LOW FUEL FLOW
5. HIGH MANIFOLD PRESSURE
6. LOW BATTERY CHARGE.

1. Before take-off, monitor the oil pressure, oil temperature, and cylinder head temperature to make sure all are within their operating ranges (as specified in Appendix A).
2. Make sure that when take-off power is applied smoothly, oil pressure, fuel flow, manifold pressure, and rpm remain stable.

NOTICE: After 25 hours of operation, change the oil. Examine the oil filter and screen. Refer to the IO-540-AG1A5 Series Engine Maintenance Manual.

- Examine the air filters every other flight for dirt and be prepared to clean or replace them if necessary.
- If the aircraft is flown in dusty conditions, more frequent oil changes are recommended. Install dust covers over openings in the cowling for additional protection.

Operation in Flight

1. Subject engines have a dynamic counterweight system and must be operated accordingly. Use a smooth, steady movement (avoid rapid opening and closing) of the throttle.
2. See the airframe manufacturer's instructions for recommended power settings.
3. Until oil consumption has stabilized after the first 50 hours of flight, cruising is to be done at 65% to 75% power to ensure correct safety of the rings.

Fuel Mixture Leaning

1. For maximum service life, the CHT must be maintained below 435ºF (224ºC) during high performance cruise operation and below 400ºF (205ºC) for economy cruise powers.
2. Manual leaning can be monitored by exhaust gas temperature indication, fuel flow indication, and by observation of engine speed and/or airspeed.

⚠ **CAUTION:** NEVER EXCEED THE MAXIMUM RED LINE CHT LIMIT.

3. On engines with manual control, maintain mixture control in FULL RICH position for rated take-off, climb and maximum cruise powers (above approximately 75%). However, during take-off from high elevation airport or during climb, roughness or loss of power can occur from over-richness. In such a case, adjust mixture control only enough for smooth operation - not for economy. Monitor instruments for temperature rise. Rough operation due to over-rich fuel/air mixture is most likely to be encountered at altitudes above 5,000 feet.
4. Always return the mixture to FULL RICH before increasing power settings.
5. Operate the engine at maximum power mixture for performance cruise powers and at best economy mixture for economy cruise power; unless otherwise specified in the POH. Refer to Appendix A.
6. During let-down flight operations, it could be necessary to manually lean fuel injected engines for smooth operation.
   A. Leaning to EGT (Normally aspirated engines with fuel injectors or carburetors).
      (1) Maximum Power Cruise (approximately 75% power) - Never lean beyond 150ºF on rich side of peak EGT unless aircraft operator's manual shows otherwise. Monitor cylinder head temperatures.
      (2) Best Economy Cruise (approximately 75% power and below) - Operate at peak EGT.
   B. Leaning to Flowmeter.
      (1) Lean to applicable fuel-flow tables or lean to indicator marked for correct fuel-flow for each power setting.
   C. Leaning with Manual Mixture (economy cruise, 75% power or less without flowmeter or EGT gage).
      (1) Slowly move the mixture control from FULL RICH to LEAN.
      (2) Continue leaning until a slight loss of power occurs (engine roughness could occur).
      (3) Enrich until the engine operates smoothly and power is restored.

Step 6. Stop the Engine

1. With the aircraft on the ground, set the propeller at minimum blade angle.
2. Keep the engine speed between 1000 to 1200 rpm.
3. Move the mixture control to IDLE CUT-OFF.
4. After the engine stops, set the ignition switch to the OFF position to stop the engine.
5. When the propeller stops rotating, turn the Fuel Selector to the OFF position.

⚠WARNING: DO NOT MANUALLY TURN THE PROPELLER ON A HOT ENGINE EVEN THOUGH THE IGNITION SWITCH IS IN THE **OFF** POSITION. THE ENGINE COULD KICK BACK AS A RESULT OF AUTO-IGNITION CAUSED BY A SMALL AMOUNT OF FUEL REMAINING IN THE CYLINDERS. AUTO-IGNITION COULD RESTART THE ENGINE AND CAUSE SERIOUS BODILY INJURY OR DEATH.

NOTICE: An independent fuel shut-off valve is supplied by the airframe manufacturer in compliance with engine shut-down integrity requirements.

6. Refer to airframe manufacturer's Pilot's Operating Handb00k (POH) for additional information.

UNUSUAL CONDITIONS

Corrective Action for Unusual Engine Conditions

Table 1 identifies corrective action for unusual engine conditions that could occur in flight. Detailed fault isolation is included in the IO-540-AG1A5 Series Engine Maintenance Manual.

NOTICE: Record any problems and maintenance-significant events in the engine logbook. Record the magnitude and duration, and any out-of-tolerance values.

TABLE 1. UNUSUAL ENGINE CONDITIONS IN FLIGHT

Unusual Condition	Explanation/Corrective Action
Engine roughness	Make a safe landing and speak to Maintenance.
Low, high or surging rpm	Make a safe landing and speak to Maintenance.
Low, high or fluctuating oil pressure	Make a safe landing and speak to Maintenance.
Low or high fuel flow	Make a safe landing and speak to Maintenance
Excessive manifold pressure	Make a safe landing and speak to Maintenance.
Engine Indication not available	Make a safe landing and speak to Maintenance.
Engine in an environment at temperatures less than 10°F (-12°C) for more than 2 hours	Refer to the section “Apply Heat to a Cold Engine” in this chapter.
Operation in climates above 100°F	Decrease climb angles to keep the engine cool. Refer to the section “Engine Operation in Hot Weather” in this chapter.
Stalled engine	Look at the Fuel Selector setting. Look at the Auxiliary Fuel Pump setting. Turn the Enable switch OFF then back to ON. If the engine does not operate, look at the starter and see if it is engaged.
Engine oscillation (either rpm or manifold pressure)	Slowly decrease the throttle rpm until the oscillations STOP. Then slowly increase rpm back to the desired operational rpm. Complete a safe landing. Identify and correct the cause.
Propeller strike, sudden stoppage and lightning strikes	If the engine restart procedure is not successful, try to complete a safe landing. Refer to the IO-540-AG1A5 Series Engine Maintenance Manual for corrective action.
Rapid decrease in cylinder head temperature	To prevent shock cooling, do not decrease cylinder head temperature at a rate more than 50°F (10°C) per minute.
Overheating (The temperature of the system components is greater than the maximum design operating temperature for the components.)	Make a safe landing as soon as possible, and identify and correct the cause. Refer to the IO-540-AG1A5 Series Engine Maintenance Manual

TABLE 1. UNUSUAL ENGINE CONDITIONS IN FLIGHT (CONT.)

Unusual Condition	Explanation/Corrective Action
Overspeed	Refer to the section “Overspeed” in this chapter.
Fire	Make a safe landing as soon as possible, get out of the aircraft and put out the fire.
Low oil pressure (below minimum specified in Appendix A)/oil starvation	Complete a safe landing as soon as possible. Refer to the section “Low Oil Pressure During Flight” in this chapter.
Volcanic ash	Make a safe landing as soon as possible. Refer to the latest revision of Service Instruction No. 1530. Refer to the IO-540-AG1A5 Series Engine Maintenance Manual.
Engine soaked in water	Examine the engine. Moisture and unwanted materials can cause damage to all systems on the engine. Refer to the IO-540-AG1A5 Series Engine Maintenance Manual for corrective action.
Dead airframe battery	⚠ **CAUTION:** THE AIRCRAFT MUST HAVE A FULLY CHARGED BATTERY (AND HAVE AT LEAST 1 AMP HOUR OF RESERVE) BEFORE FLIGHT. Use a battery charger to sufficiently charge the battery before further flight. There must be at least 1 amp hour of reserve. Jump starts usually do not supply sufficient sustained charge. ⚠ **CAUTION:** DO NOT FLY THE AIRCRAFT WITHOUT A FULLY CHARGED BATTERY.

Apply Heat to a Cold Engine

1. If an engine is in cold weather longer than 2 hours (at temperatures less than 10°F (-12°C)) it can become “cold soaked.” At these extremely low temperatures, oil can become thicker, battery capacity decreased, and the starter could be operated above capacity. Incorrect cold weather starting can cause unusual engine wear, decreased performance, shortened time between overhauls, or engine malfunctions. In the “cold soaked” condition, fuel can vaporize too slowly which could make engine start difficult.

   NOTICE: Pre-heat application will help the engine start during cold weather and is necessary when the engine has been in sub-freezing temperature + 10º F (12ºC). Do not use small electric heaters (which install in the cowling opening) to warm up an engine because they do not apply sufficient heat.

   NOTICE: Do not use a heated dipstick to apply heat because heat will be concentrated and not applied throughout the engine. Concentrated heat can cause damage to non-metal engine parts. The oil must be warmed to flow to all parts of the engine.

2. Use a high volume air heater to apply heat.
3. Apply hot air to all parts of a cold-soaked engine.

4. Make sure the engine oil is in compliance with the recommended grades in Appendix A.

⚠WARNING: IF HEAT HAS NOT BEEN APPLIED TO ALL PARTS OF THE ENGINE, THE ENGINE CAN START AND OPERATE BUT LATER FAIL BECAUSE THE THICK OIL WILL NOT FLOW FULLY THROUGH THE ENGINE. DAMAGE CAN OCCUR AND NOT BE KNOWN UNTIL AFTER SEVERAL HOURS OF OPERATION. THE ENGINE ALSO CAN FAIL AFTER APPLICATION OF HIGH POWER.

5. Apply hot air directly to the following parts in 5-minute intervals for a minimum of 30 minutes:
   - Oil sump
   - Oil filter
   - External oil lines
   - Oil cooler
   - Cylinder assemblies
   - Air intake.

⚠CAUTION: APPLY THE HOT AIR UNIFORMLY AND NOT CONCENTRATED IN ONE SPOT TO PREVENT HEAT DAMAGE TO NON-METAL PARTS. HEAT BUILD-UP CAN CAUSE DAMAGE TO WIRING, HOSES, ETC.

6. If cowl flaps are installed, open the cowl flaps to prevent heat build-up.

   NOTICE: If the aircraft is not in a hangar, use a blanket to keep hot air around the engine.

7. Between intervals, make sure the engine stays warm and keeps the heat. Make sure there is no damage from heat build-up.
8. During the last 5 minutes of the heat process, apply heat to the top of the engine.
9. Start the engine immediately after the hot air application. Refer to the section “Start the Engine” in the “Engine Start and Operation” chapter of this manual. Also, refer to additional engine start information in the section “Cold Weather Start” in this chapter.

Cold Weather Start

NOTICE: If the battery is cold, its charge can be drained quickly. An auxiliary power source is recommended as a back-up. DO NOT fly the aircraft without a fully charged battery.

1. After a cold start, do not rapidly increase acceleration or exceed the idle rpm. Allow up to 1 minute for oil pressure to become stable above 1000 rpm, since oil lines to the gage can stay cold. If oil pressure indication is not shown within 10 seconds, stop the engine. Identify and correct the cause. If no leaks or damage are found, complete the pre-heat application again before engine start.
2. Let the engine warm up at 1000 rpm until oil pressure and temperature are stable within operating limits.
3. Complete a ground check in accordance with the airframe manufacturer’s Pilot's Operating Handbook.
4. Complete a cycle of the propeller control position in accordance with the airframe and propeller manufacturer’s instructions to make sure warm oil is in the propeller dome.
5. Before take-off, monitor the oil pressure, oil temperature, and cylinder head temperature to make sure all are within their operating ranges (as specified in Appendix A).

⚠ **CAUTION:** DO NOT TAKE-OFF IF ANY OF THE FOLLOWING CONDITIONS ARE FOUND:

1. ENGINE ROUGHNESS
2. LOW, HIGH OR SURGING RPM OR FLUCTUATIONS
3. HIGH, LOW, OR FLUCTUATING OIL PRESSURE
4. HIGH OR LOW FUEL FLOW
5. HIGH MANIFOLD PRESSURE
6. LOW BATTERY CHARGE.

6. Make sure that when take-off power is applied smoothly, oil pressure, fuel flow, manifold pressure, and rpm remain stable.

Engine Operation in Hot Weather

1. During engine operation in hot weather:
   A. Monitor oil and cylinder temperatures during taxiing and engine run up.
   B. Operate with cowl flaps fully open.
   C. Do not operate the engine at maximum power any longer than necessary to make the climb configuration recommended by the aircraft manufacturer.
   D. Enrich fuel mixture as necessary.
   E. Operate at sustained sufficient airspeed to cool off the engine.
   F. Continue to closely monitor temperatures.

Volcanic Ash

1. Given the dynamic conditions of volcanic ash, Lycoming's recommendation is NOT to operate the engine in areas where volcanic ash is present - in the air or on the ground. Refer to the latest revision of Service Instruction No. 1530 for any new details.
2. Ash on the ground and runways can cause contamination in the engine compartment and subsequent engine damage during aircraft landing or take-off.
3. Piston engines can be damaged by inlet air contaminated with volcanic ash. Solid deposits from any number of sources can collect on engine baffles or other engine surfaces and prevent engine cooling. Accumulation of deposits on the induction air filter can restrict or block air flow to the engine and significantly decrease engine power. Contamination of engine oil can cause engine malfunction and/or failure from abrasive wear.
4. In the event that flight through volcanic ash clouds or with ash on the ground and subsequent contamination occurs, Lycoming recommends the following standard actions listed below.

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

   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 engine overheating).

B. If the engine is not operating smoothly in flight, make a safe landing of the aircraft as soon as possible and isolate faults on the engine.

C. Additional measures could be necessary under specific operating conditions. Refer to the IO-540-AG1A5 Series Engine Maintenance Manual for corrective action.

Overspeed

1. In *engine overspeed,* the engine operates above its rated speed (rpm). Operation of an engine above its rated rpm can cause accelerated wear on already stressed components. *Momentary overspeed* can occur during a landing attempt, when the propeller governor is in a lag as the throttle is suddenly opened for a go-around. In fixed wing aircraft, momentary overspeed is an increase of no more than 10% of rated engine rpm for 3 seconds or less.

⚠ **CAUTION:** DO NOT OPERATE AN ENGINE CONTINUOUSLY AT AN OVERSPEED RATE BECAUSE IT CAN WEAR OUT ENGINE PARTS AND EVENTUALLY CAUSE ENGINE FAILURE.

2. Refer to the latest revision of Service Bulletin No. 369 for corrective action for engine overspeed.
3. Record all incidents of engine overspeed in the engine logbook, along with the inspection and any specified corrective action taken as per the IO-540-AG1A5 Series Engine Maintenance Manual.

Low Oil Pressure During Flight

Circumstances which cause loss of oil pressure are many and varied. Therefore, it is difficult to make a prediction of the extent of damage to the engine or its future reliability. In case of oil pressure loss or engine operation with oil below the recommended minimum operating level, the most conservative action is to remove the engine, disassemble, and completely examine all engine components.

NOTICE: Very often a sudden loss of oil pressure also shows a sudden increase in oil temperature.

Any time oil pressure falls below the minimum level complete a safe landing of the aircraft as soon as possible. Identify the root cause according to the protocol per the following progressive steps:

1. Complete a check of the oil level in the oil sump. Drain the oil, if necessary, to determine the oil quantity. Refer to the IO-540-AG1A5 Series Engine Maintenance Manual.
2. If the oil level is sufficient, complete a check of the accuracy of the oil pressure indication system. If the oil pressure gage is not operating correctly, replace it.
3. Examine oil line connections for leaks. Tighten any loose connections and look for leaks. Replace leaking oil lines.
4. Examine the oil suction screen at the oil sump and the pressure screen/oil filter for blockage or metal deposits. If metal or blockage is found, remove the material and identify the origin of material. Correct the root cause.
5. Examine the oil pump for malfunction. Replace the oil pump if it is not operating correctly.
6. If the oil pressure indication system is operating correctly and oil pressure loss/oil starvation has occurred, remove and disassemble the engine and do a complete inspection.

   NOTICE: Any decision to operate an engine that had a loss of oil pressure without an inspection must be the responsibility of the agency who is putting the aircraft back into service.

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FLIGHT TEST

As shown in the "Engine Start and Operation" chapter of this manual, an operational test and a pre-flight ground run-up must be done before approval by an authorized inspector for a flight test. This flight test is necessary to make sure that the engine and aircraft are in compliance with all of the manufacturer's performance and operational specifications before release of the aircraft for normal service.

Although new and rebuilt engines sent by Lycoming Engines receive a test cell run-in before shipment, this flight test is done to make sure that the engine is in compliance with all operational parameters before release for service. Refer to Appendix A in this manual for operating specifications.

NOTICE: During the flight test, record all data in the engine logbook.

To do this flight test:

1. Start the engine and complete a pre-flight run-up in accordance with the chapter "Engine Start and Operation."
2. Complete a full power take-off in accordance with the POH.
3. During take-off, monitor the following gages:
   - — Engine rpm
   - — Fuel flow
   - — Manifold pressure (or constant speed propeller)
   - — Oil pressure
   - — Oil temperature
   - — Cylinder head temperature.
4. As soon as possible, decrease the engine speed to climb power in accordance with the airframe manufacturer's POH.
5. Complete a shallow climb angle to a suitable cruise altitude.
6. At cruise altitude, decrease power to approximately 75% and continue flight for 2 hours. For the second hour, do power settings alternating 65% and 75% power as per the applicable POH
7. If the engine and aircraft are operating to correct specifications (Appendix A), increase engine power to the maximum airframe manufacturer recommendations and hold for 30 minutes.

⚠ **CAUTION:** FOR ENGINES THAT HAVE DYNAMIC COUNTERWEIGHT ASSEMBLIES, DO NOT OPERATE AT LOW MANIFOLD PRESSURE DURING HIGH ENGINE SPEEDS UNDER 15 IN. HG. AND RAPID CHANGES IN ENGINE SPEEDS. THESE CONDITIONS CAN CAUSE DAMAGE TO THE COUNTERWEIGHTS, ROLLERS OR BUSHINGS, AND CAUSE DETUNING.

8. Decrease altitude at low cruise power and closely monitor the engine instruments. Do not do long descents at low manifold pressure. Do not decrease too rapidly. The engine temperature could decrease too quickly.

⚠ **CAUTION:** DO NOT DO CLOSED THROTTLE DESCENTS. CLOSED THROTTLE OPERATION DURING DESCENTS WILL CAUSE RING FLUTTER WHICH CAN CAUSE DAMAGE TO THE CYLINDERS AND RINGS.

9. After landing and shutdown, look for leaks at fuel and oil fittings. Identify and correct the cause of any leaks.
10. Calculate oil consumption. Oil consumption is given in Appendix A. If the oil consumption value is above the limit in Appendix A, identify and correct the cause. If there were problems that were corrected, complete the flight test again, up to and including this step, before releasing the aircraft for service.
11. Record results of the flight test in the engine logbook.

ENGINE PRESERVATION AND STORAGE

Engine Corrosion and Prevention

The life expectancy of engines in aircraft that are not in flight frequently (flown for 1 hour within 30 days) can decrease because of engine corrosion. Engine corrosion occurs when moisture from the air and products of combustion stick to cylinder walls and bearing surfaces when the aircraft is not used.

Corrosion rates can increase because of variable factors such as environmental conditions (humidity, salt air in ocean areas), seasonal changes, and engine usage.

Since conditions can change, the corrosion rate can change. Aircraft operated close to oceans, lakes, and rivers and in humid regions have a greater need for engine preservation than engines operated in arid regions. In regions of high humidity, corrosion can be found on cylinder walls of new inoperative engines in as little as 2 days. Whereas in less humid environments, cylinder walls on engines that have 50 hours or more time in service within weeks, can have a varnish coating that will protect them from corrosive action. Such engines under these atmospheric conditions can be inactive for several weeks without evidence of damage by corrosion. Engines that are in flight only occasionally (less than one time per week) are more at risk for corrosion.

NOTICE: **The best way to decrease the risk of engine corrosion is for the aircraft to be in flight at least every 30 days for at least 1 continuous hour at oil temperatures between 180°F to 200°F (80°C to 93°C),** depending on location and storage conditions. This 1 continuous hour does not include taxi, take-off and landing time. If the engine cannot be operated at the recommended oil temperatures, speak with the aircraft manufacturer about the use of oil cooler winterization plates.

NOTICE: The Lycoming warranty does not include corrosion unless otherwise identified on the notice tag for new, rebuilt, or overhauled engines sent from Lycoming Engines.

Because climate conditions are different in various geographic areas, Lycoming can only give general recommendations for corrosion prevention. The owner and operator must take into account the following factors for setting a rust and corrosion prevention maintenance schedule for the engine:

- Environmental conditions, especially humidity
- Salt spray from the ocean
- Frequency of flight
- Duration of flights
- Size of the oil cooler system for the engine and airframe installation. (If the oil cooler system is not the correct size, it can cause the engine to overheat or operate below the minimum temperatures.) Low temperature operation can cause a build-up of water and acids
- Complete oil and oil filter changes as per the recommended intervals in the latest revision of Service Bulletin No. 480
- Complete a monthly inspection of engines stored in humid conditions and/or in flight less than once and week.

For operation at the correct temperature:

- Make sure the aircraft temperature gages are correct.
- Examine the condition of cooling air baffles. There must not be any blockage.
- Make sure the baffles are the correct fit for maximum cooling air flow.

NOTICE: Lycoming recommends frequent inspection of engines that are stored in humid conditions and/or in flight less than once a week. The Lycoming warranty does not include corrosion.

The main emphasis in engine preservation is to decrease the risk of corrosion of engine parts which can decrease engine service life. The engine cylinders, piston rings, valves, valve guides, camshaft, and lifters are of primary concern with regards to corrosion prevention. Corrosion prevention uses rust inhibitive compounds applied to vulnerable surfaces to prevent corrosion.

⚠ **CAUTION:** DO NOT MANUALLY (HAND) OPERATE THE PROPELLER TO APPLY LUBRICATION TO THE ENGINE CYLINDERS. LUBRICATION IS INEFFICIENT WITH MANUAL OPERATION AND CAN CAUSE PREMATURE WEAR OF ENGINE PARTS FROM SCUFFING AND SPALLING.

NOTICE: Ground operation of the engine for brief periods of time is not a substitute for hour-long continuous engine flight. Short ground operation can make corrosive conditions worse.

Engine Preservation

Engine preservation is necessary, especially for engines that are not operated at least for 1 continuous hour every 30 consecutive days. If you know that an aircraft will not be operated for a minimum of 30 days, then you must add preservative oil to the cylinder and oil sump in accordance with this procedure.

The engine preservation procedure includes a spray application of preservative oil to the walls of each engine cylinder.

The following items from industrial suppliers are necessary for the preservation procedure:

- preservative oil mixture with one part by volume MIL-C-6529C Type I concentrated preservation compound added to three parts by volume of MIL-L-6082C (SAE J1966), Grade 100, mineral aircraft engine oil conforming to MIL-C-6529C Type II. Refer to the latest revision of Service Letter No. L180 for any new information.
- A means to heat the oil mixture
- An airless spray gun (Spraying Systems Co. "Gunjet" Model 24A-8395 or equivalent). If an airless spray gun is not available, install a moisture trap in the air line of a conventional spray gun.
- Clay desiccant bags.

NOTICE: Make sure that the preservative oil mixture is hot at the spray nozzle before application to the cylinder in the following procedure.

Complete the engine preservation procedure in a hangar or shelter.

Complete the following for engine preservation procedure with the engine installed in the aircraft or on a test stand for the engine to be operated at the start of this procedure.

1. Operate the engine until it is at the specified operating temperature in Appendix A. If temperatures are below freezing, the oil temperature must be at least 165ºF (74ºC) before the engine is stopped in the next step.
2. Stop the engine.
3. While the engine is still hot, immediately remove sufficient cowling to get access to the spark plugs.
4. Drain the lubricating oil from the sump or system.

5. Wash and brush the finger screen with mineral spirits.
6. Clean the finger screen plug.
7. Apply food grade AA anti-seize compound to the screen plug and install the finger screen, gasket and plug. Tighten until sealing surfaces are in contact then rotate an additional 135º.
8. Apply one to two drops of Loctite 564 to the threads of the oil sump drain plug..
9. Install and torque the oil drain plug in accordance with the latest revision of the Table of Limits, SSP-1776.
10. Fill the spray gun with the preservative oil mixture.
11. Fill the oil sump with the specified preservative oil mixture.

    NOTICE: Make sure the oil is hot at the nozzle before spray application to the cylinders.

12. Remove both spark plugs from each cylinder.
13. Put the spray device in either of the spark plug holes. Apply the preservative oil mixture to each cylinder, one at a time.
14. Use the spray device to apply a coat of approximately 2 oz. (60 ml) of the preservative oil mixture through the spark plug hole on the interior wall of each cylinder.

⚠ **CAUTION:** DO NOT TURN THE CRANKSHAFT AFTER YOU SPRAY THE CYLINDERS WITH PRESERVATIVE OIL.

15. After spray application is complete, remove the spray device from the spark plug hole.

⚠ **CAUTION:** FAILURE TO INSTALL A NEW SPARK PLUG GASKET ANY TIME A SPARK PLUG IS INSTALLED MAY RESULT IN INCOMPLETE SEALING OF THE COMBUSTION CHAMBER, LOSS OF SPARK PLUG HEAT TRANSFER, SPARK PLUG OVERHEATING, POSSIBLE REIGNITION/DETONATION, AND INTERNAL ENGINE DAMAGE.

16. Install either the spark plugs (or cylinder dehydrator plugs MA-27512-2 or equivalent if the aircraft is kept in a region that has high humidity or near a sea coast).
17. While the engine is still warm:
    A. Remove the exhaust system and intake pipes.
    B. Install bags of clay desiccant in the exhaust and intake ports.
    C. Install the exhaust system and intake pipes.
    D. Attach red cloth streamers as a reminder for the material to be removed when the engine is made ready for flight.
    E. With moisture-proof material and pressure sensitive tape, seal these openings.
        — Exhaust ports
        — Intake ports
        — Breather
        — Vacant accessory pad
        — All openings that connect the inside of the engine to the outside atmosphere.
    F. Apply seals and tape to areas of the engine exposed to the air.

G. Install exhaust system and intake pipes.

H. Put a note on the propeller that reads: "Engine preserved - DO NOT TURN THE PROPELLER."

I. At 15 day intervals, examine the cylinder dehydrator plugs and desiccant. When the colors of the desiccant plug and desiccant bag have turned from blue to pink, remove the used desiccant bags and plugs. Install new desiccant bags and plugs.

Fuel Injector Preservation

Refer to the fuel component manufacturer's instructions for preservation of fuel injectors.

60 to 180-Day Engine Preservation

New, rebuilt, and overhauled engines from Lycoming Engines have preservation oil for 60 days. The tag on the outside of the engine box is for indication that the engine contains preservative oil

The date of preservation is shown on the sticker on the outside corner of the engine box with the gross weight or the date written on the top of the box following a “Preservation Date” stamp.

NOTICE: Corrosion is warrantable only during the specified preservation period.

If at the end of the specified preservation period, the engine is to stay in storage, complete the following inspection, (although this inspection does not extend the corrosion warranty).

1. After the first 60 days, and every 60 days thereafter up to 180 days, examine each engine cylinder one at a time as follows:

   A. Remove the top and bottom spark plugs from each cylinder, one cylinder at a time.

   B. Rotate the crankshaft until the piston is at the bottom dead center.

      NOTICE: Do not rotate the crankshaft any further during the borescope evaluation

   C. Use a 4x borescope with a 70 degree angle of view, or equivalent internal examining device to examine each cylinder for evidence of corrosion. The diameter of the borescope must be smaller than the diameter of the spark plug hole. Refer to the IO-540-AG1A5 Series Engine Maintenance Manual.

⚠ **CAUTION:** FAILURE TO INSTALL A NEW SPARK PLUG GASKET ANY TIME A SPARK PLUG IS INSTALLED MAY RESULT IN INCOMPLETE SEALING OF THE COMBUSTION CHAMBER, LOSS OF SPARK PLUG HEAT TRANSFER, SPARK PLUG OVERHEATING, POSSIBLE REIGNITION/DETONATION, AND INTERNAL ENGINE DAMAGE.

   D. Install the top and bottom spark plugs in the cylinder each with a new gasket.

   E. Remove the rocker box covers and look for any evidence of corrosion.

   F. After the inspection is complete, install the rocker box covers.

   G. Remove the accessories. Examine the drives and shafts for moisture or corrosion.

2. When the inspection is complete, install the accessories.

3. At the first sign of corrosion speak to a Lycoming authorized distributor or a Lycoming Technical Service at 877-839-7878 (877-TEX-SUPT).

180-Day or More Engine Preservation

If the engine is to be stored for 180 days or longer, after the first 180 days, and every 60 days thereafter, do the following:

1. If the engine is still in the box, keep the engine in the box and wrapped in plastic. Otherwise, wrap the engine in clean, dry plastic without any rips, tears or openings.

   NOTICE: If available and clean, the urethane top foam pillow can be used again.

2. Examine the moisture indicator on the side of the engine. If there is moisture, the indicator will be pink. If there is no moisture the indicator will be blue.
3. If the moisture indicator is pink:
   A. Remove the wrapping from the engine.
   B. Examine each engine cylinder.
   C. Look for rips or tears in the plastic.
   D. Look for damage to the box, the engine, and the cylinder.
   E. Complete a borescope inspection on each engine cylinder as per the “60 to 180 Day Engine Preservation” section in this chapter.
   F. Repair any damage and add preservative oil as necessary as per the “Engine Preservation” section in this chapter.
   G. Replace the pink moisture indicator with a fresh blue moisture indicator.
   H. Record and report all findings to the shipping agent.
4. At the end of the 180 days, if the moisture indicator is still blue, and the engine must stay in storage, as long as the plastic is not ripped or torn, continue storage with 60-day interval checks, for up to 1 year.

   NOTICE: Completion of the previous steps for storage extension will not extend the warranty.

5. After 1 year of storage, either put the engine into service or repeat the previous steps in this procedure.

Cold Weather Storage

In cold weather, if possible, store the aircraft in a heated hangar between flights. Add oil to the engine as required with the specified oil grade. Refer to the IO-540-AG1A5 Series Engine Maintenance Manual.

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APPENDIX A

TABLE 1. IO-540-AG1A5 SERIES ENGINE SPECIFICATIONS

Number of Cylinders	6	
Cylinder Arrangement - Firing Order	1-4-5-2-3-6	
Spark Plugs - long reach	12	
Spark plug advance	20º BTC	
Maximum Continuous Horsepower (Power output can vary within +5% and -2% of the rating)	250 HP @ 2425 rpm 0.50 BSFC	
Performance Cruise (75% Rated)	190 @ 2200 rpm	
Economy Cruise (60% Rated)	150 @ 1900 rpm	
Propeller Drive Ratio	1:1	
Propeller Shaft Rotation (Hartzell Compact Propeller)	Clockwise	
Counterweight Order	One 5th order and one 6th order pendulum-type counterweight	
Compressor Bore	5.125 in.	13.018 cm
Compressor Stroke	4.375 in.	11.1 cm
Piston Displacement	541.5 $in.^3$	8873.6cm^3
Compression Ratio	7.3:1	
Weight (lb)	479 lb	217 kg
Dimensions	Height 19.60 in.	49.78 cm
	Width 34.25 in.	87.00 cm
	Length 39.24 in.	99.67 cm
Oil Sump Capacity	12 quarts	11.4 liters
Minimum quantity of oil in flight	2.75 quarts	2.6 liters
Oil Grade Specification **NOTICE:** During the first 50 hours of engine operation of a new or rebuilt engine, it is recommended that this engine be operated with mineral oil until oil consumption has stabilized.	MIL-L-6082 or SAE J1966 SAE Grades	MIL-L-22851 or Ashless Dispersant
Oil Grade at All Temperatures	------	15W-50, or 20W-50
Oil Grade at Temperatures above 80°F (27°C)	60	60
Oil Grade at Temperatures above 60°F (16°C)	50	40 or 50
Oil Grade at Temperatures between 30°F to 90°F (-1°C to 32°C)	40	40
Oil Grade at Temperatures between 0°F to 70°F (-18°C to 21°C)	30	30, 40 or 20W-40
Oil Grade at Temperatures below 10ºF (-12ºC)	20	30 or 20W-30

TABLE 1. IO-540-AG1A5 SERIES ENGINE SPECIFICATIONS (CONT.)

The correct grade of oil to be used is based on environmental conditions. If the aircraft is going to be flown into an area that is much warmer or colder than the aircraft is usually operated in, use a different viscosity of oil. During operation, if the oil inlet temperatures are near the maximum permitted temperatures, then a higher viscosity oil can help to decrease the temperatures.	
Fuel (minimum octane)	100 or 100LL (Aviation Grade)
Fuel Injector	Lycoming Type FM250 Optional Precision Airmotive 2549038
Starter Hartzell (formerly Kelly Aerospace)	12 Volt ─ Standard Geared 3.38:1
Optional Starter - B & C	24 Volt - Geared
Optional Starter - Sky Tec	24 Volt - Geared
Alternator Drive, Ratio to Crankshaft and Rotation	3.25:1 Clockwise
Optional Ratio and Rotation	3.63:1 Clockwise
Alternator - Hartzell	24 Volt, 70 Amp Standard 28 Volt, 70 Amp Optional 24 Volt, 100 Amp Optional
AN Vacuum Pump Drive, Ratio to Crankshaft and Rotation	1.30:1 Counterclockwise
Hydraulic Pump Drive, AND2000: - Ratio to Crankshaft and Rotation	Standard 1.385:1 Clockwise
Propeller Governor Drive, AND20010 Ratio to Crankshaft & Rotation	Standard 0.947:1 - Clockwise
Magnetos (2) TCM Bendix	S6LN-1208 (Left) S6LN-1209 (Right)
Optional Magnetos (2) Unison - Slick	6363 (Left) 6360 (Right)
Magneto Drive, Ratio to Crankshaft and Rotation	1.500:1 - Clockwise
Direction of rotation of magneto shafts	Clockwise (view from anti-propeller end of engine)
Fuel Pump	Standard AN

NOTICE: All locations and rotations are as viewed from the anti-propeller end of the engine unless specified differently.

NOTICE: For any possible additional optional starters and alternators, refer to the latest revision of Lycoming Service Instruction No. 1154.

TABLE 2. TABLE OF OPERATING LIMITS FOR ENGINE

Oil Pressure - Minimum Idling (rear of engine)	25 psi	172 kPa
Oil Pressure - Minimum Idling (front of engine)	20 psi	138 kPa
Oil Pressure - Operating (rear of engine)	55 to 95 psi	379 to 655 kPa
Oil Pressure - Operating (front of engine)	50 to 90 psi	345 to 621 kPa
Oil Pressure - Starting, Warm-up, Taxi, and Take-off (Maximum)	115 psi	792 kPa
Oil Temperature (during flight)	165 to 200ºF	74 to 93ºC
Optimum Oil Temperature	180ºF	82ºC
Maximum Oil Temperature	245°F	118°C
Maximum Oil Consumption for power above 75%	0.008 lb/BPH/Hr. or 19 quarts/hr - 0.95 liters/hr	
Maximum Oil Consumption for 75% continuous power and lower	0.006 lb/BPH/Hr. or 0.75 quarts/hr. - 0.71 liters/hr.	
Maximum Oil Consumption for economy power (60% rated)	0.60 quarts/hr. - 0.6 liters/hr.	
Inlet Fuel Pressure Limits to the Fuel Injector (for normal operation)	18 to 40 psi	124 to 276 kPa
Maximum Inlet Fuel Pressure Limits to the Fuel Injector (for idle)	12 psi	83 kPa
Inlet Fuel Pressure Limits to the Fuel Pump	-2 to +45 psi	14 to 310 kPa
Maximum Fuel Pressure to the Fuel Pump Inlet (with the fuel injector in idle cut-off)	65 psi	448 kPa
Fuel Injector Inlet Temperature	400ºF	204ºC
Maximum Cylinder Head Temperature (measured at thermocouple)	500°F	260°C
Cylinder Head Temperature (for maximum engine life) - Above 75% power	475°F	246°C
Cylinder Head Temperature (for maximum engine life) - At 75% power and below	435°F	224°C
Maximum Exhaust Back Pressure at Any Cylinder	2 in. Hg.	
Alternator Stator Slot Temperature	360ºF	182ºC
Alternator Stator End Turns Temperature	360ºF	182ºC
Alternator Drive End Bearing Temperature	248ºF	120ºC
Alternator Positive Heat Sink Temperature	305ºF	152ºC
Maximum Magneto Temperature (measured in the pole laminations)	225ºF	107ºC

TABLE 3. ACCESSORY DRIVES

Accessory Drive	Type of Drive	Direction of Rotation	Drive Ratio	Maximum Torque				Maximum Overhang Moment	
				Continuous		Static			
				in.-lb	Nm	in.-lb	Nm	in.-lb	Nm
Starter	SAE	Counter-clockwise	16.556:1	----	----	450	52	150	17
Alternator	SAE	Clockwise	3.250:1	60	7	120	14	175	20
Vacuum Pump	AND20000*	Counter-clockwise	1.300:1	70	8	450	52	25	2.9
Hydraulic Pump	AND20000	Clockwise	1.385:1	100	12	800	92	40	4.6
Tachometer	SAE	Clockwise	0.500:1	7	0.8	50	6	5	0.6
Propeller Governor	AND20010**	Clockwise	0.947:1***	125	14	2200***	254	25	2.9
Fuel Pump	AND20003	Counter-clockwise	1.000:1	25	2.9	450	52	25	2.9

* Except for torque limitation and rotation

** Except for torque limitations

*** On narrow deck engines 0.895:1 drive ratio and 1200 static

APPENDIX B

INSTALLATION AND WIRING DIAGRAMS

NOTICE: Installation drawings are available for purchase from Lycoming Engines. Contact the Publications Clerk at Lycoming Engines at 570-327-7274

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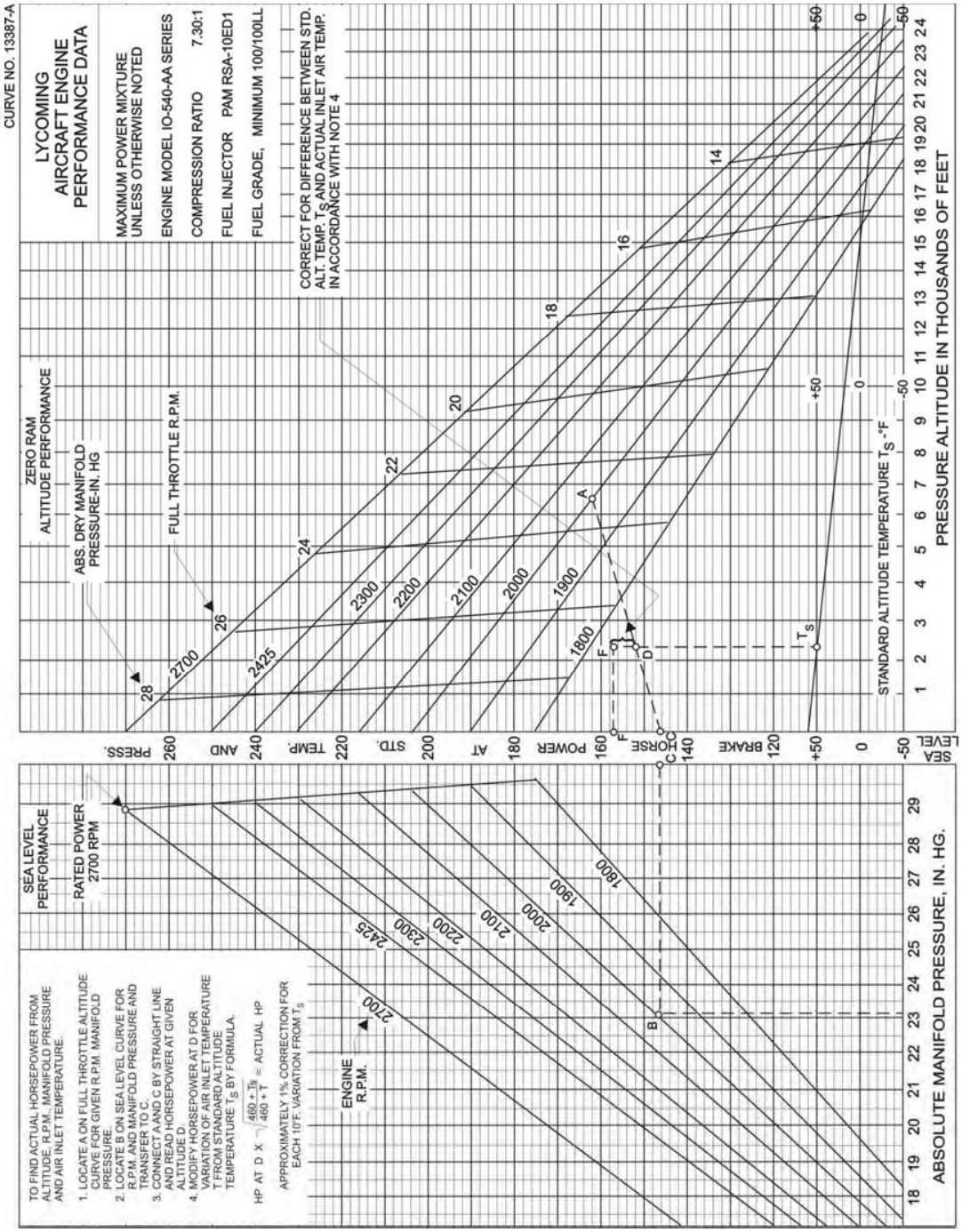
APPENDIX C

PERFORMANCE DATA



Sea Level and Altitude Performance
Figure 1

NOTICE: This curve also applies to the IO-540-AG1A5 Series Engine Model.

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