YO-233-B2A Series Engine
Installation and Operation Manual

November 2014

LYCOMING

Part No. 60297-40-B

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Lycoming Part Number: 60297-40-B

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LYCOMING

WARRANTY
NEW NON-CERTIFIED ENGINES

(1) WARRANTY AND REMEDY: Lycoming Engines, a division of Avco Corporation (hereinafter "Lycoming") warrants each new Lycoming reciprocating engine to be free from defect in material or workmanship under normal use and service. Lycoming's sole obligation under this warranty is limited to replacement or repair of parts, which are determined by Lycoming to have been defective within a period of twelve (12) months from date of first operation. Cylinders are warranted for a period of twenty-four (24) months. Warranty period commences on the earlier of the date of first operation after entered into service or twenty-four (24) months from the date of shipment from Lycoming. Lycoming will, in connection with the foregoing warranty, cover reimbursement of reasonable freight charges with respect to any such warranty replacement or repair.

(2) Within the warranty period, Lycoming will reimburse the Purchaser for labor charges associated with warranty related issues. Lycoming will only reimburse the cost of such labor charges in connection with repair or replacement of parts as provided in Lycoming's then current Removal and Installation Labor and Allowance Guidebook. Spare parts installed as warranty replacement on engines which are covered by this New Engine Warranty will be warranted for the balance of the original warranty period or for the spare part warranty, whichever is the greater. Replacement of parts may be with either new or reconditioned parts, at Lycoming's election. A claim for warranty on any part claimed to be defective must be reported in writing to Lycoming's Warranty Administration within 60 days of being found to require repair or replacement by the purchaser or service facility. Warranty adjustment is contingent upon the Purchaser complying with the Lycoming's Warranty Administration disposition instructions for defective parts. Failure to comply with all of the terms of this paragraph may, at Lycoming's sole option, void this warranty.

(3) In addition, if Lycoming determines that the engine proves to be defective in material or workmanship during the period until the expiration of Lycoming's recommended Time Between Overhaul (TBO), or twenty-four (24) months from the date of first operation, whichever occurs first, Lycoming will reimburse a pro rata portion of the charge for the repair or replacement (at its choice) with Lycoming parts, or parts required to be repaired or replaced, or a replacement engine, if it determines that engine replacement is required. Lycoming's obligation during the proration period extends to major parts of the engine, which are limited to crankcase, crankshaft, camshaft, connecting rods, pistons, sump, accessory housing and gears. The proration policy does not extend to labor or to accessories, including but not limited to magnetos, carburetors or fuel injectors, fuel pumps, starters, alternators and turbochargers and their controllers.

(4) THIS WARRANTY IS GIVEN AND ACCEPTED IN PLACE OF (i) ALL OTHER WARRANTIES OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OR CONDITIONS OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND (ii) ANY OBLIGATION, LIABILITY, RIGHT, CLAIM OR REMEDY IN CONTRACT OR IN TORT (DELICT), INCLUDING PRODUCT LIABILITIES BASED UPON STRICT LIABILITY, NEGLIGENCE, OR IMPLIED WARRANTY IN LAW AND PURCHASER HEREBY WAIVES SUCH RIGHTS AND CLAIMS.

(5) THIS WARRANTY IS THE ONLY WARRANTY MADE BY LYCOMING. THE PURCHASER'S SOLE REMEDY FOR A BREACH OF THIS WARRANTY OR ANY DEFECT IN A PART IS THE REPAIR OR REPLACEMENT OF ENGINE PARTS AND REIMBURSEMENT OF REASONABLE FREIGHT CHARGES AS PROVIDED HEREIN. LYCOMING EXCLUDES LIABILITY, WHETHER AS A RESULT OF A BREACH OF CONTRACT OR WARRANTY, NEGLIGENCE OR STRICT PRODUCT LIABILITY, FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING, BUT NOT LIMITED TO, DAMAGE TO THE ENGINE OR OTHER PROPERTY (INCLUDING THE AIRCRAFT IN WHICH THE ENGINE IS INSTALLED), COSTS AND EXPENSES RESULTING FROM REQUIRED CHANGES OR MODIFICATIONS TO ENGINE COMPONENTS AND ASSEMBLIES, CHANGES IN RETIREMENT LIVES AND OVERHAUL PERIODS, LOCAL CUSTOMS FEES AND TAXES, AND COSTS OR EXPENSES FOR COMMERCIAL LOSSES OR LOST PROFITS DUE TO

LOSS OF USE OR GROUNDING OF THE AIRCRAFT IN WHICH THE ENGINE IS INSTALLED OR OTHERWISE. LYCOMING'S TOTAL LIABILITY FOR ANY AND ALL CLAIMS RELATED TO ANY ENGINE SHALL IN NO CASE EXCEED THE ORIGINAL SALES PRICE OF THE ENGINE. SELLER MAKES NO WARRANTY AND DISCLAIMS ALL LIABILITY WITH RESPECT TO COMPONENTS OR PARTS DAMAGED BY, OR WORN DUE TO, CORROSION.

(6) LYCOMING MAKES NO WARRANTY AND DISCLAIMS ALL LIABILITY IN CONTRACT OR IN TORT, INCLUDING, WITHOUT LIMITATION, NEGLIGENCE AND STRICT TORT LIABILITY WITH RESPECT TO THE SUITABILITY OF THESE PARTS FOR USE IN ANY PARTICULAR AIRFRAME OR WITH ANY COMBINATION OF PROPELLER AND AIRFRAME. LYCOMING MAKES NO WARRANTY AND DISCLAIMS ALL LIABILITY IN CONTRACT OR IN TORT, INCLUDING, WITHOUT LIMITATION, NEGLIGENCE AND STRICT TORT LIABILITY WITH RESPECT TO THE SUITABILITY OF THESE PARTS FOR USE WITH ANY FUEL OTHER THAN THAT FOR WHICH THEY WERE DESIGNED BY LYCOMING.

(7) This warranty shall not apply to any engine or part thereof which has been repaired or altered outside Lycoming's factory in any way so as, in Lycoming's sole judgment, to affect its durability, safety or reliability, or which has been subject to misuse, negligence or accident. Repairs and alterations which use or incorporate parts and components other then genuine Lycoming parts are parts approved by Lycoming for direct acquisition from sources other than Lycoming itself are not warranted by Lycoming, and this warranty shall be void to the extent that such repair and alterations, in Lycoming's sole judgment, affect the durability, safety or reliability of the engine or any part thereof, or damage genuine Lycoming or Lycoming-approved parts. No person, corporation or organization, including Distributors of Lycoming engines, is authorized by Lycoming to assume for it any other liability in connection with the sale of its engine or parts, nor to make any warranties beyond the foregoing warranty nor to change any of the terms hereof. NO STATEMENT, WHETHER WRITTEN OR ORAL, MADE BY ANY PERSON, CORPORATION OR ORGANIZATION, INCLUDING DISTRIBUTORS OF LYCOMING ENGINES MAY BE TAKEN AS A WARRANTY NOR WILL IT BIND LYCOMING. NO AGREEMENT VARYING THE TERMS OF THIS WARRANTY OR LYCOMING'S OBLIGATIONS UNDER IT IS BINDING UPON LYCOMING UNLESS IN WRITING AND SIGNED BY A DULY AUTHORIZED REPRESENTATIVE OF LYCOMING.

(8) All legal actions based upon claims or disputes pertaining to or involving this warranty including, but not limited to, Lycoming's denial of any claim or portion thereof under this warranty, must be filed in the courts of general jurisdiction of Lycoming County, Commonwealth of Pennsylvania or in the United States District Court for the Middle District of Pennsylvania located in Williamsport, Pennsylvania. In the event that Purchaser files such an action in either of the court systems identified above, and a final judgment in Lycoming's favor is rendered by such court, then Purchaser shall indemnify Lycoming for all costs, expenses and attorneys' fees incurred by Lycoming in defense of such claims. In the event Purchaser files such a legal action in a court other than those specified, and Lycoming successfully obtains dismissal of that action or transfer thereof to the above described court systems, then Purchaser shall indemnify Lycoming for all costs, expenses and attorneys' fees incurred by Lycoming in obtaining such dismissal or transfer.

(9) Any invalidity of a provision of this Warranty shall not affect any other provision, and in the event of a judicial finding of such invalidity, this Agreement shall remain in force in all other respects.

Effective September 2006

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RECORD OF REVISIONS

Rev. No	Issue Date	Revision History
A	December, 2013	• Added new figures in System Description and Engine Reception and Lift chapters • Added timing procedure • Added EIS Installation Guidelines • Added EIS Operating Guidelines • Updated Appendix A
B	November 2014	• Appendix A, Table A-1 Changed approved fuel to only 100LL due to mandatory carburetor replacement. (Automotive fuels 91 AKI, 93, UL 91AKI Hjelmco 91/96UL not approved for use with new carburetor) • Deleted all references to Service Instruction No. SI-1070 (no longer applicable) • Page xiii, Deleted AKI acronym • Page 3, Steps 7 & 8, Replaced “roller tappet” with “hydraulic tappet.” • Page 30, in 2nd Notice, deleted reference to Table 2, Lean Mixture Settings for Automotive Fuels • Page 31, Deleted Table 2, Lean Mixture Settings for Automotive Fuels, updated table references in “Engine Start and Operation” chapter • Page 47, deleted section “Storage of Engines That Use Automotive Fuel.” • Removed references throughout the manual to “Direct Drive Overhaul” since field overhaul is not allowed on these engines. The engines must be sent to either Lycoming Engines or an authorized overhaul facility.

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SERVICE DOCUMENT LIST

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

Number	Revision Number	Incorporation Date	Subject
S.I. 1241	C	12/2013	Pre-oil the Engine Prior to Initial Start
S.I. 1014	M	12/2013	Lubricating Oil Recommendations
S.I. 1528		12/2013	Aircraft Engine Starter Recommendations
S.I. 1472		12/2013	Removal of Preservative Oil from Engine
S.I. 1505		12/2013	Cold Weather Starting
S.I. 1481	B	12/2013	Factory Engine Preservation
S.L. L180	B	12/2013	Engine Preservation for Active and Stored Aircraft

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LIST OF FIGURES

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ABBREVIATIONS AND ACRONYMS

A	
Amp	Ampere
B	
BHP	Brake Horsepower
BSFC	Brake Specific Fuel Consumption
BTC	Before Top Center
Btu	British thermal unit
C	
C	Celsius
CHT	Cylinder Head Temperature
E	
EGT	Exhaust Gas Temperature
F	
F	Fahrenheit
FAA	Federal Aviation Administration
FAR	Federal Aviation (and Space) Regulation
FOD	Foreign Object Debris
Ft.-lb	Foot Pound (torque)
G	
gph	Gallons per Hour
H	
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
lph	Liters per hour
N	
NM	Newton Meter
MSB	Mandatory Service Bulletin

P	
POH	Pilot Operating Handbook
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
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
Y	Uncertified
O	Horizontally Opposed
233	Displacement in 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 YO-233-B2A Series Lycoming aircraft engines. For maintenance refer to the YO-233-B2A Series Engine Maintenance Manual. **Do not overhaul or disassemble this engine in the field.** If the engine needs to be disassembled or overhauled, send the engine to either Lycoming Engines or an authorized overhaul facility. For spare parts information refer to the YO-233-B2A Series Engine PC-901-1 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). These service documents can be found on the company's website with a paid access subscription.

For subscription information, look on Lycoming's website or speak to Lycoming by telephone: 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, applicable service documents, 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 INJUIRY AND/OR DAMAGE TO THE ENGINE.

⚠WARNING: YOU ALSO MUST COMPLETE THE NECESSARY MAINTENANCE PROCEDURES IDENTIFIED IN THE YO-233-B2A MAINTENANCE MANUAL 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 Z535-6-2006.

Safety Advisory Conventions	
Advisory Word	**Definition**
DANGER:	Indicates a hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.
⚠WARNING:	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
⚠CAUTION:	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury. It may 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 recommends that engine owners and maintenance 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 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
Internal Customers - +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 for supply of a change of address.

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SYSTEM DESCRIPTION

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

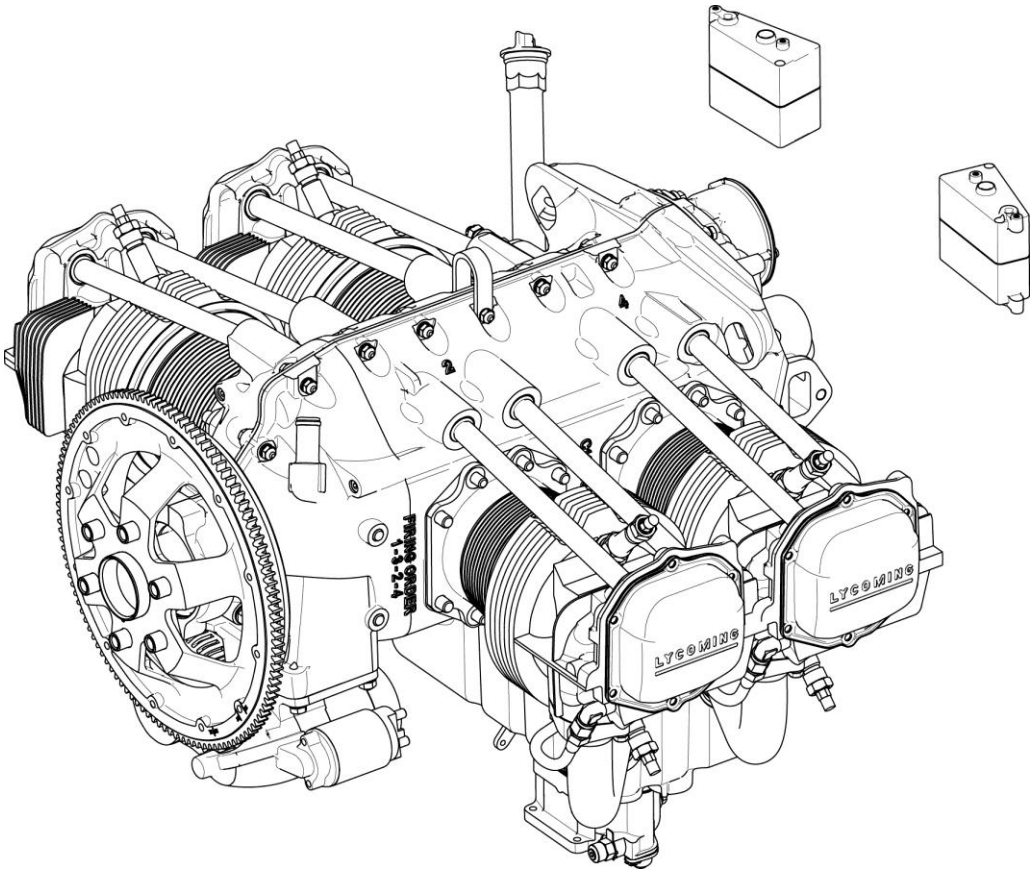

Figure 1
YO-233-B2A Series Engine

Cylinders

Each of the four engine cylinders has a cylinder head, barrel, rings, pistons, push rods, valves, valve springs, and hydraulic tappets.

Two compression rings and an oil regulating ring are on all pistons. An oil scraper ring is below the piston pin. The full float-type piston pin has a plug at each end to prevent the pin from touching the cylinder wall.

The connecting rods have replaceable bearing inserts in the crankshaft ends and split-type bronze bushings in the piston ends. Two bolts/nuts through each bearing cap attach the bearing cap to the crankshaft ends of each rod.

Each cylinder is air-cooled by integral cooling fins. Cylinder baffles push air through the cylinder fins.

Air pressure from the forward speed of the aircraft cools the engine. Close fitting baffles build pressure and force air through the cylinder fins. Air passes through the rear of the cowling as exhaust.

Crankcase

The crankcase is made up of two 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 attached without a gasket.

The crankcase forms the bearings for the camshaft. The camshaft operates the hydraulic tappets which control the opening and closing of the intake and exhaust valves.

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

The crankshaft is within the crankcase.

The crankcase has a breather to prevent excess oil pressure in the crankcase.

The filler cap and oil level gage are installed in the crankcase. An optional filler extension is available.

The airframe-supplied oil cooler keeps the oil at the correct temperature to prevent overheating.

Fuel System

The engine has the single barrel float-type MA-3PA carburetor for mixture, metering, manual mixture control, and idle cut-off.

The fuel system has a removable filter and sediment trap to collect debris from fuel. However, the engine can continue to operate within approved limits with fuel contaminated with particles up to 10 microns.

The fuel/air mixture goes through the intake riser and is turned into vapor by the heated rise.

Ignition System

The dual CDI Electronic Ignition System (EIS) includes three main components:

- Ignition module
- Low tension harness
- Coil packs with an integral high tension harness

The ignition module is used for power generation, regulation and timing control of the spark event. The EIS supplies fixed-base timing.

The EIS receives power from aircraft power for engine start, low RPM operation, and for redundant back-up during operation. An integrated Permanent Magnetic Alternator (PMA) supplies power to the EIS for flight operation.

The ignition module has two small output harnesses, one for each coil pack. Each coil pack has four ignition leads which go to each respective spark plug.

Induction System

The center zone induction system is soaked in oil within the oil sump, and distributes the fuel/air mixture to each cylinder. This induction system enables fuel vaporization and oil cooling in the sump. The fuel/air mixture is distributed to each cylinder by individual intake pipes.

Accessory Housing/Accessory Drive Pads

The accessory housing is a machined casting attached to the rear of the crankcase on top of the oil sump. This housing encloses the oil pump and accessory drives.

Lubrication System

The Lubrication System has the following:

- Impeller type oil pump (in the accessory housing)
- Full pressure wet oil sump
- Oil collectors
- Oil cooler (supplied by airframe manufacturer if necessary)
- Oil filter
- Relief valve
- Main oil galley

The wet sump-type Lubrication System supplies oil to the oil galleys in the crankcase and to the engine in all flight altitudes and atmospheric conditions. The oil sump has a suction screen, carburetor mounting pad, intake riser, and intake pipe. There are two drain plugs in the bottom of the oil sump for oil changes.

Oil circulation in the engine is as follows:

1. The oil pump pulls oil from the oil sump through a suction screen.
2. Oil from the oil pump flows through a flexible line to the external oil cooler (if necessary).
3. From the oil cooler, the pressurized oil flows through the oil filter on the accessory housing.
4. The oil filter collects any particles larger than 10 microns.
5. The filtered oil flows through an opening to the oil relief valve.
6. The filtered pressurized oil flows to the cam and valve gear openings of the main oil galley.
7. Oil flows through branch openings to the hydraulic tappets and camshaft bearings.
8. From the hydraulic tappets oil flows through indexing holes and hollow push rods to the valve mechanism. The oil lubricates the valve rocker bearings and valve stems.
9. Oil continues to flow through isolated drilled openings to the main bearings of the crankshaft for lubrication of the crankshaft journals.
10. Oil flows through the accessory housing to the accessories which include the PMA.
11. Isolated passages from the rear main bearings supply pressurized oil to both crankcase idler gears.
12. Gravity drains oil from the bearings, accessory drives, and rocker boxes to the oil sump.
13. A relief valve sends oil to the oil sump.

Engine Model Nomenclature

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

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

Cylinder Number Designations

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

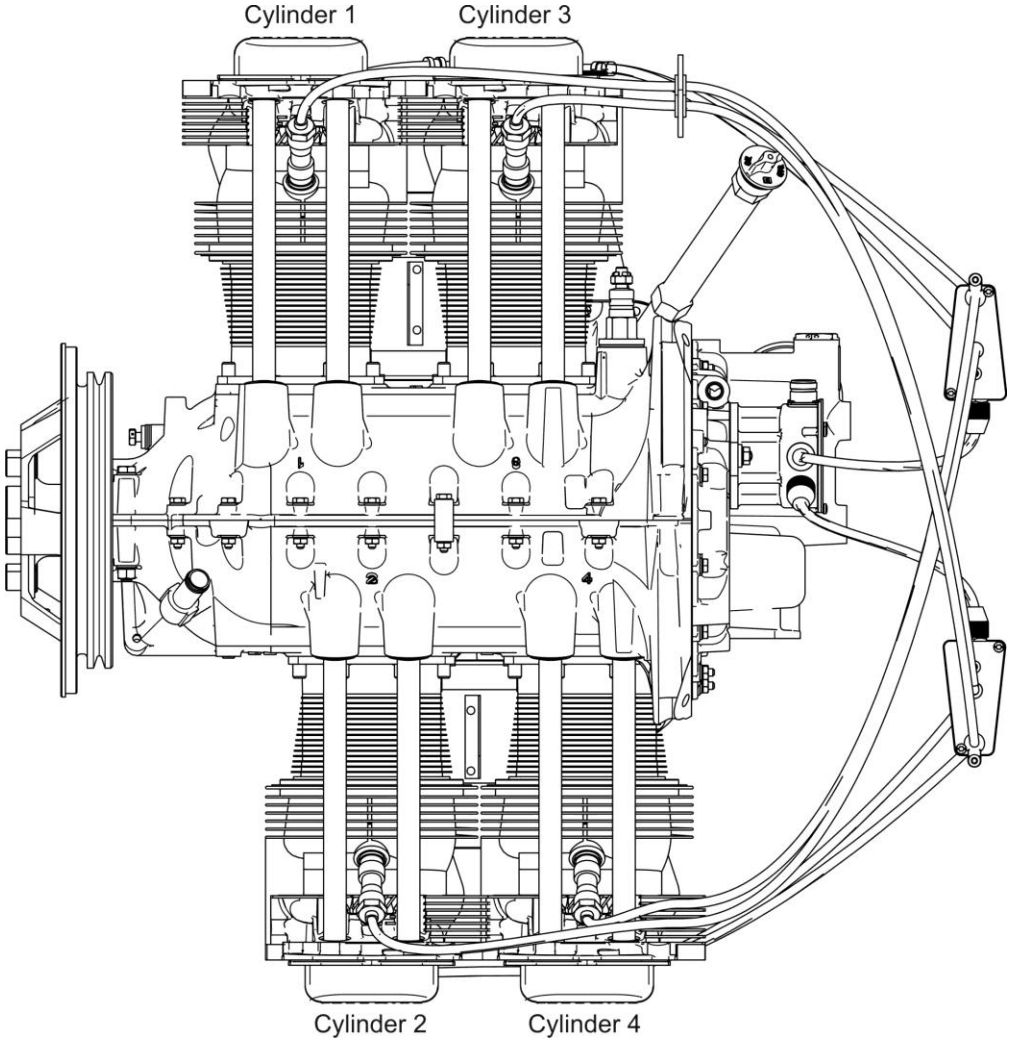

Figure 2
Cylinder Number Designation

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.

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 wrap 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.

URETHANE FOAM WILL BURN RAPIDLY WHEN TOUCHED BY FLAME. IT WILL RELEASE A LOT OF HEAT AND USE OXYGEN AT A HIGH RATE. 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, Complete a borescope inspection on 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 identification 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 corroded, identify the areas of damage and corrosion. Speak to Lycoming's Service Department and the freight shipper.

⚠ **CAUTION:** DO NOT LIFT OR INSTALL OR STOW A DAMAGED OR CORRODED ENGINE.

3. Refer to the section "Lift the Engine" in this chapter and lift the engine.
4. If the engine is not damaged and is without corrosion, it can be installed or stowed. If the engine is to be installed within 5 days after it is uncrated, refer to the section "Prepare the Engine" in the "Requirements for Engine Installation" chapter.

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

⚠ **CAUTION:** THE HOIST MUST HAVE A CAPACITY TO HOLD A MINIMUM OF 250 LBS.

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

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

NOTICE: Center of gravity position. The center of gravity of this engine, including starter and alternator is 1.13 ± 0.25 in. (2.87 ± 0.635 cm) below the centerline of the crankshaft, 0.20 ± 0.25 in. (0.51 ± 0.635 cm) to the left of the centerline of the crankshaft, and 14.75 ± 0.25 in. (37.47 ± 0.635 cm) from the front face of the propeller mounting flange.

NOTICE: moment of inertia. The moments of inertia of this engine, including starter and alternator and weighing 210 lb (95 kg), are as follows: about the axis parallel to the crankshaft centerline (ixg) 35 in.-lb. Sec. ^{2}, about the vertical axis (izg) 54 in.-lb sec. ^{2}, about the axis parallel to centerline of cylinders (iyg) 35 in.-lb sec, ^{2}. All axes pass through the center of gravity.

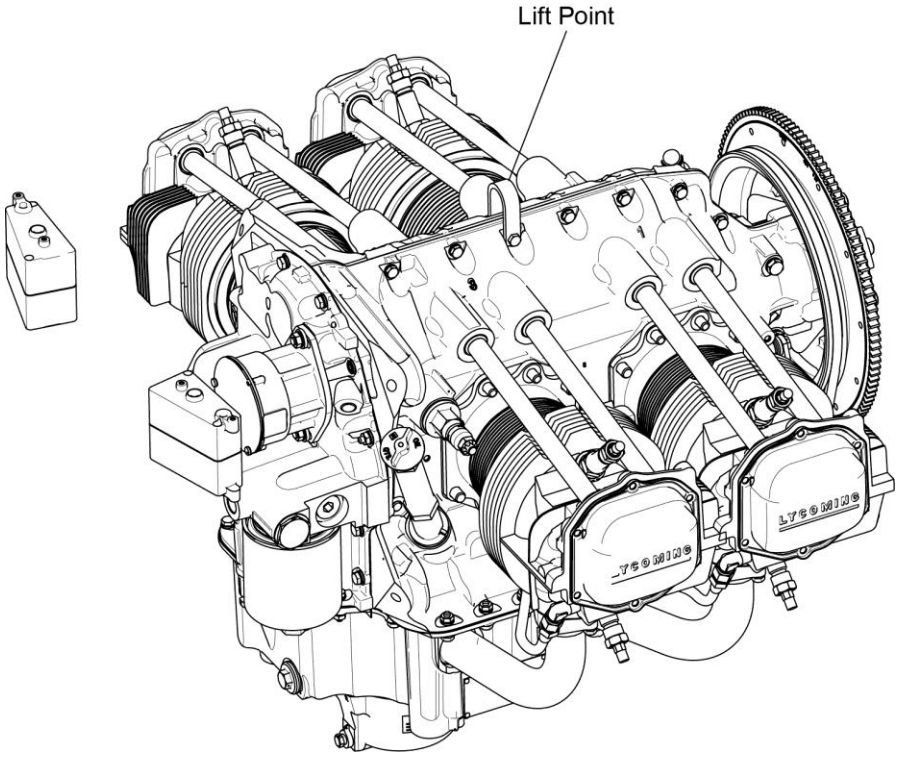

Figure 1
Engine Lift

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

2. Lift the engine slowly and vertically.
3. Examine the engine for damage.
4. If 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 put into service.

NOTICE: Refer to any available documents such as: Certification Interface Document (CDID) for data from the safety analysis, environmental testing, and software validation/verification that is necessary for systems analyses of the powerplant installation and any other associated aircraft system.

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	Do 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 stowed 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.

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

NOTICE: The engine is sent from the factory with preservative oil in the cylinders and preservative oil in the crankcase. 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:

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.
      - Clean the engine (as per the YO-233-B2A Series Engine Maintenance Manual)
      - Remove the oil strainers
      - Clean the oil strainers in gasoline or other organic solvent
      - Remove the fuel drain screen from the fuel inlet of the carburetor
      - If there is evidence of valve sticking, refer to the YO-233-B2A Series Engine Maintenance Manual for instructions.
      - If necessary, remove the engine (as per instructions in the YO-233-B2A Series Engine Maintenance Manual) and send the engine to either Lycoming Engines or an authorized overhaul facility for evaluation.
   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.
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 oil sump drain plug.
   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 Procedure” as per Chapter 12-10 in the YO-233-B2A Series Engine Maintenance Manual. The oil must be drained while hot to remove any remainder of preservative oil.

   D. Install the drain plug with a new crush washer.
   E. Torque and safety the drain plug. Refer to the latest revision of the Table of Limits, SSP-1776 for torque values.

6. Drain the fuel:
   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 oil drain from the fuel pump and outlet hose into the collection container.
   E. Connect the outlet hose to the outlet fitting on the fuel pump.
   F. Install the shipping cap.
7. Examine the spark plugs. Refer to the YO-233-B2A Series Engine Maintenance Manual for the spark plug inspection procedure.
8. 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.
9. Make sure that the induction riser is clean and dry.
   A. If you find more than 1/2 quart of preservative oil is in the induction riser:
      (1) Remove the intake pipes.
      (2) Clean the induction riser.
      (3) Examine it again.
      (4) Install the intake pipes.
10. Use the correct disposal procedure for collected oil in accordance with regulations and Environmental Protection Agency 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 stowed 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.

Within 2 hours of engine installation, 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.

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

2. 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).
3. Examine the engine for any damage.
4. 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.
5. Remove the spark plugs or protective plugs from the bottom spark plug holes.

6. Remove any other moisture-prevention seals and covers from the engine.
7. 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.
      - Clean the engine (as per the YO-233-B2A Series Engine Maintenance Manual)
      - Remove the oil strainers
      - Clean the oil strainers in gasoline or other organic solvent
      - Remove the fuel drain screen from the fuel inlet of the carburetor
      - If there is evidence of valve sticking, refer to the YO-233-B2A Series Engine Maintenance Manual for instructions.
      - If necessary, remove the engine (as per instructions in the YO-233-B2A Series Engine Maintenance Manual) and send the engine to either Lycoming Engines or an authorized overhaul facility for evaluation.
   B. Put a container under the engine to collect the cylinder preservative oil.
   C. Rotate 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.
8. Examine the cylinder bores with a borescope for rust and contamination.
9. If any corrosion or unusual conditions are found, speak to Lycoming Engine's Service Department.
10. Drain oil from the oil sump:
    A. Put a container under the oil sump.
    B. Remove the oil sump drain plug, crush washer and safety wire. Discard the crust washer and safety wire.
    C. Drain the preservative oil from the oil sump into the container.
    D. Remove the oil screen and clean it with a hydrocarbon-based solvent such as Varsol or equivalent.
    E. Install the oil screen.

       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 Procedure" as per Chapter 12-10 in the YO-233-B2A Series Engine Maintenance Manual. The oil must be drained while hot to remove any remainder of preservative oil.

    F. Install the drain plug with a new crush washer.
    G. Torque and safety wire the drain plug. Refer to the latest revision of Table of Limits, SSP-1776.

11. Remove the oil filter and install a new oil filter. Refer to the YO-233-B2A Series Engine Maintenance Manual.
12. If the carburetor was prepared for storage:
    A. Put a container under the carburetor.
    B. Remove the fuel drain plug.
    C. Clean the fuel inlet strainer assembly.
    D. Install the fuel inlet strainer and fuel drain plug.
13. If you use a constant speed propeller:
    A. Use a pointed punch tool to make a 1/8 in. to 3/16 in. hole in the center of the plug.
    B. Remove the expansion plug from the crankshaft.
    C. Examine the spark plugs. Refer to the YO-233-B2A Series Engine Maintenance Manual for the spark plug inspection procedure.
    D. 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.
    E. Remove the protectors on the ignition lead ends.
    F. Connect the ignition lead ends.
14. Make sure that the induction riser is clean and dry.
    A. If you find more than 1/2 quart of preservative oil is in the induction riser:
        (1) Remove the intake pipes.
        (2) Clean the induction riser.
        (3) Examine it again.
        (4) Install the intake pipes.
15. Install satisfactory spark plugs (if removed). Refer to the YO-233-B2A Series Engine Maintenance Manual for instructions on inspection and installation of spark plugs.
16. Remove the protectors on the ignition lead ends.
17. Connect the ignition lead ends.
18. Use the correct procedure for disposal of drained oil in accordance with local, state, federal, and Environmental Protection Agency regulations.

Step 2. Supply Interface Items

For engine installation, the airframe manufacturer must supply the items in the list below:

- Correctly-sized hose for the fuel pump supply and return vent line back to the airframe
- Fuel selector switch with an OFF position
- Fuel shut-off valve
- Airframe fuel filter with a bypass
- Means of communication to the pilot
- Fuel boost pump
- Oil cooler with a thermostatic bypass and pressure relief valve

- Indicator light in cockpit for ignition source
- Ignition switch. As both channels retard for starting the ignition switch should not ground either channel during starting
- For the power control body, a standard mechanical push-pull or power lever control in the cockpit and appropriate cable linkage and bracket
- Starter wiring controls
- Two ground straps for engine mounts
- Ground straps from the engine case to the engine mounting frame.

Step 3. Measure Engine Dimensions

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

Step 4. Remove Components

It may 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 back on the engine after the engine is installed.

Step 5. Install Aircraft-Supplied Engine Mounts

The airframer is to install engine mounts on the airframe.

Step 6. Make the Aircraft Engine Harness

A wiring diagram is to be supplied to the airframer 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 (which contains the sensors).

All wires must be in compliance with aviation standards for wiring and standard practice for bundling. Appendix B in this manual contains wiring diagrams.

Step 7. Do Electrical Interface Connections

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

The electrical interface must be grounded to the aircraft. The airframer is to identify circuit protection, as needed and identify the specified rating for the wire.

Ground Straps (Airframe Supplied)

The ground straps are from the dedicated grounding lugs (uncolored pads on the unit) to the dedicated airframe ground bus.

In accordance with FAA guidelines on High Intensity Radio Frequency (HIRF) and lightning, there must be at least three low impedance ground straps from the engine case to the engine mounting.

ENGINE INSTALLATION

Engine Installation Overview

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

Refer to the engine installation drawing in Appendix B.

Complete the following steps in Table 3 to install the engine.

Table 1
Engine Installation Steps and References

Step	Section References in This Chapter
1	Install the Engine on Mounts
2	Connect the Wiring Harnesses
3	Connect the Throttle Linkage
4	Install External Accessories
5	Install the Propeller
6	Connect Fuel Lines
7	Connect Oil Lines
8	Attach Grounding Straps
9	Install Components That Had Been Removed Before Engine Installation
10	Make Remaining Engine Connections
11	Install Baffling
12	Electronic Ignition System (EIS) Installation Guidelines
13	Add Oil
14	Engine Pre-Oil Procedure
15	Add Fuel (to aircraft as necessary)
16	Final Installation Inspection
17	Close 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 MISALIGNED ENGINE MOUNTS, THE ENGINE CAN BE PUT UNDER UNUSUAL FORCE WHICH CAN CAUSE MALFUNCTION.

NOTICE: The engine is sent from the factory with the wiring harness and spark plugs installed. Refer to Figure 1 which shows how the wiring harness is installed on the engine.

NOTICE: Install the engine with the crankshaft in the horizontal position.

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 to the torque as per airframe manufacturer's maintenance manual.
4. Disconnect the hoist from the lifting eyes.

Step 2. Connect the Wiring Harnesses

1. Examine the airframe receptacles for the airframe interface, and airframer power. Look closely at the pins and sockets. If a receptacle is damaged, repair or replace the receptacle.
2. Connect the engine wiring harness to the airframe engine wiring harness at the firewall receptacle on the airframe.
3. Connect the airframe engine wiring harness to avionics and ignition sources. Refer to the airframe manufacturer's wiring diagram.
4. Connect wiring to the starter and alternator.

Step 3. Connect the Throttle Linkage

1. Connect the cable to the throttle linkage for the engine.

Step 4. Install External Accessories

1. Install the external accessories.

Step 5. Install the Propeller

1. Install the propeller in accordance with the propeller and airframe manufacturer's instructions.
2. If necessary, install the propeller governor, use the supplied gasket and hardware.

Step 6. Connect Fuel Lines

1. Remove unwanted material from the aircraft fuel strainer. Let a minimum of 1 gallon (3.8 liters) of fuel to 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. Remove protective caps from the main fuel inlet.
4. Connect the main fuel inlet line to the fuel pump. Torque the connection as per aiframer instructions.

Step 7. Connect Oil Lines

1. Connect the oil line from the oil sump to the wastegate.

Step 8. Attach Grounding Straps

1. Connect grounding jumpers from the engine mounts to the airframe.
2. Connect three ground jumpers from the engine to the engine mounts.

Step 9. Install Components That Had Been Removed Before Engine Installation

1. Install components, such as exhaust pipe, that were removed to enable the engine to be installed.

Step 10. Make Remaining Engine Connections

2. Make engine connections to accessories.
3. Make engine connections to wires and cables.
4. Make engine connections to ducts and cowling.
5. Make engine connections to breather, hoses and pipes.
6. Connect aircraft wiring to starter and alternator.
7. In accordance with the airframe manufacturer's instructions, install all cowling and nacelle access panels.

Step 11. Install Baffling

1. Install baffling around the engine compartment.

Step 12. Electronic Ignition System (EIS) Installation Guidelines

To ensure correct engine operation as per EIS Operating Guidelines in the "Engine Start and Operation" chapter, obey these installation guidelines to keep the EIS operating temperature below the maximum limit:

1. Install baffling/ducting in a position to direct incoming airflow around the EIS to insulate the unit from fluctuations in ambient temperatures.
2. Do not mount the coil packs on the pushrod tubes; mount the coil packs behind the engine baffling away from the heat of the cylinders (cylinder head area) to minimize heat soak-back that occurs after engine shutdown.
3. Do not lengthen ignition leads – this modification is prohibited.
4. Complete any other type of modification to ignition leads (if necessary) in accordance with Champion's L-1499A Ignition Lead Assembly and Maintenance Manual (available via subscription at www.championaerospacepubs.com.

Step 13. Add Oil

1. Add oil to the engine. Refer to the YO-233-B2A Series Engine Maintenance Manual.

Step 14. Engine Pre-Oil Procedure

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

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

- After oil lines have been connected
- Before the initial start of a new, overhauled, rebuilt or stored engine
- After oil cooler replacement-draining
- After oil replacement
- After any prolonged period of inactivity.

1. Fill the oil cooler with oil.
2. Remove one spark plug from each cylinder of the engine.

3. Put the mixture control in idle cut-off and the fuel selector or shut off in the OFF position. If the engine does not have an idle cut-off, open the throttle to the FULL OPEN position and put fuel and ignition switches in the OFF position.
4. Turn the engine with the starter (or external power source) until oil is seen at the end of the oil lines.

⚠ **CAUTION:** DO NOT ENERGIZE THE STARTER FOR PERIODS OVER 10 TO 15 SECONDS. LET THE STARTER COOL AFTER EACH ENERGIZATION.

5. Turn the starter for up to 10 seconds to make sure oil pressure shows 20 lbs. on the oil gage. If there is no oil pressure after 10 to 15 seconds, let the starter cool. Energize the starter for two or more 10 to 15 second periods.
6. Install the spark plugs and immediately start the engine. Refer to the "Engine Start and Installation" chapter.

Step 15. Add Fuel

⚠ **WARNING:** USE ONLY THE SPECIFIED FUEL IN TABLE A-1 IN APPENDIX A. DO NOT USE A LOWER OCTANE OR INCORRECT GRADE OF FUEL OR JET FUEL (DIFFERENT FROM FUEL IDENTIFIED IN APPENDIX A). UNUSUAL DETONATION CAN INCREASE ENGINE TEMPERATURE AND PRESSURE WHICH CAN DAMAGE THE ENGINE.

1. Add the specified approved fuel (identified in Table A-1 of Appendix A).

Step 16. Final Installation Inspection

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

Step 17. Close 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 CEHCKLIST

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 manufacturers 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 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 specified approved fuel (identified in Table A-1 of Appendix A) 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	

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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 COMPLETE THE RECOMMENDED MAINTENANCE IN ACCORDANCE WITH THE YO-233-B2A SERIES ENGINE MAINTENANCE MANUAL. DO NOT OVERHAUL THIS ENGINE IN THE FIELD. IF AN ENGINE MUST BE DISASSEMBLED OR OVERHAULED, SEND THE ENGINE TO EITHER LYCOMING ENGINES OR AN AUTHORIZED OVERHAUL FACILITY.

Before Engine Start

Before a newly installed repaired/overhauled engine is ready for flight, Complete all of the steps shown in Table 1. These steps must be done in the sequence shown. For daily, usual flight, do steps 2, 3, and 5. Refer to the respective sections in this chapter.

⚠ WARNING: THE SEQUENCE OF STEPS IN TABLE 1 MUST BE COMPLETED ON AN ENGINE THAT HAS BEEN NEWLY INSTALLED AND/OR ROUTINELY INSPECTED OR OVERHAULED BEFORE THE AIRCRAFT IS RETURNED TO SERVICE.

Table 1

Prerequisite Requirements for Engine Operation

Step	Section References in This Chapter
1	Prepare the Engine for Operation
2	Daily Pre-Flight Inspection
3	Start the Engine
4	Do the Operational Test
5	Run Up the Engine
6	Stop the Engine

Step 1. Prepare the Engine for Operation (Part of Pre-Flight Inspection)

1. After any of the following actions, Complete a complete pre-start 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 power control and alternate air controls are free to move in the full range of travel.

4. Make sure that the aircraft battery is completely charged, especially during sub-freezing temperatures.
5. Examine the propeller and propeller hub for cracks, oil leaks, and security.

⚠WARNING: THE ENGINE HAS CERTIFICATION FOR OPERATION WITH SPECIFIED FUEL IN APPENDIX A OF THIS MANUAL. THE ENGINE MUST BE OPERATED WITH THE SPECIFIED FUEL. IF THE MINIMUM GRADE IS NOT AVAILABLE, USE THE NEXT HIGHER GRADE. NEVER USE A LOWER GRADE FUEL OR JET FUEL. THE USE OF LOWER OCTANE RATED FUEL OR JET FUEL CAN CAUSE ENGINE DAMAGE. IF INCORRECT FUEL IS USED, THE FUEL SYSTEM MUST BE COMPLETELY DRAINED AND SERVICE MUST BE DONE ON THE FUEL TANKS IN ACCORDANCE WITH THE AIRCRAFT MANUFACTURER'S RECOMMENDATIONS. ALSO REFER TO THE YO-233-B2A SERIES ENGINE MAINTENANCE MANUAL. AFTER THE FUEL SYSTEM IS CLEANED, AN ENGINE INSPECTION IS NECESSARY IN ACCORDANCE WITH THE YO-233-B2A SERIES ENGINE MAINTENANCE MANUAL.

6. As necessary, add fuel specified in Appendix A of this manual to the aircraft in accordance with the airframe manufacturer's instructions. If the minimum fuel grade is not available, use the next higher grade available.
7. Measure the engine oil level to make sure there is sufficient oil in the engine. If the oil level is too low, add the correct specified grade of oil as necessary. Refer to the section "Measure the Oil Level and Add Oil" in the YO-233-B2A Series Engine Maintenance Manual.
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 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 engine was pre-oiled. Refer to the section "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. If this filter is clogged or dirty, replace this filter with a clean filter if it is dirty. Tighten this filter if it is loose.
11. Make sure that the alternate air supply or carburetor heater operates correctly.
12. Examine the engine, propeller hub area, and cowling 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 or broken lines, hoses, fittings, clamps and connections. Remove any unwanted material. Tighten loose connections. Replace broken lines or hoses.
14. Examine for restrictions to cooling airflow. Remove any unwanted material. Replace broken lines. Tighten any loose connections.
15. Make sure that all baffles and baffle seals are installed in the correct position and are serviceable.

⚠ **CAUTION:** BEFORE EACH FLIGHT, ALWAYS EXAMINE THE FUEL HOSES AND FITTINGS FOR LEAKAGE. IF YOU NEED TO REPLACE A HOSE OR FITTING, REFER TO THE ILLUSTRATED PARTS CATALOG TO ORDER THE CORRECT PART.

16. Correct all problems before engine start.
17. Set the engine timing using the remote timing module and the timing marks on the back of the starter ring gear.

NOTICE: This procedure can be done on an engine that is installed in the airframe. This procedure is to be done for initial installation of the EIS.

A. Rotate the crankshaft 25º Before Top Dead Center (BTDC) on Cylinder 1 (location in Figure 1) using the timing mark on the starter ring gear (Figure 2).

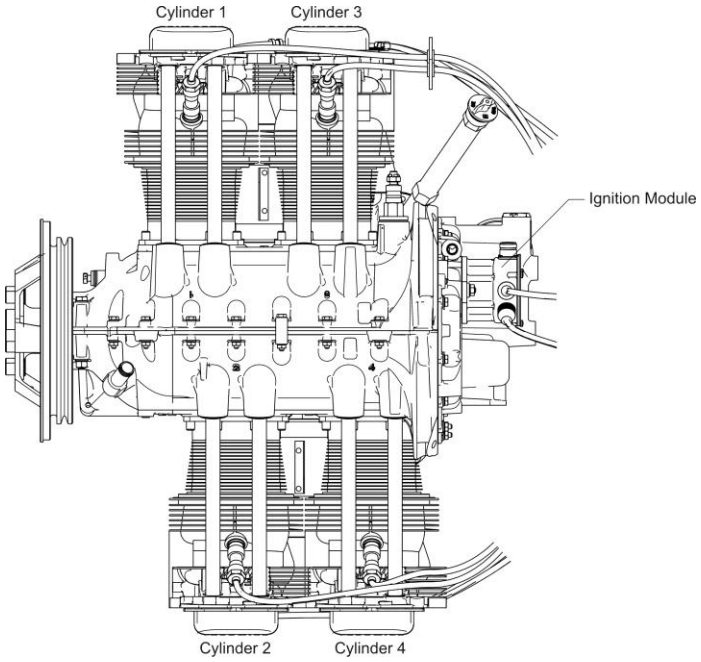

Figure 1
Cylinder Number Designations

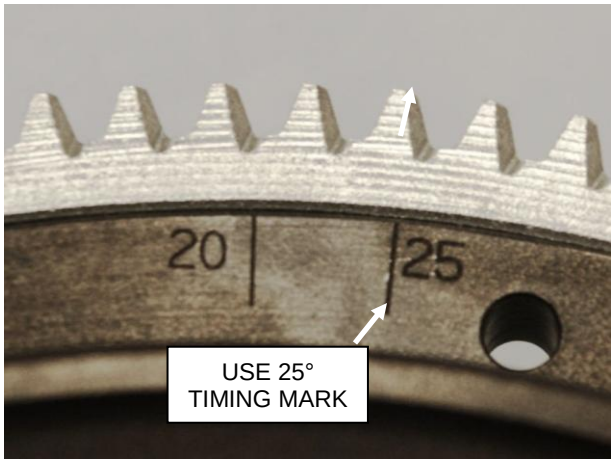

Figure 2
25º Advance Timing Mark on Starter Ring Gear

⚠ **WARNING:** DO NOT CONNECT THE COIL PACKS TO THE TWO FIVE-PIN CONNECTORS ON THE IGNITION MODULE DURING THE TIMING PROCEDURE. CONNECTION OF THE COIL PACKS ENERGIZES THE SPARK PLUGS AND COULD CAUSE ACCIDENTAL SHOCK OR FIRING OF THE ENGINE.

NOTICE: Illustrations in this document are conceptual and used solely for purposes of instruction.

B. Install the magneto gear ignition module drive shaft with a washer, nut, and cotter pin. Torque the nut to 10 to 26 ft.-lb. (14 to 35 Nm).

C. Install a new O-ring into the Ignition Module flange.

D. Attach the 10-pin connector on the Timing Tester (Figure 3) to the 10-pin port on the side of the Ignition Module. Alternately attach the Ignition Module to the aircraft 10-pin connector (Aircraft Connector must be supplying power to the connector).

E. Press the button on the Timing Tester to make sure the tester light illuminates.

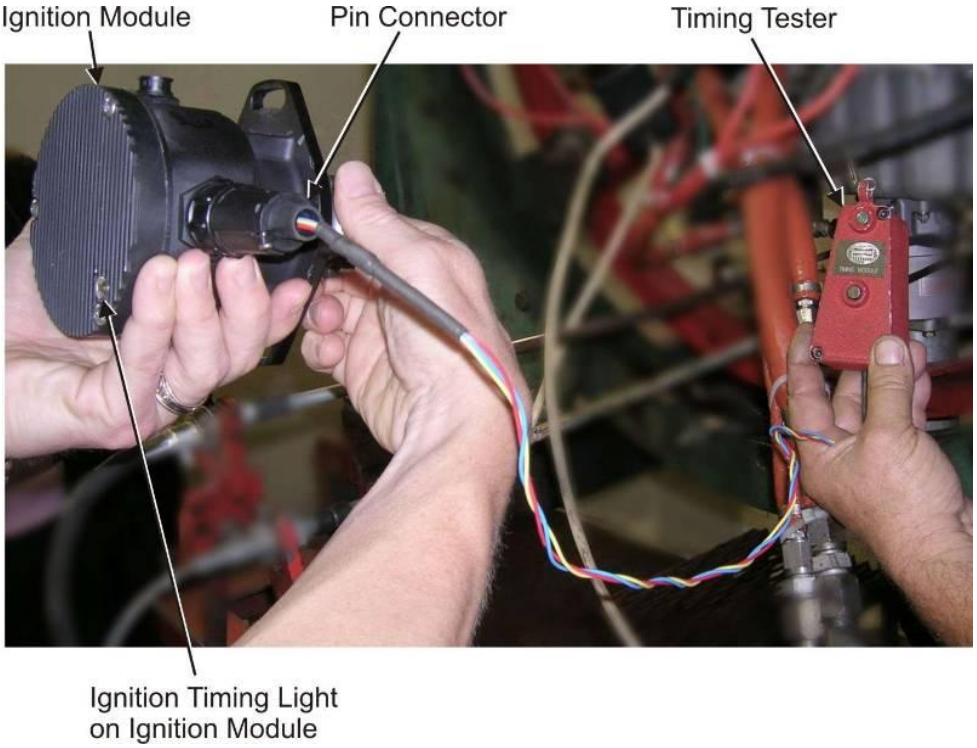

Figure 3
Ignition Module Connected to Timing Tester

F. Hold the Ignition Module with the drive gear (Figure 4) of the Ignition Module facing away from you, as shown in Figure 3.

Figure 4
Drive Gear on Ignition Module

G. Look at the light (on the Timing Tester or the Ignition Module) (which is not illuminated at this point) and turn the drive gear on the Ignition Module counterclockwise (CCW) until the light (on the Timing Tester or the Ignition Module) illuminates. Stop turning the drive gear as soon as you see the light on the (Timing Tester or Ignition Module) illuminate.

NOTICE: The engine must be timed to where the light just turns on.

H. Mark the position of the drive gear to the gear housing with a marker.

I. Rotate the drive gear CCW until just previous to the marked position before the light illuminates.

J. Install the Ignition Module onto the engine by aligning the slots in the installation flange of the Ignition Module with the mounting studs in the accessory housing on the engine. The top stud must be on the right side of the slot. Refer to Figure 5.

K. Slowly rotate the Ignition Module clockwise until the light on the Timing Tester or Ignition Module illuminates (Figure 6).

L. If the light does not illuminate, repeat the timing procedure to confirm the light does not illuminate.

M. If the light does not illuminate on the second timing attempt:

(1) Remove the drive gear and discard the cotter pin.

(2) Index the drive gear 180º and install the additional cotter pin from the kit. Torque the nut to 10 to 26 ft.-lb. (14 to 35 Nm).

(3) Repeat Steps D through M.

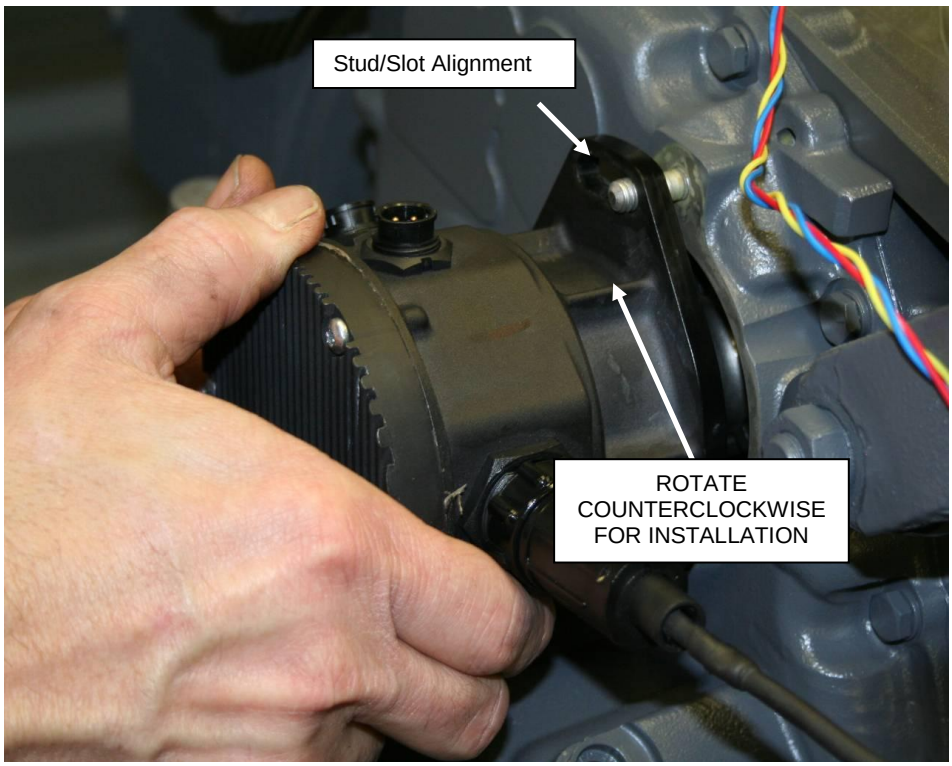

Figure 5
Ignition Module Installation

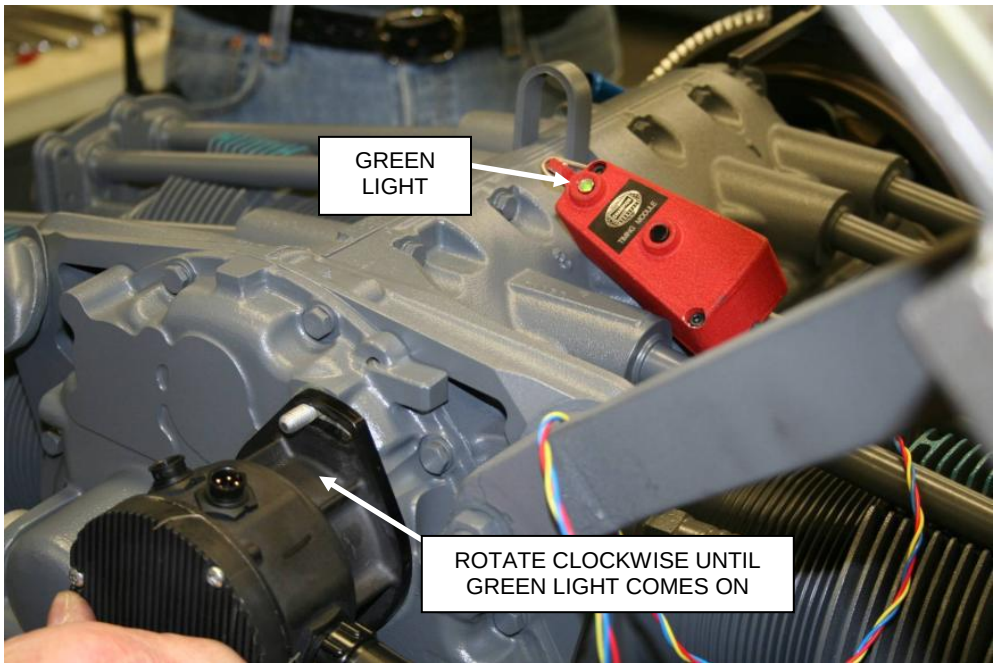

Figure 6
Green Light on Timing Tester

N. Install flat washers, new lock washers, and nuts to attach the Ignition Module to the engine. Tighten the nuts until snug.

NOTICE: Before the Ignition Module is torqued, the light must be illuminated to show correct installation.

O. Engine timing check:

(1) Rotate the crankshaft until the green light turns off.

(2) Rotate the crankshaft back to the correct timing mark.

(3) The green light is to come back on within 2º of the 25º timing mark.

(4) Torque the nuts to 15 to 18 ft.-lb. (20 to 24 Nm).

NOTICE: For safety, the Aircraft Connector must not be connected during the next steps

P. Disconnect the Timing Tester or Aircraft Connector.

Q. Install the spark plugs per the applicable YO-233 Maintenance Manual.

18. Adjust the EIS control module within the range of the slots on its mounting pad.

NOTICE: To prevent kickbacks during starting, the EIS delays the timing below 325 RPM by 20° which sets the start timing to 5° ATDC. As a guideline, the maximum recommended start timing is 5º BTDC. However, this engine model is used to calculate this start timing value.

Step 2. Daily Pre-Flight Inspection

1. Be sure all switches are in the OFF position.
2. Measure the oil level.
3. Make sure fuel tanks are full.

⚠ **CAUTION:** BEFORE EACH FLIGHT, ALWAYS EXAMINE THE FUEL HOSES AND FITTINGS FOR LEAKAGE. IF YOU NEED TO REPLACE A HOSE OR FITTING, REFER TO THE ILLUSTRATED PARTS CATALOG TO ORDER THE CORRECT PART.

4. Correct all problems before engine start.
5. Examine fuel and oil lines connections. Identify and correct the cause of any leaks before the aircraft is flown.
6. Make sure that the fuel and lubrication lines are securely connected (to prevent waffling during flight) and with the necessary clamps and hardware. Fuel lines must be held in place securely with clamps in position approximately 8 in. (20 cm) apart.
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 service in accordance with the airframe manufacturer's recommendations.

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.

⚠ **CAUTION:** DO NOT DO IN-FLIGHT ENGINE RESTARTS ABOVE 25,000 FEET.

⚠ **WARNING:** EXAMINE THE ENGINE FOR HYDRAULIC LOCK. REFER TO THE YO-233-B2A SERIES ENGINE MAINTENANCE MANUAL. DO NOT OPERATE THE ENGINE IF HYDRAULIC LOCK IS SUSPECTED. HYDRAULIC LOCK IS A CONDITION WHERE FLUID ACCUMULATES IN THE INDUCTION SYSTEM OR THE CYLINDER ASSEMBLY. HYDRAULIC LOCK CAN CAUSE ENGINE DAMAGE.

1. Refer to the aircraft POH for the engine start settings and start procedure.
2. Put the aircraft in the direction facing the wind.
3. Set the carburetor heat control in the COLD position.
4. Turn the Fuel Selector to the ON position.
5. If installed, turn the boost pump to the AUTO position.
6. Put the power control in the IDLE position.
7. Set the Mast power selector switch to the ON position.

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

8. Set the throttle to 1/4 travel.
9. Move the mixture control to FULL RICH.
10. Turn the boost pump ON.

⚠WARNING: PUMPING THE THROTTLE TO START THE ENGINE IS A FIRE HAZARD.

11. For a cold engine, if the engine has a priming system, Complete a prime of the cold engine with one to three strokes of the priming pump. If there is no priming system, move the throttle to FULL OPEN and back to the IDLE position two to three times.
12. Set the magneto selector switch. Refer to the airframe manufacturer's handbook for the correct position.
13. Turn on the starter.
14. Start the engine - engine the starter for no more than 10 seconds. If the engine does not start and there are no warning lamps illuminated, wait at least 10 seconds and engage the starter again. You can make up to five engine start attempts. If the engine does not start, refer to the "Unusual Conditions" chapter in this manual.
15. When the engine starts, put the magneto switch in the BOTH position.
16. Complete a magneto check for all three cycles LEFT/RIGHT/BOTH.
17. Look at the oil pressure gage. If oil pressure is not indicated or does not rise to the minimum oil pressure within 30 seconds of engine start, stop the engine, identify and correct the cause.

⚠CAUTION: DO NOT EXCEED THE IDLE 1000 RPM UNTIL THE OIL PRESSURE IS STABLE ABOVE THE MINIMUM IDLING RANGE.

⚠CAUTION: DO NOT OPERATE THE ENGINE AT SPEEDS ABOVE 2500 RPM UNLESS THE OIL TEMPERATURE IS AT A MINMUM OF 100°F (38°C) AND THE OIL PRESSURE IS AT 115 PSI FOR INITIAL START AND WARM-UP. ENGINE DAMAGE CAN OCCUR IF THE OIL TEMPERATURE OR OIL PRESSURE IS NOT AT THE SPECIFIED MINIMUM LEVELS.

NOTICE: Upon engine start, if smoke comes from a newly installed engine, or on the first start of an engine that has been placed into service after preservative oil has been removed, there may have been some preservative oil in the cylinders, induction system, and/or fuel nozzles/lines. If the smoke continues, stop the engine. Drain the preservative oil and add new oil. Refer to the YO-233-B2A Series Engine Maintenance Manual

NOTICE: Full power is available within 4 seconds for a cold engine and 6 seconds for a hot engine after an in-flight engine restart as long as no other faults are present.

A. While the engine is in operation, do the operational test for a newly installed engine or an engine that is returned into the service after each 50-hour, 100-hour or 500-hour inspection.

Step 4. Do the Operational Test

⚠WARNING: IF THE ENGINE IS OPERATED AT LOW OR NO OIL PRESSURE, THE ENGINE CAN MALFUNCTION OR STOP.

NOTICE: If the engine is to be operated at temperatures 90°F (32°C), refer to the section "Engine Operation in Hot Weather" in the "Unusual Conditions" chapter of this manual.

1. While the engine is in operation, monitor the oil pressure. If low or no oil pressure is noted, shut-down the engine. Identify and repair the cause. If necessary, refer to the section "Adjust the Oil Pressure". Refer to the YO-233-B2A Series Engine Maintenance Manual.
2. Operate the engine at 1000 to 1200 RPM for 1 minute. Slowly increase the speed to 1800 RPM in 3 minutes.

3. Monitor both the oil temperature and oil pressure.
4. Look for any illuminated caution or warning lights in the cockpit.
5. Carburetor Heat Control Check:
   A. Refer to the section “Use of Carburetor Heat Control” later in this chapter.
   B. Set the carburetor air heat control for FULL HEAT position. The speed or manifold pressure can decrease.
   C. Put the heat control back to the COLD position.
6. Stop the engine and allow it to cool.
7. Examine the engine. If the engine does not operate correctly, refer to the “Fault Isolation” chapter in the YO-233-B2A Series Engine Maintenance Manual to identify and correct the cause. Correct all problems.
8. Look for leaks in the following areas, correct any leaks before releasing the engine for flight:
   - Induction System
   - Exhaust System
   - Fuel System
   - Oil System.

WARNING: IF DURING AN OPERATIONAL TEST OR ENGINE IDLE, OPERATIONAL PROBLEMS OR LEAKS OCCUR, DO NOT TAKE-OFF. IDENTIFY AND CORRECT THE CAUSE OF THE PROBLEM AND DO THE OPERATIONAL TEST AGAIN.

NOTICE: After 25 hours of operation, change the oil. Inspect the filter and screen. Refer to the YO-233-B2A Series Engine Maintenance Manual.

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

Step 5. Do the Engine Run-Up

NOTICE: This engine is air cooled. Follow this procedure to prevent overheating during engine run-up.

Do the engine run-up as follows:

1. Start the engine.
2. Turn the Fuel Selector to FULLEST or BOTH.
3. Make sure the oil temperature is above the specified minimum.

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

4. Make sure the oil pressure is within operating range (Appendix A).
5. Increase throttle to 1000 to 1200 RPM.

NOTICE: Any ground check that requires full throttle operation must be limited to 3 minutes, or less if the indicated cylinder head temperature exceeds the maximum as stated in this manual.

6. Put the aircraft into the wind.
7. Keep the mixture control in FULL RICH.
8. Avoid prolonged idling at low RPM which could cause fouled spark plugs. Only do ground operation to the minimum time necessary to make the engine warm for take-off.

NOTICE: Carburetor air heat is only used on the ground for short periods only to make sure the carburetor heat control is operating properly. Refer to the section “Use of Carburetor Heat Control” in this chapter.

9. Make sure that the alternate supply or carburetor heater operates correctly.
10. Operate the carburetor air heat control on the ground as little as possible because the air does not pass through the air filter. As a result, dirt and foreign substances can be pulled into the engine and cause cylinder and piston ring wear.

⚠ **CAUTION:** EXTENDED GROUND OPERATION CAN CAUSE ENGINE DAMAGE DUE TO EXCESSIVELY HIGH CYLINDER AND OIL TEMPERATURES.

11. The engine is ready for take-off when the throttle can be opened without faltering and there are no faults and no corrective action is necessary.
12. After 10 hours of engine operation for new, rebuilt or overhauled engines, do the 10-hour inspection. Refer to the YO-233-B2A Series Engine Maintenance Manual.

Fuel Mixture Leaning Procedure

NOTICE: Incorrect fuel-air mixture during flight can cause engine problems, particularly during take-off and climb power settings. Obey the fuel-air mixture leaning procedures in this manual.

1. Do not go above the maximum red line cylinder head temperature limit.
2. For continuous operation, keep the cylinder head temperatures below 435°F (224°C).

NOTICE: Rough operation due to an over rich fuel-air mixture is most likely to be found at altitudes above 5,000 feet.

3. On direct drive engines with manual mixture control, keep the mixture control in the FULL RICH position for rated take-off maximum continuous, climb and cruise powers above 75%.

NOTICE: Refer to Table 2 for lean mixture settings at various engine powers.

Table 2
Lean Mixture Settings at Various Engine Powers if Using Aviation Fuels

Condition	Power	Lean Mixture Settings
Leaning to Exhaust Gas Temperature (EGT) Gage	Above 75% power	Never lean beyond 150°F (66°C) on the rich side of peak EGT unless aircraft operator's manual shows otherwise. Monitor cylinder head temperature.
	75% power and below	Operate at peak EGT.
Leaning with Manual Mixture Control without EGT	At 75% power or less without flowmeter or EGT gage	Slowly move mixture control from the FULL RICH position toward the LEAN position. Continue leaning until the engine operates roughly. Then move the mixture control RICH until the engine operates smoothly.
Alternate Method	In calm air and on engines with fixed pitch propellers	Slowly move the mixture control toward the LEAN position. Closely monitor the tachometer. Continue leaning until the RPM decreases. At this point, move the mixture control RICH until the RPM is regained.

4. However, during take-off from a high elevation airport or during climb, roughness or loss of power can occur from an over rich air-fuel mixture. In this case, adjust the mixture control until the engine operates smoothly - not for economy. Monitor the instruments for temperature increases.
5. Make the fuel/air mixture rich before a power increase.

NOTICE: Fuel leaning may be done at any altitude that the engine will accept leaning. The higher the altitude, the more important leaning becomes. Correct leaning is important because more engine power and increased air speed occurs along with decreased fuel consumption, longer spark plug life, less lead fouling, and more correct oil and cylinder head temperatures.

EIS Operating Guidelines

To ensure correct engine operation, the EIS must be operated at a temperature less than the maximum operating temperature of 158°F (70°C). If the EIS is operated at temperatures above 158°F (70°C) or exposed to thermal soak greater than 284°F (140°C) following engine shutdown, the coil packs can fail.

Use of Carburetor Heat Control

Engine damage from correct leaning of the mixture does not occur at the specified cruise power for the model engine in a healthy power plant. Damage is the result of incorrect leaning at any power setting.

⚠ WARNING: REFER TO THE PILOT'S OPERATING HANDBOOK OR AIRFRAME MANUFACTURER'S MANUAL FOR ADDITIONAL INSTRUCTIONS ON THE USE OF THE CARBURETOR HEAT CONTROL. INSTRUCTIONS IN EITHER PUBLICATION OVERRIDE THE FOLLOWING INFORMATION.

Under moist atmospheric conditions (generally at a relative humidity of 50% or greater) and at temperatures of 10°F to 90°F (-12°F to 32°C) it is possible for ice to form in the induction system. Even in summer weather ice can form due to loss of heat by vaporization if fuel in the carburetor venturi.

The temperature in the venturi can decrease as much as 70°F (21°C) below the temperature of the incoming air. If this air contains a large amount of moisture, the cooling process can cause precipitation in the form of ice.

Ice formation generally starts in the vicinity of the butterfly. The ice can collect to such an extent that a drop in power output can occur. If not corrected, this condition can cause the engine to stop.

To prevent this occurrence, a carburetor heat control system is used for preheat of incoming air. The air carburetor heater is a tube or jacket around the muffler or an exhaust pipe from one or more cylinder(s). Air flows over these surfaces through a duct to the aircraft induction system supplying heated air to the carburetor.

Table 3 shows the correct methods to use the carburetor heat control at various stages of engine operation.

Table 3
Carburetor Heat Control During Engine Operation

Operation Stage	Action
Ground Operation	Only use the carburetor air heat on the ground when necessary on a limited basis. On most installations, heated air does not go through the air filter. Dirt and foreign substances can be pulled into the engine which can cause engine wear. Only use carburetor air heat on the ground to make sure it is operating correctly.
Take-Off	Set the carburetor heat in the FULL COLD position.
Climbing	When climbing at throttle settings of 80% or more, set the carburetor heat control in the FULL COLD position. However, if it is necessary to use carburetor heat to prevent icing, engine roughness can occur due to the over-rich fuel-air mixture caused by the additional carburetor heat. When this occurs, make the mixture lean with the mixture control sufficiently until the engine operates smoothly. Do not continue to use carburetor heat after flight is out of icing conditions. Turn the mixture to FULL RICH when the carburetor heat is removed.
Flight Operation	During flight, keep the carburetor air heat control in the FULL COLD position. On damp, cloudy, foggy or hazy days, regardless of the outside air temperature, monitor for loss of power shown by an unaccountable loss in manifold pressure or RPM or both. In this case, apply full carburetor air heat and open the throttle to limit manifold pressure and RPM. When ice is removed from the induction system, put the carburetor heat control to the FULL COLD position. In aircraft with a carburetor air temperature gage, use partial heat to keep the mixture temperature above the freezing point of water 32°F (0°C).
Landing Approach	When landing, refer to the aircraft manufacturer's instructions regarding the use of carburetor heat icing conditions are possible, apply FULL HEAT. If full power must be applied under these conditions, put the carburetor heat to FULL COLD after full power application.

Step 6. Stop the Engine

Before engine shutdown, keep the engine speed between 1000 and 1200 RPM until the operating temperatures have stabilized. At this time the engine speed should be increased to approximately 1800 RPM for 15 to 20 seconds, then decreased to 1000 to 1200 RPM and shut-down immediately using the mixture control.

When the propeller stops rotating, turn the Master switch and Fuel Selector to the OFF position.

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

Refer to the Pilot's Operating Handbook for additional information.

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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 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.

⚠ WARNING: REPLACE ENGINE TEST CLUBS WITH APPROVED FLIGHT PROPELLERS BEFORE THE FLIGHT TEST.

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
   - Oil pressure
   - Oil temperature
   - Cylinder head temperature.
4. As soon as possible, decrease to climb power.
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 airframer 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 fuel and oil consumption and compare the limits given in Appendix A. If the oil consumption value is above the limits in Appendix A. Identify and correct the cause. If there was a problem that was corrected, do the flight test again, up to and including this step, before releasing the aircraft for service.

UNUSUAL CONDITIONS

Unusual Engine Conditions - Operator Corrective Action

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

Table 1 includes engine operation issues, explanations and applicable corrective action.

Table 1
Unusual Engine Conditions

Unusual Condition	Explanation/Corrective Action
Fire in the engine compartment	Land the aircraft as soon as possible
Engine roughness	Speak to Maintenance
Low, high or surging RPM	Speak to Maintenance
Low, high or fluctuating oil pressure	Speak to Maintenance
Low or high fuel flow	Speak to Maintenance
Excessive manifold pressure	Speak to Maintenance
Engine Indication not available	Speak to Maintenance
Engine operation 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” and section “Cold Weather Start” in this chapter.
Engine in an environment at temperatures more than 90°F (32°C)	Refer to the section “Engine Operation in Hot Weather” in this chapter.
Operation in climates above 100°F	Reduce climb angles to keep the engine cool. Refer to the section “Engine Operation in Hot Weather” in this chapter.
Oil pressure falls below the minimum level	Refer to the section “Low Oil Pressure During Flight” in this chapter.
Low oil pressure	Refer to the section “Low Oil Pressure During Flight” in this chapter.
Volcanic ash	Refer to the section “Volcanic Ash” section in this chapter.
Engine soaked in water	Examine the engine. Refer to the YO-233-B2A Series Engine Maintenance Manual. Moisture and unwanted materials can cause damage to all systems on the engine.

Volcanic Ash

1. Given the dynamic conditions of volcanic ash, Lycoming recommends not to operate the engine in areas where volcanic ash is present - in the air or on the ground.
2. Ash on the ground and runways can cause contamination of 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. Ash on the ground and runways can cause contamination of the engine compartment and subsequent engine damage during aircraft landing or take-off.
5. 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 MAY 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 the 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 may be necessary given on specific operating conditions. Refer to the YO-233-B2A Series Engine Maintenance Manual for corrective action.

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 following protocol progressive steps:

6. Complete a check of the oil level in the oil sump. Drain the oil, if necessary, to determine the oil quantity. Refer to the YO-233-B2A Series Engine Maintenance Manual.
7. 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.
8. Examine oil line connections for leaks. Tighten any loose connections and look for leaks. Replace leaking oil lines.

9. 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.
10. Examine the oil pump for malfunction. Replace the oil pump if it is not operating correctly.
11. If the oil pressure indication system is operating correctly and oil pressure loss/oil starvation has occurred, remove the engine as per instructions in Chapter 72-10 in the YO-233-B2A Series Maintenance Manual. Send the engine to either Lycoming Engines or an authorized overhaul facility for evaluation.

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.

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: Do not use small electric heaters which install in the cowling opening because they do not apply sufficient heat.

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

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

   Pre-heat application will make the engine start during cold weather and is necessary when the engine has been in sub-freezing temperatures +10F°/-12°C.

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

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

⚠ **WARNING:** IF HEAT HAS NOT BEEN APPLIED TO ALL PARTS OF THE ENGINE, THE ENGINE MAY START AND RUN 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 MAY FAIL AFTER APPLICATION OF HIGH POWER.

4. 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 DAMAGE WIRING, HOSES, ETC.

5. If cowl flaps are installed, open the flow flaps to prevent heat build-up.
6. Between intervals, touch the engine to make sure it stays warm and keeps the heat. Make sure there is no damage from heat build-up.
7. During the last 5 minutes of the heat process, apply heat to the top of the engine.
8. 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: Due to the battery being cold and subject to rapid discharge, an auxiliary power source is recommended.

1. After a cold start, do not rapidly increase acceleration or exceed idle RPM. Allow up to 1 minute for oil pressure to become stable above 1000 RPM, since all lines to the gage can remain cold. If oil pressure indication is not shown within 30 seconds, stop the engine. Identify and correct the cause. If no leaks or damage are found, do the pre-heat application again before engine start.
2. Let the engine warm up at 1000 RPM until oil pressure and temperature are stabile within operations limits.
3. Complete a ground check in accordance with the airframe manufacturer’s Pilots Operating Handbook.
4. Before takeoff, 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:

- ENGINE ROUGHNESS
- LOW, HIGH OR SURGING RPM
- HIGH, LOW, OR FLUCTUATING OIL PRESSURE
- HIGH OR LOW FUEL FLOW
- HIGH MANIFOLD PRESSURE

5. Make sure that when takeoff 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.

2. Monitor temperatures closely.
   A. Maintain sufficient airspeed to provide cooling of the engine.
   B. Keep cowl flaps (if equipped) fully open during the climb.

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ENGINE PRESERVATION AND STORAGE

Engine Corrosion and Prevention

1. 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.
2. Corrosion rates can increase because of variable factors such as environmental conditions (humidity, salt air in ocean areas), seasonal changes, and engine usage.
3. 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 1100, 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.

Do 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. Drain the lubricating oil from the sump or system.
2. Wash and brush finger screen with mineral spirits.
3. Clean the finger screen plug.
4. 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.
5. Apply Loctite 564 to oil drain plug.

6. Install and torque the oil drain plug in accordance with the latest revision of the Table of Limits SSP-1776.
7. Fill the spray gun with the preservative oil mixture.
8. Fill the oil sump with the specified preservative oil mixture.
9. 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.
10. Stop the engine.
11. While the engine is still hot, immediately remove sufficient cowling to get access to the spark plugs.

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

13. Remove both spark plugs from each cylinder.
14. Put the spray device in either of the spark plug holes. Apply the preservative oil mixture to each cylinder, one at a time.
15. 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.

16. After spray application is complete, remove the spray device from the spark plug hole.
17. 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).
18. While the engine is still warm:
    A. Install bags of clay desiccant in the exhaust and intake ports.
    B. Attach red cloth streamers as a reminder for the material to be removed when the engine is made ready for flight.
    C. 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.
    D. Apply seals and tape to areas of the engine exposed to the air.
    E. Put a note on the propeller that reads: "Engine preserved - DO NOT TURN THE PROPELLER."
    F. At 15 day intervals, examine the cylinder dehydrator plugs and desiccant. When the color 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.

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, do 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 similar equivalent internal examining device, examine each cylinder for evidence of corrosion. The diameter of the borescope must be smaller than the diameter of the spark plug hole.
   D. Install the top and bottom spark plugs in the cylinder
   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 YO-233-B2A Series Engine Maintenance Manual.

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APPENDIX A

Table A-1
YO-233-B2A Series Engine Specifications

Number of Cylinders	4	
Cylinder Arrangement - Firing Order	1-3-2-4	
Spark Plugs	8 (Spark advance 25° BTC)	
Cooling Method	Air	
Maximum Continuous Horsepower* @ RPM & BSFC Fuel Consumption (gph) @ 75% rated power Fuel Consumption (gph) @ 65% rated power	115 HP @ 2800 PRM @ 0.50 6.5 @ 86 HP 5.6 @ 75 HP	
Alt. Continuous Horsepower* @ RPM & BSFC Fuel Consumption, (gph) @ 75% Performance Cruise Fuel Consumption, (gph) @ 65% Economy Cruise	100 HP @ 2400 RPM @ 0.50 5.6 gal. @ 75 HP 4.9 gal. @ 65 HP	
Alt. Continuous Horsepower* @ RPM & BSFC Fuel Consumption,(gph) @ 75% Performance Cruise Fuel Consumption,(gph) @ 65% Economy Cruise	90 HP @ 2200 RPM @ 0.50 5.1 gal. @ 68 HP 4.4 gal. @ 59 HP	
Alt. Continuous Horsepower* @ RPM & BSFC Fuel Consumption, (gph) @ 75% Performance Cruise Fuel Consumption, (gph) @ 65% Economy Cruise	80 HP @ 2000 RPM @ 0.50 4.5 gal. @ 60 HP 3.9 gal. @ 52 HP	
Propeller Drive Ratio	1:1	
Propeller Shaft Rotation	Clockwise	
Compressor Bore (in.)	4.375 in.	11.1 cm
Compressor Stroke (in.)	3.875 in.	9.84 cm
Piston Displacement	233.3 $in.^3$	3,812.1 cm^3
Compression Ratio	8.5:1	
Weight (lb) without oil	210 lb ± 2%	95 kg ± 2%
Dimensions	Height 22. 6 in.	57.40 cm
	Width 32.0 in.	81.28 cm
	Length 27.0 in.	68.58 cm
Mounting	Rear-type 1 Dynafocal mounting system - four mounting bosses integral with the crankcase	
Maximum Oil Sump Level	6 quarts	5.7 liters
Minimum Oil Sump Level**	4 quarts	3.8 liters
Minimum Safe Oil Level	2 quarts	1.9 liters

Table A-1
YO-233-B2 Series Engine Specifications (Cont.)

Ambient Temperature °F (°C)	MIL-L-6082 or SAE J1966 SAE Grades	MIL-L-22851 or SAE J1899 Ashless Dispersant	Operating Temperature °F (°C)	
	SAE Grade	SAE Grade	Desired	Maximum
All Temperatures	------	15W-50, or 20W-50	180°F (82°C)	245°F (174°C)
Above 80°F (27°C)	60	60	180°F (82°C)	245°F (174°C)
Above 60°F (16°C)	50	40 or 50	180°F (82°C)	245°F (174°C)
30°F to 90°F (-1°C to 32°C)	40	40	180°F (82°C)	245°F (174°C)
0°F to 70°F (-18°C to 21°C)	30	40, 30, or 20W40	170°F (77°C)	245°F (174°C)
Below 10°F (-12°C)	20	30 or 20W30	160°F (71°C)	245°F (174°C)

* SL Standard Day Conditions
** For maximum service life

The correct grade of oil to be used is based on environmental conditions.
If you are going to fly an aircraft into an area that is much warmer or colder than the aircraft is usually operated in, then you must consider using 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 make the temperatures lower.

Fuels (minimum octane) used on this engine.	Low leaded aviation fuel:	100LL
Fuel Pump	Optional - Diaphragm Type	
Ignition System	Champion Aerospace 12 volt - Dual Capacitive Discharge Ignition (CDI) System	
Starter	Sky-Tec 12 volt	
Magneto Drive, Ratio to Crankshaft & Rotation	1.000:1	Clockwise
Carburetor (Includes an acceleration pump)	MA-3PA – Manual Altitude Mixture Control	
Starter Drive, Ratio to Crankshaft at Bendix & Rotation	13.55:1	Counterclockwise
Alternator (Self-rectifying)	Standard – Plane Power (12 volt, 60 Amp)	
Alternator Drive, Ratio to Crankshaft & Rotation	3.20:1	Clockwise

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

NOTE: For optional starters and alternators, refer to the latest revision of Lycoming Service Instruction No. 1154.

Table A-2
Table of Operating Limits for Engine

Minimum Oil Pressure - Idling			15 psi*		103 kPa**
Oil Pressure Range - Continuous Operation			55* to 90 psi		379** to 621 kPa
Maximum Oil Pressure - Starting, Warm-up, Taxi, and Take-off			115 psi		792 kPa
Maximum Oil Temperature			245°F		118°C
Minimum Oil Temperature Continuous Operation			170°F		77°C
Desired Oil Temperature***			180°F		82°C
Maximum Oil Consumption			0.006 lb/BHP - hr.		
Maximum Cylinder Head Temperature (CHT)			450°F		232°C
Maximum CHT @ 75% Power and below***			410°F		210°C
Ignition System Maximum Operating Temperature (Measured on leeward side of the coil packs and control module)			158°F		70°C
Maximum Alternator Temperature at Case			350°F		177°C
Maximum Alternator Temperature at Rectifier			300°F		149°C
Fuel Pressure – (above air entrance pressure) at the inlet to the carburetor.	Operating Conditions	Carburetor		Fuel Pump	
	Desired	3 psi	20.7 kPa	-	
	Maximum	8 psi	55.2 kPa	8 psi	55.2 kPa
	Minimum	0.5 psi•	3.4 kPa	-2 psi	-13.8 kPa

* 10 psi less when measuring from front of engine
** 69 kPa less when measuring from front of engine
*** For maximum service life
• For gravity feed systems, minimum fuel pressure is 7.5 in. of gasoline differential pressure across the fuel inlet fitting

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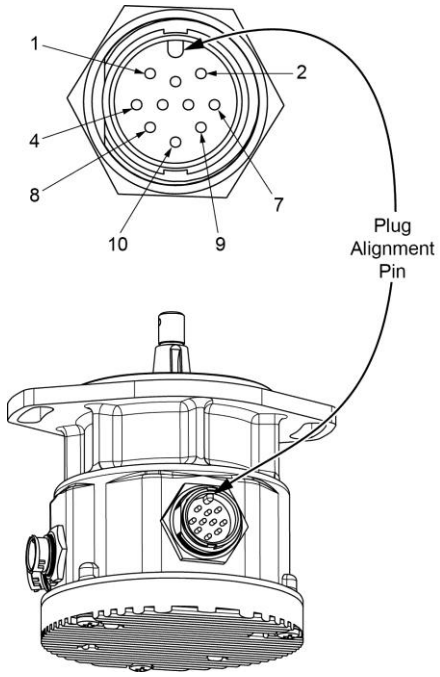
APPENDIX B

INSTALLATION AND WIRING DIAGRAMS

The Champion Dual CDI Ignition System interfaces to the airframe through the 10-Pin connector on the Control Module. Figure 1 shows the Pin Out of the 10-Pin Connector as viewed from the pin side as well as a description of each of the pins. The airframe manufacturer is responsible for furnishing the mating Conxall/Switchcraft P/N 13382-10SG-331 connector. The airframe connector will have the same Pin Out when viewed from the airframe wiring harness side of the connector.



Control Module Interface Diagram Description		
Pin	**Name**	**Description**
1	LEFT MAGNETO	Deactivates Left Ignition Channel when Pulled to Ground
2	RIGHT MAGNETO	Deactivates Right Ignition Channel when Pulled to Ground
3	-----	Not Used
4	TACH SIGNAL	+12 Volt Nominal Signal Pulsed Twice per Revolution
5	-----	Not Used
6	-----	Not Used
7	GROUND	Aircraft Ground
8	PMA LAMP SIGNAL	Pulls to Ground when Ignition is operating on Aircraft Power Current Limited for an LED
9	BATTERY (NEGATIVE)	Negative Aircraft Battery (5 Amps Max)
10	BATTERY (POSITIVE)	Positive Aircraft Battery (+12 Volt Nominal / 5 Amps Max)

Figure 1
Control Module Interface Information

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APPENDIX C

SUSBSTANTIATED AND FAA APPOVED DATA

Performance Charts

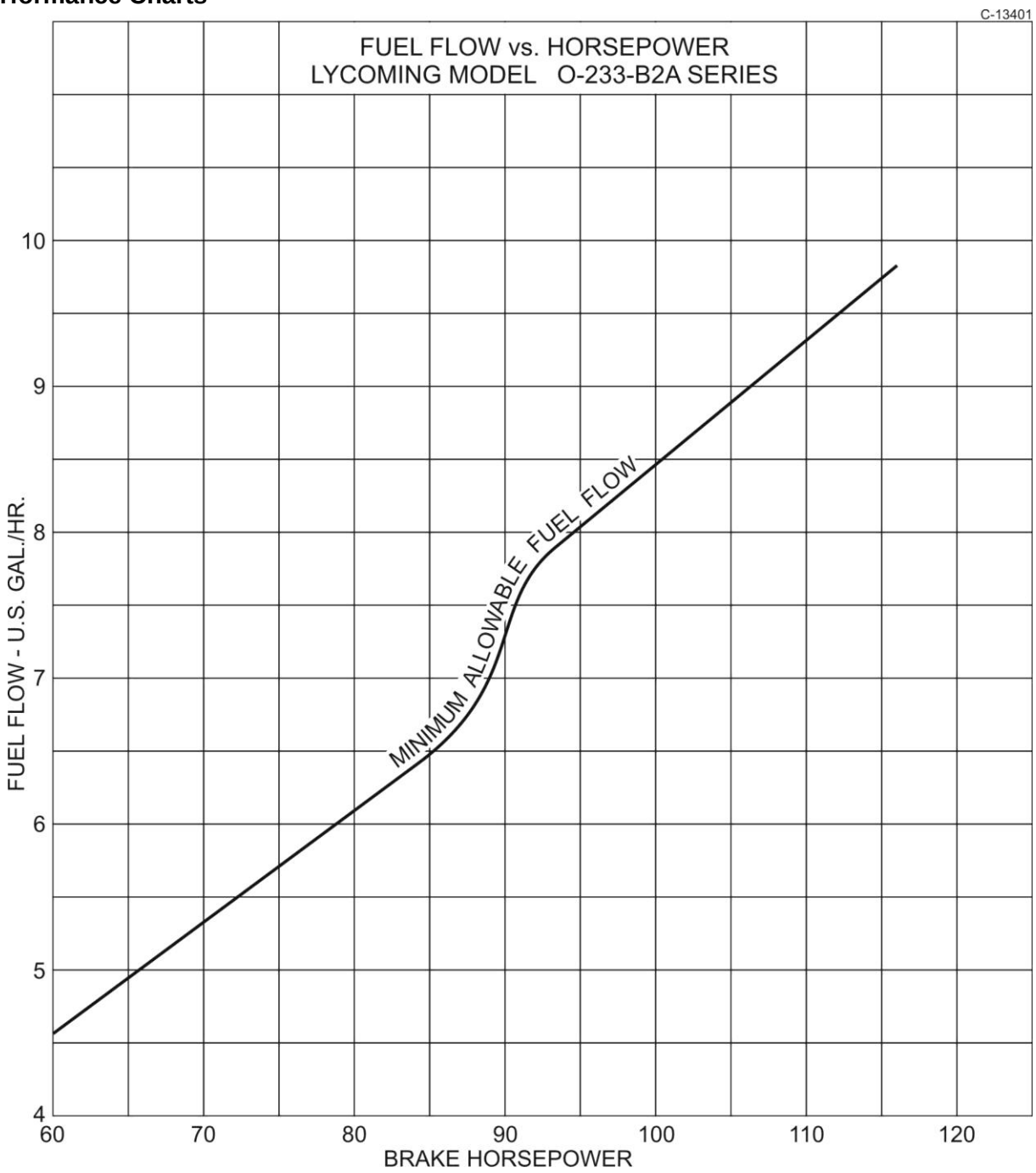

Figure 1
Fuel Flow vs Horsepower

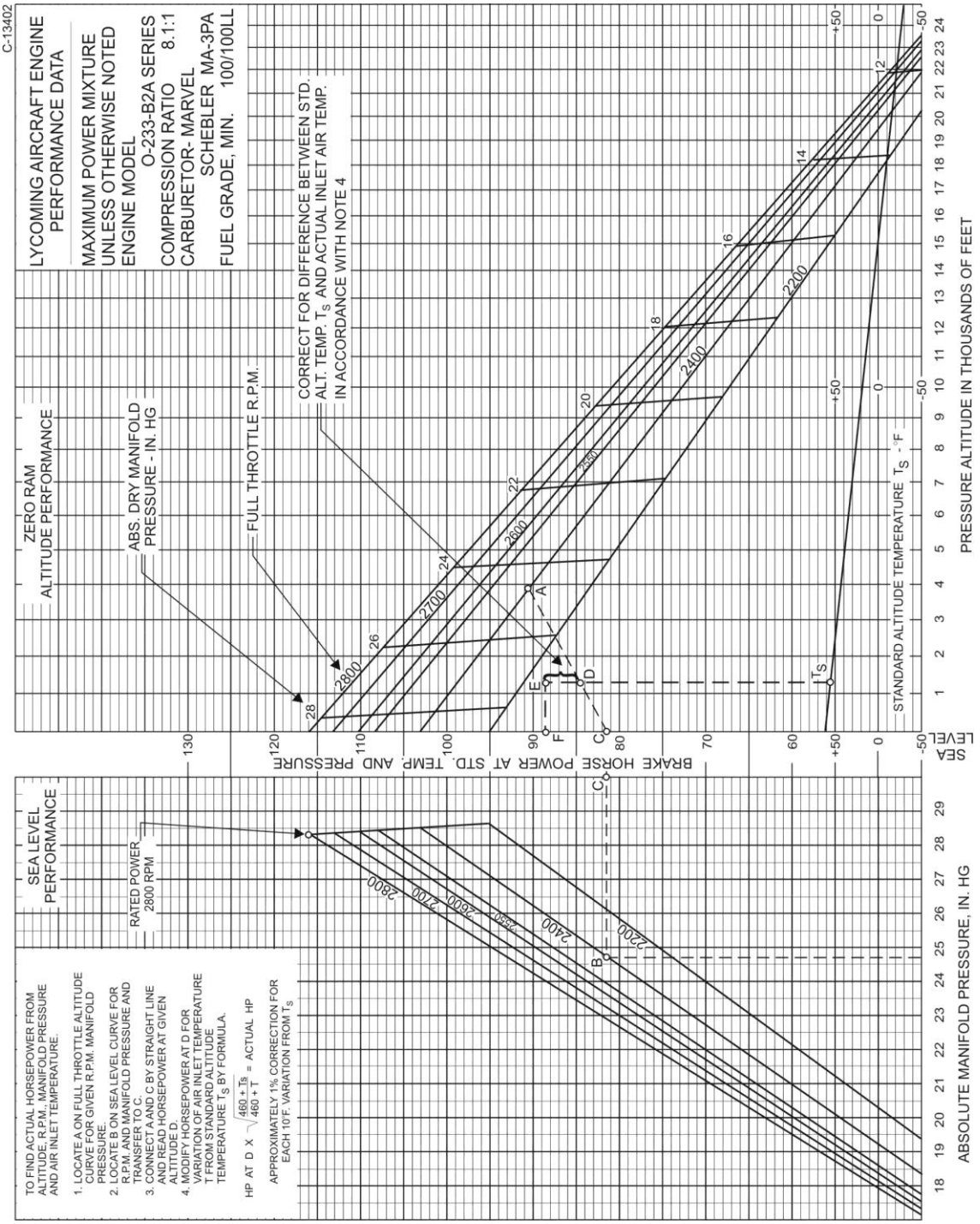

Figure 2
Sea Level and Altitude Performance