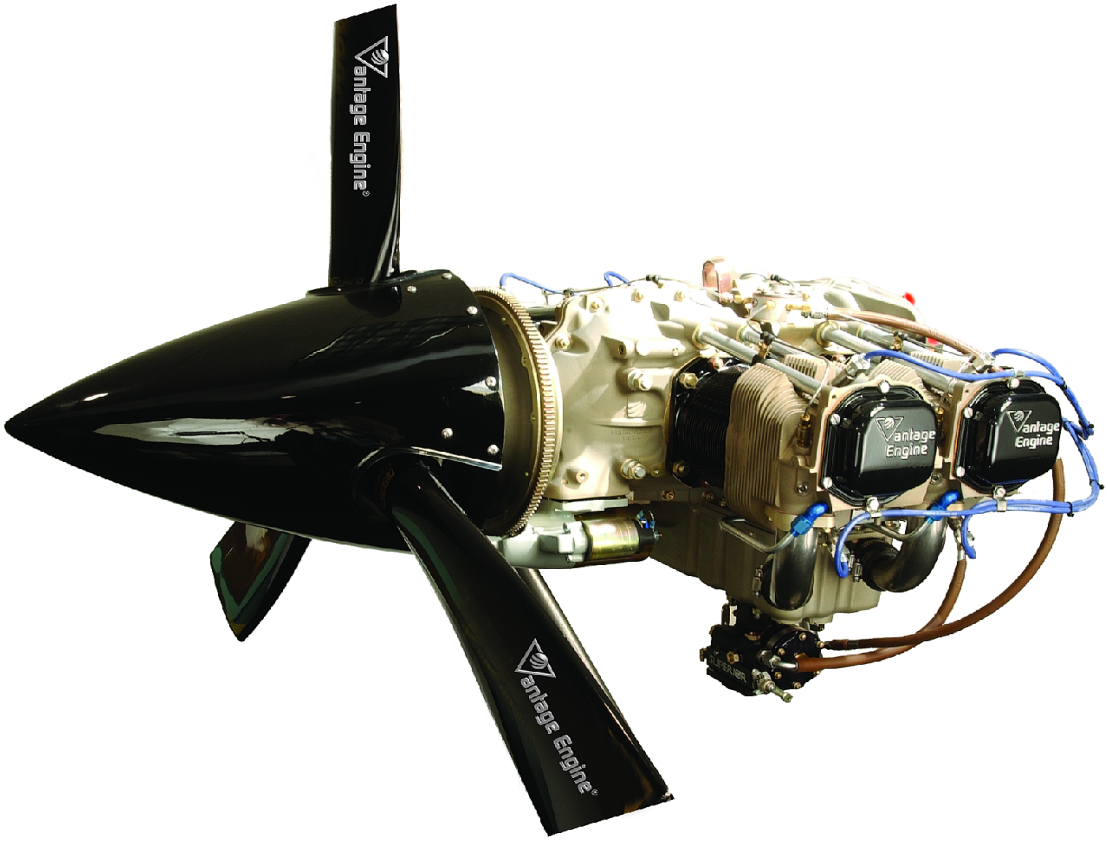
O-360 & IO-360 SERIES ENGINES

MAINTENANCE MANUAL



SUPERIOR AIR PARTS, INC.

621 South Royal Lane, Suite 100 / Coppell, TX 75019 / 800-277-5168
www.superiorairparts.com

Manual P/N SVMM01, Revision B, February 2007

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Manual Number SVMM01

Revision History

Revision Letter	Effective Date	Description	Pages Revised
IR	02/27/06	Initial Release	All
A	3/6/06	SAP CR# 8004, del magneto 100 hr insp. from ALS, add “or annual” to & del mag cap removal from 100 hr insp	05-00-00, p1 05-20-00, p3
B	02/28/07	Add Celsius Temperature conversions to Fahrenheit temperatures	72-00-10 All 72-00-12 All 72030-00 All 72-50-00 All

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SAFETY ADVISORY

WARNING: **BEFORE MATERIALS CALLED OUT IN THIS PUBLICATION ARE USED, KNOW THE HANDLING, STORAGE AND DISPOSAL PRECAUTIONS RECOMMENDED BY THE MANUFACTURER OR SUPPLIER. FAILURE TO COMPLY WITH THE MANUFACTURER'S OR SUPPLIER'S RECOMMENDATION CAN RESULT IN PERSONAL INJURY.**

CAUTION: INFORMATION IS TO EMPHASIZE INSTRUCTIONS OR PREVENT POSSIBLE EQUIPMENT DAMAGE.

The user must know the manufacturer or supplier information and obey the procedures, recommendations, warnings, and cautions set forth for the use, handling, storage, and disposal of materials.

The WARNINGS used in this manual inform the user about dangerous materials or equipment that can cause injury. They do not replace the manufacturer's instructions.

This Safety Advisory has all the warnings included in this manual.

WARNING: **OPERATION OF A DEFECTIVE ENGINE WITHOUT A PRELIMINARY EXAMINATION CAN CAUSE FURTHER DAMAGE TO A DISABLED COMPONENT AND POSSIBLE INJURY TO PERSONNEL. MAKE SURE THOROUGH INSPECTION AND TROUBLESHOOTING PROCEDURES ARE ACCOMPLISHED. THIS WILL HELP TO PREVENT INJURIES TO PERSONNEL AND/OR DAMAGE TO THE EQUIPMENT.**

WARNING: **FUEL IS TOXIC AND FLAMMABLE. DO NOT BREATHE VAPORS. USE IN A WELL-VENTILATED AREA FREE FROM SPARKS, FLAME, OR HOT SURFACES. PUT ON SPLASH GOGGLES, SOLVENT-RESISTANT GLOVES, AND OTHER PROTECTIVE GEAR. IN CASE OF EYE CONTACT, FLUSH WITH WATER FOR 15 MINUTES AND SEEK MEDICAL ATTENTION. IN CASE OF SKIN CONTACT, WASH WITH SOAP AND WATER.**

WARNING: **HOT OIL MAY CAUSE BURNS TO EYES AND SKIN. PUT ON SPLASH GOGGLES, INSULATED GLOVES, AND OTHER PROTECTIVE GEAR. IN CASE OF EYE CONTACT, FLUSH WITH WATER FOR 15 MINUTES AND SEEK MEDICAL ATTENTION. IN CASE OF SKIN CONTACT, WASH WITH SOAP AND WATER.**

WARNING: **DO NOT INSTALL THE IGNITION HARNESS "B" NUTS ON THE SPARK PLUGS UNTIL THE PROPELLER INSTALLATION IS COMPLETED. FAILURE TO COMPLY COULD RESULT IN BODILY INJURY WHEN THE PROPELLER IS ROTATED DURING INSTALLATION.**

WARNING: **SOLVENT IS TOXIC. USE IN WELL-VENTILATED AREA. PREVENT EYE AND SKIN CONTACT AND DO NOT BREATHE VAPORS. IN CASE OF EYE CONTACT, FLUSH WITH WATER. IN CASE OF SKIN CONTACT, WASH WITH SOAP AND WATER.**

WARNING: **WHEN YOU USE COMPRESSED AIR TO CLEAN OR DRY PARTS, MAKE SURE THAT THE PRESSURE IS NOT MORE THAN 30 PSI. DO NOT DIRECT THE AIRSTREAM AT PERSONNEL OR LIGHT OBJECTS. PUT ON GOGGLES OR A FACE SHIELD TO PROTECT YOUR EYES. THIS WILL HELP PREVENT INJURIES TO PERSONNEL OR DAMAGE TO THE EQUIPMENT. IF YOU HAVE AN EYE INJURY, GET MEDICAL ATTENTION.**

WARNING: **USE METHYL ETHYL KETONE (MEK) SOLVENT CORRECTLY. THE SOLVENT IS FLAMMABLE AND REACTIVE. IT CAN HAVE A BAD EFFECT ON YOUR HEALTH OR SAFETY. BEFORE YOU USE THE SOLVENT, GET THE MATERIAL SAFETY DATA SHEET (MSDS) FROM THE MANUFACTURER OR SUPPLIER OF THE MATERIAL AND READ IT CAREFULLY. BEFORE YOU USE THE SOLVENT, PUT ON SAFETY SPLASH GOGGLES, SOLVENT-RESISTANT GLOVES (BUTYL RUBBER), RUBBER APRON, AND CHEMICAL-SAFETY SHOES. MAKE SURE THAT YOU HAVE SUFFICIENT AIRFLOW TO KEEP THE SOLVENT FUMES BELOW THE MSDS LIMIT.**

WARNING: **ENGINE OIL IS HAZARDOUS AND MAY CAUSE INJURY TO SKIN AND EYES. PUT ON RUBBER GLOVES AND GOGGLES.**

WARNING: **PLACE A SUITABLE STAND UNDER THE AIRCRAFT TAILCONE IF NEEDED BEFORE REMOVING THE ENGINE. THE LOSS OF WEIGHT MAY CAUSE THE AIRCRAFT TAIL TO DROP.**

WARNING: **USE THE CORRECT PERSONAL PROTECTION. SOME CHEMICAL SOLUTIONS CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CLEANING SOLUTION.**

WARNING: **TO PREVENT THE POSSIBILITY OF SERIOUS BODILY INJURY OR DEATH, BEFORE MOVING THE PROPELLER DO THE FOLLOWING:**

- **DO NOT STAND WITHIN THE ARC OF THE PROPELLER BLADES WHILE TURNING THE PROPELLER.**
- **VERIFY ALL SPARK PLUG LEADS ARE DISCONNECTED.**
- **VERIFY MAGNETO SWITCHES ARE CONNECTED TO MAGNETOS AND THAT THEY ARE IN THE "OFF" POSITION AND P-LEADS ARE GROUNDED.**
- **THROTTLE POSITION "CLOSED".**
- **MIXTURE CONTROL POSITION "IDLE-CUT OFF".**
- **SET BRAKES AND BLOCK AIRCRAFT WHEELS. ENSURE THAT AIRCRAFT**
- **TIE DOWNS ARE INSTALLED AND VERIFY THAT THE CABIN DOOR LATCH IS OPEN.**

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INTRODUCTION

About This Manual

Information contained in this Engine Maintenance Manual fulfills the content requirements of FAR 33.4 Appendix A33.3(a) and has been found acceptable to the Federal Aviation Administration (FAA). The purpose of this Maintenance Manual is to provide the necessary instructions for performing maintenance on the Superior Vantage Engine. Repair and replacement information may be found in the overhaul manual.

The information in this publication is based on data available at the time of publication and is updated, supplemented, and automatically amended by Publication Revisions and Service Bulletins that are issued by Superior Air Parts.

This manual is divided into separate sections relating to the general and specific maintenance instructions required for the engine. These general and specific instructions are organized and numbered per the recommendations of the General Aviation Manufacturers Association (GAMA). In this way, information may be located in a conventional manner to aid in both accuracy and timeliness.

Page numbering is organized within each section. The section number (e.g., 72-00-01) is displayed in the right hand section of the footer on each page. The page number is displayed in the center of the footer on each page.

All measurements are noted in English (U.S.) units. Conventional unit abbreviations are used.

Be sure to ground magneto P-leads prior to any maintenance and perform normal pre-run checks and inspections upon completion any maintenance.

Superior Air Parts has made clear and accurate information available for those who maintain, own and repair the Vantage O-360 and IO-360 Series Engines. Superior Air Parts values your input regarding revisions and additional information for our manuals. Please forward your comments and input to:

Superior Air Parts
Attn: Engineering Department
621 South Royal Lane Suite 100
Coppell, Texas 75019

Table 01-00-00.1 • Special Tools and Equipment

Item	Vendor
Electrical Tester	Commercially Available

Related Publications

The following are related engine publications.

- SVIOM01, O-360 & IO-360 Installation and Operation Manual
- SVOHM01, O-360 & IO-360 Overhaul Manual

Obtaining Revisions to Instructions for Continued Airworthiness

All Vantage Engine manuals and service information may be downloaded at *www.superiorairparts.com*

Or may be purchased by contacting:

Superior Air Parts
621 South Royal Lane, Suite 100
Coppell, Texas 75019

or call: 972-829-4600

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DESCRIPTION AND OPERATION

General Description

Superior Vantage Engines are four-cylinder, horizontally opposed, air-cooled, direct drive powerplants incorporating a wet sump, bottom mounted induction, bottom exhaust with either carbureted or port injected fuel systems. Provisions exist for both front and rear mounted accessories. All engine components will be referenced as they are installed in the airframe. Therefore, the "front" of the engine is the propeller end and the "rear" of the engine is the accessory mounting drive area. The oil sump is on the "bottom" of the engine and the cylinder shroud tubes are on the "top". The terms "left" and "right" are defined as being viewed from the rear of the engine looking toward the front. Cylinder numbering is from the front to the rear with odd numbered cylinders on the right side of the engine. The direction of crankshaft rotation is clockwise as viewed from the rear of the engine looking forward unless otherwise specified. Accessory drive rotation direction is defined as viewed from the rear of the engine looking forward.

Continued Airworthiness

Vantage Engines discussed in this document must be installed and operated in accordance with the limitations, conditions and operating procedures described in the Installation and Operation Manual (SVIOM01). They must also be maintained and repaired in accordance with this manual and the Overhaul Manual (SVOHM01).

Model Designations

The model number designation is defined in a way that the digits of the model number can easily identify the basic configuration of the engine as described in Figure 02-00-00.1.

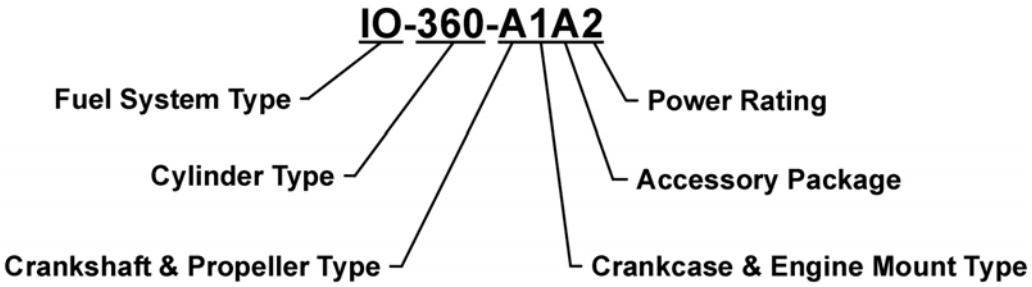
Engine Components General Description

The Vantage Engine O-360 and IO-360 series engines are air-cooled, four cylinder, horizontally opposed, direct drive engines. See Table 02-00-00.1 for General Specifications.

The complete engine includes the following components and assemblies:

Crankcase Assembly
Crankshaft Assembly
Camshaft Assembly
Valve Train Assembly
Cylinder Assemblies
Connecting Rod Assemblies
Oil Sump Assembly
Intercylinder Baffles
Starter
Lubrication System (Includes Oil Filter)
Accessory Drive
Ignition System (Includes Spark Plugs)
Fuel System
Starter Support Assembly
Oil Level Gage
Induction System

NOTE: Complete engine does not include outer cylinder baffles, airframe to engine control cables, attaching hardware, hose clamps, vacuum pump, exhaust system, or fittings. Unless otherwise specified, the fuel pump is included on carbureted engines. Alternator or propeller governor systems may be included, if specified the Model Specification Data (MSD) .



Fuel System Type

O Denotes a Carbureted system and "opposed cylinder" arrangement.
IO Denotes a Fuel Injection system and "opposed cylinder" arrangement.

Cylinder Type

360 Parallel valve cylinder, 361 cubic inches.

Model Suffix Denotes detail engine configuration

1st Digit Crankshaft & Propeller Type

A	Fixed-Pitch, Thin-wall front main
B	Constant-Speed, Thin-wall front main
C	Fixed-Pitch, Heavy-wall front main
D	Constant-Speed, Heavy-wall front main
E	Fixed-Pitch, Solid front main

2nd Digit Crankcase & Engine Mount Type

1	#1 Dynafocal Mount
2	#2 Dynafocal Mount
3	Conical Mount
4	#1 Dynafocal Mount, Front Propeller Governor
5	#2 Dynafocal Mount, Front Propeller Governor
6	Conical Mount, Front Propeller Governor

3rd Digit Accessory Package

	Ignition System	Fuel System
A	Unison Magnetos	Precision Fuel System

4th Digit Power Rating: Piston Compression Ratio

	CR	HP
2	8.5:1	180

Figure 02-00-00.1 • Engine Model Number Designation

Specifications

The physical specifications of the O-360 and IO-360 series engines are listed in Table 02-00-00.3. Accessory Drive Specifications are provided in Table 02-00-00.2. Information on Primary Accessories, fuel and ignition systems, are provided in Table 02-00-00.4. The Model Specification Data (MSD) in the Installation and Operation Manual may provide more specific information, such as secondary engine accessories provided.

Illustrated views of the O-360 and IO-360 engines identifying key components and sub-assemblies are provided in Figures 02-00-00.1 thru 02-00-00.9 of this section and are listed in Table 02-00-00.5 for convenience.

Table 02-00-00.1 • General Specifications

Model		O-360 and IO-360 series
Rated Power	Hp	180
Rated Speed, RPM	RPM	2700
Bore, inches	In	5.125
Stroke, inches	In	4.375
Displacement cubic inches	In^3	361.0
Compression Ratio		8.5:1
Firing Order		1-3-2-4
Spark timing	°BTDC	25
Propeller drive ratio		1:1
Propeller drive rotation (viewed from rear)		Clockwise

Table 02-00-00.2 • Accessory Drive Specifications

Accessory	Drive Ratio	Direction of Rotation
Starter	16.556:1	Counter-
Alternator	3.250:1	Clockwise
Tachometer	0.500:1	Clockwise
Magneto	1.000:1	Clockwise
Vacuum Pump	1.300:1	Counter-
Propeller Governor	0.866:1	Clockwise
Fuel Pump	0.500:1	Plunger Operated

Table 02-00-00.3 • Physical Specifications

Model	Height (In)	Width (In)	Length (In)	Weight* (Lb)
O-360-Axxx	24.6	33.4	32.8	288
O-360-Bxxx	24.6	33.4	32.8	291
O-360-Cxxx	24.6	33.4	32.8	291
O-360-Dxxx	24.6	33.4	32.8	294
O-360-Exxx	24.6	33.4	32.8	295
IO-360-Axxx	24.0	33.4	32.8	290
IO-360-Bxxx	24.0	33.4	32.8	293
IO-360-Cxxx	24.0	33.4	32.8	293
IO-360-Dxxx	24.0	33.4	32.8	296
IO-360-Exxx	24.0	33.4	32.8	297

*Base engine weight with accessories listed in Table 02-00-00.4 below and a 7.8 lb. starter, the front propeller governor crankcase option adds 7 lb. to the engine weight.

Table 02-00-00.4 • Primary Engine Accessories*

Model	Left Magneto	Right Magneto	Ignition Harness	Fuel System	Fuel Pump (if furnished)
O-360	Unison 4371	Unison 4371	Unison M4001	Precision MA-4-5	Aero Accessories AF15472
IO-360	Unison 4371	Unison 4371	Unison M4001	Precision RSA-5-AD1	Aero Accessories AF15473

* See Table 72-00-15.4 for approved consumables (spark plugs, oil filters, belts, hoses) and Table 02-09-00.6 below for approved secondary engine accessories.

Table 02-00-00.5 • Illustrated Views of the Engine

Engine View	Figure Number
O-360 Engine Front View	Figure 02-00-00.2
O-360 Engine Left Side View	Figure 02-00-00.3
O-360 Engine Top View	Figure 02-00-00.4
O-360 Engine Rear View	Figure 02-00-00.5
IO-360 Engine Front View	Figure 02-00-00.6
IO-360 Engine Left Side View	Figure 02-00-00.7
IO-360 Engine Top View	Figure 02-00-00.8
IO-360 Engine Rear View	Figure 02-00-00.9

Table 02-00-00.6 • Secondary Engine Accessories (if provided)

Accessory & Manufacturer	Model	Voltage	Amperage	Weight
Starters				
Sky-Tec	149-12LS	12	n/a	7.8 pounds
Sky-Tec	149-24LS	24	n/a	7.8 pounds
Sky-Tec	149-NL	12 or 24	n/a	9.4 pounds
Alternators				
Kelly Aerospace	ALY8520LS	12	60	10.9 pounds
Plane-Power	AL12-F60	12	70	9.8 pounds
Plane-Power	AL24-F60	24	70	9.8 pounds

Features and Operating Mechanisms

Crankshaft - The crankshaft is made from high quality, aerospace grade steel. All bearing journal surfaces are nitrided to surface harden. There are 3 kinds of crankshafts: thin-wall, thick-wall, and solid front mains which can be identified by looking at the center of the front of the crankshaft or prop oil cavity. The thin-wall and thick-wall crankshafts are each available as fixed-pitch or constant-speed. Fixed-pitch models have a plug installed in front of the inner diameter of the front main bearing cavity. Constant speed models have a plug installed at the rear of the front main bearing cavity.

Connecting Rods - The connecting rods are made from aerospace grade, high quality steel. They have replaceable bearing inserts in the crankshaft ends and bronze bushings in the piston ends. The bearing caps on the crankshaft ends are retained by two bolts with self locking nuts. Caps are tongue and groove type for improved alignment and rigidity.

Camshaft and Valve Operating Mechanism - The camshaft is located above and parallel to the crankshaft. The camshaft actuates hydraulic lifters that operate the valves through push rods and valve rockers.

Crankcase - The crankcase is made from aerospace grade, stabilized structural aluminum alloy. The assembly consists of two reinforced aluminum alloy castings fastened together by means of studs, bolts, and nuts. The main bearing bores are machined for use with precision type main bearing inserts.

Accessory Housing - The accessory housing is made from an aluminum casting and is fastened to the rear of the crankcase and the top rear of the sump.

Oil Sump - The sump incorporates an oil drain plug, oil suction screen, mounting pad for carburetor or fuel injector, the intake riser, and intake pipe connections.

Cylinders - *Millennium®* Cylinders are used exclusively. These air-cooled cylinders are manufactured by screwing and shrinking the two major parts, head and barrel, together. The cast heads are made from a special aluminum alloy. All barrels are made from forgings produced to aerospace specifications. They are internally choked and honed to allow optimal operating conditions for the rings and pistons at operating temperatures.

Pistons - The pistons are made from an aluminum alloy. The piston pin is a full floating type with a plug located in each end of the pin. The piston is a 3-ring type with 2 compression rings and 1 oil control ring.

Cooling System – Superior Vantage Engines are designed to be air-cooled. Baffles are provided to build up air pressure and force the air between the cylinder fins. The air is exhausted to the atmosphere through the rear of the cowling.

Induction System - The distribution of the air to each cylinder is through the center zone of the induction system. This is integral with the oil sump.

Lubrication System - The full pressure wet sump lubrication system is supplied by a gear type pump. It is contained within the accessory housing.

Priming System - A manual primer system is provided on all engines using a carburetor. Fuel injected engines do not require a manual priming system, relying instead on the fuel injectors for priming.

Ignition System - Dual ignition is furnished by two Unison magnetos with two spark plugs per cylinder.

Electrical System – Engines may be furnished with an alternator, if provided for in the model specification. If an alternator is furnished, installation brackets, hardware and belt are provided. Alternators are available in either 12 or 24 volt systems and a range of amperages

Fuel Systems

Carbureted - Superior Air Parts O-360 engines are equipped with a float type carburetor The MA-4-5 carburetors are of the single barrel float type equipped with a manual mixture control and an idle cut-off.

Fuel Injected - IO-360 series engines are equipped with a direct cylinder injected RSA-5-AD1 fuel injection system. The fuel injection system schedules fuel flow in proportion to airflow. Fuel vaporization takes place at the intake ports. The RSA fuel injection system is based on the principle of measuring airflow and converting the air pressure into a fuel pressure. The fuel pressure, when applied across the fuel metering section, makes fuel flow proportional to airflow.

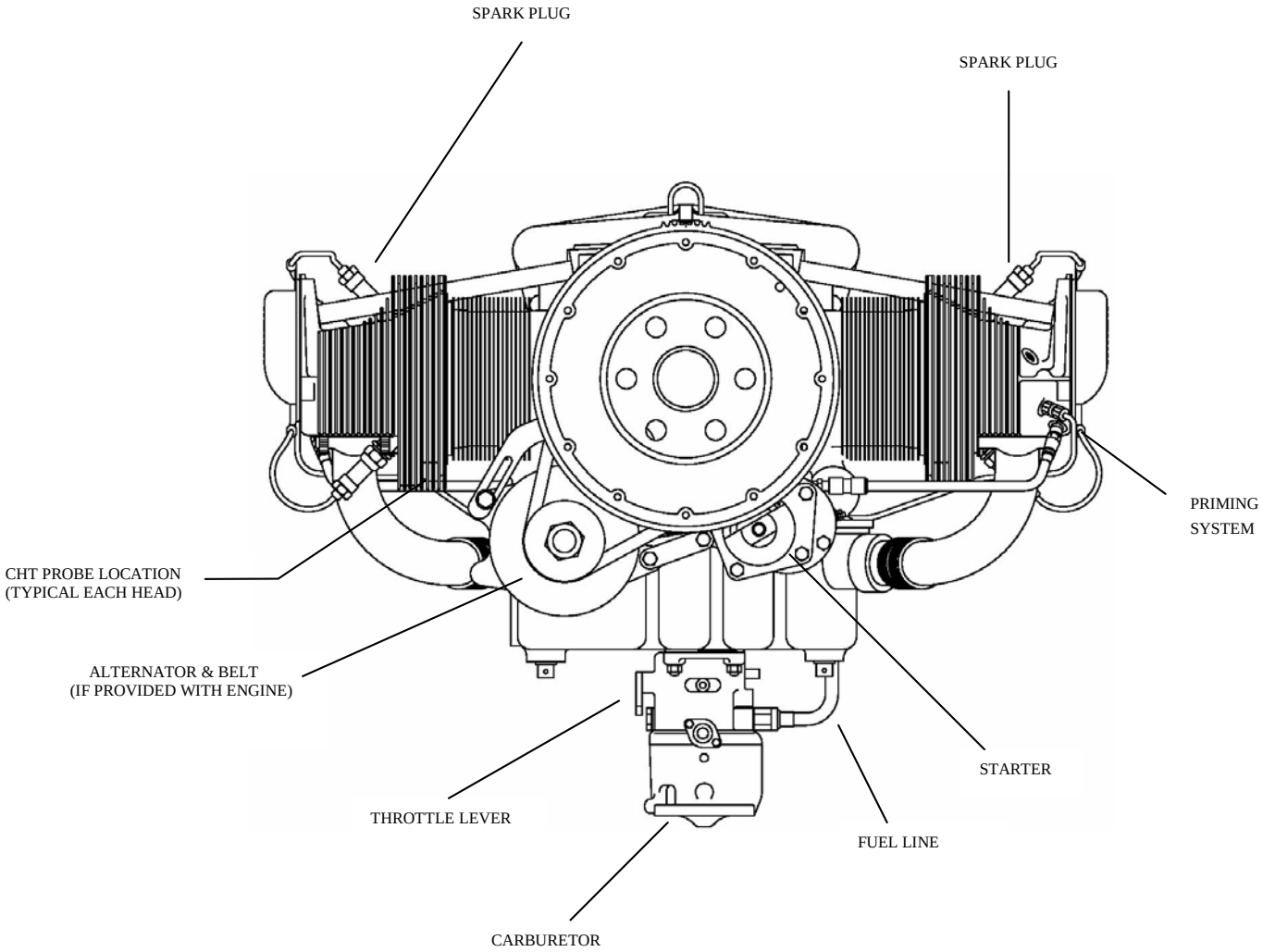


Figure 02-00-00.2 • O-360 Engine Front View

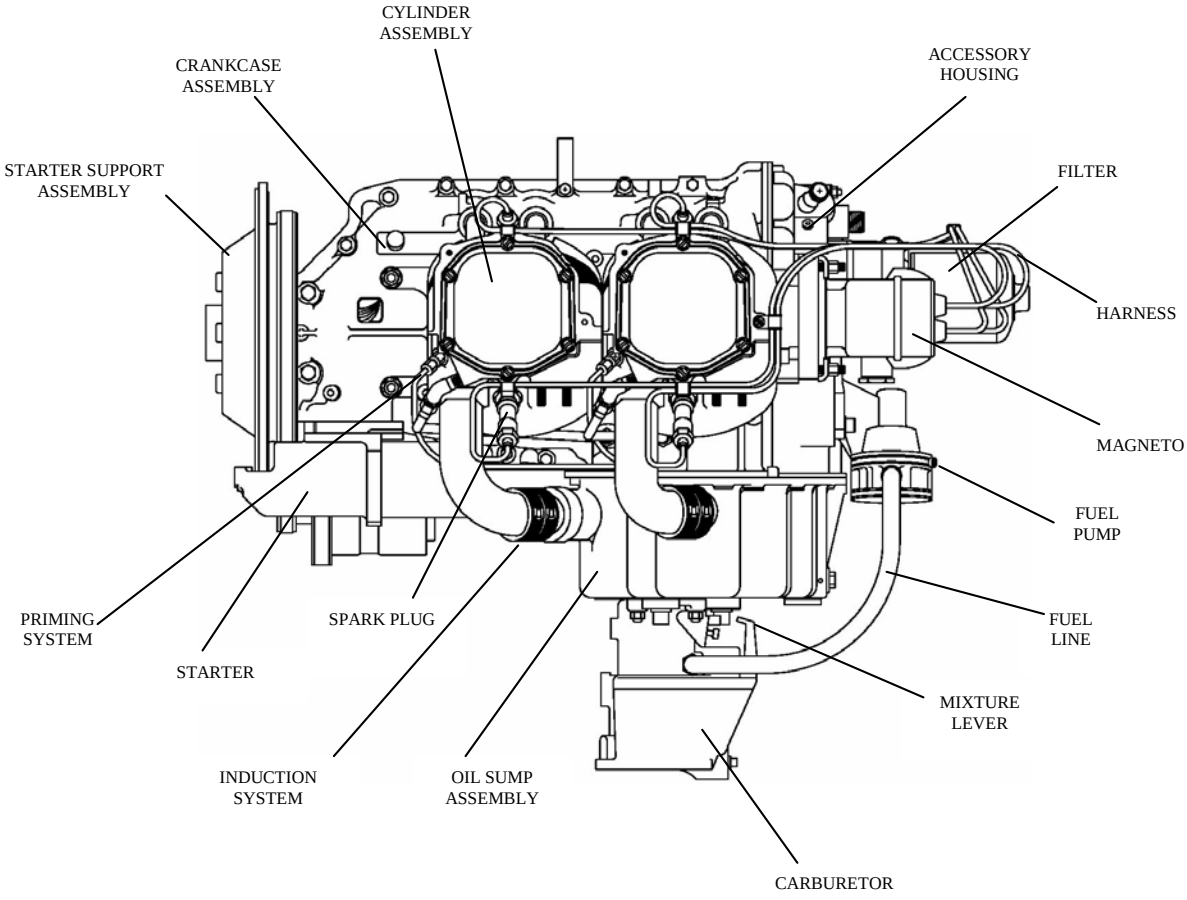


Figure 02-00-00.3 • O-360 Engine Left Side View

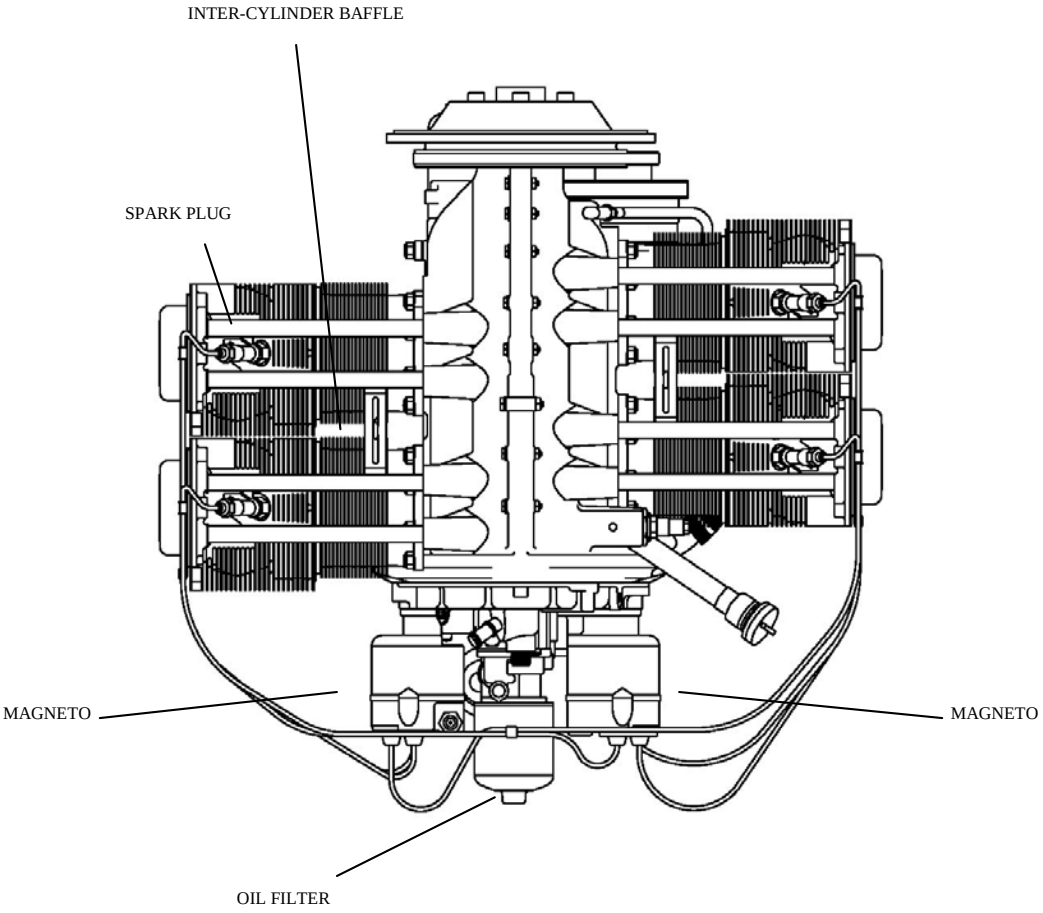


Figure 02-00-00.4 • O-360 Engine Top View

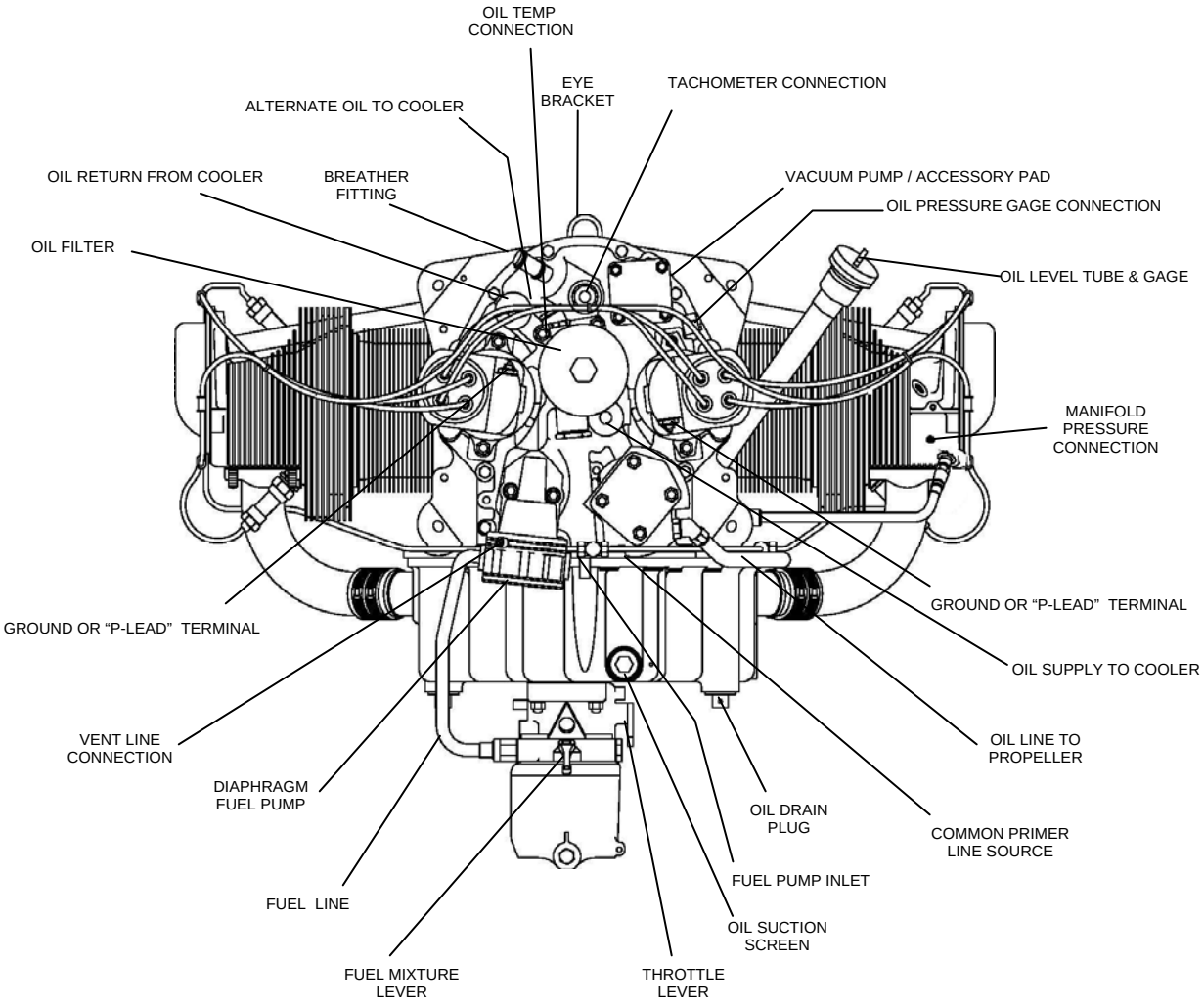


Figure 02-00-00.5 • O-360 Engine Rear View

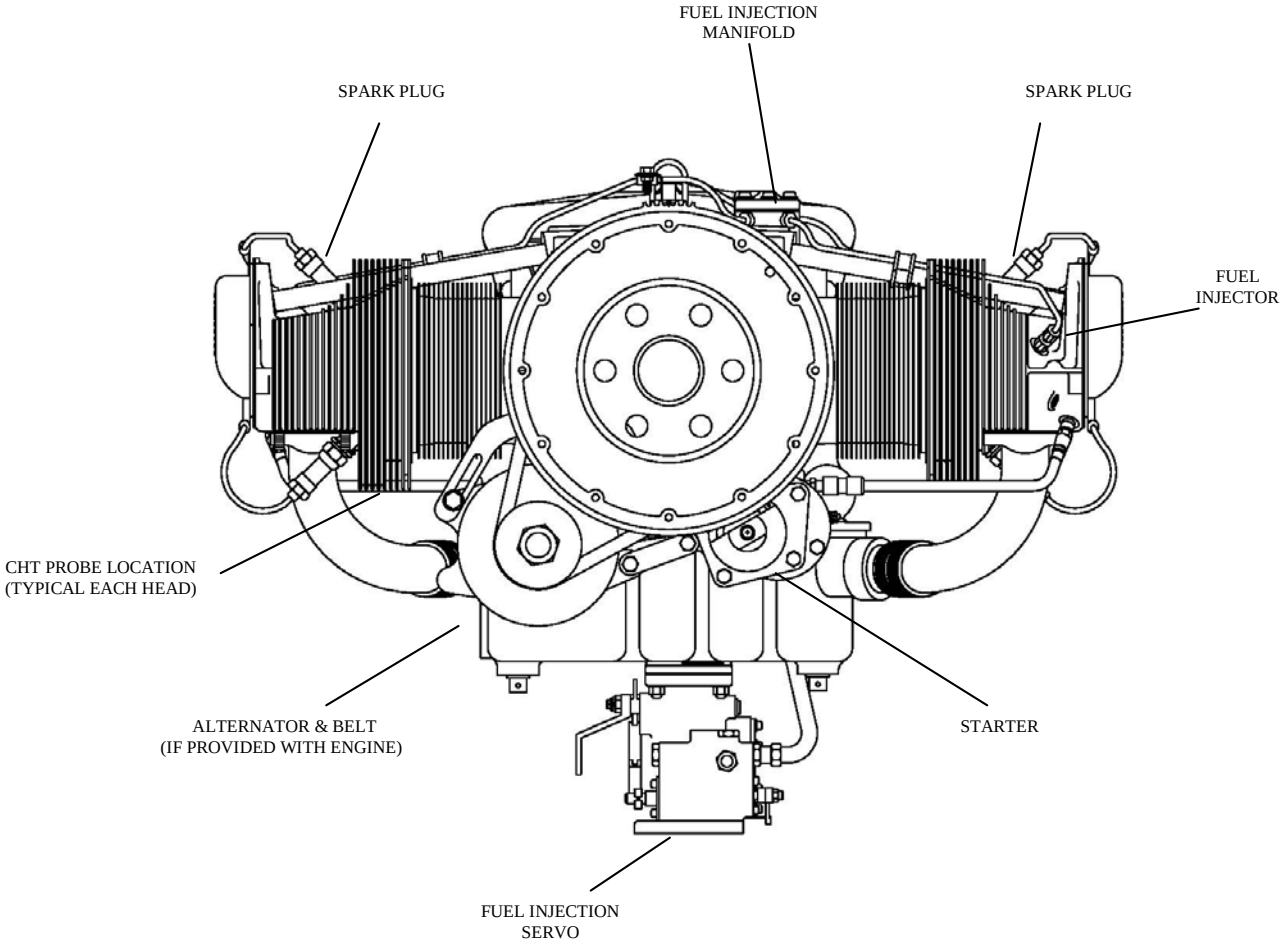


Figure 02-00-00.6 • IO-360 Engine Front View

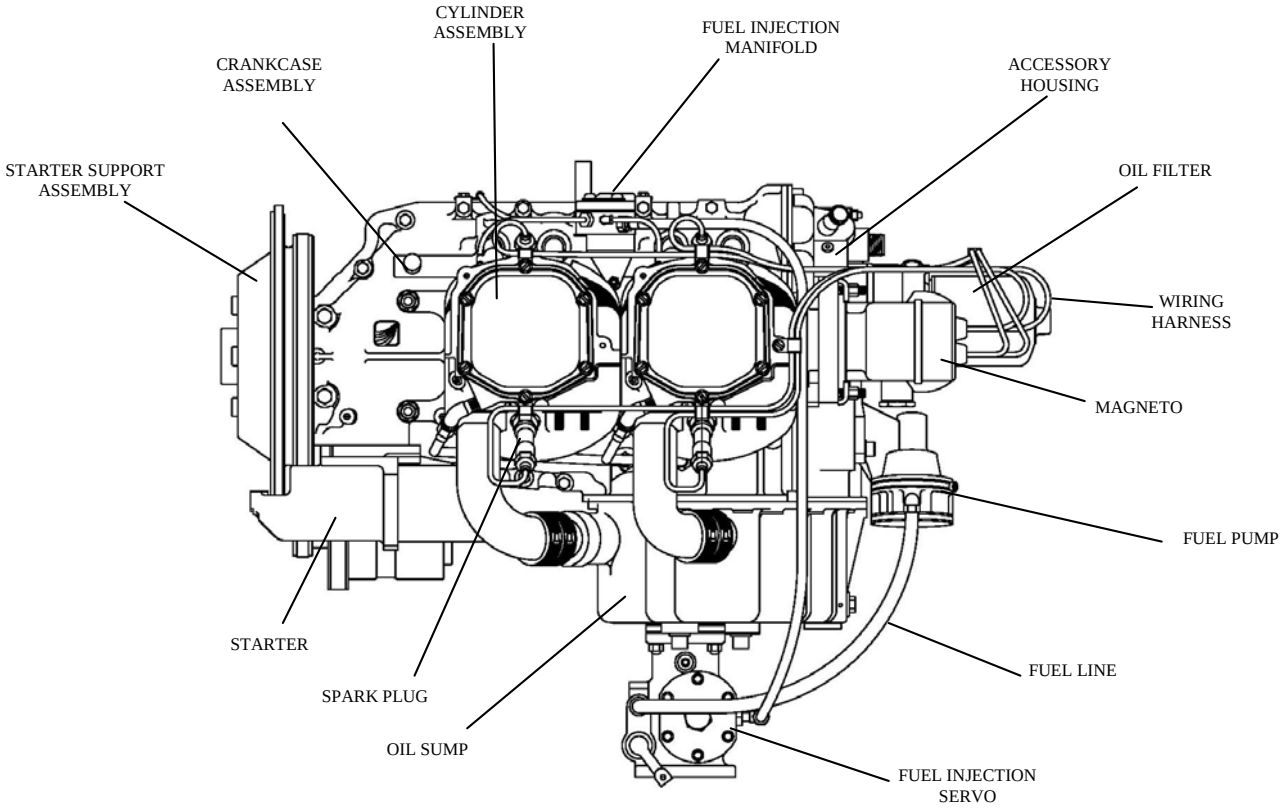


Figure 02-00-00.7 • IO-360 Engine Left Side View

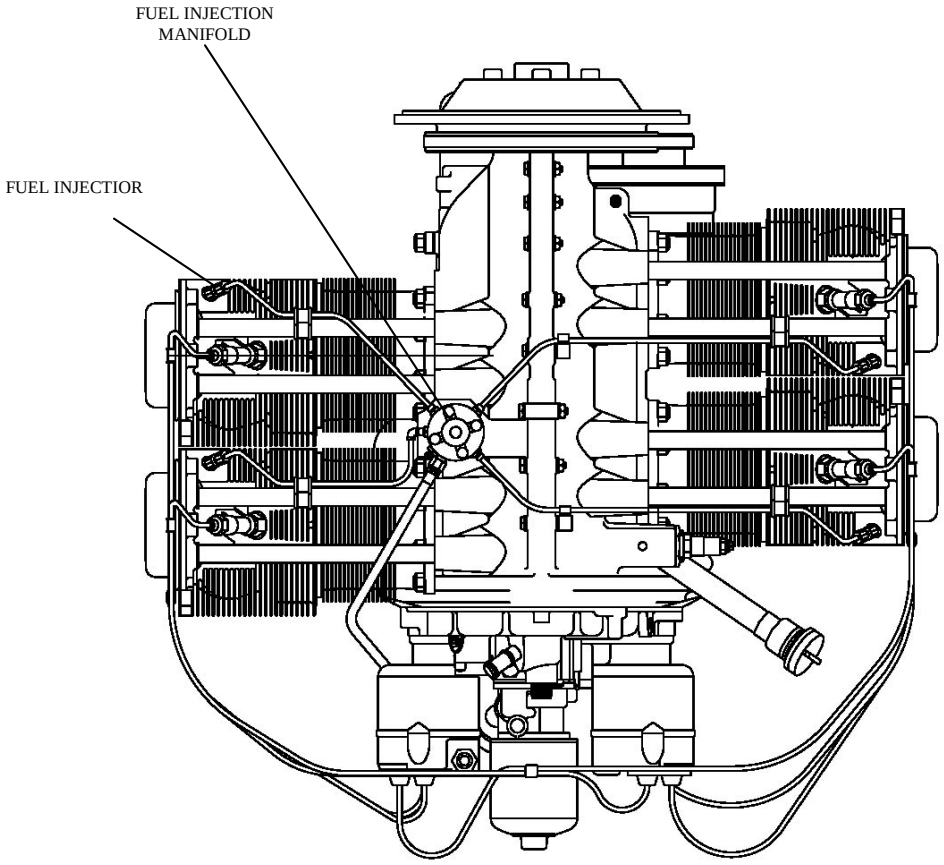


Figure 02-00-00.8 • IO-360 Engine Top View

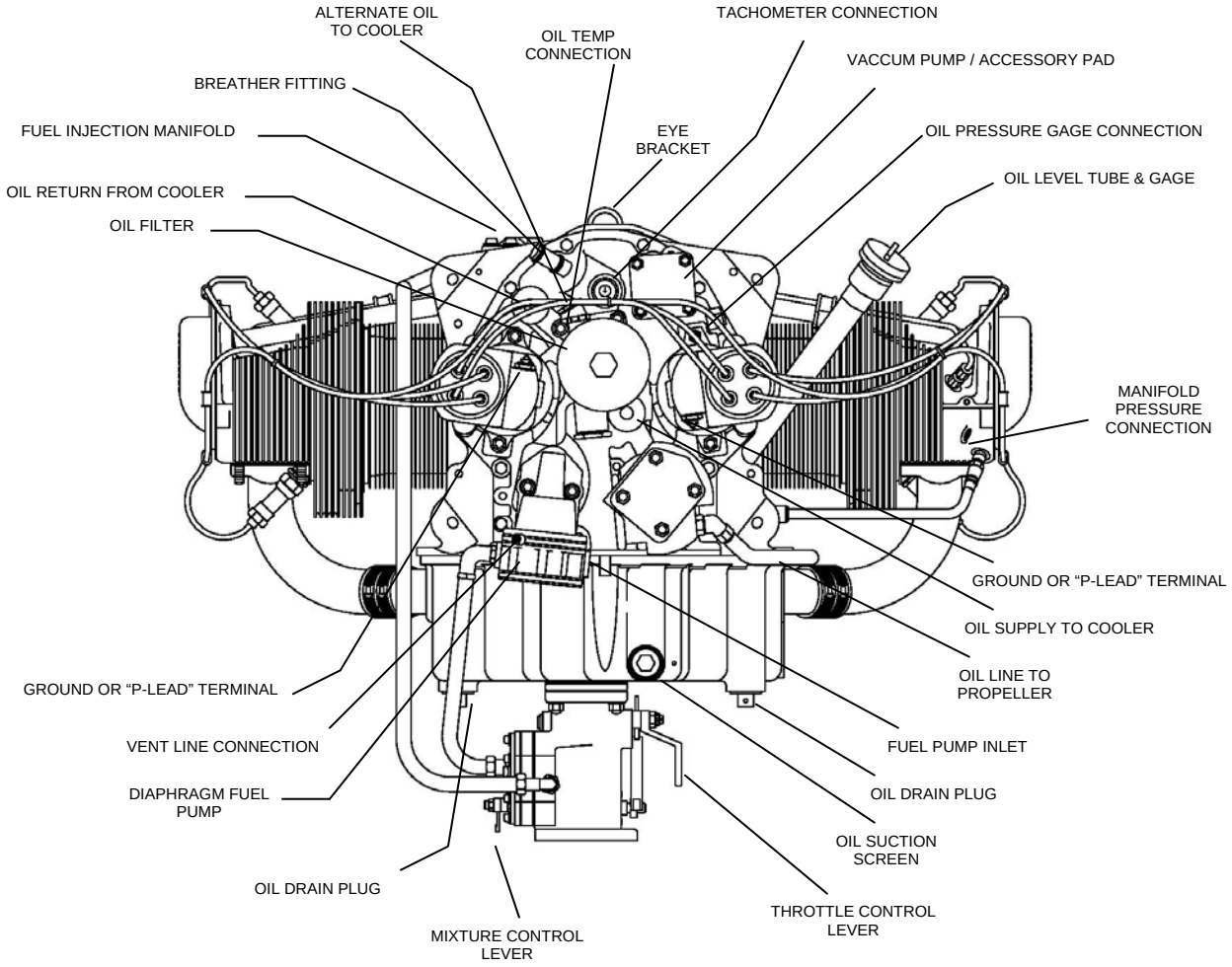


Figure 02-00-00.9 • IO-360 Engine Rear View

AIRWORTHINESS LIMITATIONS SECTION

The Airworthiness Limitations Section is FAA approved and specifies maintenance required under sections 43.16 and 91.403 of the Federal Aviation Regulations, unless an alternative program has been FAA approved.

This section is part of the type design of the Superior Vantage O-360 and IO-360 series pursuant to certification requirements of the Federal Aviation Regulations.

Mandatory Replacement Time

The O-360 and IO-360 engine series do not contain any components having mandatory replacement times required for type certification.

Mandatory Inspection Intervals

The O-360 and IO-360 engine magnetos have a mandatory inspection interval of 500 (+/-10) hours for internal inspection. Refer to 500 Hour Inspection Program for details of this inspection. See the included Unison Industries L-1363B 4300/6300 Series Magneto Maintenance and Overhaul Manual, in Appendix 1, for additional information.

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SCHEDULED INSPECTION AND MAINTENANCE

General

This section contains the Scheduled Inspection and Maintenance necessary to maintain the safety and durability of the engine. Regular checks and prompt maintenance and repairs are vital to continued engine reliability. Refer to the Description and Operation section of this document for a general overview of component locations. As with all maintenance, be sure to perform normal pre-run checks and inspections upon compeletion of scheduled inspection and maintenance.

- Standard aviation shop tools and materials are required.
- Periodic inspections are listed in Table 05-00-00.01.

NOTE: The following inspections do not constitute a complete aircraft inspection. They apply to the engine only. Refer to the airframe manufacturer's instructions for additional information regarding airframe inspections. Refer to the propeller manufacturer's instructions for additional information regarding propeller inspections.

Table 05-00-00.1
Scheduled Inspection and Maintenance Intervals

Inspection Name	Time Interval
25 Hour Inspection	First 25 Hours Operation
50 Hour Inspection	50 (+/- 5) Hours Operation
100 Hour Inspection	100 (+/-10) Hours Operation or at Annual Inspection
500 Hour Inspection	500 (+/-10) Hours Operation
1000 Hour Inspection	1000 (+/-20) Hours Operation
Unscheduled Inspections	One time inspection as dictated by unexpected damage.

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Inspection Program

25 Hour Inspection

After the first 25 hours of operating time, perform a 50 hour inspection. This inspection should include draining and renewing lubricating oil. This inspection only applies to new and newly overhauled engines.

50 Hour Inspection

In addition to the items contained in a normal daily or preflight inspection, perform the following inspection after every 50 (+/-5) hours of operation.

- **Ignition System**
  - If fouling of spark plugs is apparent, clean and rotate bottom plugs to upper position.
  - Examine spark plug leads and ceramic insulators for corrosion and deposits. This can be evidence of leaking spark plugs, improper cleaning of the spark plug walls, or connector ends. When these conditions are found, clean the cable ends, spark plug walls, and ceramics with a dry, clean cloth or a clean cloth moistened with acetone or MEK. All parts of the spark plug should be clean and dry before reassembly.

WARNING: USE METHYL ETHYL KETONE (MEK) SOLVENT CORRECTLY. THE SOLVENT IS FLAMMABLE AND REACTIVE. IT CAN HAVE A BAD EFFECT ON YOUR HEALTH OR SAFETY. BEFORE YOU USE THE SOLVENT, GET THE MATERIAL SAFETY DATA SHEET (MSDS) FROM THE MANUFACTURER OR SUPPLIER OF THE MATERIAL AND READ IT CAREFULLY. BEFORE YOU USE THE SOLVENT, PUT ON SAFETY SPLASH GOGGLES, SOLVENT-RESISTANT GLOVES (BUTYL RUBBER), RUBBER APRON, AND CHEMICAL-SAFETY SHOES. MAKE SURE THAT YOU HAVE SUFFICIENT AIRFLOW TO KEEP THE SOLVENT FUMES BELOW THE MSDS LIMIT.

  - Check ignition harness for security of mounting clamps. Check harness covers for cracks or evidence of chafing. Be sure connections are tight at spark plug and magneto terminals.

- **Fuel and Induction System**
  - Check the fuel primer and injector lines for leaks and security of the clamps. Remove and clean the fuel inlet strainers. Carefully inspect steel fuel lines for evidence of scrapes or nicks. Check hoses for evidence of softening or other deterioration. Check mounting clamps and clips for security of attachment and deterioration of the cushion. Discard and replace any clamps with improper cushions or fuel lines with nicks.
  - Check the mixture control and throttle linkage for travel, freedom of movement, and clamp attachment. Lubricate the linkage if necessary.
  - Check the air intake ducts for leaks, security of attachment, or filter damage. Evidence of dust or other solid material in the ducts is an indication of inadequate filter care or a damaged filter. Replace or clean as required. Inspect and service air filters in accordance with the airframe manufacturer's handbook.
  - Check vent lines for evidence of fuel or oil seepage. If seepage is discovered, the fuel pump may require replacement.

- **Lubrication System**
  - Refer to the Servicing section (72-00-15) of this manual for correct oil grade and quantity and approved consumables.

WARNING: ENGINE OIL IS HAZARDOUS AND MAY CAUSE INJURY TO SKIN AND EYES. PUT ON RUBBER GLOVES AND GOGGLES.

- Remove external full flow oil filter. Install new integral bypass, full flow oil filter by applying a light coat of Dow Corning #4 or equivalent to the rubber seal at the base of the new filter. Lightly lubricate the filter threads and install to the adapter, applying 192-216 in-lb (16-18 ft-lb) torque. Install safety wire from oil filter to adapter.
- Cut open the used filter and check the element for metal particles indicative of engine damage. Drain and renew lubricating oil.
- Remove oil suction screen and inspect the screen carefully for presence of metal particles that are indicative of internal engine damage. Clean thoroughly prior to replacement. Refer to Lubrication Section for further information.
- Check oil lines for leaks. Pay particular attention to connection attachments for wear from rubbing or vibration and for dents and cracks.

- **Exhaust System**

  Check the exhaust port flanges for evidence of leakage. If they are loose or distorted, they must be removed and machined flat before they are reassembled and tightened. Examine the general condition of the exhaust manifolds.

- **Cooling System**

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

- **Cylinders**

  Check rocker box covers for evidence of oil leaks. If found, replace gasket and tighten screws to specified torque. Check cylinders for evidence of excessive heat, oil or combustion gas leakage indicated by discoloration of the cylinder. This condition indicates possible internal damage to the cylinder and the source must be determined and corrected before the aircraft resumes operation.

- **Carburetor / Fuel Injection System**

  Check carburetor or fuel injection servo attaching screws (as appropriate to engine type) for tightness. Tighten to 40-50 inch-pounds.

- **Belt and Hoses**

  Check all belts and hoses for wear. Replace if worn or damaged. Refer to section 72-10-00 for alternator belt tension requirements.

100 Hour or Annual Inspection

In addition to the items listed for 50 hour inspection, perform the following inspections after every 100 (+/-10) hours of operation or at each Annual Inspection, which ever comes first.

- **Electrical System**

  Clean with a damp cloth and check all wiring connected to the engine or accessories. Any shielded cables that are damaged should be replaced. Replace clamps or loose wires as necessary. Check terminals for security and cleanliness. Any wires that do not bend easily or are brittle must be replaced. Any wire that is soft, oil-soaked, or swollen must be replaced.

- **Ignition Harness**

  - Ignition harness must be securely fastened to the engine by clamps and tie wraps. Be sure that tie wraps are not overtightened and crushing the lead wires.
  - Ignition leads should be routed so they don't rub against hot or sharp areas of the engine or have sharp bends. Correct any discrepancies.
  - Check electrical continuity of ignition leads.
  - Check insulation of ignition insulators.

- **Magnetos**

  - Check magneto to engine timing. The timing procedure is described in the Ignition Section of this manual.
  - Inspect Unison magnetos externally for condition and damage.
    - Vent holes must be clean and clear of any obstruction. Correct as necessary.
    - Confirm that the P-lead is securely attached to the condenser stud. Torque P-lead nut to 13-15 inch-pounds.
    - Wires should be held in place by cap ferrule. Replace any loose connections.
    - Replace any insulators showing signs of discoloration, burning, deterioration or deformation.
    - Wire springs showing signs of burning or corrosion must be replaced.

- **Spark Plugs**

  - Spark plug nuts showing signs of wear, excessive corrosion, or overtorquing must be replaced.
  - Inspect areas around spark plug for overheating damage.
  - Remove spark plugs with appropriate deep socket wrench. Hold 7/16" hex ferrule with wrench to prevent lead rotation. Be sure to remove the gasket with each spark plug. Identify each spark plug with cylinder and location.
  - Inspect terminal well insulator, contact, and ignition lead termination for arcing or other damage.
  - Inspect firing end of spark plugs for wear, bridged gap, or oil, carbon, or lead fouling. Replace any plug with severely fouled or worn firing end. Heavy deposits may be removed by vibratory cleaners. Clean by lightly wiping with solvent and air dry. Replace if necessary. Replace any spark plug with a cracked core.
  - Inspect threads on the shell and shielding barrel. Threads may be cleaned with a wire hand brush. Replace any spark plug with heavy thread damage.
  - To be properly reconditioned, spark plugs must be mechanically and electrically sound, have clean firing and terminal barrel ends, have sufficient electrode material remaining with proper contours, and be properly gapped, tested, and handled.
  - Never install a spark plug that has been dropped. Dispose of dropped spark plug and install new spark plug.

- Gap spark plugs to .016" - .021".
  - Projected nose massive spark plugs can be gapped until the electrodes are worn to a point where it becomes difficult to properly adjust the gap.
  - Adjustment should be limited when gapping fine-wire spark plugs. The iridium material is very brittle. Using small needle-nose pliers, grasp the side wire perpendicular to the face of the plug. One wire at a time, smoothly twist the pliers to achieve the proper gap.
  - Never bend the center electrode or apply pressure to the ground electrode while setting the gap.
- If desired, sparingly apply anti-seize compound to all but the last thread of spark plug.
- Reinstall by switching spark plugs from the top of the cylinder to the bottom and bottom to top. Reinstall using a new copper mounting gasket and a six-point socket. Torque to 30-35 foot-pounds.
- Reinstall ignition harness.
- Never apply antiseize compound to the harness connector threads.
- Do not touch the spark plug connector or harness spring with fingers. Contamination may cause arcing or misfire.
- Finger-tighten the harness connector "B" nut. Hold 7/16" hex ferrule with wrench to prevent lead rotation and tighten with open-end wrench to 80-90 inch-pounds.

- **Cylinders**

  Visually check cylinders and baffling for cracked or broken cooling fins, corrosion, oil or fuel stains and visual damage.

- **Cylinder Compression Test**

  The purpose of testing a cylinder's compression is to determine if any significant leakage is occurring in the combustion chamber due to worn or damaged components. Typically leakage will occur either past the valve seat or rings. The principle of a differential pressure compression test is that for a given airflow through a fixed orifice, a constant pressure drop will occur across the orifice. The orifice used for this test has a .04 inch diameter, .25 inch long with a 60° approach angle. Following is the procedure for a differential pressure compression check.

  - The operating and maintenance records of the engine should be reviewed. Records of previous compression tests are of assistance in determining the progressive wear conditions and help to establish the necessary maintenance actions. Before beginning a compression check, precautions should be taken to prevent the accidental starting of the engine.
  - Perform the compression test as soon as possible after the engine is shut down to ensure that the piston rings, cylinder walls, and other engine parts are well lubricated.
  - With the air valve closed, apply an external source of clean air (approximately 100 to 120 PSI) to the tester.
  - Repeat the following for each cylinder being tested:
    - Remove the most accessible spark plug from the cylinder being tested.
    - Install the adapter in the spark plug hole and connect the compression tester to the cylinder.
    - Adjust the pressure regulator to obtain a reading of 80 PSI on the regulator pressure gauge. At this time, the cylinder pressure gauge should also register 80 PSI.
    - Turn the crankshaft by hand in the direction of rotation until the piston (in the cylinder being checked) is coming up on its compression stroke. Slowly open the air valve and pressurize the cylinder to approximately 20 PSI.
    - Continue rotating the engine against this pressure until the piston reaches top dead center (TDC). Reaching TDC is indicated by a sudden decrease in force required to turn the crankshaft. If the crankshaft is rotated too far, back up at least one-half revolution and start over again

to eliminate the effect of backlash in the valve operating mechanism and to keep piston rings seated on the lower ring lands.

CAUTION

Care must be exercised in opening the air valve since sufficient air pressure will have to be built up in the cylinder to cause it to rotate the crankshaft if the piston is not at TDC.

- Open the air valve completely. Check the regulated pressure and adjust, if necessary, to 80 PSI.
- Observe the pressure indication on the cylinder pressure gauge. The difference between this pressure and that shown by the regulator pressure gauge is the amount of leakage through the cylinder.
- An individual cylinder pressure reading of less than 55 PSI, or a difference of more than 20 PSI from the highest to lowest cylinder reading, is cause to suspect the cylinder of being defective. See Cylinder section of this manual to remove and replace cylinder.
- Re-install the spark plug.

– If cylinder pressure readings indicate there may be a defective cylinder, recheck the readings after operating the engine for at least 3 minutes to allow for sealing of the rings with oil.
– If leakage is still occurring after a recheck, it may be possible to correct a low reading due to foreign material between the valve face and seat. This is accomplished by placing a fiber drift on the rocker arm directly over the valve stem and tapping the drift several times with a hammer to dislodge any material.
– If cylinder pressure readings still indicate a defective cylinder, remove and inspect the suspect cylinder IAW Vantage Engine Overhaul Manual, or replace the cylinder, see section 72-30-01.

- **Engine Mounts**

  Check engine mounting bolts and bushings for security or excessive wear. Replace any bushings that are excessively worn.

- **Engine Accessories**

  Engine mounted accessories such as starters, vacuum pumps, fuel system, alternators, pumps, temperature and pressure sensing units should be checked for secure attachment and tight connections.

- **Carburetor / Fuel Injection**

  Check fuel injection servo or carburetor for dye stains. Stains indicate leakage. Check all controls and linkages for security and proper operation. Check all attaching hardware for security. Repair or replacement must be accomplished before the aircraft resumes operation.

- **Fuel Injection Manifold, Nozzles and Lines**

  Check fuel injector nozzles for tightness. Torque to 60 in-lb. Check fuel lines for dye stains at connections. Stains indicate leakage. Check all attaching hardware for security. Repair or replacement must be accomplished before the aircraft resumes operation.

- **Alternator**

  Remove drive belt and turn alternator rotor to check condition of bearings for abnormal noise or roughness. Repair or replacement must be accomplished before the aircraft resumes operation.

500 Hour Inspection

In addition to the items listed for 50 hour, and 100 hour inspections, perform the following inspections after every 500 (+/-10) hours of operation.

- **Magneto Inspection**

Completely inspect magnetos internally including removal, cleaning, and inspection of the ball bearing assembly, impulse coupling, coil, contact points, condenser, and carbon brush. Lubricate, reassemble and reinstall magneto.

  - Perform above inspection in accordance with Unison Industries 4300/6300 Series Magneto Maintenance and Overhaul Manual L-1363B, in Appendix 1, or

  - If desired, or necessary, replace with new Unison Magneto, refer to 74-00-00 Ignition Section.

1000 Hour Inspection

In addition to the items listed for 50 hour, 100 hour, and 500 hour inspections, perform the following inspections after every 1000 (+/-20) hours of operation.

If the Vantage Engine is provided with an alternator, remove alternator field brush assembly and inspect brushes for excessive wear. Replace brush assembly if brushes extend less than .25” from edge of brush holder case.

Recommended TBO

The Vantage Engine has a recommended TBO of 1000 hours.

Recommended Accessory Replacement

The Vantage Engine accessories are recommended to be replaced at engine TBO or other interval as specified in the appropriate accessory sections of this manual.

UNSCHEDULED INSPECTION AND MAINTENANCE

One-time unscheduled inspections as dictated by unexpected damage from Propeller/Rotor Strike, Foreign Object Damage (FOD), Overspeed, Overboost, Lightning Strike, Contaminated Fuel, Detonation, and Water Immersion are described below.

- **Propeller/Rotor Strike**

A prop/rotor strike may result in engine damage and requires complete engine disassembly and inspection IAW the Overhaul Manual prior to returning the engine back to service. In addition to the inspections required in the overhaul manual, inspect all engine accessories IAW manufacturer's instructions. Failure to do so may result in catastrophic engine failure. Further operation of an engine involved in a propeller/rotor strike incident without inspection is the responsibility of the authority returning the engine to service. A propeller/rotor strike is defined as:

  - Any incident, whether the engine is operating or not, for which repair of the propeller or rotor requires removal (see FOD below).
  - Any incident during engine operation in which contact of the propeller or rotor with any object results in the loss of engine RPM. This includes objects such as the ground, water, grass, sand, stone, etc., even if the propeller or rotor continues to rotate.

- **FOD**

Foreign object damage is defined as damage to the propeller or rotor from small objects (such as a small stone) during operation of the engine. FOD repair must be accomplished IAW the prop or rotor manufacturer's instructions. Any damage requiring removal of the prop or rotor for repair is considered a prop/rotor strike and the engine must be inspected as described in the previous section.

- **Overspeed**

Operation of an engine in excess of 105% rated RPM for more than 10 seconds, or 110% rated RPM for any time, can cause serious damage. Engines that have experienced overspeed must be assessed for excessive loading damage by complete engine disassembly and inspection IAW the Overhaul Manual prior to returning the engine back to service. Specific attention should be paid during inspection for damage to cylinders, bearings, and rotating and reciprocating components. All damaged components should be destroyed to prevent future use. Failure to do so may result in catastrophic engine failure. Further operation of an engine that has experienced overspeed without inspection is the responsibility of the authority returning the engine to service.

- **Overboost**

Operation of an engine in excess of 110% rated manifold pressure for more than 10 seconds, or 120% rated manifold pressure for any time, can cause serious damage. Engines that have experienced overboost must be assessed for excessive temperature or loading damage by complete engine disassembly and inspection IAW the Overhaul Manual prior to returning the engine back to service. Specific attention should be paid during inspection for damage to cylinders, bearings, and rotating and reciprocating components. All damaged components should be destroyed to prevent future use. Failure to do so may result in catastrophic engine failure. Further operation of an engine that has experienced overboost without inspection is the responsibility of the authority returning the engine to service.

- **Lightning Strike**

Damage to the engine or engine accessories resulting from a lightning strike is impossible to determine without complete engine disassembly and inspection IAW the Overhaul Manual prior to returning the engine back to service. All steel components must be magnaflux inspected and degaussed during this inspection. In addition to the inspections required in the Overhaul Manual, inspect all engine accessories IAW manufacturer's instructions. Failure to do so may result in catastrophic engine failure. Further operation of an engine involved in a lightning strike incident without inspection is the responsibility of the authority returning the engine to service.

- **Contaminated Fuel**

Engines operated on lower grade fuels than approved for the engine can result in internal damage, which can only be assessed by complete engine disassembly and inspection IAW the Overhaul Manual prior to returning the engine back to service. Inspection for detonation damage to cylinders and rotating/reciprocating components should be performed as described in the section below. Failure to do so may result in catastrophic engine failure. Further operation of an engine operated on contaminated fuel without inspection is the responsibility of the authority returning the engine to service.

- **Detonation**

Improper engine operation, excessive CHT's, or operation on contaminated fuel or lower octane fuel than approved may result in detonation damage. Excessive engine temperatures, rough engine operation or vibration, or high oil consumption may be some indications of detonation damage. Engines that have experienced detonation must be assessed for excessive temperature or loading damage by complete engine disassembly and inspection IAW the Overhaul Manual prior to returning the engine back to service. Specific attention should be paid during inspection for detonation damage to cylinders, bearings, and rotating and reciprocating components. All damaged components should be destroyed to prevent future use. Failure to do so may result in catastrophic engine failure. Further operation of an engine that has experienced detonation without inspection is the responsibility of the authority returning the engine to service.

- **Water Immersion**

Damage to the engine or engine accessories resulting from water immersion is impossible to determine without complete engine disassembly and inspection IAW the Overhaul Manual prior to returning the engine back to service. In addition to the inspections required in the Overhaul Manual, inspect all engine accessories IAW manufacturer's instructions. Failure to do so may result in catastrophic engine failure. Further operation of an engine immersed in water without inspection is the responsibility of the authority returning the engine to service.

ENGINE SECTION

General

The scope of this section of the manual is limited to basic engine maintenance. This section includes detailed information on the following topics:

- Testing and Fault Isolation
- Cleaning
- Engine Removal
- Engine Installation
- Torques, Fits, and Clearances
- Preservation and Storage
- Servicing
- Front Section
- Cylinder Section
- Lubrication Section

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TESTING AND FAULT ISOLATION

General

This section provides the Fault Isolation procedures. Review all probable causes given. The engine electrical diagram and engine oil system schematic should be referenced as an additional aid in determining probable cause.

Electrical testing is limited to continuity checks of the ignition wiring harness.

- Special tools and equipment are listed in Table 01-00-01.1.
- The Abnormal Operation Troubleshooting Procedures are listed in Table 72-00-01.2.

Table 72-00-01.1 • Abnormal Operation Troubleshooting Procedures

Symptom	Table
Engine will not start	72-00-01.3
Rough Idling	72-00-01.4
Engine Not Able to Develop Full Power	72-00-01.5
Rough Engine Operation	72-00-01.6
Low Power and Engine Runs Rough	72-00-01.7
Low Oil Pressure On Engine Gage	72-00-01.8
High Oil Temperature	72-00-01.9
Excessive Oil Consumption	72-00-01.10

Testing and Fault Isolation

WARNING: OPERATION OF A DEFECTIVE ENGINE WITHOUT A PRELIMINARY EXAMINATION CAN CAUSE FURTHER DAMAGE TO A DISABLED COMPONENT AND POSSIBLE INJURY TO PERSONNEL. MAKE SURE THOROUGH INSPECTION AND TROUBLESHOOTING PROCEDURES ARE ACCOMPLISHED. THIS WILL HELP TO PREVENT INJURIES TO PERSONNEL AND/OR DAMAGE TO THE EQUIPMENT.

WARNING: HOT OIL MAY CAUSE BURNS TO EYES AND SKIN. PUT ON SPLASH GOGGLES, INSULATED GLOVES, AND OTHER PROTECTIVE GEAR. IN CASE OF EYE CONTACT, FLUSH WITH WATER FOR 15 MINUTES AND SEEK MEDICAL ATTENTION. IN CASE OF SKIN CONTACT, WASH WITH SOAP AND WATER.

WARNING: FUEL IS TOXIC AND FLAMMABLE. DO NOT BREATH VAPORS. USE IN A WELL-VENTILATED AREA FREE FROM SPARKS, FLAME, OR HOT SURFACES. PUT ON SPLASH GOGGLES, SOLVENT-RESISTANT GLOVES, AND OTHER PROTECTIVE GEAR. IN CASE OF EYE CONTACT, FLUSH WITH WATER FOR 15 MINUTES AND SEEK MEDICAL ATTENTION. IN CASE OF SKIN CONTACT, WASH WITH SOAP AND WATER.

NOTE: The Fault Isolation sequence is in order of approximate ease of checking, not necessarily in order of probability.

Table 72-00-01.2 • Engine Will Not Start

Probable Cause/ Added Possible Indications	Correction
No Fuel	Fill with fuel.
Excessive Priming; difficult to start engine, fuel vapors or fuel draining	Leave ignition "Off" and mixture control in "Idle Cut-Off", open throttle and clear cylinders by cranking a few seconds. Turn ignition switch "On" and proceed to start.
Defective ignition wire; rough running or misfiring engine, colder than normal EGT	Check with electric tester, and replace any defective wires.
Dead battery; no starter engagement	Replace battery.
Malfunction of magneto breaker	Clean points. Check internal timing of magnetos
Lack of sufficient fuel flow; high EGT	Disconnect fuel line and check fuel flow.
Water in fuel injector or carburetor; rough running engine	Drain fuel injector or carburetor and fuel lines.
Internal failure; rough running engine, smoke, engine noise	Check oil screens for metal particles. If found, complete overhaul of the engine may be required.

Table 72-00-01.3 • Rough Idling

Probable Cause/ Added Possible Indications	Correction
Incorrect idle mixture	Adjust mixture.
Leak in the induction system; high RPM idle, high manifold pressure	Tighten all connections in the induction system. Replace any damaged parts.
Incorrect idle adjustment	Adjust throttle stop to obtain correct idle.
Uneven cylinder compression	Check condition of piston rings and valve seats.
Faulty ignition system; engine misfire	Check entire ignition system.

Table 72-00-01.4 • Engine Not Able To Develop Full Power

Probable Cause/ Added Possible Indications	Correction
Leak in the injection system; fuel leakage	Tighten all connections and replace damaged parts.
Throttle lever out of adjustment	Adjust throttle lever.
Improper fuel flow; fouled plugs, black exhaust	Check strainer, gage and flow at the fuel inlet.
Restriction in air scoop	Examine air scoop and remove restrictions.
Improper fuel; detonation, high CHT	Drain and refill tank with proper fuel.
Faulty ignition; rough running engine	Tighten all connections. Check system with tester. Check ignition timing.

Table 72-00-01.5 • Rough Engine Operation	
Probable Cause/ Added Possible Indications	**Correction**
Broken engine mount; evidence of external engine component wear, rubbing or abrasion	Replace or repair mount.
Mounting bushings worn	Install new mounting bushings.
Unstable compression	Check cylinder compression.

Table 72-00-01.6 • Low Power & Engine Runs Rough	
Probable Cause/ Added Possible Indications	**Correction**
Mixture too rich; indicated by sluggish engine operation, red exhaust flame at night. Extreme cases indicated by black smoke from exhaust	Readjustment of fuel injector or carburetor may be required by authorized personnel.
Mixture too lean; indicated by overheating or back firing	Check fuel lines for dirt or other restrictions. Readjustment of fuel injector or carburetor may be required by authorized personnel.
Leaks in induction system; high manifold pressure	Tighten all connections. Replace damaged parts.
Defective spark plugs; engine misfire	Clean and gap or replace spark plugs.
Improper fuel; detonation	Drain and refill tank with proper grade.
Magneto breaker points not working properly	Clean points. Check internal timing of magnetos.
Defective ignition wire	Check wire with electric tester. Replace defective wire.
Defective spark plug terminal connectors	Replace connectors on spark plug wire.

Table 72-00-01.7 • Low Oil Pressure On Engine Gage	
Probable Cause/ Added Possible Indications	**Correction**
Lack of oil; high oil temperature	Add to proper level.
Air lock or dirty relief valve	Clean relief valve.
Leak in line; evidence of oil near engine or on ground	Inspect gaskets and hose fittings
High oil temperature	See Table 72-00-01.9, “High Oil Temperature”.
Defective pressure gage.	Replace defective gage.
Stoppage in oil pump intake passage	Check line for obstruction. Clean suction strainer.

Table 72-00-01.8 • High Oil Temperature

Probable Cause/ Added Possible Indications	Correction
Insufficient air cooling	Check air inlet and outlet for deformation or obstruction.
Insufficient oil supply	Fill to proper level with specified oil.
Low grade of oil	Replace with oil conforming to specifications.
Clogged oil lines or strainers	Remove and clean oil strainers.
Excessive blow-by; black or wet exhaust oil on belly	Check condition of engine rings. Replace if worn or damaged.
Failing or failed bearing	Examine sump for metal particles. If found, engine overhaul may be required.
Defective temperature gage	Replace gage.

Table 72-00-01.9 • Excessive Oil Consumption

Probable Cause/ Added Possible Indications	Correction
Low grade of oil	Fill tank with oil of proper weight and grade.
Failing or failed bearings	Check sump oil for metal particles.
Worn piston rings; excessive blow-by	Install new rings.
Incorrect installation of piston rings	Install new rings. Inspect barrel, rehone or replace if neccessary
Failure of rings to seat on new cylinders; oil fouled plugs	Use mineral base oil. Climb to cruise altitude at full power and operate at 75% cruise power setting until oil consumption stabilizes. See Cylinder Break-In Procedures Section of this manual.
Oil siphoned from engine in flight; oil on firewall or in engine compartment	Insure that oil filler cap is tight and that o-ring is in good condition. Insure that breather hose exit is cut and located to avoid creating a vacuum in the breather hose.

ENGINE REMOVAL

General

This section contains engine removal procedures for the purposes of engine preservation or maintenance. Equipment and materials to accomplish removal procedures are listed in Table 72-00-05.1.

Table 72-00-05.1
Equipment and Materials List

Item	Vendor
Engine Stand	Commercially Available
Engine Hoist	Commercially Available
Protective Covers for Open Lines or Ports	Commercially Available

NOTE: Standard aviation shop tools are required.

Removal

Remove the engine from the airframe as follows:

NOTE: Identify each item as the item is disconnected from the engine to aid in reinstallation.

- Turn all cockpit switches and fuel selector valves to OFF.
- Remove aircraft cowling as required.
- Disconnect the battery ground cable.
- Disconnect the start cable.
- Remove engine baffles as required.
- Remove air intake ducting and heat ducting as required.
- Remove engine exhaust system as required.
- Disconnect and remove the “B” nuts from the spark plugs.
- Tag and disconnect the engine wiring bundles from all applicable components.
- Remove all clamps attaching engine wire bundles to engine components and route bundles clear of the engine.
- Drain the engine oil from the sump. Replace drain plug and tighten.
- Remove propeller in accordance with the airframe manufacturer’s instructions.
- Consult the airframe manufacturer for engine to airframe connections.

WARNING: PLACE A SUITABLE STAND UNDER THE AIRCRAFT TAILCONE IF NEEDED BEFORE REMOVING THE ENGINE. THE LOSS OF WEIGHT MAY CAUSE THE AIRCRAFT TAIL TO DROP.

- Attach a hoist to the engine lifting eye bracket and relieve the weight from the engine mounts. Only the lifting eye bracket installed on the backbone of the crankcase should be used to hoist the engine.

- Remove the engine mounts and engine as follows:
  1. Loosen and remove the engine mounts bolts in accordance with airframe manufacturer’s instructions.
  2. Hoist the engine vertically out of the nacelle and clear of the aircraft.

NOTE: Hoist the engine slowly and make sure that all wires, lines, and hoses have been disconnected.

  3. Install the engine onto a transportation stand, dolly, or an engine shipping container base.

- Install protective covers/plugs on any remaining open fuel, oil/hydraulic lines, and electrical leads and exhaust ports.

Preservation

If the engine is to be stored for longer than 90 days, refer to the Preservation and Storage section of this manual for procedures and materials.

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ENGINE DISASSEMBLY

General

The disassembly scope of this manual is limited to cylinder and accessory removal and replacement. Refer to instructions in the Overhaul Manual (SVOHM01) to remove and replace other defective parts or components.

Refer to section 72-10 for alternator and starter removal and replacement.

Refer to section 72-30 for cylinder assembly removal and replacement.

Refer to section 72-50 for lubrication system component removal and replacement.

Refer to Chapter 74 for ignition system removal and replacement.

- Disassemble the engine only to the level necessary to replace the defective parts or components. Refer to instructions in the appropriate sections of this manual to replace defective parts.
- If there are no visual signs of damage, corrosion, or contamination, follow the appropriate procedures to determine the extent of maintenance that is necessary.

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CLEANING

General

Cleanliness of the aircraft engine is crucial to its optimum performance in daily operations. This section provides basic materials, tools, and guidelines for cleaning.

For most of the cleaning requirements during normal maintenance or periodic inspections, special instructions for cleaning are not required. Use standard industry practices.

It is important to remember to visually inspect an engine prior to cleaning. Residue from the engine's operation can provide information as to hidden defects or other dangerous conditions.

For tools required during cleaning, refer to Table 72-00-07.1. For consumable materials required during cleaning, refer to Table 72-00-07.2.

Table 72-00-07.1
Equipment Required for Cleaning

Item	Vendor
Brushes (soft and stiff bristles)	Commercially Available
Immersing tank	Commercially Available
Scraper (wood)	Commercially Available
Grit blaster	Commercially Available

Cleaning Instructions

Two processes are used in cleaning engine parts; degreasing to remove dirt and sludge (soft carbon) and the removal of hard carbon by decarbonizing, brushing or scraping and grit blasting.

CAUTION: DO NOT USE SAND OR METALLIC ABRASIVES WITH THE GRIT BLASTING EQUIPMENT.

Overall Engine Cleaning

- Spray the engine with degreaser solvent and allow to soak for a minimum of 15 minutes.
- Rinse the solvent mix off thoroughly with clear water and allow to dry. Compressed air may be used to dry the surfaces.

Table 72-00-07.2
Materials Required for Cleaning

Item	Vendor
Cleaning solvent or degreaser such as acetone, white furnace oil, Varsol, or Perm-A-Chlor	Commercially Available
Decarbonizing solutions such as Gunk, Penetrol, Carbrax, Super-Chemco, or Gerlach #70	Commercially Available
Isopropyl Alcohol	Commercially Available
Aerosol electrical contact cleaner	Commercially Available
Lubricating Oil (SAE 20)	Commercially Available
Corrosion preservative oil	Commercially Available
Abrasive cloth (crocus cloth)	Commercially Available

NOTE: Residue from the solvent washing must be captured and contained to prevent contamination of the surrounding environment.

WARNING: USE THE CORRECT PERSONAL PROTECTION. SOME CHEMICAL SOLUTIONS CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CLEANING SOLUTION.

Spark Plugs and Electrical Components

- Spark plugs should be removed from the engine and placed into a rack designating their original locations in the engine.

1. Wipe with lint-free cloth moistened with acetone or equivalent solvent to remove oil and loose carbon residue.
2. If necessary, use a blast cleaner to thoroughly clean the plugs prior to further inspection.

- Electrical harness components should be wiped with a dry, lint free cloth. Contact ends and connectors may be wiped with a lint free cloth moistened with alcohol or other suitable contact cleaner and dried.

CAUTION: DO NOT ALLOW SOLVENTS OR OTHER LIQUID CLEANERS TO ENTER ELECTRICAL COMPONENTS INSTALLED ON THE ENGINE. WRAP THESE ITEMS OR HARNESSES WITH ALUMINUM FOIL AND SEAL TO PREVENT DAMAGE.

Oil System Components

Oil drain components require no special cleaning. Oil filter screens should be rinsed with solvent and air dried.

Degreasing

Degreasing is accomplished by immersing or spraying the part in a solution of white furnace oil (38-40 specific gravity) or another suitable solvent such as Varsol or Perm-A-Chlor.

CAUTION: IF ANY WATER-MIXED DEGREASING SOLUTIONS CONTAINING CAUSTIC COMPOUNDS OR SOAP ARE USED, EXTREME CARE MUST BE EXERCISED. THESE COMPOUNDS IN ADDITION TO BEING POTENTIALLY DANGEROUS TO ALUMINUM AND MAGNESIUM, MAY BECOME IMPREGNATED IN THE PORES OF THE METAL AND CAUSE OIL FOAMING WHEN THE ENGINE IS RETURNED TO SERVICE. WHEN USING THESE WATER-MIXED SOLUTIONS ALWAYS THOROUGHLY RINSE THE PART IN CLEAN BOILING WATER. REGARDLESS OF METHOD OR SOLUTION USED ALWAYS COAT AND SPRAY ALL PARTS WITH LUBRICATING OIL IMMEDIATELY AFTER CLEANING IN ORDER TO PREVENT CORROSION.

CAUTION: USE THE CORRECT PERSONAL PROTECTION. HEATED PARTS WILL CAUSE BURNS.

Decarbonizing

Decarbonizing is usually accomplished by immersion of the part in a decarbonizing solution (usually heated). Decarbonization solutions such as Gunk, Penetrol, Carbrax, Super-Chemco, Gerlach No. 70 or any suitable solution. Refer to the caution below for water-soluble decarbonizers. Remove hard carbon deposits after degreasing by brushing, scraping or grit blasting. After cleaning, rinse the parts in petroleum solvent, dry, and remove loose particles by blowing the particles out with compressed air. Use a shop air supply with an appropriate water trap.

CAUTION: EXTREME CAUTION SHOULD BE EXERCISED WHEN USING A DECARBONIZING SOLUTION. IT IS RECOMMENDED THAT THE USE OF HEATED SOLUTIONS BE AVOIDED UNLESS THE OPERATOR IS THOROUGHLY FAMILIAR WITH THE PARTICULAR SOLUTION BEING USED. IN ADDITION THE OPERATOR IS STRONGLY ADVISED AGAINST IMMERSING STEEL AND MAGNESIUM PARTS IN THE SAME DECARBONIZING TANK, BECAUSE THIS PRACTICE OFTEN RESULTS IN DAMAGE TO THE MAGNESIUM PARTS FROM CORROSION.

CAUTION: DO NOT DAMAGE MACHINED SURFACES. MASK ALL MACHINE SURFACES PLUG ALL DRILLED OIL PASSAGES TO PREVENT DAMAGE OR ENTRY OF FOREIGN MATTER.

WARNING: WHEN YOU USE COMPRESSED AIR TO CLEAN OR DRY PARTS, MAKE SURE THAT THE PRESSURE IS NOT MORE THAN 30 PSI. DO NOT DIRECT THE AIRSTREAM AT PERSONNEL OR LIGHT OBJECTS. PUT ON GOGGLES OR A FACE SHIELD TO PROTECT YOUR EYES. THIS WILL HELP PREVENT INJURIES TO PERSONNEL OR DAMAGE TO THE EQUIPMENT. IF YOU GET AN EYE INJURY, SEEK MEDICAL ATTENTION.

Corrosion Removal

Remove corroded or pitted surfaces by polishing with crocus cloth or other mild abrasive material. Brush or wipe off any loose particles created by this procedure. Clean the part that has been abraded. Replace primer and paint as required. Refer to Repair section in Overhaul Manual.

Parts Preservation and Corrosion Prevention

After completion of any cleaning or degreasing operation the engine or part should be cleaned, rinsed, and dried completely to prevent corrosion resulting from residual moisture. Inspect the engine and its components to be sure they are clean and dry.

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ENGINE ASSEMBLY

General

The assembly scope of this manual is limited to cylinder and accessory removal and replacement. Refer to instructions in the Overhaul Manual (SVOHM01) to remove and replace other defective parts or components.

Refer to section 72-10 for alternator and starter removal and replacement.

Refer to section 72-30 for cylinder assembly removal and replacement.

Refer to section 72-50 for lubrication system component removal and replacement.

Refer to Chapter 74 for ignition system removal and replacement.

- Assemble the engine as required based on the level of disassembly. Refer to instructions in the appropriate sections of this manual to replace defective parts.

- Perform normal pre-run checks and inspections upon completion of assembly and prior to engine run.

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ENGINE INSTALLATION

General

This section consists of engine installation procedures after engine removal from the aircraft for maintenance or long term storage and preservation. Additional information may be found in the Installation and Operation Manual (SVIOM01).

- Equipment and Materials to accomplish installation procedures are listed in Table 72-00-10.1.
- Model specific data may be found in the Model Specification Data in the Installation and Operation Manual (SVIOM01).

Table 72-00-10.1
Equipment and Materials List

Item	Vendor
Engine Stand	Commercially Available
Engine Hoist	Commercially Available
Aircraft engine oil	Commercially Available
Accessory drive pad gaskets as required	Commercially Available

NOTE: Standard aviation shop tools are required.

Preparing Engine for Service

- If necessary, remove engine from shipping or storage container. Use only the lifting eye bracket installed on the backbone of the crankcase to hoist the engine.
- If the engine has been preserved, perform the following steps:
  1. Remove the shipping plugs installed in the upper spark plug holes and inspect the cylinder bores for rust or contamination.
  2. Remove the shipping plugs installed in the lower spark plug holes and turn the crankshaft through at least twice in order to remove the cylinder preservation oil from the cylinders.
  3. Service the engine with oil.
- Engines that have been subjected to a cold environment for long periods of time should be placed into at least a 70°F (21°C) atmosphere for 24 hours or more before attempting to drain the preservative oil. If this cannot be done, heat the cylinders with heating lamps before attempting to drain the engine.
- Remove exhaust port protective plugs.
- If installing engine accessories, see appropriate section of this manual for instructions.
- Optional accessories such as vacuum pumps, hydraulic pumps, etc., may be installed on the accessory drive pads located on the rear of the accessory housing. Remove the accessory drive covers and install new gaskets. Install accessories in accordance with the manufacturer's instructions.
- Install all airframe manufacturers' required cooling baffles, hoses, fittings, brackets and ground straps in accordance with airframe manufacturer's instructions.

Installation of Engine

- Install per airframe manufacturer's instructions. Use only the lifting eye bracket installed on the backbone of the crankcase to hoist the engine.
- Consult airframe manufacturer's instructions for engine to airframe connections. Remove all protective covers, plugs, caps and identification tags as each item is connected or installed.

CAUTION: FAILURE TO PURGE THE AIRCRAFT FUEL TANKS AND LINES CAN CAUSE ERRATIC FUEL INJECTION SYSTEM OPERATION AND DAMAGE TO ITS COMPONENTS.

- The aircraft fuel tanks and lines must be purged to remove all contamination prior to installation in the main fuel inlet line to the fuel pump.
- Install the approved propeller in accordance with the airframe manufacturer's instructions.

WARNING: DO NOT INSTALL THE IGNITION HARNESS "B" NUTS ON THE SPARK PLUGS

UNTIL THE INSTALLATION IS COMPLETED. FAILURE TO COMPLY COULD RESULT IN BODILY INJURY WHEN THE PROPELLER IS ROTATED DURING INSTALLATION.

TORQUES, FITS, AND CLEARANCES

General

These limits provide dimensions, clearances and interference fits necessary to maintain Superior Vantage O-360 and IO-360 series engines. Service limits for used parts are provided where they have been established. If no service limits are provided, new limits must be maintained.

Service Limits

The following information is provided in this section:

- Dimensional Limits are provided in Table 72-00-11.1.
- Backlash and Clearances Limits are provided in Table 72-00-11.2.
- Torque Limits are provided in Table 72-00-11.3.
- Spring Limits are provided in Table 72-00-11.4.
- Crush Type Gasket Tightening Angles are provided in Table 72-00-11.5.

NOTE: Limits followed by the letter "T" indicate a "tight", i.e., an interference fit. An example is the fit of the valve guide in the cylinder head. Where no "T" exists, the fit is a clearance dimension.

Table 72-00-11.1 • Dimensional Limits

Description of Limit	Minimum (in.)	Maximum (in.)
Piston		
Piston in Cylinder (Bottom of Skirt Clear)	0.0065	0.0095
Piston Weight Difference (Opposing Pairs)	-	.4 oz.
Piston Rings		
Piston Ring in Groove Side Clearance (Top Compression)	0.0025	0.0055
Piston Ring in Groove Side Clearance (2nd Compression)	0.0000	0.0040
Piston Ring in Groove Side Clearance (3rd Oil)	0.0020	0.0040
End Gap (Top Compression)	0.0450	0.0550
End Gap (2nd Compression)	0.0450	0.0550
End Gap (Oil Control)	0.0150	0.0300
NOTE: Measure end gaps 1.0" to 4.0" from bottom of barrel. Minimum ring gap at top of stroke is 0.0075" (measure compression ring gaps approx. 6.5" from bottom of barrel and oil ring gap approx. 6" from bottom of barrel).		
Piston Pin		
Piston Pin and Plug in Cylinder (End Clear)	0.0250	0.0570
Piston Pin in Piston (Diameter)	0.0003	0.0014
Piston Pin in Connecting Rod Bushing	0.0008	0.0021
Oil Seal in Propeller Governor Adapter	0.0010T	0.0030T
Valve Rocker Arm (Side Clearance)	0.0050	0.0130
Dry Tappet Clearance	0.0280	0.0800
Valve Tappet in Crankcase	0.0010	0.0033

Table 72-00-12.2 • Backlash and End Clearance Limits

Description of Limit	Minimum (in.)	Maximum (in.)
Propeller Governor Gear (End Clear)	0.002	0.024
Vacuum Pump Gear (End Clear)	0.010	0.057

Table 72-00-11.3 • Torque Limits	
Description of Limit	**Torque (in-lb)**
Spark Plug	360-420
Plug and Fitting (1/2-14 NPT)	160
Plug and Fitting (1/16-27 NPT)	40
Plug and Fitting (1/8-27 NPT)	40
Plug and Fitting (1/4-18 NPT)	85
Plug and Fitting (3/8-18 NPT)	110
Nut ¼" (Nut and Capsrew)	96-108
Slotted Nut ¼" (Nut and Capscrew)	55-60
Nut 5/16" (Nut and Capscrews)	200
Slotted Nut 5/16" (Idler Shaft)	150
Nut ½-20 Cylinder to Crankcase	600
Nut 3/8-24 Cylinder to Crankcase	300
Nut 3/8-24 Crankcase to Crankcase	300
Nut 3/8-24 Connecting Rod	480
Slotted Nut 3/8-24 (Drilled Stud Over Camshaft)	300
5/16-24 Crankshaft Gear Bolt	204
¼-20 Push Rod Shroud Retaining Nut	50-70
¼-20 Rocker Cover Screws	50
Oil Spray Nozzles (1/16-27 NPT)	100
Oil Gage Tube (1-1/8-12)	300
Drain Back Tube Nut	35
Drain Back Hose Clamp	10
Intake Hose Clamps	45
Fuel Pump and Prop Governor Hose Nuts	35
Fuel Injector Hose Nuts	30
Fuel and Prop Governor Elbow Locknuts	30
Spin-on Oil Filter	192-216
Fuel Pump Socket Head Bolts (3/8-16)	225-250
Vernatherm Valve	300
Injector and Primer Nozzle	60
Nut and Capscrews (10-24, 10-32)	49
Primer and Injector Tubing Nuts	25

Table 72-00-11.4 • Valve Spring Dimensional Limits

Description of Limit	Wire Dia. (In.)	Compressed Height (In.)	Compression Force (Lb)	
			Min	Max
Spring Valve, Inner	0.135	1.17	59	67
Spring Valve, Outer	0.177	1.30	111	122

Table 72-00-11.5 • Crush Type Gasket Tightening Angles

Description of Limit	Angle
Oil Suction Screen Gasket	135º
Pressure Relief Valve Gasket	90º
Oil Cooler Bypass Plug Gasket	135º

NOTE: Install Crush Gasket with seam toward aluminum case. Tighten thread until cap or valve body contacts gasket. Turn additional angle shown above. Lock wire in place.

PRESERVATION AND STORAGE

General

There is no practical procedure that will ensure corrosion prevention on installed aircraft engines. Geographical locations, season and usage all influence the degree of corrosion. The owner/operator is responsible for recognizing the conditions that are conducive to corrosion and for taking appropriate precautions.

Corrosion can occur in engines that are flown only occasionally, regardless of geographical location. In coastal areas and areas of high humidity, corrosion can occur in as little as a few days. The best method for reducing the likelihood of corrosion is to fly the aircraft at least once every week for a minimum of one hour.

NOTE: Corrosion may reduce engine service life. Primary wear concerns are cylinders, piston rings, camshaft and lifters.

WARNING: HOT OIL MAY CAUSE BURNS TO EYES AND SKIN. PUT ON SPLASH GOGGLES AND INSULATED GLOVES, AND OTHER PROTECTIVE GEAR. IN CASE OF EYE CONTACT, FLUSH WITH WATER FOR 15 MINUTES AND SEEK MEDICAL ATTENTION. IN CASE OF SKIN CONTACT, WASH WITH SOAP AND WATER.

WARNING: ENGINE OIL IS HAZARDOUS AND MAY CAUSE INJURY TO SKIN AND EYES. PUT ON RUBBER GLOVES AND GOGGLES.

Table 72-00-12.1 • Preservation and Storage Materials

NOMENCLATURE	VENDOR
Preservative Oil MIL-C-6529 Type II, or equivalent	Commercially Available
Preservative Oil MIL-L-46002, Grade 1, or equivalent	Commercially Available
Cortec VpCI-326 Preservative Oil Concentrate, or equivalent	Cortec Corp. 4119 White Bear Pkwy St. Paul, MN 55510 612-429-1100
Preservative Oil Mil-C-16173 Grade 2, or equivalent	Commercially Available
Dehydrator plugs, AN4062-1 or MS27215-2	Commercially Available
Covers, as required	Commercially Available
Moisture Resistant Caps	Commercially Available
Moisture Resistant Tape	Commercially Available

The following instructions are general and apply to both temporary and indefinite storage.

- If engine contains engine oil, remove oil sump drain plug and drain oil. Replace drain plug, torque and safety. Remove oil filter. Install new oil filter, torque and safety.
- Service engine to proper sump capacity with MIL-C-6529 Type II preservative oil or equivalent, or a mixture of 1 part Cortec VpCI-326 to 10 parts regular single grade engine oil. This oil is not to be used as a lubricant.
- On aircraft: Perform a ground run-up. Perform a pre-flight inspection and correct any discrepancies. Fly the aircraft for approximately one hour or until 180°F oil temperature is reached. Do not exceed 400°F (200°C) cylinder head temperature.
- On test cell: Perform run-up to warm engine to a minimum of 180°F (82°C) oil temperature. Do not exceed 400°F (180°C) cylinder head temperature. Run at these conditions for a minimum of 15 minutes

<u>WARNING</u>: TO PREVENT POSSIBILITY OF SERIOUS BODILY INJURY OR DEATH, BEFORE MOVING THE PROPELLER DO THE FOLLOWING:

- **DO NOT STAND WITHIN THE ARC OF THE PROPELLER BLADES WHILE TURNING THE PROPELLER**
- **VERIFY ALL SPARK PLUG LEADS ARE DISCONNECTED.**
- **VERIFY MAGNETO SWITCHES ARE CONNECTED TO MAGNETOS AND THAT THEY ARE IN THE "OFF" POSITION AND THE P-LEADS ARE GROUNDED.**
- **THROTTLE POSITION "CLOSED".**
- **MIXTURE CONTROL POSITION "IDLE-CUT OFF".**
- **SET BRAKES AND BLOCK AIRCRAFT WHEELS. ENSURE THAT AIRCRAFT TIE DOWNS ARE INSTALLED AND VERIFY THAT THE CABIN DOOR LATCH IS OPEN.**

- After operation, verify all spark plug leads are removed and remove the top spark plugs. Protect the ignition lead ends with AN-4060 protectors or equivalent. Using a common garden sprayer or equivalent, spray approximately 2-3 ounces of atomized preservative oil MIL-P-46002 Grade I, or Cortec VpCI-326, at room temperature through the upper spark plug hole of each cylinder with the piston at bottom dead center position. Rotate crankshaft as opposite cylinders are sprayed. Stop crankshaft with none of the pistons at top dead center.

- Remove carburetor or fuel injection servo, drain all fuel from system and lines and cap lines. Insert desiccant bag in intake port. Attach a red "Remove Before Flight" streamer to each bag of desiccant and seal the openings.

- Preserve carburetor or fuel injection servo IAW manufacturer's storage instructions.

Follow the appropriate section below for temporary or indefinite preservation and storage.

Temporary Storage

After following the above steps, and while the engine is still warm, prepare the engine for short-term (90 days or less) storage or shipment in the following manner.

- Drain preservative oil. Re-spray each cylinder. To thoroughly cover all surfaces of the cylinder interior move the nozzle or spray gun from the top to the bottom of the cylinder.
- Install dehydrator plugs in top spark plug holes. Make sure each plug is blue in color when installed. Install caps in bottom spark plug holes
- Seal all engine openings exposed to the atmosphere using suitable plugs and covers.
- On aircraft, tag each propeller or, if propeller is not installed, on the propeller flange, with the following notation on the tag, : "Do Not Turn Propeller – Engine Preserved – (Preservation Date)"

<u>NOTE:</u> If the engine is not returned to flyable status on or before the 90 day expiration it must be preserved IAW "Indefinite Storage" procedures.

Indefinite Storage

After following the step in the general section above, and while the engine is still warm, prepare the engine for long-term storage in the following manner.

- Do not drain preservative oil. Re-spray each cylinder. To thoroughly cover all surfaces of the cylinder interior move the nozzle or spray gun from the top to the bottom of the cylinder.
- Install dehydrator plugs in top spark plug holes. Make sure each plug is blue in color when installed. Install caps in bottom spark plug holes
- Install desiccant bags in exhaust ports. Attach a red "Remove Before Flight" streamer to each bag of desiccant in the exhaust ports and seal the openings.
- Seal all engine openings exposed to the atmosphere using suitable plugs and covers.
- Preserve crankshaft propeller flange with Mil-C-16173 Grade 2, or equivalent, preservative oil.
- On aircraft, tag each propeller or, if propeller is not installed, on the propeller flange, with the following notation on the tag, : "Do Not Turn Propeller – Engine Preserved – (Preservation Date)"
- Aircraft prepared for indefinite storage must have the cylinder dehydrator plugs visually inspected every 15 days. The plugs must be changed as soon as they indicate other than a dark blue color. If the dehydrator plugs have changed color in one-half or more of the cylinders, all desiccant material on the engine must be replaced.
- The cylinder bores of all engines prepared for indefinite storage must be re-sprayed with corrosion preventive oil mixture every 90 days.

Returning an Engine to Service After Storage

- Remove all seals and all desiccant bags.
- Remove cylinder dehydrators and plugs from upper and lower spark plug holes.

WARNING: TO PREVENT THE POSSIBILITY OF SERIOUS BODILY INJURY OR DEATH, BEFORE MOVING THE PROPELLER DO THE FOLLOWING:

- **DO NOT STAND WITHIN THE ARC OF THE PROPELLER BLADES WHILE TURNING THE PROPELLER.**
- **VERIFY ALL SPARK PLUG LEADS ARE DISCONNECTED.**
- **VERIFY MAGNETO SWITCHES ARE CONNECTED TO MAGNETOS AND THAT THEY ARE IN THE "OFF" POSITION AND P-LEADS ARE GROUNDED.**
- **THROTTLE POSITION "CLOSED".**
- **MIXTURE CONTROL POSITION "IDLE-CUT OFF".**
- **SET BRAKES AND BLOCK AIRCRAFT WHEELS. ENSURE THAT AIRCRAFT TIE DOWNS ARE INSTALLED AND VERIFY THAT THE CABIN DOOR LATCH IS OPEN.**

- Rotate propeller by hand for several revolutions to remove preservative oil.
- Remove oil sump drain plug and drain the corrosion preventive oil mixture. Replace drain plug, torque and safety. Remove oil filter. Install new oil filter torque and safety. Service the engine with oil in accordance with the maintenance instructions.
- Service and install spark plugs and ignition leads and carburetor or fuel injection servo IAW the manufacturer's instructions.
- Service engine and aircraft in accordance with the manufacturer's instructions.
- Thoroughly clean the aircraft and engine. Perform visual inspection.
- Correct any discrepancies.
- Conduct a normal engine start.
- Perform a test flight in accordance with "Operation Instructions" of the Installation and Operation Manual.
- Correct any discrepancies.
- Perform a test flight in accordance with airframe manufacturer's instructions.
- Correct any discrepancies prior to returning aircraft to service.
- Change oil and filter after 25 hours of operation.

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REPAIR PROCEDURES

General

The repair scope of this manual is limited to cylinder and accessory removal and replacement. Refer to instructions in the Overhaul Manual (SVOHM01) to remove and replace or repair other defective parts or components.

Refer to section 72-10 for alternator and starter removal and replacement.

Refer to section 72-30 for cylinder assembly removal and replacement.

Refer to section 72-50 for lubrication system component removal and replacement.

Refer to Chapter 74 for ignition system removal and replacement.

- Perform normal pre-run checks and inspections upon completion of assembly and prior to engine run. Refer to instructions in the Inspection and Check section of this manual.

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SERVICING

General

This section specifies the fuels, lubricants, and consumables required to operate the Vantage series engines. For aircraft servicing, refer to the aircraft manufacturer's manual.

Lubricants

Oil grades are listed in Table 72-00-15.1 below. Oil sump capacity is listed in Table 72-00-15.2

Fuels

Superior Vantage Engines are certified for use with the following fuels. Minimum octane fuels are listed in Table 72-00-15.3.

- 100LL Avgas per ASTM D910
- 91/98 (lead optional) Avgas per ASTM D910
- Motor Gasoline with a minimum antiknock index (R+M/2 method) of 91 per ASTM D4814.

Table 72-00-13.1 • Oil Grades

All Models Average Ambient Air Temperature	Recommended Grade Oil
All Temperatures	SAE 15W50 or 20W50
Cold (<30°F) (<-1°C)	SAE 30 or 10W30
Standard (30° - 90°F) (-1° - 32°C)	SAE 40
Hot (>60°F) (>15°C)	SAE 50

Notes:

(1) For Break-In Operation straight mineral oil meeting MIL-L-6082 should be used. After Break-In, Ashless Dispersant Oils meeting MIL-L-22851 or SAE J-1899 are to be used.

(2) Semi-Synthetic Oils may be used after break-in provided that they meet MIL-L-22851 or SAE J-1899.

Table 72-00-13.2 • Oil Sump Capacity

Maximum Oil Capacity	8 U.S. Quarts
Minimum Safe Oil Quantity for Operation	2.5 U.S. Quarts
Minimum Safe Oil Quantity for Take-off	5 U.S. Quarts

Aviation Fuel
The minimum aviation fuel grade is 91/98 Octane Avgas, lead optional. Under no circumstances should aviation fuel of a lower octane rating be used.

91 Octane Motor Fuel
The Vantage series engine can operate and perform at rated power with unleaded automotive fuel (without alcohol) of at least 91 Octane. When operating with unleaded automotive fuel, use only 91 minimum octane premium grade fuel without alcohol.

CAUTION: AVOID AUTOMOTIVE FUEL TEMPERATURES OVER 85°F (29°C) AT OPERATING ALTITUDES OVER 12,500 FEET. THIS FUEL HAS A HIGHER VAPOR PRESSURE AND IS MORE LIKELY TO CAUSE CARBURETOR ICING AND VAPOR LOCK.

CAUTION: USE OF AUTO FUEL BLENDED WITH ETHANOL, OR GASOHOL, IS FORBIDDEN. USE AN ALCOHOL AND WATER TESTER TO DETERMINE ALCOHOL OR WATER CONTENT OF THE FUEL.

Table 72-00-15.3 • Minimum Octane Fuels

Minimum Octane	
Aviation Grade Fuel	Motor Fuel
91/98 Avgas (Lead Optional)	91 (R+M/2) (No Alcohol)

Consumables

Vantage Engines are equipped with spark plugs, an integral bypass spin-on oil filter, hoses and, if furnished with alternator, an alternator drive belt. Table 72-00-15.4 specifies these consumable items and their corresponding manufacturer's part numbers. Table 72-00-15.5 lists hoses used on Vantage Engines.

Table 72-00-15.4 • Consumables

Spark Plugs	**5/8"- 24 Thread**
Unison Industries	UREM40E (Massive) UREM38E (Massive) UREM38S (Fine Wire) UREM37BY (Projected Nose)
Champion Aviation	REM40E (Massive) REM38E (Massive) REM38S (Fine Wire) REM37BY (Projected Nose)
Oil Filters	**Integral Bypass, ¾"–16 Thread**
Champion Aviation	CH48108 CH48108-1
Aero Accessories	AA48108
Alternator Belt	**3/8" Belt**
Superior Air Parts	SL76026

Table 72-00-15.5 • Hoses

Fuel System	Hose Part Number	
Fuel Pump to Carburetor or Fuel Inj. Servo	Superior Stratoflex Aeroquip	SV1002-6CR-161 124J001-6CR-0161 AE3663163G0161
Fuel Injection Servo to Fuel Manifold	Superior Stratoflex Aeroquip	SV1001-4CR-334 124J001-4CR-0334 AE3663161E0334
Propeller Governor		
Rear Governor Adapter to Front of Crankcase	Superior Stratoflex Aeroquip	SV1001-6CR-400 124J001-6CR-0400 AE3663161G0400

FRONT SECTION

General

Maintenance of the Front Section of the O-360 and IO-360 series Vantage Engine includes the starter and, if furnished, alternator and propeller governor systems. Overhaul of starters, alternators, and propeller governors must be performed by approved facilities

Starter

Improper functioning of the starter is typically indicated by grinding sounds, smoke or a burning smell, or failure to turn the engine. See aircraft manufacturer's troubleshooting guide for additional information.

Before performing maintenance on the starter, **ground magneto P-leads and disconnect ignition harness "B" nuts from spark plugs.**

The starter should be overhauled or replaced at engine overhaul or a maximum of 2700 hours of operation. No other maintenance is required.

Starter Replacement

The starters used on the Superior Vantage Engines are for 12 or 24 volt electrical systems, as required by the airframe, and have a drive gear appropriate for a 149 tooth ring gear.

WARNING: DO NOT INSTALL THE IGNITION HARNESS "B" NUTS ON THE SPARK PLUGS UNTIL THE INSTALLATION IS COMPLETED. FAILURE TO COMPLY COULD RESULT IN BODILY INJURY WHEN THE PROPELLER IS ROTATED DURING INSTALLATION.

Removal of the starter requires disconnecting the electrical power supply from the airframe battery and removing the four nuts or bolts attaching the starter to the pad on the crankcase.

Install the new starter, using new lock washers, by torquing the three nuts and one bolt to 100 in-lb as shown in Figure 72-10-01.1.

If using the Sky-Tec 149NL starter in a 12 volt application, install jumper between large battery power terminal and the smaller 'S' terminal. For 24 volt applications remove jumper.

Torque power terminal nut to 60 in-lb and 'S' terminal nut to 10 in-lb. Place MS2571S and MS2571-2S (or similar) nipples over terminal connections. Reconnect the electrical power supply from the airframe.

Reconnect ignition harness "B" nuts and unground magneto P-leads. Start aircraft, checking starter for proper operation.

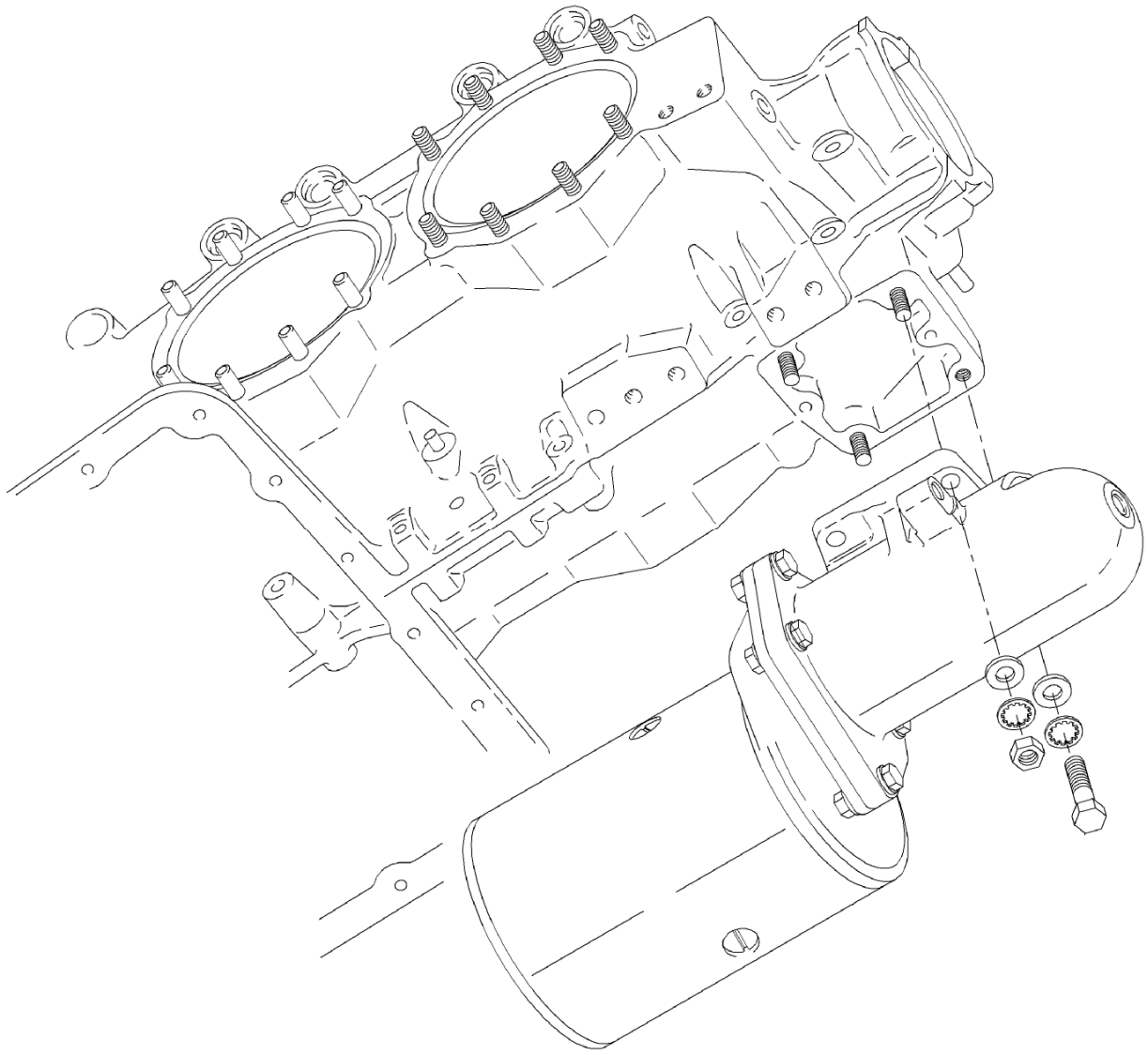

Figure 72-10-00.1 • Starter Installation

Alternator

Improper functioning of the alternator is typically indicated by a low or no voltage indicated in the aircraft.

Before performing maintenance on the alternator or alternator belt, **ground magneto P-leads and disconnect ignition harness "B" nuts from spark plugs.**

Alternator Belt Tension Adjustment and Replacement

There are two methods of checking belt tension. The belt tension may be verified by determining the load at midspan required to deflect the belt by 0.31 inch. An alternate method of checking belt tension is by measuring the torque required to slip the belt at the small pulley. Refer to table 72-10-01.1 below.

WARNING: DO NOT INSTALL THE IGNITION HARNESS "B" NUTS ON THE SPARK PLUGS UNTIL THE INSTALLATION IS COMPLETED. FAILURE TO COMPLY COULD RESULT IN BODILY INJURY WHEN THE PROPELLER IS ROTATED DURING INSTALLATION.

The tension adjustment arm connecting the crankcase to the alternator is adjustable to allow movement of the alternator to maintain tension of the drive belt. Refer to Figure 72-10-00.2 below.

Loosen the bolt connecting the adjustment arm to the alternator. This allows movement of the alternator to adjust belt tension. Moving the alternator outward, away from the engine, increases belt tension and movement inward reduces tension. Adjust alternator location appropriately, torque adjustment arm bolt appropriately, and check for required belt tension. Readjust, as necessary, to meet tension required.

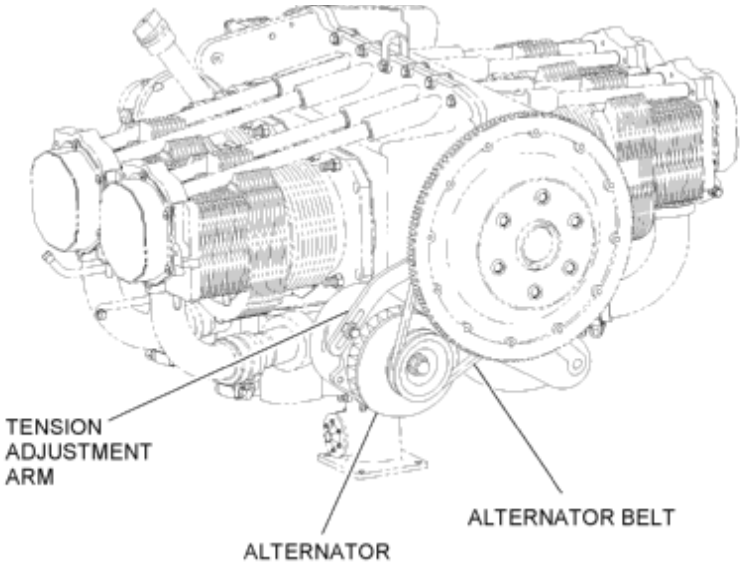

Figure 72-10-00.2 • Alternator Installation

If required tension can not be achieved or belt is worn, replace belt. To remove belt, cut belt midspan and discard. Replace belt with new SL76026 belt by first removing propeller IAW airframe manufacturer's instructions. Install slave bolt on propeller flange to secure starter support without propeller. Loosen the bolt connecting the adjustment arm to the alternator. Install new belt on starter support pulley and then over alternator pulley. Adjust tension arm to provide required belt tension and torque adjustment arm bolt. Verify tension on belt as described above. Remove slave bolt and install propeller IAW airframe manufacturer's instructions.

Reconnect ignition harness "B" nuts and unground magneto P-leads. Start aircraft and check alternator output for proper operation.

Check the tension of a newly installed alternator drive belt after 25 hours of operation and tighten as required to meet specifications.

Table 72-10-00.1 • Alternator Belt Tension Requirements

Belt Condition	Tension Load for 0.31" midspan deflection (lb)	Torque at Pulley (ft-lb)
New	14 ±1	12 ±1
Used	10 ±1	8 ±1

Alternator Replacement

If replacement of the alternator is required, first disconnect the airframe battery power leads. Cut the old alternator belt midspan and discard. Remove the propeller IAW airframe manufacturer's instructions.

<u>WARNING</u>: DO NOT INSTALL THE IGNITION HARNESS "B" NUTS ON THE SPARK PLUGS UNTIL THE INSTALLATION IS COMPLETED. FAILURE TO COMPLY COULD RESULT IN BODILY INJURY WHEN THE PROPELLER IS ROTATED DURING INSTALLATION.

Remove alternator from attaching brackets by removing the two attaching bolts, nuts, and washers on the tension adjustment arm and the crankcase attaching bracket, see Figure 72-10-00.3 below.

Install new alternator by re-installing the two attaching bolts, nuts and washers through the tension adjustment arm and crankcase attaching bracket.

Install battery wire with MS25171-2S terminal nipple on 6mm output terminal and torque to 50 in-lb. Install ground wire to any of the three 5 mm studs on rear of alternaotr and torque to 35 in-lb. Install field wire with MS25171-1S terminal nipple to F1 terminal on rear of alternator and torque to 20 in-lb.

The F2 terminal is to remain grounded with ground strap unless the aircraft voltage regulator is a Type "A" regulator using a 2-wire field circuit, in this case remove and disgard ground strap from F2 terminal and connect wiring from voltage regulator to F1 and F2 terminals. Torque to 20 in-lb.

If aircraft is equipped with an "alternator out" light circuit, connect that wire to the AUX terminal and torque to 20 in-lb, otherwise leave AUX terminal open.

Install new alternator belt as described above.

Unground magneto P-leads and reconnect ignition harness "B" nuts. Start aircraft and check alternator output for proper operation.

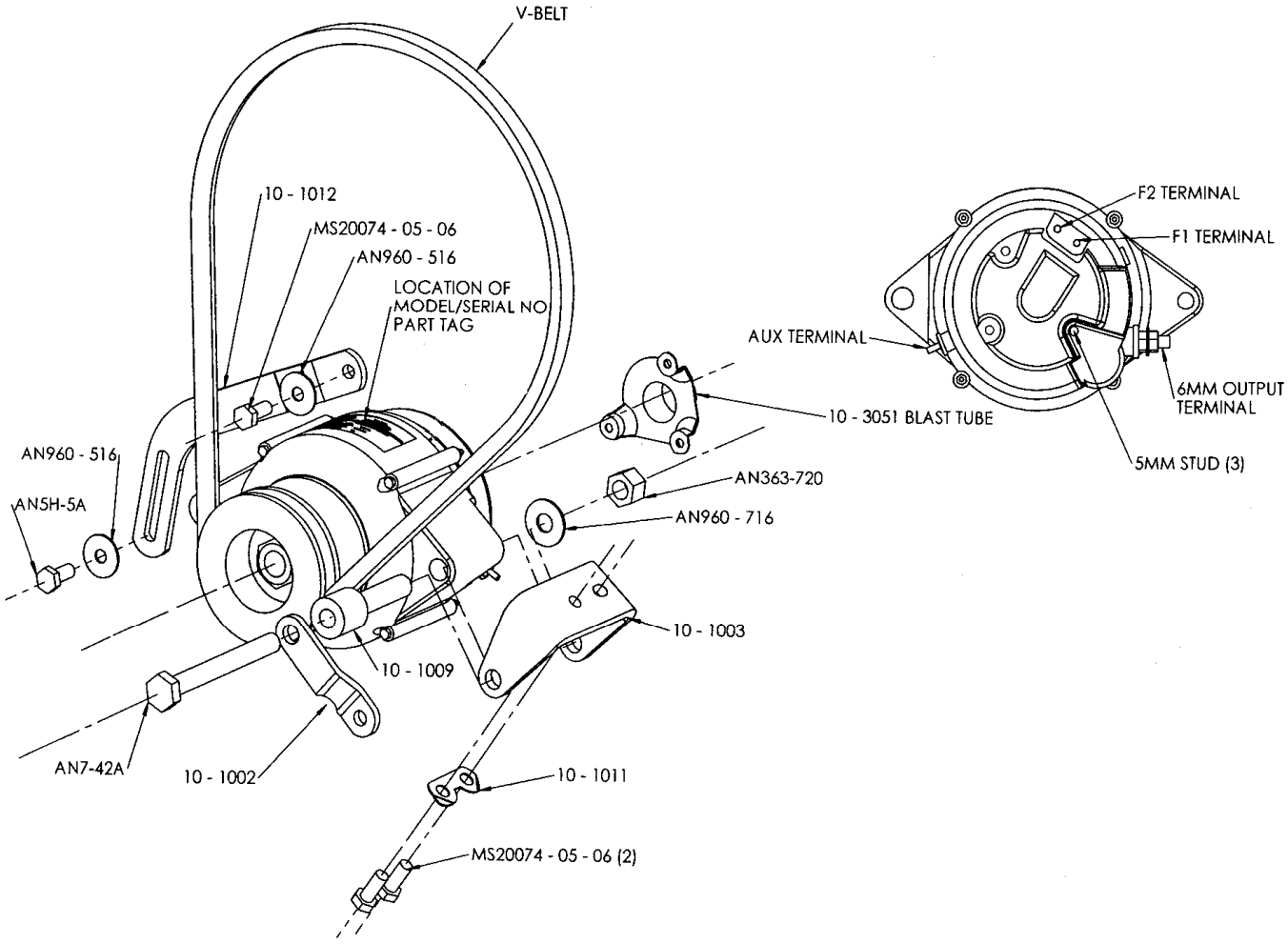

Figure 72-10-01.2 • Alternator and Mounting Hardware Detail

Propeller Governor System

Propeller governors are not furnished as part of the Vantage Engine. Refer to airframe manufacturer's instructions for maintenance of propeller governor.

There are two possible locations of the propeller governor, depending on engine model. There is a rear governor drive pad available on the rear accessory housing and, on models equipped with the front propeller governor crankcase, a governor drive pad intergral with the front of the crankcase.

The propeller governor furnishes pressurized oil, through the center cavity of the front main bearing journal of the crankshaft, to control propeller pitch.

Models equipped with provisions for a rear governor also have a propeller governor adapter which provides an oil port to deliver the pressurized oil. Front propeller governor crankcases deliver oil internally to the front main bearing cavity and require no maintenance.

Propeller Governor Hose Replacement

Models with rear governors deliver pressurized oil to the front of the crankshaft by means of an oil hose from the propeller governor adapter to the front of the crankcase.

To remove the propeller governor hose, disconnect both ends of the hose from the front and rear fittings. Remove any hose clamps attaching the hose to the engine by removing the appropriate hardware. Discard used lock washers. Retain remaining hardware for installation of the new hose.

Replacement hoses are listed in the Servicing section. Install clamps, removed from the old hose, onto the new hose. Connect new hose to the front and rear elbow fittings on the engine, torque hose nuts to 35 in-lb. Route the new hose appropriately to re-install hose clamps with new lock washers and previously removed hardware.

Start aircraft, check for proper operation of propeller governor. Shut down aircraft and check for oil leaks and correct as necessary.

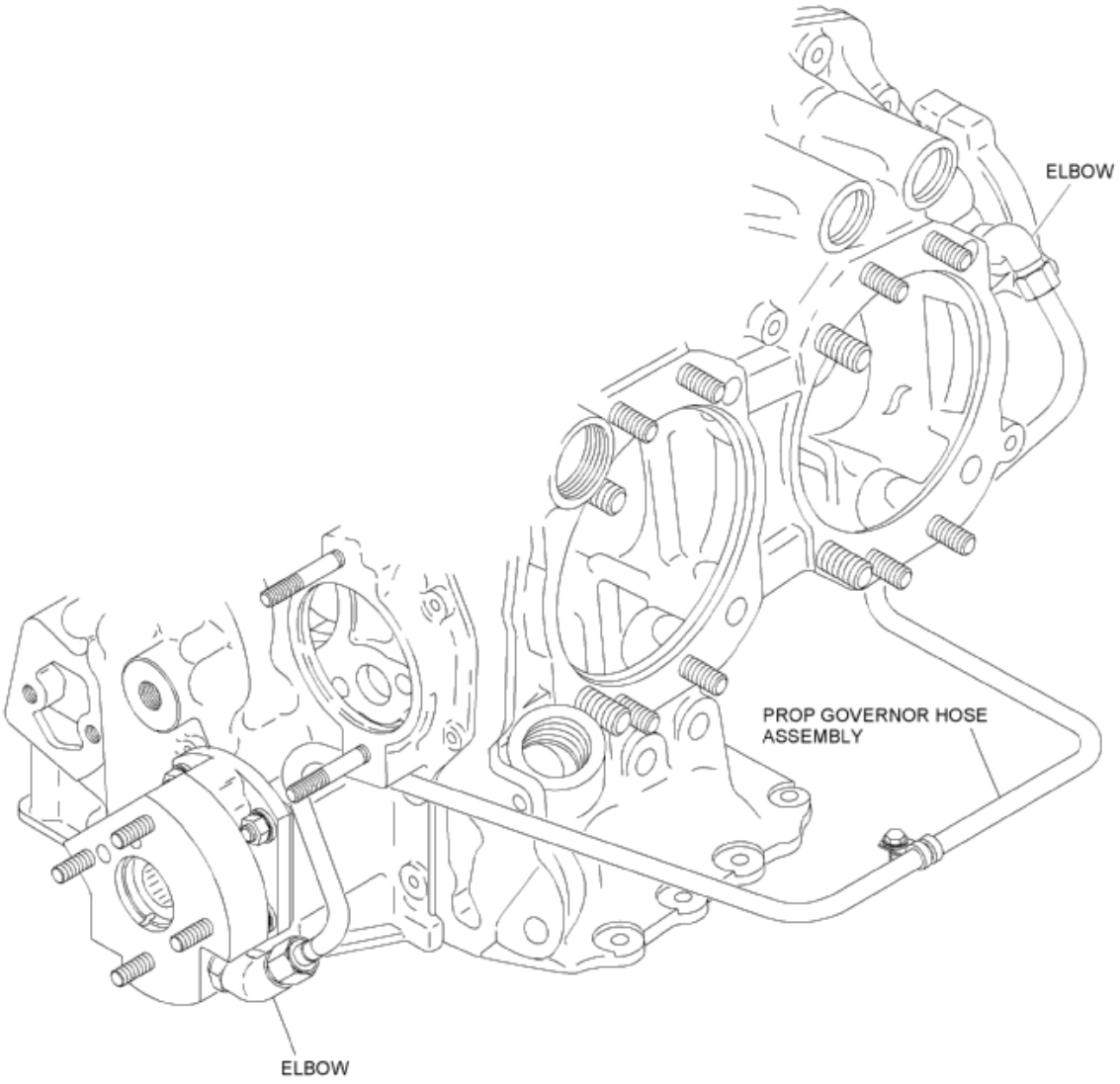

Figure 05-00-00.4 • Propeller Governor Oil Hose

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CYLINDER SECTION

General

The complete cylinder assembly can be replaced as a field operation. For cylinder valve or piston and piston ring replacement refer to the Superior Vantage O-360 and IO-360 engine series Overhaul Manual (SVOHM01).

Table 72-30-00.1
Equipment and Materials List

Item	Vendor
Piston Ring Compressor	Commercially Available
Baffle Removal and Installation Tool	Commercially Available

NOTE: Standard aviation shop tools are required.

Cylinder Replacement

- Gound magneto P-leads
- Disconnect the ignition leads and remove the bottom spark plug from the cylinder to be replaced.
- Remove the exhaust manifold.
- Remove the rocker box drain tube, intake pipe, baffle, and any clips interfering with cylinder removal. Refer to Figure 72-30-00.1.
- Remove the rocker box cover and rotate the crankshaft clockwise until the compression stroke is reached.
- Slide the valve rocker shafts from the cylinder head and remove the valve rocker arms. Remove the rotator cap from the exhaust valve system. Refer to Figure 72-30-00.6.
- Remove the push rods by holding the ball end and pulling the rod out of the shroud tube. Detach the shroud tube spring and the lock plate and pull the shroud tubes through the holes in the cylinder head. Note the original location of the hydraulic tappets, push rods, rocker arms and valves. These must be reassembled and put back in the same locations.
- Remove the cylinder base nuts. Then, by pulling it directly away from the crankcase, remove the cylinder. Do not allow the piston to drop out of the cylinder and hit the crankcase.
- Remove the piston pin from the connecting rod. Support the connecting rod with a heavy rubber band. Do not allow the connecting rod to rest on the cylinder bore of the crankcase. Discard the cylinder base oil ring seal.

Hydraulic Tappet Removal and Replacement

To check dry tappet clearance when reinstalling the cylinder assembly it is necessary to remove and bleed the hydraulic tappet plunger assembly. This is accomplished in the following manner:

- Remove the hydraulic tappet push rod socket by inserting a finger into the concave end of the socket and withdrawing. If the socket cannot be removed this way, try grasping the edge of the socket with a pair of needle nose pliers, do not scratch the socket.

- To remove the hydraulic tappet plunger assembly, form a hook in the end of a short piece of safety wire and insert so that the hook engages the spring of the plunger assembly. Then gently pull the wire, drawing the plunger assembly out of the tappet body. Do not use a magnet to remove hydraulic plunger assemblies from the crankcase, as this may cause the check ball to remain off its seat, rendering the unit inoperative.

To assemble the unit; unseat the ball by inserting a thin clean wire through the oil inlet hole. With the ball off its seat, insert the plunger and twist clockwise so that the spring catches. Remember that all oil must be removed before the plunger is inserted.

Assembly of Cylinder and Related Parts

Rotate the crankshaft so that the connecting rod of the new cylinder is at the top of the compression stroke. To make sure it is at the top, place two fingers on the intake and exhaust tappet bodies and rotate the crankshaft back and forth over the top center. If the tappet bodies do not move, the crankshaft is at the top of the compression stroke.

- Place each plunger assembly in its appropriate tappet body and assemble the socket on top of the plunger assembly.
- Assemble the piston with the rings so that the number stamped on the piston pin boss is toward the front of the engine. The piston pin should be a hand-push fit. Use a generous quantity of oil in the piston hole and on the piston pin during assembly.
- Place a new rubber oil seal ring around the cylinder skirt. Coat the inside of the cylinder, piston, and rings generously with straight-weight, non-detergent oil.
- Using a piston ring compressor, assemble the cylinder over the piston with the intake port at the bottom of the engine. Refer to Figure 72-30-00.3. Push the cylinder all the way on and catch the ring compressor as it is pushed off. Before installing the cylinder hold-down nuts, lubricate crankcase through stud threads with either 85% SAE 50W engine oil and 15% STP, or Parker Thread Lube, or 60% SAE 30W engine oil and 40% Parker Thread Lube.
- Assemble cylinder base hold down nuts and tighten as follows. It is necessary to re-torque the through studs on the cylinder on the opposite side of the engine any time a cylinder is replaced. Tighten the 1/2-inch nuts to 300 inch-pounds torque, using the sequence shown in Figure 72-30-00.4. Using the same sequence, tighten the 1/2-inch nuts to 600 inch-pounds torque. Tighten the 3/8-inch hold down nuts to 300 inch-pounds torque in any sequence. As a final check, hold the torque wrench on each nut for about five seconds. If the nut does not turn, it is tightened to the correct torque.
- Install new shroud tube oil seals on both ends of the push rod tube. Install the push rod tube and lock it in place with a new lockplate, spring, and nut. Refer to Figure 72-30-00.6.
- Install each push rod in its respective push rod tube. Install each in its respective position by placing the rocker between the bosses and sliding the valve rocker shaft in place to retain the rocker. Ensure rocker shaft “thrust buttons” are installed in shaft ends. Place the rotator cap over the end of the exhaust valve stem before installing the exhaust valve rocker. Refer to Figure 72-30-00.6.
- Be sure that the piston is at the top center of the compression stroke and that both valves are closed. Check the clearance between the valve stem tip and the valve rocker arm. Check the clearance by pushing your thumb down on the rocker push rod end to compress the hydraulic tappet spring. Refer to Figure 72-30-00.6. While holding the spring compressed, the valve clearance should be between 0.028 and 0.080 inch. Replace push rod with a longer or shorter push rod, if required, to correct the clearance.
- Install the intercylinder baffles, rocker box covers, intake pipes, rocker box drain tubes, and exhaust manifold. Refer to Figure 72-30-00.1.

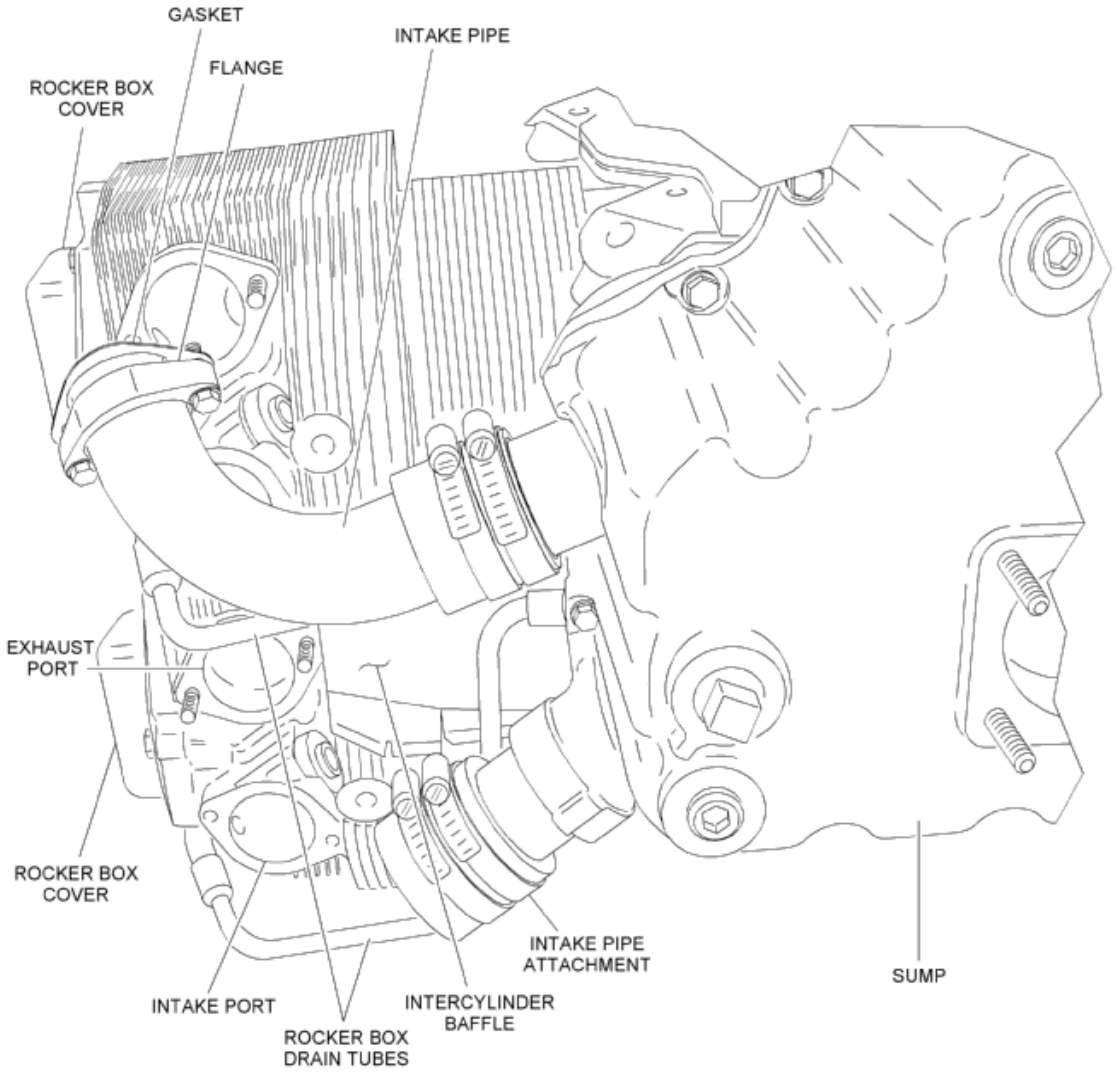

Figure 72-30-00.1 • Assembled Cylinders

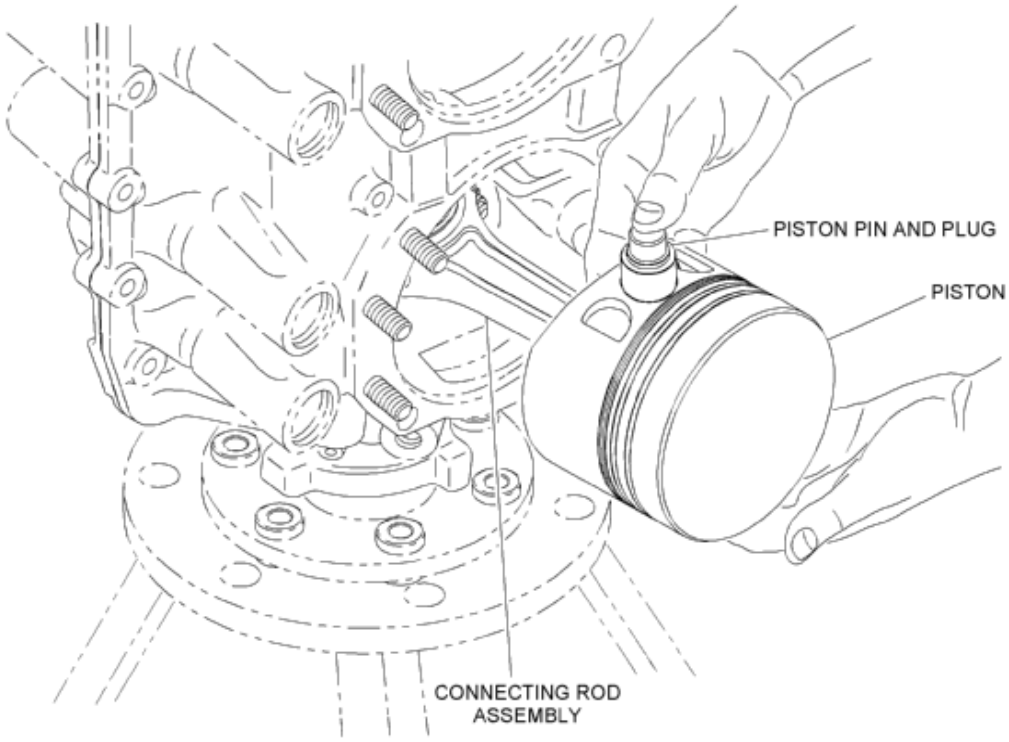

Figure 72-30-00.2 • Piston Pin and Piston Assembly

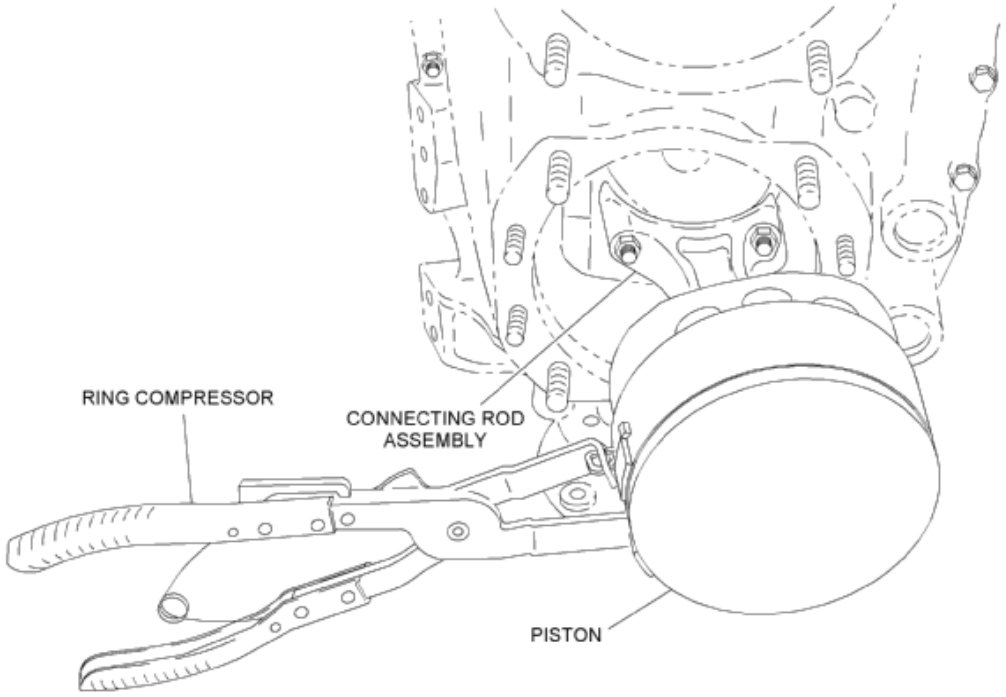

Figure 72-30-00.3 • Piston Ring Compressor

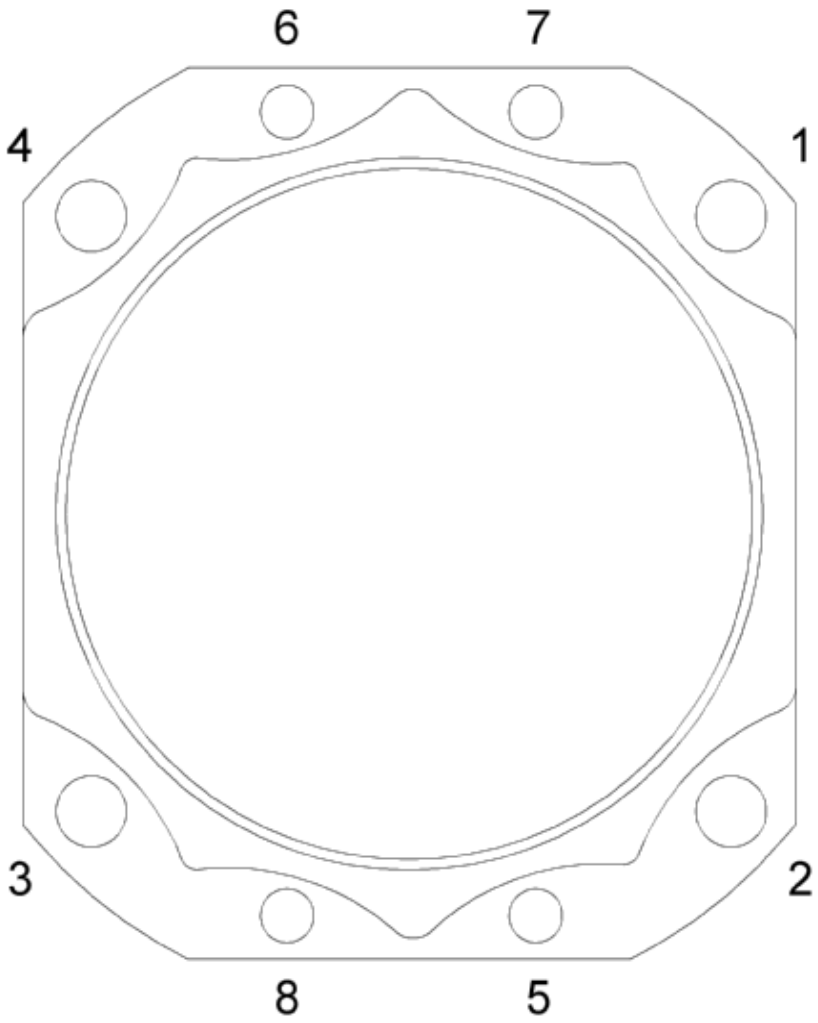

Figure 72-30-00.4 • Cylinder Base Nut Tightening Sequence

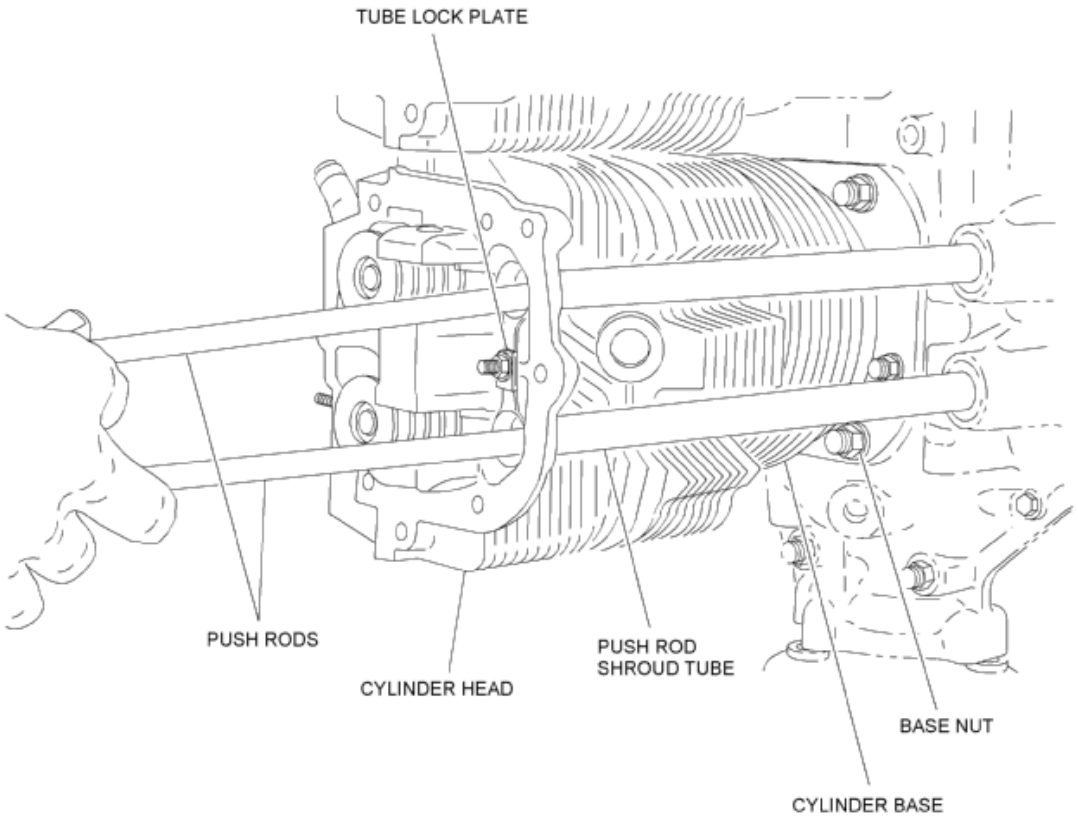

Figure 72-30-00.5 • Installation of Pushrods

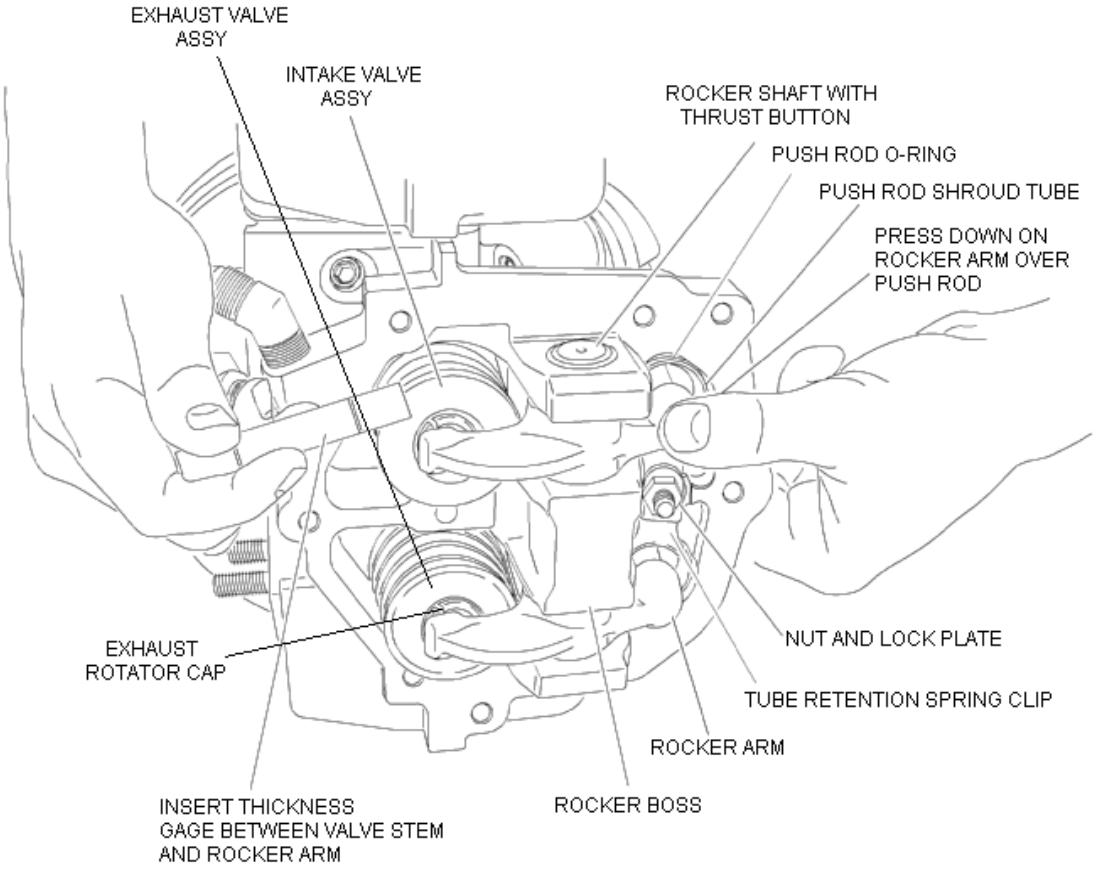

Figure 72-30-00.6 • Rocker Arm and Pushrod Assembly

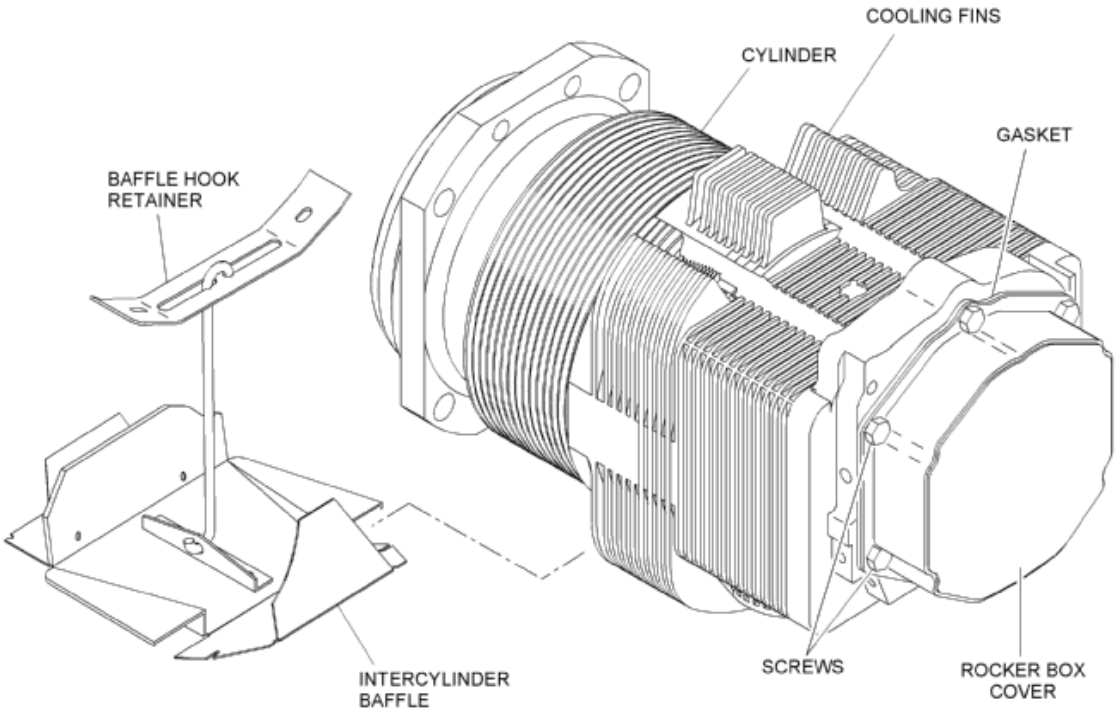

Figure 72-30-00.7 • Intercylinder Baffle Assembly

Cylinder Break-In Procedures

This section provides the Break-In Procedures to achieve satisfactory ring seating and long cylinder life. After top overhaul or major engine overhaul, break-in is critical. Standard aviation shop tools are required. The aircraft can be a suitable test stand for running-in cylinders.

NOTE: Refer to the engine warranty. Violation of these procedures will void the engine's warranty.

WARNING: OPERATION OF A DEFECTIVE ENGINE WITHOUT A PRELIMINARY EXAMINATION CAN CAUSE FURTHER DAMAGE TO A DISABLED COMPONENT AND POSSIBLE INJURY TO PERSONNEL. MAKE SURE THOROUGH INSPECTION AND TROUBLESHOOTING PROCEDURES ARE ACCOMPLISHED. THIS WILL HELP TO PREVENT INJURIES TO PERSONNEL AND/OR DAMAGE TO THE EQUIPMENT.

Prior to Break-In Start-Up

- Engine oil sump should be filled with 100% straight weight mineral oil. Use MIL-L-6082, specific grade depending on ambient temperature. Refer to Servicing section for fluid requirements.
- Engine must be pre-oiled and oil pressure obtained prior to start-up.
- To pre-oil an engine, do the following:
  1. Attach pressure-oiling equipment to one end of the main galley and force oil through the galley at 35 psi until oil flows from the opposite galley with the plug removed from the front end of the opposite galley.
  2. Engine baffles and seals must be in good condition and properly installed.
  3. Verify accuracy of instruments required for engine operation.

  An alternate method of pre-oiling the engine is as follows:
  1. Disconnect ignition system, and ground P-leads and remove top spark plugs from all four cylinders.
  2. Using starter switch, engage starter to rotate engine for 30 seconds or until 20 psi oil pressure is indicated.
  3. If 30 seconds expires prior to 20 psi being indicated, let starter cool for 1 minute and repeat previous step.
  4. When 20 psi is achieved, disengage starter.
  5. Re-install spark plugs and ignition harness and disconnect P-lead ground.

CAUTION: BREAK-IN OF AN ENGINE IN FRIGID CONDITIONS CAN LEAD TO CYLINDER GLAZING AND FAILED BREAK-IN DUE TO LOW OIL TEMPERATURE. IT IS RECOMMENDED THAT OIL TEMPERATURE BE MAINTAINED BETWEEN 180° AND 190°F (82° AND 92°C).

Break-In Ground Run

- Flight propeller may be used if test club is not available.
- Head aircraft into the wind.
- Start engine and observe oil pressure. Oil pressure should be indicated within 30 seconds. If this does not occur, shut down engine and determine cause.
- Run engine just long enough to confirm all components are properly adjusted and secured. There must be no fuel and/or oil leaks.
- Install cowling.
- Operate engine at 1000 -1200 RPM until oil has reached minimum operating temperature 120 °F (49°C).
- Check magneto drop at 1700 RPM.
- If engine is equipped with a controllable pitch propeller, cycle only to a 100 RPM drop.
- Shut down engine and check for fuel and/or oil leaks and repair any discrepancies.
- At no time should cylinder head temperature be allowed to exceed recommended maximum cruise limit of 430°F (221°C).

Break-In Flight Operation

- Perform normal pre-flight and run-up in accordance with the Installation and Operation Manual, SVIOM01 (remember to cycle controllable pitch prop to only a 100 RPM drop). Keep ground runs to a minimum.
- Conduct normal take-off at full power, full rich mixture, to a safe altitude.

NOTE: In certain geographic locations and weather conditions (eg; high density altitudes) "Full Rich" operation may not be practical. In this event, substitute the requirement of "Full Rich" as discussed in this chapter with the "richest practical setting".

NOTE: Verify the crankcase breather and vent lines are correctly installed and positioned. Excessive oil discharge through the breather can often be directly related to an improperly installed or restricted breather line.

- Maintain shallow climb. Use caution to not overheat the cylinders. Should overheating occur, reduce power and adjust mixture appropriately.
- Monitor RPM, oil pressure, oil temperature and cylinder temperature.
- During the first hour of operation, maintain level flight at 75% power. Vary the power setting every 15 minutes during the second hour between 65-75%.
- Avoid long descents at cruise RPM and low manifold pressure (constant speed applications) as this could cause ring flutter.
- Continue flying at 65-75% power with mixture adjusted to approximately 75° rich of peak EGT on subsequent flights, while monitoring RPM, Oil Pressure, Oil Temperature, Cylinder Head Temperature and oil consumption. Continue until oil consumption stabilizes and cylinder head temperatures drop and stabilize. These are indications that the piston rings have seated and the cylinders are broken in.
- At no time should cylinder head temperature be allowed to exceed recommended maximum cruise limit 430°F (221°C).
- After landing, check again for any fuel and/or oil leaks, or other discrepancies, and repair as required.

Post Break-In Procedures

- After break-in, drain all mineral oil. Examine this oil for foreign matter or metal particle content.
- Fill with ashless dispersant oil of the appropriate grade for the expected normal operating conditions and ambient temperature.

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LUBRICATION SECTION

General

Maintenance of the O-360 and IO-360 series Vantage Engine lubrication system is limited to the procedures in this section.

Oil Pressure Adjustment

The adjustable oil pressure relief valve enables the operator to maintain engine oil pressure within specified limits. Oil pressure limits may be found in the Installation and Operation Manual (SVIOM01). Refer to Figure 72-50-00.1, Oil System Schematic, for additional information. Over time, normal wear of components in an engine will eventually cause a gradual reduction in oil pressure due to increased clearances.

If oil pressure under normal operating conditions always exceeds the maximum or minimum specified limits, adjust the oil pressure relief valve as follows:

- With the engine warmed up with oil temperature above 180°F (82°C) and running at approximately 2000 RPM, observe the oil pressure gage reading.
- If the pressure is above maximum or below minimum specified limits, stop the engine. Turn the adjusting screw using either a flathead screwdriver or a 9/16-inch box wrench, outward (counter-clockwise) to decrease pressure or inward (clockwise) to increase pressure. Repeat pressure check above.
- If unable to achieve proper oil pressure by screw adjustment, changing the valve spring may be required. There are two springs available, see table below. Approximately a 10 psi difference in oil pressure should be indicated when changing springs.
- Remove oil pressure relief valve. Remove and replace spring from cavity of valve with lower or higher pressure spring as appropriate.
- Re-install, torque and safety wire oil pressure relief valve. Repeat oil pressure check above.

Table 72-50-00.1
Oil Pressure Springs

Part Number (color)	Description
SL68668 (purple)	lower pressure
SL61084 (clear)	higher pressure

Oil Filter Adapter and Vernatherm Valve

The spin-on oil filter used on the Vantage engine uses an integral bypass type oil filter with ¾" x 16 thread. The integral bypass insures an oil supply even in the case of complete filter fouling.

See Servicing section for oil filter part numbers and the 50 Hour Inspection of Scheduled Inspection and Maintenance section for instructions on changing the oil filter.

The oil filter adapter allows for a variety of oil filter orientations and locations to be selected based on airframe manufacturer's installation requirements. Installed into the oil filter adapter is the vernatherm oil temperature control valve. This valve routes oil to the oil cooler when oil temperature exceeds 185°F (85°). Refer to Figure 72-50-00.2 below.

If high, low, or erratic oil temperature is indicated, the vernatherm valve may not be functioning properly. Proper functioning of the vernatherm can be verified by removing the valve from the adapter, cleaning and putting into a container of water and bringing the water temperature up to near boiling. A thermometer should be used to determine temperature. The valve should open at approximately 185°F (85°C) (boiling point is 212°F (100°C)).

If valve is not working properly, replace with new SL53E19600 valve assembly, which includes a new crush gasket. Torque to 300 in-lb and safety wire to adapter.

Oil Sump Suction Screen

The oil sump suction screen traps larger particles from entering the oil system from the oil sump. If damage to the engine or oil system contamination is suspected, the screen should be removed after draining the oil. Inspection of the oil filter element may also give some indication of oil system contamination.

Remove oil sump finger screen by cutting the safety wire securing it to the sump and removing screen plug. Inspect screen for debris.

If metal debris is found inside of the screen, engine overhaul is required. Refer to Overhaul Manual SVOHM01.

If no debris is found, reinstall screen, new crush gasket and plug. Tighten until the plug contacts the gasket and then turn an additional 135°. Install safety wire, securing plug to sump.

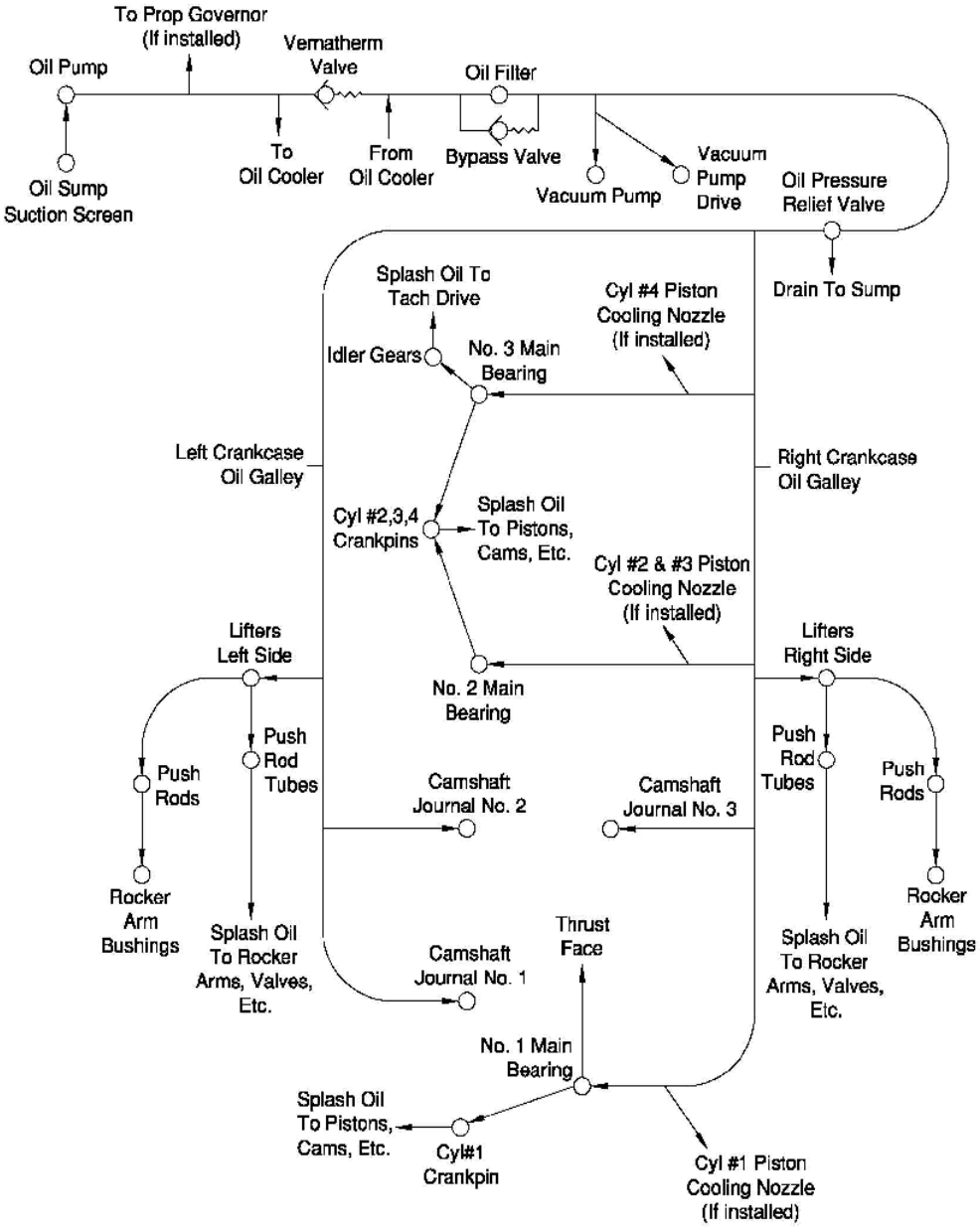

Figure 72-50-00.1 • Oil System Schematic

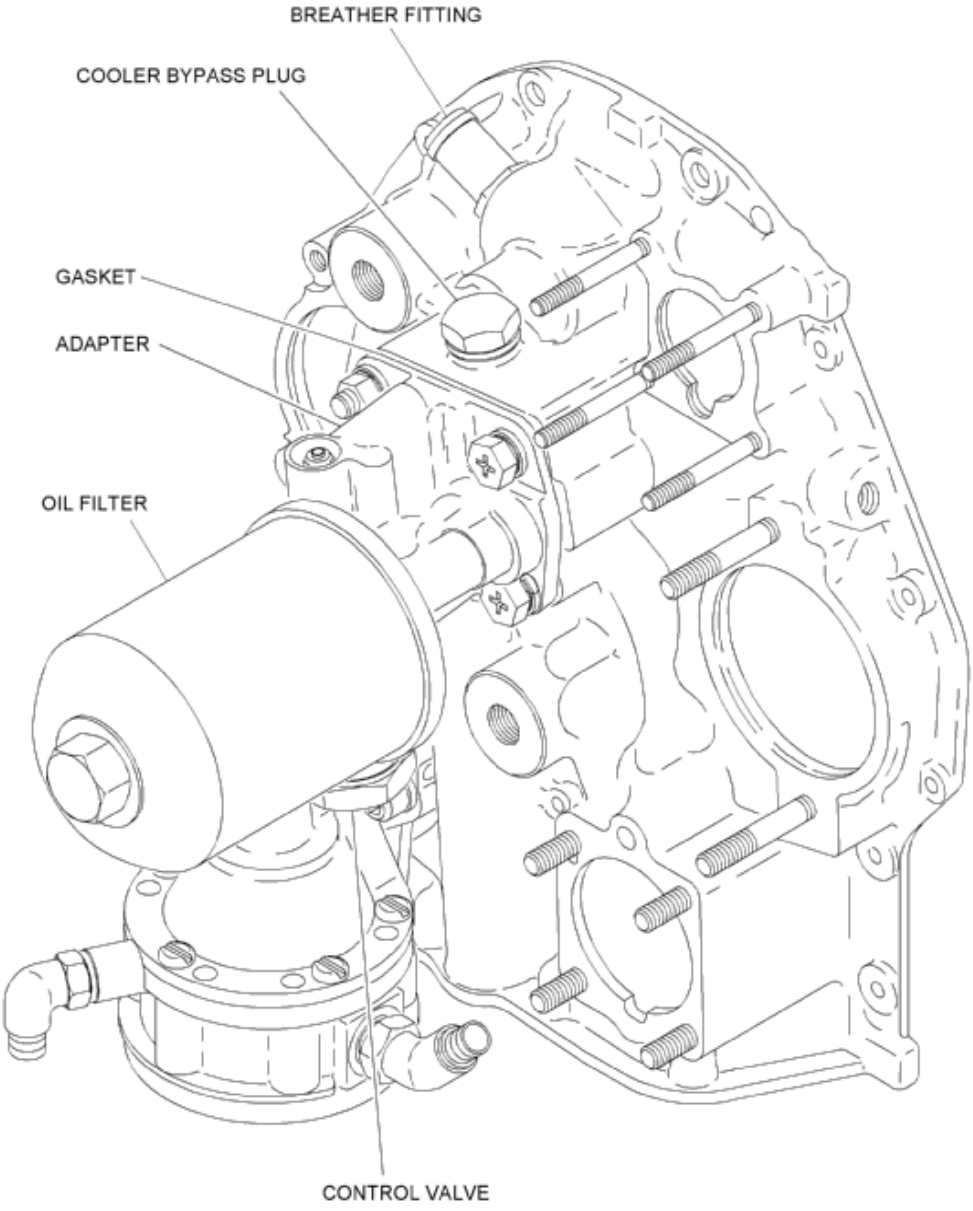

Figure 72-50-00.2 • Oil Filter and Adapter Assembly

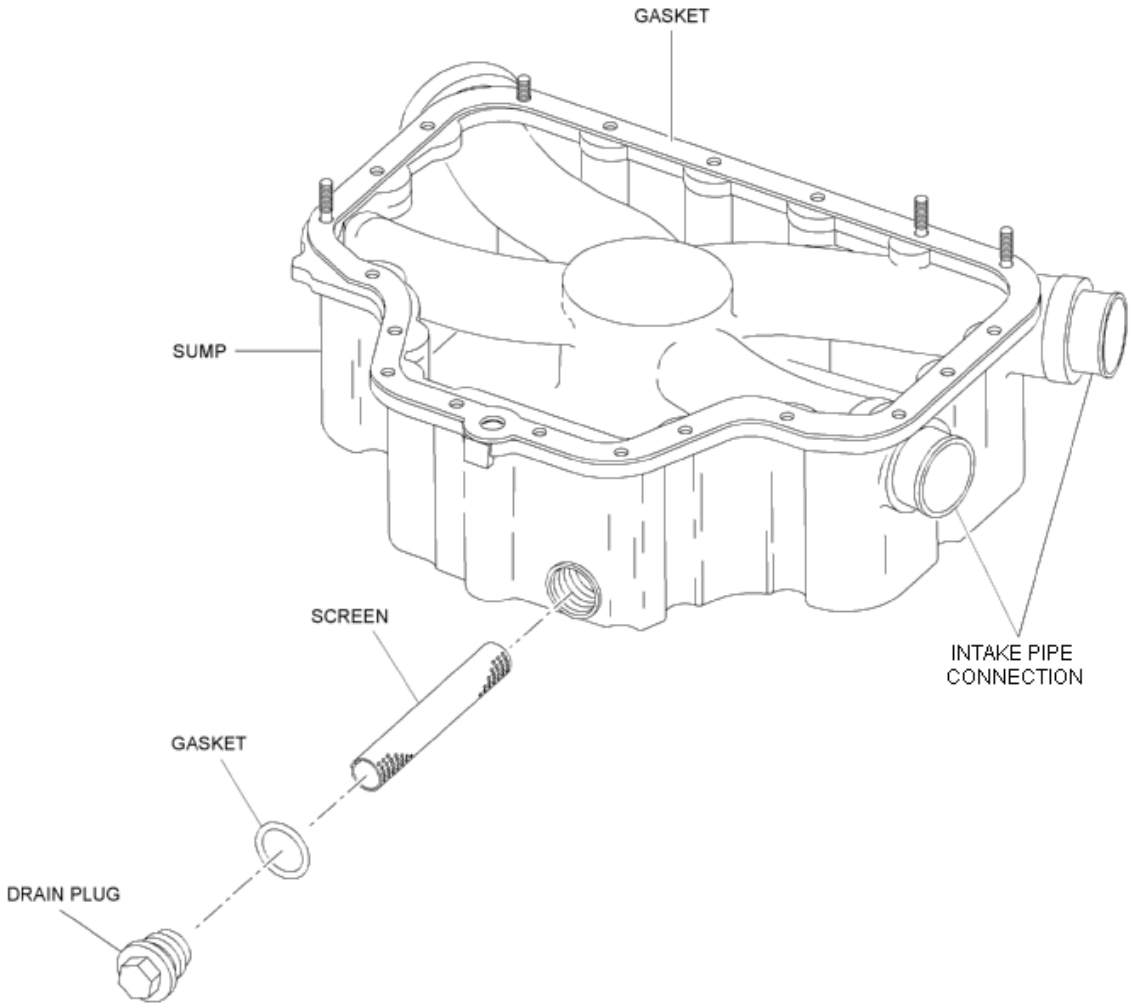

Figure 72-50-00.3 • Oil Sump Assembly

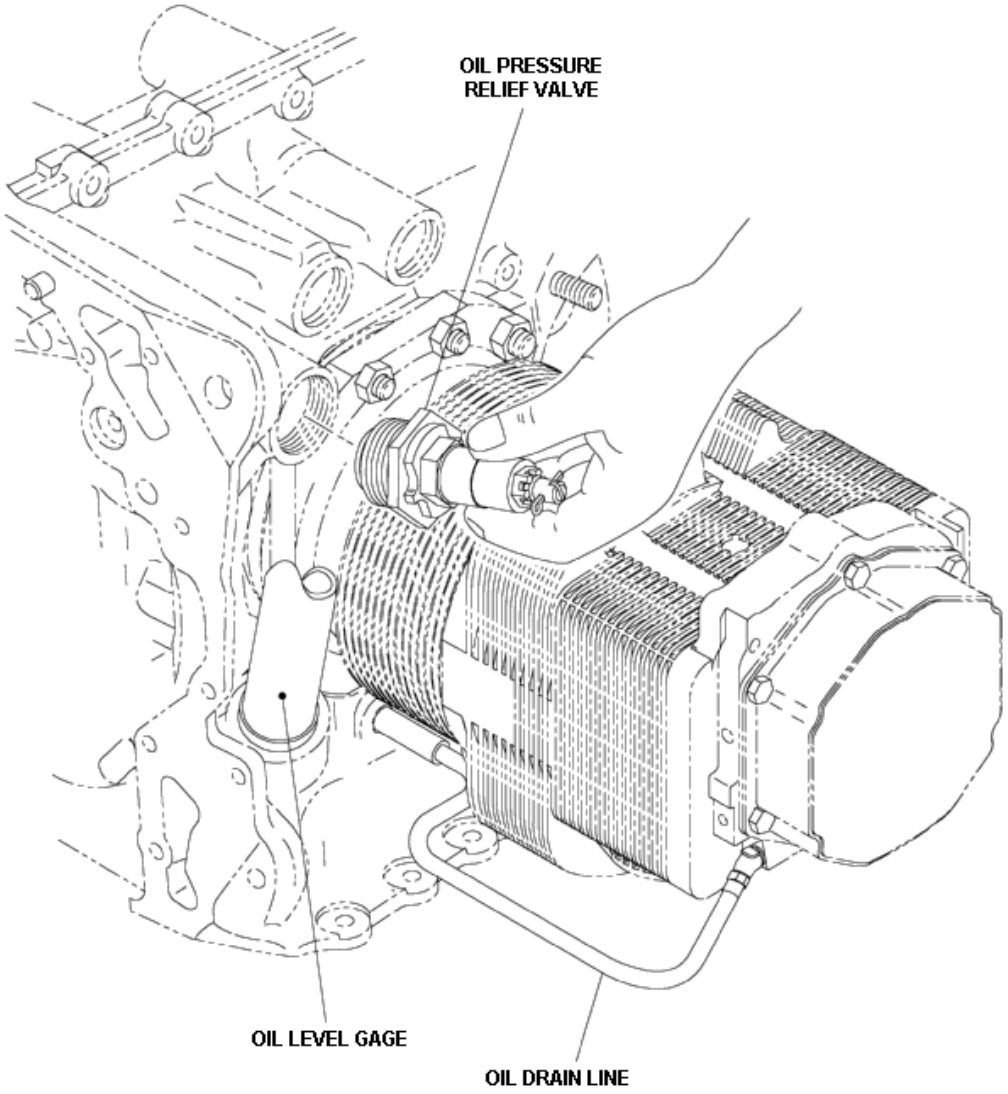

Figure 72-50-00.4 • Oil Pressure Relief Valve

ENGINE FUEL SYSTEM

General

Maintenance of the O-360 and IO-360 series Vantage Engine fuel systems is limited to the procedures in this section. It is recommended that fuel pumps (if provided), carburetors and fuel injections systems be replaced at engine overhaul or a maximum of 2400 hours. Overhaul of fuel pumps (if provided), carburetors and fuel injections systems must be performed by approved facilities.

Table 73-00-00.1 • List of Materials

Material	Source
Thread lubricant	Commercially Available
Loctite™ Hydraulic Sealant	Commercially Available
Abrasive cloth (crocus cloth)	Commercially Available
Fuel-soluble lubricant	Commercially Available
Toluene AMS3180 or equivalent FS TT-T-548	Commercially Available
Methyl Ethyl Ketone (MEK)	Commercially Available
Isopropyl Alcohol	Commercially Available
Acetone	Commercially Available
Stoddard Solvent	Commercially Available

Fuel System Leaks

- Check the fuel system threaded fittings for leaks or damage. Check fuel pump for leaks or damage.

WARNING: FUEL IS TOXIC AND FLAMMABLE. DO NOT BREATHE VAPORS. USE A WELL-VENTILATED AREA FREE FROM SPARKS, FLAME OR HOT SURFACES. PUT ON SPLASH GOGGLES, SOLVENT-RESISTANT GLOVES AND OTHER PROTECTIVE GEAR. IN CASE OF EYE CONTACT, FLUSH WITH WATER FOR 15 MINUTES AND SEEK MEDICAL ATTENTION. IN CASE OF SKIN CONTACT, WASH WITH SOAP AND WATER.

CAUTION: WHEN REPLACING A FUEL LINE OR FITTING, USE ONLY SOLUBLE LUBRICANTS SUCH AS CLEAN ENGINE OIL OR LOCTITE® HYDRAULIC SEALANT ON TAPERED THREADS. DO NOT USE ANY OTHER FORM OF THREAD COMPOUND.

- Inspect all fuel system fittings for leaks.
  1) Tighten fittings if loose. Be sure threads and seats of fittings are not damaged.
  2) Remove and discard damaged components. Replace with new components.
  3) Replacement fittings should have only soluble lubricants such as clean engine oil, anti-seize or Loctite® Hydraulic Sealant on tapered threads.

- Inspect all fuel system plumbing for leaks.
  1) Visually inspect all hard lines for evidence of dents, chafing, abrasion, or kinks. Pay special attention to solder joints and to any clamps or clips.
  2) Remove and discard damaged components. Replace with new components. Hard fuel lines with dents or cracks or having an inside bend radius of less than 5/8 in. must be replaced.
  3) Replace any missing clamps or clamps with deteriorated cushion material. Clamps or clips may be located to provide clearance between the clamp or line and any engine surface.
  4) Inspect all replaced fuel lines to confirm a minimum of 3/16 in. clearance from any engine surface.

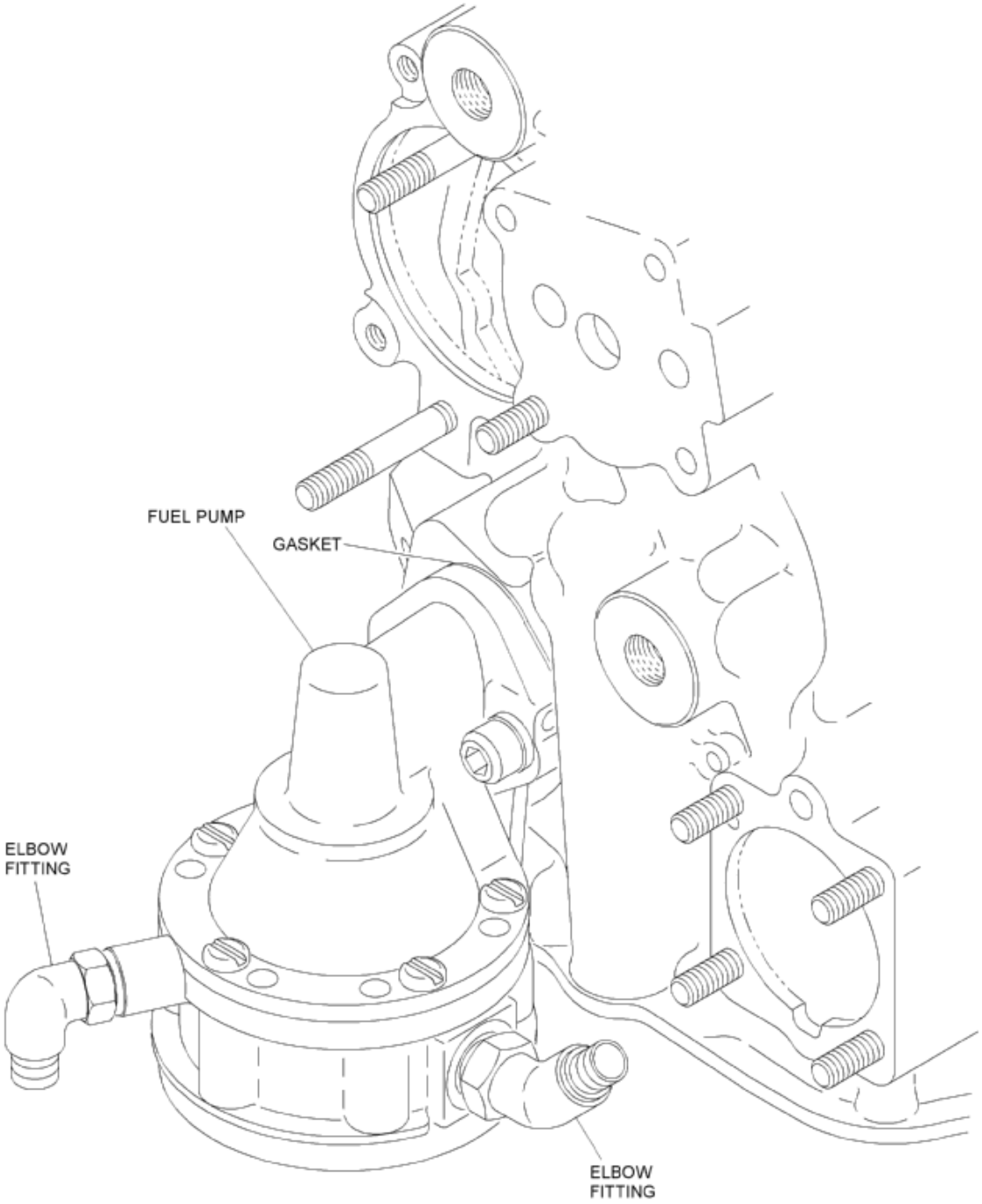

Figure 73-00-00.1 • Engine Fuel Pump Assembly

Fuel Pump Replacement

If the fuel pump is not functioning properly and requires removal and replacement, do the following:

WARNING: FUEL IS TOXIC AND FLAMMABLE. DO NOT BREATHE VAPORS. USE A WELL-VENTILATED AREA FREE FROM SPARKS, FLAME OR HOT SURFACES. PUT ON SPLASH GOGGLES, SOLVENT-RESISTANT GLOVES AND OTHER PROTECTIVE GEAR. IN CASE OF EYE CONTACT, FLUSH WITH WATER FOR 15 MINUTES AND SEEK MEDICAL ATTENTION. IN CASE OF SKIN CONTACT, WASH WITH SOAP AND WATER.

- Drain all fuel from fuel system and fuel lines.
- Ground magneto P-leads.
- Remove fuel lines from fuel pump.
- Cut safety wire and remove screws attaching fuel pump to accessory housing. Discard gasket.
- Rotate engine to provide least amount of fuel pump plunger extension inside accessory housing.
- Install new gasket and appropriate new fuel pump.
- Install fuel pump socket head bolts, torque to 225-250 in-lb. Safety wire the two drilled socket head screws to each other.

Fuel Screen

- Remove the screen assembly and check for gaps or distortions. If these conditions exist, discard the screen.
- If the screen is reusable, clean the screen with solvent. Dry with compressed air. Refer to the Cleaning section of this manual.
- Reinstall the fuel inlet screen assembly and torque to 35-40 in-lb for carburetor and 65-70 in-lb for fuel injectors.

WARNING: SOLVENT IS TOXIC. USE IN WELL-VENTILATED AREA. PREVENT EYE AND SKIN CONTACT AND DO NOT BREATHE VAPORS. IN CASE OF EYE CONTACT, FLUSH WITH WATER. IN CASE OF SKIN CONTACT, WASH WITH SOAP AND WATER.

WARNING: WHEN YOU USE COMPRESSED AIR TO CLEAN OR DRY PARTS, MAKE SURE THAT THE PRESSURE IS NOT MORE THAN 30 PSI. DO NOT DIRECT THE AIRSTREAM AT PERSONNEL OR LIGHT OBJECTS. PUT ON GOGGLES OR A FACE SHIELD TO PROTECT YOUR EYES. THIS WILL HELP PREVENT INJURIES TO PERSONNEL OR DAMAGE TO EQUIPMENT. IF YOU GET AN EYE INJURY, GET MEDICAL ATTENTION.

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FUEL INJECTION SYSTEM

Fuel Injector Nozzle Cleaning

Remove the nozzle from the end of the fuel line and cylinder. Submerge in a cleaning solvent such as Stoddard solvent, MEK or equivalent and allow to soak for a minimum of 10 minutes. Remove from solvent, dry with clean compressed air and reassemble.

CAUTION: DO NOT USE A SHARP TOOL TO CLEAN OR DISASSEMBLE FUEL NOZZLES.

NOTE: Under normal conditions, the shield and screen are NOT removed from the nozzle assembly. If removal is necessary, both must be thoroughly cleaned prior to reassembly. The shield must have a tight fit on the body.

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CARBURETION SYSTEM

Idle Speed and Mixture Adjustment

Perform idle speed and mixture adjustments for carbureted engines as follows:

- Start the engine and warm up until oil and cylinder head reach normal temperatures.
- Check the magnetos. If the "mag drop" (drop in RPM) is normal, proceed with the idle adjustment, otherwise refer to the Testing and Fault Isolation section of this manual to determine cause and correct the problem.
- Set throttle stop screw so the engine idles at the airframe manufacturer's recommended RPM. If the RPM changes substantially after making the following idle adjustment, readjust the idle speed to the correct RPM.
- Once the idling speed has been stabilized, move the cockpit mixture control lever with a smooth pull toward the "Idle-Cut-Off" position. Observe the tachometer for any change during the "leaning out" process. Be sure to return the mixture control to the "Full Rich" position before the RPM drops to where the engine stops. An increase in engine speed of more than 50 RPM during the leaning process indicates an excessively rich idle mixture. An instant decrease in RPM (not preceded by a brief increase in RPM) indicates that the idle is too lean.
- If the above procedure indicates that the idle adjustment is either too rich or too lean, turn the mixture adjustment in the appropriate direction and check this setting by repeating the above steps. The goal is to find a setting that will obtain maximum RPM with minimum manifold pressure. Make added adjustments until the above check results in a momentary increase of about 50 RPM. Every time the idle is adjusted, the engine should be run up to 2000 RPM to clear the engine before proceeding with the RPM check.
- Make the final tuning of the idle speed adjustment with a closed throttle. If the setting does not remain stable, check the linkage. Loose linkage can cause erratic idling. Consideration for the effect of weather conditions and altitude on idling adjustments must be made.

Primer Nozzle Cleaning

Remove the nozzle from the end of the fuel line and cylinder. Submerge in a cleaning solvent such as Stoddard solvent, MEK or equivalent and allow to soak for a minimum of 10 minutes. Remove from solvent, dry with clean compressed air and reassemble.

CAUTION: DO NOT USE A SHARP TOOL TO CLEAN OR DISASSEMBLE FUEL NOZZLES.

NOTE: Under normal conditions, the shield and screen are NOT removed from the nozzle assembly. If removal is necessary, both must be thoroughly cleaned prior to reassembly. The shield must have a tight fit on the body.

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IGNITION SECTION

General

Maintenance of the O-360 and IO-360 series Vantage Engine ignition systems is limited to the procedures in this section. Overhaul of magnetos and ignition system components must be performed by approved facilities.

Magneto Replacement

Magneto Removal

- Remove the harness from the magneto.
- Remove magneto, nut, washer, and clamp. Refer to Figure 74-10-01.1.
- Remove the magneto and discard gasket.
- Remove the adapter and discard gasket.
- Remove cotter pin, nut, and washer.
- Remove magneto gear and return the washer and nut to drive shaft to prevent damage to drive shaft threads.

NOTE: Clamp gear in “soft jaw” type vise to aid in removal and reassembly.

Table 74-00-00.1 • List of Equipment

Description	Source
Timing light	Commercially Available
T-118 Timing pin	Commercially Available

Timing Magneto To Engine

- Remove one spark plug from the No. 1 cylinder and place thumb over the spark plug hole. Refer to Figure 74-10-01.2.
- Rotate the crankshaft clockwise until the compression stroke is reached. This will be noted when the pressure inside the cylinder pushes your thumb off the spark plug hole.
- Continue to rotate the crankshaft until the timing mark on the front of the starter support is in alignment with the small hole on the front face of the starter housing. The ring gear is marked at 20° and 25° BTDC. Refer to engine specifications in the model specific Installation and Operation Manual (SVIOM01) or engine dataplate for the correct timing of your engine model. Refer to Figure 74-10-01.2.

Timing Magnetos

- Align magneto rotor shaft to fire cylinder #1.
- Insert the T-118 timing pin provided in the L hole (for left-handed or counter-clockwise rotation) of the distributor block.
- Turn the rotor shaft clockwise until the timing pin inserts to the shoulder or 7/8-inch into the distributor block. The timing pin will seat against the distributor block when properly installed.
- If the timing pin is not seated 7/8-inch into the distributor block and the rotor shaft cannot be turned, remove the pin and turn the rotor shaft 1/8 turn and re-insert the timing pin.
- With the timing pin fully seated in the distributor block, the magneto is aligned to fire cylinder #1.

CAUTION: REMOVE THE TIMING PIN FROM THE MAGNETO BEFORE ROTATING THE MAGNETO ROTOR SHAFT OR THE PROPELLER. FAILURE TO REMOVE THE TIMING PIN FROM THE MAGNETO DISTRIBUTOR BLOCK MAY DAMAGE THE MAGNETO.

Install Magnetos

- Install new gasket and reinstall adapter if required. Refer to Figure 74-10-01.1.
- Install magneto gear in new magneto and secure with supplied nut, washer, and cotter pin.
- Clean the magneto flange. Install new gasket to adapter.
- Install the magneto on to adapter flange and secure with clamp, washer, and nut. Tighten “finger tight” in order to hold the magneto in place.
- Remove the timing pin from the distributor block.

Final Engine Timing

CAUTION: REMOVE THE TIMING PIN FROM THE MAGNETO BEFORE ROTATING THE MAGNETO ROTOR SHAFT OR THE PROPELLER. FAILURE TO REMOVE THE TIMING PIN FROM THE MAGNETO DISTRIBUTOR BLOCK MAY DAMAGE THE MAGNETO.

- Attach a timing light to the magneto condenser stud according to the timing light manufacturer's instructions.
- Rotate the magneto clockwise, until the timing light indicates the breaker points are open. Most timing lights indicate open points with a light-on condition or an audible signal.
- Slowly rotate the magneto counter-clockwise until the light goes out or the audible signal stops.
- If installing impulse coupling magneto, move to front of engine and rotate crankshaft ring gear to approximately 40°BTDC to disengage impulse coupling and then slowly rotate back to correct timing per engine data plate. Adjust magneto accordingly for points to close at proper time. Synchronize timing of both magnetos.
- If installing non-impulse coupling magneto, move to front of engine and rotate crankshaft ring gear to timing per engine dataplate. Adjust magneto accordingly for points to close at proper time. Synchronize timing of both magnetos.

Secure Magneto

- Fasten the magneto to the engine by tightening the magneto mounting clamps.
- Alternately tighten the engine mounting clamp nuts to 96 in-lb torque.
- Continue to tighten both nuts in alternating steps to 200 in-lb torque.
- Remove the timing light from the magneto condenser stud.
- Re-install harness cap to magnetos.

Attach the Ignition P-Lead Terminal

- Attach the ignition P-lead terminal to the condenser stud using the lock-washer and nut on the magneto.
- Tighten the P-lead terminal nut to 13-15 in-lb torque.
- Attach P-lead ground shield, if applicable, to the ground screw on the side of the magneto. Tighten the P-lead ground shield screw to 18-20 in-lb torque.

Ignition Harness Replacement

- Confirm that the harness or lead in question is installed correctly. Refer to the Ignition Wiring Diagram (Figure 72-00-02.10) and the ignition harness arrangement as shown in the engine rear views, Figures 72-00-02.5 and 72-00-02.9.

- If an ignition harness or an individual lead needs to be replaced, do the following:

  1) Identify the harness or lead for its location on the magneto and/or spark plug.

  2) Remove the screws securing the clips and clamps. Mark the location so the replacement harness or individual leads, clips, and clamps can be reinstalled in the correct location.

NOTE: An attaching hardware kit is provided with new replacement harnesses.

Install and route the harness or individual lead and secure with clips, clamp, and other screws or kit hardware

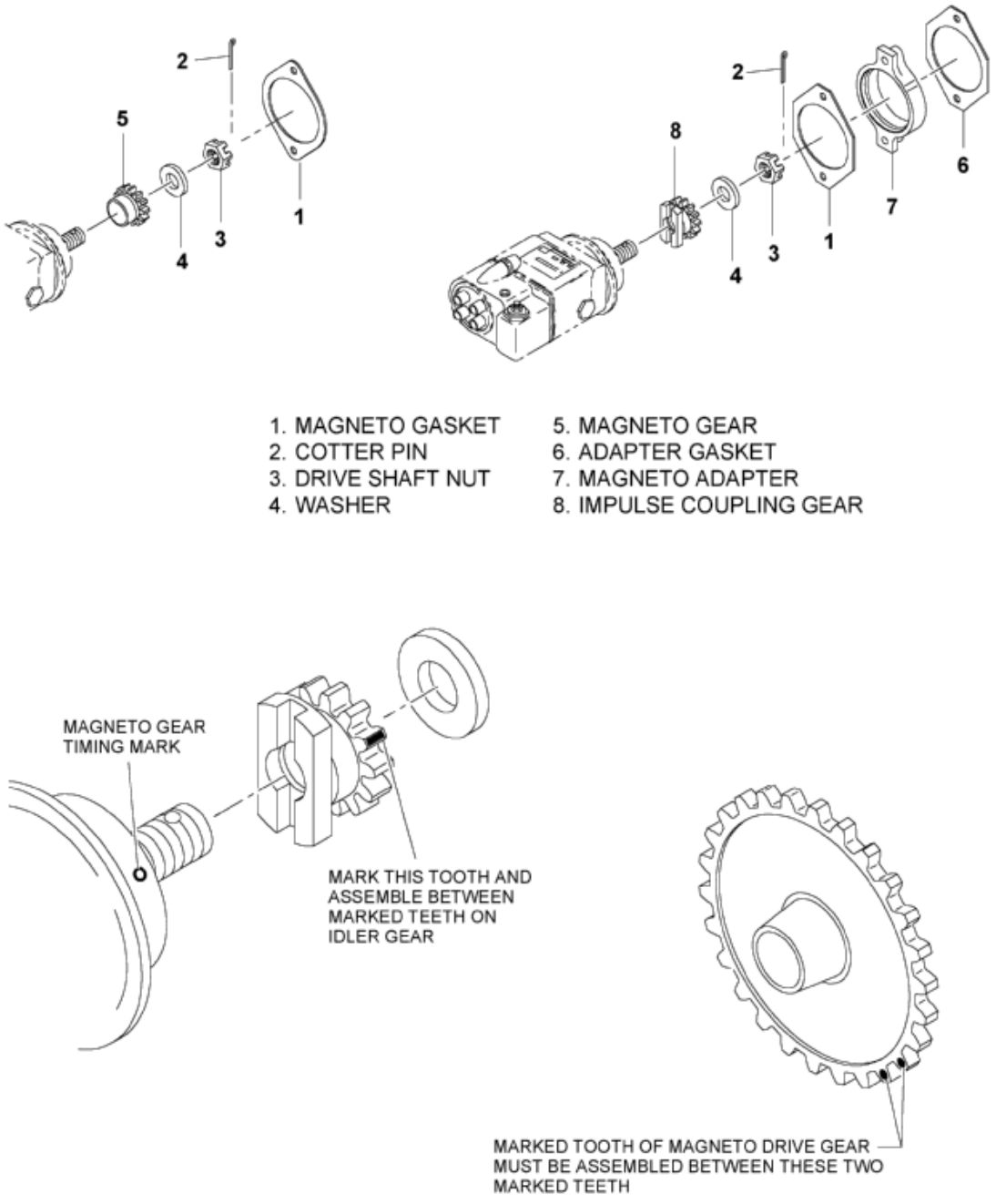

Figure 74-10-01.1 • Magneto Components

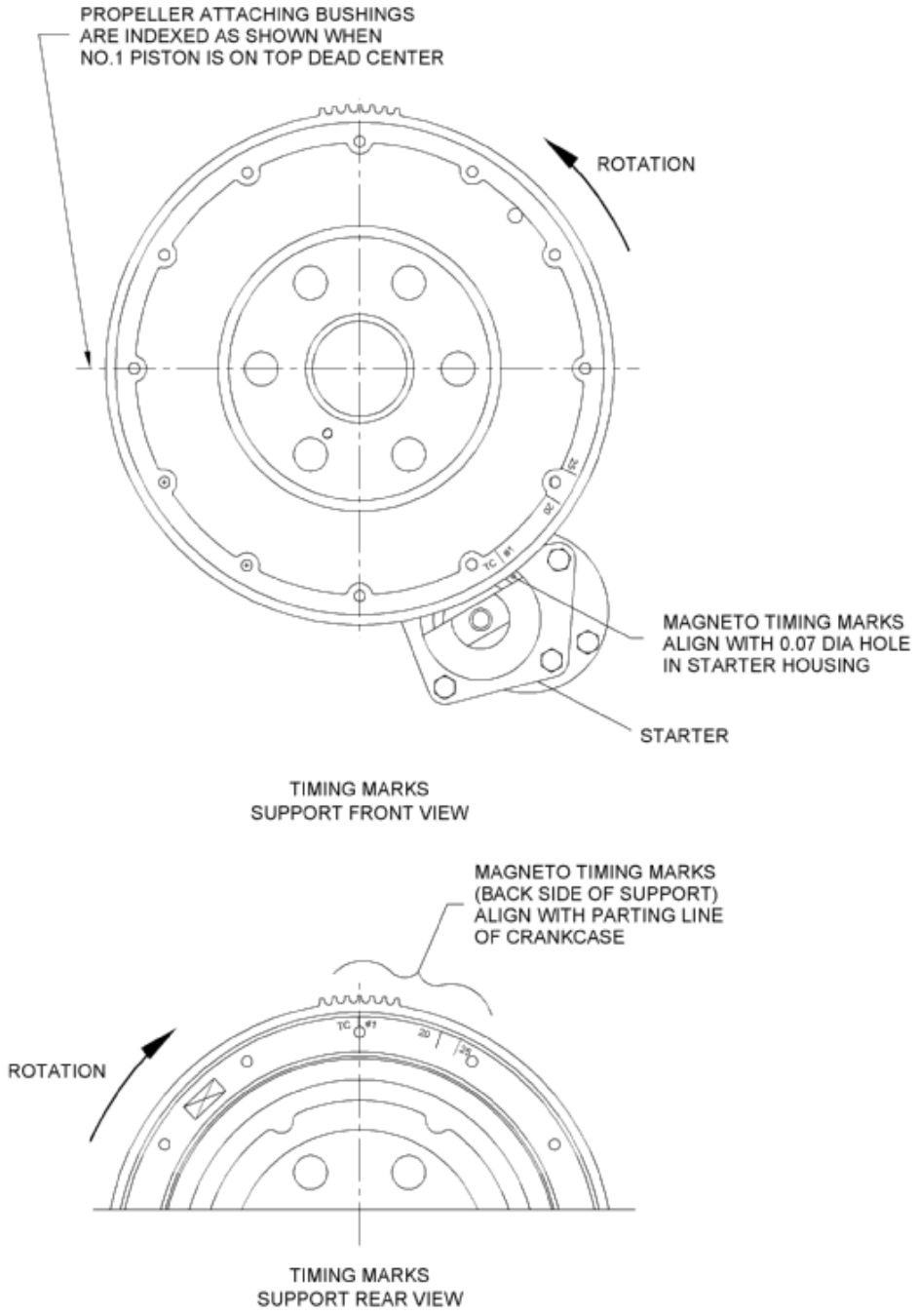

Figure 74-10-01.2 • Timing Diagram

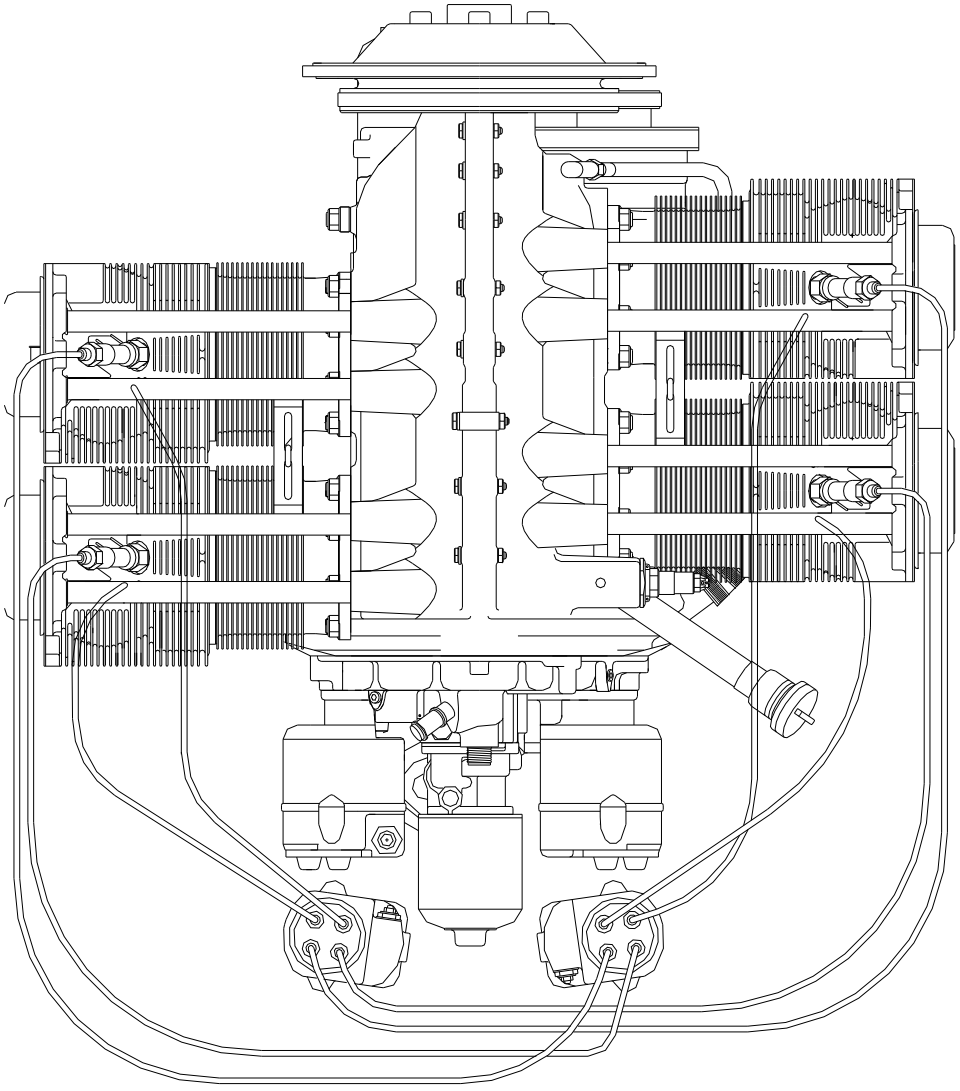

Figure 74-20-00.10 • Ignition Wiring Diagram

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Appendix 1

Unison Industries L-1363B

4300/6300 Series Magneto Maintenance and Overhaul Manual

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