IO-360-A, AB, AF
C, CB
D, DB, ES
G, GB
H, HB
J, JB
K & KB

CONTINENTAL AIRCRAFT ENGINE

MAINTENANCE AND OVERHAUL MANUAL



Technical Portions Accepted by the Federal Aviation Administration

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Supersedure Notice

This manual incorporates references to M-0, Standard Practice Maintenance Manual, and is a revision of the maintenance and overhaul information contained in Publication Number M-7, dated 30 September 2015. Upon FAA acceptance and publication release, this manual supersedes all previous editions of Publication Number M-7 in its entirety.

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PREFACE

This manual was developed in accordance with Title 14, Code of Federal Regulations (CFR) Part 33 §33.4 as the Instructions for Continued Airworthiness (ICA) for IO-360 series engines. Except for authorized owner preventive maintenance, defined in Title 14, Code of Federal Regulations (CFR) Part 43 §§43.3 and 43.13, Continental Motors ICAs are written for exclusive use by FAA (or equivalent authority) licensed mechanics or FAA (or equivalent authority) certified repair station employees. Information and instructions contained in this manual anticipate the user possesses and applies the knowledge, training, and experience commensurate with the requirements to meet the prerequisite FAA license and/or certification requirements. No other use is authorized. It is the responsibility of the owner to verify the person or facility operating, maintaining or servicing the engine uses the most current ICA, including manual change pages, service documents and FAA Airworthiness Directives (ADs), to perform those functions.

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Electronic versions of all current Continental Motors publications are available on the Continental Motors web site to Fixed Base Operators (FBOs), mechanics and others who subscribe to Continental Motors Internet Services. Printed copies of manuals and service subscriptions are also available. Refer to “Publication Access” in Section 1-2.1.

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Chapter 1. Introduction

1-1. Scope and Purpose of This Manual

This manual provides engine maintenance and overhaul instructions applicable to IO-360-A, AB, AF, C, CB, D, DB, ES, G, GB, H, HB, J, JB, K and KB aircraft engine models, referred to collectively as "IO-360 Series" engines, manufactured by Continental Motors. These Instructions for Continued Airworthiness (ICA) are supplied to the owner with the engine. Instructions in this manual are specific to the IO-360 series engines. For information specific to other Continental Motors engine series, accessories, or the aircraft, refer to the appropriate manual.

Chapter 2 contains detailed engine model descriptions and specifications. Chapter 3 list special tools and consumables such as lubricants, sealants and adhesives. Chapter 4 has the airworthiness limitations. Chapter 5 provides instructions for engine removal and installation. Chapter 6 contains the inspection and service intervals and instructions. Chapter 7 provides the supplemental information for the Aircraft Flight Manual (AFM) or Pilot Operating Handbook (POH) in regards to specific engine operating procedures. Chapter 8 contains engine troubleshooting instructions. Chapter 9 contains the engine preservation and storage instructions. Chapter 10 provides the non-overhaul repair and replacement instructions. Chapters 11 through 18 provide the engine overhaul instructions. Appendix A contains a glossary of common terms and acronyms used throughout the manual; Appendix B provides torque specifications; Appendix C contains standard maintenance practices and Appendix D provides the engine overhaul dimension fits and limits.

1-1.1. Instructions for Continued Airworthiness

CM P/N M-7 is the principal instruction for continued airworthiness for the IO-360 series engines as defined by Title 14 CFR§33.4. This manual and the manuals (as applicable to engine specification) listed below are delivered to the customer with the engine. Service documents and Airworthiness Directives may also affect ICAs. Refer to Section 1-2.4 for instructions to check current publication status.

Part Number	Title	Applicability
M-7	Maintenance and Overhaul Manual	IO-360 engines
M-0	Standard Practice Maintenance Manual	Various
X30592	Starter Service Manual	Various
X30531	Alternator Service Manual	Various
X42002	S-20 and S-200 Series Magneto Service Manual	Various

1-1.2. Effectivity Symbols

Slight variations in IO-360 Series engine models require specific instructions or illustrations. When peculiar information pertains to only a specific engine model in the series, an effectivity symbol will accompany the information. Effectivity symbols found in this publication are:

IO-360-A A	IO-360-AB AB	IO-360-AF AF
IO-360-C C	IO-360-CB CB	IO-360-D D
IO-360-DB DB	IO-360-ES ES	IO-360-G G
IO-360-GB GB	IO-360-H H	IO-360-HB HB
IO-360-J J	IO-360-JB JB	IO-360-K K
IO-360-KB KB		
Energizer Starter EZR	SkyTec Starter SKY	

1-1.3. Advisories

This manual utilizes three types of advisories; defined as follows:

WARNING

A warning emphasizes information which, if disregarded, could result in severe injury to personnel or equipment failure.

CAUTION: Emphasizes certain information or instructions, which if disregarded, may result in damage to the engine or accessories.

NOTE: Provides special interest information, which may facilitate performance of a procedure or operation of equipment.

Warnings and cautions precede the steps to which they apply; notes are placed in the manner which provides the greatest clarity. Warnings, cautions, and notes do not impose undue restrictions. Failure to heed advisories will likely result in the undesirable or unsafe conditions the advisory was intended to prevent. Advisories are inserted to ensure maximum safety, efficiency, and performance. Abuse, misuse, or neglect of equipment can cause eventual engine malfunction or failure.

1-1.4. Using this Manual

This manual, applicable FAA ADs and CM service documents, the accessory manuals listed in Table 1-1, and all changes incorporated in the ICAs as revisions constitute the Instructions for Continued Airworthiness (ICA) prepared by Continental Motors and accepted by the FAA. We prepared this manual in a user-friendly format suited equally for electronic viewing and print. Illustrations in this manual are for reference only, depicting the most prominent configuration in the engine series. Consult the electronic engine parts catalog for engine model-specific illustrated parts breakdowns. The current information available from CM must be used to perform engine service, repair or overhaul.

Continental Motors provides Instructions for Continued Airworthiness based on the design, testing, and certification of engines and parts for which Continental Motors is the holder of the Type Certificate (TC) or Parts Manufacture Approval (PMA) issued by the Federal Aviation Administration (FAA).

WARNING

Continental Motors ICAs are applicable *only* to Continental Motors engines conforming to the approved, type certified engine model configuration. Continental Motors ICAs *must not* be used for aftermarket parts or products modified by Supplemental Type Certificate.

Installation of aftermarket parts on a Continental Motors engine constitutes a deviation from type-design criteria. Continental Motors has not participated in design, test, or certification of any aftermarket parts. Continental Motors does not provide product manufacturing specifications to aftermarket parts manufacturers and accepts no liability for the suitability, durability, longevity, or safety of such parts installed on Continental Motors engines. Installation of aftermarket parts on a Continental Motors engine must be performed using Instructions for Continued Airworthiness prepared by the manufacturer

and approved by the FAA for the subject installation. For work with the engine installed in the aircraft, the aircraft maintenance manual may also be required to gain access to, or install some items. Use only the current information from the aircraft manufacturer.

Exploded assembly illustrations accompany instructions throughout the manual. Parts in illustrations (Figure 1-1) are identified with numerical callouts (indexes). Corresponding parts listings follow the illustrations for reference. The first time instructions refer to an illustration, the figure number is identified in parentheses, followed by the callout. In subsequent parts references, only the callout will be specified unless the referenced illustration changes.

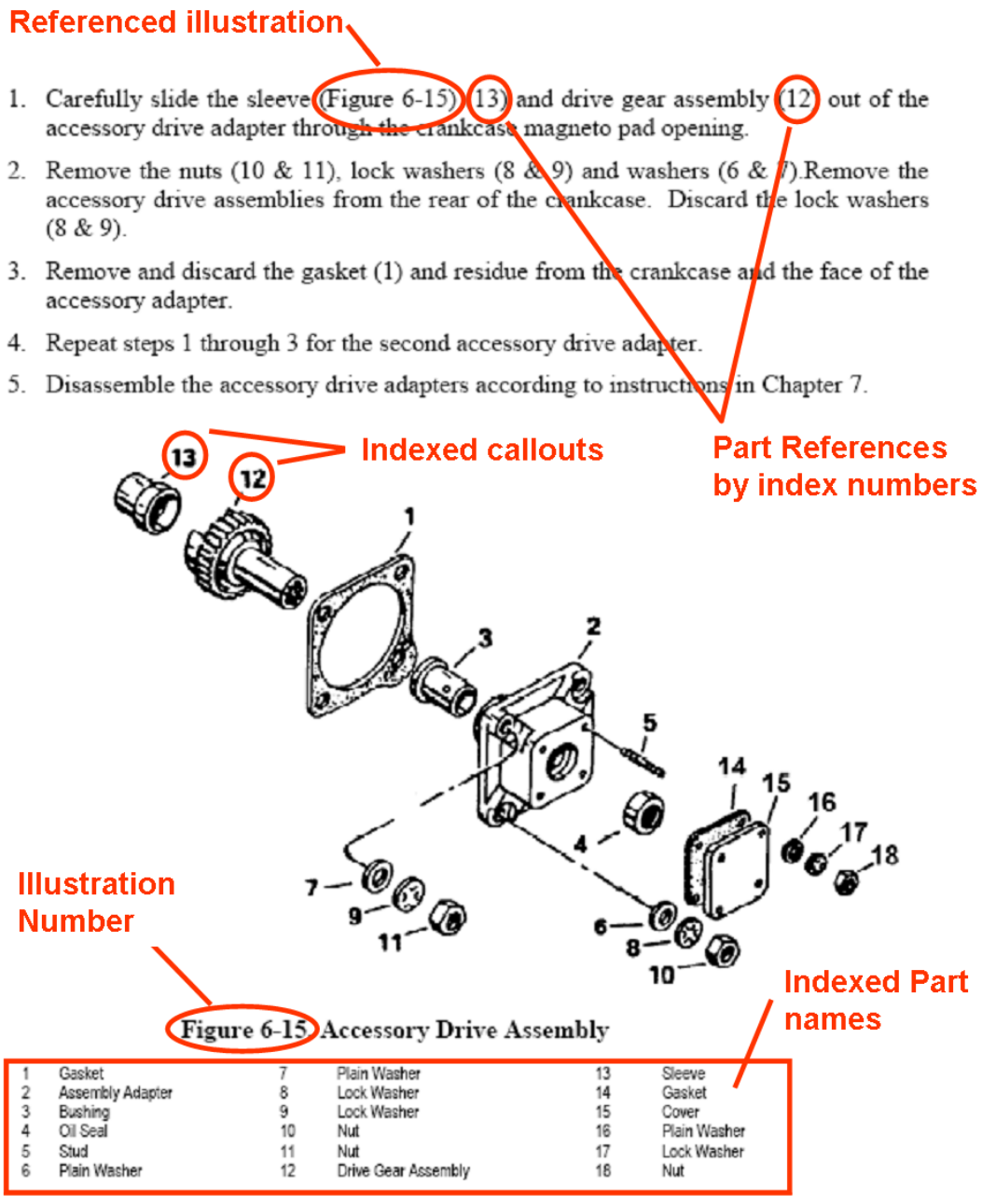


Figure 1-1. Figure and Index Reference

1-1.5. Compliance

The owner/operator is responsible for ensuring the engine is maintained in an airworthy condition, including compliance with FAA Airworthiness Directives. Engine service life is calculated based on compliance with the aircraft and engine manufacturer's required instructions, inspections, and maintenance schedule. Failure to comply will void the engine warranty.

WARNING

Prior to authorizing engine maintenance, the owner must ensure the facility or mechanic meets the Federal Aviation Administration (or equivalent authority) regulatory requirements. The engine owner must verify the repair facility or mechanic uses the most current revision, including change pages of the applicable ICA. Use of Instructions for Continued Airworthiness which have been designated as obsolete, superseded, or inactive is prohibited.

Except for Title 14, Code of Federal Regulations (CFR) Part 43 § 43.3. "authorized owner preventive maintenance", Continental Motors ICAs are written for exclusive use by FAA (or equivalent authority) licensed mechanics or FAA (or equivalent authority) certified repair station employees. Information and instructions contained in this manual anticipate the user possesses and applies the knowledge, training, and experience commensurate with the prerequisite FAA license and certification requirements. No other use is authorized.

WARNING

Failure to comply with ICAs may result in personal injury, death and subsequent engine failure. Pursuant to Title 14 CFR Part 43 §43.13(a), each person performing maintenance, alteration or preventive maintenance on an engine or accessory must use methods, techniques and practices set forth in the Instructions for Continued Airworthiness or other methods, techniques, and practices found acceptable to the Administrator.

This manual shall be used in conjunction with the latest revision of FAA Advisory Circular 43.13-1, "Acceptable Methods, Techniques, and Practices" as well as related publications and accessory manufacturer's instructions. Pursuant to Title 14 CFR Part 43 §43.13(a), each person performing maintenance, alteration, or preventive maintenance on the engine or accessories must use methods, techniques, and practices prescribed in the ICAs or other methods, techniques, and practices found acceptable by the Administrator.

1-1.6. Order of Precedence

Continental Motors engine operating instructions are generated prior to and independently of the aircraft operating instructions. Continental Motors operating instructions are developed using factory controlled parameters that are not necessarily the same as those specifications required to satisfy a specific aircraft/engine installation.

WARNING

The aircraft operator must use the aircraft manufacturer's operating instructions found in the Airplane Flight Manual/ Pilot's Operating Handbook (AFM/POH) and applicable Airplane Flight Manual Supplements (AFMS) while operating the engine in the aircraft unless the AFM/POH directs otherwise.

Refer to the current AFM/POH published by the aircraft manufacturer for operating instructions and specifications relative to your aircraft.

Prior to commencing engine maintenance, consult the Continental Motors web site to verify the current status of the ICAs relating to the intended procedure. For "layered instructions", where instructions are provided in both M-0, the Standard Practice Maintenance Manual, and the principal ICA, instructions in M-0 shall be used.

1-2. Publications

This most current approved version of this manual is delivered to the customer at time of purchase. This manual and all subsequent revisions or changes are published in Adobe Portable Document Format (PDF) and available for download on the Continental Motors Internet web site at http://www.continentalmotors.aero.

1-2.1. Publication Access

Printed technical publications may be ordered through authorized Continental Motors distributors or via the Internet at http://www.continentalmotors.aero. Contact a Continental Motors customer service representative to discuss publication or service subscription options and pricing or visit our web site.

1-2.2. Publication Changes

WARNING

Use only the latest revision of all publications. Using superseded information may jeopardize engine airworthiness. Service documents, published by the manufacturer, or Airworthiness Directives, published by the FAA, may alter or provide supplemental information to the Maintenance and Overhaul Manual. Verify and use only the current versions of all instructions.

The instructions in this manual represent the best and most complete information available at the time of publication. Product or process improvements may trigger changes to existing product design specifications or procedures contained in publications. As new

technical information becomes available, Continental Motors will make the information available to the customer.

Continental Motors releases publication changes in the form of either change pages or complete publication revisions, depending upon the extent of change.

Continental Motors issues service documents in the form of Service Bulletins on a wide variety of topics. Some service documents may affect or supplement information in this manual and should be reviewed prior to performing maintenance. All active service documents applicable to the IO-360 series engine have been incorporated in these instructions as of the date of publication.

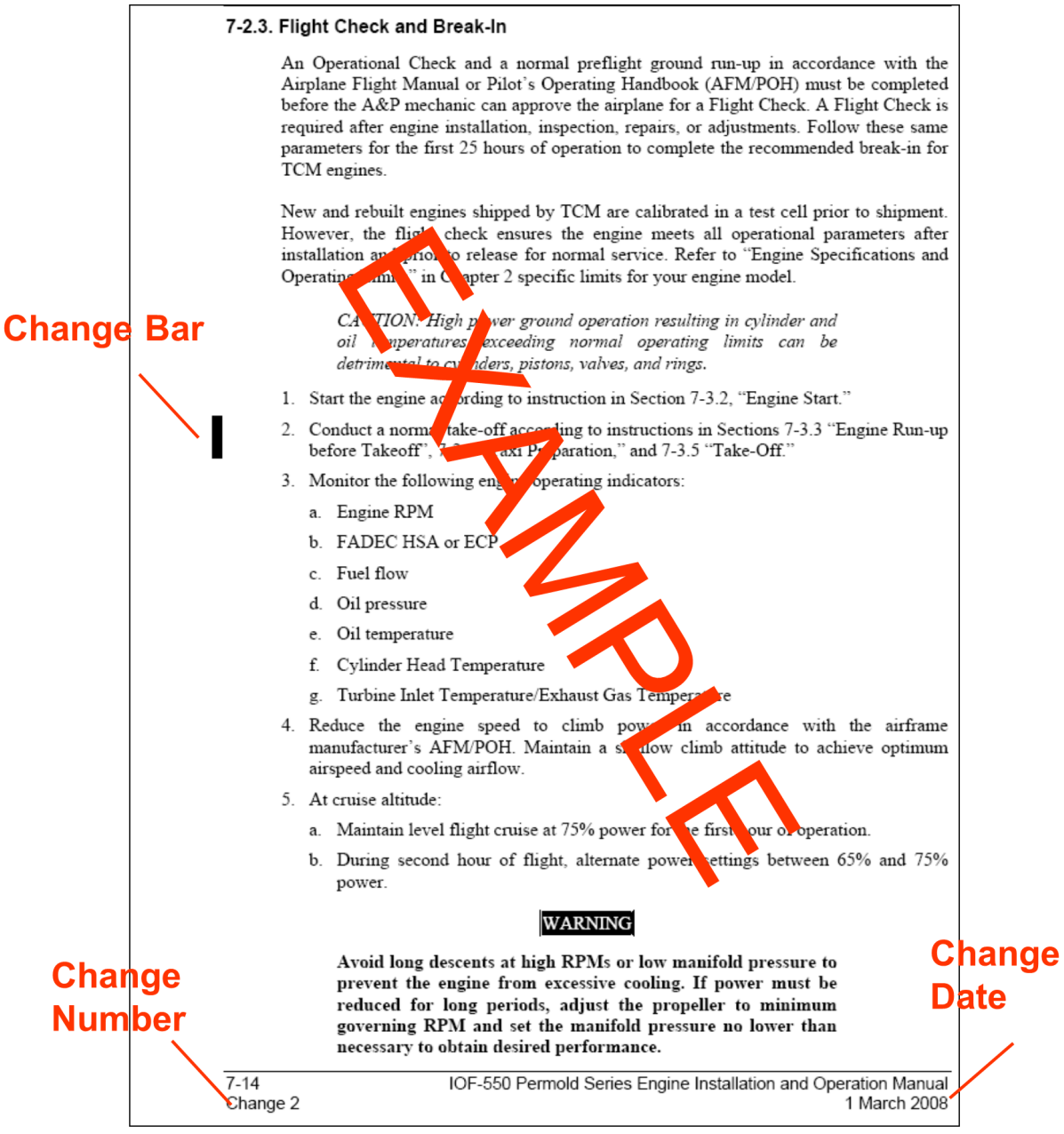
1-2.2.1. Update/Change Distribution

Document updates are available on our web site upon notification of FAA document acceptance/approval. Printed publication subscribers receive printed changes and revisions as they are released.

Document revisions are released if the update changes more than 50% of the contents of a publication. Revisions replace the previous version of a publication from cover to cover. Minor corrections are released as change pages to the original publication, identified with a change number and effective change date in the page footer. Information on the page that changed from the previous edition is identified by a vertical, six-point black line (Figure 1-2), referred to as a “change bar” in the outside margin of the page.

A change page replaces only the previous edition of the affected page. In the event a change page forces re-pagination, a new page will be inserted with a decimal extension added to the page number. For example, if additional pages are required between pages 1-6 and 1-7, the inserted page numbers will be 1-6.1, 1-6.2, and so on until sufficient pages are added to incorporate the new material. This method allows the new material to be incorporated without affecting the remaining pages in the manual.

Page A of the manual contains the original publication date and an itemized list of changes issued for the technical manual (Figure 1-3). If change pages are issued for the manual, the change will be identified, with an effective date under the heading “Effective Changes for This Manual” on Page A. The list of effective pages, itemizes the pages in each section, by change number. Original pages are designated by a 0 in the List of Effective Pages “Change” column.



7-2.3. Flight Check and Break-In

An Operational Check and a normal preflight ground run-up in accordance with the Airplane Flight Manual or Pilot's Operating Handbook (AFM/POH) must be completed before the A&P mechanic can approve the airplane for a Flight Check. A Flight Check is required after engine installation, inspection, repairs, or adjustments. Follow these same parameters for the first 25 hours of operation to complete the recommended break-in for TCM engines.

New and rebuilt engines shipped by TCM are calibrated in a test cell prior to shipment. However, the flight check ensures the engine meets all operational parameters after installation and prior to release for normal service. Refer to "Engine Specifications and Operating Limits" in Chapter 2 specific limits for your engine model.

CAUTION: High power ground operation resulting in cylinder and oil temperatures exceeding normal operating limits can be detrimental to cylinders, pistons, valves, and rings.

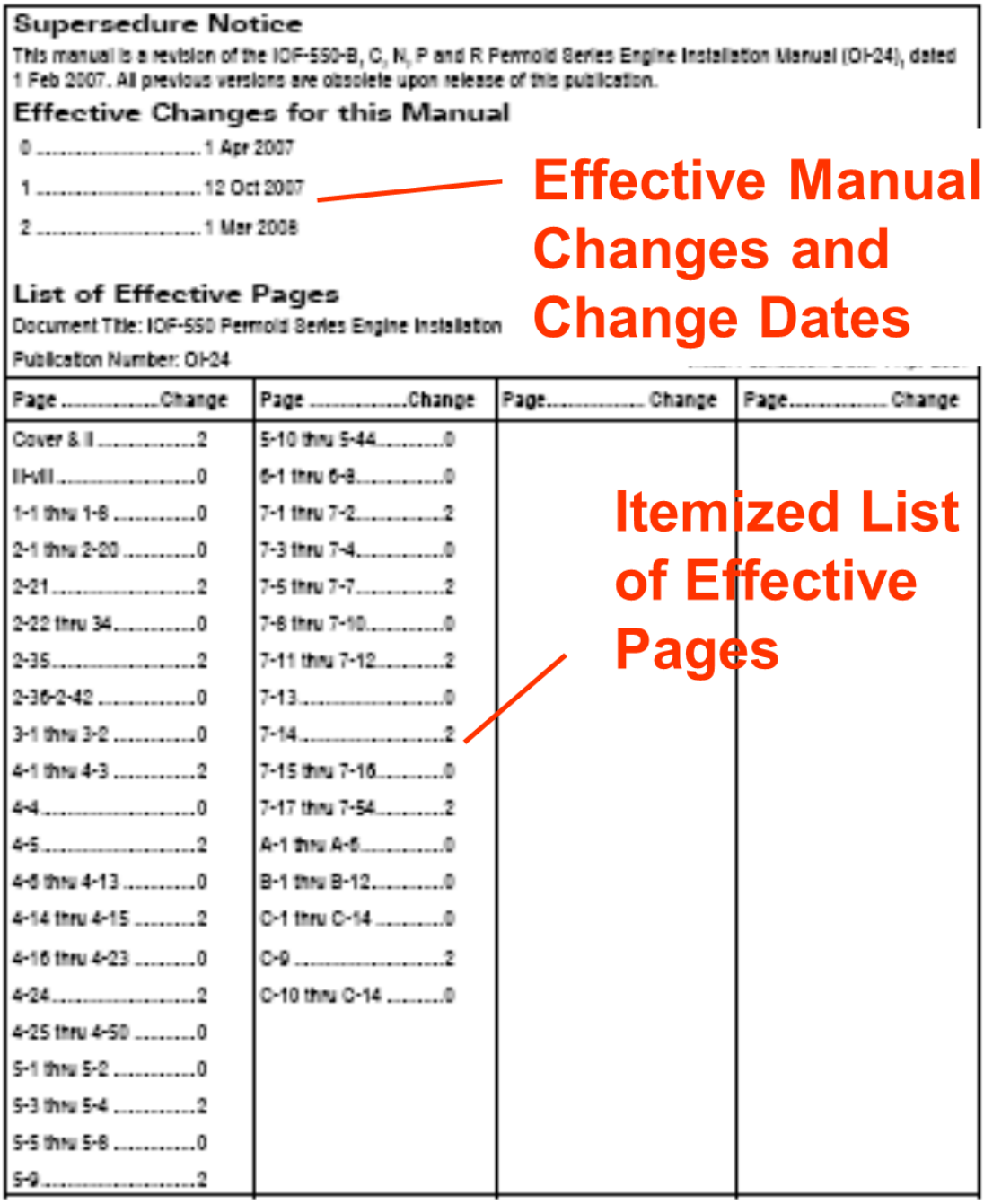
1. Start the engine according to instruction in Section 7-3.2, "Engine Start."
2. Conduct a normal take-off according to instructions in Sections 7-3.3 "Engine Run-up before Takeoff", 7-3.4 "Taxi Preparation," and 7-3.5 "Take-Off."
3. Monitor the following engine operating indicators:
   a. Engine RPM
   b. FADEC HSA or ECP
   c. Fuel flow
   d. Oil pressure
   e. Oil temperature
   f. Cylinder Head Temperature
   g. Turbine Inlet Temperature/Exhaust Gas Temperature
4. Reduce the engine speed to climb power in accordance with the airframe manufacturer's AFM/POH. Maintain a slow climb attitude to achieve optimum airspeed and cooling airflow.
5. At cruise altitude:
   a. Maintain level flight cruise at 75% power for the first hour of operation.
   b. During second hour of flight, alternate power settings between 65% and 75% power.

WARNING

Avoid long descents at high RPMs or low manifold pressure to prevent the engine from excessive cooling. If power must be reduced for long periods, adjust the propeller to minimum governing RPM and set the manifold pressure no lower than necessary to obtain desired performance.

7-14 IOF-550 Permold Series Engine Installation and Operation Manual
Change 2 1 March 2008

Figure 1-2. Change Page Identification



Supersedure Notice

This manual is a revision of the IOF-550-B, C, N, P and R Permold Series Engine Installation Manual (OI-24), dated 1 Feb 2007. All previous versions are obsolete upon release of this publication.

Effective Changes for this Manual

0 ..... 1 Apr 2007

1 ..... 12 Oct 2007

2 ..... 1 Mar 2008

Effective Manual Changes and Change Dates

List of Effective Pages

Document Title: IOF-550 Permold Series Engine Installation

Publication Number: OI-24

Page ..... Change	Page ..... Change	Page ..... Change	Page ..... Change
Cover & II 2	5-10 thru 5-44 0		
III-VII 0	6-1 thru 6-8 0		
1-1 thru 1-8 0	7-1 thru 7-2 2		
2-1 thru 2-20 0	7-3 thru 7-4 0		
2-21 2	7-5 thru 7-7 2		
2-22 thru 34 0	7-8 thru 7-10 0		
2-35 2	7-11 thru 7-12 2		
2-36-2-42 0	7-13 0		
3-1 thru 3-2 0	7-14 2		
4-1 thru 4-3 2	7-15 thru 7-16 0		
4-4 0	7-17 thru 7-54 2		
4-5 2	A-1 thru A-6 0		
4-6 thru 4-13 0	B-1 thru B-12 0		
4-14 thru 4-15 2	C-1 thru C-14 0		
4-16 thru 4-23 0	C-9 2		
4-24 2	C-10 thru C-14 0		
4-25 thru 4-50 0			
5-1 thru 5-2 0			
5-3 thru 5-4 2			
5-5 thru 5-6 0			
5-9 2			

Itemized List of Effective Pages

Figure 1-3. List of Effective Pages

1-2.3. Service Documents

Continental Motors may issue Service Documents ranging from mandatory (Category 1) to informational (Category 6). Definitions of the categories are listed below:

> NOTE: Upon FAA approval, Continental Motors publishes service documents for immediate availability on our web site. The service document cover page indicates the engine models affected by the service document. Service documents may alter or replace the manufacturer's Instructions for Continued Airworthiness. Insert a copy of applicable Service Documents in affected manuals until the service document instructions are incorporated in the manual, or the service document is canceled or superseded.

Category 1: Mandatory Service Bulletin (MSB)

Used to identify and correct a known or suspected safety hazard which has been incorporated in whole or in part into an Airworthiness Directive (AD) issued by the FAA or have been issued at the direction of the FAA by the manufacturer requiring compliance with an already-issued AD (or an equivalent issued by another country's airworthiness authority). May contain updates to Instructions for Continued Airworthiness (ICAs) to address a safety issue.

Category 2: Critical Service Bulletin (CSB)

This category identifies a condition that threatens continued safe operation of an aircraft, persons or property on the ground unless some specific action (inspection, repair, replacement, etc.) is taken by the owner or operator. Documents in this category are candidates for incorporation into an FAA Airworthiness Directive. May contain updates to ICAs to address a safety issue.

Category 3: Service Bulletin (SB)

Information which the product manufacturer believes may improve the inherent safety of an aircraft or aircraft component; this category includes the most recent updates to ICAs.

Category 4: Service Information Directive (SID)

The manufacturer directs the owner/operator/mechanic in the use of a product to enhance safety, maintenance or economy. May contain updates to ICAs in the form of maintenance procedures or specifications.

Category 5: Service Information Letter (SIL)

This category includes all information (not included in categories 1 through 4) that may be useful to the owner/operator/technician. May contain updates to ICAs for optional component installations, which are not covered in the Applicable Operator, Maintenance, or Overhaul Manuals.

Category 6: Special Service Instruction (SSI)

This category is used to address an issue limited to specific model and/or serial number engines. Continental Motors will distribute SSI notification directly to the affected engine's owners. SSIs will not be included in the general service document set but will be made available through our Customer Service Department to owners of the affected engines only. An SSI may update the applicable engine's Instructions for Continued Airworthiness.

1-2.3.1. Service Documents Incorporated in this Manual

Applicable technical information in the service documents listed below, relevant to the engine models covered by this engine manual, have been incorporated in this manual. The full content of active Continental Motors service documents are available on http://www.continentalmotors.aero. Refer to Section 1-3, "Contact Information" for Continental Motors web site details.

Service Document	Subject	Affected Chapter
M88-9, Lightning Strikes	Unscheduled Maintenance	M-0
M88-10, Contaminated Fuels	Unscheduled Maintenance	M-0
M89-9, Excessive Crankcase Pressure	Unscheduled Maintenance	M-0
M90-13, Exhaust Valve Stem Corrosion/Erosion	Inspection	10
M90-17, Crankcase Inspection Criteria	Inspection Criteria	M-0
M91-9, Cam and Lifter Lubrication During Engine Build	Cam and Lifter Assembly	17
M92-7, Crankcase Cylinder Deck Studs	Replacement	15
M93-4, Crankshaft Counterweights	Replacement	15
M93-8, Rocker Arm to Rotocoil Clearance	Inspection and Repair	15
SIL93-11B, New Service Document Format	Service Documents	1 and M-0
SIL93-15, General Practices for Installation of Lock Wire, Tab Washers and Cotter Pins	Standard Practices	M-0
SB94-2, Oil Filter Adapter Mounting Stud	Inspection and Part Replacement	6 and 15
MSB94-8D, Magneto to Engine Timing	Service	M-0
SB95-2, Inspection and Maintenance of Engine Control Cables and Linkage	Inspection	M-0
SB653, Hot Magneto Test	Operational Check	6, 7 and 10
SB95-3B, Alternator/Generator Drive Coupling	Inspection	M-0
SIL95-5, Hose and Tubing Installation	Installation of Hose and Tubing	M-0
SB95-7, Manifold Valve Cover Inspection	Scheduled Inspection	6
SB96-7C, Torque Limits	Fastener Torque	M-0
SB96-11B, Propeller Strikes and Hydraulic Locks	Scheduled Inspection	M-0
SB96-12, Continued Airworthiness Instructions for TCM Cylinders	Scheduled Inspection and Removal	M-0
SIL97-1, Airworthiness Limitations	Airworthiness Limitations	4
SID97-3G, Procedures and Specifications for Adjustment of CMI Continuous Flow Fuel Injection Systems	Operational Checks and Adjustments	M-0
SID97-4F, Cylinder Bore and Piston Fit Specifications	Cylinder fits and limits	M-0
SB97-6B, Mandatory Replacement Parts	Part Replacement	M-0
SIL98-9E, Time Between Overhaul Periods	Engine Specifications	M-0
SIL99-1, Engine Preservation for Active and Stored Aircraft	Engine preservation	M-0
SIL99-2C, Current Listing of Sealants, Lubricants and Adhesives Authorized by TCM	Materials	M-0

Service Document	Subject	Affected Chapter
SB99-8, Engine Fuel Injection System Preservation	Engine Installation and System Purge	5
SB00-3A, Crankshaft, Counterweight and Connecting Rod Repair Information	Repair Information	M-0
SIL00-11B, Release of New Cylinder Induction Port Drain Connector	Cylinder Assembly	M-0
SIL03-1, Cold Weather Operation - Engine Preheating	Preheating Procedures	M-0
SIL03-2C, Currently Active Approved Spark Plug Application	Spark Plugs	M-0
SB03-3, Differential Pressure Test and Borescope Inspection	Inspection Criteria	M-0
SB04-10, Piston Position Marking	Overhaul	15
SB04-11, Valve Guide Application, Installation and Reaming Procedures	Valve Guide Repairs	10, 15 and Appendix D
SIL04-12A, TCM Authorized Engine Adjustments, Component Replacement and Repositioning	Engine Specification	M-0
SB643B, Maintenance Intervals for All CMI and Bendix Aircraft Magnetos and Related Equipment	Inspection and Service	6
SID05-1A, Design, Operation, Maintenance for TCM Camshafts and Hydraulic Lifters	Inspection Criteria	10, 15 and Appendix D
SB05-2, Overspeed Limitations	Unscheduled Maintenance	M-0
SB07-1, Connecting Rod Piston Pin Bushing Inspection	Inspection and Installation	10, 15 and Appendix D
CSB08-3C, Throttle and Mixture Control Levers	Inspection and Installation	M-0
SB08-4, Fuel Injection System Contamination	Fuel Injection Service	5 and 6
SB08-13, Induction System Hose and Clamp Installation	Induction System Inspection and Assembly	M-0
SB09-14, Crankshaft Corrosion Treatment	Crankshaft Inspection	6, 10, 13 and 15
SIL15-8, Front Mounted Alternator Bracket Assembly Inspection	Inspection and Installation	6, 10, 12 and 17

1-2.3.2. Service Documents Released After Publication

Continental Motors strives to provide clear, concise, and accurate information and instructions based on best known engineering data at the time of publication. Ongoing process improvements may change a specification or procedure after a manual is released. Service documents, defined in Section 1-2.3, expedite customer notification and serve as the prevailing instruction over conflicting information until the new information is incorporated in the manual text. As service documents are received, note the service document number, release date, title, and applicable section affected by the service document in the blank cells below and insert a copy of the service document behind the last page of this section. Make pen and ink corrections, where appropriate, to the original text in the manual with a citation to the service document; i.e. see SB9X-1. For paragraphs or entire sections, draw an "X" through the affected information in the manual and reference the service document containing the correction.

Service Documents Release After This Manual

Document Number:		Release Date:	/ /	Affected Sections:	
Title:					
Document Number:		Release Date:	/ /	Affected Sections:	
Title:					
Document Number:		Release Date:	/ /	Affected Sections:	
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Document Number:		Release Date:	/ /	Affected Sections:	
Title:					

1-2.4. Related Publications

The table below lists related publications, source, and accessibility relevant to IO-360 series engine installation, operation, maintenance and overhaul.

WARNING

Use only the latest revision of all publications. Using superseded information may jeopardize engine airworthiness

Table 1-1. Related Publications

Publication	Supplied With Engine	Internet via CM web site[1]	Printed Manual Available for Purchase
Instructions for Continued Airworthiness			
Maintenance and Overhaul Manual (M-7) (this manual)	Yes	Yes	Yes
Standard Practice Maintenance Manual (M-0)	Yes	Yes	Yes
Starter Service Manual (X30592)	Yes	Yes	Yes
Alternator Service Manual (X30531)	Yes	Yes	Yes
S-20 and S-200 Series Magneto Service Manual (X42002)	Yes	Yes	Yes
Engine Installation Manual			
Installation and Operation Manual (OI-7)	Yes[2]	Yes	Yes
Illustrated Parts Catalog			
Parts Catalogs	No	Yes	No

1. Our web site (www.continentalmotors.aero) provides 24-hour access to engine technical data. If you are an Internet service subscriber, you can access our web site to confirm and review the latest revision of this manual. If you have not subscribed to our Internet service and are using printed manuals, contact a service representative using the "Contact Information" on page 1-15. to confirm you have the latest revision of the manual.
2. The Installation and Operation Manual is provided to the aircraft manufacturer as part of the engine interface control document to aid in development of the Airplane Flight Manual/Pilot's Operating Handbook with detailed installation instructions and dimensional limits.

1-2.4.1. Suggestions and Corrections

Continental Motors solicits and encourages user comments regarding suggested changes to this manual. Direct recommended changes or questions to the attention of "Publications" at the address listed in Section 1-3 or send comments via e-mail to CM.techpubs@cmg.aero.

Notify our Customer Service Department immediately, using our toll-free number, if you discover incorrect information which adversely affects safety.

1-3. Contact Information

Continental Motors is available to answer technical questions and encourages suggestions regarding products, parts, or service. If customers have an inquiry or require technical assistance, they should contact their local Continental Motors distributor or field representative. To contact a factory representative, refer to the contact information below:

Continental Motors
P. O. Box 90
Mobile, AL 36601

Customer Service Department:
Toll free within the Continental United States: 1-888-826-5465
International: 1-251-436-8299

Internet: http://www.continentalmotors.aero

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Chapter 2. Engine Description

2-1. General Engine Description

The IO-360-A, AB, AF, C, CB, D, DB, ES, G, GB, H, HB, J, JB, K and KB engines are air cooled, having six horizontally opposed, inclined overhead valve cylinders. The cylinder displacement of 360 inches^3 (5899 cm^3) is achieved with a 4.44 inch (11.278 mm) bore and a 3.88 inch (9.86 mm) stroke. The IO-360 series engines have an 8.5 to 1 compression ratio (AF model 7.5 to 1 compression ratio). The IO-360 series engines are fuel injected and naturally aspirated. The crankshaft is equipped with pendulum type vibration absorber that suppress torsional vibrations.

Basic engine weights, minus accessories, are listed in Section 2-3. Engine weights vary by model specification, refer to the OI-7 for installed engine weights, including accessories.

The IO-360 engines have a doweled six bolt hole configuration propeller flange. A mounting pad is provided for a governor which provides control for a hydraulically operated constant speed propeller.

The IO-360 series engine are of a wet sump design with a positive displacement oil pump installed in the center portion of the accessory case. The desired oil pressure is maintained by a pressure relief valve located on the left side of the accessory case.

On all IO-360 engines except the AF model, the engine cranking is accomplished by a geared right angle drive starter adapter and a direct current starter motor. The AF model direct drive starter motor mounts directly to the accessory case.

The oil cooler is installed on the left rear side of the crankcase rearward of the No. 2 cylinder. The engine is equipped with two gear driven magnetos. The exhaust system may or may not be supplied with the engine by the engine manufacturer depending on the particular engine model.

2-1.1. Engine Model Number Definition

The engine model number indicates key features of the engine. Each alphanumeric character in the engine model number has a specific meaning, Figure 2-1 depicts the significance of each character in the IO-360-C1B engine model designation.

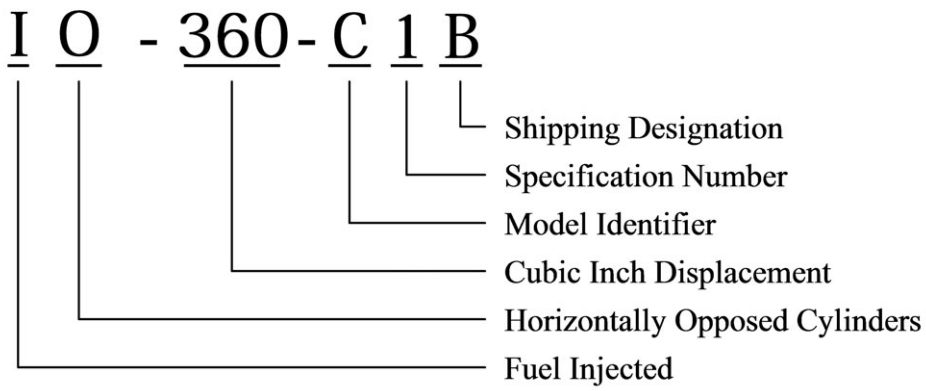


Figure 2-1. Engine Model Definition

2-1.2. Cylinder Number Designations

Refer to Figure 2-2:

- The front of the engine is the end closest to the propeller and the rear of the engine is the accessory end
- Viewed from the rear of the engine, the left-side cylinders are designated by even numbers 2-4-6, with Cylinder 2 being closest to the rear.
- The right side cylinders have odd number sequential designation 1-3-5, with Cylinder 1 being closest to the rear.
- Firing order of the engine is 1-6-3-2-5-4.

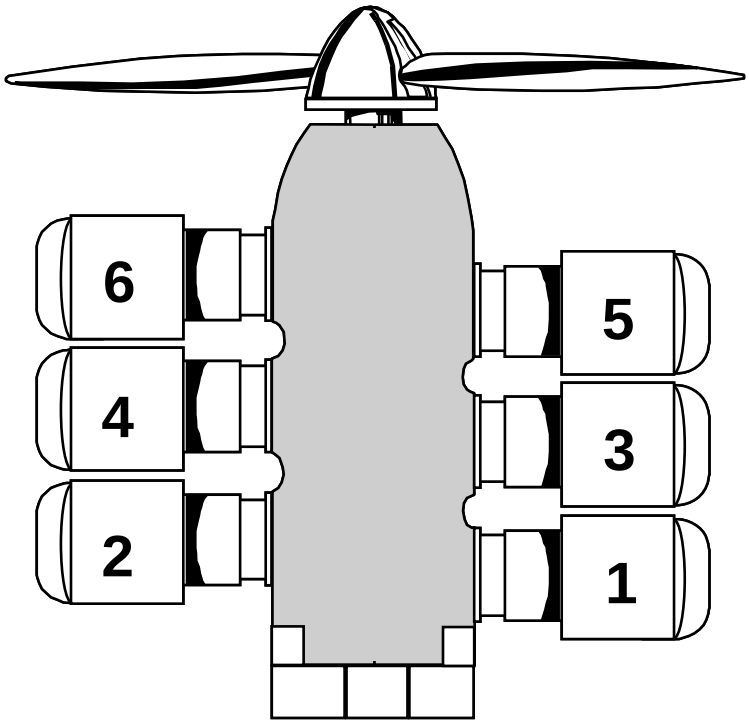


Figure 2-2. Cylinder Number Designation

2-2. Detailed Engine Description

2-2.1. Crankcase

The crankcase is composed of two aluminum alloy castings joined along the center vertical plane. The individual castings with studs and inserts will be referred to as left and right crankcases throughout the manual.

Bosses molded in the castings are line bored in the assembled casting to form bearings for the camshaft and saddles for precision main bearing inserts. Guides are bored through lateral bosses for hydraulic lifters and on the left crankcase half for the governor drive shaft gear. A needle bearing bore is located on the upper rear center of the crankcase halves for a needle bearing or plug (AF).

Cylinder mounting pads on the left crankcase are farther forward than the corresponding pads on the right crankcase to permit each connecting rod to work on a separate crankpin. There are six studs and two through bolts for attaching cylinder base flanges. The propeller governor mount pad is located on the lower front corner of the left crankcase half. A fuel pump pad is located on the right crankcase forward of the number five cylinder mount pad.

The crankcase interior is ventilated by a breather consisting of a tube and baffle assembly with a side extension for hose attachment. The breather assembly is pressed into the forward upper right crankcase half.

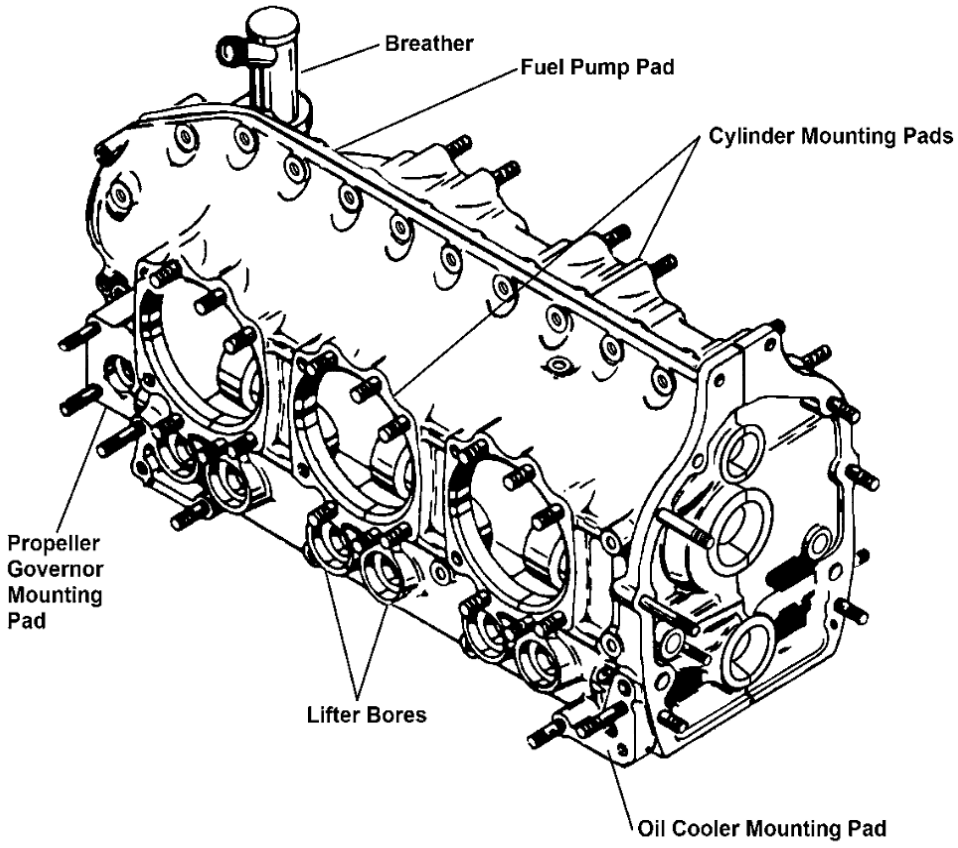


Figure 2-3. Crankcase Features

2-2.2. Engine Drive Train

When starting the engine, torque is transmitted from the starter through the starter adapter components (except AF model) depending on the adapter configuration. As the worm wheel is turned, the spring mounted on the hub tightens to grip the knurled drum of the shaft gear. After starting, the spring returns to its normal position releasing the shaft gear and disengaging the starter. Some starter adapters incorporate additional accessory drive pads. On the AF model, torque is transmitted directly from the starter to the crankshaft gear. A solenoid engages and disengages the starter motor from the crankshaft gear.

Torque from the crankshaft gear is transmitted directly to the camshaft gear. The camshaft gear drives the magneto gears. The alternator drive gear meshes with the inner camshaft gear and turns the alternator shaft through a rubber bushing drive coupling. The oil pump is driven by a spur gear which meshes with the inner camshaft gear.

The governor drive gear is keyed to the camshaft and meshes with and drives the governor driven gear.

The splined end of the fuel pump drive shaft mates with the internal spline of the governor driven gear.

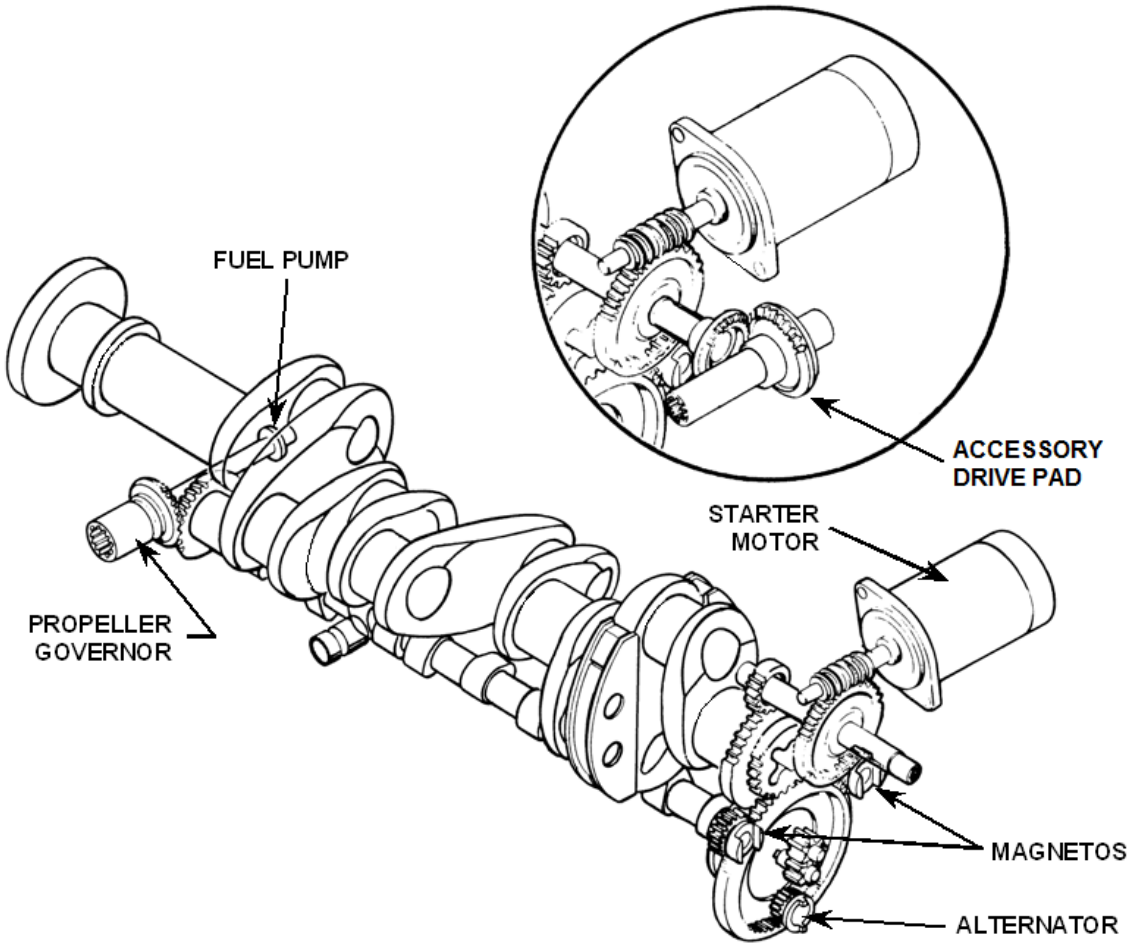


Figure 2-4. Drive Train (Except AF)

2-2.2.1. Crankshaft

The crankshaft is precision machined aircraft quality steel supported within the crankcase by precision tri-metallic bearing inserts installed in each of the four main bearings saddles. Six, machined rod journals provide for attachment of the connecting rod assemblies.

Counterweights are supplied in matched pairs with the bushings installed; total weight difference between pairs is not to exceed two grams. Counterweight order number designates the vibration order the counterweight is capable of absorbing. A sixth order counterweight is designed to counteract six vibrations per revolution of the crankshaft. Similarly, if a crankshaft produces five vibrations per revolution, a fifth order counterweight is used to offset the vibration. Counterweights are installed on hanger blades on the number two crankshaft cheek.

IO-360-**A**, **C** and **D** incorporate a crankshaft with two 6th order dampers. All other models incorporate a crankshaft with one 6th order and one 4 1/2 order damper.

The crankshaft gear is heated prior to installation to facilitate installation. The gear is positioned on the crankshaft by a dowel pin. The gear also has a machined timing mark to properly position the crankshaft and camshaft angles.

A neoprene oil seal and a split retainer ring are seated between the crankcase castings in the front crankshaft exit area and is sealed to the crankshaft by a helical spring inside the seal cavity.

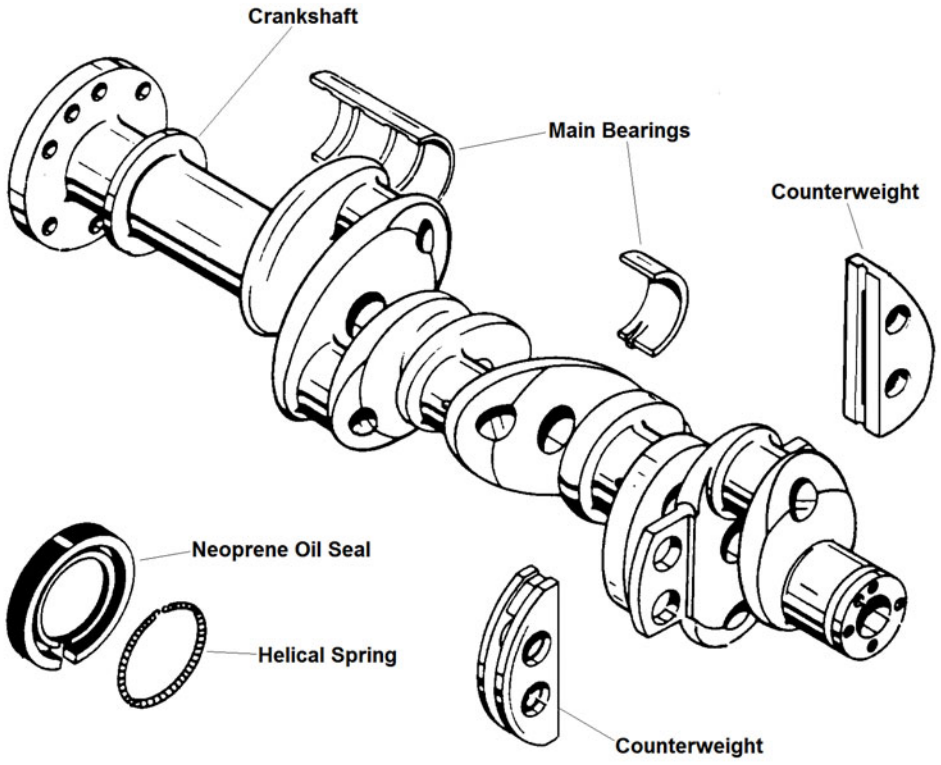


Figure 2-5. Crankshaft

2-2.2.2. Connecting Rods

The connecting rods halves are machined from a single forging of aircraft quality steel and cut into two pieces, splitting the center of the larger opening of the connecting rod assembly. The resulting pieces, called the rod and cap are fitted with a two piece bearing and attach to the crankpin or rod journal with special bolts and nuts.

The portion of the rod between the crankpin and piston pin ends is called the “I” beam. A split steel-backed bronze bushing is pressed into the piston pin end and machined for a precision piston pin-to-bushing fit. Weight variations between opposing crankshaft crank pin positions is limited to 0.5 ounce (14.175 grams).

NOTE: Some older models used a castellated nut with cotter pin, the current models use a spiral lock nut.

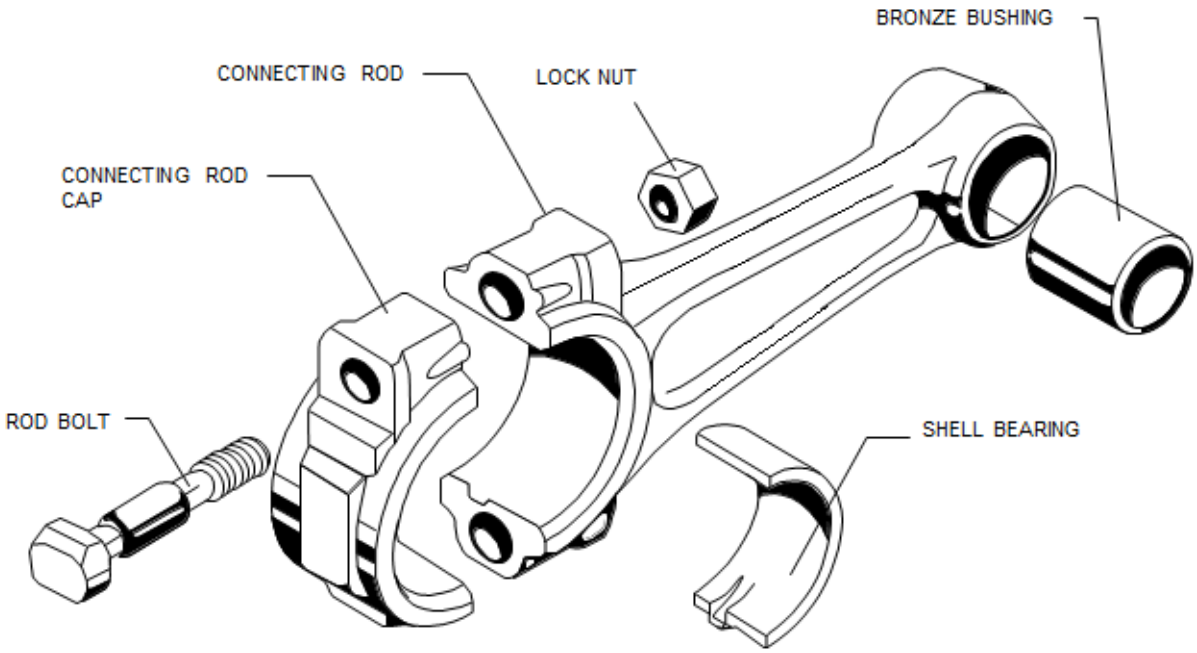


Figure 2-6. Connecting Rod

2-2.2.3. Camshaft

The camshaft is forged from aircraft quality steel, machined on four main journals with nine ground and hardened lobes and a gear mount flange at the rear of the camshaft. The camshaft journals are supported by four precision line bored saddles within the crankcase. Four unequally spaced bolts attach the gear to the camshaft. Camshaft to crankshaft timing is accomplished by aligning the timing marks of the crankshaft and camshaft gears in the crankcase. As the crankshaft turns the camshaft in the crankcase, hydraulic lifters follow the eccentric lobes of the camshaft in the crankcase lifter bores. Inward and outward movement of the lifters open and close the intake and exhaust valves within the cylinder head by mechanical linkage of the push rods and rocker arms to the lifters. The exact moment of valves opening and closing is synchronized by the crankshaft to camshaft timing. The camshaft gear incorporates a splined drive for the engine oil pump. The inner teeth of the camshaft gear drive the alternator. The camshaft gear also drives the right and left magneto drive gears. A front mounted splined bevel drive gear provides momentum for the prop governor bevel driven gear.

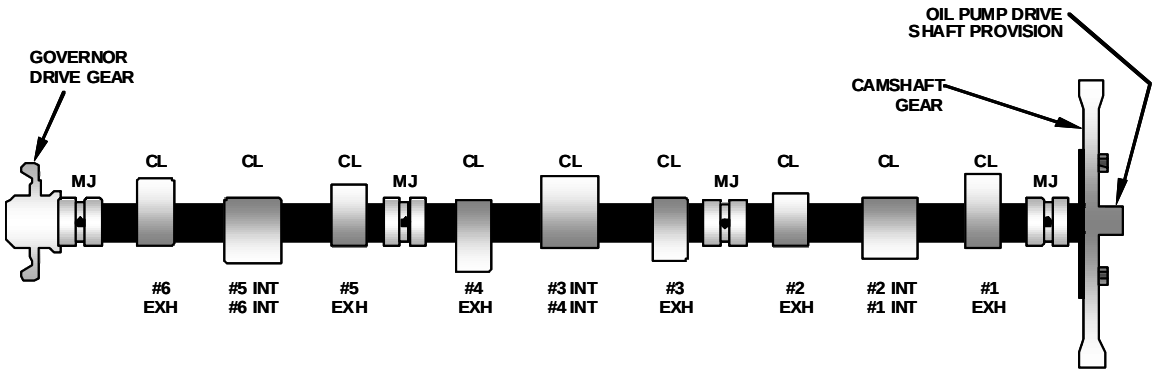


Figure 2-7. Camshaft

2-2.3. Cylinders

The externally finned aluminum alloy head castings are heated and valve seat inserts are installed before the head is screwed and shrunk onto an externally finned steel alloy barrel to make the permanent head and barrel assembly. Aluminum/bronze intake valve guides and ni-resist or nitralloy exhaust valve guides are pressed into the cylinder assembly.

Special 18 mm (0.71 in.) helical coil thread inserts are installed in the top and bottom spark plug holes. The exhaust ports are on the bottom and intake ports are on the top of the head when the cylinder is installed. Exhaust valve faces and stem tips are hardened. Valve stems are solid. Outer retainers of the two concentric springs surrounding each valve are locked to the stems by tapered, semi-circular keys which engage grooves around the stems. Roto coils are installed on intake and exhaust valves. The controlled rotating action of this type of retainer helps prevent burning and erosion of the valve and valve seat. Inner spring retainers are pressed steel.

Valve rocker covers are rolled sheet steel or stamped aluminum alloy. Rocker shafts are fully machined, case hardened steel. The rocker shafts are held in place by studs in the cylinder rocker boxes. Valve rockers are steel forgings with hardened sockets and rocker faces, and have pressed in bronze bearings. They are drilled for lubrication.

Push rods are constructed of steel tubes and pressed in, hardened, forged steel ball ends, which are center drilled for oil passages. The push rod housings are beaded steel tubes. The bead at the cylinder end retains an “O” ring. The bead at the crankcase end retains a heavy spring, washer, seal and second washer.

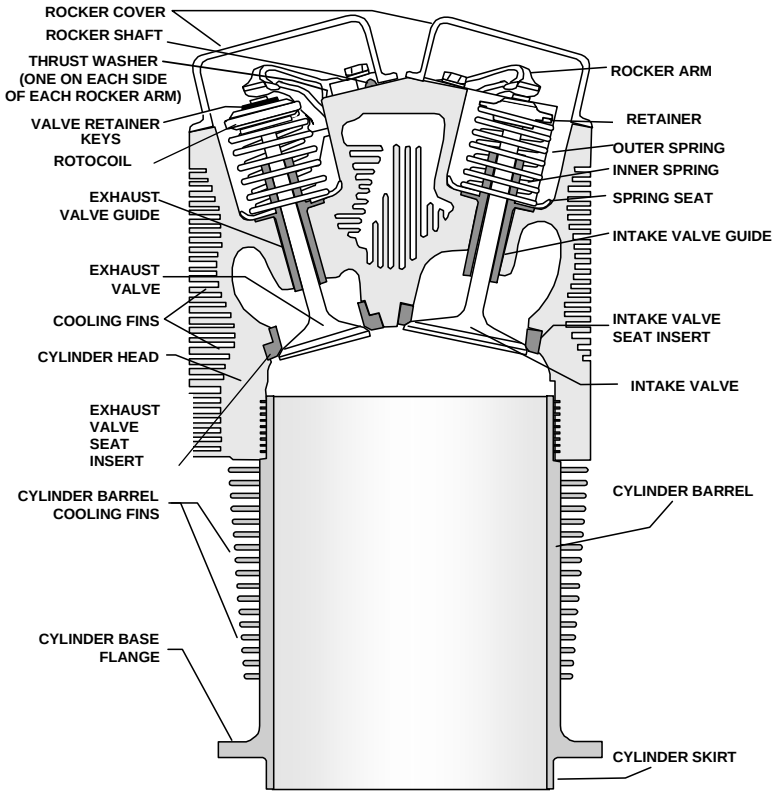


Figure 2-8. Crossflow Cylinder Features

2-2.3.1. Pistons

Pistons are forged or cast, aluminum alloy with a steel insert cast into the top ring groove. The skirts are solid with cylindrical relief cuts at the bottom. Pistons have three ring grooves above the piston pin hole and one ring groove below. Compression rings are installed in the top and second grooves. The groove below the pin hole contains an oil scraper. A center grooved and slotted oil control ring is installed in the third groove which has six oil drain holes to the interior. Weight differences are limited to 0.5 ounce (14.175 grams) between opposing cylinders. Piston pins are full floating ground steel tubes with permanently pressed-in aluminum end plugs.

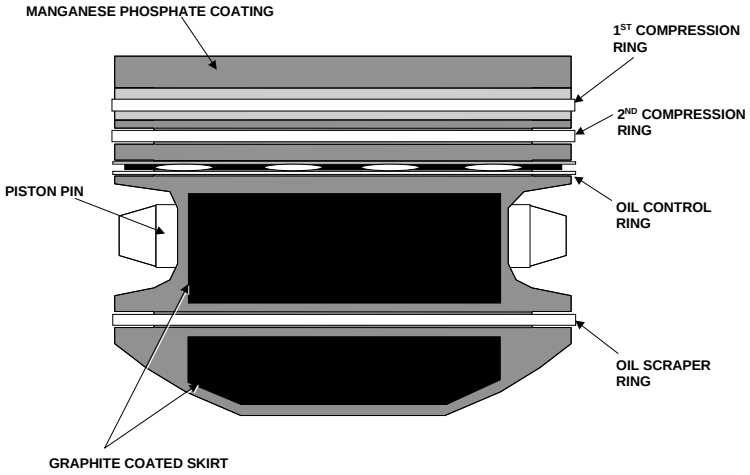


Figure 2-9. Piston Features

2-2.3.2. Hydraulic Valve Lifters

The hydraulic valve lifter performs two functions. First, it provides an interface between the camshaft lobe and the remaining valve train. Hydraulic valve lifters ride on the eccentric cam lobes, opening and closing the intake and exhaust valves mechanically via push rods and rocker arms. This allows conversion of the cam lobe profile into a linear movement for actuation of the intake and exhaust valves. Secondly, the hydraulic mechanism inside the lifter maintains zero clearance between the valve and its actuating components.

The interface between a cam lobe and lifter is intended to wear to some degree as the engine operates. This is similar to the piston ring to cylinder wall interface that must seat together for proper operation and wear over time.

2-2.4. Lubrication System

The engine oil supply is contained in the oil sump. Oil is drawn through a screen into the oil suction tube from the sump to the oil pump inlet. (Due to the modification to the oil sump and accessory case of the HB9, ES3 and ES14 engine oil may be picked up from two separate locations depending on engine position and flight attitude. A baffle and valve assembly located in the oil sump retains oil around the pick-up tube during variable attitude flight operations to prevent oil starvation.) Pressurized oil from the oil pump outlet is directed past the oil pressure relief valve to the full flow, oil filter/screen. If the filter element becomes blocked, a bypass relief valve will open to permit unfiltered oil to flow to the engine. From the oil filter discharge port, pressurized oil flows through a crankcase passage to the oil cooler. As oil enters the oil cooler, it will flow in one of two directions: (a) When the oil is cold, the oil temperature control valve (vernatherm) will open and most of the oil will bypass the cooler. Some oil always flows through the cooler to help prevent congealing in cold weather. (b) As the oil warms, the oil temperature control valve actuates to close off the cooler bypass, forcing oil flow through the cooler core. In operation, the oil temperature control valve modulates to maintain oil temperature in the normal range of approximately 170° F (77° C).

Oil entering the engine is directed to the hollow camshaft which serves as the engine main oil gallery. Oil leaving the camshaft interior at the front of the crankcase is directed to the left crankcase gallery. From there, oil is directed upward through the crankcase oil passages to the front main bearings and thrust washers, the governor drive gear, and propeller governor pad. From the propeller governor pad, lubricating oil is directed through the propeller governor and drilled crankcase passages to the crankshaft. Oil then travels through a transfer plug inside the crankshaft and routed to the variable pitch propeller. Hydraulic valve lifters transfer oil from the oil galleries to the cylinder overhead through hollow push rods to drilled oil passages in the rocker arms. Oil exiting the rocker arms lubricates the rocker shafts, valves stems, roto coils and springs. The oil then flows through the lower portion of the rocker cavity and returns to the crankcase and sump through the push rod housings.

Oil from the left crankcase gallery is also directed through crankcase oil passages to the crankshaft main bearings. Oil from the idler shaft bushing feeds both accessory drive bushings. Oil lubricating the crankshaft mains is directed through the upper main bearing oil holes, through crankcase passages to oil squirt nozzles that spray a mist of oil on the under side of the piston for cooling; gravity returns the engine oil to the sump to repeat the lubrication process.

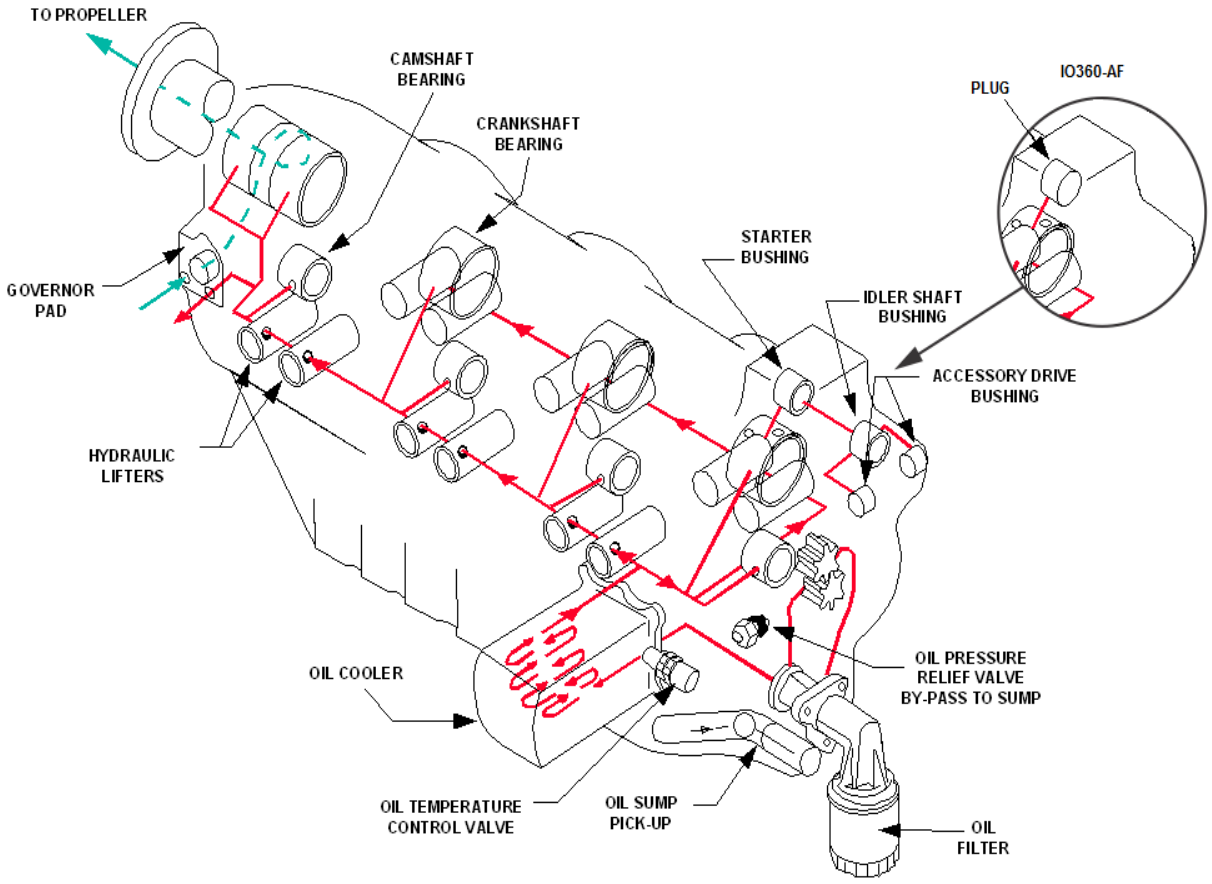


Figure 2-10. Lubrication Schematic

2-2.4.1. Oil Pump

The positive displacement oil pump consists of two meshed gears that revolve inside the pump housing cavity.

The inner camshaft gear drives the oil pump drive gear which turns the oil pump driven gear. The oil pump driven gear is supported by a shaft pressed into the oil pump housing. The oil pump drive gear shaft is supported by the outboard cover (or tach drive housing, if equipped) on one end and the oil pump housing at the opposite end. The oil pump drive gear may feature a tachometer drive gear outboard of the oil pump housing to drive a tachometer shaft gear inside the tach drive housing for either electrical or mechanical tachometers.

As the engine rotates, the oil pump drive gear turns counterclockwise (viewed from rear of engine). The drive gear meshes with the driven gear to turn it clockwise. The rotating gears create the suction necessary to draw oil from the sump through the oil suction tube to the pump gear inlet.

Oil flows from the oil pump to the oil filter housing and filter element. Passing through the filter element, oil flows to the oil cooler. A bypass relief valve opens to divert oil around the filter element, back to the engine in the event the filter element becomes clogged. An adjustable oil pressure relief valve limits oil pressure to a predetermined value. Oil pressure is adjusted by turning the oil pressure relief valve adjusting screw.

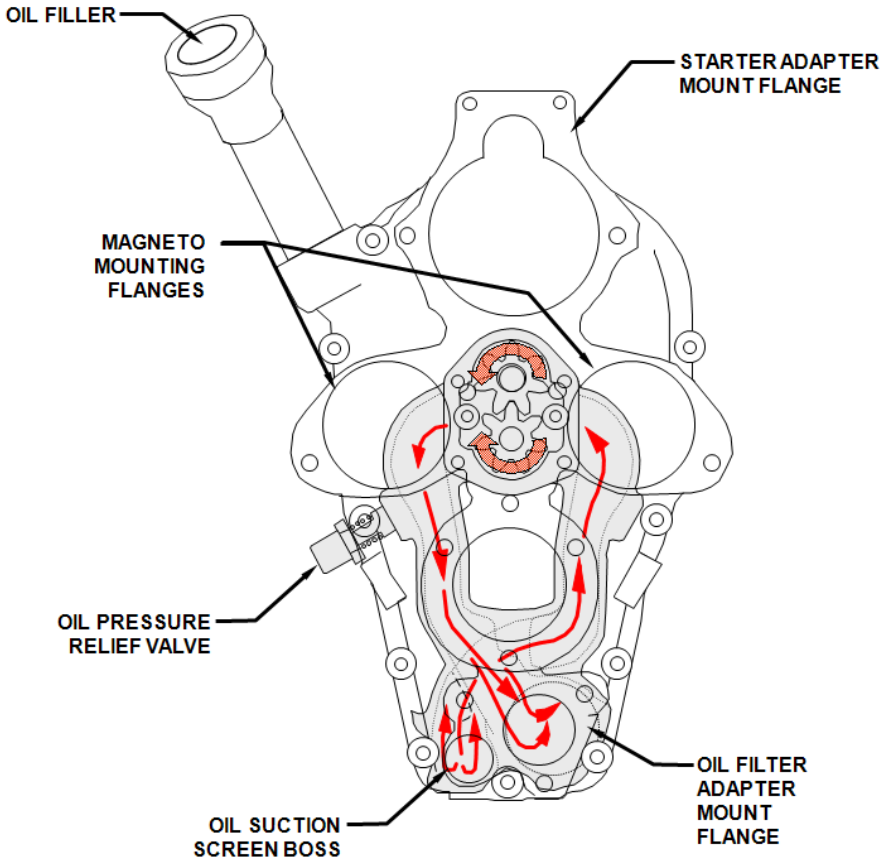


Figure 2-11. Oil Pump

2-2.4.2. Oil Sumps

The sump is attached to the crankcase oil sump and accessory case mounting flanges with bolts, nuts, washers, and lock washers. The oil sump assembly incorporates a threaded boss for a drain plug and copper crush washer to facilitate draining engine oil. The drain plug boss has provisions for safety wiring the magnetic drain plug after it has been properly torqued.

The oil suction tube is immersed in the oil supply and extends outward from the oil sump, through the rear of the oil sump where it is secured to the scavenge oil screen in the accessory case with a crush washer.

2-2.4.3. Oil Cooler and Oil Temperature Control Valve

As oil enters the oil cooler, it will flow in one of two directions: (a) When the oil is cold, the oil temperature control valve (vernatherm) will open and most of the oil will bypass the cooler. Some oil always flows through the cooler to help prevent congealing in cold weather. (b) As the oil warms, the oil temperature control valve actuates to close off the cooler bypass, forcing oil flow through the cooler core. In operation, the oil temperature control valve modulates to maintain oil temperature in the normal range of approximately 170° F (77° C).

As the oil flows through the cooler core, ram air flows through the oil cooler fins to dissipate heat from the oil. Oil exiting the oil cooler returns to the crankcase to feed the camshaft and crankshaft via the left oil gallery.

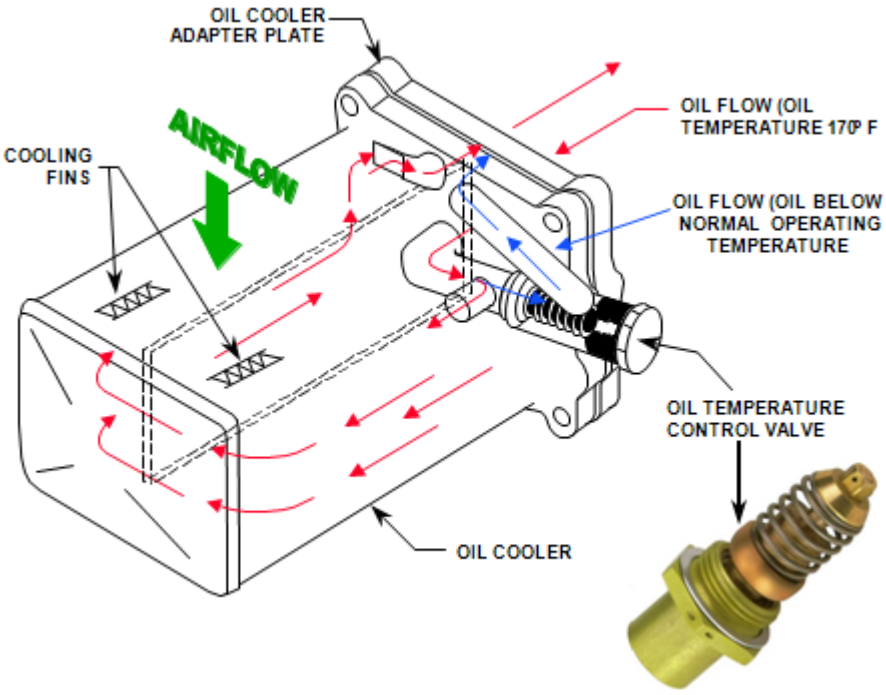


Figure 2-12. Oil Cooler

2-2.5. Fuel System

All Models except D34, DB34 and ES

The fuel system is composed of an engine driven fuel pump, mixture control valve, air throttle body, fuel metering valve, fuel manifold valve and fuel injector assemblies.

The multi-nozzle, continuous flow fuel injection system controls fuel flow to match engine requirements. Refer to Figure 2-13. The fuel metering valve/air throttle body controls the amount of intake air admitted through the intake manifold and meters the proportionate amount of fuel to the fuel manifold valve. Refer to Figure 2-14. The manual mixture control valve is provided for leaning/enriching at any combination of altitude and power setting.

The continuous flow system permits the use of a typical rotary vane pump with a integral relief valve. An auxiliary pump is supplied by the aircraft manufacturer for use in starting or as an emergency pump if the engine driven pump fails.

When fuel leaves the engine driven fuel pump it is directed to the mixture control valve which is an integral part of the fuel pump assembly. The mixture control valve is linked to the cockpit mixture control. From the mixture control valve, fuel is directed to the fuel metering valve which is mounted on the side of the air throttle body. The shaft that positions the air throttle body butterfly valve also positions the metering valve. The air throttle body valve and metering shaft are linked to the cockpit throttle control.

The fuel manifold valve contains a diaphragm chamber and necessary outlet ports which connect to the fuel injector lines. The spring loaded diaphragm works with a ported plunger to allow fuel through to the fuel injector lines.

D34, DB34 and ES Models Only

The fuel system is composed of an engine driven fuel pump, mixture control valve, air throttle body, fuel metering valve, fuel manifold valve and fuel injector assemblies. Refer to Figure 2-14 and Figure 2-15.

The multi-nozzle, continuous flow fuel injection system controls fuel flow to match engine requirements. Any change in air throttle position, engine speed, mixture position or a combination of these causes changes in fuel pressure in the correct relation to the engine requirements. As fuel flow is directly proportional to metered fuel pressure, settings can be predetermined and fuel consumption can be accurately predicted, monitored and controlled.

The continuous flow system permits the use of a typical rotary vane pump with a integral relief valve. With the system there is no need for an intricate mechanism for timing injection to the engine.

The fuel pump is a single stage, vane type of advanced design which has improved vapor suppression characteristics and performs well at high altitude and at low pressure inlet conditions. Its flow rate depends on engine RPM. An aneroid unit is incorporated as an integral part of the pump and functions to decrease pump output during operation at altitude. The fuel pump forces fuel into the fuel metering control assembly.

The fuel metering unit/air throttle controls the amount of intake air admitted into the intake manifold and meters the proportionate amount of fuel to the fuel manifold valve.

The fuel injection system may utilize a primer diverter valve that directs fuel flow to the engine priming nozzle rather than the fuel manifold valve when energized.

The manifold valve receives fuel from the metering unit. When fuel pressure reaches appropriate pressure, the valve in the manifold valve admits fuel to the six ports in the manifold valve. The manifold valve also serves to provide a clean cutoff of fuel to the cylinders when the engine is shut down.

The injector nozzle lines connect the manifold valve to the fuel injector nozzles.

The injector nozzles are “air bleed” type fuel nozzles which spray fuel directly into the intake port of the cylinders. When the engine is running, flow through the nozzle is continuous and will enter the cylinder combustion chamber when the intake valve opens.

Since the size of the fuel nozzles is fixed, the amount of fuel flowing through them is determined by the pressure drop across the nozzle. For this reason, fuel flow may be accurately determined by measuring the pressure at the manifold valve.

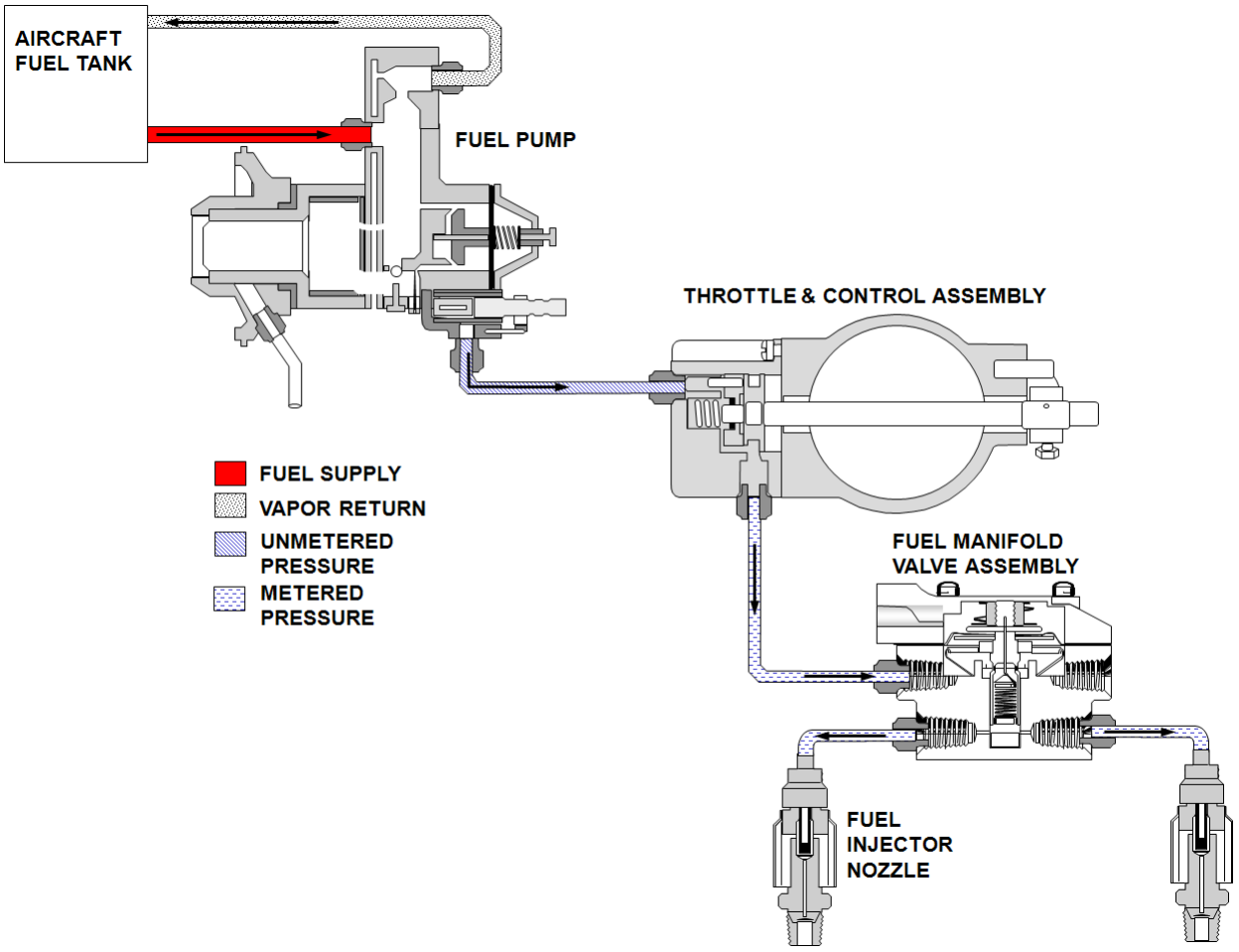


Figure 2-13. IO-360 Fuel System Schematic (Except D34, DB34 and ES)

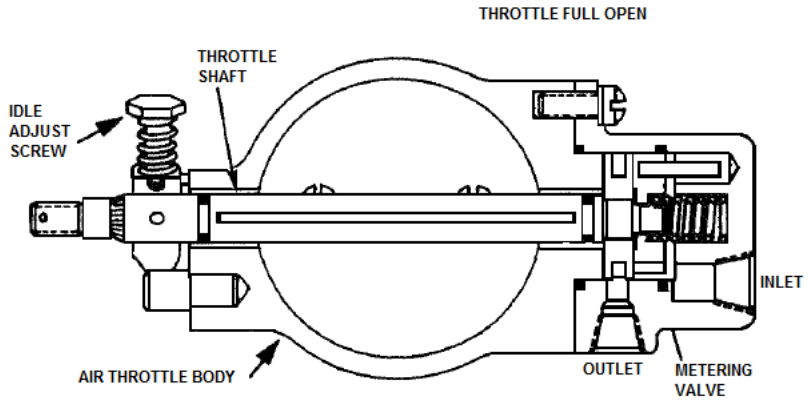


Figure 2-14. IO-360 Air Throttle and Metering Unit

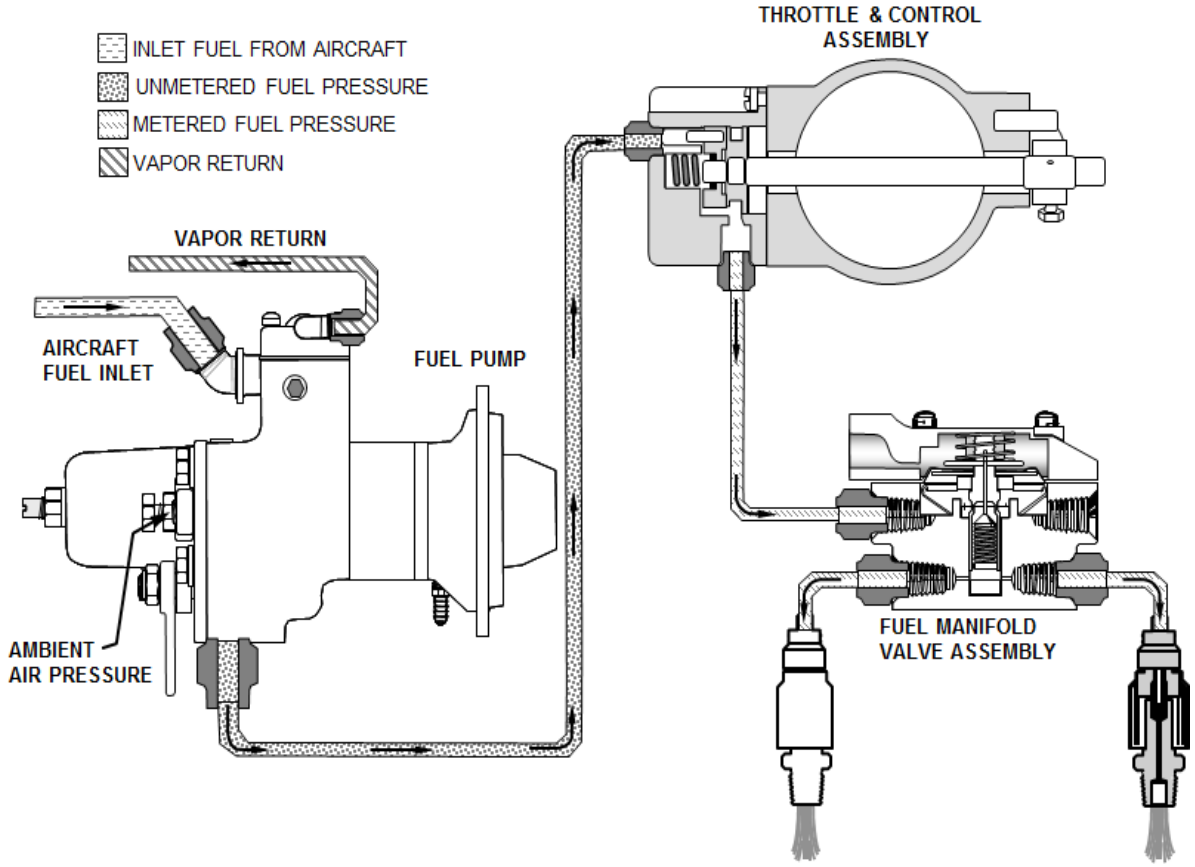


Figure 2-15. IO-360 Fuel System Schematic (D34, DB34 and ES Models)

2-2.5.1. Fuel Pump

Fuel enters the fuel pump at the top of the vapor separator swirl chamber where it is centrifuged, separating the liquid from fuel vapors. Liquid fuel is forced through the fuel pump inlet vanes which create the necessary differential pressure required to draw fuel into the pump inlet and expel pressurized fuel through the pump outlet. Fuel vapors separated in the swirl chamber return to the aircraft fuel tank. Pressurized fuel flows from the pump outlet through fuel hoses to the mixture control valve, fuel metering valve, fuel manifold valve and finally the fuel injector nozzles.

The positive displacement, engine driven pump responds to changes in engine speed, affecting pump flow and pressure proportionally. The fuel pump is designed to exceed engine fuel requirements. The combination of mechanical control circuits makes sure proper pump pressure and fuel delivery for all engine operating speeds.

A check valve allows the use of an auxiliary aircraft fuel boost pump pressure to bypass the engine driven fuel pump during engine priming and starting.

The altitude compensation feature on the IO-360-D34, DB34 and ES fuel pumps adjusts fuel pressure output in response to barometric pressure changes.

Table 2-1. Standard Fuel Pump Features

1	Fuel Pump Inlet	5	Low Pressure Relief Valve
2	Fuel Pump Outlet	6	Adjustable Orifice
3	Vapor Return	7	Mixture Control Lever
4	Fuel Drain		

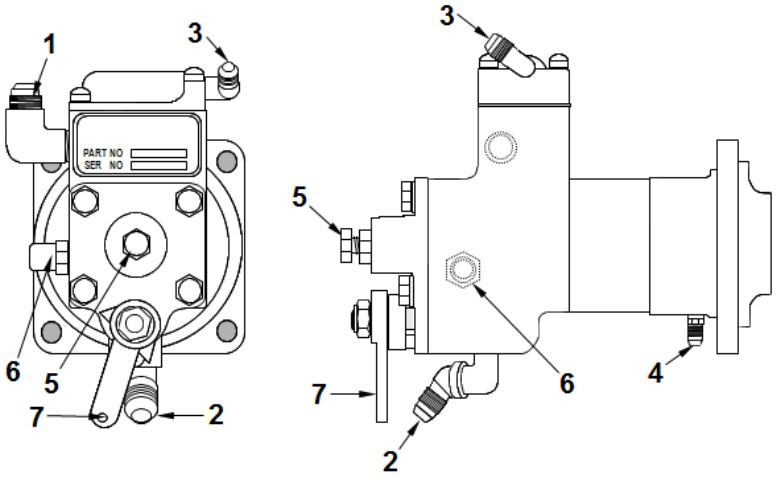


Figure 2-16. IO-360 Standard Fuel Pump (All Models Except D34, DB34 and ES)

Table 2-2. Aneroid Fuel Pump Features

1	Fuel Pump Inlet	6	Mixture Control Lever
2	Vapor Return	7	Aneroid Adjustment
3	Low Pressure Relief Valve	8	Aneroid Pressure (OPT)
4	Aneroid Pressure	9	Fuel Drain
5	Fuel Pump Outlet		

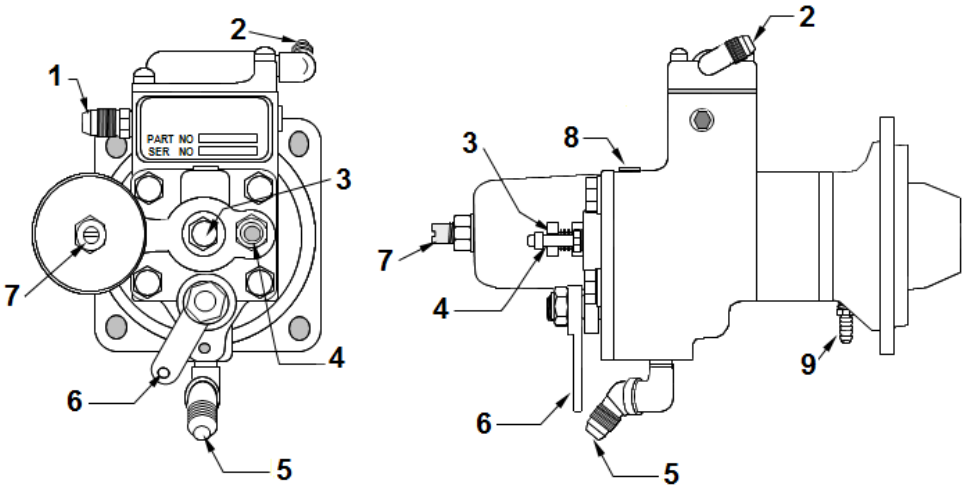


Figure 2-17. IO-360 Aneroid Fuel Pump (D34, DB34 and ES Models)

2-2.5.2. Fuel Injectors

Fuel injectors are a constant flow design. The fuel pump delivers fuel to the manifold valve where the liquid is divided into equal amounts for delivery to the individual cylinder injectors. The fuel injectors are calibrated to work as a set, compensating for variations in distance from the manifold valve, resulting in each cylinder matching the performance of the other five for consistent, balanced operation. Each injector atomizes the fuel into the cylinder intake port. Atomized fuel enters the cylinder when the intake valve opens.

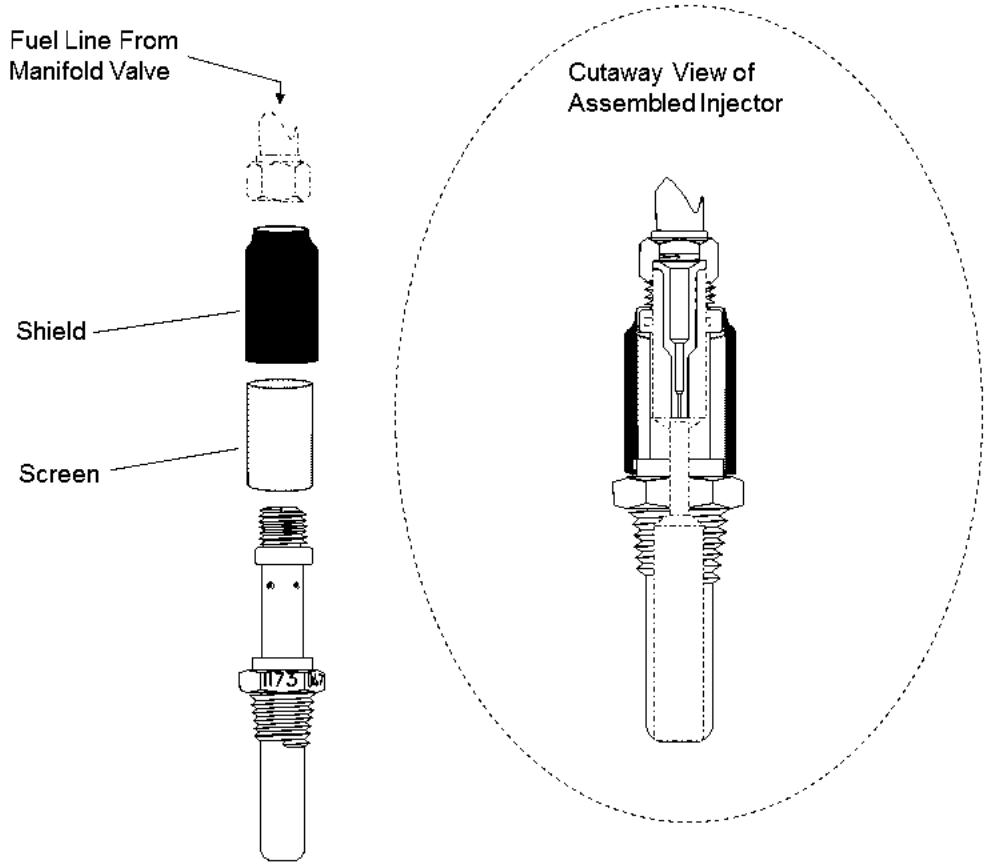


Figure 2-18. IO-360 Fuel Injector Nozzle

2-2.6. Starter Assembly

The Starting System consists of an electric starter motor mounted on a right angle starter drive adapter except the AF model. When the starter motor is electrically energized, the adapter worm shaft and gear engage the starter shaft gear through a spring and clutch assembly by turning the starter worm wheel.

As the shaft gear turns, it rotates the crankshaft gear and crankshaft. When the engine starts, electrical energy is removed from the starter motor. The gripping action of the clutch spring is relieved, disengaging the shaft gear from the worm shaft and electric starter motor. The starter shaft gear extends from the rear of the starter adapter.

On the AF model, the starter motor is mounted directly to the accessory case. When the starter motor is electrically energized, a solenoid engages the starter motor to the crankshaft gear. When the engine starts, electrical energy is removed from the solenoid and the starter motor disengages from the crankshaft gear.

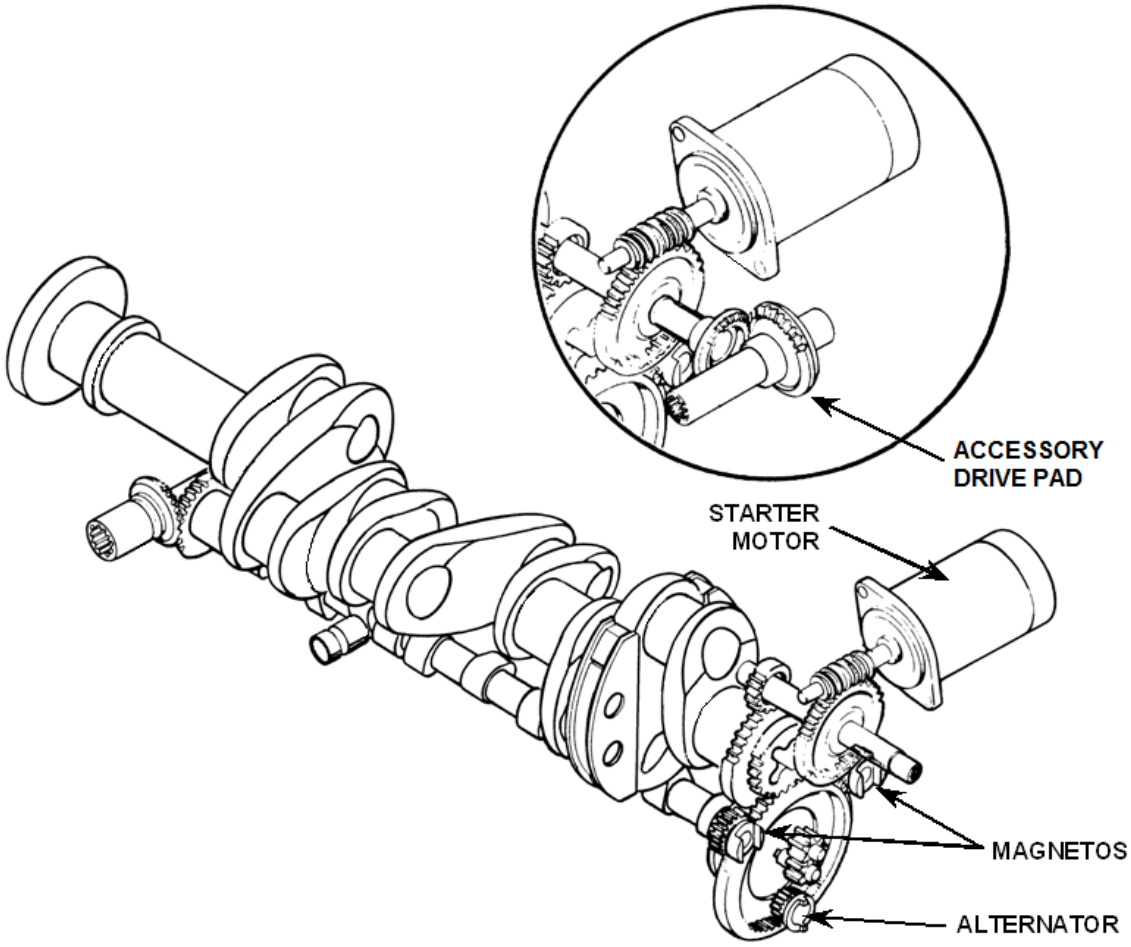


Figure 2-19. Starting System (Except AF)

2-2.7. Alternator

The alternator converts mechanical energy into electrical energy and supplies it to the voltage regulator to power aircraft electrical accessories and recharges the aircraft batteries. CM alternators are available in multiple voltage/amperage output options to match aircraft circuit requirements.

2-2.8. Ignition System

Engine firing order is 1-6-3-2-5-4. As viewed from the distributor end, the magneto rotor turns counterclockwise, passing in succession the terminals of spark plug cables in engine firing order. Cables are connected to the magnetos so that the right magneto fires the 1-3-5 top plugs on the right side and 2-4-6 bottom plugs on the left side. The left magneto fires the 2-4-6 top plugs on the left side and the 1-3-5 bottom plugs on the right side. The magneto cases, spark plugs, cables and connections are shielded to prevent radio interference.

Torque from the engine crankshaft is transmitted through the camshaft gear to the magneto drive gear. The magneto drive gear incorporates rubber bushings that engage the magneto impulse coupling. As the rubber bushings in the drive gear turn the coupling drive lugs, a counterweighted flyweight, inside the coupling cover, engage a pin on the magneto case and hold back the latch plate until it is forced inward by the coupling cover. When the latch plate is released, the coupling spring spins the magneto shaft through its neutral position and the breaker opens to produce a high voltage surge in the secondary coil. The spring action permits the latch plate, magneto and breaker to be delayed through a lag angle of 30 degrees of drive gear rotation during the engine cranking period. Two stop pins in the case and two lobes on the breaker cam produce two sparks per revolution of the drive shaft. After the engine is started, counterweights hold the flyweight clear of the stop pins and the magnet shaft is driven at full advance.

IO-360 Series engines ignition systems may use either CMI (Bendix) impulse coupled or Champion (Slick) magnetos in a dual configuration for redundant ignition to each cylinder. Dual spark plugs are installed in bosses in each cylinder head.

The magnetos are installed at the rear of the engine. The magneto drive gears are driven by the camshaft gear which is driven by the crankshaft gear. Magnetos may be fitted with a tachometer sensor installed in the magneto housing.

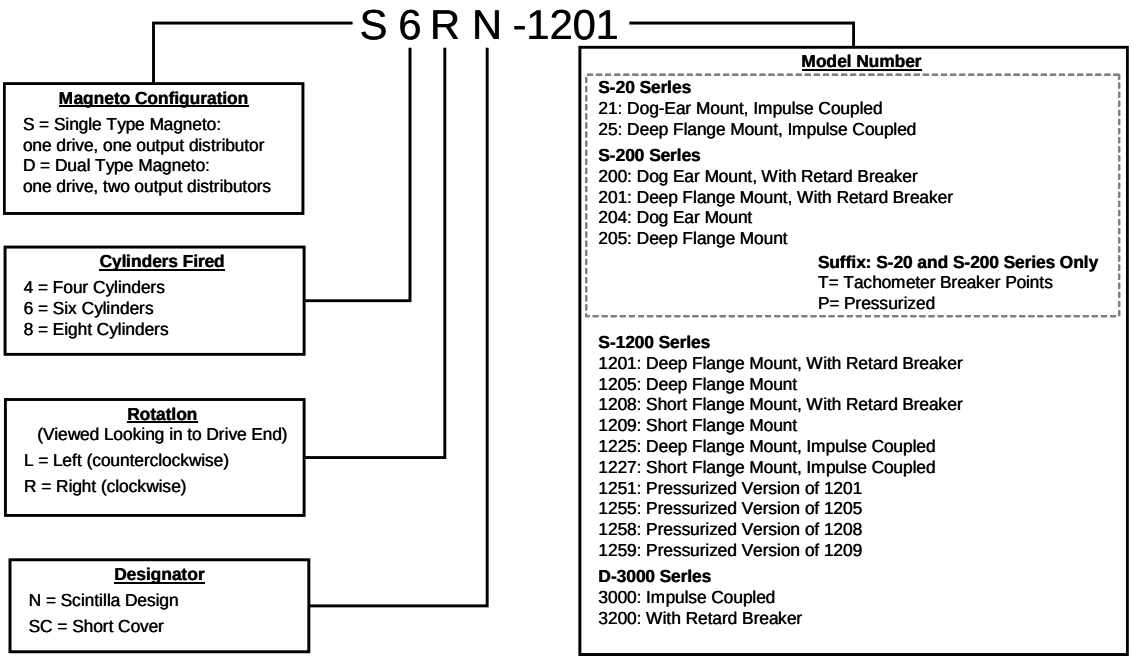


Figure 2-20. Continental Motors Magneto Part Number Definition

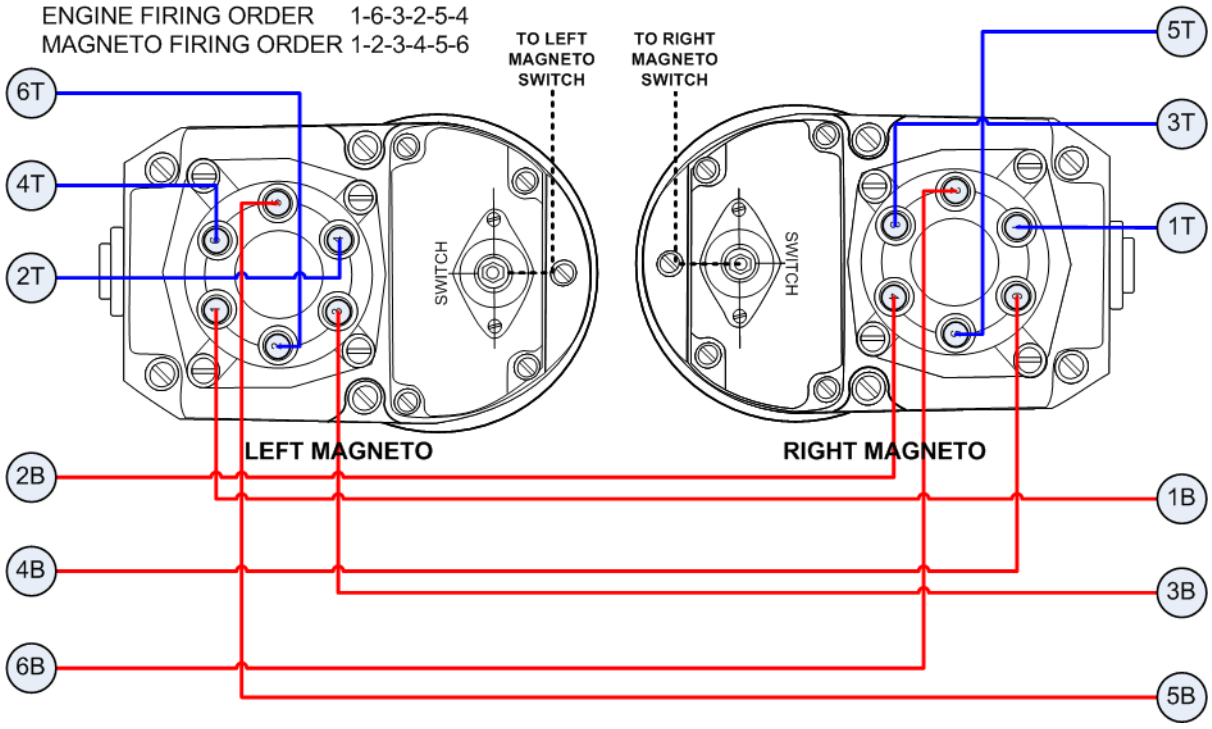


Figure 2-21. CM Ignition System Schematic

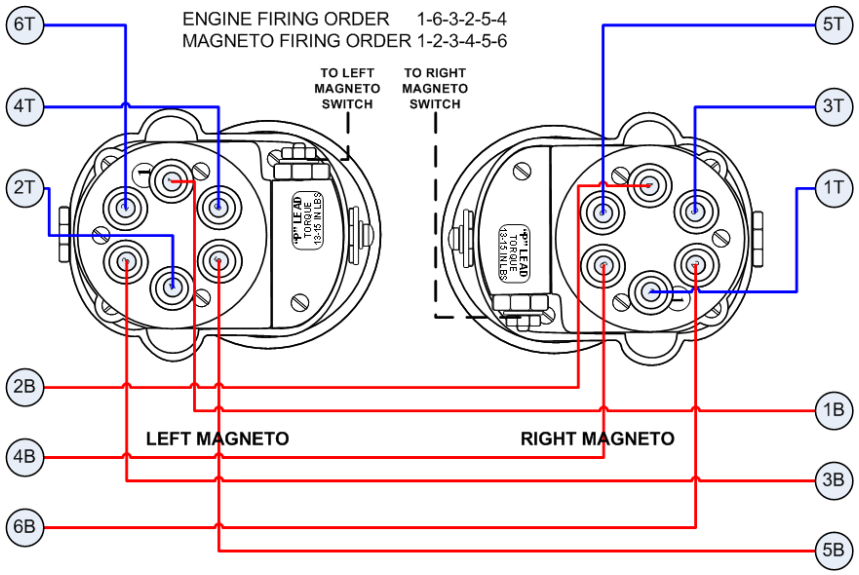


Figure 2-22. Champion (Slick) Ignition System Schematic

2-2.9. Engine Cooling

The engine cylinders are cooled by transferring heat from the cylinder barrel and cylinder head cooling fins to the surrounding airflow. The aircraft engine cowling, baffles, and baffle seals direct cooling air (which is ram air-induced by the aircraft's forward speed) evenly around the cylinders. This airflow is regulated by the size of the cooling air inlets and outlets. Increasing or decreasing outlet size with the use of cowl flaps changes airflow and is used as an aid in controlling engine operating temperatures.

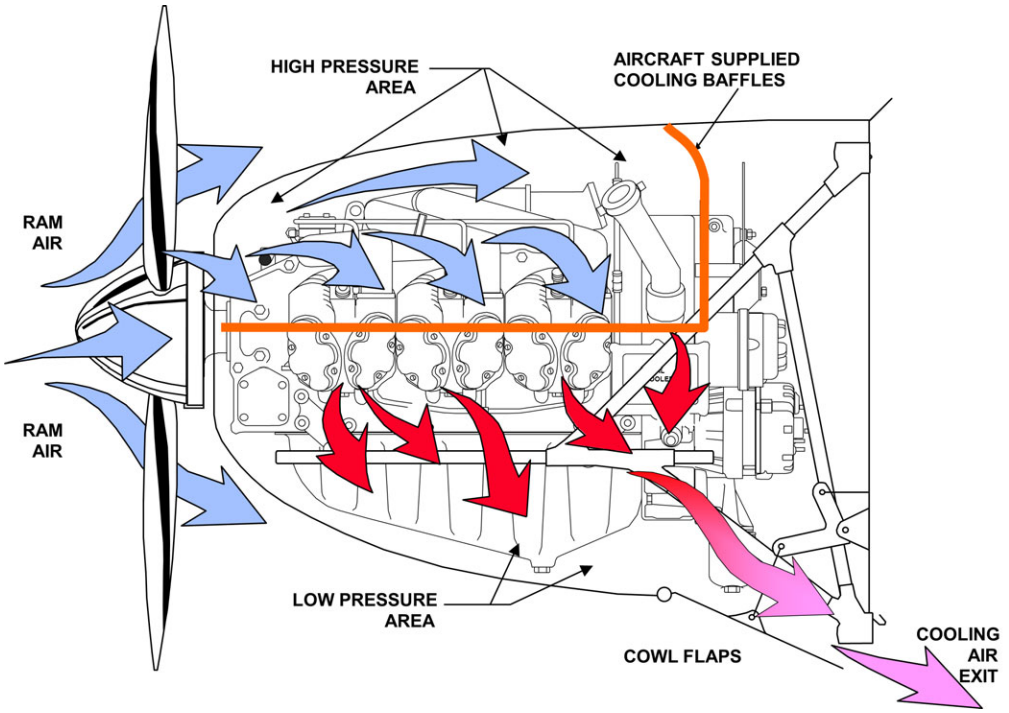


Figure 2-23. Engine Cooling

2-2.10. Induction System

The induction system components include the aircraft filter/alternate air door, throttle, manifold and cylinder intake ports. Air flows through these components in the order they are listed.

Refer to Aircraft Operating Handbook for alternate air door operation.

The induction system on the IO-360 (except AF and ES) is a six-tube, air distribution system mounted atop the engine. It serves to carry induction air to the individual cylinder intake ports. Refer to Figure 2-24.

The induction system on the IO-360-AF-ES is a eight-tube with a plenum intake manifold, air distribution system mounted atop the engine. It serves to carry induction air to the individual cylinder intake ports. Refer to Figure 2-25.

The cylinder intake ports are cast into the cylinder head assembly. Air from the manifold is carried into the intake ports, mixed with fuel from the injector nozzles, and then enters the cylinder as a combustible mixture when the intake valve opens.

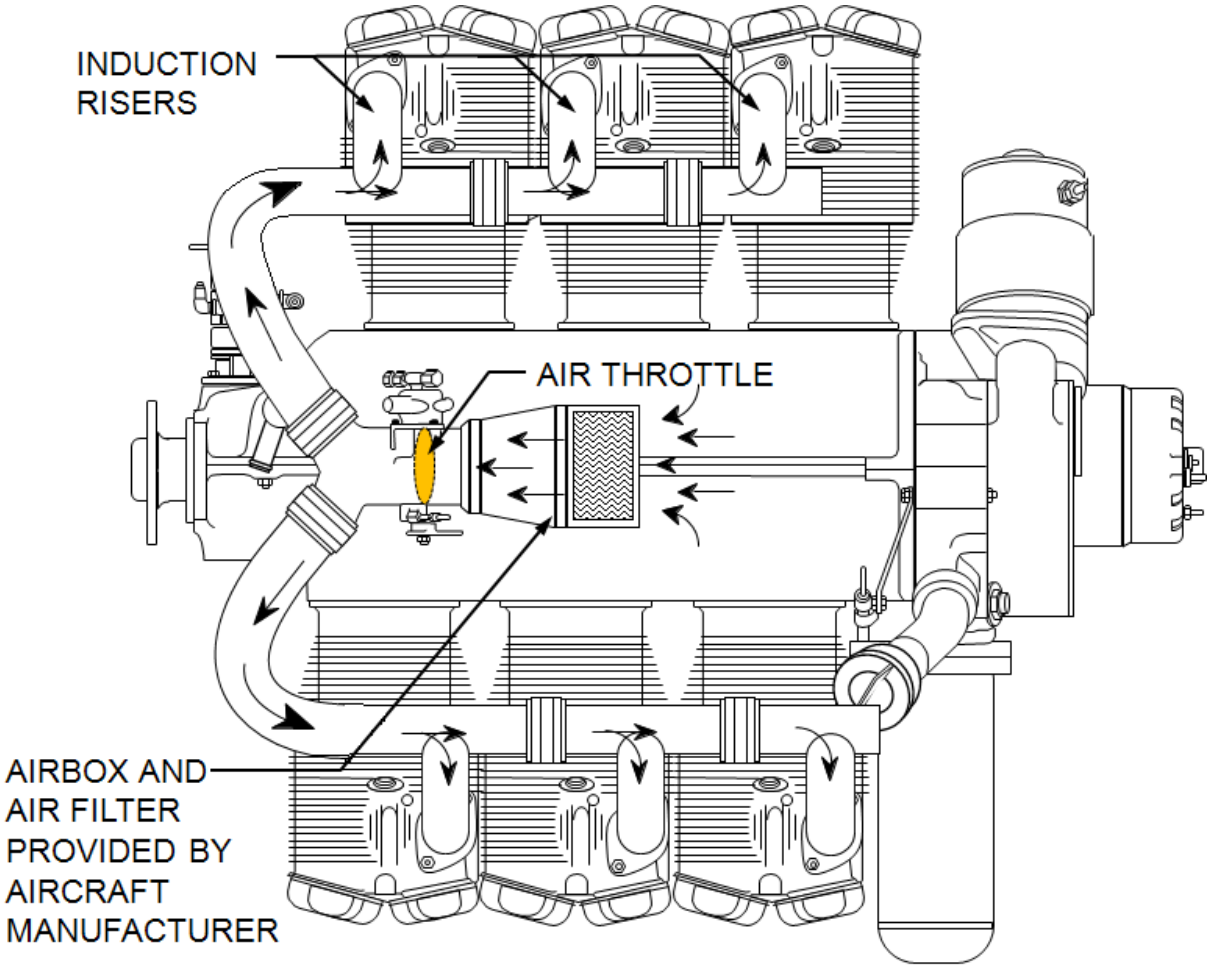


Figure 2-24. Induction System (Except AF and ES)

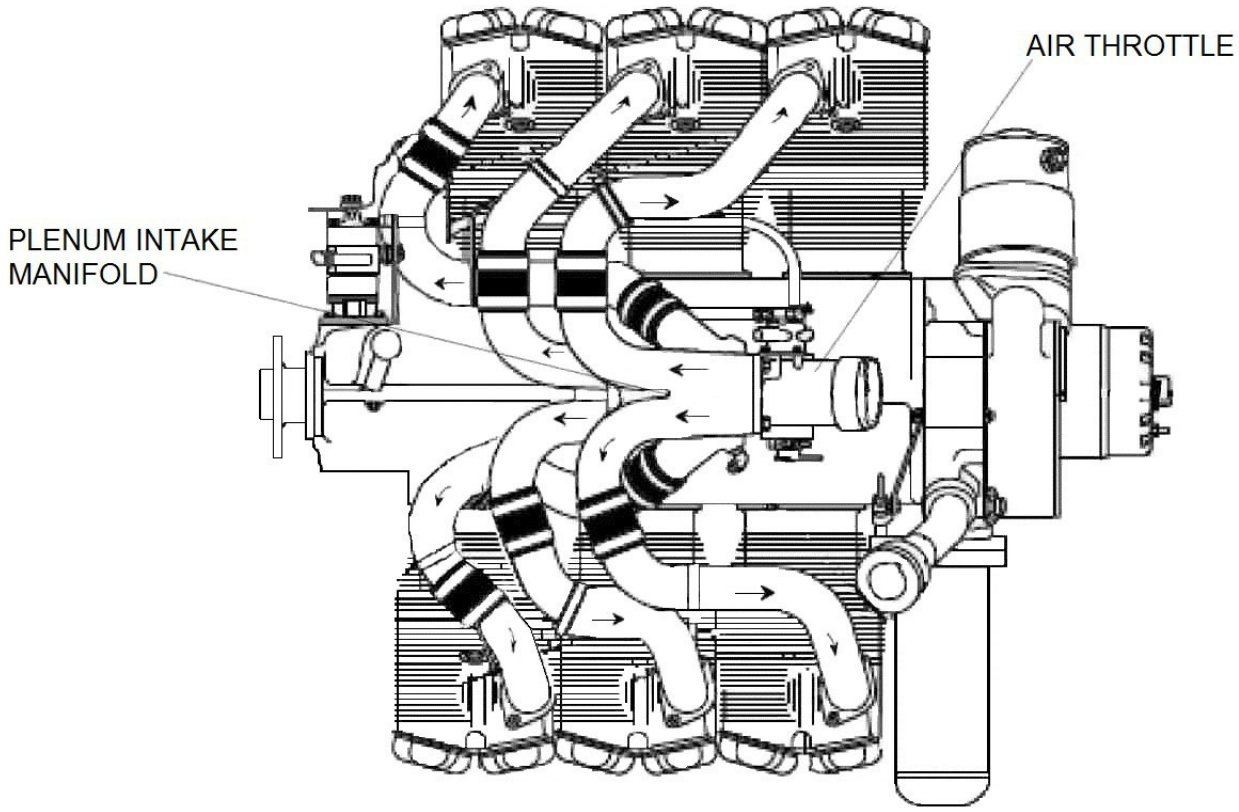


Figure 2-25. Induction System (AF and ES Models)

2-2.11. Exhaust System

CM provides exhaust manifold studs, gaskets and nuts with the engine. The balance of the engine exhaust system is provided by the aircraft manufacturer.

2-3. Engine Specifications

The IO-360 Series engine model specifications and operating limits are presented in separate tables on the following pages:

2-3.1. IO-360-A, AB Specifications

Table 2-3. IO-360-A, AB Specifications

General		
Model	IO-360-A, AB	
FAA Type Certificate	E1CE	
Installation Drawing Number	629385 - IO360A6B, A8B 631721 - IO360A5B, AB5B	
Arrangement	Individual cylinders, horizontally opposed	
Compression Ratio	8.5:1	
Number of Cylinders	6	
Firing Order	1-6-3-2-5-4	
Recommended Time Between Overhaul (TBO)	Refer to Chapter 6-3 in the Standard Practice Maintenance Manual (M-0)	
Bore	4.44 in.	11.278 cm
Stroke	3.88 in.	9.86 cm
Piston Displacement	360 cubic inches	5.90 L
Crankshaft Speed & Brake Horsepower		
Rated Maximum Continuous Operation[1]	195 bhp ±2.5% @2800 rpm	
Takeoff (5 minute, rpm full throttle)	210 bhp ±2.5% @2800 rpm	
Crankshaft Speed (Maximum rated)	2800 rpm	
Engine Idle Speed, Minimum	600 +/- 25 rpm	
Maximum Recommended Cruise	146 bhp @ 2450 rpm	
Fuel System Specifications		
Fuel Control System	CM Continuous Flow Fuel Injection	
Fuel Minimum Grade[2]	100LL Blue or 100 Green (ASTM D910)	
Russian Commonwealth of Independent States[3]	B95/130 (GOST 1012-72)	
People's Republic of China[3]	RH95/130 (GB1787-2008)	
Fuel System Pressure & Flow	Refer to Table 6-3	
Boost Fuel Pump Specifications	Refer to OI-7	
Fuel Consumption		
Power Level	BHP (kW)	lbs./hr (max)
Takeoff	210 (157)	
Rated Power, 100%	195 (145)	95
Cruise, 75%	146 (109)	70
Cruise, 65%	127 (95)	62
Cruise, 55%	107 (80)	55
Ignition		
Spark Plugs to be used	Refer to Chapter 6 in the Standard Practice Maintenance Manual (M-0)	
Ignition Timing	20° BTC ± 1°	
Spark Plug Gap	Refer to Chapter 6 in the Standard Practice Maintenance Manual (M-0)	

Table 2-3. IO-360-A, AB Specifications

Cylinder Temperature		
Normal Head Operational Temperature (cruise)[4]	380°F	193°C
Maximum Allowable Head Operational Temperature[4]	460°F	238°C
Minimum Head Takeoff Temperature[4]	240°F	116°C
Maximum Barrel Operational Temperature[5]	310°F	154°C
Exhaust		
Exhaust System back-pressure, maximum, measured at port, in Hg (kPa)		2.5 (8.5)
Oil		
Oil Pressure - Normal Operation @ 75° to 225°F (24° to107°C)[6]	30 to 60 psig	
Maximum Allowable Oil Pressure[6] (cold oil)	100 psig	
Minimum Oil Pressure @ Idle (600 RPM)[6]	10 psig at or below 200°F	
Maximum Allowable Oil Temperature[6]	225°F	107°C
Minimum Take-off Oil Temperature[6]	75°F	24°C
Cruise Flight Oil Temperature	160° to 180°F	71° to 82°C
Oil Sump Capacity	10.0 quarts	9.46L
Usable Oil - 25° Nose Up (10 quart fill)	7.0 quarts	6.62L
Usable Oil - 25° Nose Down (10 quart fill)	7.0 quarts	6.62L
Recommended Oil Grade, SAE - above 40° F	50 or Multi viscosity	
Recommended Oil Grade, SAE - below 40° F	30 or Multi viscosity	
Oil Grade	Refer to Chapter 3 in the Standard Practice Maintenance Manual (M-0)	
CAUTION: Oil must be aviation oil conforming to SAE J-1899 or SAE J -1966 specification.		
Brake Specific Oil Consumption		
Maximum BSOC = 0.006 lb./HP/HR		
Engine Physical Specifications		
Weight, dry (basic engine), lb. (kg) +/- 2.5% Detailed Weights by Specification Number	277.81 (126.0) Refer to OI-7	
Overall Dimensions, inches (mm) Height Width Length	 23.74 31.40 34.03	 (603.00) (797.6) (864.4)

1. Performance is based on sea level, standard day, zero water vapor pressure conditions at the throttle inlet and exhaust exit with no engine accessory load. Standard day conditions are 29.92 in. Hg and 59°F. Horsepower will vary approximately 1% for each 10° F (5.6° C) change in compressor inlet air temperature. Correction must also be made for the effect of exhaust back pressure and accessory drive losses. Contact CM engineering for correction factors for specific applications.
2. Engine is certified for operation with 100-LL Blue or 100 Green aviation fuel. If the minimum fuel grade is not available, use the next higher grade available; never use a lower grade fuel.
3. Operation with this fuel is limited to 9840 ft (2999 m) at maximum continuous power and speed and 19680 ft (5998 m) at maximum recommended cruise power and speed.
4. All temperatures are measured with bayonet thermocouples
5. Two drilled holes in flange to barrel fillet, thermocouple to be installed with CM drawing 630361.
6. Oil pressure and temperature are measured at the oil cooler adapter.

2-3.2. IO-360-AF Specifications

Table 2-4. IO-360-AF Specifications

General		
Model	IO-360-AF	
FAA Type Certificate	E1CE	
Installation Drawing Number	658511	
Arrangement	Individual cylinders, horizontally opposed	
Compression Ratio	7.5:1	
Number of Cylinders	6	
Firing Order	1-6-3-2-5-4	
Recommended Time Between Overhaul (TBO)	2000 accumulated hours or 12 years[1, 2]	
Bore	4.44 in.	11.278 cm
Stroke	3.88 in.	9.86 cm
Piston Displacement	360 cubic inches	5.90 L
Crankshaft Speed & Brake Horsepower		
Rated Maximum Continuous Operation[3]	195 bhp -0% +5% @2800 rpm	
Crankshaft Speed (Maximum rated)	2800 rpm	
Engine Idle Speed, Minimum	600 +/- 25 rpm	
Maximum Recommended Cruise	170 bhp @ 2600 rpm	
Fuel System Specifications		
Fuel Control System	CM Continuous Flow Fuel Injection	
Fuel Minimum Grade	91UL (ASTM D7547), 94UL (ASTM D7592)	
	91, 100, 100VLL, 100LL (ASTM D910)	
Russian Commonwealth of Independent States[4]	B95/130 (GOST 1012-72)	
People's Republic of China[4]	RH95/130 (GB1787-2008)	
Fuel System Pressure & Flow	Refer to Table 6-3	
Boost Fuel Pump Specifications	Refer to OI-7	
Fuel Consumption		
Power Level	BHP (kW)	lbs./hr (max)
Rated Power, 100%	195 (145.4)	100 - 107
Cruise, 75%	146 (108.9)	69 - 74
Cruise, 65%	128 (95.4)	63 - 68
Cruise, 60%	117 (87.2)	58 - 63
Ignition		
Spark Plugs to be used	Refer to Chapter 6 in the Standard Practice Maintenance Manual (M-0)	
Ignition Timing	24° BTC ± 1°	
Spark Plug Gap	Refer to Chapter 6 in the Standard Practice Maintenance Manual (M-0)	

Table 2-4. IO-360-AF Specifications

Cylinder Temperature		
Normal Head Operational Temperature (cruise)[5]	380°F	193°C
Maximum Allowable Head Operational Temperature[5]	460°F	238°C
Minimum Head Takeoff Temperature[5]	240°F	116°C
Maximum Barrel Operational Temperature[6]	310°F	154°C
Exhaust		
Exhaust System back pressure, maximum, measured at port, in Hg (kPa)		2.5 (8.5)
Oil		
Oil Pressure - Normal Operation @ 75° to 240°F (24° to116°C)[7]	30 to 60 psig	
Maximum Allowable Oil Pressure[7] (cold oil)	100 psig	
Minimum Oil Pressure @ Idle (700 RPM)[7]	10 psig at or below 240°F	
Maximum Allowable Oil Temperature[7]	240°F	116°C
Minimum Take-off Oil Temperature[7]	75°F	24°C
Cruise Flight Oil Temperature[7]	160° to 220°F	71° to 104°C
Oil Sump Capacity	8.0 quarts	7.6L
Usable Oil - 26° Nose Up (8 quart fill)	5.0 quarts	4.7L
Usable Oil - 18° Nose Down (8 quart fill)	5.0 quarts	4.7L
Recommended Oil Grade, SAE - above 40°F	50 or Multi viscosity	
Recommended Oil Grade, SAE - below 40°F	30 or Multi viscosity	
Oil Grade	Refer to Chapter 3 in the Standard Practice Maintenance Manual (M-0)	
CAUTION: Oil must be aviation oil conforming to SAE J-1899 or SAE J -1966 specification.		
Brake Specific Oil Consumption		
Maximum BSOC = 0.004 lb./HP/HR		
Engine Physical Specifications		
Weight, dry (basic engine), lb. (kg) +/- 2.5% Detailed Weights by Specification Number	293.66 (133.2) Refer to OI-7	
Overall Dimensions, inches (mm) Height Width Length	 26.22 33.05 36.32	 (665.9) (839.5) (922.5)

1. If an engine consistently accumulates 40 or more hours per month since being placed in service, add 200 hours to recommended TBO.
2. Engine models with serial number 1006000 and higher, add 200 hours to recommended TBO.
3. Performance is based on sea level, standard day, zero water vapor pressure conditions at the throttle inlet and exhaust exit with no engine accessory load. Standard day conditions are 29.92 in Hg and 59°F. Horsepower will vary approximately 1% for each 10°F (5.6° C) change in compressor inlet air temperature. Correction must also be made for the effect of exhaust back pressure and accessory drive losses. Contact CM engineering for correction factors for specific applications.
4. Operation with this fuel is limited to 9840 ft (2999 m) at maximum continuous power and speed and 19680 ft (5998 m) at maximum recommended cruise power and speed.
5. All temperatures are measured with bayonet thermocouples.
6. Two drilled holes in flange to barrel fillet, thermocouple to be installed with CM drawing 630361.
7. Oil pressure and temperature are measured at the oil cooler adapter.

2-3.3. IO-360-C, CB, G, GB, H, HB Specifications

Table 2-5. IO-360-C, CB, G, GB, H, HB Specifications

General		
Model	IO-360-C, CB, G, GB, H, HB	
FAA Type Certificate	E1CE	
Installation Drawing Number	632619	
Arrangement	Individual cylinders, horizontally opposed	
Compression Ratio	8.5:1	
Number of Cylinders	6	
Firing Order	1-6-3-2-5-4	
Recommended Time Between Overhaul (TBO)	Refer to Chapter 6-3 in the Standard Practice Maintenance Manual (M-0)	
Bore	4.44 in.	11.278 cm
Stroke	3.88 in.	9.86 cm
Piston Displacement	360 cubic inches	5.90 L
Crankshaft Speed & Brake Horsepower		
Rated Maximum Continuous Operation[1]	210 bhp ±2.5% @2800 rpm	
Crankshaft Speed (Maximum rated)	2800 rpm	
Engine Idle Speed, Minimum	600 +/- 25 rpm	
Maximum Recommended Cruise	157 bhp @ 2600 rpm	
Fuel System Specifications		
Fuel Control System	CM Continuous Flow Fuel Injection	
Fuel Minimum Grade [2]	100LL Blue or 100 Green (ASTM D910)	
Russian Commonwealth of Independent States[3]	B95/130 (GOST 1012-72)	
People's Republic of China[3]	RH95/130 (GB1787-2008)	
Fuel System Pressure & Flow	Refer toTable 6-3	
Boost Fuel Pump Specifications	Refer to OI-7	
Fuel Consumption		
Power Level	BHP (kW)	lbs./hr (max)
Rated Power, 100%	210 (157)	103
Cruise, 75%	157 (117)	76
Cruise, 65%	136 (101)	67
Cruise, 55%	115 (86)	58
Ignition		
Spark Plugs to be used	Refer to Chapter 6 in the Standard Practice Maintenance Manual (M-0)	
Ignition Timing	20° BTC ± 1°	
Spark Plug Gap	Refer to Chapter 6 in the Standard Practice Maintenance Manual (M-0)	

Table 2-5. IO-360-C, CB, G, GB, H, HB Specifications

Cylinder Temperature		
Normal Head Operational Temperature (cruise)[4]	380°F	193°C
Maximum Allowable Head Operational Temperature[4]	460°F	238°C
Minimum Head Takeoff Temperature[4]	240°F	116°C
Maximum Barrel Operational Temperature[5]	310°F	154°C
Exhaust		
Exhaust System back pressure, maximum, measured at port, in Hg (kPa)		2.5 (8.5)
Oil		
Oil Pressure - Normal Operation @ 75° to 240°F (24° to116°C)[6]	30 to 60 psig	
Maximum Allowable Oil Pressure[6] (cold oil)	100 psig	
Minimum Oil Pressure @ Idle (600 RPM)[6]	10 psig at or below 240°F	
Maximum Allowable Oil Temperature[6]	240°F	116°C
Minimum Take-off Oil Temperature[6]	75°F	24°C
Cruise Flight Oil Temperature[6]	160° to 180°F	71° to 82°F
Oil Sump Capacity	10.0 quarts	9.46L
Usable Oil - 25° Nose Up (10 quart fill)	7.0 quarts	6.62L
Usable Oil - 25° Nose Down (10 quart fill)	7.0 quarts	6.62L
Recommended Oil Grade, SAE - above 40°F	50 or Multi viscosity	
Recommended Oil Grade, SAE - below 40°F	30 or Multi viscosity	
Oil Grade	Refer to Chapter 3 in the Standard Practice Maintenance Manual (M-0)	
CAUTION: Oil must be aviation oil conforming to SAE J-1899 or SAE J -1966 specification.		
Brake Specific Oil Consumption		
Maximum BSOC = 0.006 lb./HP/HR		
Engine Physical Specifications		
Weight, dry (basic engine), lb. (kg) +/- 2.5% Detailed Weights by Specification Number	277.81 (126.0) Refer to OI-7	
Overall Dimensions, inches (mm) Height Width Length	 22.43 33.03 35.34	 (569.7) (839.0) (897.6)

1. Performance is based on sea level, standard day, zero water vapor pressure conditions at the throttle inlet and exhaust exit with no engine accessory load. Standard day conditions are 29.92 in Hg and 59°F. Horsepower will vary approximately 1% for each 10°F (5.6° C) change in compressor inlet air temperature. Correction must also be made for the effect of exhaust back pressure and accessory drive losses. Contact CM engineering for correction factors for specific applications.
2. Engine is certified for operation with 100-LL Blue or 100 Green aviation fuel. If the minimum fuel grade is not available, use the next higher grade available; never use a lower grade fuel.
3. Engine operation with this fuel is limited to 9840 ft (2999 m) at maximum continuous power and speed and 19680 feet (5998 m) at maximum recommended cruise power and speed.
4. All temperatures are measured with bayonet thermocouples.
5. Two drilled holes in flange to barrel fillet, thermocouple to be installed with CM drawing 630361.
6. Oil pressure and temperature are measured at the oil cooler adapter.

2-3.4. IO-360-D,DB Specifications

Table 2-6. IO-360-D, DB Specifications

General		
Model	IO-360-D, DB	
FAA Type Certificate	E1CE	
Installation Drawing Number	629385 - IO360D23C, D37B only 631721 - IO360D33B, DB33B only 632619 - applicable to all other D and DB model specifications	
Arrangement	Individual cylinders, horizontally opposed	
Compression Ratio	8.5:1	
Number of Cylinders	6	
Firing Order	1-6-3-2-5-4	
Recommended Time Between Overhaul (TBO)	Refer to Chapter 6-3 in the Standard Practice Maintenance Manual (M-0)	
Bore	4.44 in.	11.278 cm
Stroke	3.88 in.	9.86 cm
Piston Displacement	360 cubic inches	5.90 L
Crankshaft Speed & Brake Horsepower		
Rated Maximum Continuous Operation[1]	210 bhp ±2.5% @2800 rpm	
Crankshaft Speed (Maximum rated)	2800 rpm	
Engine Idle Speed, Minimum	600 +/- 25 rpm	
Maximum Recommended Cruise	157 bhp @ 2600 rpm	
Fuel System Specifications		
Fuel Control System	CM Continuous Flow Fuel Injection	
Fuel Minimum Grade [2]	100LL Blue or 100 Green (ASTM D910)	
Russian Commonwealth of Independent States[3]	B95/130 (GOST 1012-72)	
People's Republic of China[3]	RH95/130 (GB1787-2008)	
Fuel System Pressure & Flow	Refer to Table 6-3	
Boost Fuel Pump Specifications	Refer to OI-7	
Fuel Consumption		
Power Level	BHP (kW)	lbs./hr (max)
Rated Power, 100%	210 (157)	103
Cruise, 75%	157 (117)	76
Cruise, 65%	136 (101)	67
Cruise, 55%	115 (86)	58
Ignition		
Spark Plugs to be used	Refer to Chapter 6 in the Standard Practice Maintenance Manual (M-0)	
Ignition Timing	20° BTC ± 1°	
Spark Plug Gap	Refer to Chapter 6 in the Standard Practice Maintenance Manual (M-0)	

Table 2-6. IO-360-D, DB Specifications

Cylinder Temperature		
Normal Head Operational Temperature (cruise)[4]	380°F	193°C
Maximum Allowable Head Operational Temperature[4]	460°F	238°C
Minimum Head Takeoff Temperature[4]	240°F	116°C
Maximum Barrel Operational Temperature[5]	310°F	154°C
Exhaust		
Exhaust System back pressure, maximum, measured at port, in Hg (kPa)		2.5 (8.5)
Oil		
Oil Pressure - Normal Operation @ 75° to 240°F (24° to116°C)[6]	30 to 60 psig	
Maximum Allowable Oil Pressure[6] (cold oil)	100 psig	
Minimum Oil Pressure @ Idle (600 RPM)[6]	10 psig at or below 240°F	
Maximum Allowable Oil Temperature[6]	240°F	116°C
Minimum Take-off Oil Temperature[6]	75°F	24°C
Cruise Flight Oil Temperature[6]	160° to 180°F	71° to 82°F
Oil Sump Capacity	10.0 quarts	9.46L
Usable Oil - 25° Nose Up (10 quart fill)	7.0 quarts	6.62L
Usable Oil - 25° Nose Down (10 quart fill)	7.0 quarts	6.62L
Recommended Oil Grade, SAE - above 40°F	50 or Multi viscosity	
Recommended Oil Grade, SAE - below 40°F	30 or Multi viscosity	
Oil Grade	Refer to Chapter 3 in the Standard Practice Maintenance Manual (M-0)	
CAUTION: Oil must be aviation oil conforming to SAE J-1899 or SAE J -1966 specification.		
Brake Specific Oil Consumption		
Maximum BSOC = 0.006 lb./HP/HR		
Engine Physical Specifications		
Weight, dry (basic engine), lb. (kg) +/- 2.5% Detailed Weights by Specification Number	277.81 (126.0) Refer to OI-7	
Overall Dimensions, inches (mm) Height Width Length	 22.43 33.04 34.03	 (569.7) (839.2) (864.4)

1. Performance is based on sea level, standard day, zero water vapor pressure conditions at the throttle inlet and exhaust exit with no engine accessory load. Standard day conditions are 29.92 in Hg and 59°F. Horsepower will vary approximately 1% for each 10° F (5.6° C) change in compressor inlet air temperature. Correction must also be made for the effect of exhaust back pressure and accessory drive losses. Contact CM engineering for correction factors for specific applications.
2. Engine is certified for operation with 100-LL Blue or 100 Green aviation fuel. If the minimum fuel grade is not available, use the next higher grade available; never use a lower grade fuel.
3. Engine operation with this fuel is limited to 9840 ft (2999 m) at maximum continuous power and speed and 19680 feet (5998 m) at maximum recommended cruise power and speed.
4. All temperatures are measured with bayonet thermocouples.
5. Two drilled holes in flange to barrel fillet, thermocouple to be installed with CM drawing 630361.
6. Oil pressure and temperature are measured at the oil cooler adapter.

2-3.5. IO-360-J, JB, K Specifications

Table 2-7. IO-360-J, JB, K Specifications

General		
Model	IO-360-J, JB, K	
FAA Type Certificate	E1CE	
Installation Drawing Number	632619	
Arrangement	Individual cylinders, horizontally opposed	
Compression Ratio	8.5:1	
Number of Cylinders	6	
Firing Order	1-6-3-2-5-4	
Time Between Overhaul (TBO)	Refer to Chapter 6-3 in the Standard Practice Maintenance Manual (M-0)	
Bore	4.44 in.	11.278 cm
Stroke	3.88 in.	9.86 cm
Piston Displacement	360 cubic inches	5.90 L
Crankshaft Speed & Brake Horsepower		
Rated Maximum Continuous Operation[1]	195 bhp ±2.5% @ 2600 rpm	
Takeoff (5 minute, rpm full throttle)[2]	210 bhp ±2.5% @2800 rpm	
Crankshaft Speed (Maximum rated)	2800 rpm	
Engine Idle Speed, Minimum	600 +/- 25 rpm	
Maximum Recommended Cruise	157 bhp @ 2600 rpm	
Fuel System Specifications		
Fuel Control System	CM Continuous Flow Fuel Injection	
Fuel Minimum Grade [3]	100LL Blue or 100 Green (ASTM D910)	
Russian Commonwealth of Independent States[4]	B95/130 (GOST 1012-72)	
People's Republic of China[4]	RH95/130 (GB1787-2008)	
Fuel System Pressure & Flow	Refer to Table 6-3	
Boost Fuel Pump Specifications	Refer to OI-7	
Fuel Consumption		
Power Level	BHP (kW)	lbs./hr (max)
Takeoff	210 (157)	
Rated Power, 100%	195 (145)	95
Cruise, 85%	157 (117)	76
Cruise, 75%	136 (101)	67
Cruise, 65%	115 (86)	58
Ignition		
Spark Plugs to be used	Refer to Chapter 6 in the Standard Practice Maintenance Manual (M-0)	
Ignition Timing	20° BTC ± 1°	
Spark Plug Gap	Refer to Chapter 6 in the Standard Practice Maintenance Manual (M-0)	

Table 2-7. IO-360-J, JB, K Specifications

Cylinder Temperature		
Normal Head Operational Temperature (cruise)[5]	380°F	193°C
Maximum Allowable Head Operational Temperature[5]	460°F	238°C
Minimum Head Takeoff Temperature[5]	240°F	116°C
Maximum Barrel Operational Temperature[6]	310°F	154°C
Exhaust		
Exhaust System back pressure, maximum, measured at port, in Hg (kPa)		2.5 (8.5)
Oil		
Oil Pressure - Normal Operation @ 75° to 240°F (24° to116°C)[7]	30 to 60 psig	
Maximum Allowable Oil Pressure[7] (cold oil)	100 psig	
Minimum Oil Pressure @ Idle (600 RPM)[7]	10 psig at or below 240°F	
Maximum Allowable Oil Temperature[7]	240°F	116°C
Minimum Take-off Oil Temperature[7]	75°F	24°C
Cruise Flight Oil Temperature[7]	160° to 180° F	71° to 82° F
Oil Sump Capacity	10.0 quarts	9.46L
Usable Oil - 25° Nose Up (10 quart fill)	7.0 quarts	6.62L
Usable Oil - 25° Nose Down (10 quart fill)	7.0 quarts	6.62L
Recommended Oil Grade, SAE - above 40° F	50 or Multi viscosity	
Recommended Oil Grade, SAE - below 40° F	30 or Multi viscosity	
Oil Grade	Refer to Chapter 3 in the Standard Practice Maintenance Manual (M-0)	
CAUTION: Oil must be aviation oil conforming to SAE J-1899 or SAE J -1966 specification.		
Brake Specific Oil Consumption		
Maximum BSOC = 0.006 lb./HP/HR		
Engine Physical Specifications		
Weight, dry (basic engine), lb. (kg) +/- 2.5% Detailed Weights by Specification Number	277.81 (126.0) Refer to OI-7	
Overall Dimensions, inches (mm) Height Width Length	 22.43 33.03 35.34	 (569.7) (839.0) (897.6)

1. Performance is based on sea level, standard day, zero water vapor pressure conditions at the throttle inlet and exhaust exit with no engine accessory load. Standard day conditions are 29.92 in Hg and 59°F. Horsepower will vary approximately 1% for each 10° F (5.6° C) change in compressor inlet air temperature. Correction must also be made for the effect of exhaust back pressure and accessory drive losses. Contact CM engineering for correction factors for specific applications.
2. J and JB Only
3. Engine is certified for operation with 100-LL Blue or 100 Green aviation fuel. If the minimum fuel grade is not available, use the next higher grade available; never use a lower grade fuel.
4. Engine operation with this fuel is limited to 9840 ft (2999 m) at maximum continuous power and speed and 19680 feet (5998 m) at maximum recommended cruise power and speed.
5. All temperatures are measured with bayonet thermocouples.
6. Two drilled holes in flange to barrel fillet, thermocouple to be installed with CM drawing 630361.
7. Oil pressure and temperature are measured at the oil cooler adapter.

2-3.6. IO-360-KB Specifications

Table 2-8. IO-360-KB Specifications

General		
Model	IO-360-KB	
FAA Type Certificate	E1CE	
Installation Drawing Number	632619	
Arrangement	Individual cylinders, horizontally opposed	
Compression Ratio	8.5:1	
Number of Cylinders	6	
Firing Order	1-6-3-2-5-4	
Time Between Overhaul (TBO)	Refer to Chapter 6-3 in the Standard Practice Maintenance Manual (M-0)	
Bore	4.44 in.	11.278 cm
Stroke	3.88 in.	9.86 cm
Piston Displacement	360 cubic inches	5.90 L
Crankshaft Speed & Brake Horsepower		
Rated Maximum Continuous Operation[1]	195 bhp ±2.5% @ 2600 rpm	
Crankshaft Speed (Maximum rated)	2800 rpm	
Engine Idle Speed, Minimum	600 +/- 25 rpm	
Maximum Recommended Cruise	157 bhp @ 2600 rpm	
Fuel System Specifications		
Fuel Control System	CM Continuous Flow Fuel Injection	
Fuel Minimum Grade [2]	100LL Blue or 100 Green (ASTM D910)	
Russian Commonwealth of Independent States[3]	B95/130 (GOST 1012-72)	
People's Republic of China[3]	RH95/130 (GB1787-2008)	
Fuel System Pressure & Flow	Refer to Table 6-3	
Boost Fuel Pump Specifications	Refer to OI-7	
Fuel Consumption		
Power Level	BHP (kW)	lbs./hr (max)
Rated Power, 100%	195 (145)	95
Cruise, 85%	157 (117)	76
Cruise, 75%	136 (101)	67
Cruise, 65%	115 (86)	58
Ignition		
Spark Plugs to be used	Refer to Chapter 6 in the Standard Practice Maintenance Manual (M-0)	
Ignition Timing	20° BTC ± 1°	
Spark Plug Gap	Refer to Chapter 6 in the Standard Practice Maintenance Manual (M-0)	

Table 2-8. IO-360-KB Specifications

Cylinder Temperature		
Normal Head Operational Temperature (cruise)[4]	380°F	193°C
Maximum Allowable Head Operational Temperature[4]	460°F	238°C
Minimum Head Takeoff Temperature[4]	240°F	116°C
Maximum Barrel Operational Temperature[5]	310°F	154°C
Exhaust		
Exhaust System back pressure, maximum, measured at port, in Hg (kPa)		2.5 (8.5)
Oil		
Oil Pressure - Normal Operation @ 75° to 240°F (24° to116°C)[6]	30 to 60 psig	
Maximum Allowable Oil Pressure[6] (cold oil)	100 psig	
Minimum Oil Pressure @ Idle (600 RPM)[6]	10 psig at or below 240°F	
Maximum Allowable Oil Temperature[6]	240°F	116°C
Minimum Take-off Oil Temperature[6]	75°F	24°C
Cruise Flight Oil Temperature[6]	160° to 180° F	71° to 82° F
Oil Sump Capacity	10.0 quarts	9.46L
Usable Oil - 25° Nose Up (10 quart fill)	7.0 quarts	6.62L
Usable Oil - 25° Nose Down (10 quart fill)	7.0 quarts	6.62L
Recommended Oil Grade, SAE - above 40° F	50 or Multi viscosity	
Recommended Oil Grade, SAE - below 40° F	30 or Multi viscosity	
Oil Grade	Refer to Chapter 3 in the Standard Practice Maintenance Manual (M-0)	
CAUTION: Oil must be aviation oil conforming to SAE J-1899 or SAE J -1966 specification.		
Brake Specific Oil Consumption		
Maximum BSOC = 0.006 lb./HP/HR		
Engine Physical Specifications		
Weight, dry (basic engine), lb. (kg) +/- 2.5% Detailed Weights by Specification Number	277.81 (126.0) Refer to OI-7	
Overall Dimensions, inches (mm) Height Width Length	 22.43 33.03 35.34	 (569.7) (839.0) (897.6)

1. Performance is based on sea level, standard day, zero water vapor pressure conditions at the throttle inlet and exhaust exit with no engine accessory load. Standard day conditions are 29.92 in Hg and 59°F. Horsepower will vary approximately 1% for each 10° F (5.6° C) change in compressor inlet air temperature. Correction must also be made for the effect of exhaust back pressure and accessory drive losses. Contact CM engineering for correction factors for specific applications.
2. Engine is certified for operation with 100-LL Blue or 100 Green aviation fuel. If the minimum fuel grade is not available, use the next higher grade available; never use a lower grade fuel.
3. Engine operation with this fuel is limited to 9840 ft (2999 m) at maximum continuous power and speed and 19680 feet (5998 m) at maximum recommended cruise power and speed.
4. All temperatures are measured with bayonet thermocouples.
5. Two drilled holes in flange to barrel fillet, thermocouple to be installed with CM drawing 630361.
6. Oil pressure and temperature are measured at the oil cooler adapter.

2-3.7. IO-360-ES Specifications

Table 2-9. IO-360-ES Specifications

General		
Model	IO-360-ES	
FAA Type Certificate	E1CE	
Installation Drawing Number	656139 - IO360ES6B, 16B, 21B, 22B, 25B, 26B, 27B and 28B only 652898 - applicable to all other model specifications	
Arrangement	Individual cylinders, horizontally opposed	
Compression Ratio	8.5:1	
Number of Cylinders	6	
Firing Order	1-6-3-2-5-4	
Recommended Time Between Overhaul (TBO)	Refer to Chapter 6-3 in the Standard Practice Maintenance Manual (M-0)	
Bore	4.44 in.	11.278 cm
Stroke	3.88 in.	9.86 cm
Piston Displacement	360 cubic inches	5.90 L
Crankshaft Speed & Brake Horsepower		
Rated Maximum Continuous Operation[1]	210 bhp -0% +5% @2800 rpm	
Crankshaft Speed (Maximum rated)	2800 rpm	
Engine Idle Speed, Minimum	600 +/- 25 rpm	
Maximum Recommended Cruise (75% Power)	157 bhp @ 2500 rpm	
Fuel System Specifications		
Fuel Control System	CM Continuous Flow Fuel Injection	
Fuel Minimum Grade[2]	100LL Blue or 100 Green (ASTM D910)	
Russian Commonwealth of Independent States[3]	B95/130 (GOST 1012-72)	
People's Republic of China[3]	RH95/130 (GB1787-2008)	
Fuel System Pressure & Flow	Refer to Table 6-3	
Boost Fuel Pump Specifications	Refer to OI-7	
Fuel Consumption		
Power Level	BHP (kW)	lbs./hr (max)
Rated Power, 100%	210 (156.6)	100 - 107
Cruise, 75%	157 (117.1)	60 - 80
Cruise, 65%	137 (102.2)	53 - 72
Cruise, 55%	116 (86.5)	49 - 64
Ignition		
Spark Plugs to be used	Refer to Chapter 6 in the Standard Practice Maintenance Manual (M-0)	
Ignition Timing	24° BTC ± 1°	
Spark Plug Gap	Refer to Chapter 6 in the Standard Practice Maintenance Manual (M-0)	

Table 2-9. IO-360-ES Specifications

Cylinder Temperature		
Normal Head Operational Temperature (cruise)[4]	420°F	216°C
Maximum Allowable Head Operational Temperature[4]	460°F	238°C
Minimum Head Takeoff Temperature[4]	240°F	116°C
Maximum Barrel Operational Temperature[5]	310°F	154°C
Induction		
Mass Flow - sea level, standard day conditions, 210 bhp (231 kW)		22 lb./min (9.9 kg/min)
Exhaust		
Exhaust System back pressure, maximum, measured at port, in Hg (kPa)		2.5 (8.5)
Oil		
Oil Pressure - Normal Operation @ 75° to 240°F (24° to116°C)[6]	30 to 60 psig	
Maximum Allowable Oil Pressure[6] (cold oil)	100 psig	
Minimum Oil Pressure @ Idle (700 RPM)[6]	10 psig at or below 240°F	
Maximum Allowable Oil Temperature[6]	240°F	116°C
Minimum Take-off Oil Temperature[6]	75°F	24°C
Cruise Flight Oil Temperature[6]	160° to 220°F	71° to 104°C
Oil Sump Capacity	8.0 quarts	7.6L
Usable Oil - 26° Nose Up (8 quart fill)	5.0 quarts	4.7L
Usable Oil - 18° Nose Down (8 quart fill)	5.0 quarts	4.7L
Recommended Oil Grade, SAE - above 40°F	50 or Multi viscosity	
Recommended Oil Grade, SAE - below 40°F	30 or Multi viscosity	
Oil Grade	Refer to Chapter 3 in the Standard Practice Maintenance Manual (M-0)	
CAUTION: Oil must be aviation oil conforming to SAE J-1899 or SAE J -1966 specification.		
Brake Specific Oil Consumption		
Maximum BSOC = 0.004 lb./HP/HR		
Engine Physical Specifications		
Weight, dry (basic engine), lb. (kg) +/- 2.5% Detailed Weights by Specification Number	305.00 (138.3) Refer to OI-7	
Overall Dimensions, inches (mm) Height Width Length	 26.22 33.05 36.32	 (665.9) (839.5) (922.5)

1. Performance is based on sea level, standard day, zero water vapor pressure conditions at the throttle inlet and exhaust exit with no engine accessory load. Standard day conditions are 29.92 in Hg and 59°F. Horsepower will vary approximately 1% for each 10°F (5.6° C) change in compressor inlet air temperature. Correction must also be made for the effect of exhaust back pressure and accessory drive losses. Contact CM engineering for correction factors for specific applications.
2. Engine is certified for operation with 100-LL Blue or 100 Green aviation fuel. If the minimum fuel grade is not available, use the next higher grade available; never use a lower grade fuel.
3. Operation with this fuel is limited to 9840 ft (2999 m) at maximum continuous power and speed and 19680 ft (5998 m) at maximum recommended cruise power and speed.
4. All temperatures are measured with bayonet thermocouples.
5. Two drilled holes in flange to barrel fillet, thermocouple to be installed with CM drawing 630361.
6. Oil pressure and temperature are measured at the oil cooler adapter.

2-3.8. IO-360-Accessory Drive Ratios

The IO-360 Series engine model accessory drive ratios are presented in separate tables on the following pages:

Table 2-10. IO-360-A, AB Accessory Drive Ratios

Accessory	Direction of Rotation[1]	Drive Ratio to Crankshaft	Maximum Torque (in. lbs.)		Maximum Overhang Moment, (in lbs.)
			Cont.	Static	
Magneto	CCW	1.5:1	-	-	-
Starter Motor	CW	24.727:1	-	-	-
Alternator	CCW	2.035:1	60	100	100
Propeller Governor[2]	CW	1:1	29	825	50
Fuel Pump	CW	1:1	-	-	-
Vacuum Pump[3]	CCW	1.545:1	100	800	25

1. CW = Clockwise Rotation CCW = Counterclockwise rotation; viewed facing the drive.
2. Drive is a modified AND20010 and shall be supplied with a cover
3. Drive pads conform to AND20000, optionally, per MS3325 modified, and shall be provided with covers

Table 2-11. IO-360-AF Accessory Drive Ratios

Accessory	Direction of Rotation[1]	Drive Ratio to Crankshaft	Maximum Torque (in. lbs.)		Maximum Overhang Moment, (in lbs.)
			Cont.	Static	
Optional Tachometer Adapter (mechanical)	CCW	1.239	-	-	-
Optional Tachometer Reduction Adapter[2]	CW	0.495	-	-	-
Magneto	CCW	1.5:1	-	-	-
Propeller Governor[3]	CW	1:1	29	825	50
Fuel Pump	CW	1:1	-	-	-
Alternator	CCW	2.035:1	60	100	100
Oil Cooler	-	-	-	-	65

1. CW = Clockwise Rotation CCW = Counterclockwise rotation; viewed facing the drive.
2. Installs onto mechanical tachometer adapter.
3. Drive is a modified AND20010 and shall be supplied with a cover.

Table 2-12. IO-360-ES Accessory Drive Ratios

Accessory	Direction of Rotation[1]	Drive Ratio to Crankshaft	Maximum Torque (in. lbs.)		Maximum Overhang Moment, (in lbs.)
			Cont.	Static	
Optional Tachometer Adapter (mechanical)	CCW	1.239	-	-	-
Optional Tachometer Reduction Adapter[2]	CW	0.495	-	-	-
Magneto	CCW	1.5:1	-	-	-
Vacuum Pump Pad[3]	CCW[4]	1.545:1	100	400	25
Propeller Governor[5]	CW	1:1	29	825	50
Fuel Pump	CW	1:1	-	-	-
Alternator	CCW	2.035:1	60	100	100
Oil Cooler	-	-	-	-	65
Optional Compressor Drive (V-Belt)	CW	3.25:1	110	400	-
Optional Alternator Drive (V-Belt)	CW	3.18:1	110	400	-

1. CW = Clockwise Rotation CCW = Counterclockwise rotation; viewed facing the drive.
2. Installs onto mechanical tachometer adapter.
3. Drive pads conform to AND20000, optionally, per MS3325 modified, and shall be provided with covers.
4. When optional alternator drive is installed, the right drive on the extension gear box rotates CW.
5. Drive is a modified AND20010 and shall be supplied with a cover.

Table 2-13. IO-360-C, CB, G, GB Accessory Drive Ratios

Accessory	Direction of Rotation[1]	Drive Ratio to Crankshaft	Maximum Torque (in. lbs.)		Maximum Overhang Moment, (in lbs.)
			Cont.	Static	
Tachometer (Mag. Pick-up)	-	-	-	-	-
Magneto	CCW	1.5:1	-	-	-
Starter Motor	CW	24.727:1	200	400	60
Alternator (Gear Drive)	CCW	2.035:1	60	600	50
Propeller Governor[2]	CW	1:1	29	825	50
Fuel Pump (Injection)	CW	1:1	25	680	60
Accessory Drive (1-3-5 Side)[3]	CW	1.316:1	27	800	8.3
Accessory Drive (2-4-6 Side)[4]	CCW	1.316:1	27	800	8.3
Oil Cooler	-	-	-	-	65 Wet

1. CW = Clockwise Rotation CCW = Counterclockwise rotation; viewed facing the drive.
2. Drive is a modified AND20010 (speed increased to 2800 RPM) and shall be supplied with a cover.
3. Drive is a modified AND20000 (No oil provisions and accessory clearance restricted) and shall be supplied with a cover.
4. Drive is a modified AND20000 (opposite rotation) and shall be supplied with a cover.

Table 2-14. IO-360-D, DB, H, HB, J, JB Accessory Drive Ratios

Accessory	Direction of Rotation[1]	Drive Ratio to Crankcase	Maximum Torque (in. lbs.)		Maximum Overhang Moment, (in lbs.)
			Cont.	Static	
Tachometer (Mag. Pick-up)	-	-	-	-	-
Magneto	CW	1.5:1	-	-	-
Starter Motor	CW	24.727:1	200	400	60
Alternator (Gear Drive)	CCW	2.035:1	60	600	50
Propeller Governor[2]	CW	1:1	29	825	50
Fuel Pump (Injection)	CCW	1:1	25	680	60
Accessory Drive (1)[3]	CCW	1.545:1	100	800	50
Oil Cooler	-	-	-	-	65 Wet

1. CW = Clockwise Rotation CCW = Counterclockwise rotation; viewed facing the drive.
2. Drive is a modified AND20010 (speed increased to 2800 RPM) and shall be supplied with a cover.
3. Drive is a modified AND20000 (speed increased to 4326 RPM and opposite rotation) and shall be supplied with a cover.

Table 2-15. IO-360-K, KB Accessory Drive Ratios

Accessory	Direction of Rotation[1]	Drive Ratio to Crankcase	Maximum Torque (in. lbs.)		Maximum Overhang Moment, (in lbs.)
			Cont.	Static	
Tachometer (Mag. Pick-up)	-	-	-	-	-
Magneto	CW	1.5:1	-	-	-
Starter Motor	CW	24.727:1	200	400	60
Alternator (Gear Drive)	CCW	2.035:1	60	600	50
Propeller Governor[2]	CW	1:1	29	825	50
Fuel Pump (Injection)	CCW	1:1	25	680	60
Accessory Drive (1)[3]	CCW	1.545:1	100	800	50
Oil Cooler	-	-	-	-	65 Wet

1. CW = Clockwise Rotation CCW = Counterclockwise rotation; viewed facing the drive.
2. Drive is a modified AND20010 (speed increased to 2600 RPM) and shall be supplied with a cover.
3. Drive is a modified AND20000 (speed increased to 4017 RPM and opposite rotation) and shall be supplied with a cover.

2-3.8.1. Accessory Drive Pad

The accessory drive pads are AND20000 or AND20010 specifications depending on engine model that has been modified for speed, torque, and moment and provides an oil feed to the face of the pad. The drive pad is provided with a cover in the event that its use is not required.

2-3.9. Oil Specifications

Commercially available ashless dispersant aviation oils are described in Chapter 3 of the Standard Practice Maintenance Manual (M-0). Do not use any other commercial quality oil.

2-3.10. Performance Data

Refer to the OI-7 Installation and Operation Manual for complete engine technical specifications, installation requirements, certification data, and engine test stand performance.

WARNING

The performance charts included in this manual indicate uninstalled engine performance under controlled conditions and will vary from installed performance. The charts are neither intended nor suitable for installed performance specifications or flight planning. Consult the Airplane Flight Manual or Pilot's Operating Handbook for installed aircraft performance specification.

2-3.10.1. IO-360-A, AB Performance Charts

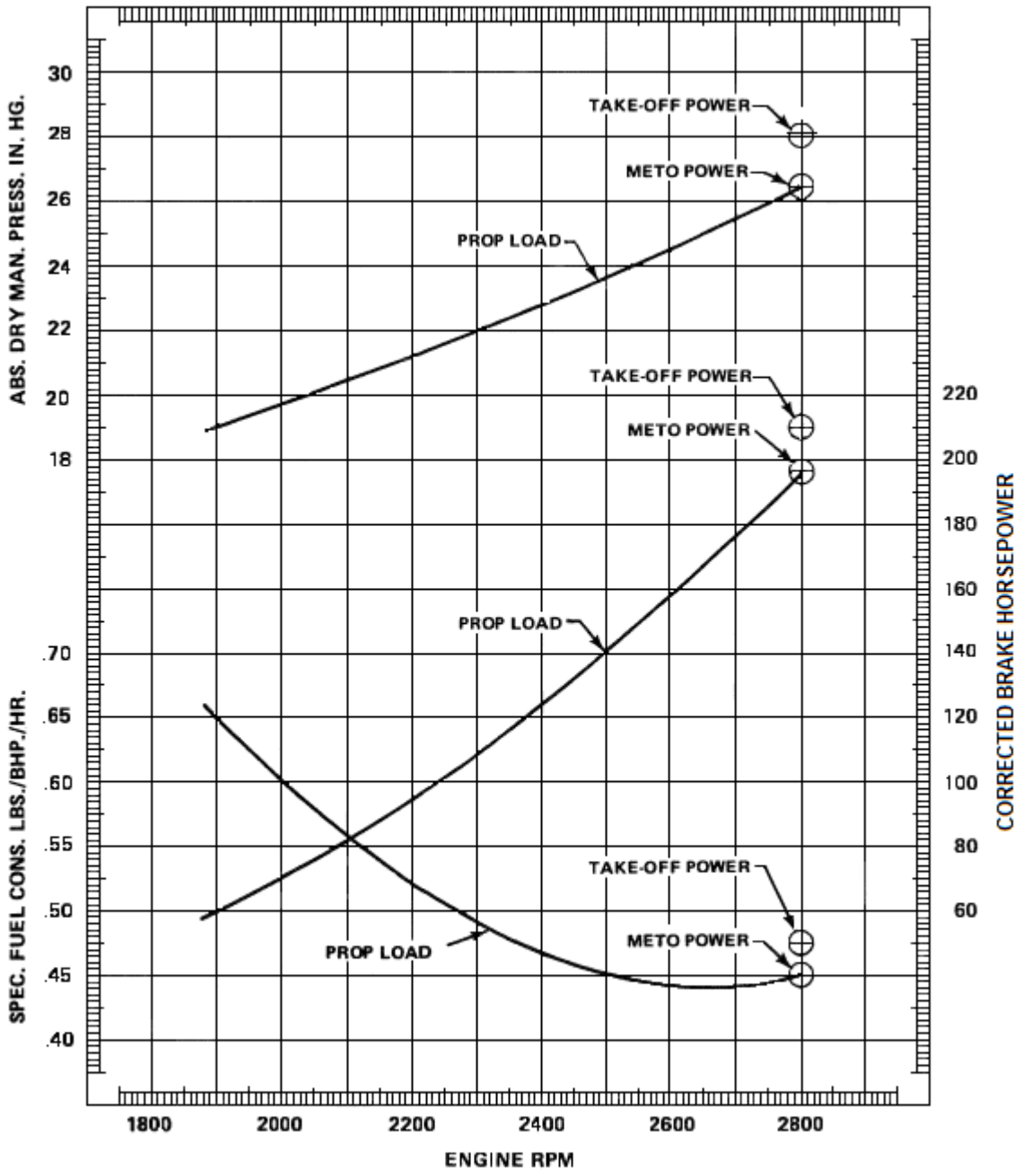


Figure 2-26. IO-360-A, AB Sea Level Performance Curves

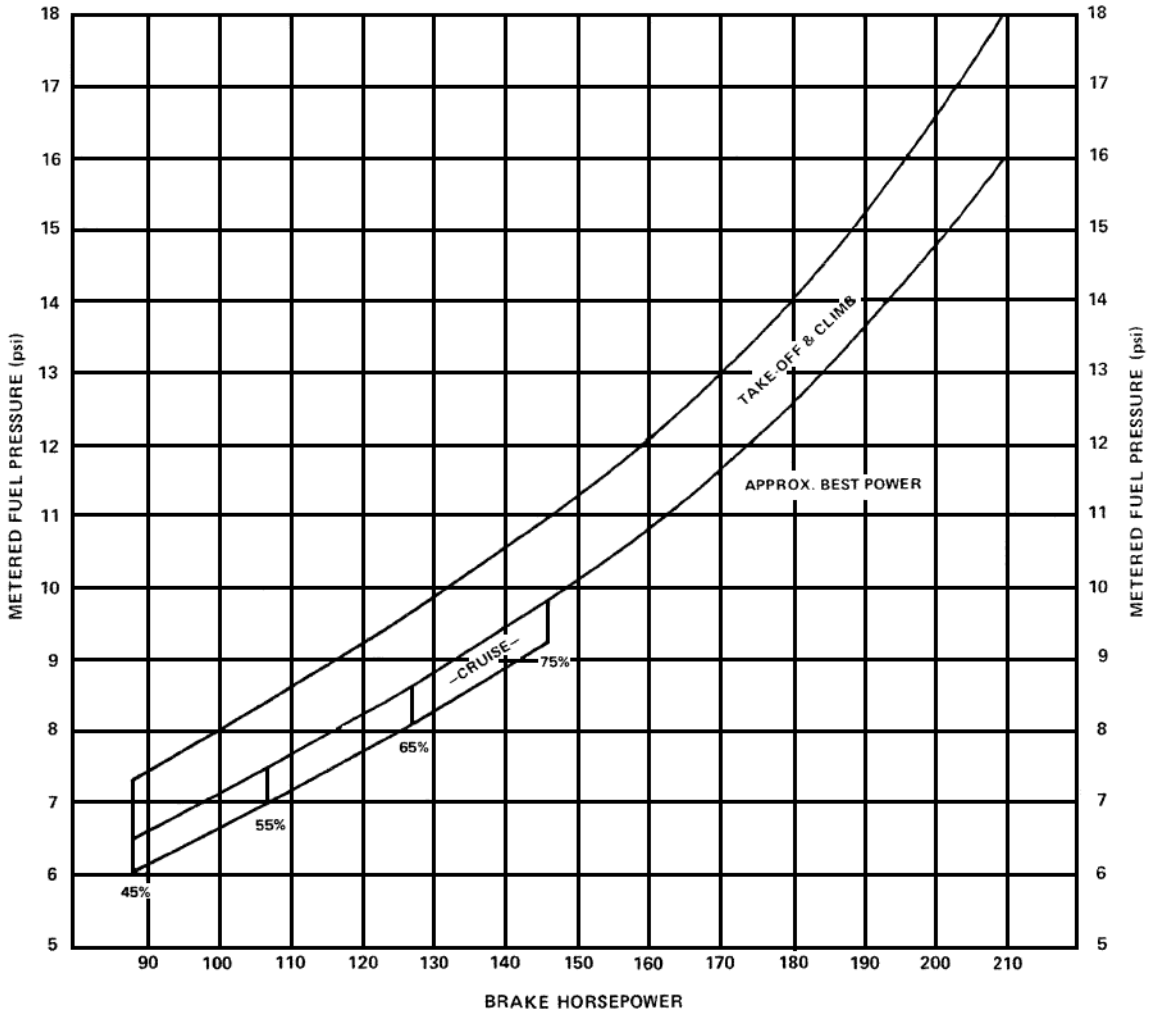


Figure 2-27. IO-360-A, AB Fuel Pressure vs. Sea Level Standard Brake Horsepower

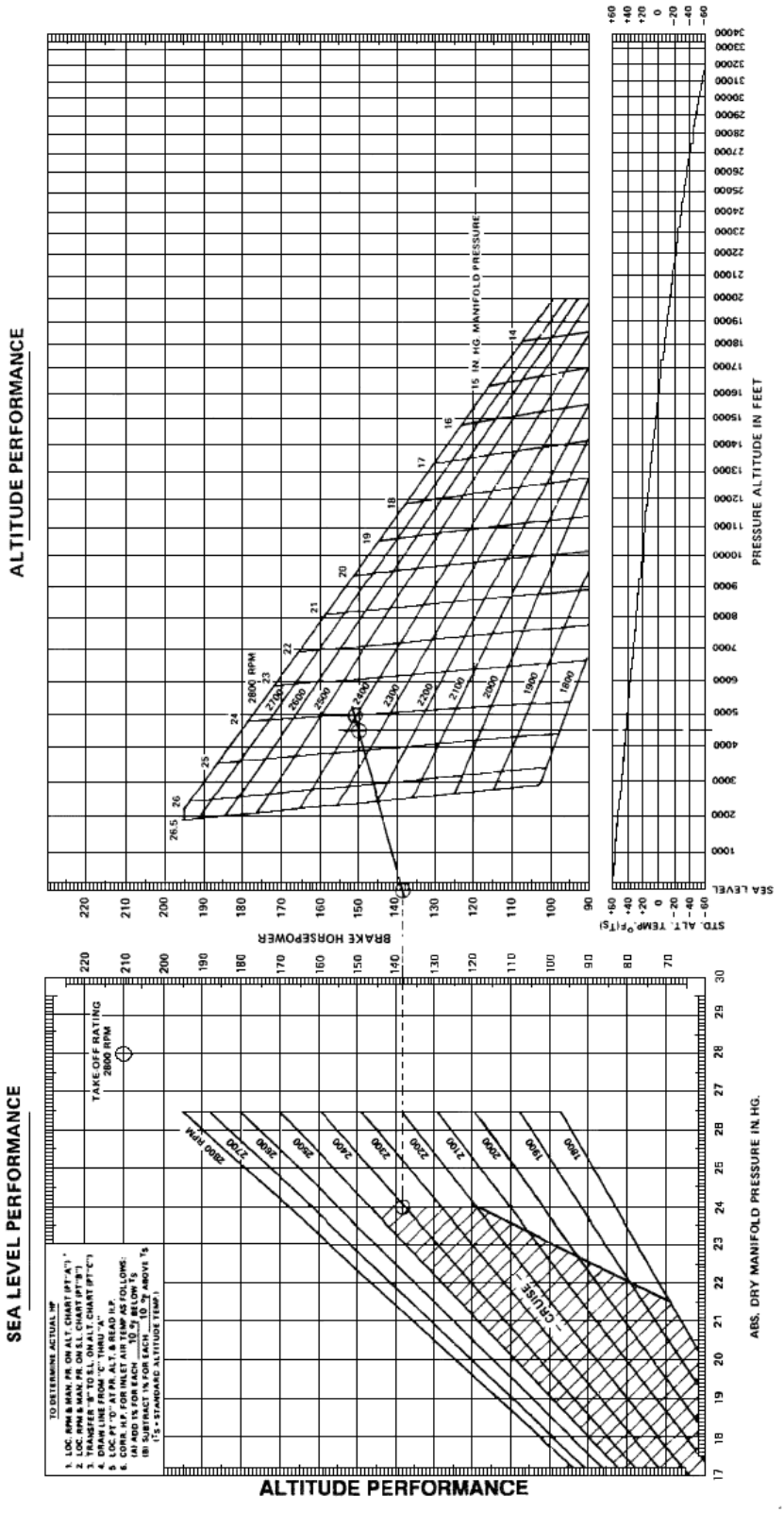


Figure 2-28. IO-360-A, AB Altitude Performance

2-3.10.2. IO-360-AF Performance Charts

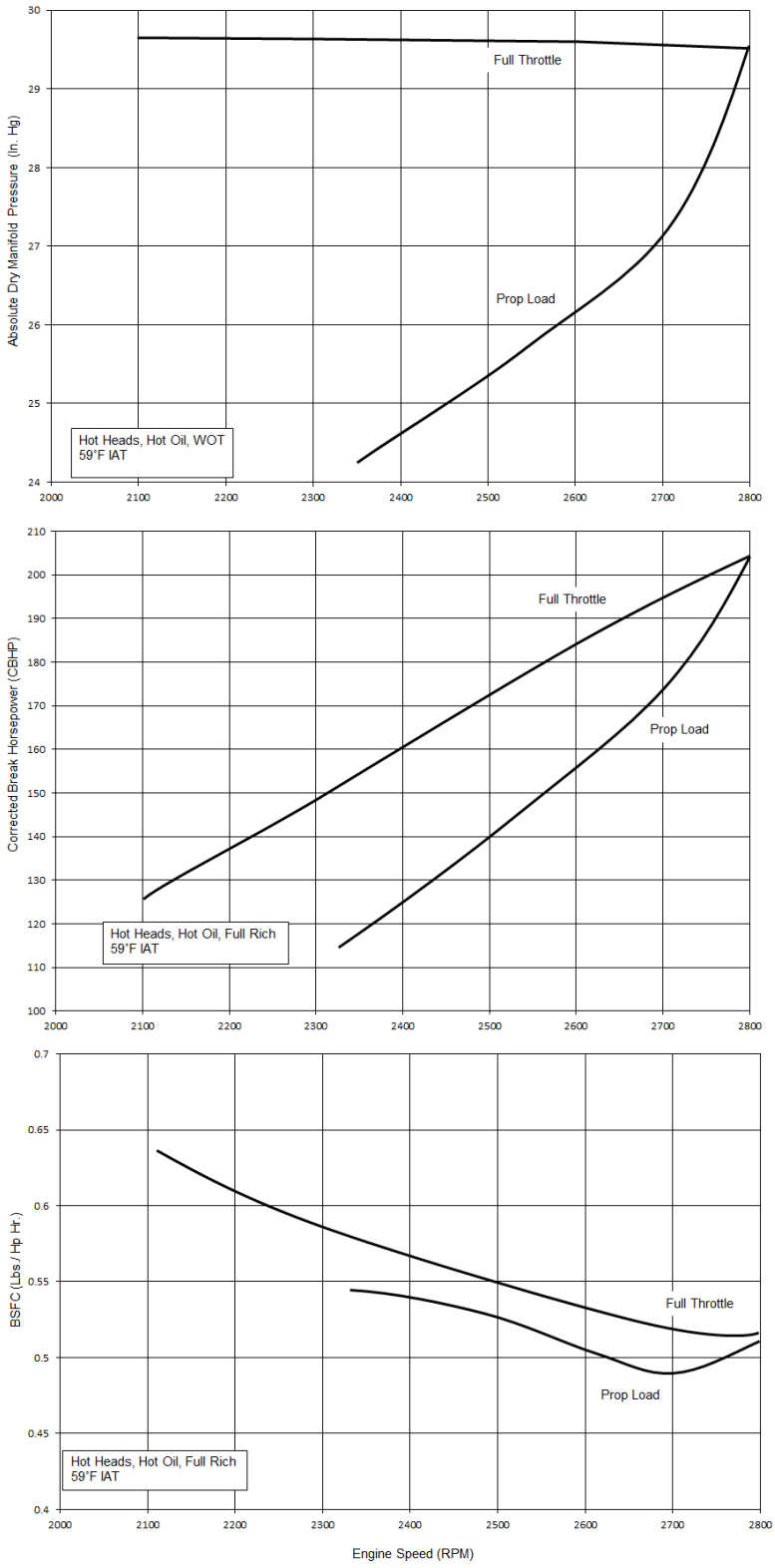


Figure 2-29. IO-360-AF Sea Level Performance Curves

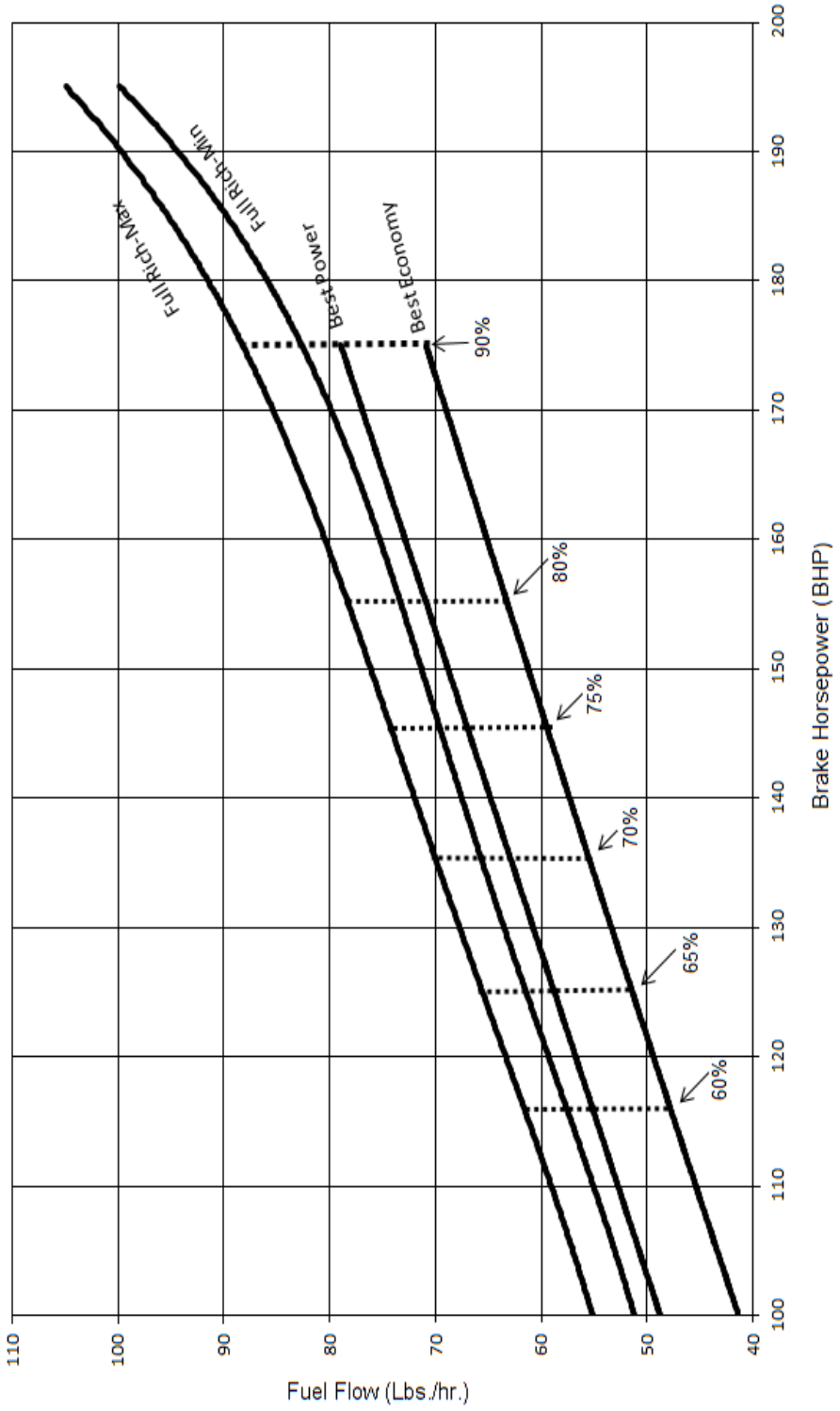


Figure 2-30. IO-360-AF Fuel Flow vs. Brake Horsepower

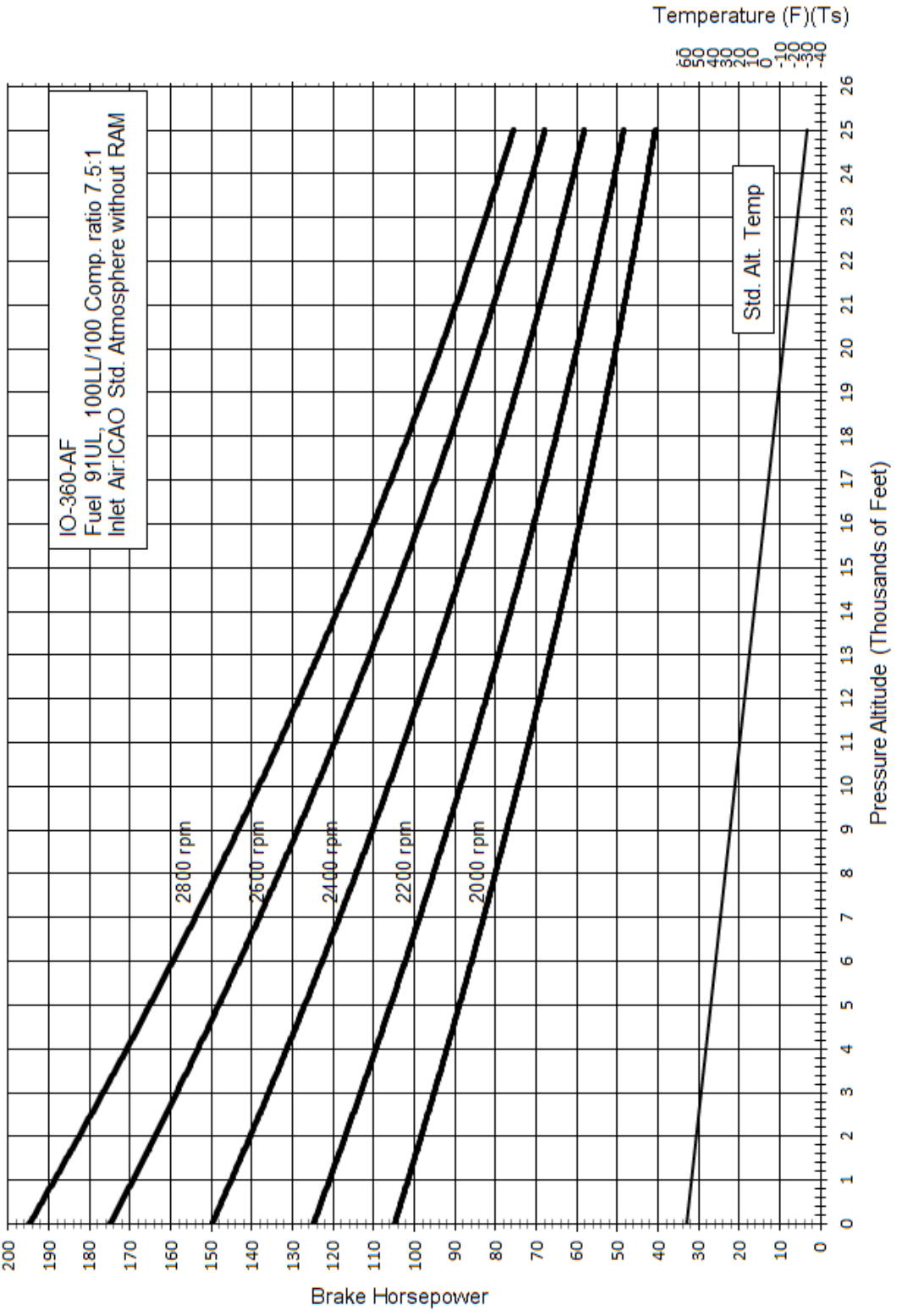


Figure 2-31. IO-360-AF Altitude Performance

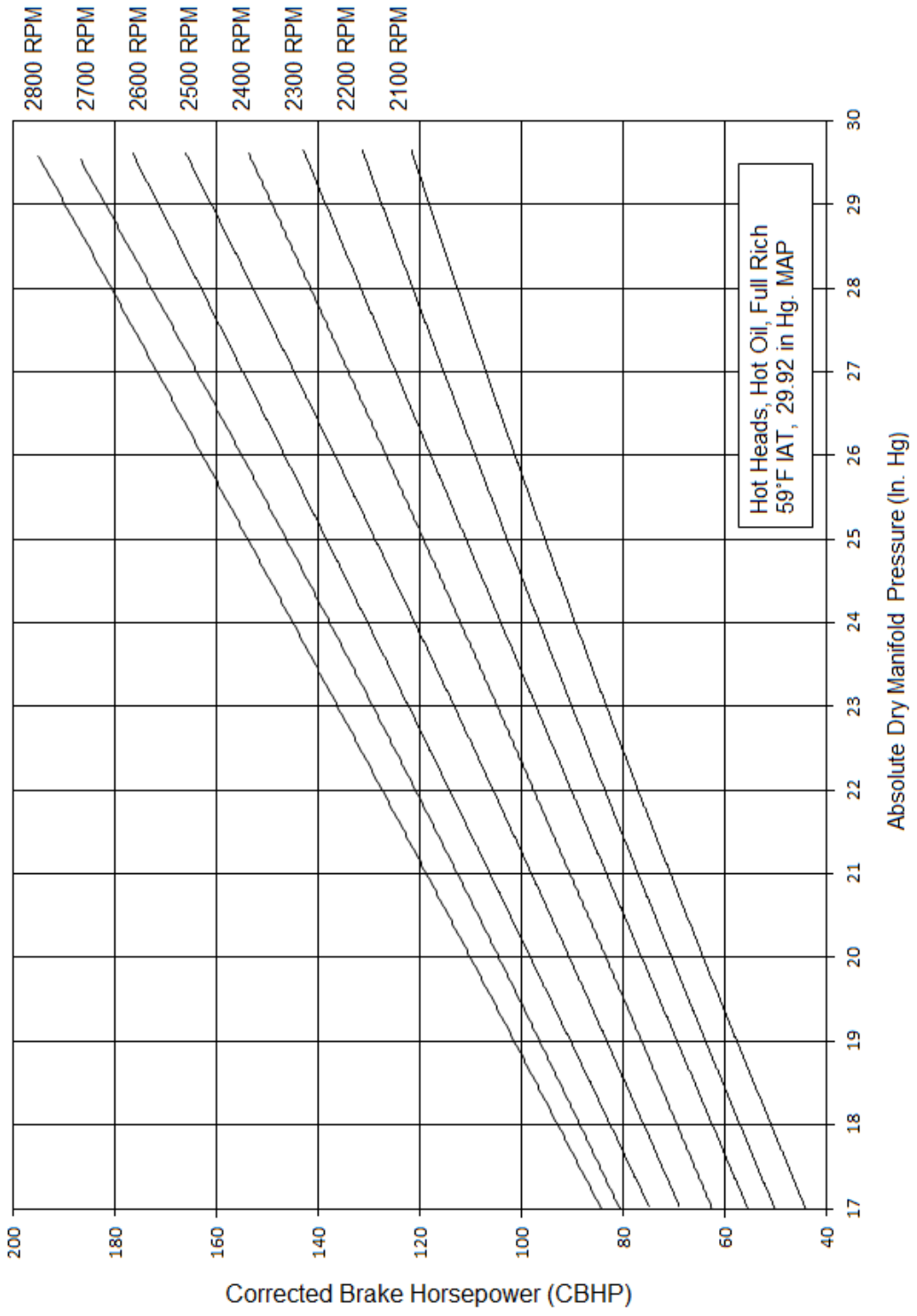


Figure 2-32. IO-360-AF Sea Level Performance - Full Rich

2-3.10.3. IO-360-C, CB, D, DB, G, GB, H, HB Performance Charts

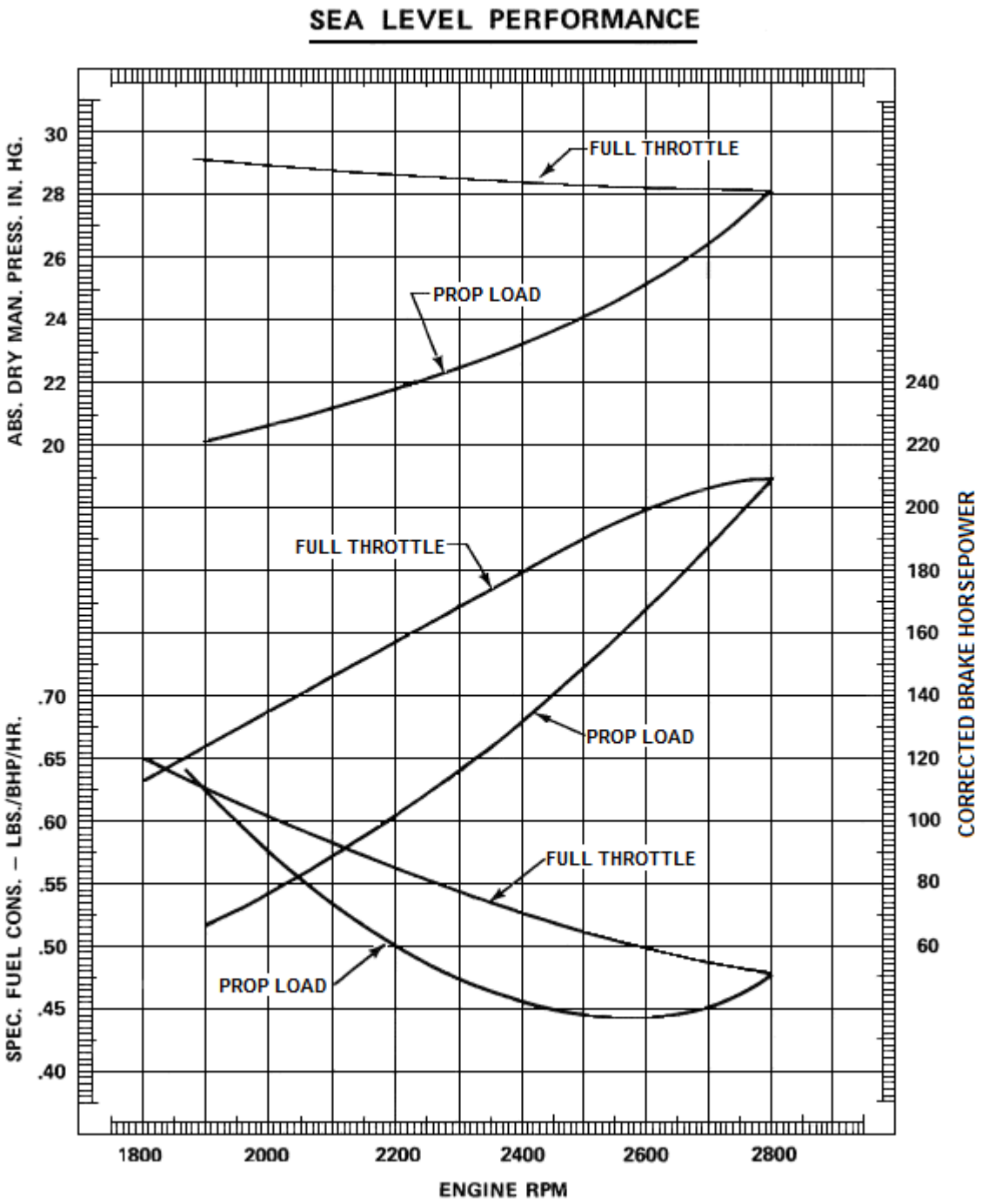


Figure 2-33. IO-360-C, CB, D, DB, G, GB, H, HB Sea Level Performance Curves

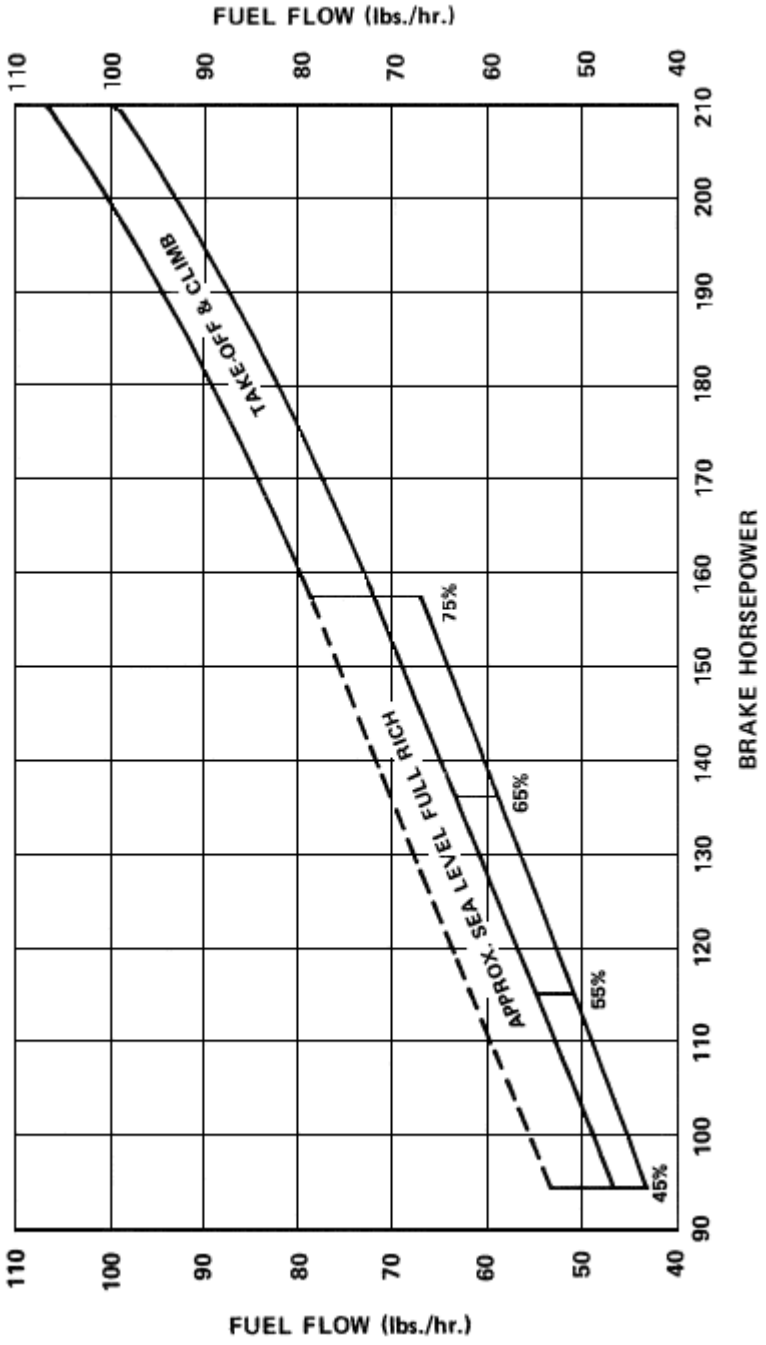


Figure 2-34. IO-360-C, CB, D, DB, G, GB, H, HB Fuel Flow vs. Sea Level Standard Brake Horsepower

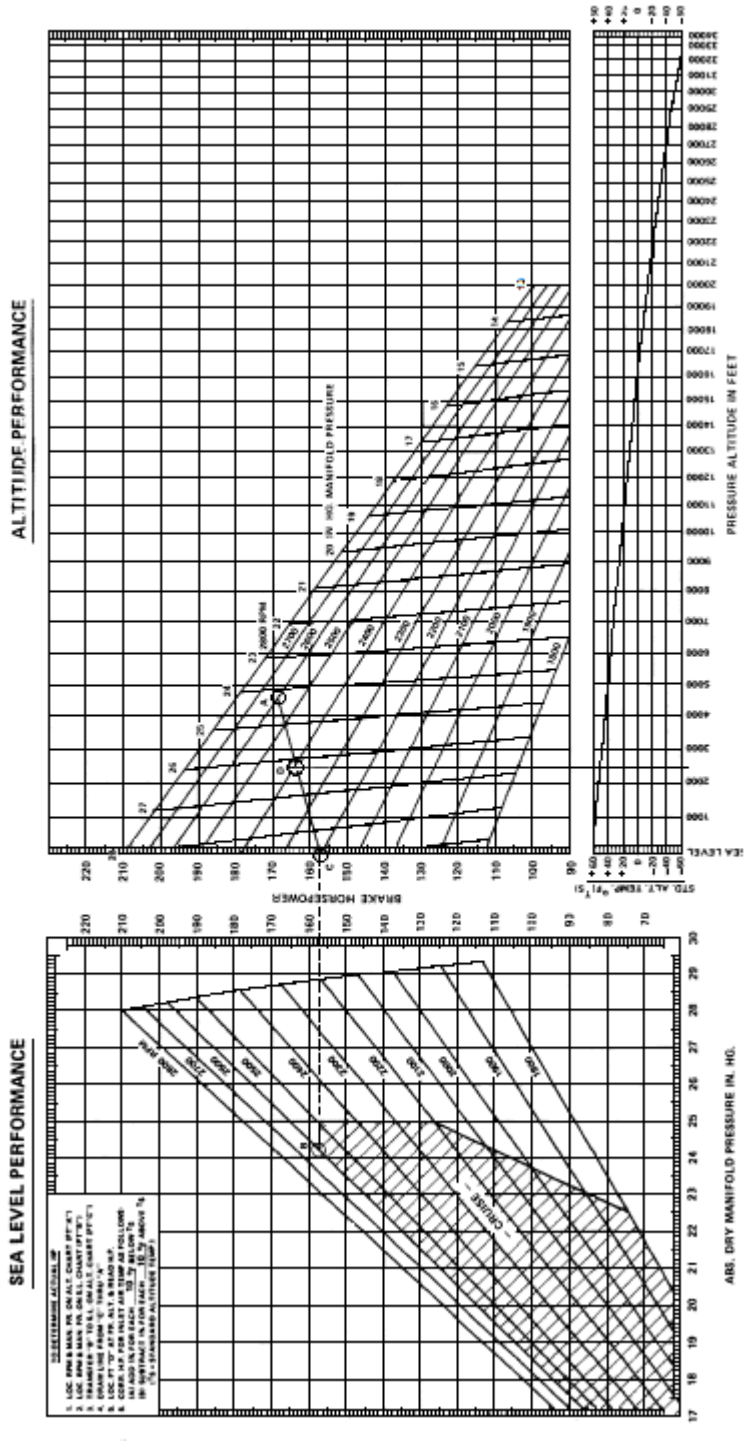


Figure 2-35. IO-360-C, CB, D, DB, G, GB, H, HB Altitude Performance

2-3.10.4. IO-360-J, JB Performance Charts

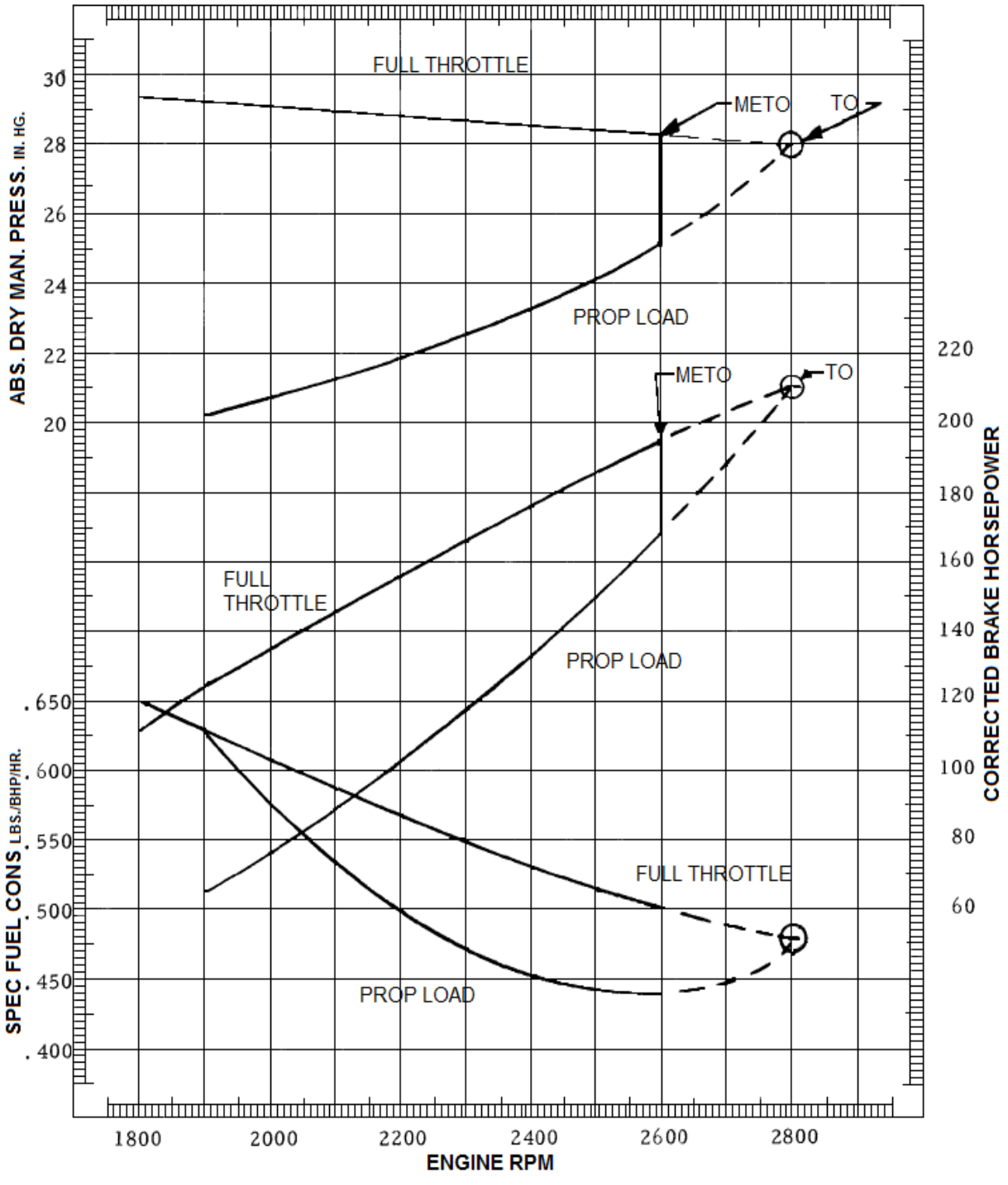


Figure 2-36. IO-360-J, JB Sea Level Performance Curves

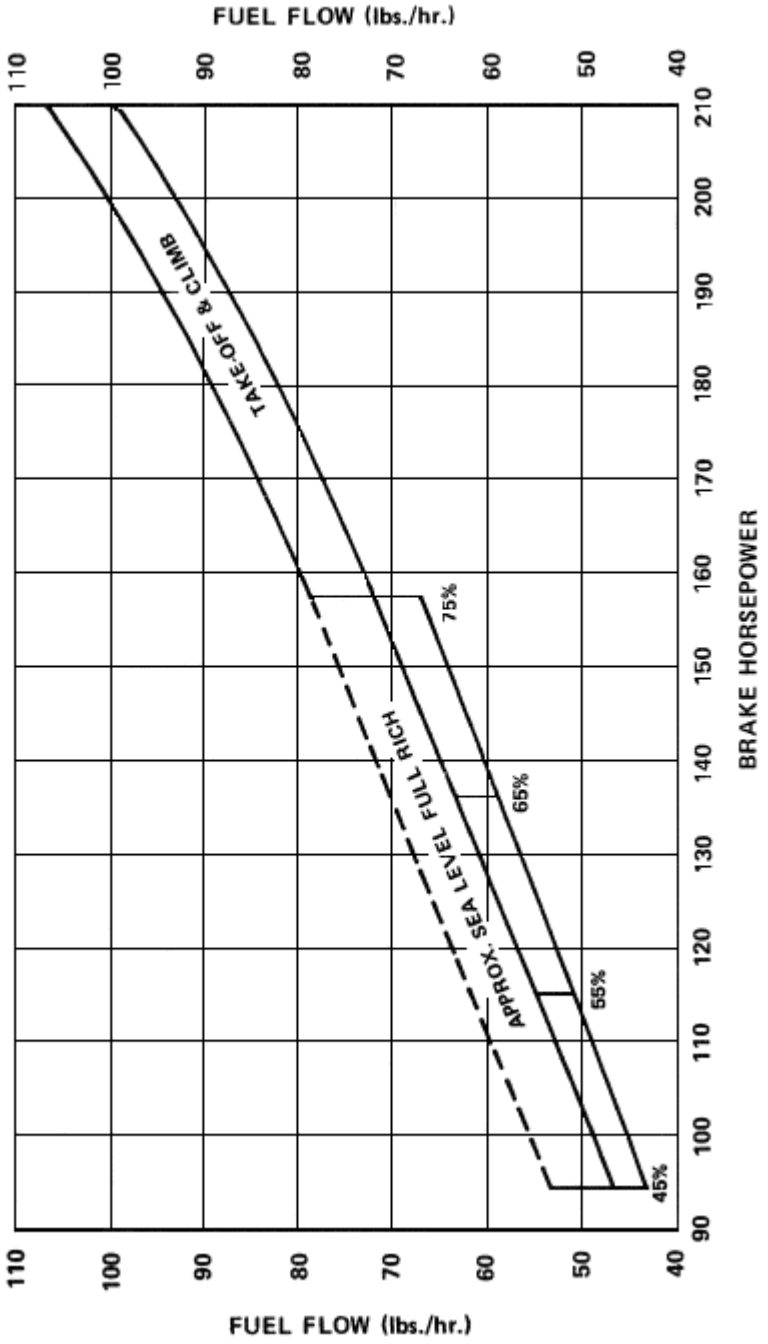


Figure 2-37. IO-360-J, JB Fuel Flow vs. Sea Level Standard Brake Horsepower

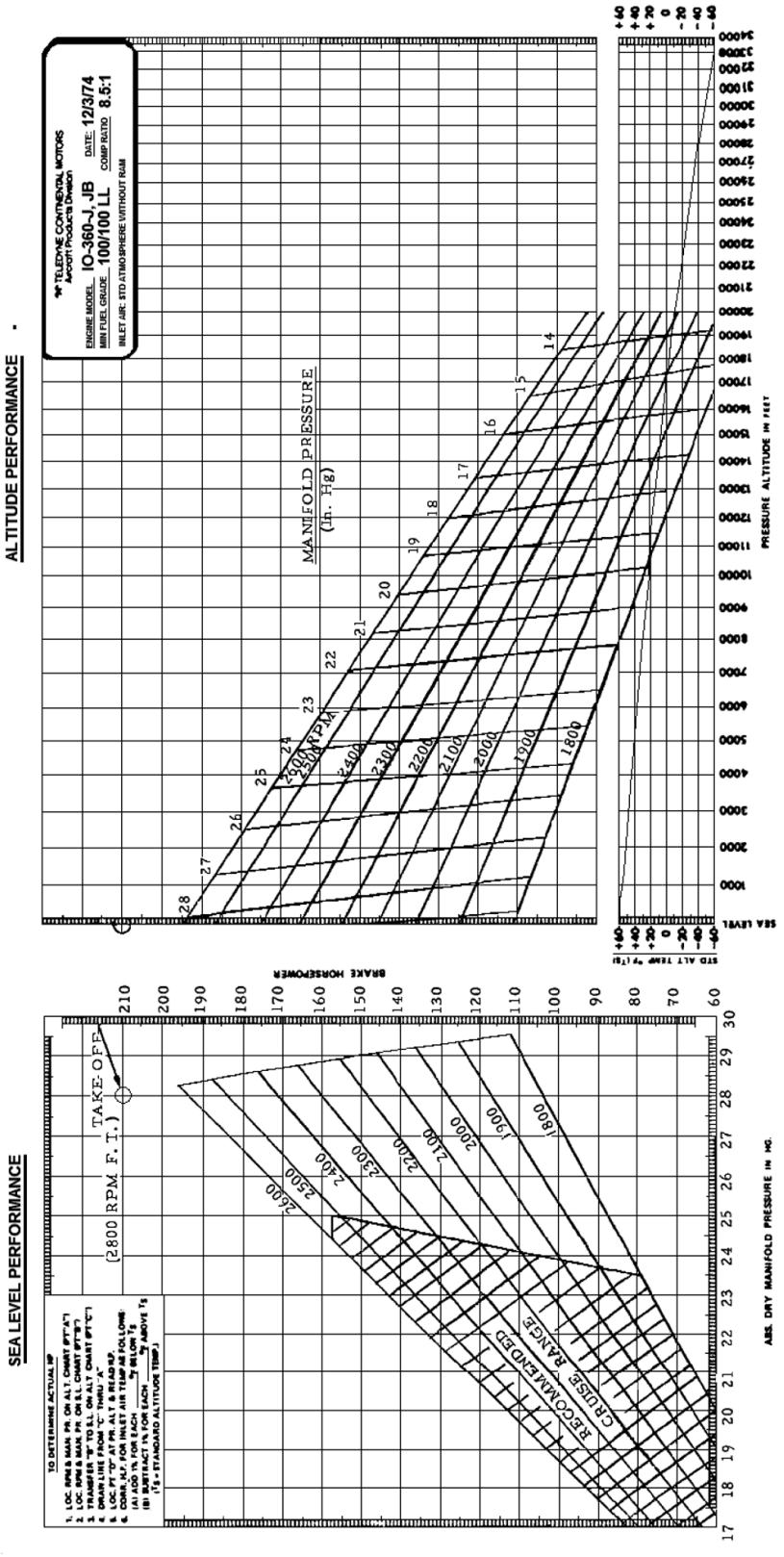


Figure 2-38. IO-360-J, JB Altitude Performance

2-3.10.5. IO-360-K, KB Performance Charts

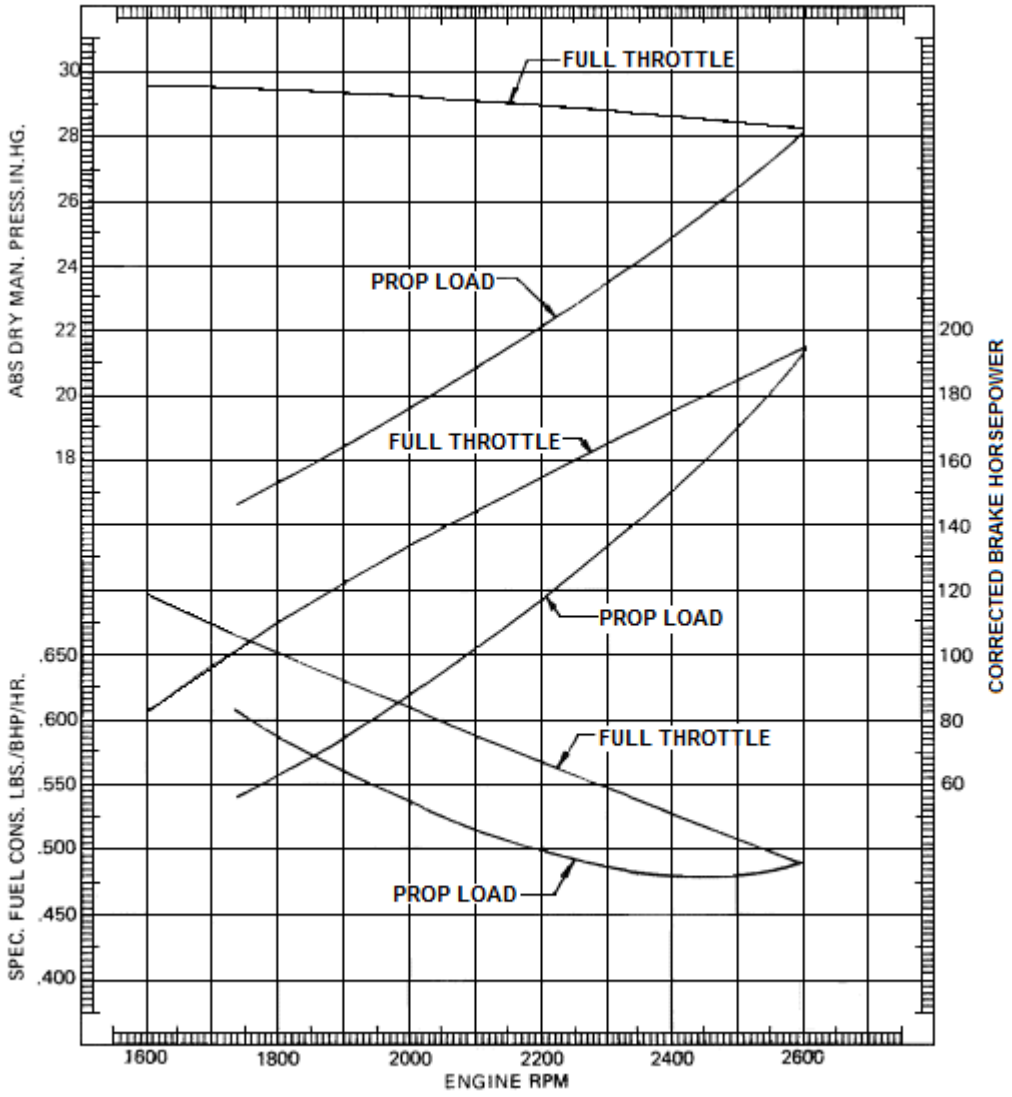


Figure 2-39. IO-360-K, KB Sea Level Performance Curves

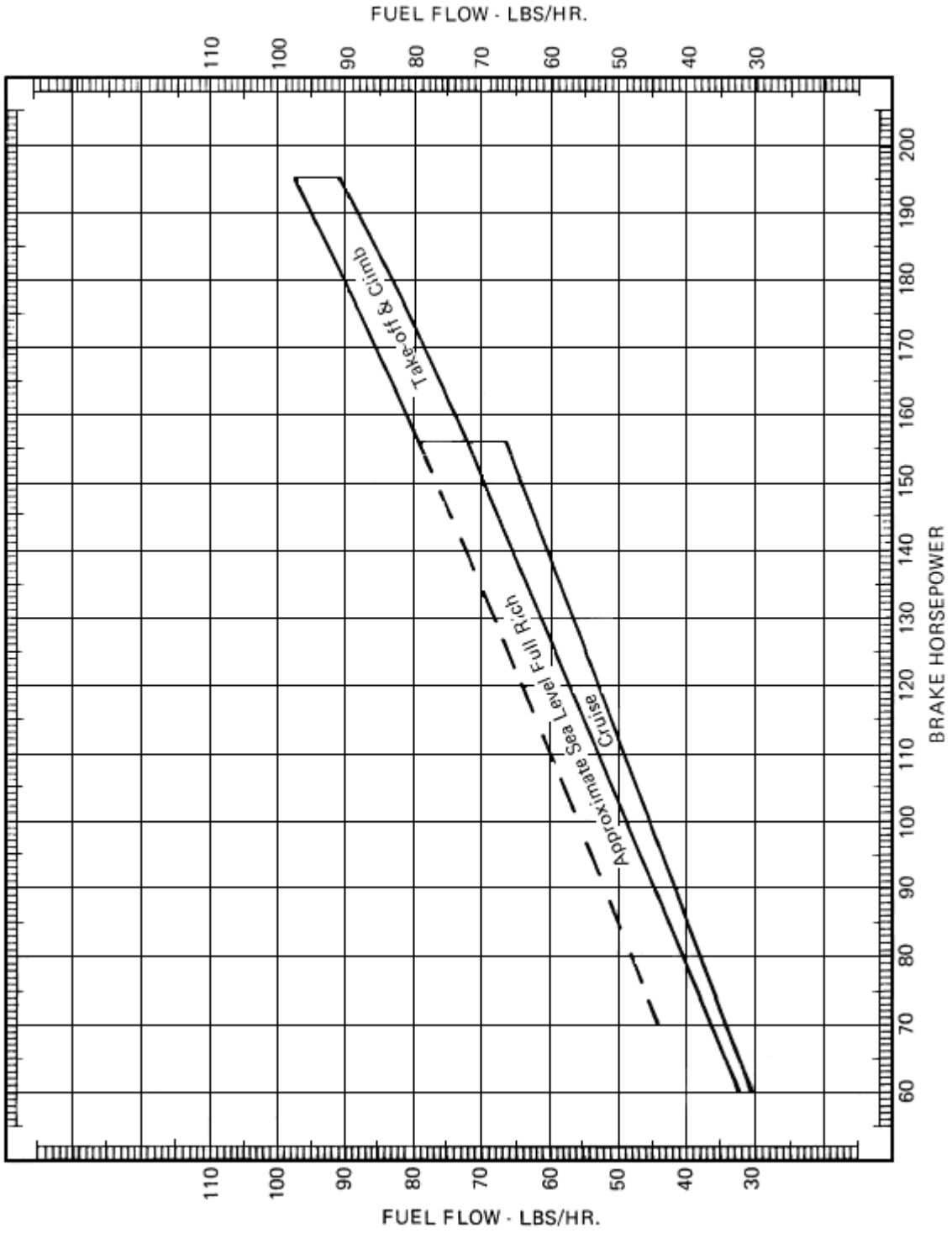


Figure 2-40. IO-360-K, KB Fuel Flow vs. Sea Level Standard Brake Horsepower

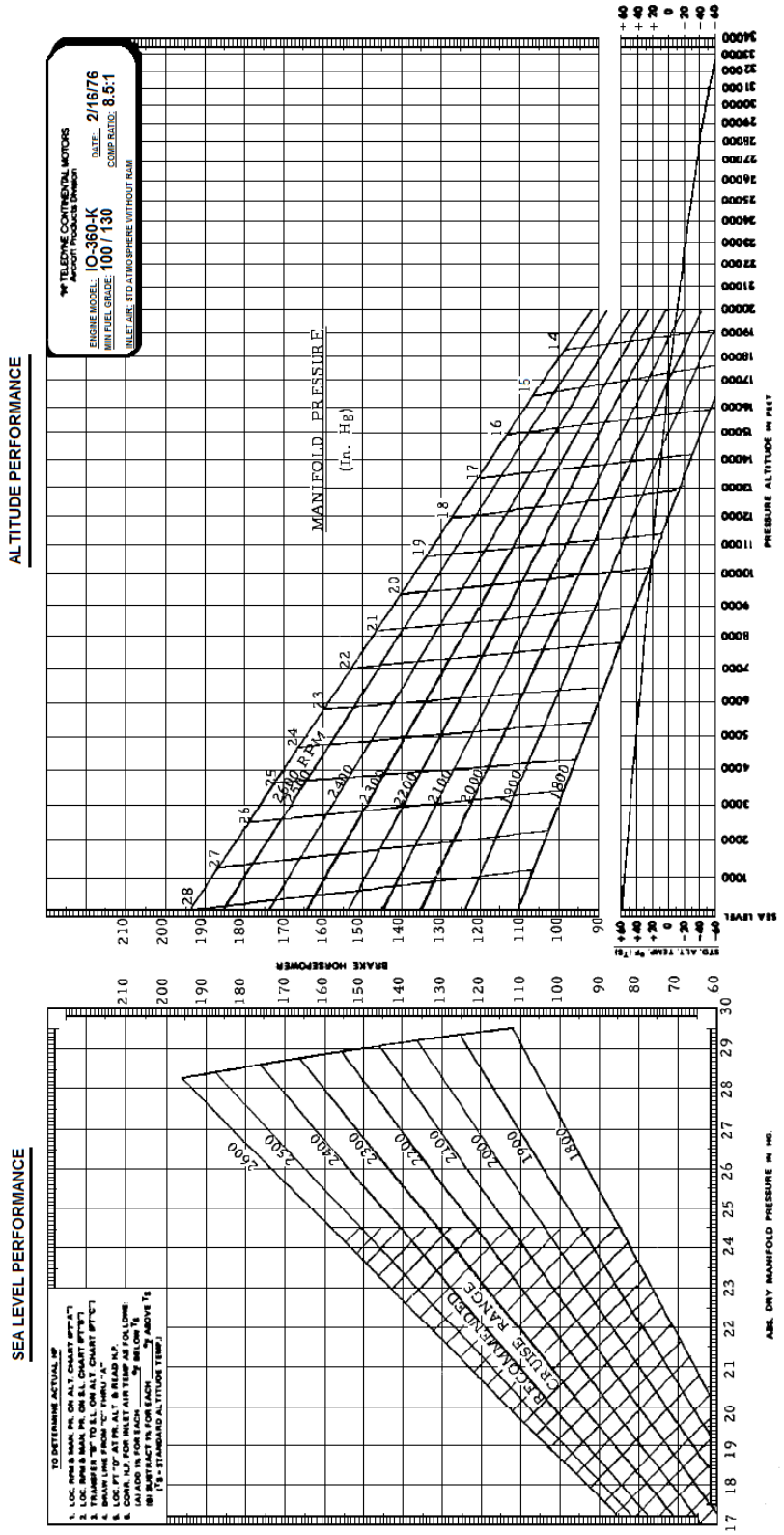


Figure 2-41. IO-360-K, KB Altitude Performance

2-3.10.6. IO-360 ES Performance Charts

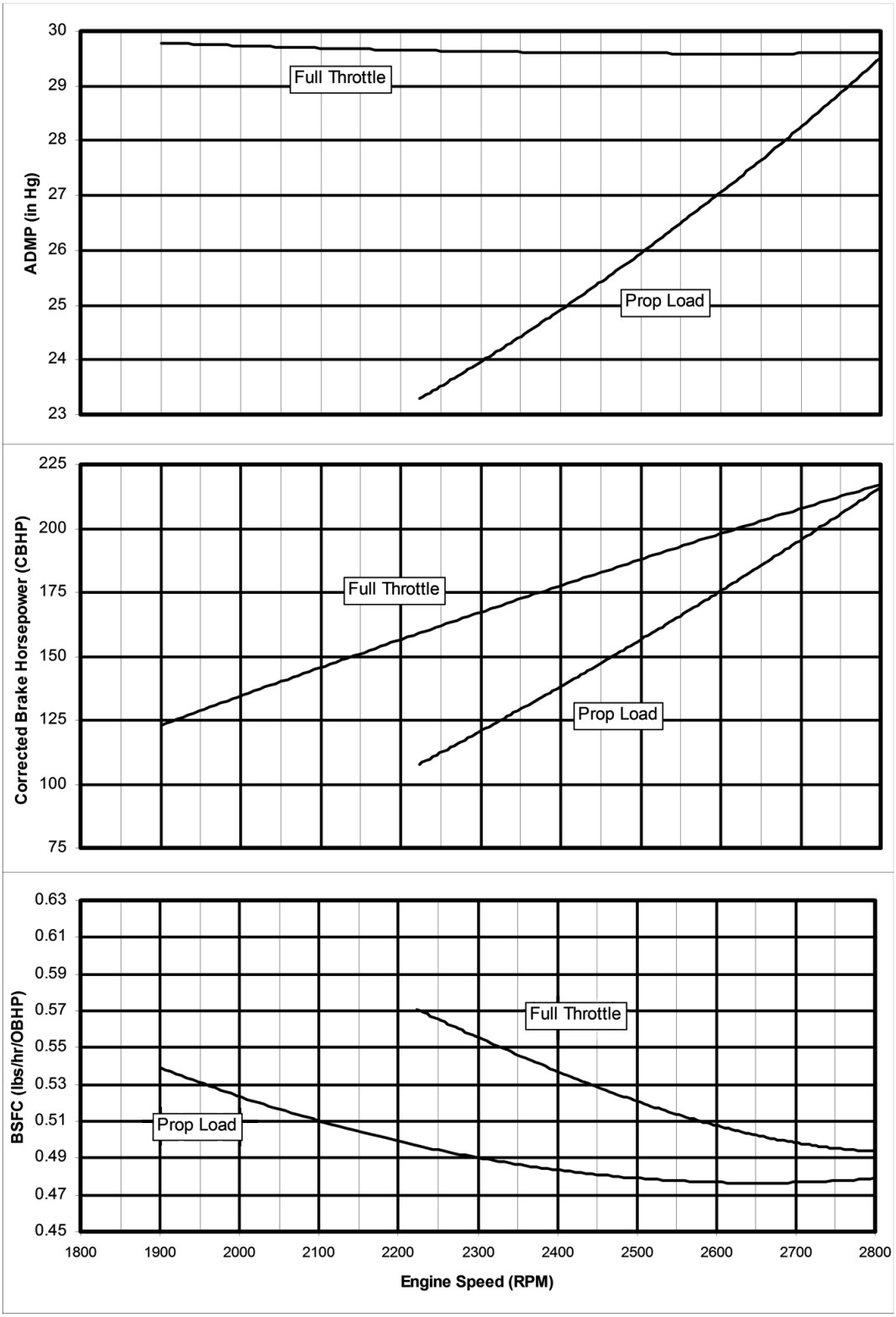


Figure 2-42. IO-360-ES Sea Level Performance Curves

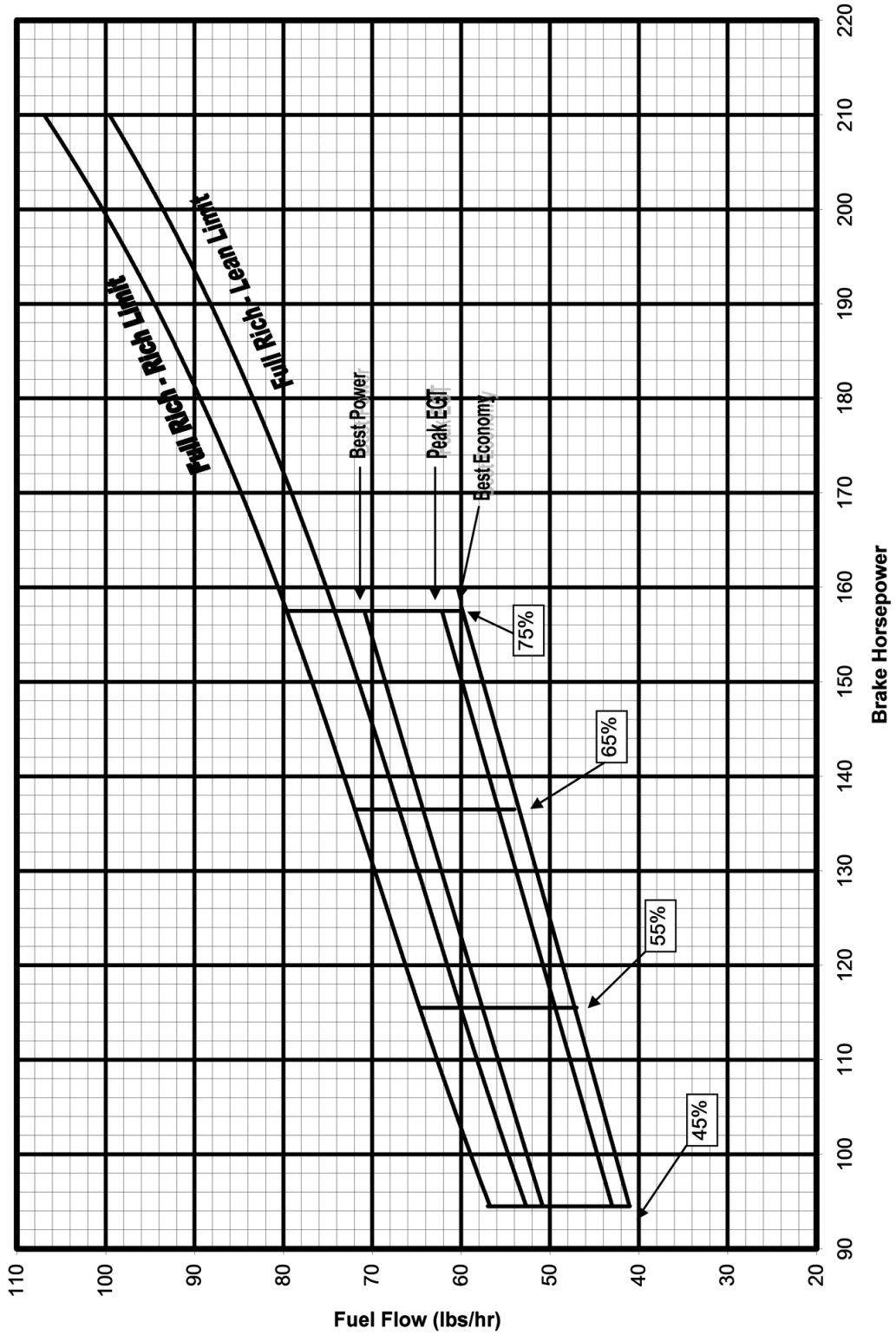


Figure 2-43. IO-360-ES Fuel Flow vs. Sea Level Standard Brake Horsepower

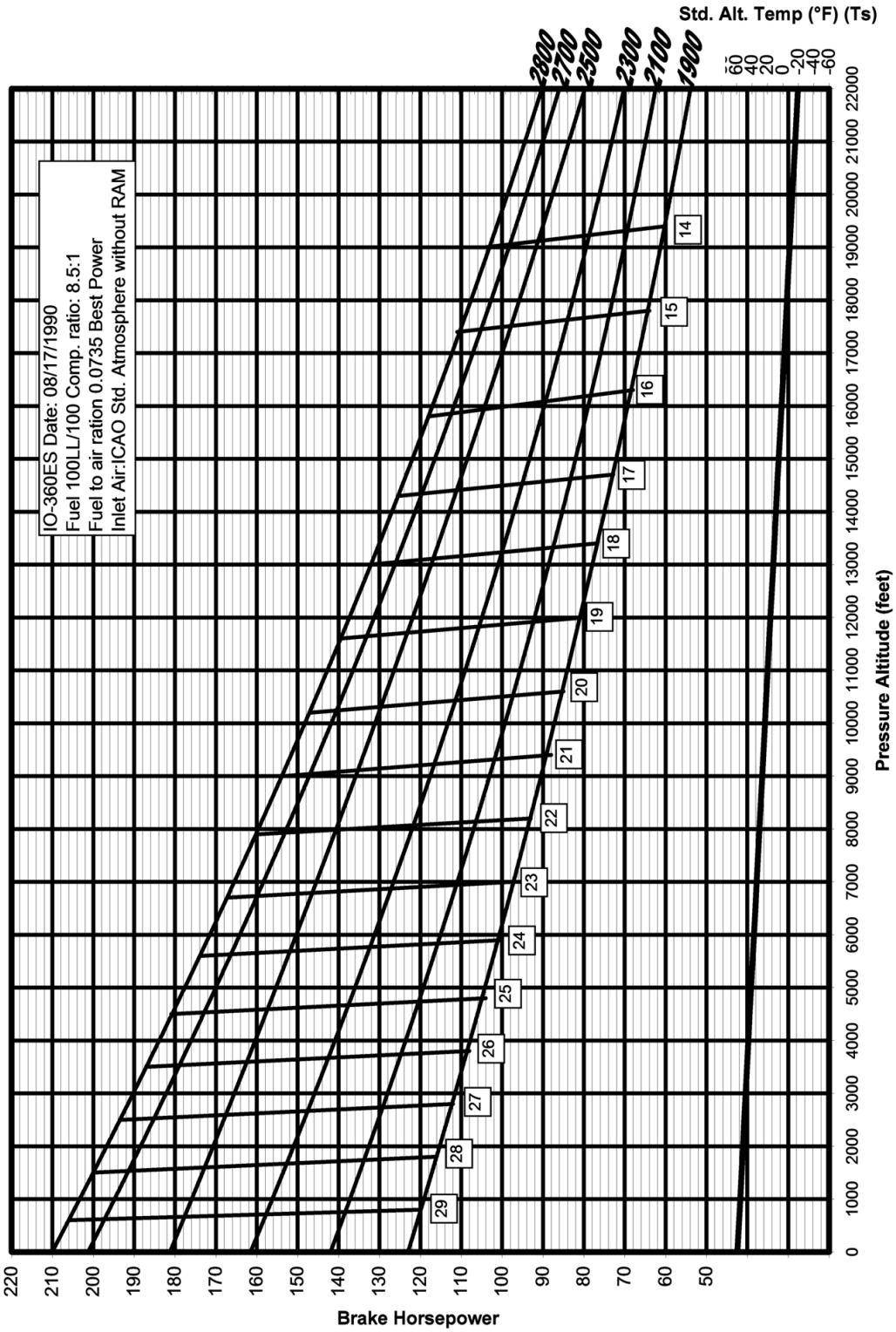


Figure 2-44. IO-360-ES Altitude Performance

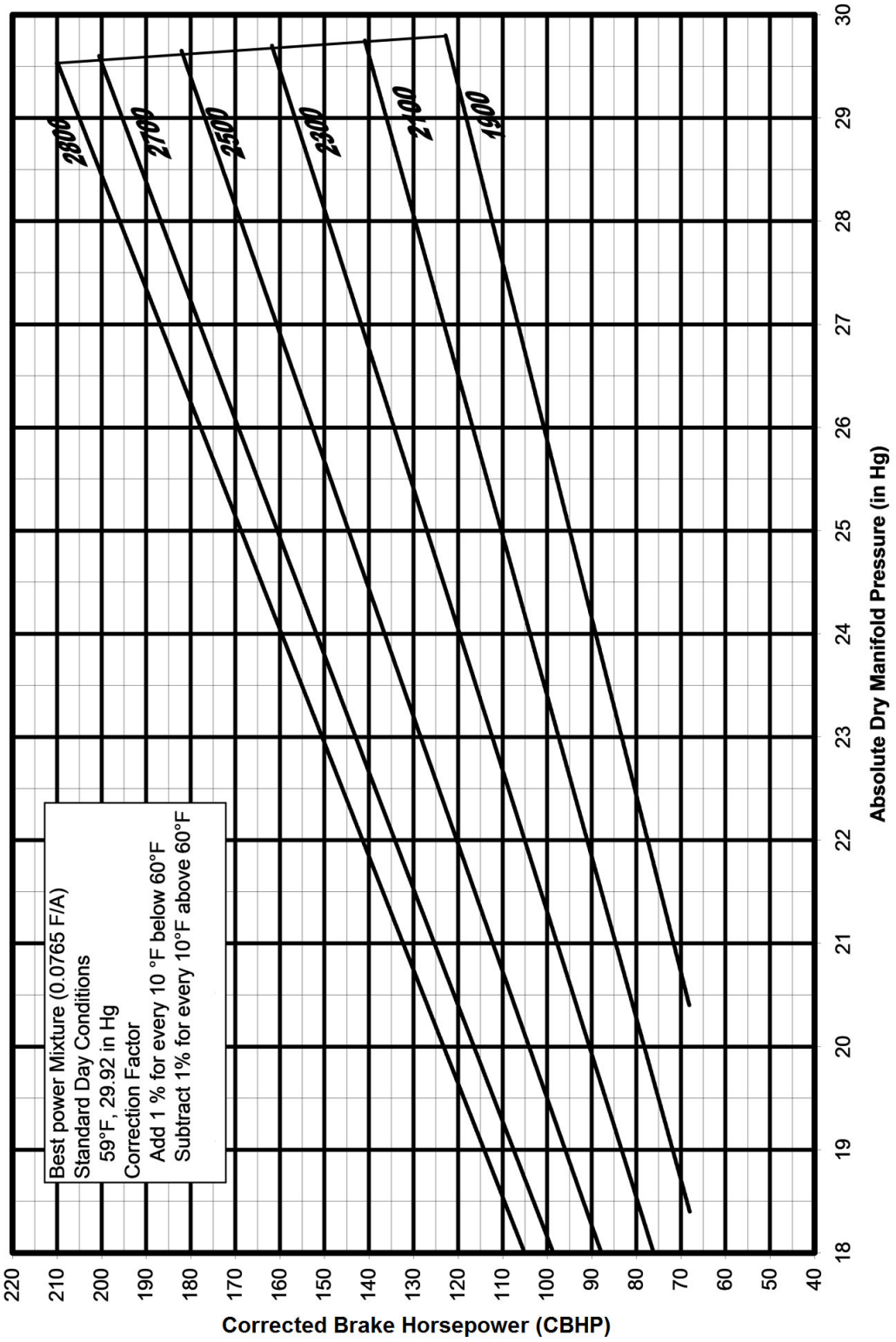


Figure 2-45. IO-360-ES Sea Level Performance - Full Rich

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Chapter 3. Special Tools and Supplies

3-1. Special Tools

Refer to Chapter 2-1, “Special Tools” in M-0, Standard Practice Maintenance Manual.

3-1.1. Vendor Contact Information

Refer to Chapter 2-1.1, “Vendor Contact Information” in M-0, Standard Practice Maintenance Manual.

3-1.2. Mechanic’s Tools

Refer to Chapter 2-2, “Mechanic’s Tools” in M-0, Standard Practice Maintenance Manual.

3-2. Lubricants, Sealants and Adhesives

Refer to Chapter 3, “Lubricants, Sealants, and Adhesives” in M-0, Standard Practice Maintenance Manual.

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Chapter 4. Airworthiness Limitations

The Airworthiness Limitations Section is FAA approved and specifies maintenance required under §§ 43.16 and 91.403 of the Title 14 Code of Federal Regulations (CFR) unless an alternative program has been FAA approved.

Title 14 CFR §§ 43.16 and 91.403 require owner/operator compliance with all maintenance limitations in this section concerning mandatory replacement times, inspection intervals, and other related procedures that are specific to this engine. Any such limitations listed below are part of the design limits of the engine, which was type certified based upon required owner/operator compliance with the limitations.

4-1. Mandatory Replacement Times

Subject to additional information contained in FAA Airworthiness Directives issued after the date of certification, the engines covered in this manual do not contain any components having mandatory replacement times required by type certification.

4-2. Mandatory Inspection Intervals

Subject to additional information contained in FAA Airworthiness Directives issued after the date of certification, the engines covered in this manual do not require specific intervals of inspection pursuant to type certification.

4-3. Other Related Procedures

Subject to additional information contained in Airworthiness Directives issued after the date of certification, there are no other related procedures required pursuant to the type certification for the engines covered in this manual.

4-4. Distribution of Changes to Airworthiness Limitations

Changes to this Airworthiness Limitations Section constitute changes to the type design of the engines covered in this manual and require FAA approval pursuant to Federal Aviation Regulations. Changes which result in new or more restrictive limits, will be published in FAA Airworthiness Directives.

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Chapter 5. Engine Removal and Installation

5-1. Engine Removal

5-1.1. Tools and Consumable Supplies Required

1. Engine Hoist

WARNING

Ensure engine slings are designed to support the weight of the engine or total engine weight including all accessories.

Use of engine lifting eyes to lift aircraft is strictly prohibited.

CAUTION: Keep crankshaft axis horizontal during handling operations.

2. Two (2) engine slings rated for 800 lbs. minimum static load
3. Engine Transport Stand
4. Catch Basins (Oil and Fuel)
5. Tank Sprayer

5-1.2. Engine Removal Procedure

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch and Master Power Switch off according to the aircraft manufacturer's instructions. Open the circuit breakers powering the switches according to the aircraft manufacturer's instructions. Turn the fuel selector valve to the OFF position and disconnect engine electrical (aircraft battery) power according to the aircraft manufacturer's instructions.
2. If the cylinders will be overhauled, perform a “Differential Pressure Test” according to the instructions in Section 6-3.11.2; use the Cylinder Inspection checklist to record test results. If all cylinders will be replaced during overhaul, proceed to step 3.
3. Remove the engine compartment cowling and aircraft accessories that could obstruct engine removal according to the aircraft manufacturer’s instructions.
4. Disconnect and tag the aircraft electrical harness from the starter and alternator according to the aircraft manufacturer’s instructions.
5. Remove the propeller according to the aircraft manufacturer’s instructions.
6. Remove the aircraft baffling required to avoid contact with the nacelle during removal according to the aircraft manufacturer’s instructions.

7. Remove the oil sump drain plug and gasket; drain the oil according to the “Engine Oil Servicing” instructions in Section 6-3.8.
8. Temporarily re-install the oil sump drain plug and gasket to prevent contamination during transit. The gasket will be replaced when the oil is serviced.
9. Disconnect and tag the ignition circuit switch or p-leads from the magnetos according to the aircraft manufacturer's instructions.
10. Disconnect and tag the engine wiring bundles and other connections from the following components according to the aircraft manufacturer’s instructions.
    a. Pneumatic, vacuum pumps or air conditioning compressor
    b. Tachometer drive (electrical or mechanical)
    c. Oil temperature and pressure sensor connections
    d. Exhaust gas temperature sensor connection
    e. Cylinder head temperature sensor connection
    f. Fuel pressure sensor connection
    g. Fuel flow sensor connection
    h. Manifold pressure gauge line
    i. Aircraft fuel supply and return hoses to the engine driven fuel pump
    j. Throttle and mixture control cables
    k. Aircraft accessories and instrument connections
11. Remove all wiring bundle attaching clamps and hardware according to the aircraft manufacturer’s instructions. Route wiring bundle clear of engine.
12. Disconnect the propeller governor, hoses and/or lines according to the aircraft manufacturer’s instructions to allow the engine to be removed from the aircraft.

    CAUTION: Do not use tape or makeshift plugs inside open lines or fittings.

13. Properly cap (or plug) off lines and connections to prevent fuel spillage and debris from entering the engine.
14. Ensure all wires, lines, hoses and attachments between the engine and aircraft are disconnected.
15. Disconnect and remove the Exhaust System according to the aircraft manufacturer’s instructions.

CAUTION: Do not allow chains to become entangled in the engine or its hardware. Ensure the area is clear when lifting the engine. Do not allow the front, rear, sides or bottom of the engine to bump or strike any obstructions to prevent damage to the engine or its components. Do not connect engine hoist, hooks, cables, etc to any point on the engine other than the lifting eyes.

16. Attach the engine hoist to the engine using lifting eyes. (lifting eye locations are depicted in the "Engine Installation Drawings" in Section 5-4.
17. Remove the engine mount isolators and fastening hardware according to the aircraft manufacturer's instructions.
18. Relieve the engine weight from the engine mounts and carefully lift the engine slowly out of the aircraft.
19. Place the engine on an engine stand, transport dolly or engine shipping container base.
20. Use a sprayer tank filled with Stoddard solvent and soft bristle brush to pre-clean the engine, followed by a wash with a mild soap and water solution Rinse thoroughly with clean water to minimize contamination before bringing the engine in the shop area.

5-2. Engine Installation

Multiple steps are required to complete engine installation in aircraft. Instructions in this manual provide steps necessary to install engine, as it is provided to aircraft manufacturer. The aircraft manufacturer is responsible for selection and installation of various accessories and interface components necessary to integrate engine into certified aircraft configuration. Instructions applicable to these aircraft-specific configuration items and continued airworthiness requirements are beyond the scope of engine manufacturer and shall be provided by aircraft manufacturer.

5-2.1. Tools and Consumable Supplies Required

NOTE: Engine Installation Drawings are provided in Section 5-4.

1. Hoist

WARNING

Ensure engine slings are designed to support the weight of the engine or total engine weight including all accessories.

Use of engine lifting eyes to lift aircraft is strictly prohibited.

CAUTION: Keep crankshaft axis horizontal during handling operations.

2. Two (2) engine slings
3. Engine Transport Stand
4. Oil conforming to SAE J-1966 (break-in oil, non-dispersant mineral oil) or MIL-C-6529 Type II (Fly-away oil)
5. Ashless dispersant oil conforming to SAE J-1899
6. ASTM D910 (100LL/100), or B95/130, or RH95/130 aviation fuel
   AF model ASTM D7547 (91UL), ASTM D7592 (94 UL) or ASTM D910 (91, 100, 100VLL and 100LL)
7. Spark plugs and copper gaskets
8. MS 20995 Type A Safety Wire (0.020 in. and 0.032 in.)
9. Cable ties (various sizes, including 120# nylon) or nylon lacing cord
10. Bladder-type pressure pot (at least 1 gallon capacity)
11. Type 1 flammable fuel container (for waste fuel)
12. Clean fuel hoses
13. AN union fittings
14. Rubber grommets
15. MS-122AD Spray (available from Miller-Stephenson)
16. Spark Plug Manufacturer’s recommended spark plug thread lubricant
17. P/N 646940, Loctite Hydraulic Sealant

18. P/N 646943, Anti-seize Lubricant
19. P/N 592 Loctite Pipe Sealant
20. Other tools and materials, as required by the aircraft manufacturer's installation instructions.

5-2.2. Engine Receipt and Handling

NOTE: The engine is preserved for indefinite storage at the factory; if it is not immediately installed after acceptance, refer to the "Engine Preservation and Storage" instructions in Chapter 9 of M-0, Standard Practice Maintenance Manual, for ongoing corrosion protection instructions. Environmental conditions (humidity), seasonal changes, and engine usage influence susceptibility to corrosion. The owner/operator is responsible for recognizing the risk of corrosion and taking the appropriate precautions.

1. Inspect shipping container for visible damage.
   a. If shipping container appears damaged, notify freight shipping company immediately for resolution.
   b. If shipping container appears intact, verify lead tamper seals are in place on shipping container pallet. If lead tamper seals are broken or missing, contact CM prior to any further action.
2. If crating appears intact, proceed to Section 5-2.3.

5-2.3. Uncrating the Engine

1. Remove the lag screws attaching the wooden cover to the base.
2. Lift the wooden cover and remove it.
3. Locate and inspect desiccant bag through plastic shipping bag. Desiccant bag is fastened to engine mount at rear of engine.
   a. If color of desiccant material is blue, engine is protected. If engine won't be immediately installed, it may be placed in storage.
   b. If color of desiccant material is pink, engine has been exposed to moisture and engine preservation has been compromised; contact CM prior to any further action.
4. Inspect condition of plastic shipping bag. If bag is damaged, contact CM prior to any further action.
5. Open plastic bag wrapped around engine.
6. Inspect engine according to the "Acceptance Inspection" criteria in Section 5-2.5.

NOTE: The engine is preserved for indefinite storage at the factory; if it is not immediately installed after acceptance, refer to the "Engine Preservation and Storage" instructions in Chapter 9 of M-0, Standard Practice Maintenance Manual, for ongoing corrosion protection instructions. Environmental conditions (humidity), seasonal changes, and engine usage influence susceptibility to corrosion. The owner/operator is responsible for recognizing the risk of corrosion and taking the appropriate precautions.

7. If the engine is to be preserved, follow the "Engine Preservation and Storage" instructions in Chapter 9 of M-0, Standard Practice Maintenance Manual.
8. Remove engine from crate according to "Engine Transport" in Section 5-2.6.
9. Store shipping crate in a safe location for future use.

5-2.4. Crating an Engine for Shipping

1. Remove engine from aircraft according to "Engine Removal" instructions in Section 5-1.
2. Lower the engine onto the container base.
3. Attach the engine using shock mounts and bolts.
4. Install shipping plugs in engine openings; install shipping dust caps on fittings.
5. Preserve engine for indefinite storage according to "Engine Preservation and Storage" instructions in Chapter 9 of M-0, Standard Practice Maintenance Manual.
6. Cover the engine with a plastic bag.
7. Install desiccant bag on transportation mount.
8. Install and attach the container cover to the base.

5-2.5. Acceptance Inspection

CAUTION: If hidden engine damage or corrosion is discovered, contact engine supplier (see "Contact Information" in Section 1-3). Do not install or place a damaged/corroded engine in storage.

1. Open engine log book and verify recorded engine preservation date. "Next Due Date" should be later than current date. If "Next Due Date" has passed, contact CM prior to any further action.
2. Record current date in engine log book.
3. Verify engine model number and serial number correlate with model number and serial number stamped on engine data plate and recorded in engine logbook and packing list.
4. Inspect engine for signs of damage or corrosion.
   a. If engine exhibits no sign of damage or corrosion, proceed with installation. If engine is to be installed within 30 days of unpacking, proceed with instructions in Section 5-3.2, "Prepare the Engine for Installation."
   b. If damage or corrosion is discovered, contact supplier of engine for disposition. Do not install a damaged or corroded engine or place it in storage.

5-2.6. Engine Transport

Refer to the "Engine Installation Drawings" in Section 5-4 for the engine lifting eye locations.

WARNING

Ensure engine slings are designed to support the weight of the engine or total engine weight including all accessories.

Using engine lifting eyes to lift aircraft is strictly prohibited.

CAUTION: Keep crankshaft axis horizontal during handling operations.

CAUTION: Do not allow chains to become entangled in the engine or its hardware. Ensure the area is clear when lifting the engine. Do not allow the front, rear, sides or bottom of the engine to bump or strike any obstructions to prevent damage to the engine or its components. Do not connect engine hoist, hooks, cables, etc to any point on the engine other than the lifting eyes.

CAUTION: Visually inspect engine lifting eye fasteners for security. Torque seal across lifting eye fasteners and crankcase indicates fastener torque has been verified.

1. Position engine hoist above engine.
   a. Attach front engine sling to front lifting eye.
   b. Attach rear engine sling to rear lifting eye.
   c. Connect hoist to front and rear slings.
2. Take up slack on hoist prior to loosening engine mount bolts; remove bolts from shipping cradle shock mounts.

   CAUTION: It is prohibited to rest engine on oil sump.
3. Lift engine clear of shipping cradle and place it on an engine transport stand or dolly.

   NOTE: If engine will be stored for any length of time, refer to "Engine Preservation and Storage" instructions in Chapter 9 of M-0, Standard Practice Maintenance Manual.

5-3. Installation Procedures

5-3.1. Prepare Aircraft for Engine Installation

1. Verify aircraft fuel filter and boost pump are installed and operate according to the aircraft manufacturer's instructions.

WARNING

Purge aircraft fuel tanks and lines to remove all contamination prior to connecting main fuel supply to fuel pump inlet. Failure to purge contamination may cause erratic fuel injection system operation, fuel pump damage and/or malfunction.

CAUTION: Follow aircraft manufacturer's scheduled interval for aircraft mounted fuel and oil hose replacement. Hoses become brittle with age; CM recommends hose replacement coincident with engine overhaul to avoid immediate contamination or failure at a later date.

2. Replace all aircraft flexible oil and fuel hoses according to aircraft manufacturer's instructions prior to engine installation.
3. Clean the aircraft fuel strainer and allow at least one quart (0.94 L) of fuel to flow through strainer and fuel supply line into a Type 1 fuel container through a paper filter.
4. Inspect paper filter for contamination; if fuel supply is free of contamination, proceed with engine installation. If contaminants are found in fuel supply, isolate and correct source of contamination prior to connecting aircraft fuel supply to engine driven fuel pump.

5-3.2. Prepare the Engine for Installation

Remove packing material, tags, and the preservative fluid from oil sump and fuel injection systems of new, rebuilt, overhauled or stored engines prior to installation.

NOTE: If the engine will not be installed immediately, preserve it according to "Engine Preservation and Storage" instructions in Chapter 9 of M-0, Standard Practice Maintenance Manual.

1. Remove the shipping plugs or dehydrator plugs from the spark plug holes.
2. Remove the AN-4060 protectors from the ignition leads.
3. Place a basin under the engine to catch the engine preservation oil.

NOTE: A small amount of preservative oil remaining in the cylinder bore is acceptable; it will burn off during the first engine start.

4. Remove the oil sump drain plug and drain the remaining preservation oil from the oil sump. Drain plug locations are depicted in the "Engine Installation Drawings" in Section 5-4.
5. Turn the crankshaft through at least two complete revolutions to remove the engine preservation oil from the cylinders.
6. Catch the preservation oil draining out of the lower spark plug holes.

7. Inspect the cylinder bores with a borescope for rust and contamination.

   NOTE: If corrosion or abnormal conditions are discovered during the borescope inspection, contact the supplier (If the engine was obtained from Continental Motors, refer to "Contact Information" in Section 1-3) for disposition instructions.

8. Install the shipping plugs or dehydrator plugs back into the spark plug holes.
9. Install the drain plug with a new crush washer; torque the drain plug according to Appendix B specifications and safety wire the drain plug according to instructions in Appendix C-3.
10. Place a catch basin underneath the fuel pump.
11. Remove the shipping cap installed on the fuel pump inlet fitting. Disconnect the fuel hose from the fuel pump outlet fitting. Allowing the preservative fluid to drain from the fuel pump and hoses.
12. Connect the fuel hose to the fuel pump outlet fitting and torque fitting to Appendix B specifications. Re-install the shipping cap on the fuel pump inlet fitting.

WARNING

Oil pressure is applied to the face of the accessory drive pads. If gasket or accessory covers are not properly installed and torqued to Appendix B specifications, oil leakage will occur.

13. Remove the shipping plate from the propeller governor pad forward of the No. 6 cylinder.

    CAUTION: Align the governor drive gear spline and ensure the governor is fully seated to the crankcase prior to installing the attaching hardware. Forcing the drive gear over the camshaft will require engine disassembly.

14. Install the propeller governor according to the aircraft manufacturer's instructions.

    NOTE: Optional accessories such as hydraulic pumps, vacuum pumps, etc. may be installed in the accessory drive pads located on the starter adapter. Remove the accessory drive covers and install new gaskets. Install accessories in accordance with the aircraft manufacturer's instructions.

15. Install all aircraft manufacturer-required components according to the aircraft manufacturer's instructions, including the following:
    a. Cooling baffles
    b. Hoses and fittings
    c. Brackets
    d. Ground straps
    e. Hydraulic, air conditioning or vacuum pumps

f. Exhaust system

NOTE: All IO-360 engines use two gaskets with concave sides together. After ground run-up and prior to flight service, torque all exhaust nuts according to Appendix B specifications.

g. Other aircraft manufacturer required item(s)

16. Install the engine in the sequence indicated in Section 5-3.3.

5-3.3. Installation Sequence

CAUTION: Do not allow chains to become entangled in the engine or its hardware. Ensure the area is clear when lifting the engine. Do not allow the front, rear, sides or bottom of the engine to bump or strike any obstructions to prevent damage to the engine or its components. Do not connect engine hoist, hooks, cables, etc to any point on the engine other than the lifting eyes.

1. Install the engine in the aircraft mounts according to the aircraft manufacturer's instructions. Refer to the "Engine Installation Drawings" in Section 5-4 for engine dimensions, clearances, and connections.

WARNING

Oil pressure is applied to the face of the accessory drive pads. If gaskets or accessory covers are not properly installed and torqued to the settings specified in Appendix B, oil leakage will occur.

2. Connect the fuel supply, vapor return and fuel pump drain connections to the engine driven fuel pump fittings according to the aircraft manufacturer's instructions.
3. Turn the Ignition Switch to the OFF position.

WARNING

Do not install the ignition harness "B" nuts on the spark plugs until the propeller installation and the ignition system operational checkout is complete. Failure to comply can result in bodily injury when the propeller is rotated during installation.

4. Connect the starter wiring and torque fasteners according to Appendix B specifications.
5. Connect the alternator wiring and torque fasteners according to Appendix B specifications.
6. Install the propeller according to the aircraft and propeller manufacturer's instructions.
7. Connect the aircraft ignition switch wiring to the P-leads of each magneto and perform a functional check of the circuit to verify the ignition switch properly disables the magnetos.
8. If the magnetos were loosened or rotated during engine installation, adjust magneto to engine timing according to the "Magneto Timing" instructions in Section 6-3.9.1.

9. Install aircraft accessories, listed below, according to the aircraft manufacturer's instructions.
   a. Pneumatic, vacuum pumps or air conditioning compressor
   b. Tachometer (mechanical) drive cable or (electrical) sensor connection
   c. Oil temperature sensor and oil pressure sensor connections
   d. Fuel pressure sensor and fuel flow sensor connections
   e. Exhaust Gas Temperature sensor connections
   f. Manifold pressure gauge line
   g. Throttle and mixture control cables
   h. Remaining aircraft manufacturer supplied accessories and instrument connections
10. Perform the "Engine Pre-oiling" procedure according to Section 5-3.4.
11. Complete a "Fuel Injection System Purge" according to instructions in Section 5-3.5.
12. Perform an "Installation Inspection" according to instructions in Section 5-3.6.

WARNING

Do not operate the engine until all hardware, spark plugs, gaskets, and seals are in place and torqued and the oil sump is properly filled to the specified capacity with oil.

13. Perform an "Engine Operational Check" according to instructions in Section 6-3.7.

5-3.4. Engine Pre-oiling

Engine pre-oiling must be accomplished prior to engine start-up after engine installation or overhaul/re-assembly. Two methods are provided in Section 5-3.4.1 and Section 5-3.4.2, "Pre-oiling Method 1" is preferred.

NOTE: If engine cylinders were installed or the engine has been overhauled, follow instructions in Section 5-3.4.1.

5-3.4.1. Pre-oiling Method 1

1. Install and torque the spark plugs and ignition lead wires according to instructions in Section 6-3.9.2, "Spark Plug Maintenance" and Section 6-3.9.3, "Ignition Harness Maintenance."
2. Verify the lubrication lines, fittings, hoses, screens, and filters are in place prior to pre-oiling.
3. Obtain a 1-gallon capacity bladder-type pressure pot with an output pressure of 50 psi (not to exceed 60 psi).
4. Connect the pre-oiler supply hose to the engine oil pressure port. It may be necessary to remove the aircraft oil pressure sensor fitting according to the aircraft manufacturer's instructions.
5. Remove the rocker covers according to Section 10-8.1.

6. Open the pre-oiler valve and monitor the rocker arms for oil flow. Depending upon the oil temperature, it may take several minutes to see an indication of oil flow.
7. After oil flow confirmation, close the pre-oiler valve.
8. Install rocker covers with new gaskets according to Section 10-8.8.
9. Disconnect the pre-oiler supply hose and cap; connect the engine oil pressure output to the oil pressure gauge connection (fitting).

WARNING

Do not operate the engine unless the oil is serviced to the proper level.

10. Check the oil level in the sump using the oil gage rod (dip stick). Verify the engine oil is at the proper level according to instructions in Section 6-3.8.1.

5-3.4.2. Pre-oiling Method 2

1. Service the engine oil level according to instructions in Section 6-3.8.

WARNING

Do not exceed the starter duty cycle in any mode of operation. The duty cycle for Energizer starter motor is 30 seconds. The SkyTec starter motor duty cycle is 10 seconds.

2. Turn the fuel selector valve to the OFF position.
3. Position the throttle to the IDLE/CUTOFF position.
4. Repeatedly engage the starter, respectful of the starter motor duty cycle, until oil pressure is indicated on the oil pressure gauge. If no oil pressure is indicated after a maximum of three engage/cool down intervals, check connections and gauge operation.
5. Install and torque the spark plugs and ignition lead wires according to instructions in Section 6-3.9.2, “Spark Plug Maintenance” and Section 6-3.9.3, “Ignition Harness Maintenance.”

WARNING

Do not operate the engine unless the oil is serviced to the proper level.

6. Check the oil level in the sump using the oil gage rod (dip stick). Verify the engine oil is at the proper level according to instructions in Section 6-3.8.1.

5-3.5. Fuel Injection System Purge

Prior to shipping from the factory, the fuel injection system was preserved with MIL-PRF-6081D Grade 1010. The preservative fluid was drained during completion of Section 5-3.2. Flushing the system with aircraft fuel will complete the purge and prime the fuel injection system for operation.

1. Disconnect the fuel supply line at the inlet to the fuel manifold valve.
2. Connect a length of the appropriate size hose to the disconnected fuel manifold supply hose using an AN union fitting. Route the end of the hose to a properly grounded Type 1 flammable fluid container through a paper filter.

   CAUTION: Ensure the ignition switch is in the OFF position and clear the rotational arc of the propeller before proceeding.

3. Have an assistant turn the aircraft Master Power switch on.
4. Place the aircraft boost pump in the ON position for approximately one minute while cycling the throttle and mixture controls through the full range of travel several times.
5. Turn the aircraft boost pump and Master Power switches to the OFF positions.
6. Close the mixture and throttle controls.
7. Inspect the paper filter for contamination; isolate and correct the source of contamination and continue flushing until no contamination is present in the paper filter.
8. Remove the extra length of hose and union installed in step 2 from the fuel manifold valve supply hose.
9. Connect the fuel manifold valve fuel supply hose to the inlet fitting on the manifold valve and torque the fuel hose “B” nut to Appendix B specifications.

   NOTE: Place approved containers at the induction system drain locations to collect fuel as it drains overboard.

10. Turn the aircraft Master Power switch to the ON position.
11. With the Mixture Control in FULL RICH and the Throttle ¼ OPEN, turn the aircraft boost pump to the ON position.
12. Inspect fuel injection system lines, hoses and fitting for evidence of fuel leakage.
13. Place the Mixture Control to IDLE CUT-OFF and CLOSE the Throttle.
14. Turn the aircraft fuel boost pump OFF.
15. Turn the aircraft Master Power switch OFF.
16. Correct any discrepancies noted.
17. Dispose of the fuel/oil mixture in accordance with Federal and State Hazardous Material Regulations.

5-3.6. Installation Inspection

Perform a "Visual Inspection" of the engine according to instructions in Section 6-3.6 prior to engine start.

5-3.7. Preflight and Run-up

Perform an Engine Operational Check after completing the engine installation and before performing the flight check according to the Airplane Flight Manual (AFM) or Pilot Operating Handbook (POH). Perform a flight check prior to releasing the aircraft for normal service to ensure the engine meets the manufacturer's performance and operational specifications.

WARNING

The fuel system must be adjusted after installation in the aircraft according to the "Engine Operational Check" in Section 6-3.7 to ensure proper operation. Correct all discrepancies prior to release for flight.

IO-360 Series engines are neither designed, nor approved, for continuous negative or zero "G" operation. Engine Mount loads shall not exceed FAR 23 utility category load factors.

CAUTION: Adhere to the Operating Limits in Section 2-3 during the Flight Check.

Check the oil level in the sump and service, if necessary, to the capacity specified in Section 2-3, "Engine Specifications" with oil meeting the SAE specification described in "Engine Oil Specifications" in Chapter 3 of the Standard Practice Maintenance Manual (M-0). Pressure check the fuel system for leaks before starting the engine.

NOTE: Perform a flight check according to instructions in Section 7-2.3 before releasing the engine for normal operations. New and rebuilt engines, and engine with one or more new cylinders or pistons, require a 25-hour break-in. After installation, avoid prolonged ground operation at high power.

1. Perform an "Engine Operational Check" according to instructions in Section 6-3.7.
2. Re-torque the exhaust flange nuts to Appendix B specifications after initial engine run-up, prior to first flight.
3. Perform a "Flight Check" according to instructions in Section 7-2.3.

5-4. Engine Installation Drawings

Installation drawings are provided to assist the aircraft manufacturer in determining the appropriate fittings and fasteners for aircraft interconnect and determine engine compartment fit and limit requirements. Slight variations between the basic IO-360 and subsequent engine models require separate engine installations. Pay particular attention to the model depicted when referencing drawings for engine installation requirements.

5-4.1. IO-360 Common Installation Drawings

Exhaust port dimensions are identical for the IO-360 series engines. Refer to Figure 5-1. Propeller flange dimensions are identical with exception to bolt hole diameters of AF and ES models for the IO-360 series engines. Refer to Figure 5-2. Specific engine model dimensions follow the common installation drawings.

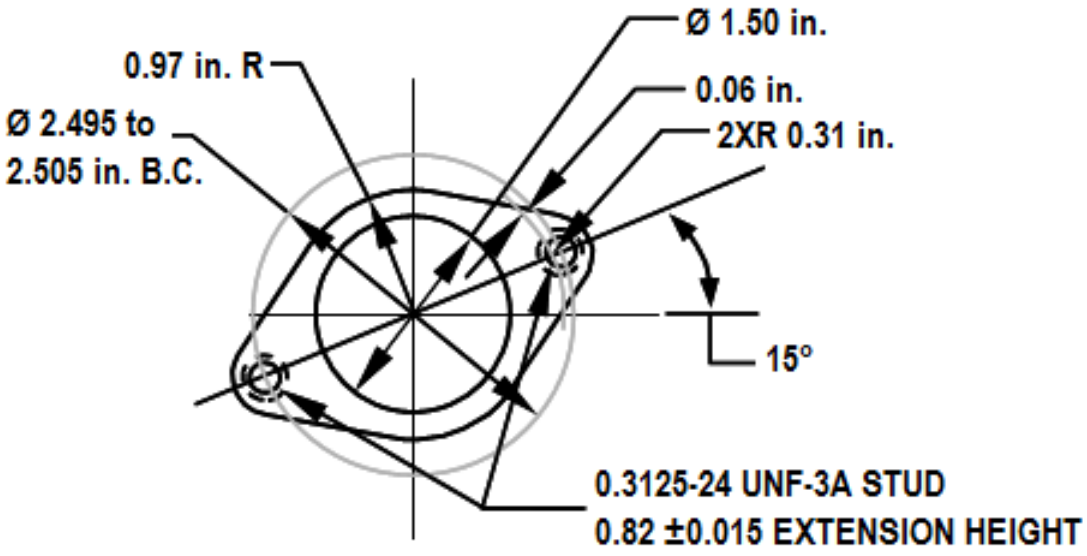


Figure 5-1. Exhaust Port Dimensions

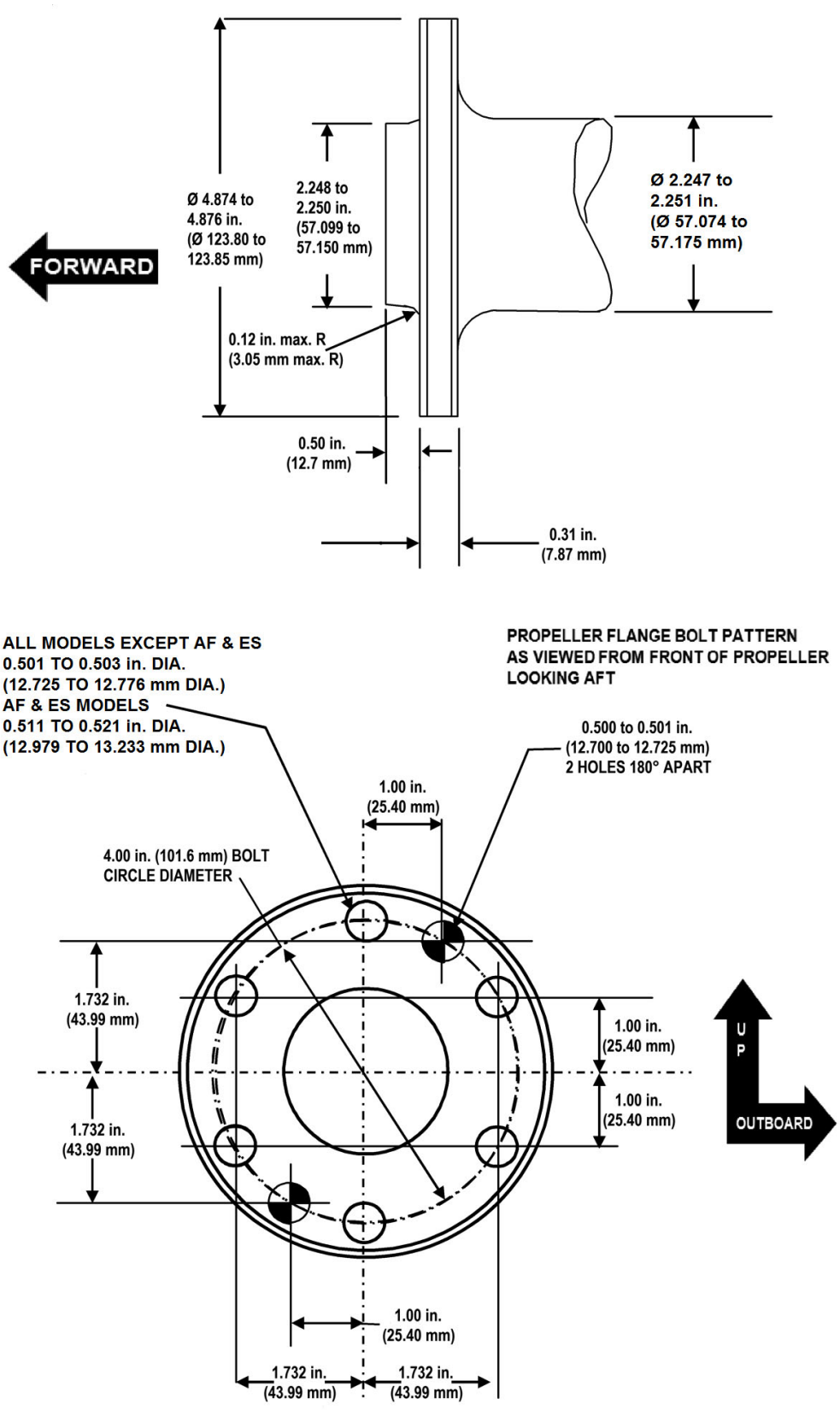


Figure 5-2. Propeller Flange Dimensions

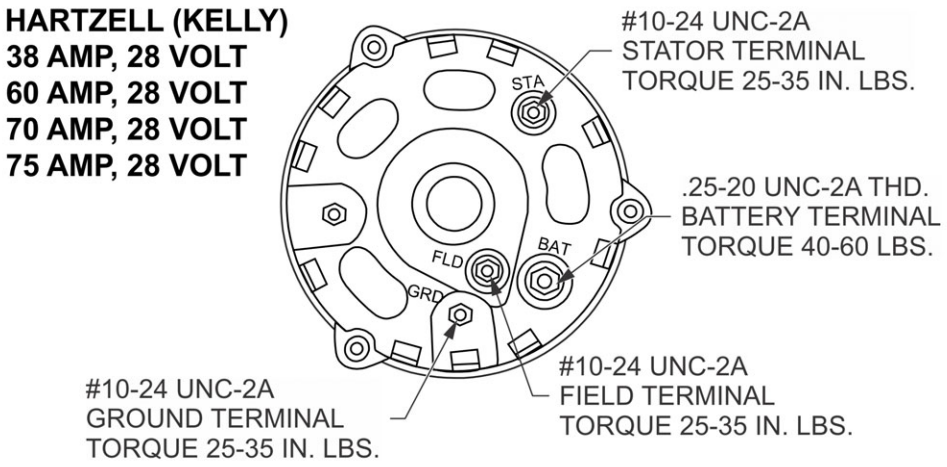


Figure 5-3. 28V Gear Driven Alternator Detail

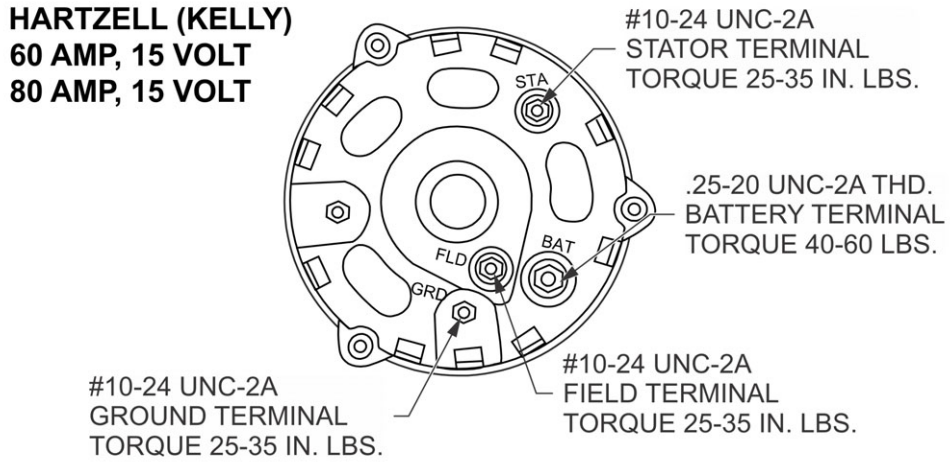


Figure 5-4. 15V Gear Driven Alternator Detail

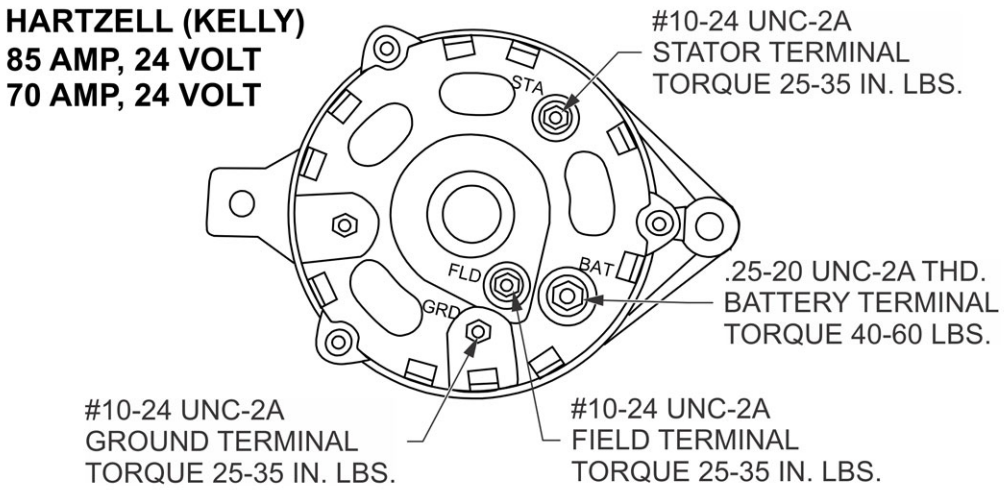
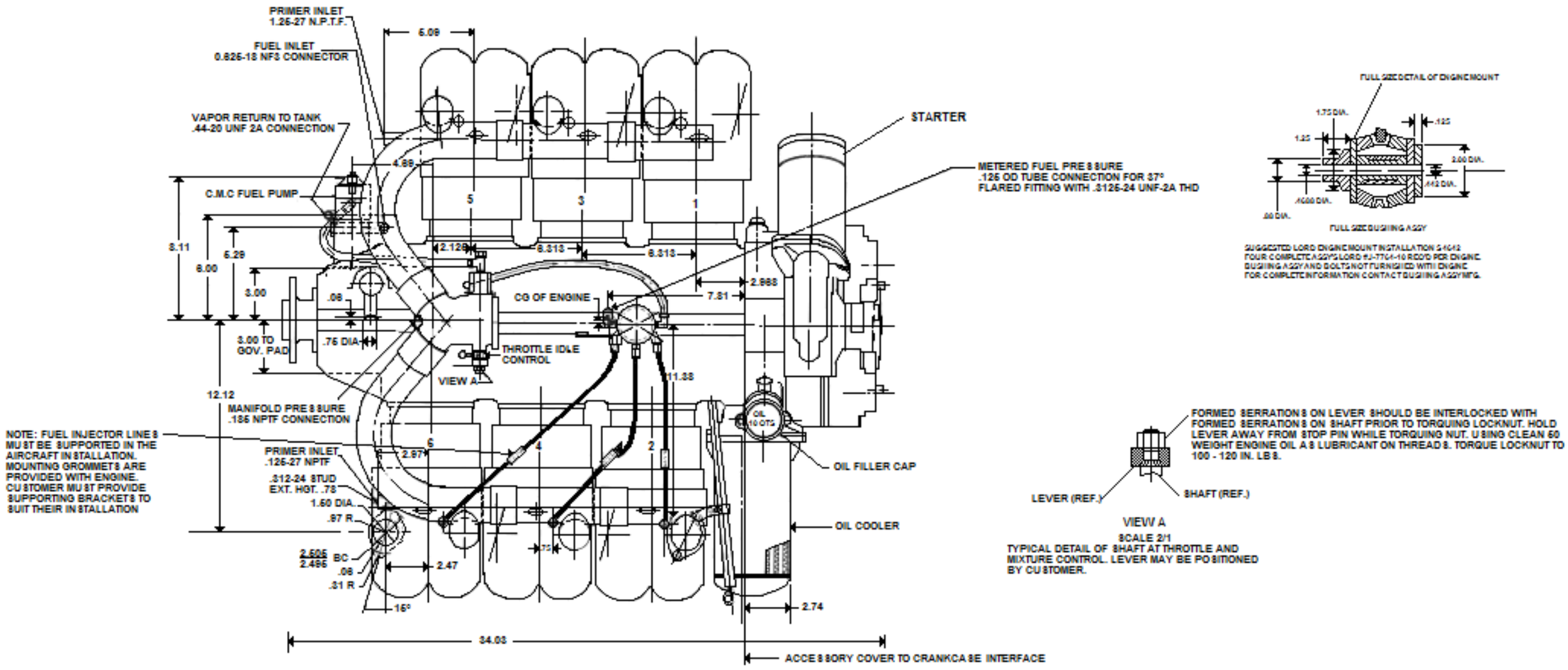


Figure 5-5. 24V Belt Driven Alternator Detail

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SUGGESTED LORD ENGINE MOUNT INSTALLATION 5-1012
FOUR COMPLETE ASSYS LORD #J-7701-10 REQ'D PER ENGINE.
BUSHING ASSY AND BOLTS NOT FURNISHED WITH ENGINE.
FOR COMPLETE INFORMATION CONTACT BUSHING ASSY MFG.

VIEW A
SCALE 2/1
TYPICAL DETAIL OF SHAFT AT THROTTLE AND
MIXTURE CONTROL. LEVER MAY BE POSITIONED
BY CUSTOMER.

Figure 5-6. Installation Drawing 629385 (Top View) (1 of 3)

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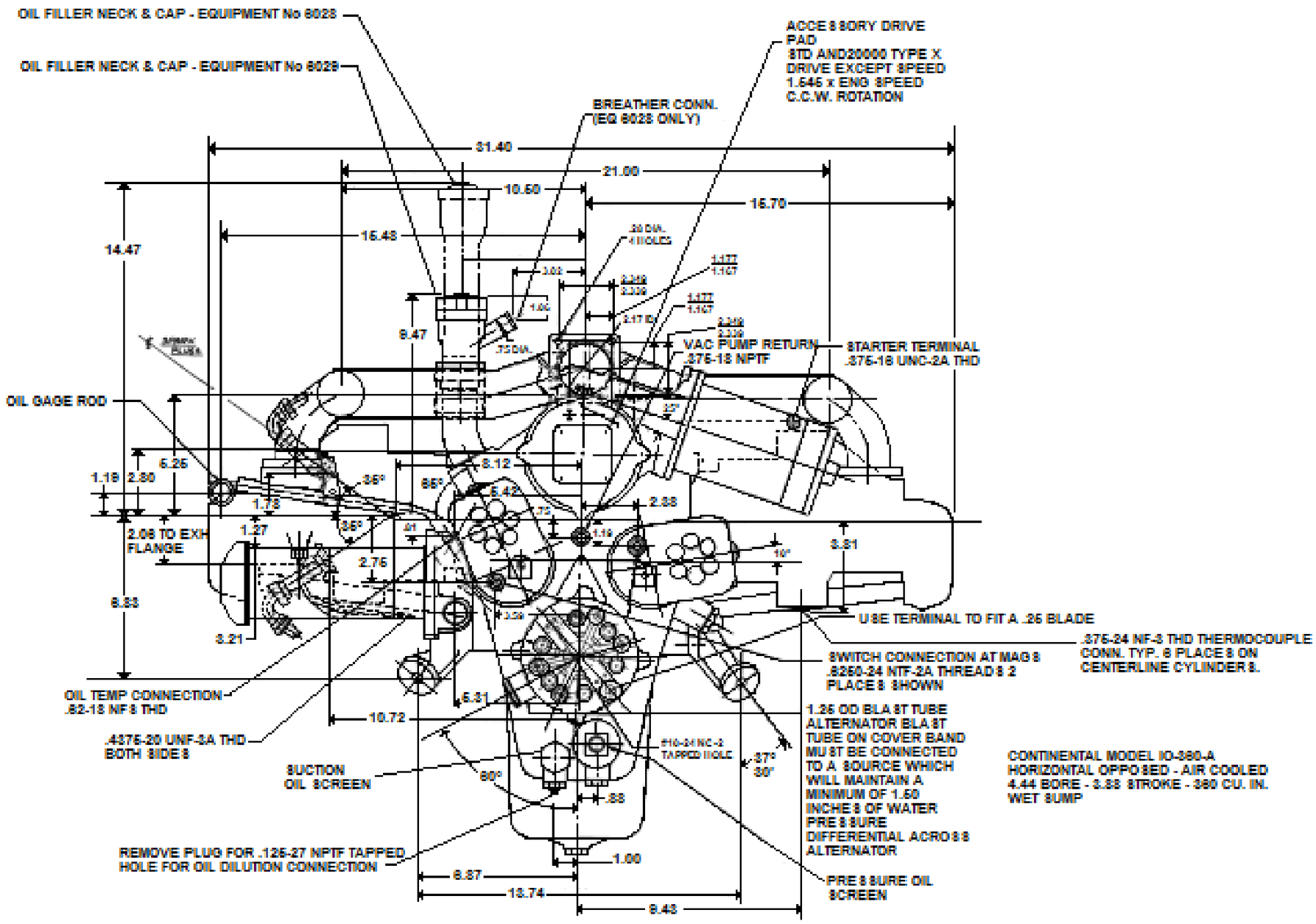


Figure 5-7. Installation Drawing 629385 (Rear View) (2 of 3)

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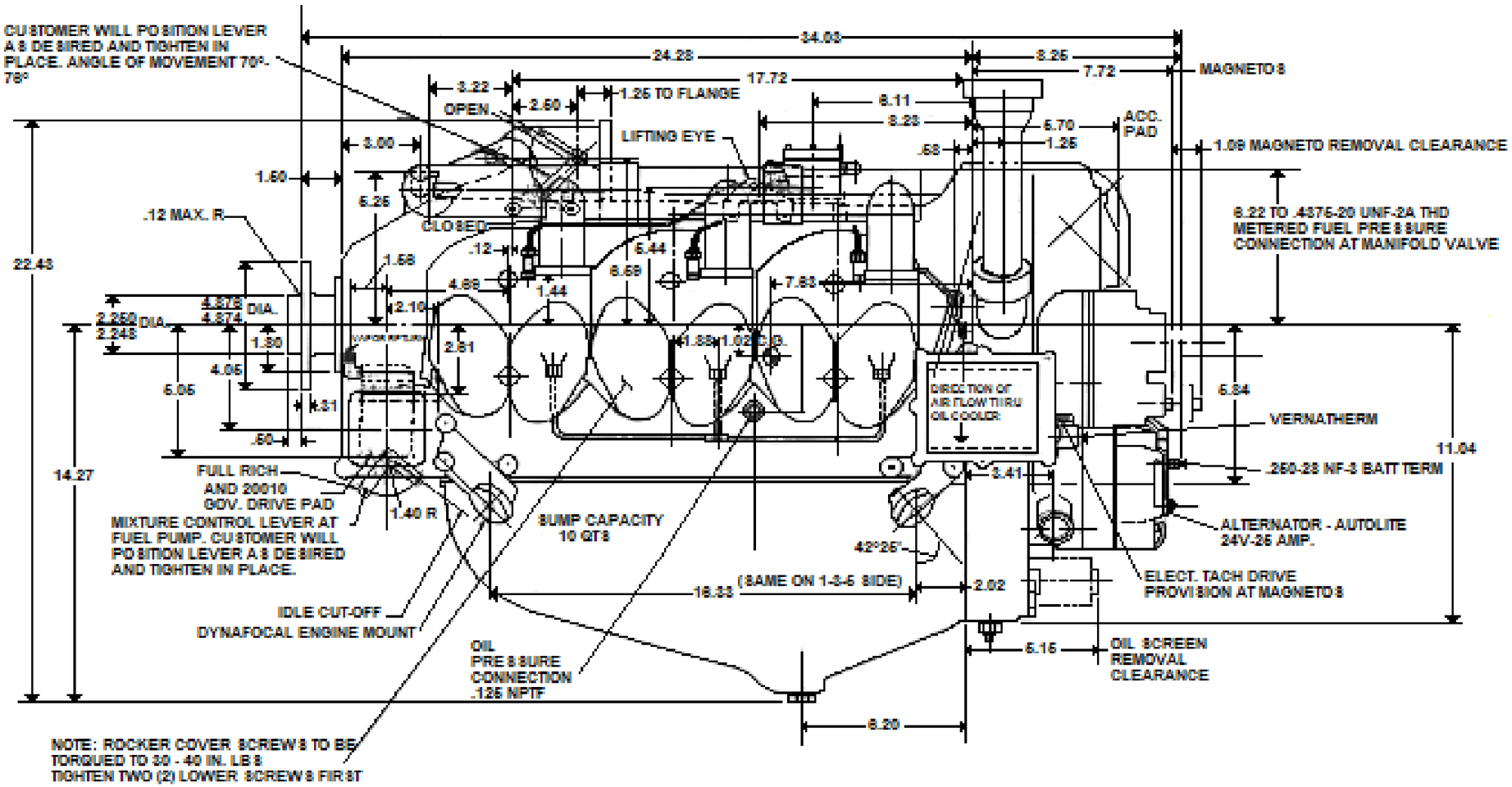


Figure 5-8. Installation Drawing 629385 (Left Side View) (3 of 3)

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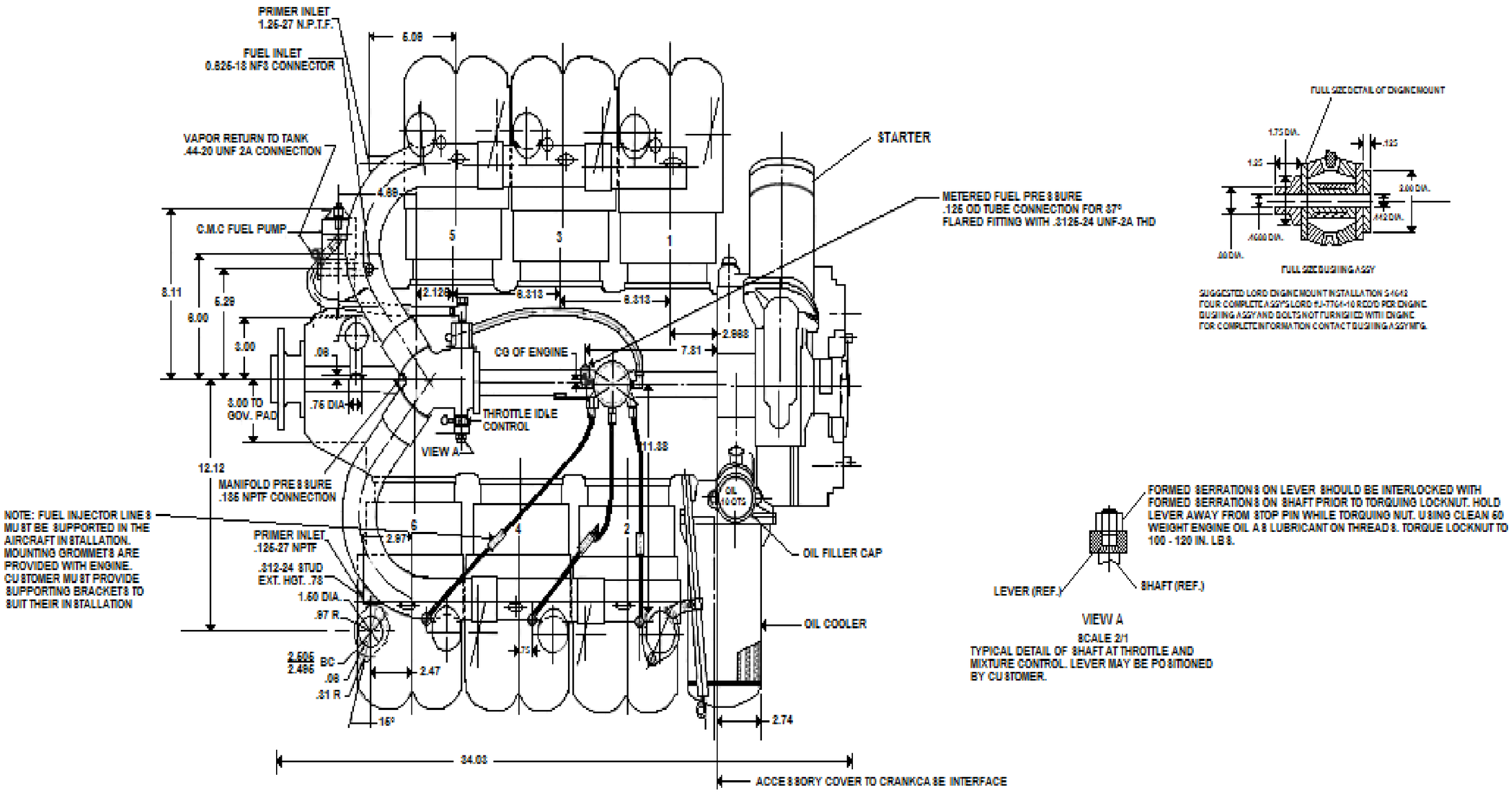


Figure 5-9. Installation Drawing 631721 (Top View) (1 of 3)

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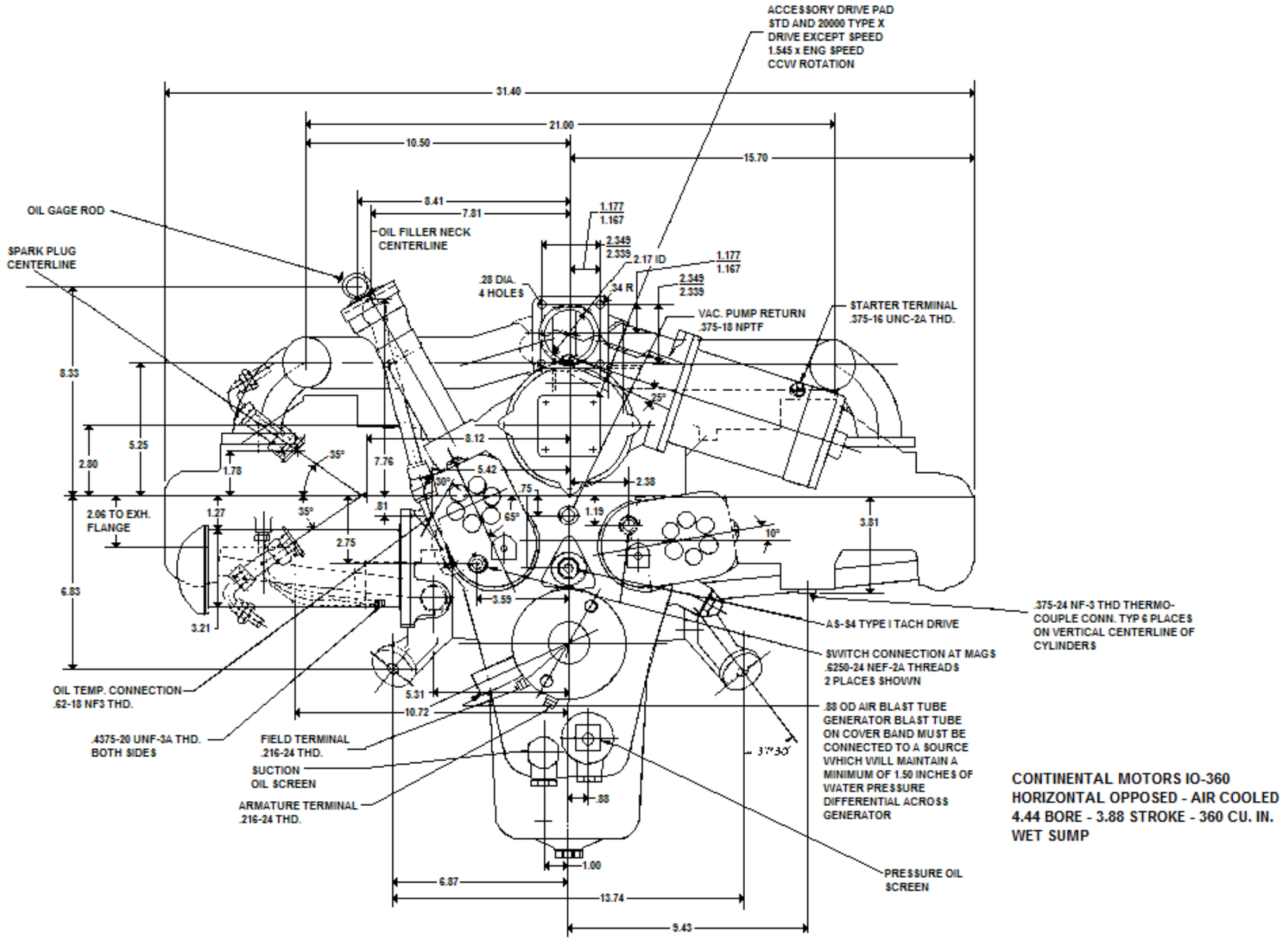


Figure 5-10. Installation Drawing 631721 (Rear View) (2 of 3)

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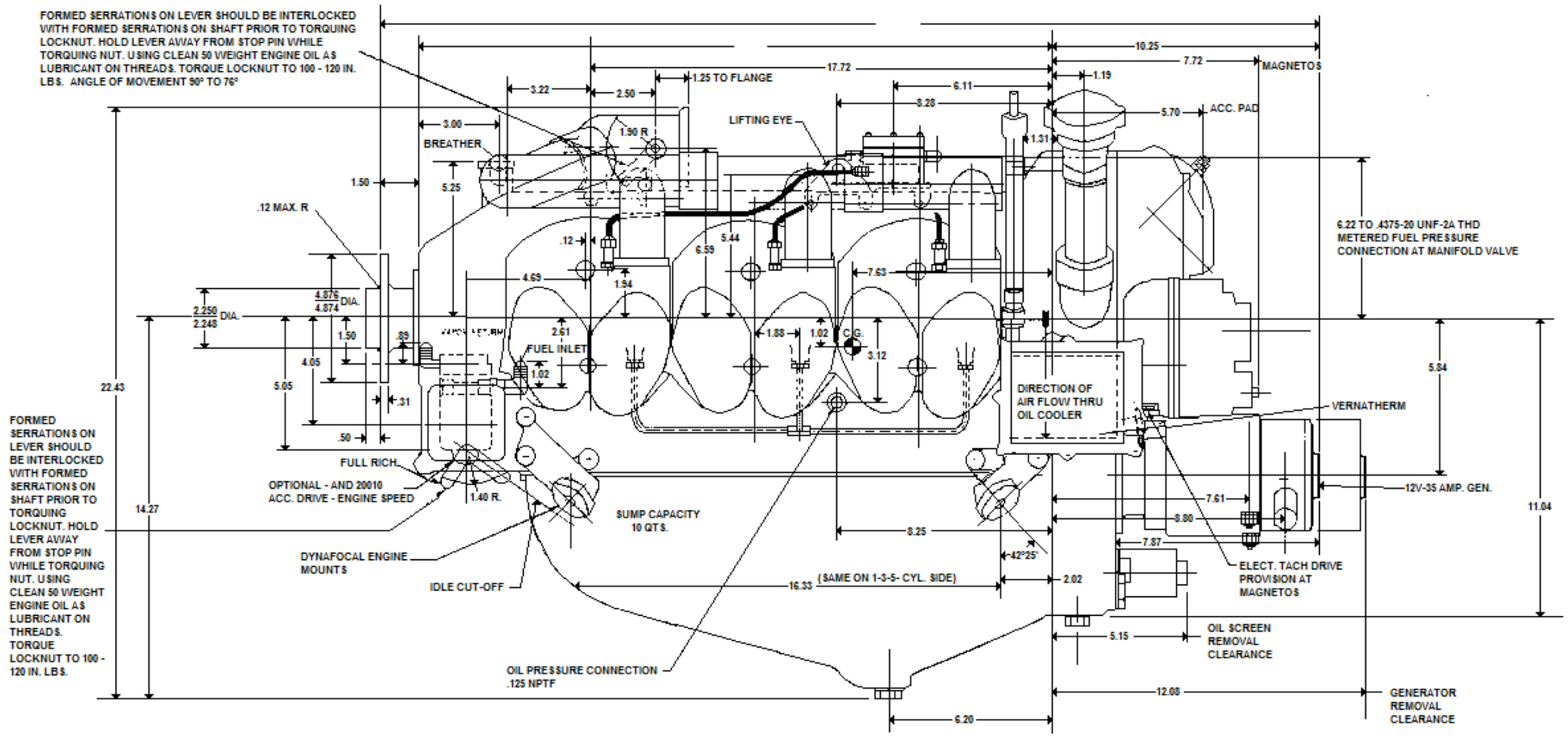


Figure 5-11. Installation Drawing 631721 (Left Side View) (3 of 3)

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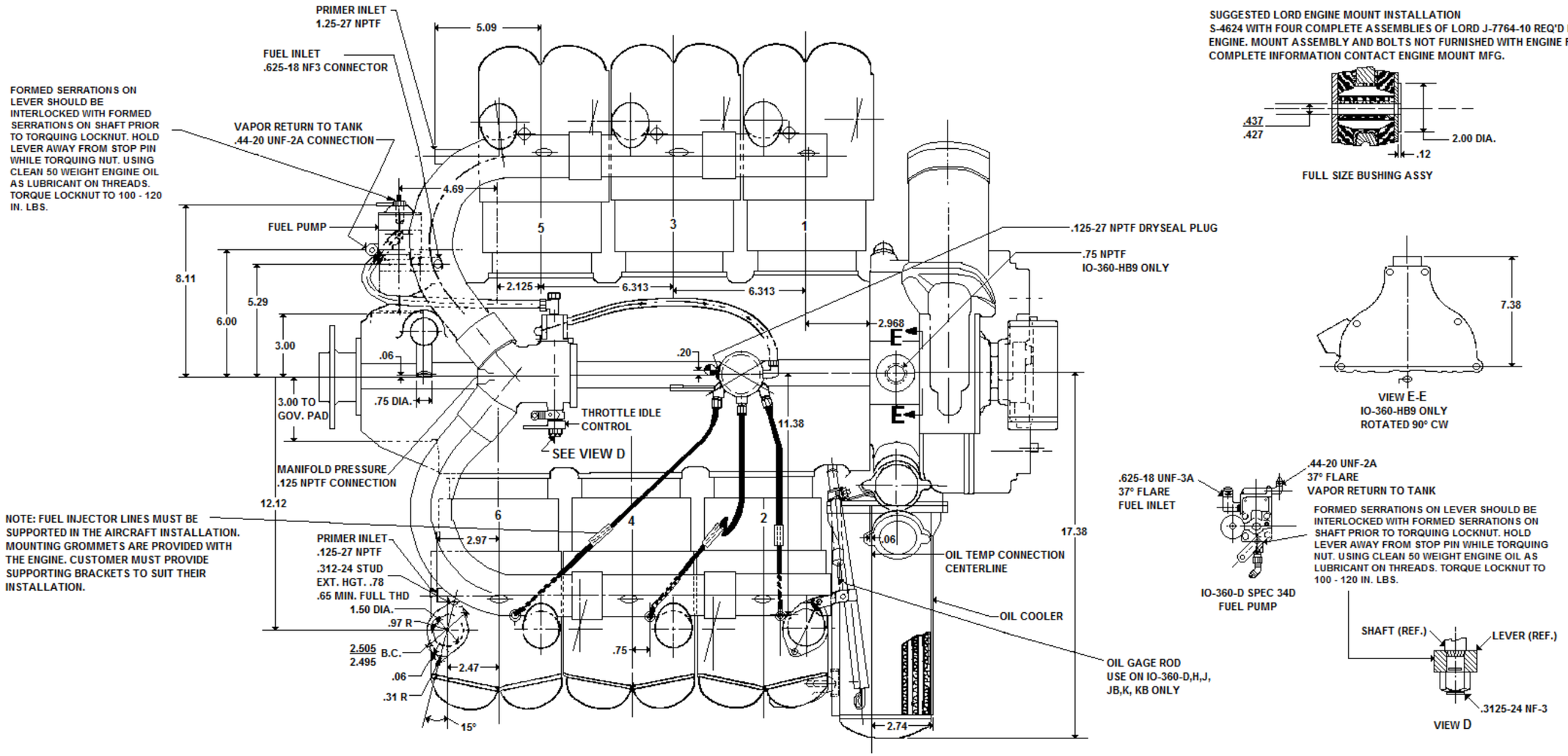


Figure 5-12. Installation Drawing 632619 (Top View) (1 of 3)

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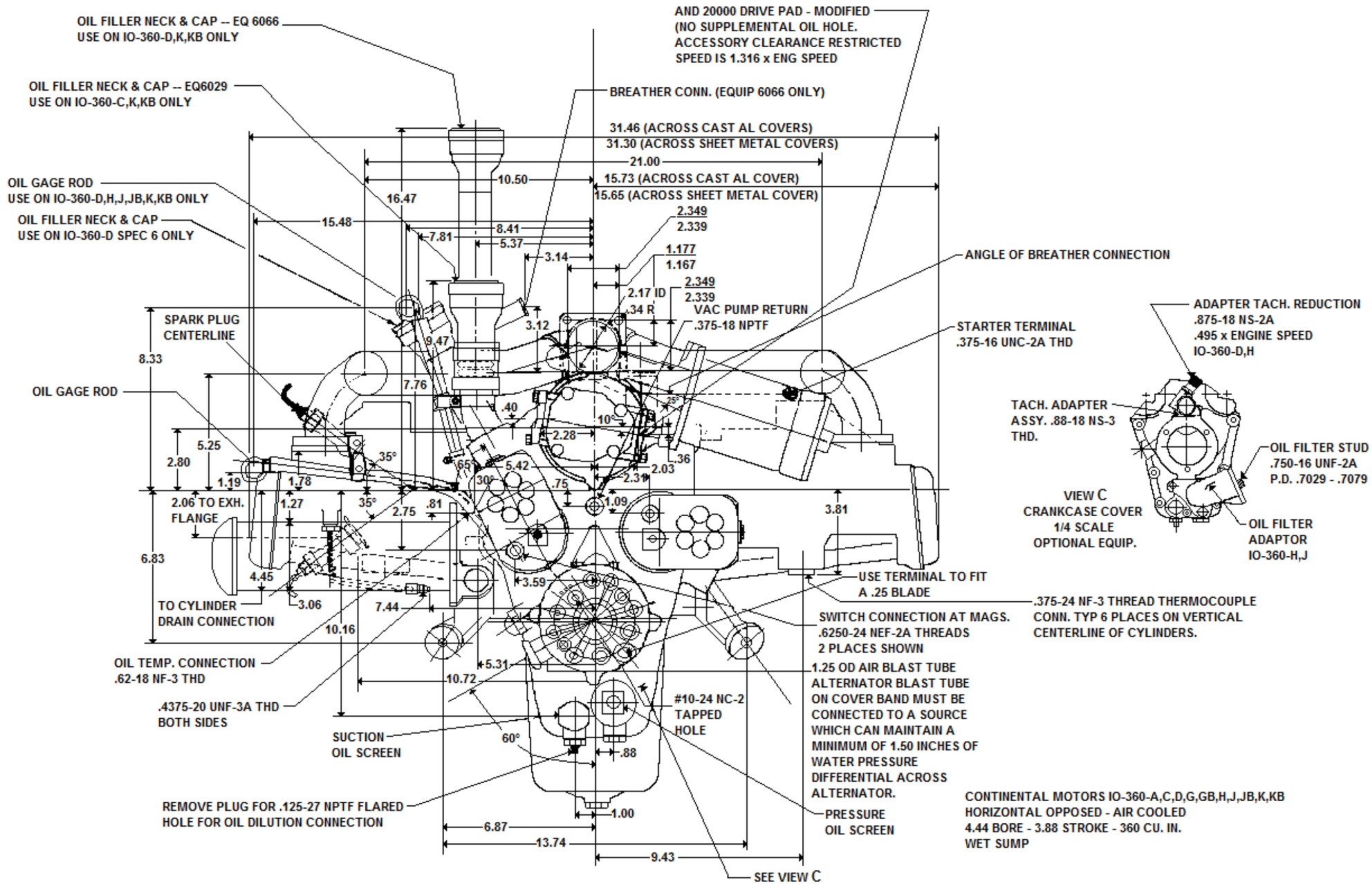


Figure 5-13. Installation Drawing 632619 (Rear View) (2 of 3)

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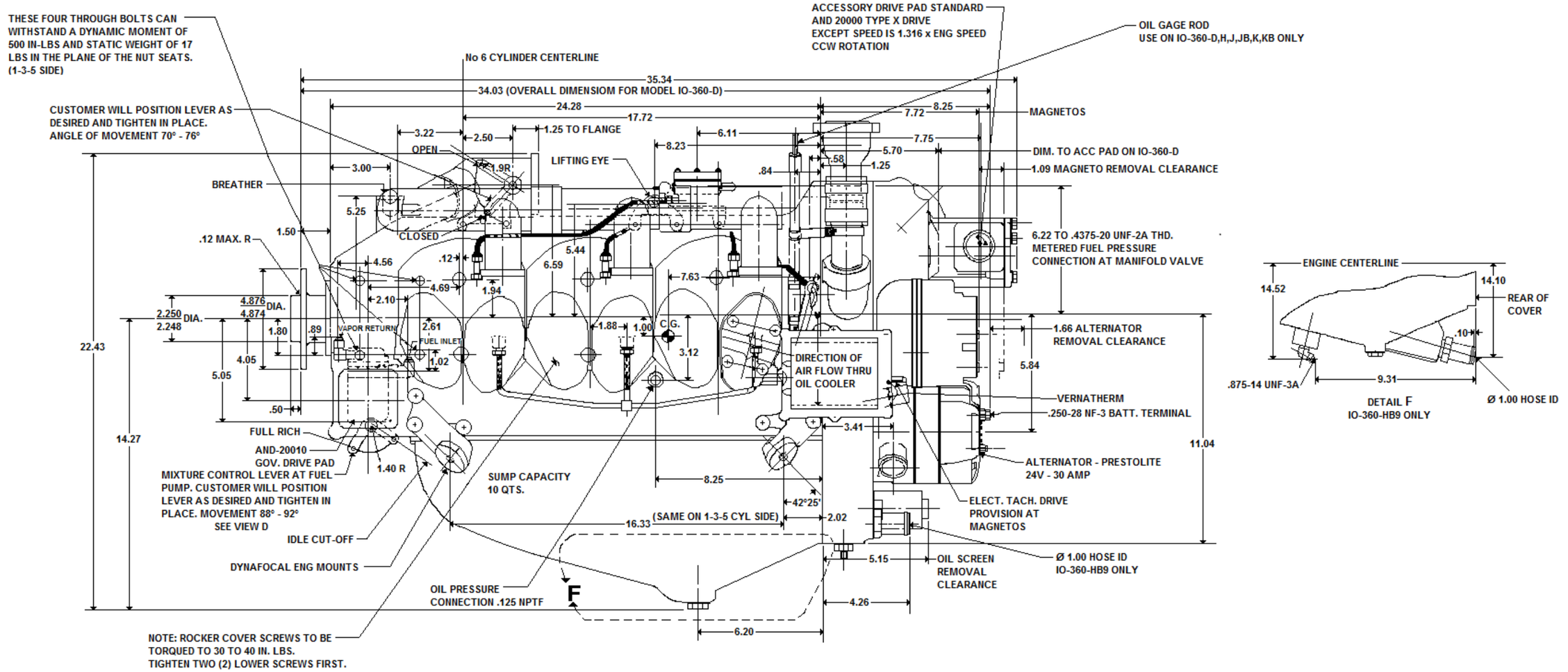
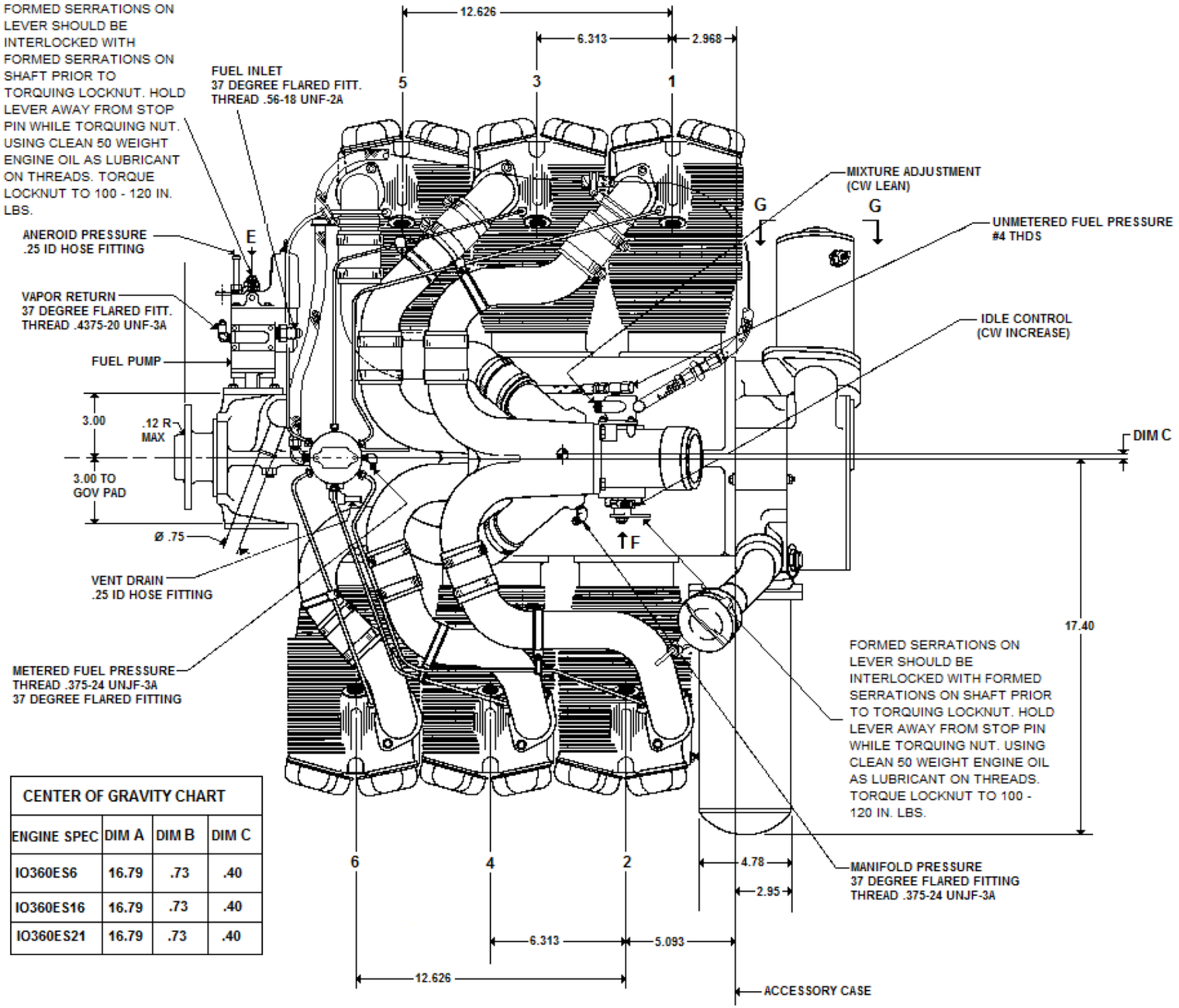
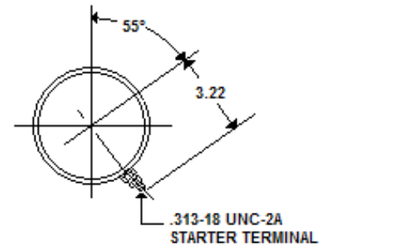


Figure 5-14. Installation Drawing 632619 (Left Side View) (3 of 3)

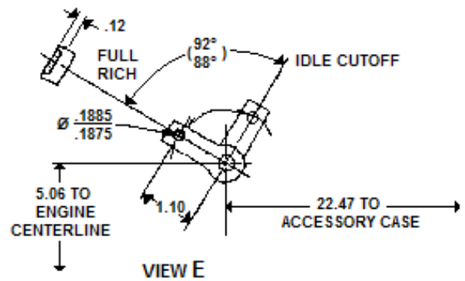
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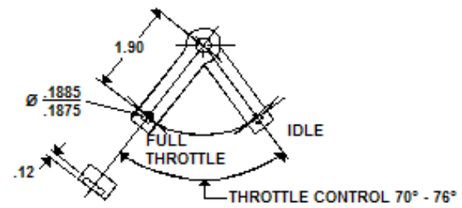
CENTER OF GRAVITY CHART			
ENGINE SPEC	DIM A	DIM B	DIM C
IO360ES6	16.79	.73	.40
IO360ES16	16.79	.73	.40
IO360ES21	16.79	.73	.40



VIEW G - G



VIEW E



VIEW F

CONTINENTAL MOTORS, INC.
MODELS IO360ES6,ES16,ES21,ES22,ES25,ES26,ES27&ES28

HORIZONTAL OPPOSED AIRCOOLED
BORE: 4.44
STROKE: 3.88
DISPLACEMENT: 360 CU IN
WET SUMP

Figure 5-15. Installation Drawing 656139 (Top View) (1 of 4)

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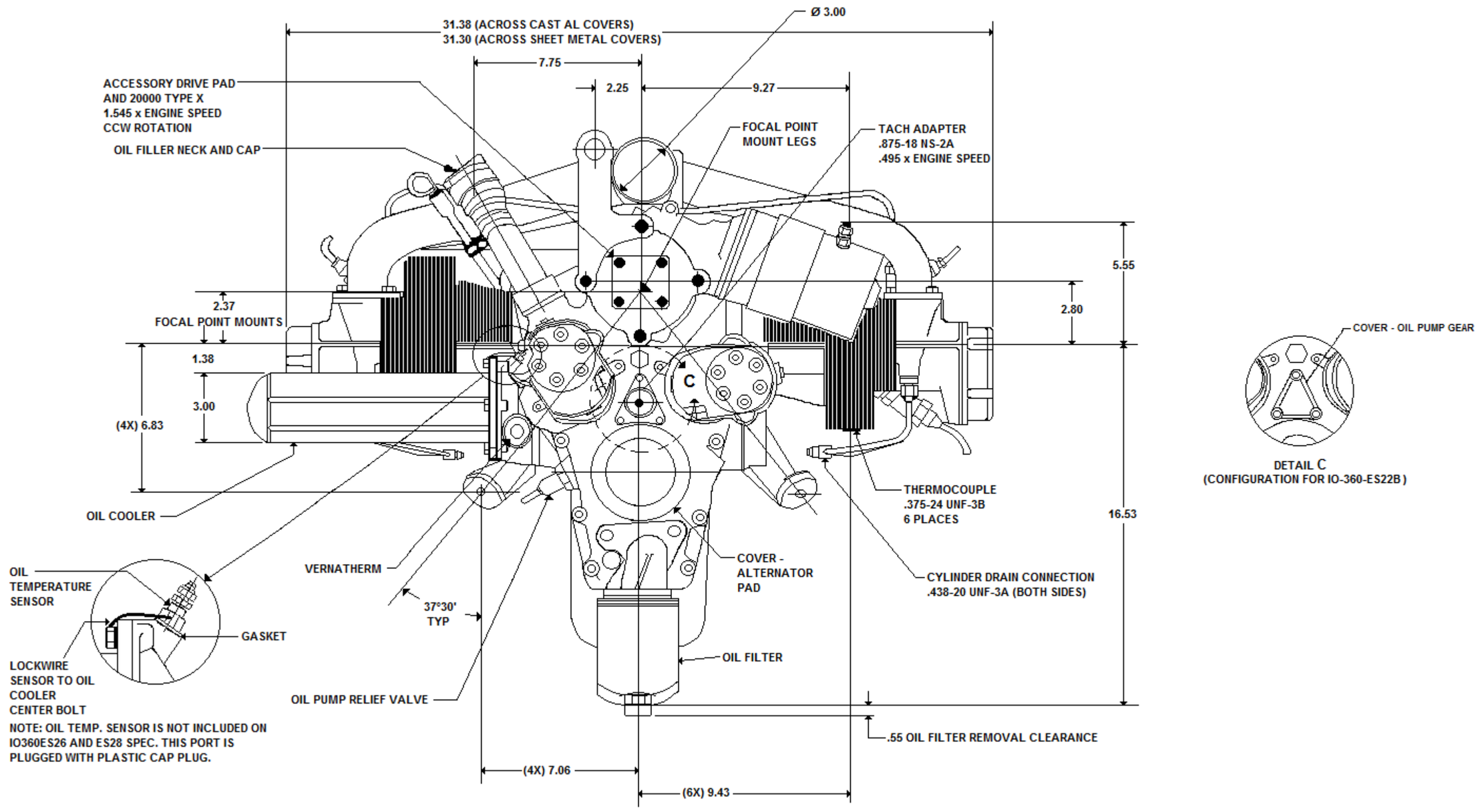


Figure 5-16. Installation Drawing 656139 (Rear View) (2 of 4)

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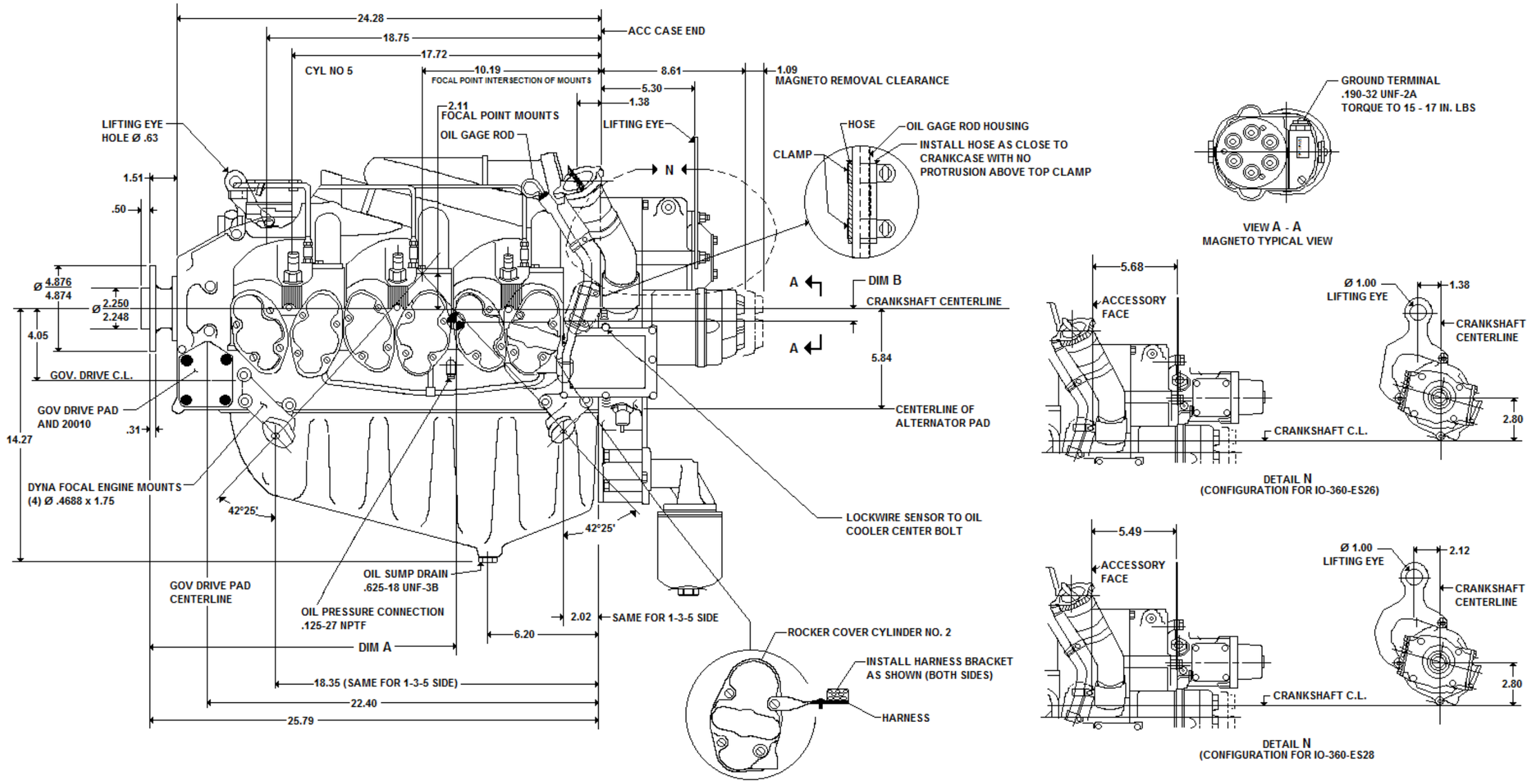


Figure 5-17. Installation Drawing 656139 (Left Side View) (3 of 4)

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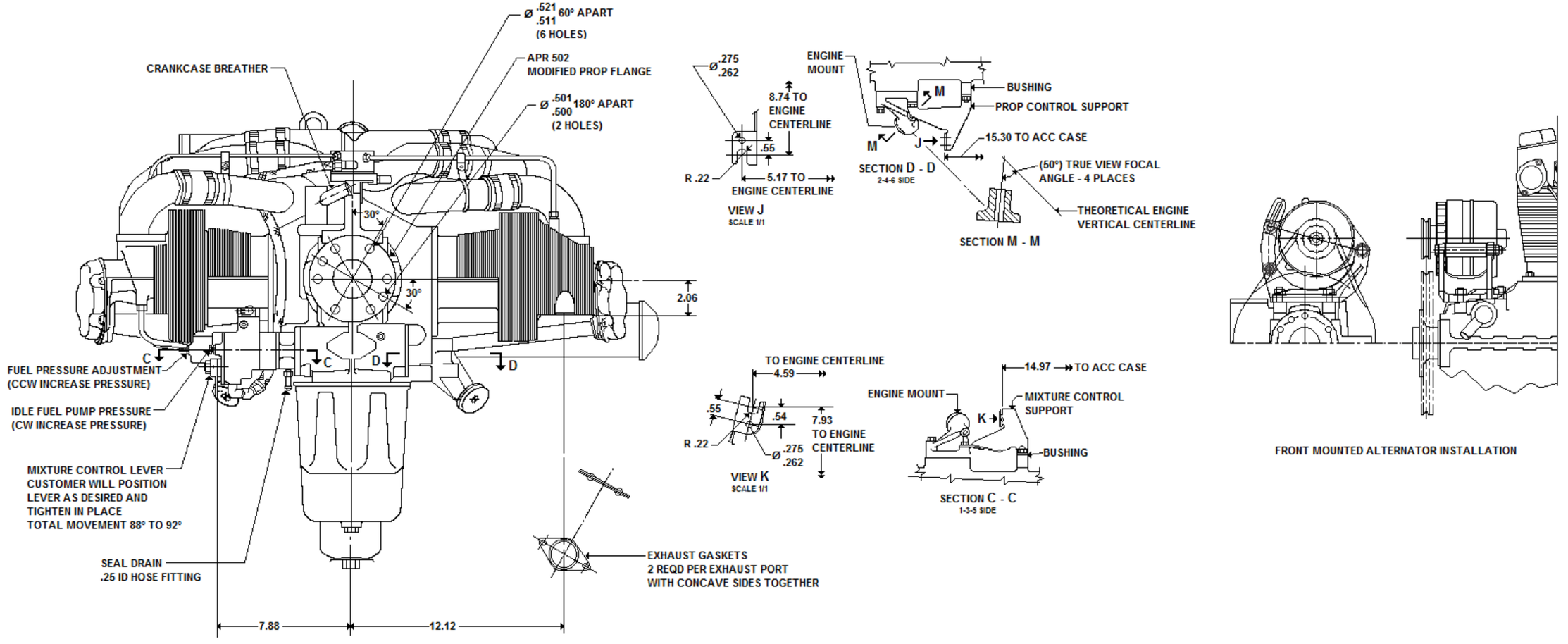


Figure 5-18. Installation Drawing 656139 (Front View) (4 of 4)

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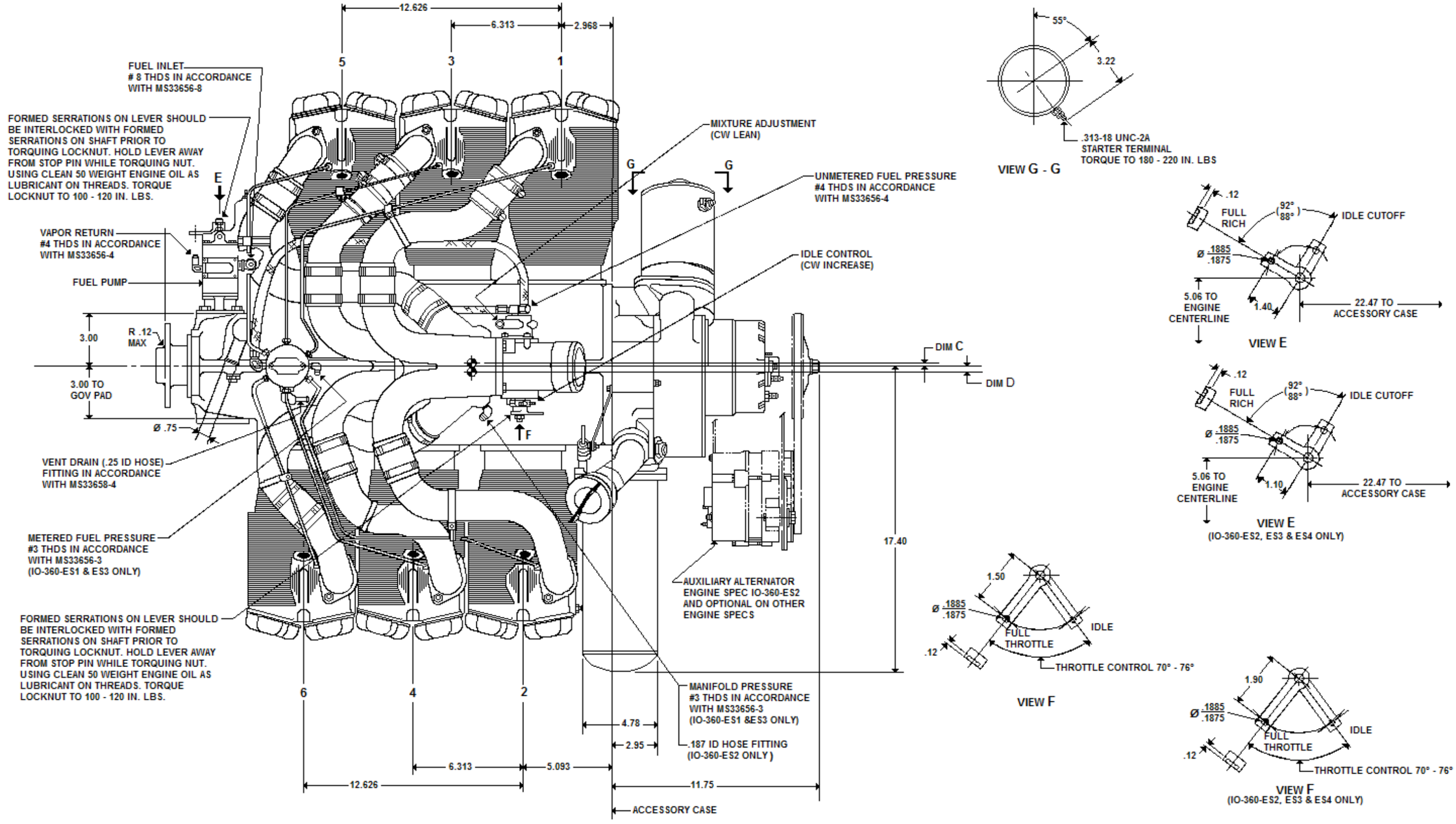
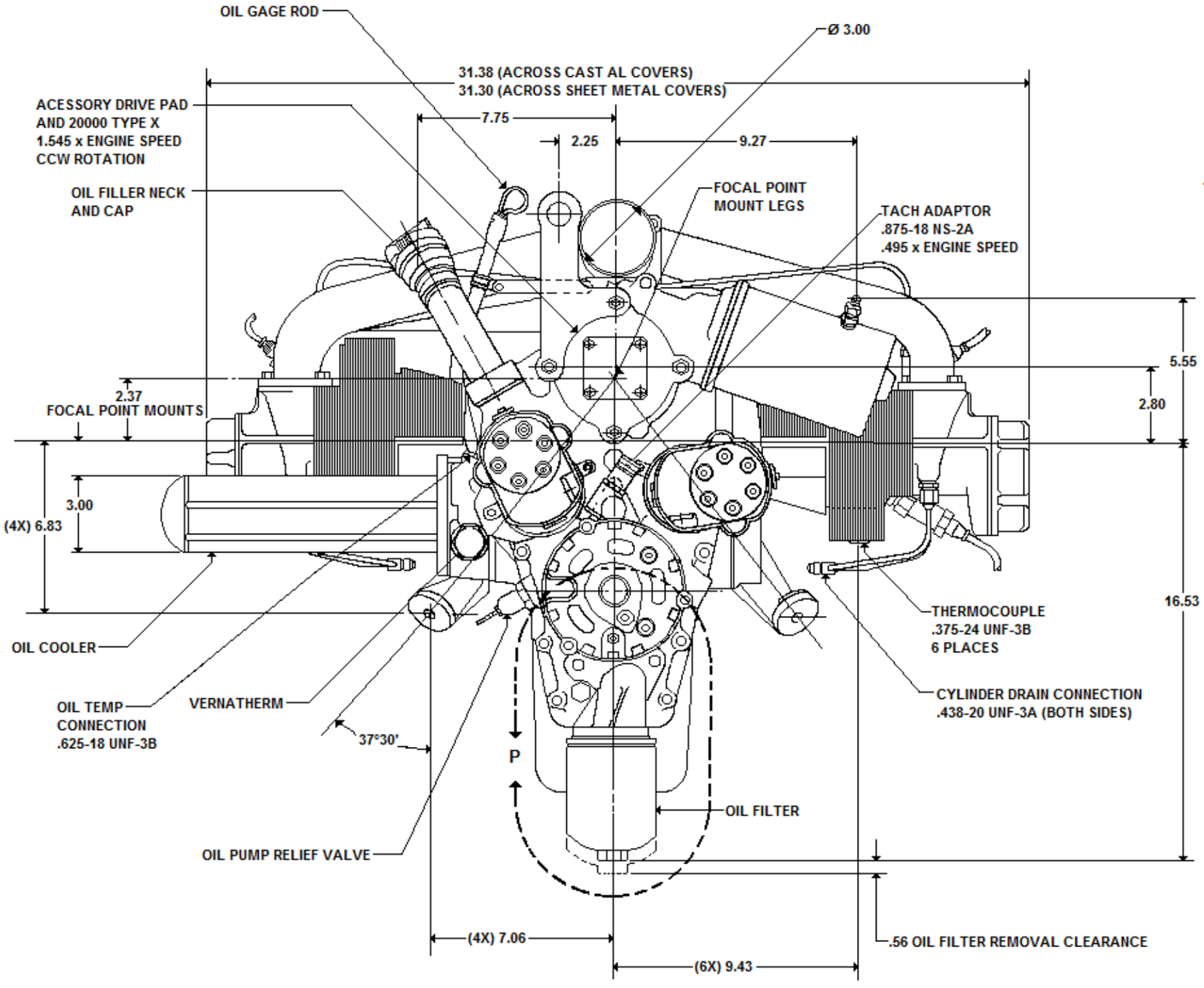
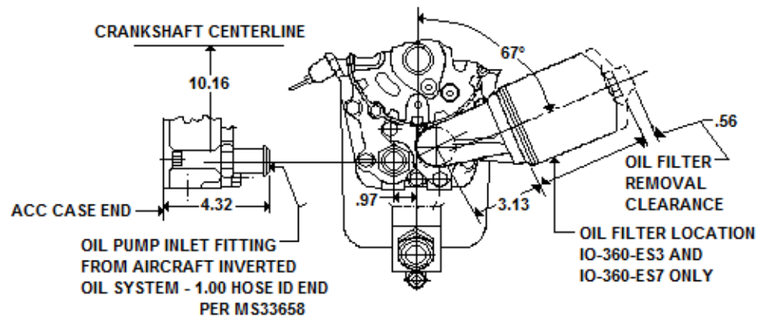


Figure 5-19. Installation Drawing 652898 (Top View) (1 of 4)

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VIEW P
(IO-360-ES3 ONLY)

CENTER OF GRAVITY CHART				
ENGINE SPEC	DIM A	DIM B	DIM C	DIM D
IO360ES1B	17.74	.73	.19	
IO360ES2B	18.71	.46		.14
IO360ES3B	17.74	.73	.22	
IO360ES4B	17.74	.73	.22	
IO360ES7B	17.74	.73	.24	
IO360ES8B	17.74	.73	.22	
IO360ES9B	17.74	.73	.19	
IO360ES11B	18.71	.46		.14
IO360ES12B	18.71	.46		.14
IO360ES13B	17.74	.73	.19	
IO360ES14B	17.74	.73	.22	
IO360ES15B	17.74	.73	.22	
IO360ES17B	17.74	.73	.24	
IO360ES18B	17.74	.73	.22	
IO360ES19B	17.74	.73	.19	
IO360ES20B	18.71	.46		.14
IO360ES23B	17.74	.73	.22	
IO360ES24B	17.74	.73	.22	

CONTINENTAL MOTORS, INC.
MODEL IO-360-ES
HORIZONTAL OPPOSED AIRCOOLED
BORE - 4.44
STROKE - 3.88
DISPLACEMENT = 360 CU. IN.
WET SUMP

Figure 5-20. Installation Drawing 652898 (Rear View) (2 of 4)

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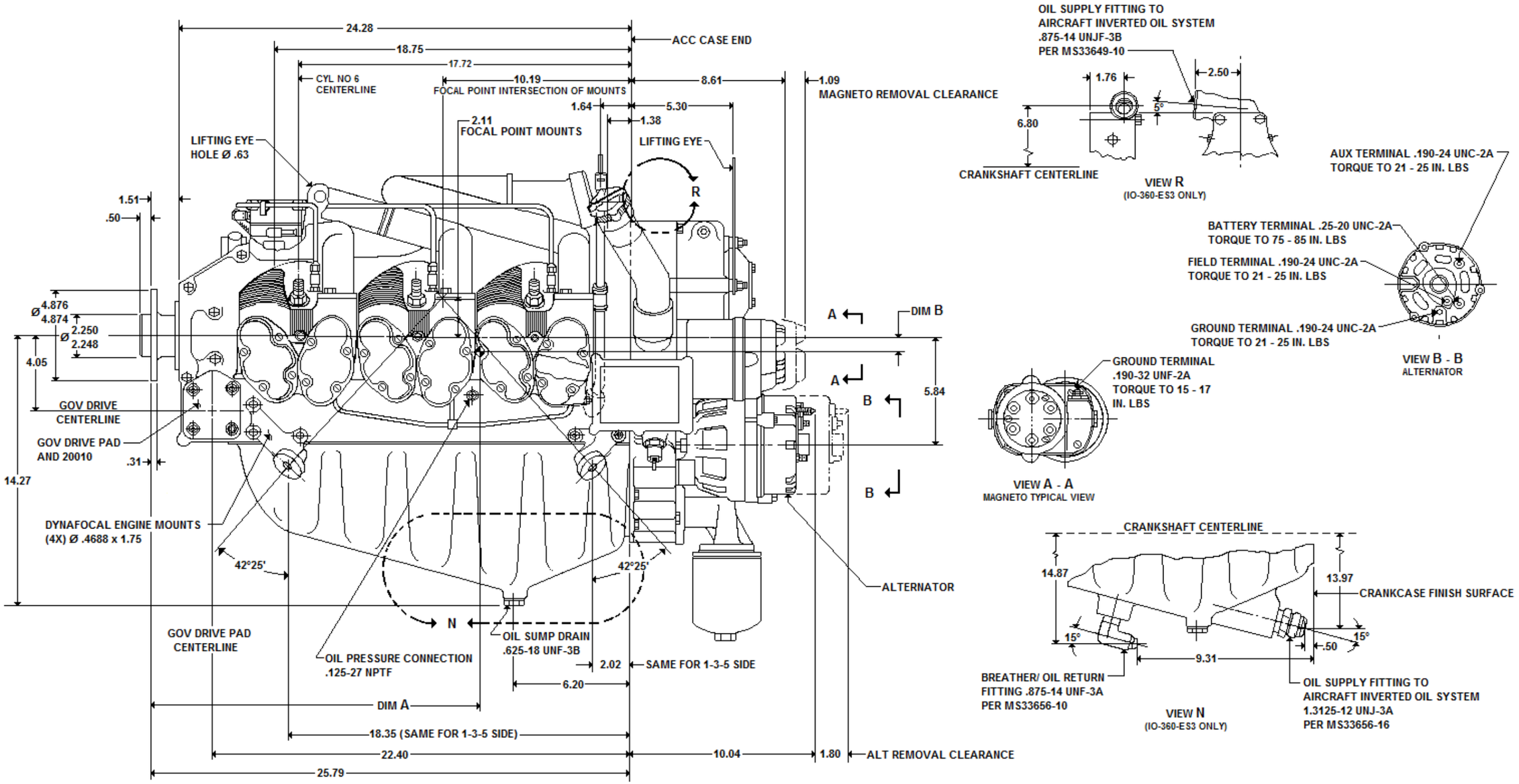


Figure 5-21. Installation Drawing 652898 (Left Side View) (3 of 4)

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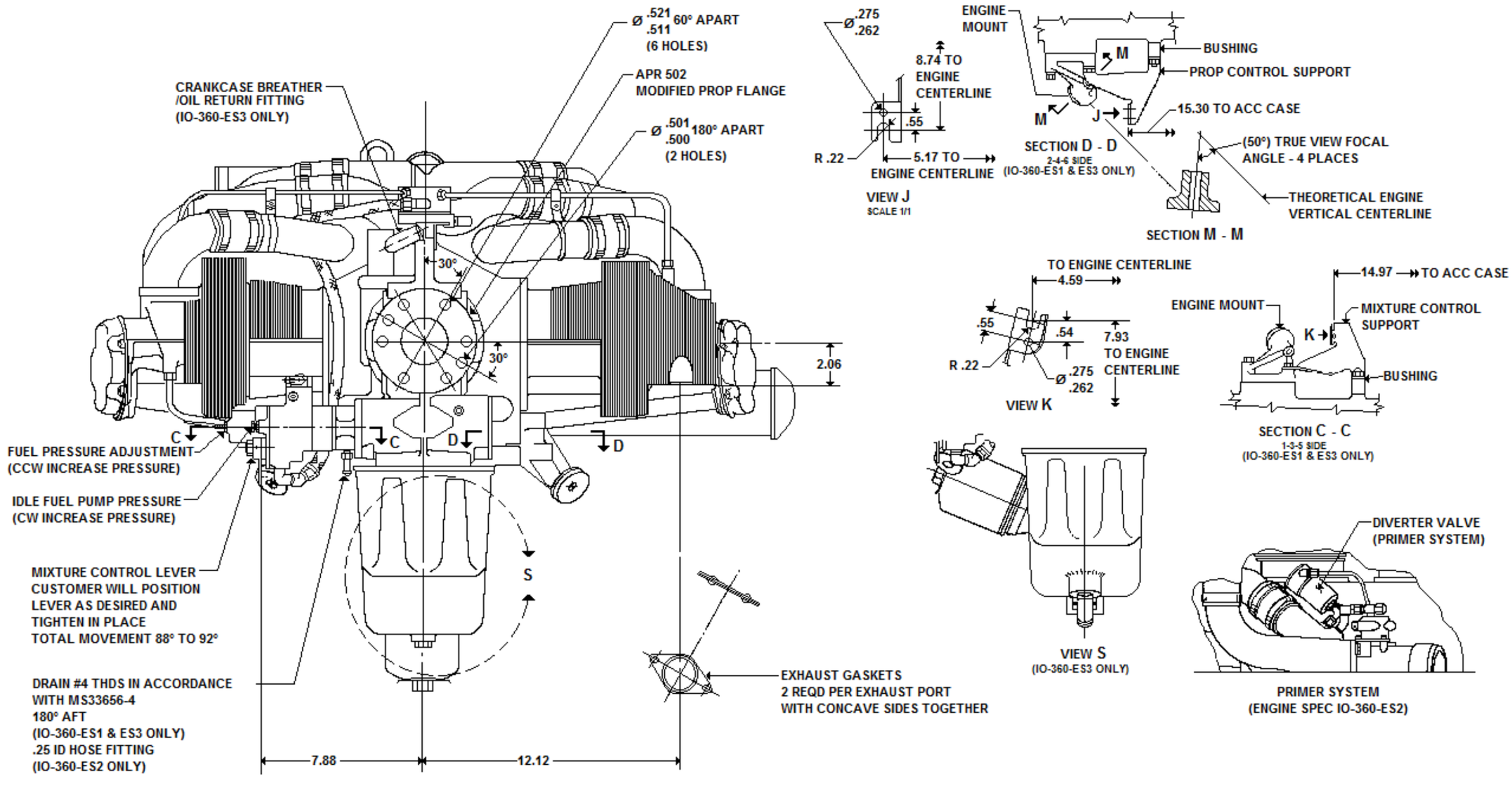


Figure 5-22. Installation Drawing 652898 (Front View) (4 of 4)

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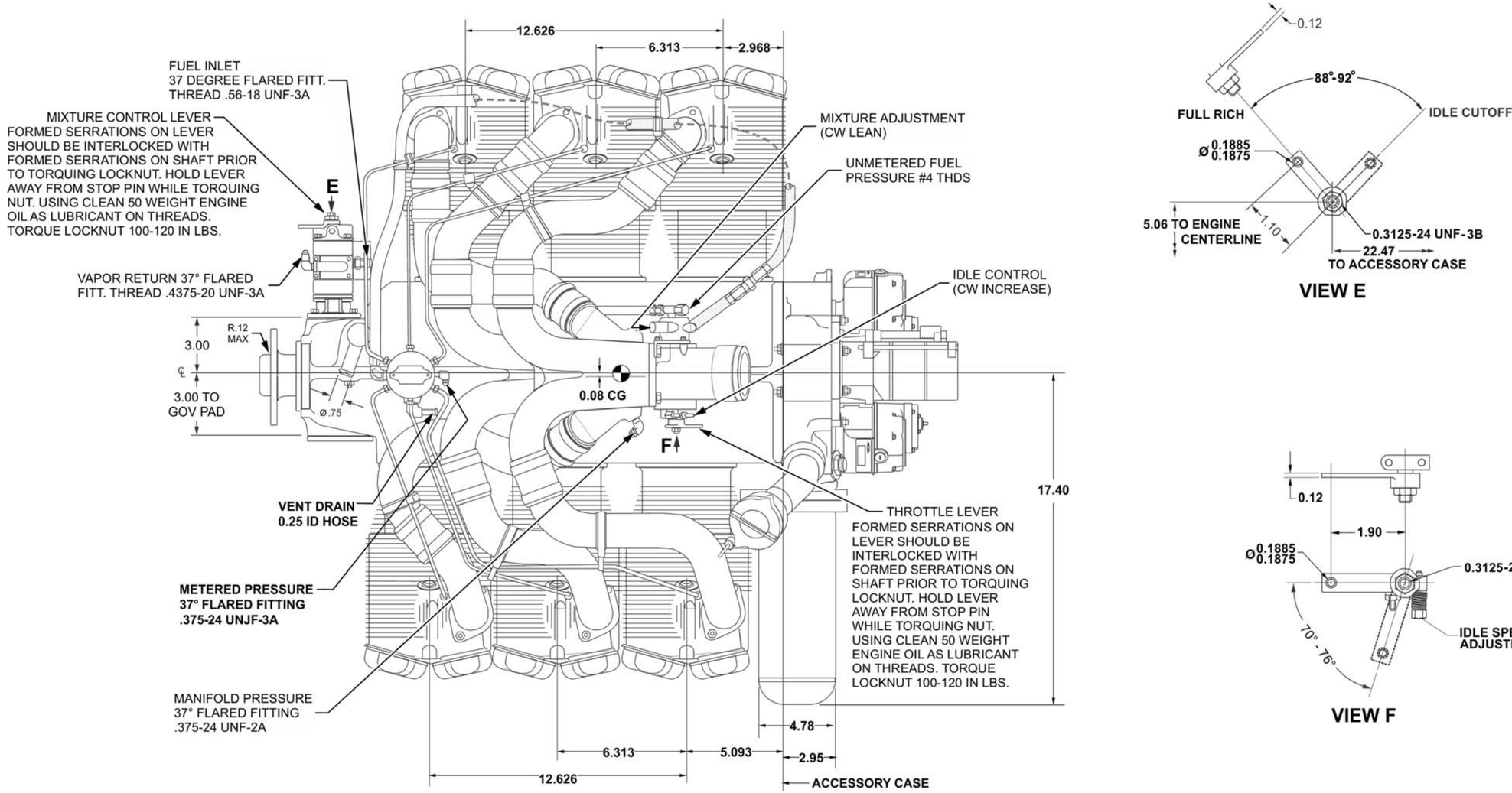


Figure 5-23. Installation Drawing 658511 (Top View) (1 of 4)

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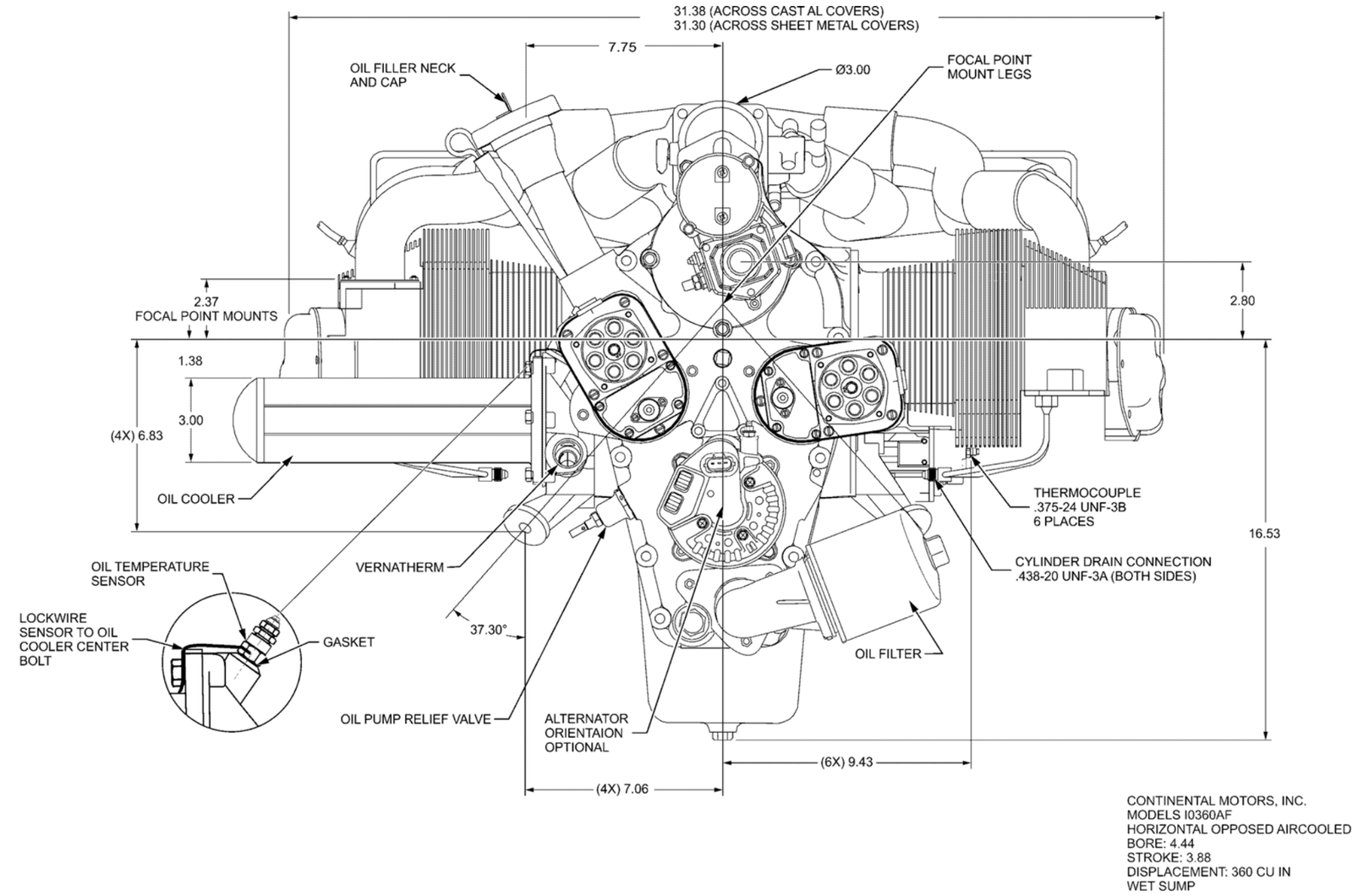


Figure 5-24. Installation Drawing 658511 (Rear View) (2 of 4)

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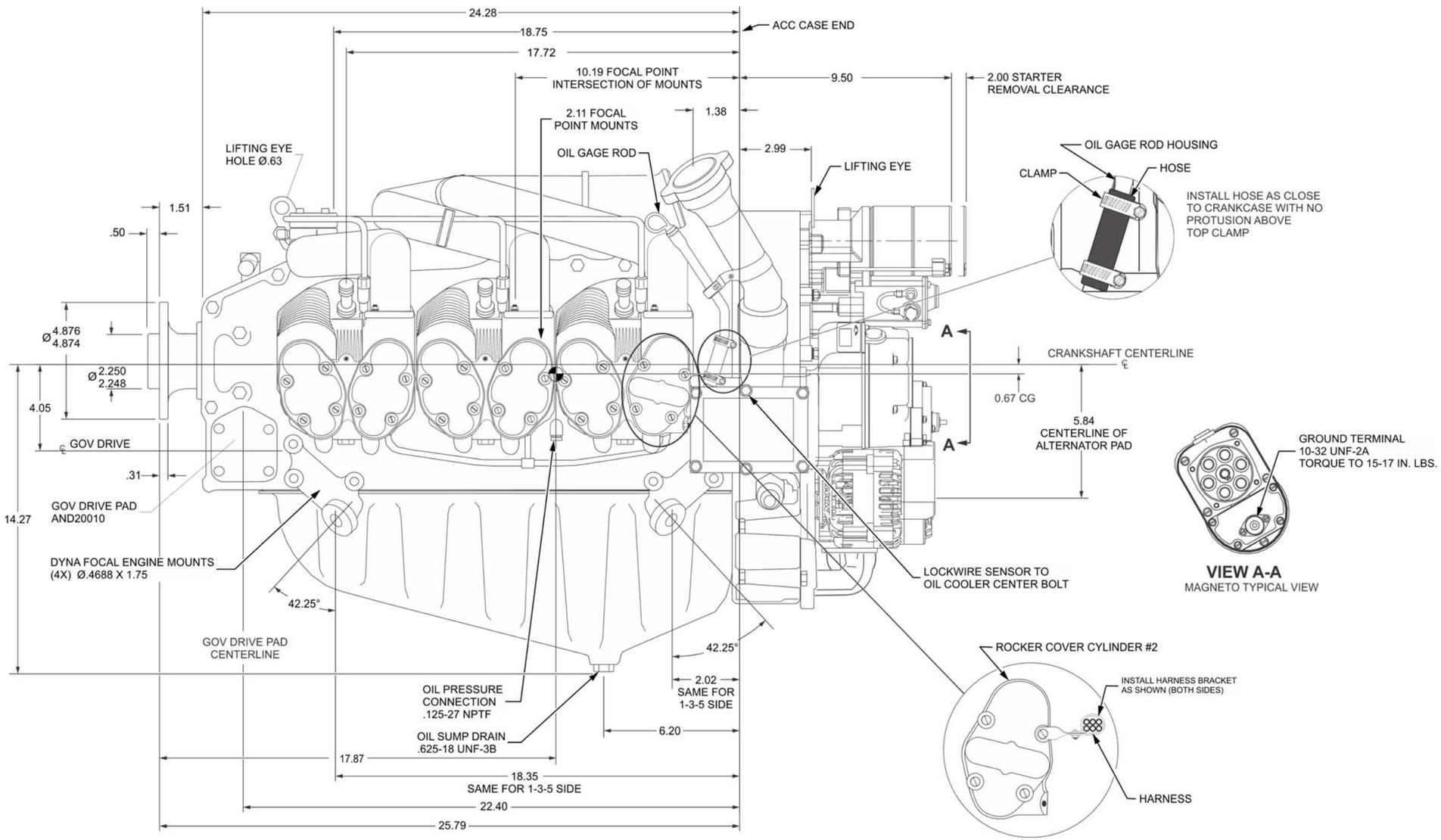


Figure 5-25. Installation Drawing 658511 (Left Side View) (3 of 4)

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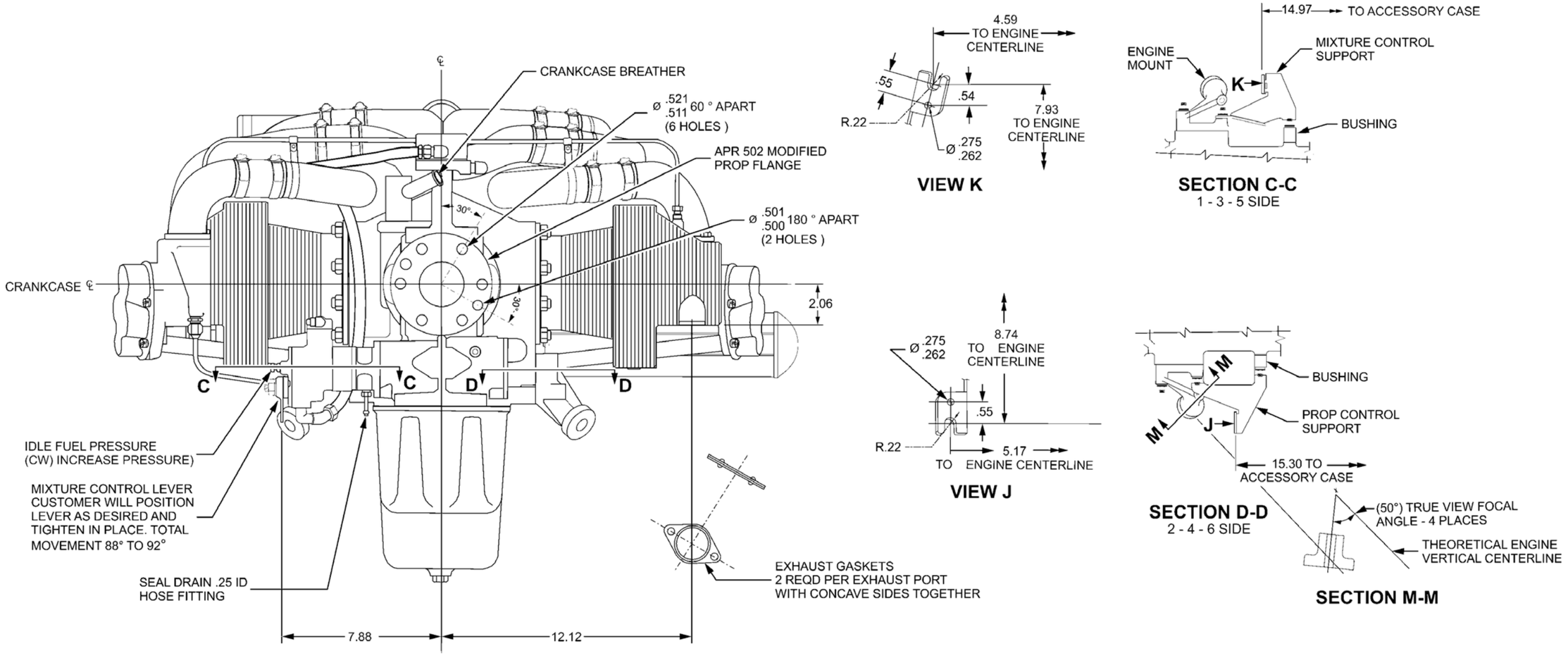


Figure 5-26. Installation Drawing 658511 (Front View) (4 of 4)

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Chapter 6. Engine Inspection and Service

6-1. Inspection Program Introduction

Inspections described in this chapter apply only to the Continental Motors engines covered by this manual. Perform the engine inspections according to the instructions provided. Perform aircraft inspections according to the aircraft maintenance manual. Refer to the following sections:

- Section 6-2, “Inspection and Maintenance Schedule”
- Section 6-3, “Scheduled Inspections”
- Section 6-5, “Inspection Checklists”

Some inspections are at predetermined intervals (scheduled) while others are based on circumstance (unscheduled). Engine servicing is performed at scheduled intervals but may also be performed “on condition.” The first part of this chapter is devoted to scheduled maintenance intervals and associated procedures; unscheduled maintenance instructions follow the scheduled maintenance instructions.

> NOTE: Discrepancies discovered by the person conducting the scheduled or unscheduled inspections, even if the discrepancy is not an itemized inspection item, should be corrected upon discovery. Fuel and oil system contamination affects engine performance and service life. If oil or fuel system contamination is discovered, do not limit the correction to the symptom; isolate and correct the source of the contamination, including any residual material left in the engine by the source of the contamination.

6-2. Inspection and Maintenance Schedule

Unless another FAA-approved Inspection Program is established, the Engine Inspection and Maintenance Schedule shows the inspections for the subject engines covered by this manual in their original type design. The inspections described in this chapter apply to the engine and not to the aircraft. Refer to the aircraft maintenance manual for aircraft inspection requirements.

The inspections are progressive; commencing from the date the engine is placed in service. The inspection intervals are tracked by Engine Log entries and designated by hours of operation or calendar time, whichever occurs first.

Inspection techniques must be executed consistently for reliability.

6-3. Scheduled Inspections

Scheduled inspections are performed at predetermined intervals to verify the system and subsystem integrity; Scheduled inspections and maintenance are intended to enhance serviceability by discovering minor discrepancies and correcting them before the condition degrades. Scheduled inspections are based on calendar days or operating hours or a combination of both. Scheduled maintenance and service tasks are included in the inspections for convenience.

Table 6-1. Engine Inspection and Maintenance Schedule

NOTE: If operating hours and a calendar period are specified, perform the inspection coincident with the earliest occurrence.			
Interval			
Cumulative Operating Hours	Calendar	Task	Reference
.33 min./ 2 max.	---	Compressor Drive Belt (optional equipment) Tension Check	Section 6-3.1
5	---	Drive Belt (optional equipment) Tension Check	Section 6-3.1
10	---	Alternator Initial Inspection (One Time)	Section 6-3.1
25	4 months	Oil Change (with integral oil screen)	Section 6-3.8
25	6 months	Initial operation inspection after placing a new, rebuilt, or overhauled engine in service, including cylinder replacement. Repeat this inspection after each 25 hours of operation until oil consumption stabilizes.	Section 6-3.2
50	4 months	50-hour engine inspection	Section 6-3.3
50	6 months	Oil and Filter Change (w/ 4.8” replaceable filter cartridge)	Section 6-3.8
100	Annual	100-hour engine inspection	Section 6-3.4
300	Annual	Clean fuel injector nozzles	Section 6-3.4
500	4 years	Magneto inspection	Section 6-3.5
500	---	500-hour inspection	Section 6-3.5
NOTE: At engine TBO, engine accessories, including the starter, alternator, magnetos and fuel system must be replaced with new assemblies or assemblies which have been overhauled according to FAA approved procedures.			
---	---	IO-360-A, AB, C, CB, D, DB, G, GB, H, HB, J, JB and K Recommended Time Between Overhaul (TBO)	Refer to Chapter 6-3 in M-0
---	---	IO-360-KB, and ES Recommended Time Between Overhaul (TBO)	Refer to Chapter 6-3 in M-0
2000[1, 2]	12 years	IO-360-AF Recommended Time Between Overhaul (TBO)	Section 2-3.2

1. If an engine consistently accumulates 40 or more hours per month since being placed in service, add 200 hours to recommended TBO.
2. Engine models with serial number 1006000 and higher, add 200 hours to recommended TBO.

6-3.1. One Time Post - Installation Inspections

Check new compressor drive belt tension after minimum of twenty minutes and a maximum of two hours run-in with compressor loaded. Adjust belt tension, as required, according to the instructions in Section 6-3.10.4, “Belt Tension Check and Adjustment.”

Check new alternator drive belt tension after the first five hours of operation. Adjust belt tension, as required, according to the instructions in Section 6-3.10.4, “Belt Tension Check and Adjustment.”

Perform a visual inspection (Section 6-3.6) of all alternators, associated wiring and hardware after the first ten hours of operation. Inspect the bolts and safety wire application. Look for signs of arcing or overheating. Check the cooling duct connections for cleanliness and security. Check terminals and insulators for tightness and condition.

6-3.2. 25-Hour Initial Operation Inspection

Frequency

- Twenty-five (25) hours or six months (whichever occurs first) after:
  - Placing a new, rebuilt, or overhauled engine in service
  - Replacement of one or more engine cylinder and/or piston rings
- After every 25 hours of engine operation until oil consumption stabilizes

WARNING

Turn the Ignition Switch OFF and disconnect engine electrical power before commencing maintenance or inspections. Confirm continuity between the magneto capacitor and aircraft ground to prevent accidental engine start during maintenance. Do not stand or place equipment within the arc of the propeller.

Procedure

WARNING

Correct all fuel or oil leaks. Flammable petroleum products may ignite if exposed to an ignition source.

1. Perform a visual inspection according to instructions in Section 6-3.6; correct any discrepancies.
2. Perform a normal “Engine Start” according to instructions in Section 7-3.2 and “Ground Run-up” according to instructions in Section 7-3.3. When the engine reaches normal operating temperatures, check the following:
   a. Idle RPM ..... 600 RPM
   b. Idle Cut-Off Mixture Rise ..... 25-50 RPM
   c. Acceleration ..... Smooth from IDLE to Wide Open
      If acceleration is rough or the Idle RPM or Idle Cut-Off Mixture Rise is outside the parameters specified in Table 6-3, perform an “Engine Operational Check” according to Section 6-3.7 and adjust the fuel system accordingly.

3. Determine oil consumption by reviewing engine log book service record. Calculate the brake specific oil consumption (BSOC) using the formula in Section 2-3. If oil consumption exceeds the maximum limit, consumption is excessive, proceed to step 3a. If consumption is acceptable, proceed to step 4.

   a. If oil consumption is excessive, troubleshoot according to the instructions in Chapter 8, “Troubleshooting.”

   b. Perform a “Cylinder Borescope Inspection” according to the instructions in Section 6-3.11.3.

   c. Service the engine with mineral oil conforming to SAE J-1966 rather than the ashless dispersant oil specified in step 5. Repeat this inspection after 25 hours of operation.

4. Establish an oil analysis profile by collecting an oil sample according to the instructions in Section 6-3.8.4, “Oil Sample Collection” and Section 6-3.8.5, “Oil Trend Monitoring and Spectrographic Oil Analysis.”

5. Change the oil and filter according to instructions in Section 6-3.8.2, “Oil Change.”. Fill the oil sump to the proper capacity for the engine model (Section 2-3) with fresh, ashless dispersant aviation engine oil conforming to SAE J-1899 (Chapter 3-1 of M-0, Standard Practice Maintenance Manual).

6. Remove and inspect the induction air filter. Clean or replace the filter media if necessary. Verify the induction air filter is installed properly; tighten any loose fastening hardware. With the induction air filter installed, verify the induction air filter retainer is properly installed and the attaching hardware is secure in accordance with the aircraft maintenance manual.

7. Inspect the induction/cylinder system drains according to the instructions in Section 6-3.19.

8. For any other optional engine accessories, refer to the accessory manufacturer’s maintenance instructions for inspection criteria.

6-3.3. 50-Hour Engine Inspection

Frequency

- 25 hours after the 25 hour Initial Operation Inspection
- After every 50 hours of engine operation or four months

WARNING

Turn the Ignition Switch OFF and disconnect engine electrical power before commencing maintenance or inspections. Confirm continuity between the magneto capacitor and aircraft ground to prevent accidental engine start during maintenance. Do not stand or place equipment within the arc of the propeller.

Procedure

WARNING

Correct all fuel or oil leaks. Flammable petroleum products may ignite if exposed to an ignition source.

1. Perform a "Visual Inspection" according to instructions in Section 6-3.6; correct any discrepancies.
2. Perform a normal "Engine Start" according to instructions in Section 7-3.2 and "Ground Run-up" according to instructions in Section 7-3.3. When the engine reaches normal operating temperatures, check the following:
   a. Idle RPM ..... 600 RPM
   b. Idle Cut-Off Mixture Rise ..... 25-50 RPM
   c. Acceleration ..... Smooth from IDLE to Wide Open
      If acceleration is rough or the Idle RPM or Idle Cut-Off Mixture Rise are outside the normal operating parameters specified in the "Engine Specifications" in Section 2-3, perform an "Engine Operational Check" according to instructions in Section 6-3.7.
3. Collect an engine oil sample according to the instructions in Section 6-3.8.4, "Oil Sample Collection" and submit it for analysis according to Section 6-3.8.5, "Oil Trend Monitoring and Spectrographic Oil Analysis."
4. Change the oil and filter according to instructions in Section 6-3.8.2, "Oil Change.". Fill the oil sump to the proper capacity for the engine model (Section 2-3) with fresh, ashless dispersant aviation engine oil conforming to SAE J-1899 (Chapter 3-1 of M-0, Standard Practice Maintenance Manual).
5. Perform an "Induction System Inspection" according to Section 6-3.14.
6. Inspect the induction/cylinder fuel drains according to the instructions in Section 6-3.19.
7. For any other optional engine accessories, refer to the accessory manufacturer's maintenance instructions for inspection criteria.

6-3.4. 100-Hour (Annual) Engine Inspection

Frequency

The 100-Hour Inspection is accomplished under two circumstances:

- After every 100 hours of accumulated engine operation
- Annually, if the engine did not accumulate 100 hours of operation during the calendar year since the last 100-Hour Engine Inspection.

WARNING

Turn the Ignition Switch OFF and disconnect engine electrical power before commencing maintenance or inspections. Confirm continuity between the magneto capacitor and aircraft ground to prevent accidental engine start during maintenance. Do not stand or place equipment within the arc of the propeller.

Procedure

WARNING

Correct all fuel or oil leaks. Flammable petroleum products may ignite if exposed to an ignition source.

NOTE: Clean the fuel injector nozzles during the first 100-Hour Inspection after installation of a new, rebuilt or overhauled engine. Thereafter, clean the nozzles every 300 hours or annually.

1. Perform a “Visual Inspection” according to instructions in Section 6-3.6; correct any discrepancies.
2. Perform an “Engine Operational Check” according to instructions in Section 6-3.7.
3. Collect an engine oil sample according to the instructions in Section 6-3.8.4, “Oil Sample Collection” and submit it for analysis according to Section 6-3.8.5, “Oil Trend Monitoring and Spectrographic Oil Analysis.”
4. Perform the “Cylinder Inspections” according to instructions in Section 6-3.11. The cylinder inspections consist of multiple inspections and checks including Cylinder Power Stroke Area, Differential Pressure, Borescope, Baffle, Cowling, and Cylinder Mounting Deck Inspections.
5. Perform a “Crankcase Inspection” according to Section 6-3.12.
6. Perform an “Engine Mount Inspection” according to Section 6-3.13.
7. Perform an “Induction System Inspection” according to Section 6-3.14.
8. Perform an “Ignition System Inspection” according to Section 6-3.15.
9. Perform an “Engine Gauge Inspection” according to Section 6-3.16.
10. Perform a “Fuel System Inspection” according to Section 6-3.17.
11. Perform an “Engine Control Linkage Inspection” according to Section 6-3.18.
12. Perform a “Induction or Cylinder Drain Inspection” according to Section 6-3.19.
13. Inspect the Exhaust System according to the aircraft maintenance manual.

14. Change the oil and filter according to instructions in Section 6-3.8.2, "Oil Change.". Fill the oil sump to the proper capacity for the engine model (Section 2-3) with fresh, ashless dispersant aviation engine oil conforming to SAE J-1899 (Chapter 3-1 of M-0, Standard Practice Maintenance Manual).
15. Inspect installed accessories for mounting security, condition, and proper operation according to the aircraft maintenance manual or accessory manufacturer's instructions.
16. Remove and perform a visual inspection on all surface areas of front mounted alternator bracket assembly P/N 657046, Revision A or earlier, using a 10X magnifier and bright light source. Reinstall, if serviceable, or replace with serviceable replacement.
17. For any other optional engine accessories, refer to the accessory manufacturer's maintenance instructions for inspection criteria.

6-3.5. 500-Hour Engine Inspection

Frequency

- After each 500 hours of accumulated engine operation

WARNING

Turn the Ignition Switch OFF and disconnect engine electrical power before commencing maintenance or inspections. Confirm continuity between the magneto capacitor and aircraft ground to prevent accidental engine start during maintenance. Do not stand or place equipment within the arc of the propeller.

Procedure

1. Complete the "100-Hour (Annual) Engine Inspection" requirements in Section 6-3.4.
2. Replace magnetos which are not manufactured by Continental Motors with new, rebuilt, or serviceable units. Perform a 500-Hour Magneto Inspection on Continental Motors magnetos according to the Magneto Service Manual (See Section 1-2.4, "Related Publications.")
3. Replace paper type induction air filters according to the aircraft maintenance manual, regardless of condition.
4. Perform an "Alternator Inspection" according to the instructions in Section 6-3.20. Inspect and test the alternator for proper operation.
5. For any other optional engine accessories, refer to the accessory manufacturer's maintenance instructions for inspection criteria.

6-3.6. Visual Inspection

Frequency

- Begin any service interval with a visual inspection

Procedure

1. Verify the engine nacelle is clean and free of fuel leaks, oil leaks, dirt and debris.
2. Inspect all fuel and oil lines for signs of chafing.
3. Inspect the oil cooler and oil filter (or screen) for signs of leaks and physical discrepancies.
4. Check the following on the engine for cracks, dents, pitting or physical damage:
   a. External cylinder barrels
   b. Cylinder barrel fins
   c. Areas between and adjacent to the cylinder barrel fins
   d. External surfaces of the cylinder head, including areas around
      1) Cylinder head fins
      2) Top and bottom spark plug bosses
      3) Fuel nozzle bosses
      4) Crankcase external surfaces
      5) Accessories
      6) Support structures adjacent to accessories

   NOTE: If cylinder discrepancies are discovered during the visual inspection, perform the "Cylinder Inspections" in Section 6-3.11.
5. Check security of engine and accessory wiring harnesses, including ignition leads. Check for signs of thermal breakdown, chafing, deterioration or improper routing.
6. Replace broken or damaged cushion clamps and stressed or broken wire ties.
7. Check magnetos for external damage, cracks and mounting security. Ensure the harness outlet plate is securely fastened to the magneto and the harness is properly routed.
8. Inspect external drive belts for nicks, cracks and visible wear; replace belts exhibiting nicks, cracks, or visible wear. Check belt tension and adjust, as required, according to instructions in Section 6-3.10.4.
9. Inspect the exposed area of the crankshaft between the crankshaft nose oil seal and the propeller flange for evidence of corrosion.
   a. If corrosion is detected, use a Scotch-Brite pad and a non-corrosive soap solution to remove surface corrosion.
   b. If the cleaning process eliminated the corrosion and no evidence of pitting exists, apply a generous coat of silver or aluminum paint according to the paint

manufacturer's instructions to the exposed portion of the crankshaft to prevent further corrosion.

c. If cleaning is unsuccessful (suspected corrosion has advanced to pitting), disassemble the engine and replace the crankshaft.

10. Check electrical connectors for signs of corrosion or contamination; if external corrosion or contamination is discovered, disconnect the connectors and inspect the internal pins for corrosion or contamination.

11. Inspect installed accessories for proper mounting and security. Inspect alternator brush holders for soot accumulation. If large amount of soot is present, inspect brushes (Section 6-3.20).

NOTE: For items 12 - 15, inspect for obvious signs of physical damage, wear or deterioration, loose or missing hardware, leaks or foreign material that may hinder normal operation. Correct any discrepancies.

12. Inspect the physical integrity of the fuel system.

13. Inspect the physical integrity of the induction system airbox, ducts, seals and gaskets according to the aircraft maintenance manual.

14. Inspect the physical integrity of the lubrication system.

15. Inspect the physical integrity of the exhaust system according to the aircraft maintenance manual.

16. Repair any observable damage or deficiency before the aircraft is returned to service. Refer to Chapter 10, "Non-Overhaul Repair and Replacement" Procedures.

6-3.7. Engine Operational Check

WARNING

Flight is prohibited until the engine successfully completes the operational check and is released for normal operation. If, during an operational check or engine warm-up, abnormal operation is observed or leaks occur, do not take-off. Determine the cause of the problem and take corrective action.

Perform an engine operational check after any of the following activities:

- Engine Installation
- Fuel Injection System parts replacement, maintenance or troubleshooting
- Post-Overhaul
- Return from storage
- After each 100-Hour/Annual, and 500-Hour Inspection

Perform the tasks listed in Table 6-2 on a newly installed, repaired or overhauled engine before the engine can be released for normal flight.

Table 6-2. Engine Operation Prerequisites

Sequence	Requirement	Section Reference
1	Prepare the engine for operation	Maintenance Preflight Inspection
2	Check Engine Operation	Engine Operational Check
3	Complete the Engine Operational Checklist	Operational Checklist
4	Perform Flight Check	"Flight Check" in Section 7-2.3[1]

1. and according to the AFM/POH

6-3.7.1. Engine Operating Limits

Table 6-3. IO-360 Engine Operating Limits

Specification	Engine Model Limits							
	A, AB	AF	C, CB, D[1], DB[1], G, GB, H, HB	J, JB	ES[2], [3]	ES CIRRUS [2, 3, 4] (Sea Level)	ES CIRRUS [2, 3, 4] (1500 ft Press Alt)	K, KB
Full Throttle Speed +/- 25 RPM	2800	2800	2800	2600 2800[5]	2800	2700	2700	2600
Idle Speed +/- 25 RPM	600	600	600	600	600	600	600	600
Unmetered Fuel Pump Pressure (Idle) (psi)	7.0-9.0	7.0-9.0	7.0-9.0	7.0-9.0	7.0-9.0	7.0-9.0	7.0-9.0	7.0-9.0
Metered Fuel Pump Pressure (Full Power) (psi)	15.8-18.2	14.3-16.5	15.8-18.2	15.8-18.2	14.3-16.5	13.8-15.5	13.3-14.6	14.3-16.3
Unmetered Fuel Pump Pressure (Full Power) (psi) (reference)	24.0-27.0	23.0-26.0	24.0-27.0	24.0-27.0	23.0-26.0	21.0-24.0	19.0-22.0	21.0-24.0
Oil Temperature	75° - 225°F (24°-107°C)	75° - 240°F (24°-116°C)						
Oil Pressure (min.-max.)	10-100 psig							
Oil Sump Capacity (quarts)	10	8	10	10	8	8	8	10
Magneto Drop/ Spread	150/50							
Cylinder Head Temperature (max.)	460°F (238°C)							

1. D34 and DB34 Only: Engines with altitude compensating fuel pumps. NOTE 3 applies to these engines.
2. Engines with altitude compensating fuel pumps.
3. Flight test required to verify fuel flow vs. pressure altitude values are within limits specified.
4. This engine installed in Cirrus SR20 aircraft. IO-360-ES engines has been derated by Cirrus from original 210 HP at 2800 RPM to 200 HP at 2700 RPM. Engine data plate reflects original CM data of 210 HP at 2800 RPM. Refer to Cirrus SR20 Maintenance Manual and POH.
5. Take Off (5 minute, rpm full throttle)

6-3.7.2. Maintenance Preflight Inspection

Prior to starting the engine, perform a preflight inspection of the engine, propeller, nacelle, and aircraft. This inspection must be performed prior to the first flight after engine installation, inspection, troubleshooting, maintenance, or overhaul work to determine if the aircraft and engine are in an airworthy condition. Do not release a malfunctioning engine for flight.

WARNING

Operation of a malfunctioning engine can result in additional damage to the engine, possible bodily injury or death.

Procedure

1. Turn the Master Power Switch and the Ignition Switch to the OFF position.
2. Remove engine cowling according to the aircraft maintenance manual.
3. Check the throttle, propeller, and alternate air supply controls for freedom of movement and full range of travel.
4. Drain the aircraft fuel sumps according to the aircraft maintenance manual.
5. Remove, clean, inspect, and reinstall the aircraft fuel screens according to the aircraft maintenance manual.
6. Inspect the aircraft vapor return system for proper operation in accordance with aircraft maintenance manual.
7. Purge the aircraft fuel system according to the “Fuel System Purge” instructions in Appendix C-9.1 of M-0, Standard Practice Maintenance Manual.

WARNING

Use of inaccurate gauges will result in incorrect fuel system adjustment, probable accelerated engine wear and possible engine damage.

8. Verify the fuel system components are properly configured (part numbers conform to type design and parts are installed properly).
9. Ensure the fuel manifold valve vent and fuel pump drain lines are properly installed, open and free of obstructions.
10. Inspect the engine control rod ends for wear, proper installation and security in accordance with aircraft maintenance manual.
11. Lubricate engine control rod ends and fuel system moving parts using the approved lubricants listed in Chapter 3 of M-0, Standard Practice Maintenance Manual and the aircraft maintenance manual.

WARNING

Engines described in this manual are certified for operation with the aviation fuel specifications listed in Section 2-3. If the minimum grade required is not available, use the next higher grade. Use of lower octane rated fuel or jet fuel will result in damage to, or destruction of, an engine the first time high power is applied. If the aircraft is inadvertently serviced with the wrong grade of fuel, or jet fuel, drain the fuel system completely and service the fuel tanks in accordance with the aircraft maintenance manual and perform a "Contaminated Fuel System Inspection" according to instructions in Section 6-4.5.

12. Service the aircraft fuel system according to the aircraft maintenance manual.
13. If the engine is newly installed or being returned to service after indefinite storage, pre-oil the engine according to the instructions in Section 5-3.4.
14. Check the engine oil level. Service the oil sump as required with the oil grade specified in Chapter 3-1 of M-0, Standard Practice Maintenance Manual.
15. Verify the engine crankcase breather hose is secured according to the aircraft maintenance manual and no breather air flow restrictions exist.
16. Verify the induction air filter is clean and secured according to the aircraft maintenance manual. Replace the air filter with a clean one if it is dirty; tighten the filter if it is loose.
17. Visually inspect the engine, propeller hub area, and nacelle for evidence of fuel and engine oil leaks. Correct any discrepancies.
18. Visually inspect the engine and nacelle for debris, loose, missing or broken lines, hoses, fittings, clamps and connections. Inspect for restrictions to cooling airflow; remove any debris.
19. Verify all baffles and baffle seals are installed, correctly positioned, and serviceable according to the aircraft maintenance manual.
20. If the engine has been exposed to temperatures below 20ºF (-7°C) for more than two hours, preheat the engine according to "Engine Preheating" instructions in Section 7-5.1.1. If the engine has been exposed to an ambient temperature between 20º to 40ºF (-7º to 4º C), refer to the "Cold Weather Starting Without Preheating" instructions in Section 7-5.1.1.3.

6-3.7.3. Oil Pump Operational Check

1. Perform a "Maintenance Preflight Inspection" according to Section 6-3.7.2.
2. Perform a normal "Engine Start" according to instructions in Section 7-3.2 and "Ground Run-up" according to Section 7-3.3 to allow the engine to warm to normal operating temperatures (75-240°F (24-116°C)).
3. Oil Pressure..... Check
   RESULT: Verify oil pressure is between 30 and 60 psi at full power RPM. If necessary, adjust according to the "Oil Pressure Adjustment" instructions in Section 6-3.10.1. If no oil pressure is noted, shut down the engine immediately and investigate the cause.
4. If no further checks are required, proceed to "Post Shutdown Inspection" on page 6-16.

6-3.7.4. Fuel System Operational Check

A fuel system operational check is required after replacement of fuel injection system components, such as the fuel pump, fuel manifold valve, or fuel injectors. The fuel system setup is a critical component of proper engine operation.

Refer to the instructions in Chapter 6-4.7.4 of M-0, Standard Practice Maintenance Manual, to gather the test equipment for the operational check.

Setup instructions are provided for the Porta-Test unit or calibrated gauges. Use the "Fuel System Operational Checkout Setup Instructions" and "Test Equipment Connection Schematics" instructions in Chapter 6-4.7.4.1 and Chapter 6-4.7.4.2 of M-0, Standard Practice Maintenance Manual. When the test equipment is set up properly, proceed with the "Fuel System Operational Checkout Procedure" in Chapter 6-4.7.4.3 of M-0, Standard Practice Maintenance Manual.

Upon completion of the operational check, a flight check, according to instructions in Section 7-2.3, is required for engines equipped with an altitude compensating fuel pump or for engines that fail to reach rated full power engine RPM during the operational check on the ground.

6-3.7.4.1. Fuel System Operational Checkout with the Port-Test Unit

Refer to the "Fuel System Operational Checkout Setup Instructions" and "Test Equipment Connection Schematics" instructions in Chapter 6-4.7.4.1 and Chapter 6-4.7.4.2 of M-0, Standard Practice Maintenance Manual.

6-3.7.4.2. Fuel System Operational Checkout with Calibrated Gauges

Refer to the "Fuel System Operational Checkout Setup Instructions" and "Test Equipment Connection Schematics" instructions in Chapter 6-4.7.4.1 and Chapter 6-4.7.4.2 of M-0, Standard Practice Maintenance Manual.

6-3.7.4.3. Fuel System Operational Checkout Procedure

Perform the "Fuel System Operational Checkout Procedure" according to the instructions in Chapter 6-4.7.4.3 of M-0, Standard Practice Maintenance Manual.

6-3.7.5. Magneto RPM Drop Check

WARNING

Absence of RPM drop during magneto check may be an indication of a faulty ignition circuit (Hot Magneto). Should the propeller be turned by hand (as in during preflight), the engine could inadvertently start and cause personal injury or death. Flight is prohibited until the condition is corrected.

CAUTION: When operating on single ignition, some RPM drop and slight engine roughness as each magneto is switched off should be noted. Excessive (greater than 150 RPM) RPM drop may indicate a faulty magneto or fouled spark plugs.

NOTE: If the engine runs roughly after single magneto operation, increase engine speed to 2200 RPM in the BOTH position and lean the mixture control until the RPM peaks for ten seconds before returning to the FULL RICH position to clear the spark plugs and smooth operation before returning to single magneto operation.

Procedure

1. Start the engine according to the "Engine Start" instructions in Section 7-3.2.
   RESULT: No defects noted. Allow the engine oil to warm to minimum normal (75°F (24°C)) operating temperature.

   CAUTION: Avoid prolonged single magneto operation to preclude spark plug fouling.

2. Throttle.....1700 RPM
3. Ignition Switch.....R
   RESULT: RPM drop does not exceed 150 RPM; record Left Magneto RPM drop result. Maximum allowable RPM drop spread between magnetos is 50 RPM.
4. Ignition Switch.....BOTH
   RESULT: Engine RPM returns to approximately 1700 RPM.
5. Ignition Switch.....L
   RESULT: RPM drop does not exceed 150 RPM; record Right Magneto RPM drop result. Maximum allowable RPM spread between magnetos is 50 RPM.
6. Ignition Switch.....BOTH
7. Throttle.....Reduce to IDLE
8. If no further checks are required, proceed to "Post Shutdown Inspection" on page 6-16.

6-3.7.6. Post Shutdown Inspection

Procedure

1. Perform a normal engine shutdown according to the "Engine Shutdown" instructions in Section 7-3.4.
2. Remove installed test equipment.
   a. Disconnect the metered fuel pressure test hose from the engine fittings.
   b. Disconnect the unmetered fuel pressure test hose from the engine fittings.
   c. Remove the tee fittings and any additional test fittings installed to adapt the plumbing to the test equipment.
3. Reconnect and torque the fuel system hose and caps to Appendix B specifications.

   CAUTION: Use only the protective cap designed for the integrated throttle body/metering unit. Aftermarket cap assemblies may damage the fitting.

   a. Install protective caps on the throttle and control assembly (unmetered pressure) and/or fuel manifold valve (metered pressure).
   b. Connect the metered pressure fuel supply hose to the manifold valve inlet fitting.
4. Leak Check
   a. Master Power Switch ..... ON
   b. Mixture..... FULL RICH
   c. Throttle..... WIDE OPEN
   d. Boost Pump Switch..... ON (according to AFM/POH)
   e. Check for leaks in the following areas and correct any discrepancies before releasing the engine for flight:
      1) Induction System
      2) Exhaust System
      3) Fuel System
      4) Lubrication System
   f. Throttle..... IDLE
   g. Mixture..... IDLE CUT-OFF
   h. Boost Pump Switch..... OFF (according to AFM/POH)
   i. Master Power Switch ..... OFF

6-3.8. Engine Oil Servicing

The engine lubrication system provides either pressure or splash oil to areas of the engine subject to frictional loading. A certain amount of oil consumption is normal if the aircraft is flown on a regular basis. However, if oil consumption exceeds the Brake Specific Oil Consumption rate in Section 2-3 or there is an abrupt change in the rate of oil consumption, determine the cause and correct it before further flight.

WARNING

Do not fly the aircraft if oil consumption is abnormal or is suspect; investigate for oil leakage. If no oil leakage is noted, perform the "Cylinder Inspections" in Section 6-3.11.

6-3.8.1. Check and Replenish Engine Oil Level

Maintain the oil sump capacity at the specified level. To check the oil level or add oil, perform the following procedure:

WARNING

Check the oil level before each flight and maintain the engine oil at the specified level. Engine operation with less than the specified capacity will cause engine malfunction or failure.

Petroleum based aviation engine oil is flammable. Follow fire hazard precautions. Store oil in a well-ventilated area away from heat or ignition sources.

NOTE: Ensure aircraft is parked on level ground and engine has been shutdown for at least five minutes to ensure accurate reading on oil gage rod.

Procedure

1. Withdraw the oil gage rod (dipstick) (See Figure 6-1 or Figure 6-2 for engine oil servicing points).
2. Wipe the oil from the oil gage rod with a clean, lint-free cloth. Avoid getting any lint or debris in the oil sump.
3. Insert the cleaned oil gage rod back into the oil sump and withdraw the rod again.
4. Verify the oil on the rod touches, but does not pass the oil fill line on the rod.

   NOTE: IO-360 oil sump capacities differ by engine models. Refer to the "Engine Specifications" in Section 2-3.

   CAUTION: When adding oil, completely remove the protective seal from the oil container to prevent the seal from falling into the oil fill port. Prevent any debris from falling into the oil fill port.

5. If more oil is required, add a sufficient quantity of oil meeting the specifications in Chapter 3-1 of M-0, Standard Practice Maintenance Manual, to reach the fill line on the oil gage rod.

   NOTE: If oil is spilled on the engine or nacelle during servicing, clean the spilled oil immediately and dispose of oily rags and absorbent materials according to local environmental regulations.

6. Install and lock the oil gage rod in the tube after servicing the engine.

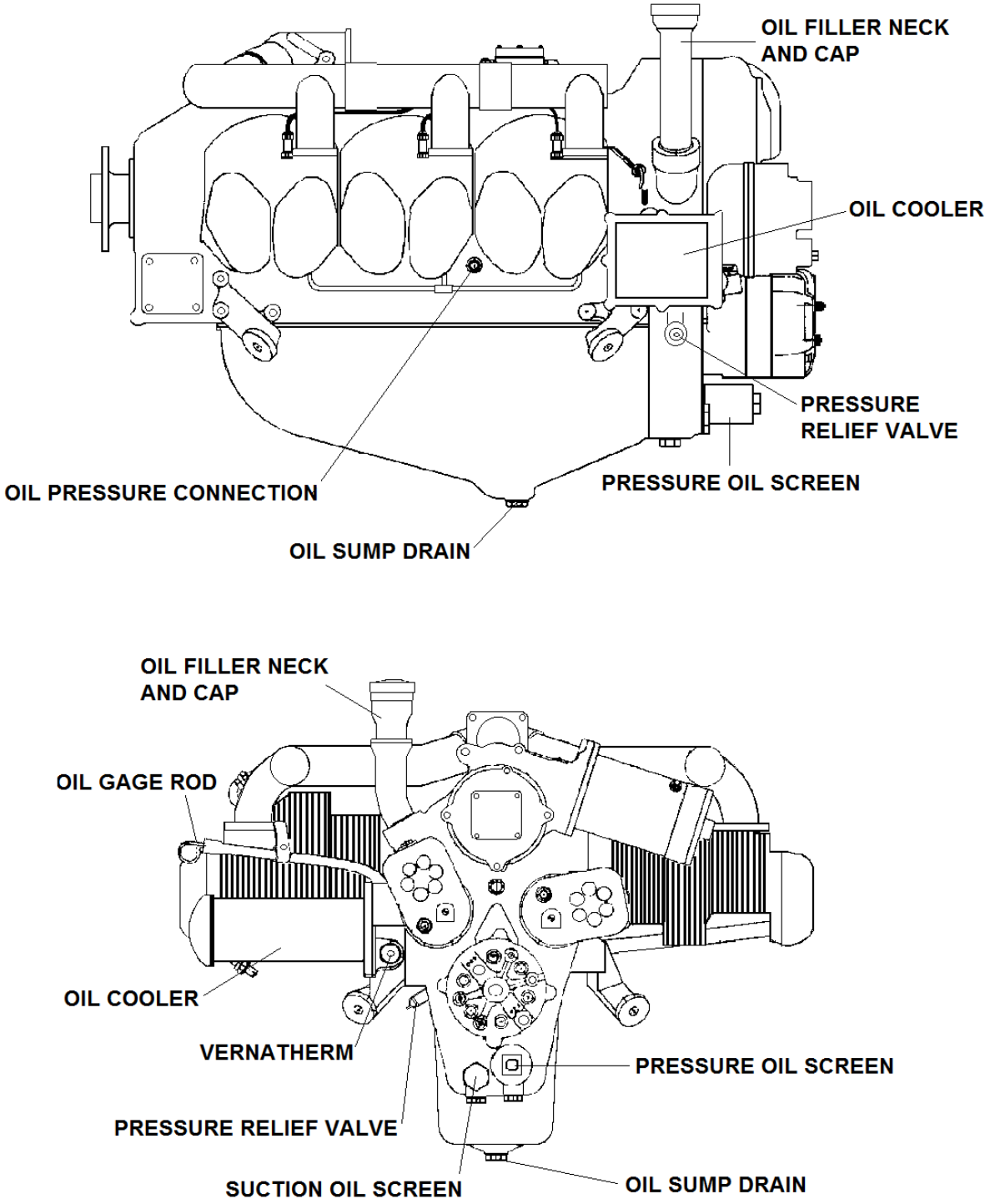


Figure 6-1. IO-360 Oil Servicing Points

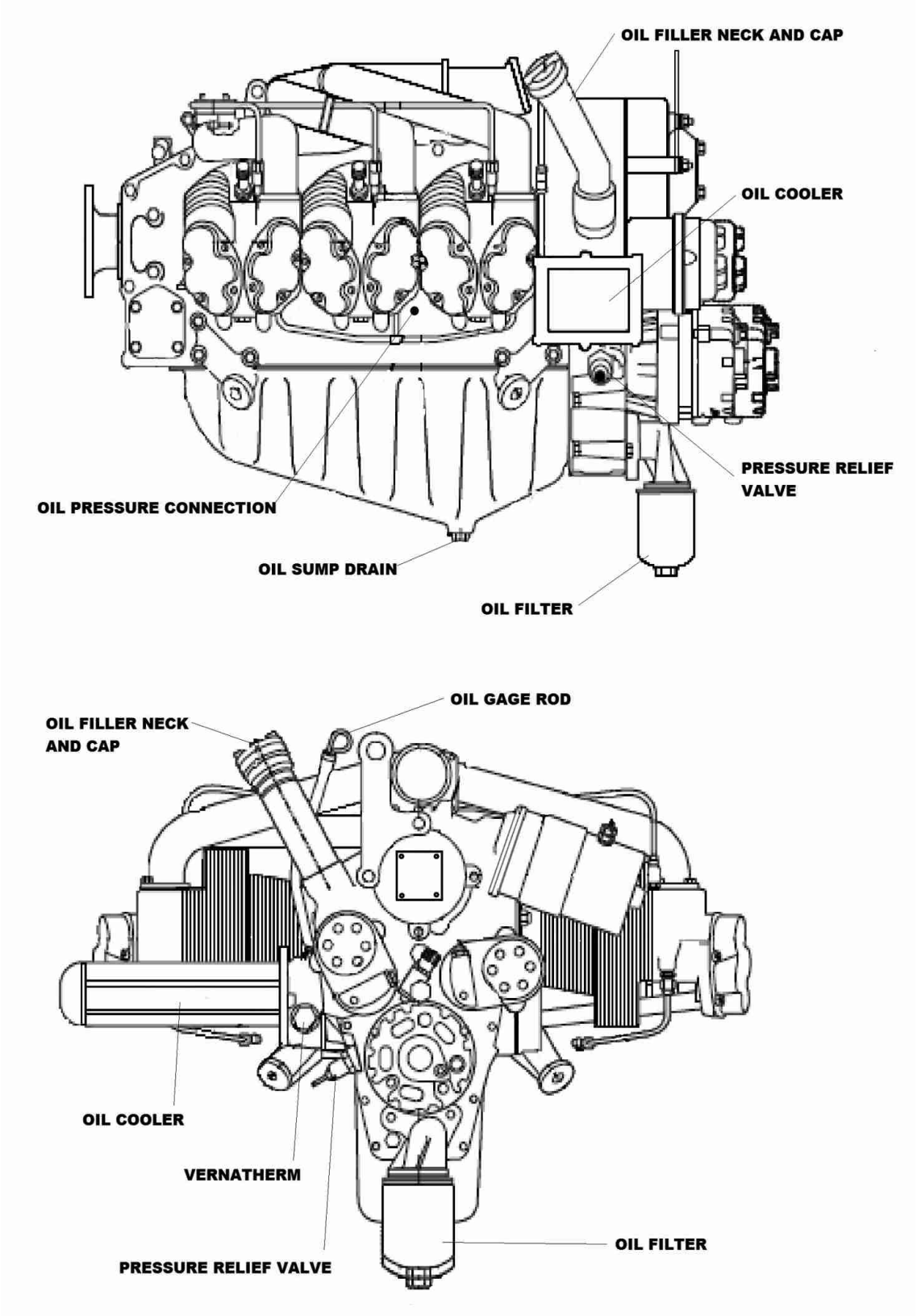


Figure 6-2. IO-360-AF and ES Oil Servicing Points

6-3.8.2. Oil Change

Perform an oil change within 30 minutes of engine shutdown (to obtain a useful oil sample) according to the oil change intervals specified in Table 6-1.

NOTE: More frequent oil changes are recommended under extreme usage (flight training, shuttle service, or crop dusting) or adverse (desert or arctic climates) weather conditions.

Procedure

CAUTION: Dispose of used engine oil in accordance with local environmental standards.

1. Place a catch basin, approved for collecting oil, beneath the oil sump. Remove the oil sump drain plug (Figure 6-1 or Figure 6-2) and drain the oil into the catch basin.
2. Collect an oil sample according to the "Oil Sample Collection" instructions in Section 6-3.8.4. Inspect the oil sump drain plug for evidence of wear material. Metal fragments on the drain plug may indicate excessive wear or part disintegration. Evidence of bronze in the oil sump suggests piston pin bushing wear or part disintegration. If bronze is found, remove the cylinders and inspect the piston pin bushings for proper installation according to instructions in Section 10-8.

   NOTE: Continental Motors recommends customers submit a sample of the oil drained during each oil change, or if engine trouble is suspected, for spectrographic oil analysis. The first three samples establish the oil analysis trend baseline.

   The amount of wear material present in new, rebuilt, or overhauled engines is typically greater during the engine break in period, tapering off during subsequent oil changes. If the amount of wear material does not decrease during subsequent oil changes, note the wear material characteristics (refer to Section 6-3.8.5, "Oil Trend Monitoring and Spectrographic Oil Analysis") and troubleshoot the engine according to instructions in Chapter 8.
3. Oil Filter or Integral Screen Change
   Engines covered in this manual are equipped with either a screw-on, disposable full-flow oil filter or an integral screen (Figure 6-3). Maintenance pertaining to these filter media is listed in the "Engine Inspection and Maintenance Schedule" in Section 6-1 on page 2. To change the disposable filter, follow step a. instructions; for the integral screen, follow step b.

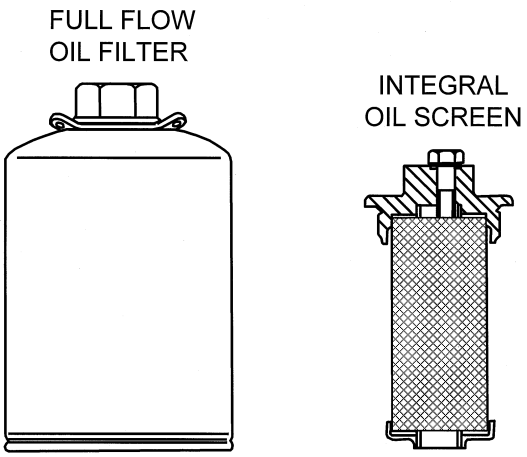


Figure 6-3. Disposable Oil Filter and Integral Screen

a. Remove the oil filter (Figure 6-2). Cut the filter in two parts using an Oil Filter Can Cutter, P/N CT-923 (Chapter 2-1 of M-0, Standard Practice Maintenance Manual).

   1) Inspect the oil filter element for metal debris trapped within the filter to assess the engine condition. If debris is found, wash the filter media in a clean glass container to determine content. Use a magnet to check for steel particulate.

   2) New, rebuilt, or overhauled engines exhibit more wear material during the break-in period. Wear material will decrease after the third and subsequent oil changes. If wear material in the oil filter/screen does not decrease after the third and subsequent oil changes, note the characteristics of the wear material (Section 6-3.8.5, “Oil Trend Monitoring and Spectrographic Oil Analysis”) and troubleshoot the engine according to instructions in Chapter 8.

   3) Inspect oil filter adapter mounting stud for security and proper setting height of 0.50 to 0.70 inch. Refer to Figure 15-8.

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

b. If the engine is equipped with an integral screen (Figure 6-1), cut the safety wire from the oil screen and remove the fastening hardware. The integral screen is not disposable. Clean the integral screen with mineral spirits.

4. Install the oil filter or integral screen. For disposable filters, perform step a; to install the integral screen, follow step b.

   a. Apply a thin coating of Dow Corning No. 4 compound (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the oil filter gasket to prevent gasket material sticking to the mating surface. Install the new oil filter; torque the filter to Appendix B specifications and safety wire the filter according to instructions in Appendix C-3.

b. After through cleaning, install a new copper gasket on the oil screen flange and install oil screen in receptacle. Install a new copper gasket on the plug (or aircraft manufacturer supplied oil temperature sensor) and secure screen with plug (or temperature sensor). Torque the plug (or temperature sensor) to Appendix B specifications and safety wire according to instructions in Appendix C-3.

5. Reinstall the oil drain plug with a new crush gasket; torque the drain plug to Appendix B specifications and safety wire the drain plug according to instructions in Appendix C-3.
6. Add fresh oil and check the oil level according to instructions in Section 6-3.8.1.
7. Check for oil leaks according to instructions in Section 6-3.8.3.

6-3.8.3. Check for Oil Leaks

WARNING

Keep the engine compartment, nacelle, and fuselage adjacent to the nacelle clean to enable detection of oil leaks.

Procedure

1. Perform a normal "Engine Start" according to instructions in Section 7-3.2 and "Ground Run-up" according to Section 7-3.3 to allow the engine to warm to normal operating temperatures. Document engine oil pressure and temperature.
2. Shut down the engine according to the "Engine Shutdown" instructions in Section 7-3.4.
3. Check the engine nacelle, engine compartment, and adjacent area for oil leaks. If leaks are found, determine the source and correct the cause of the leak(s).
4. Check the oil level in the sump according to Section 6-3.8.1, "Check and Replenish Engine Oil Level."

6-3.8.4. Oil Sample Collection

Refer to the "Oil Sample Collection" instructions in Chapter 6-4.8.4 of M-0, Standard Practice Maintenance Manual.

6-3.8.5. Oil Trend Monitoring and Spectrographic Oil Analysis

Refer to the "Oil Trend Monitoring and Spectrographic Analysis" instructions in Chapter 6-4.8.5 of M-0, Standard Practice Maintenance Manual.

6-3.9. Ignition System Maintenance

6-3.9.1. Magneto Timing

Refer to the “Ignition Timing” instructions in Chapter 6-4.9.1 of M-0, Standard Practice Maintenance Manual.

6-3.9.1.1. Crankshaft Top Dead Center Alignment

Refer to the “Crankshaft Top Dead Center Alignment” instructions in Chapter 6-4.9.1.1 of M-0, Standard Practice Maintenance Manual.

6-3.9.1.2. Magneto to Engine Timing

Refer to the “Magneto to Engine Timing” instructions in Chapter 6-4.9.1.2 of M-0, Standard Practice Maintenance Manual.

6-3.9.2. Spark Plug Maintenance

Refer to the “Spark Plug Maintenance” instructions in Chapter 6-4.9.2 of M-0, Standard Practice Maintenance Manual.

6-3.9.3. Ignition Harness Maintenance

Refer to the “Ignition Harness Maintenance” instructions in Chapter 6-4.9.3 of M-0, Standard Practice Maintenance Manual.

6-3.10. Engine Adjustments

WARNING

Turn the Ignition Switch OFF and disconnect engine electrical power before commencing maintenance or inspections. Confirm continuity between the magneto capacitor and aircraft ground to prevent accidental engine start during maintenance. Do not stand or place equipment within the arc of the propeller.

The procedures listed herein apply to Continental Motors fuel injected engines in their original type design. For modified engine designs, refer to the Supplemental Type Certificate holder information and instructions.

NOTE: Before performing any engine fuel system adjustment, verify the aircraft fuel system and fuel pump are operating according to the aircraft manufacturer's specifications and perform an "Engine Operational Check" according to the instruction in Section 6-3.7.

6-3.10.1. Oil Pressure Adjustment

Refer to the "Oil Pressure Adjustment" instructions in Chapter 6-4.10.1 of M-0, Standard Practice Maintenance Manual.

6-3.10.2. Fuel System Adjustment

Refer to the "Fuel System Adjustment" instructions in Chapter 6-4.10.2 of M-0, Standard Practice Maintenance Manual.

6-3.10.3. Auto Leaning Schedule Adjustments

Refer to the "Fuel Pump Auto-Lean Schedule Adjustment" instructions in Chapter 6-4.10.2.4 of M-0, Standard Practice Maintenance Manual.

6-3.10.4. Belt Tension Check and Adjustment

IO-360-AF and ES engines may be fitted with an optional belt driven air conditioning compressor or belt driven alternators.

Refer to the "Air Conditioning Compressor Drive Belt Tension Check and Adjustment" instructions in Chapter 6-4.10.4.2 of M-0, Standard Practice Maintenance Manual.

Refer to the "Alternator Drive Belt Tension Check and Adjustment" instructions for the front mounted belt driven alternator in Chapter 6-4.10.4.5 of M-0, Standard Practice Maintenance Manual.

Refer to the "Alternator Drive Belt Tension Check and Adjustment" instructions for the aft mount belt driven alternator in Chapter 6-4.10.4.6 of M-0, Standard Practice Maintenance Manual.

6-3.11. Cylinder Inspections

A complete cylinder inspection entails the tasks described in the respective sections of Table 6-4 below. Performing all of the tasks in Table 6-4 ensures items that can affect cylinder operation have been inspected and verified for proper operation. Use a copy of the "Cylinder Inspection Checklist" in M-0, Standard Practice Maintenance Manual, to record inspection progress and findings.

Table 6-4. Cylinder Inspection Tasks and References

Task[1]	Section Reference
Visually inspect cylinders	Section 6-3.11.1
Check cylinder differential pressure	Section 6-3.11.2
Inspect engine cylinders with borescope	Section 6-3.11.3
Inspect cylinder to crankcase mounting deck	Section 6-3.11.4
Inspect baffles	Section 6-3.11.5
Inspect cowling	Section 6-3.11.6

1. All tasks in this table must be performed for a complete cylinder inspection.

6-3.11.1. Cylinder Visual Inspections

Refer to the "Cylinder Visual Inspection" instructions in Chapter 6-4.11.1 of M-0, Standard Practice Maintenance Manual.

6-3.11.2. Differential Pressure Test

Refer to the "Differential Pressure Test" instructions in Chapter 6-4.11.2 of M-0, Standard Practice Maintenance Manual, for tools required, frequency and procedural instructions to perform a cylinder differential pressure test.

6-3.11.2.1. Differential Pressure Tester E2M Setup

Refer to the "Differential Pressure Tester E2M Setup" instructions in Chapter 6-4.11.2.1 of M-0, Standard Practice Maintenance Manual.

6-3.11.2.2. Differential Pressure Tester Reliability Check

Refer to the "Differential Pressure Tester Reliability Check" instructions in Chapter 6-4.11.2.2 of M-0, Standard Practice Maintenance Manual.

6-3.11.2.3. Leak Check

Refer to the "Leak Check" instructions in Chapter 6-4.11.2.3 of M-0, Standard Practice Maintenance Manual.

6-3.11.2.4. Cylinder Differential Pressure Test

Refer to the "Cylinder Differential Pressure Test" instructions in Chapter 6-4.11.2.4 of M-0, Standard Practice Maintenance Manual.

6-3.11.3. Cylinder Borescope Inspection

Refer to the "Cylinder Borescope Inspection" instructions in Chapter 6-4.11.3 of M-0, Standard Practice Maintenance Manual, for equipment required, frequency and the procedural instructions to complete the borescope inspection.

6-3.11.4. Cylinder to Crankcase Mounting Deck Inspection

Refer to the "Cylinder to Crankcase Mounting Deck Inspection" instructions in Chapter 6-4.11.4 of M-0, Standard Practice Maintenance Manual, for frequency and the procedural instructions to complete the mounting deck inspection.

6-3.11.5. Baffle Inspection

Refer to the "Baffle Inspection" instructions in Chapter 6-4.11.5 of M-0, Standard Practice Maintenance Manual, for equipment required, frequency and the procedural instructions to complete the baffle inspection.

6-3.11.6. Cowling Inspection

Refer to the "Cowling Inspection" instructions in Chapter 6-4.11.6 of M-0, Standard Practice Maintenance Manual, for equipment required, frequency and the procedural instructions to complete the cowling inspection.

6-3.12. Crankcase Inspection

Refer to the "Crankcase Inspection" instructions in Chapter 6-4.12 of M-0, Standard Practice Maintenance Manual, for frequency and the procedural instructions to complete the crankcase inspection.

6-3.13. Engine Mount Inspection

Refer to the "Engine Mount Inspection" instructions in Chapter 6-4.13 of M-0, Standard Practice Maintenance Manual, for frequency and the procedural instructions to complete the engine mount inspection.

6-3.14. Induction System Inspection

Refer to the "Induction System Inspection" instructions in Chapter 6-4.14 of M-0, Standard Practice Maintenance Manual, for frequency and the procedural instructions to complete the induction system inspection.

6-3.15. Ignition System Inspection

Refer to the "Ignition System Inspection" instructions in Chapter 6-4.15 of M-0, Standard Practice Maintenance Manual, for frequency and the procedural instructions to complete the ignition system inspection.

6-3.15.1. Impulse Coupling Functional Check

Refer to the "Impulse Coupling Functional Check" instructions in Chapter 6-4.15.1 of M-0, Standard Practice Maintenance Manual, for the procedural instructions to complete the impulse coupling functional check.

6-3.15.2. Magneto Drive Coupling Inspection

Refer to the "Magneto Drive Coupling Inspection" instructions in Chapter 6-4.15.3 of M-0, Standard Practice Maintenance Manual, for the procedural instructions to complete the magneto drive coupling inspection.

6-3.16. Engine Gauge Inspection

Refer to the "Engine Gauge Inspection" instructions in Chapter 6-4.16 of M-0, Standard Practice Maintenance Manual, for frequency and the procedural instructions to complete the engine gauge inspection.

6-3.17. Fuel System Inspection

Refer to the "Fuel System Inspection" instructions in Chapter 6-4.17 of M-0, Standard Practice Maintenance Manual, for frequency and the procedural instructions to complete the fuel system inspection.

6-3.18. Engine Control Linkage Inspection

Refer to the "Engine Control Linkage Inspection" instructions in Chapter 6-4.19 of M-0, Standard Practice Maintenance Manual, for frequency and the procedural instructions to complete the engine control linkage inspection.

6-3.19. Induction or Cylinder Drain Inspection

Refer to the "Induction or Cylinder Drain Inspection" instructions in Chapter 6-4.20 of M-0, Standard Practice Maintenance Manual, for frequency and the procedural instructions to complete the induction or cylinder drain inspection.

6-3.20. Alternator Inspection

Refer to the "Alternator Inspection" instructions in Chapter 6-4.22 of M-0, Standard Practice Maintenance Manual, for frequency and the procedural instructions to complete the alternator inspection.

6-3.20.1. Alternator Drive Hub Inspection

NOTE: This procedure only applies to the direct drive alternators. The alternator drive hub single piece coupling is designed to slip when abnormal torque is required to rotate the alternator shaft.

NOTE: Some alternators use a single piece coupling, identify the type of coupling used by alternator by referring to the illustrated parts catalog.

Refer to the "Alternator Drive Hub Inspection" instructions in Chapter 6-4.22.2 of M-0, Standard Practice Maintenance Manual, for the procedural instructions to complete the alternator drive hub inspection.

6-4. Unscheduled Maintenance

6-4.1. Propeller Strike

Refer to the “Propeller Strike” instructions in Chapter 6-5.1 of M-0, Standard Practice Maintenance Manual.

6-4.1.1. Propeller Strike Inspection

Refer to the “Propeller Strike Inspection” instructions in Chapter 6-5.1.1 of M-0, Standard Practice Maintenance Manual, for the procedural instructions to complete the propeller strike inspection.

6-4.2. Hydraulic Lock Inspection

Refer to the “Hydraulic Lock Inspection” instructions in Chapter 6-5.2 of M-0, Standard Practice Maintenance Manual, for the procedural instructions to complete the hydraulic lock inspection.

6-4.3. Engine Overspeed Inspections

Refer to the “Engine Overspeed Inspection” instructions in Chapter 6-5.3 of M-0, Standard Practice Maintenance Manual.

6-4.3.1. Category I Overspeed Inspection

Refer to the “Category I Overspeed Inspection” instructions in Chapter 6-5.3.1 of M-0, Standard Practice Maintenance Manual, for the procedural instructions to complete the Category I overspeed inspection.

6-4.3.2. Category II Overspeed Inspection

Refer to the “Category II Overspeed Inspection” instructions in Chapter 6-5.3.2 of M-0, Standard Practice Maintenance Manual, for the procedural instructions to complete the Category II overspeed inspection.

6-4.3.3. Category III Overspeed Inspection

Refer to the “Category III Overspeed Inspection” instructions in Chapter 6-5.3.3 of M-0, Standard Practice Maintenance Manual, for the procedural instructions to complete the Category III overspeed inspection.

6-4.4. Lightning Strike Inspection

Refer to the “Lightning Strike Inspection” instructions in Chapter 6-5.5 of M-0, Standard Practice Maintenance Manual, for the procedural instructions to complete the lightning strike inspection.

6-4.5. Contaminated Fuel System Inspection

Refer to the “Contaminated Fuel System Inspection” instructions in Chapter 6-5.6 of M-0, Standard Practice Maintenance Manual, for the procedural instructions to complete the contaminated fuel system inspection.

6-4.6. Foreign Object Contamination Inspection

Refer to the “Foreign Object Contamination Inspection” instructions in Chapter 6-5.7 of M-0, Standard Practice Maintenance Manual, for the procedural instructions to complete the foreign object contamination inspection.

6-5. Inspection Checklists

Inspection checklists are included as a convenient record of inspection progress and findings. Using a copy of the form ensures a blank form will be available for the next scheduled inspection. When an inspection is due, make a copy of the inspection checklist to record inspection progress and findings while following the steps in the inspection procedures. The checklists are not designed to replace the procedures; only augment them. File the completed checklists in the aircraft logbook.

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Table 6-5. Engine Operational Checklist
See "Engine Operational Checklist" (Table 6-26) of M-0, Standard Practice Maintenance Manual

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Table 6-6. 25-Hour Initial Operation Inspection Checklist
See "25-Hour Initial Operation Inspection Checklist" (Table 6-27) of M-0, Standard Practice Maintenance Manual

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Table 6-7. 50-Hour Engine Inspection Checklist

See "50-Hour Engine Inspection Checklist" (Table 6-28) of M-0, Standard Practice Maintenance Manual

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Table 6-8. 100-Hour Engine Inspection Checklist

See "100-Hour Engine Inspection Checklist" (Table 6-29) of M-0, Standard Practice Maintenance Manual

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Table 6-9. 500-Hour Engine Inspection Checklist
See “500-Hour Engine Inspection Checklist” (Table 6-30) of M-0, Standard Practice Maintenance Manual

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Table 6-10. Cylinder Inspection Checklist
See "Cylinder Inspection Checklist" (Table 6-31) of M-0, Standard Practice Maintenance Manual

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Chapter 7. Engine Operation

7-1. Introduction

Refer to the “Introduction” instructions in Chapter 7-1 of M-0, Standard Practice Maintenance Manual.

7-2. Flight Prerequisites

Refer to the “Flight Prerequisites” instructions in Chapter 7-2 of M-0, Standard Practice Maintenance Manual.

7-2.1. Oil Change Interval

Refer to the “Oil Change Interval” instructions in Chapter 7-2.1 of M-0, Standard Practice Maintenance Manual.

7-2.2. Engine Fuel Requirements

Refer to the “Engine Fuel Requirements” instructions in Chapter 7-2.2 of M-0, Standard Practice Maintenance Manual.

7-2.3. Flight Check and Break-In

Refer to the “Flight Check and Break-In” instructions in Chapter 7-2.4 of M-0, Standard Practice Maintenance Manual.

7-2.3.1. Engine Break-In

Refer to the “Engine Break-In” instructions in Chapter 7-2.4.1 of M-0, Standard Practice Maintenance Manual.

7-2.3.2. Flight Check

Refer to the “Flight Check” instructions in Chapter 7-2.4.2 of M-0, Standard Practice Maintenance Manual.

7-2.3.2.1. IO-360 Standard Fuel System Flight Check (except D34, DB34 and ES)

Refer to the “Standard Flight Check Instructions” in Chapter 7-2.4.2.1 of M-0, Standard Practice Maintenance Manual.

7-2.3.2.2. IO-360 Altitude Compensating Fuel System Flight Check (D34, DB34 and ES Models)

Refer to the “Flight Check for CM Continuous Flow Fuel Injection Systems with Altitude Compensating Fuel Pump” instructions in Chapter 7-2.4.2.2 of M-0, Standard Practice Maintenance Manual.

7-3. Normal Operation

Refer to the "Normal Operation" instructions in Chapter 7-3 of M-0, Standard Practice Maintenance Manual.

7-3.1. Pre-operational Requirements

Refer to the "Pre-operational Requirements" instructions in Chapter 7-3.1 of M-0, Standard Practice Maintenance Manual.

7-3.2. Engine Start

WARNING

Do not attempt to start an engine with an over-primed or flooded induction system. Starting an engine with a flooded induction system can result in hydraulic lock and subsequent engine malfunction or failure. Allow excess fuel to drain from the intake manifold and/or cylinder prior to attempting to start the engine.

Refer to the AFM/POH for detailed engine starting procedures. Complete the "Pre-operational Requirements" tasks listed in Section 7-3.1 prior to starting the engine; ensure you are familiar with the quantity and location of the engine fuel system drains.

CAUTION: Attempting to start an engine with a partially discharged aircraft battery may result in damage to the starter relay, possible engine kick-back resulting in a broken starter adapter clutch spring and/or subsequent internal engine damage.

When starting the engine, ensure the battery is completely charged, especially in sub-freezing temperatures.Verify the tasks listed in Table 7-2, "Flight Prerequisites" have been completed in addition to those required by the AFM/POH or Supplemental Type Certificate (STC) holder. Note the following:

- If the engine is being started in extreme cold, preheating is required if the temperature is at or below 20°F. Refer to Section 7-5.1, "Engine Operation in Extreme Cold."
- If the engine is started in hot weather, refer to Section 7-5.2, "Engine Operation in Hot Weather."
- If the engine is being started at high altitude, refer to Section 7-5.2.3, "Ground Operation at High Density Altitude."

1. Propeller..... Clear
2. Fuel Selector Valve ..... BOTH or fullest tank
3. Master Power Switch ..... ON
4. Ignition Switch..... BOTH
5. Mixture Control ..... FULL RICH
6. Propeller Control..... High RPM

CAUTION: If the engine is hot, engage starter first, then turn on the boost pump as instructed by the aircraft manufacturer.

7. Boost Pump ..... ON (according to AFM/POH)
8. Throttle ..... ¼ Open

WARNING

Ensure the propeller arc is clear of personnel and obstructions before starting the engine.

CAUTION: Release the starter as soon as the engine fires. Never engage the starter while the propeller is turning.

EZR *Do not energize the starter for longer than 30 seconds.If the engine does not start after cranking for 30 seconds, release the starter switch and allow the starter motor to cool for 3-5 minutes before another starting attempt.*

SKY *Do not engage the starter for longer than 10 seconds. Allow 20 seconds for the starter to cool after each engagement. If engine does not start after six attempts, release the starter switch and allow the starter motor to cool for 30 minutes before another starting attempt.*

9. Ignition Switch ..... START, then RELEASE
10. Throttle ..... Adjust for 900 - 1100 RPM

CAUTION: Engine operation without oil pressure will result in engine malfunction and probable failure.

11. Oil Pressure ..... Check
    RESULT: Must have oil pressure indication within 30 seconds.

NOTE: Check oil pressure frequently. Oil pressure indication must be noted within 30 seconds in normal weather. If no oil pressure is observed, stop the engine and investigate the cause.

7-3.2.1. Cold Start

Refer to the “Cold Start” instructions in Chapter 7-3.2.1 of M-0, Standard Practice Maintenance Manual.

7-3.2.2. Flooded Engine

Refer to the “Flooded Engine” instructions in Chapter 7-3.2.2 of M-0, Standard Practice Maintenance Manual.

7-3.2.3. Hot Start

Refer to the “Hot Start” instructions in Chapter 7-3.2.3 of M-0, Standard Practice Maintenance Manual.

7-3.3. Ground Run-up

Refer to the “Ground Run-up” instructions in Chapter 7-3.3 of M-0, Standard Practice Maintenance Manual.

7-3.4. Engine Shutdown

Refer to the “Engine Shutdown” instructions in Chapter 7-3.4 of M-0, Standard Practice Maintenance Manual.

7-4. Emergency Operation

Information in this section supplements instructions for emergency operations found in the AFM/POH. Perform the following engine-specific steps in addition to the AFM/POH requirements when responding to emergency conditions.

If a malfunction should occur during maintenance, certain remedial actions may eliminate or reduce the severity of the condition. Some malfunctions which might occur are listed in this chapter with a recommended corrective action. However, no single procedure will be applicable in every situation.

Thorough aircraft and engine familiarity are invaluable assets in assessing a given situation and responding accordingly.

7-4.1. Engine Fire During Start

Supplement the AFM/POH instructions, if possible, with the following if flames are observed in the induction or exhaust system during engine start:

1. Fuel Selector ..... OFF (according to AFM/POH)
2. Mixture Control ..... IDLE CUT-OFF
3. Throttle ..... FULL OPEN
4. Ignition Switch ..... START (Hold in cranking position to extinguish fire)

7-4.2. Engine Roughness

WARNING

If roughness is severe or the cause cannot be determined, engine failure may be imminent. Follow the AFM/POH emergency procedures and shutdown the engine.

Upon engine shutdown, perform a visual inspection of the fuel injection system, induction system and magnetos to determine if physical damage exists. Inspect the propeller for physical damage according to the aircraft or propeller manufacturer's instructions. If no physical damage is discovered, perform an Engine Operational Check to evaluate engine performance versus specifications.

7-4.3. High Cylinder Head Temperature

Supplement AFM/POH instructions with these steps:

1. Cowl Flaps ..... OPEN
2. Mixture Control ..... Adjust to maintain proper fuel flow for power being produced
3. If temperature cannot be maintained within limits, reduce power.
4. Shutdown engine according to Section 7-3.4.
5. Troubleshoot and correct the cause of the high cylinder head temperature indication prior to further ground run.

7-4.4. High Oil Temperature

CAUTION: If these steps do not restore normal oil pressure, engine failure or severe damage is imminent. Follow the AFM/POH emergency instructions and shutdown the engine.

NOTE: Prolonged high oil temperature indications are accompanied by reduced oil pressure. If oil pressure remains normal, a high temperature indication may be caused by a faulty gauge or thermocouple.

1. Cowl Flaps ..... OPEN
2. Reduce Power if step 1 does not reduce oil temperature.
3. Shutdown engine according to Section 7-3.4.
4. Troubleshoot and correct the cause of the high oil temperature indication prior to further ground run.

7-4.5. Low Oil Pressure

WARNING

If oil pressure drops below 30 psi, an engine failure is imminent. Follow AFM/POH emergency procedures.

WARNING

If the oil pressure drops suddenly from a normal indication of 30-60 psi, monitor temperature closely and shutdown the engine. Troubleshoot and correct the cause of the low oil pressure indication prior to further ground run.

7-4.6. Engine Overspeed

Operating engine beyond its capacity can damage engine and result in subsequent engine failure. Engine overspeed severity is divided into three categories in Table 7-1:

Table 7-1. Overspeed Categories

Category	Engine Speed
CAT I	Rated Full Power RPM to 3000 RPM
CAT II	3000-3300 RPM
CAT III	Over 3300 RPM

NOTE: Rated RPM limits for aircraft equipped with digital RPM measuring equipment may be adjusted to include a +2% deviation for normal operations. Any operation beyond rated RPM limit plus the 2% deviation must follow inspection criteria.

Category I: If duration of overspeed event is less than ten seconds (CAT I), no action is required. If overspeed event persists longer than ten seconds, land the aircraft and perform a Category I Overspeed Inspection according to instructions in Chapter 6 of M-0, Standard Practice Maintenance Manual.

Category II: If the overspeed event duration is less than ten seconds, perform a Category I Overspeed Inspection according to instructions in Chapter 6 of M-0, Standard Practice Maintenance Manual. If the overspeed event last longer than ten seconds, land the aircraft and perform a Category II Overspeed Inspection according to instructions in Chapter 6 of M-0, Standard Practice Maintenance Manual.

Category III: Overspeed conditions in this category are considered extreme. Perform a Category III Overspeed Inspection according to instructions in Chapter 6 of M-0, Standard Practice Maintenance Manual.

7-5. Engine Operation in Abnormal Environments

The anticipated types of abnormal environments are:

- Extreme cold weather
- Extreme hot weather
- High density altitude ground operation

7-5.1. Engine Operation in Extreme Cold

Refer to the "Engine Operation in Extreme Cold" instructions in Chapter 7-4.1 of M-0, Standard Practice Maintenance Manual.

7-5.1.1. Engine Preheating

Refer to the "Engine Preheating" instructions in Chapter 7-4.1.1 of M-0, Standard Practice Maintenance Manual.

7-5.1.1.1. Engine Preheat with a Combustion Heater

Refer to the "Engine Preheat with a Combustion Heater" instructions in Chapter 7-4.1.1.1 of M-0, Standard Practice Maintenance Manual.

7-5.1.1.2. Engine Preheat with an Engine-Mounted Preheater

Refer to the "Engine Preheat with an Engine-Mounted Preheater" instructions in Chapter 7-4.1.1.2 of M-0, Standard Practice Maintenance Manual.

7-5.1.1.3. Cold Weather Starting Without Preheating

Refer to the "Cold Weather Starting Without Preheating" instructions in Chapter 7-4.1.1.3 of M-0, Standard Practice Maintenance Manual.

7-5.2. Engine Operation in Hot Weather

"Hot weather" is defined as ambient temperature exceeding 90°F (32°C). After an engine is shutdown, the temperature of various components will begin to stabilize. The hotter parts such as cylinders and oil will cool, while other parts will begin to heat up due to lack of air flow or heat convection from those engine parts that are cooling. At some point following engine shutdown, the entire unit will stabilize near the ambient temperature. This time period will be determined by temperature and wind conditions and may take several hours.

Heat soaking occurs between 30 minutes to one hour following shutdown. During this time, the fuel system will warm causing the fuel in the pump and fuel lines to "boil" or vaporize. During subsequent starting attempts, the fuel pump will initially be pumping a combination of fuel and fuel vapor. At the same time, the fuel lines will be filled with varying amounts of fuel and vapor. Until the entire fuel system becomes filled with liquid fuel, difficult starting and unstable engine operation can be expected.

Three hot weather operation situations requiring special instructions are:

- "Cooling an Engine in Hot Weather" (Section 7-5.2.1)
- "Engine Restart in Hot Weather" (Section 7-5.2.2)
- "Ground Operation at High Density Altitude" (Section 7-5.2.3)

Ensure the engine is serviced to the full level with oil conforming to the "Engine Oil Specifications" in Chapter 3-1 of M-0, Standard Practice Maintenance Manual, prior to starting the engine. Service the oil sump, as required, to maintain the oil capacity specified for the engine model in Section 2-3, "Engine Specifications" according to the "Engine Oil Servicing" instructions in Section 6-3.8.

Operating Tips

- Inspect the induction air filter frequently for contamination; be prepared to clean or replace it, if necessary.
- If the aircraft is flown in dusty conditions, CM recommends more frequent oil changes.
- Use dust covers over openings in the cowling for additional protection.

7-5.2.1. Cooling an Engine in Hot Weather

- Reduce ground operation to a minimum to keep engine temperatures down.
- Open cowl flaps fully while taxiing.
- Face the nose of aircraft into the wind to take advantage of the cooling effect.

7-5.2.2. Engine Restart in Hot Weather

Restarting attempts will be the most difficult from 30 to 60 minutes after shutdown. Following that interval, fuel vapor will decrease and present less of a restart problem.

WARNING

Allow excess fuel to drain from the induction system prior to starting the engine.

1. Fuel selector ..... ON
2. Throttle ..... CLOSED
3. Mixture Control ..... IDLE CUT-OFF
4. Boost Pump ..... ON (15 - 20 seconds)
5. Boost Pump ..... OFF
6. Follow the "Engine Start" instructions in the AFM/POH and Section 7-3.2.

7-5.2.3. Ground Operation at High Density Altitude

CAUTION: Reduced engine power will result from higher density altitude associated with high temperature.

High density altitude conditions may cause the idle fuel mixture to be too rich for stable operation. Lean the fuel mixture to sustain operation at low RPM. When practical, operate the engine at higher idle speed during ground operation. Refer to the AFM/POH for high density altitude takeoff operation.

- Monitor oil and cylinder temperatures closely during taxiing and engine run up.
- Operate with cowl flaps full open
- Do not operate engine at high RPM except for necessary operational checks.
- If take-off is not to be made immediately following engine run up, face the aircraft into the wind with the engine idling between 900 - 1000 RPM.

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Chapter 8. Troubleshooting

Fault isolation paths within this section indicate the most likely causes of given symptoms and corrective action. The fault isolation paths and repair procedures are developed using real world scenarios (log book entries) and best known practices. New symptoms, fault isolation methods, and corrective actions may be added in the future, when warranted.

WARNING

Any attempt by unqualified personnel to adjust, repair, or replace any parts may result in engine malfunction or failure. Continued operation of a malfunctioning engine can cause further damage to a disabled component and possible injury to personnel. Do not return an engine to service unless it functions according to specifications.

8-1. General Troubleshooting

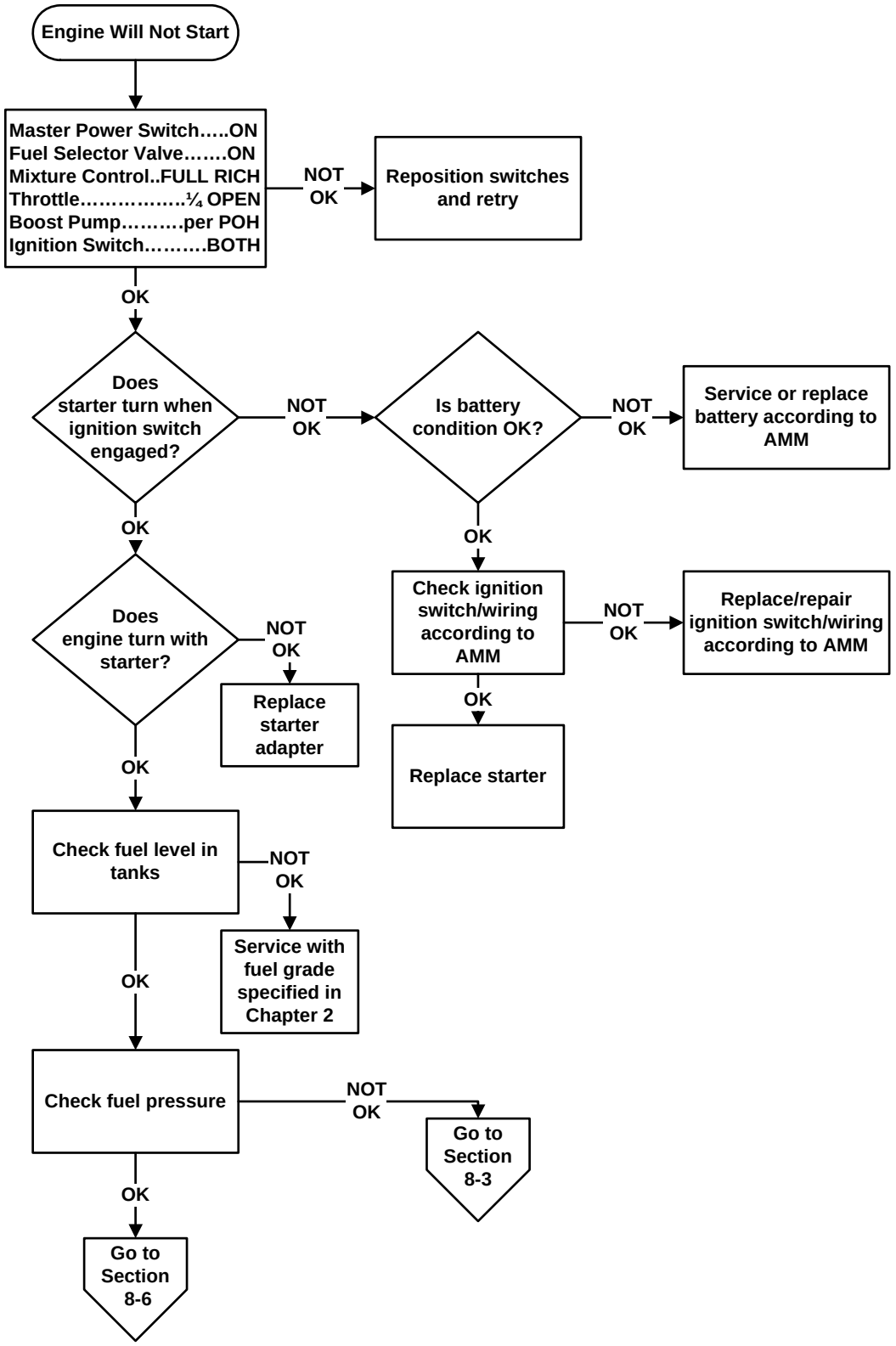


Figure 8-1. Engine Will Not Start

8-1.1. Engine Runs Rough

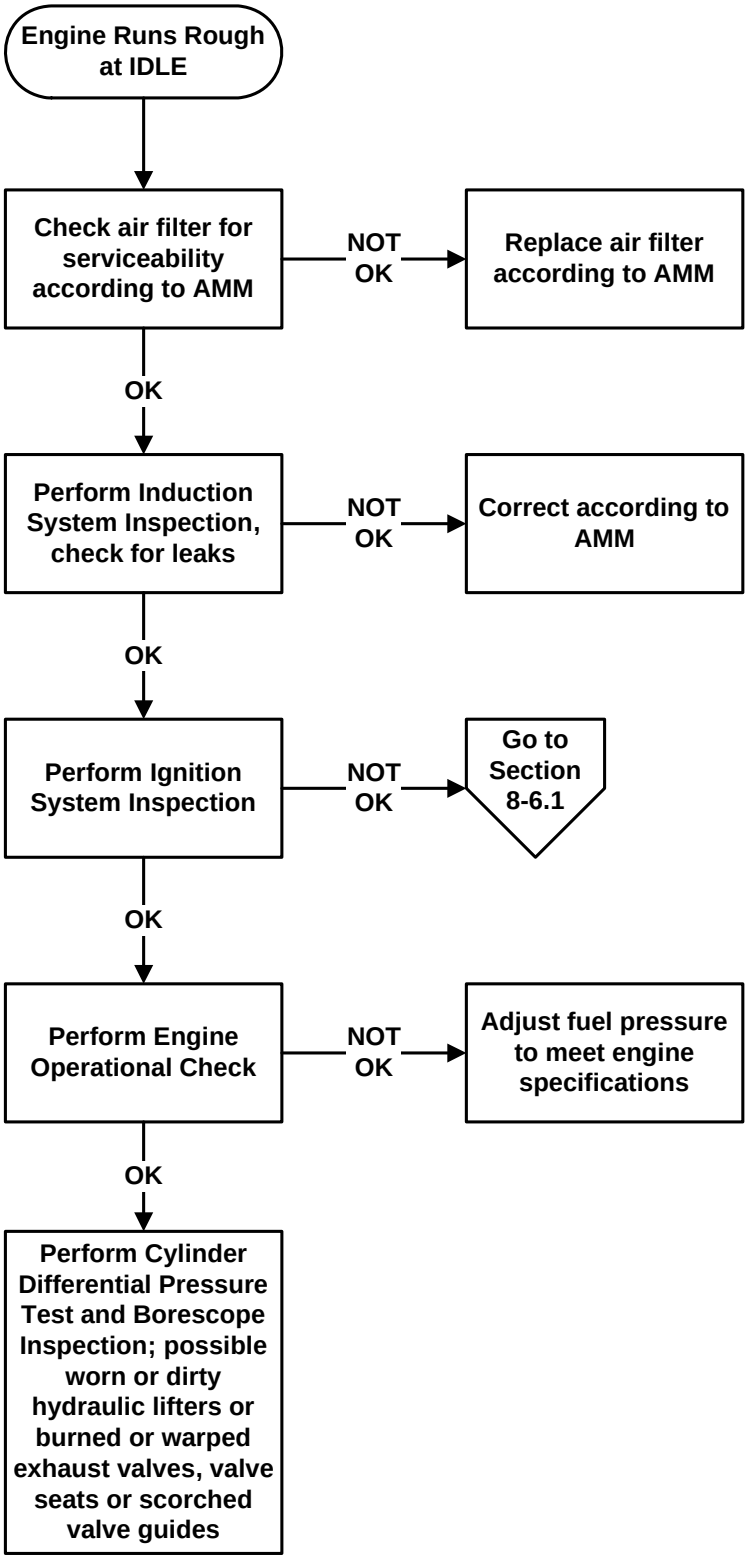


Figure 8-2. Engine Runs Rough at IDLE

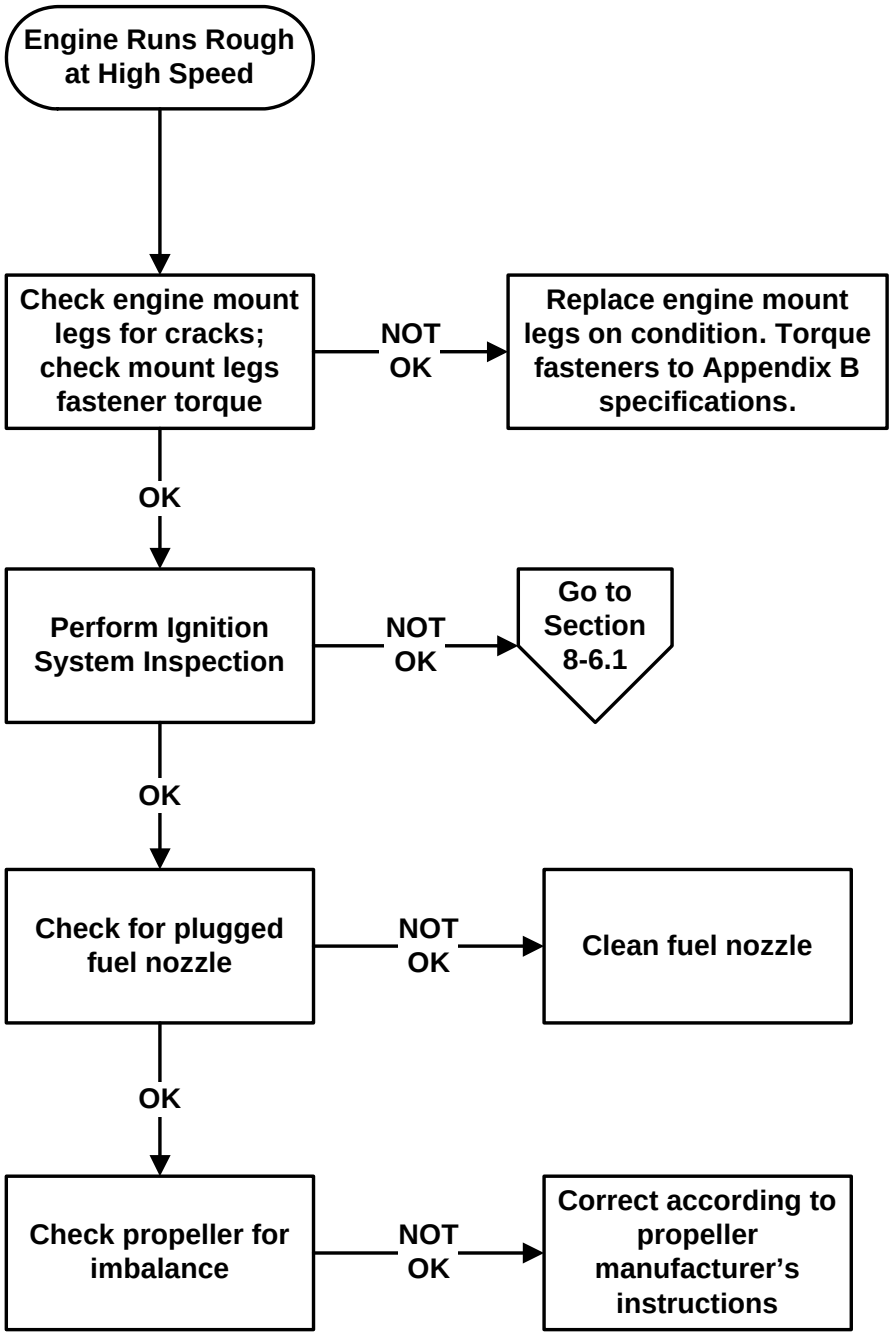


Figure 8-3. Engine Runs Rough at High Speed

8-1.2. Engine Will Not Run

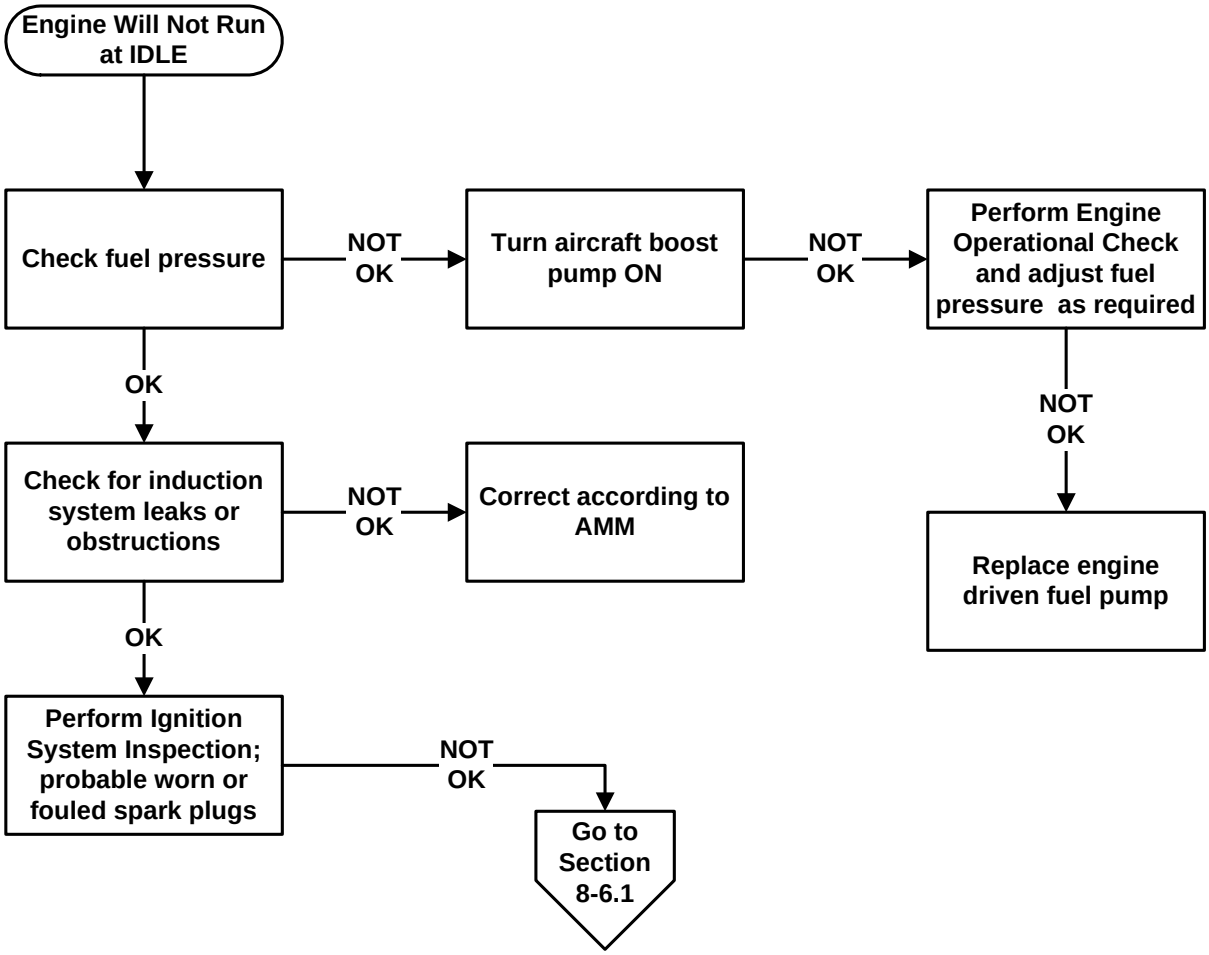


Figure 8-4. Engine Will Not Run at IDLE

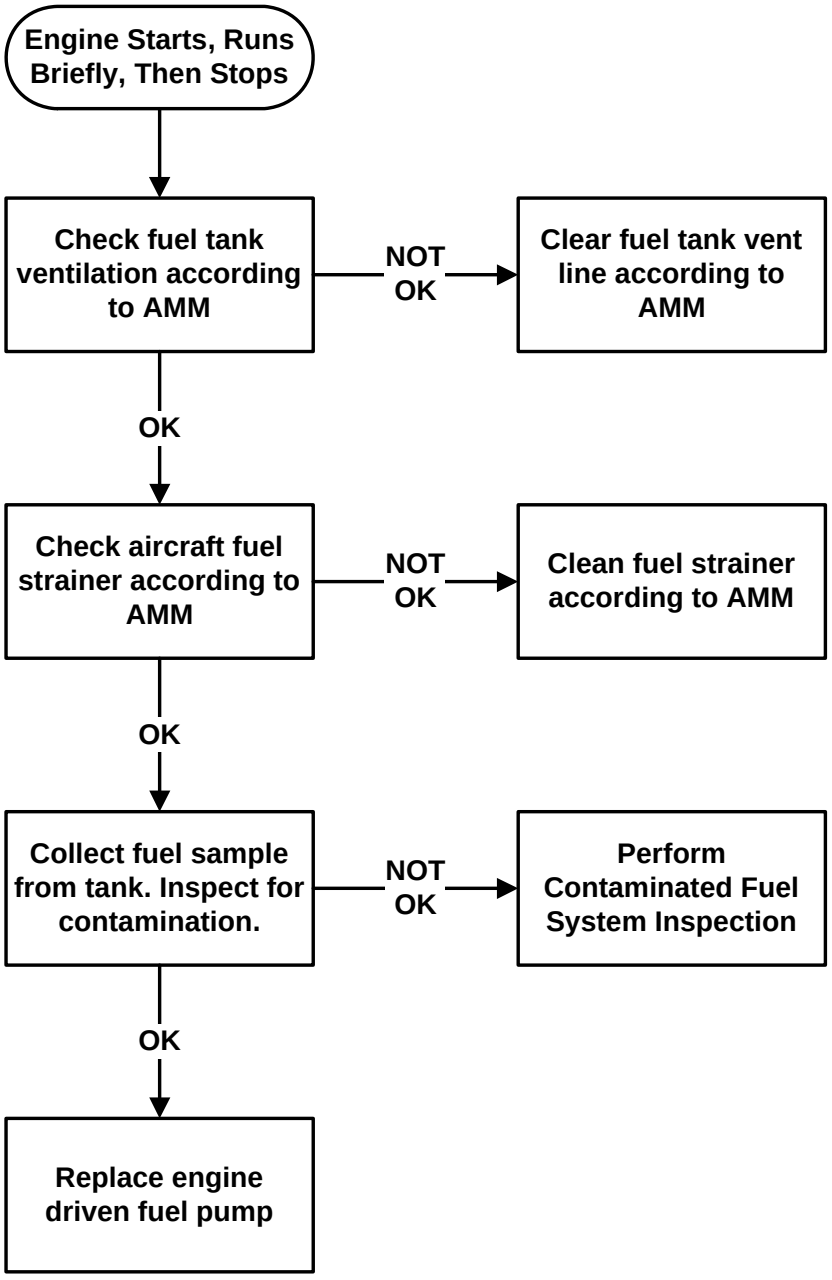


Figure 8-5. Engine Starts, Runs Briefly, Then Stops

8-1.3. Engine Performance Malfunctions

Engine Runs Rich at Cruise Power.....Go to Figure 8-8
Engine Acceleration Poor.....Go to Figure 8-6
Engine Misses at High Speed.....Go to Section 8-8

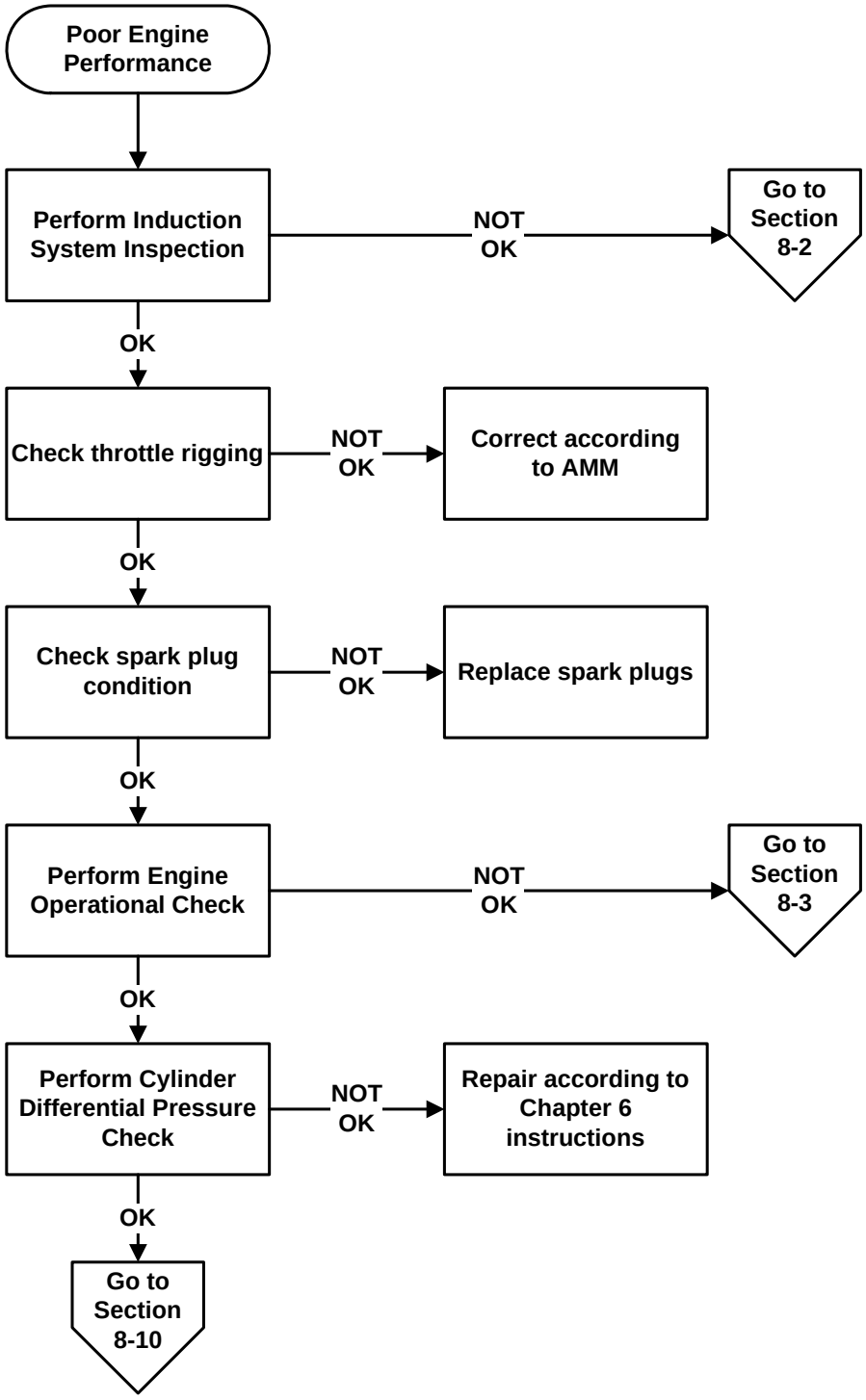


Figure 8-6. Poor Engine Performance

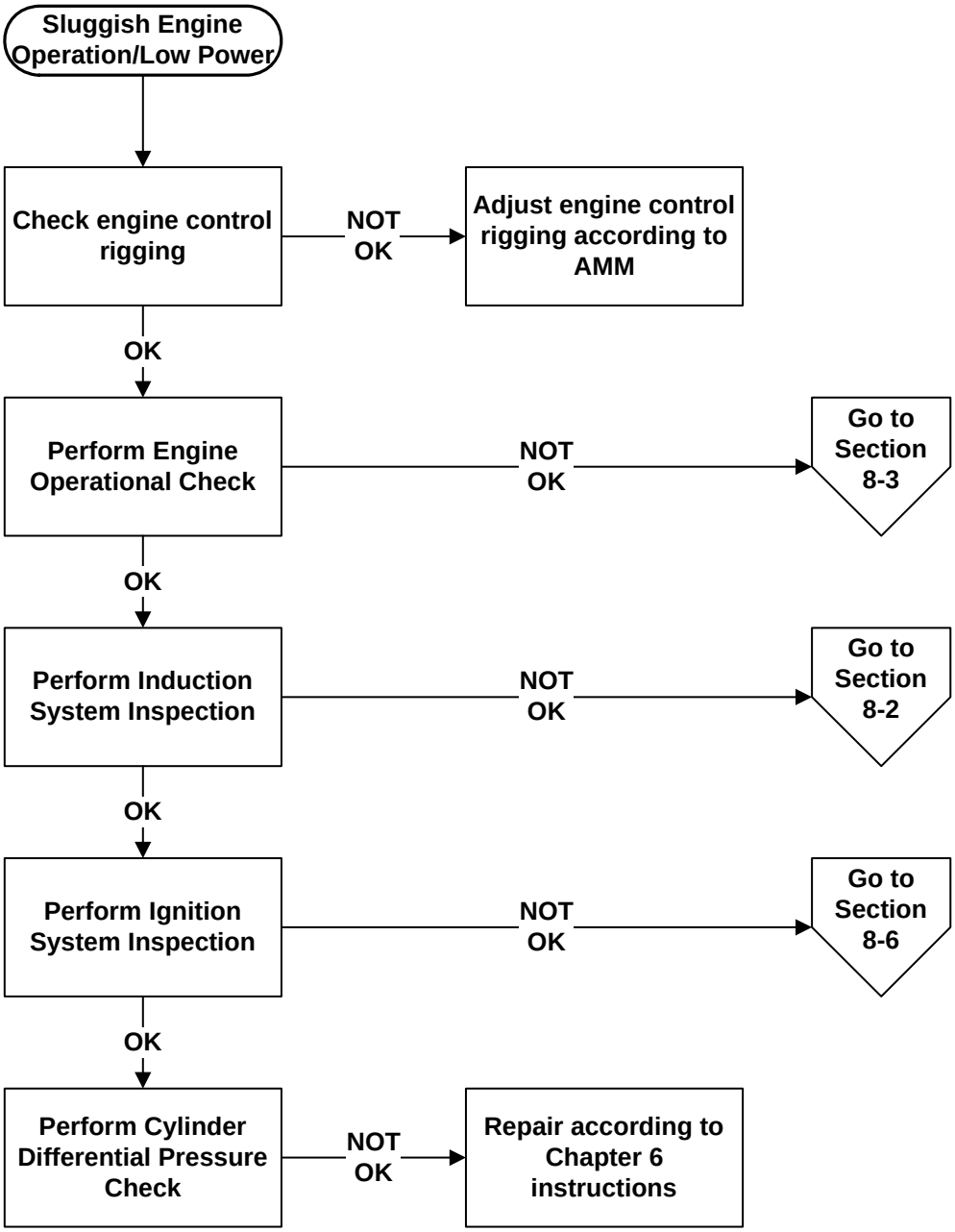


Figure 8-7. Sluggish Engine Operation/Low Power

8-2. Induction System

Low Manifold Pressure.....Go to Figure 8-10
Loss of Aircraft Critical Altitude.....Go to Figure 8-10

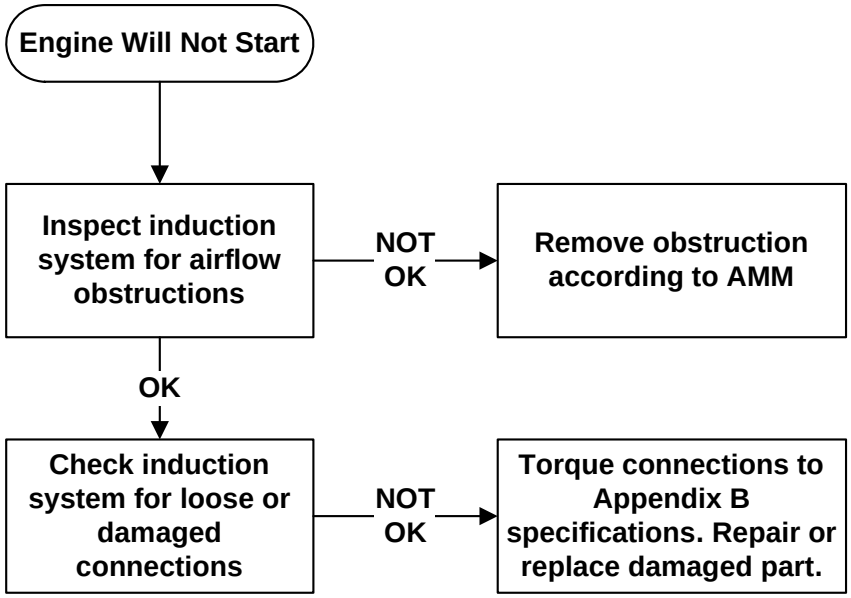


Figure 8-8. Induction - Engine Will Not Start

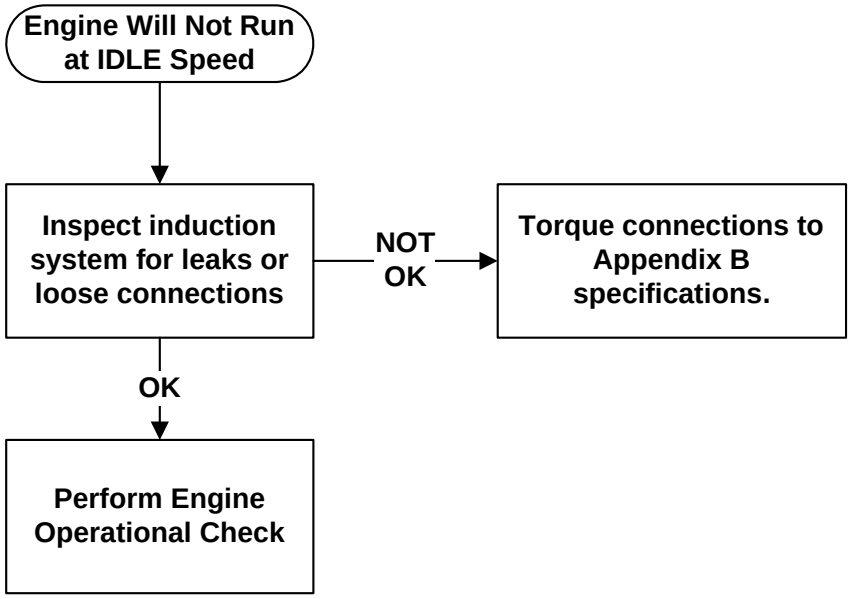


Figure 8-9. Induction - Engine Will Not Run at IDLE

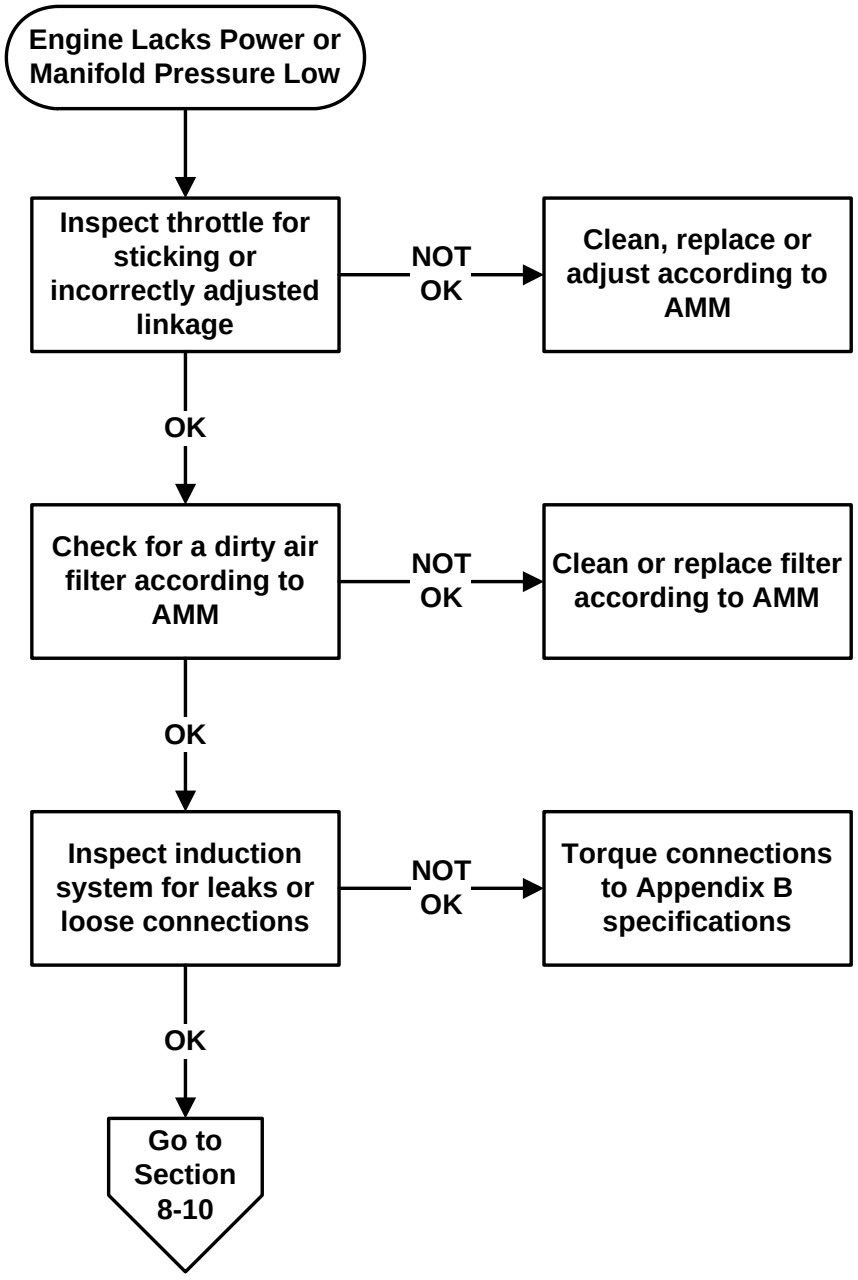


Figure 8-10. Induction - Engine Lacks Power/Manifold Pressure Low

8-3. Fuel Injection System

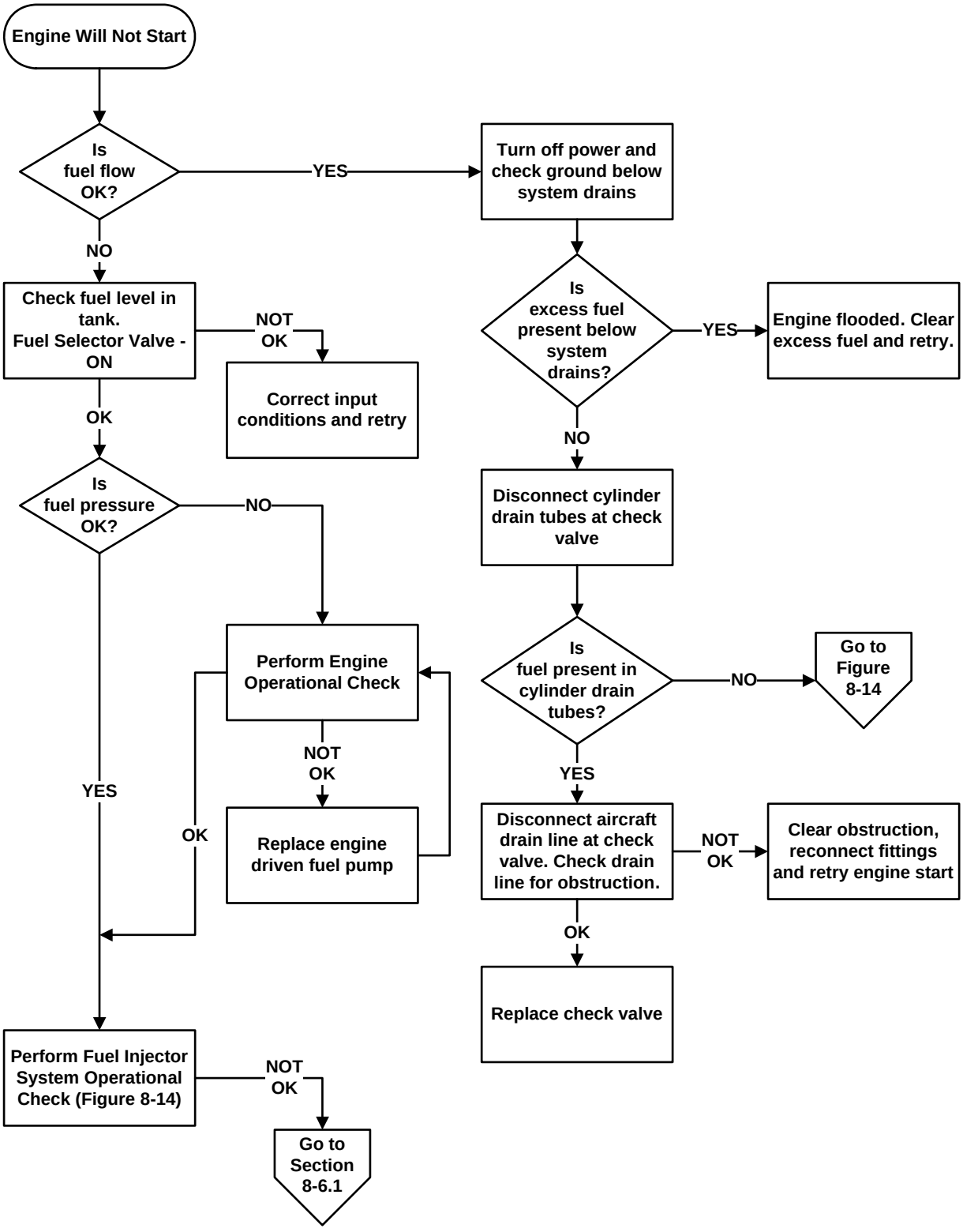


Figure 8-11. Fuel Injection - Engine Will Not Start

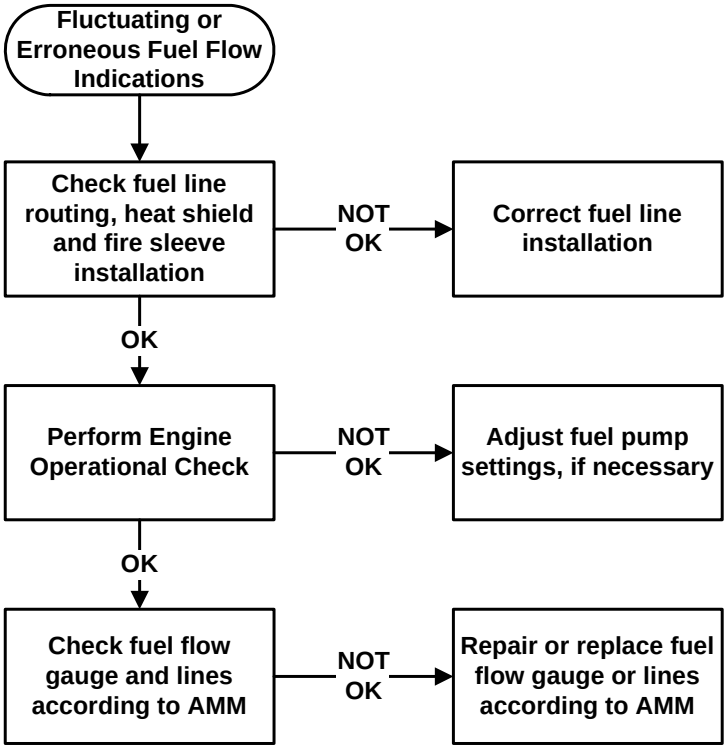


Figure 8-12. Fuel Injection - Fluctuating or Erroneous Fuel Flow

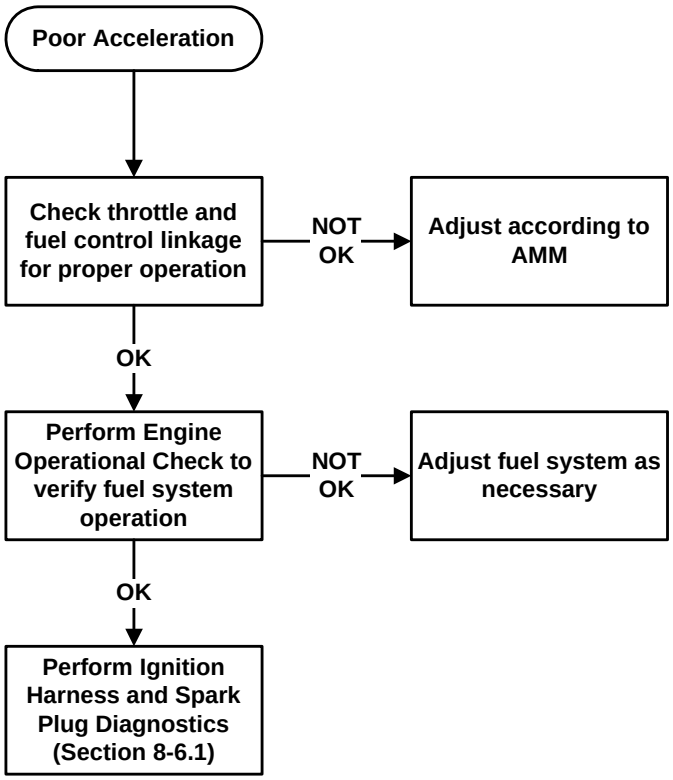


Figure 8-13. Fuel Injection - Poor Acceleration

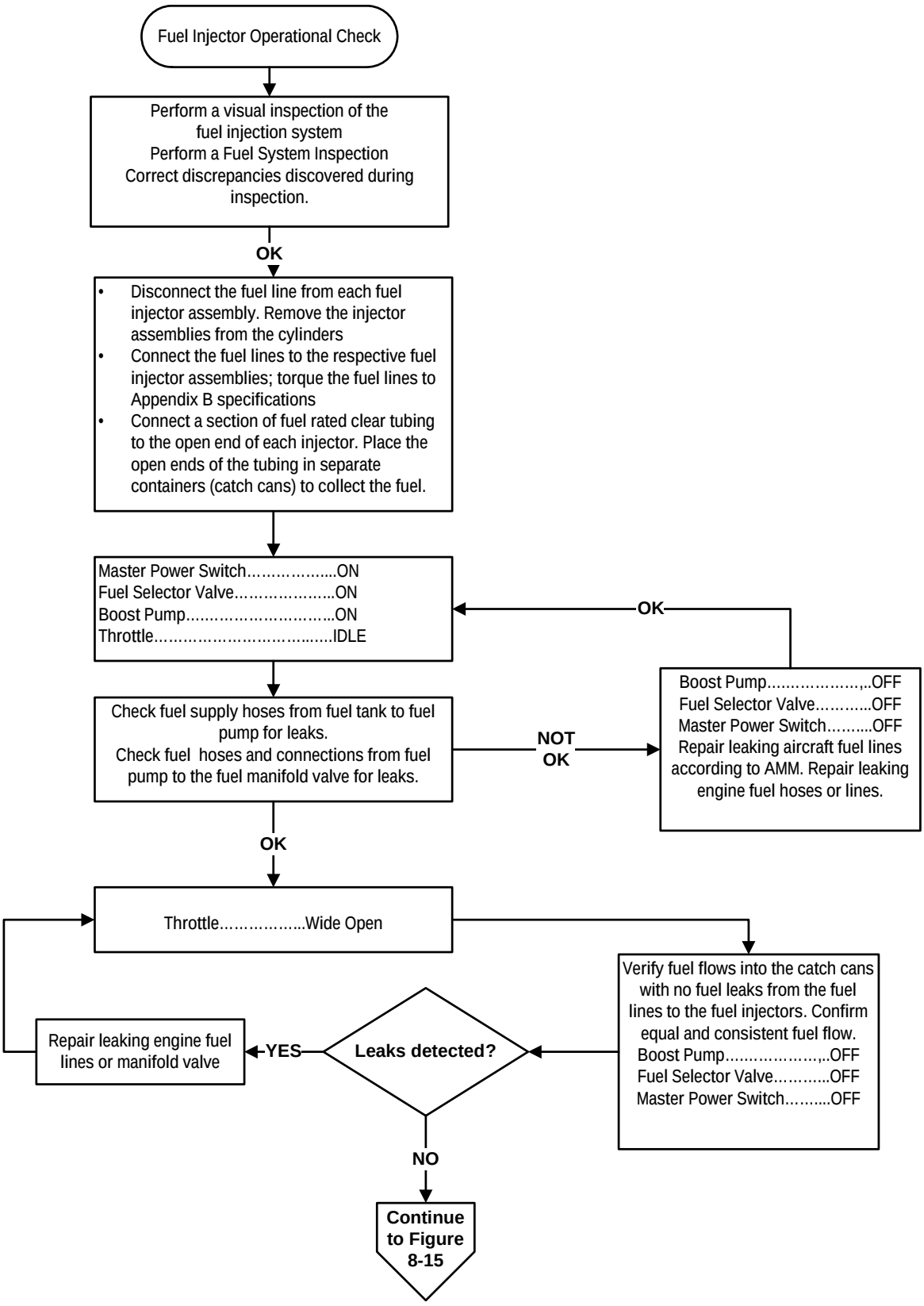


Figure 8-14. Fuel Injector Operational Check

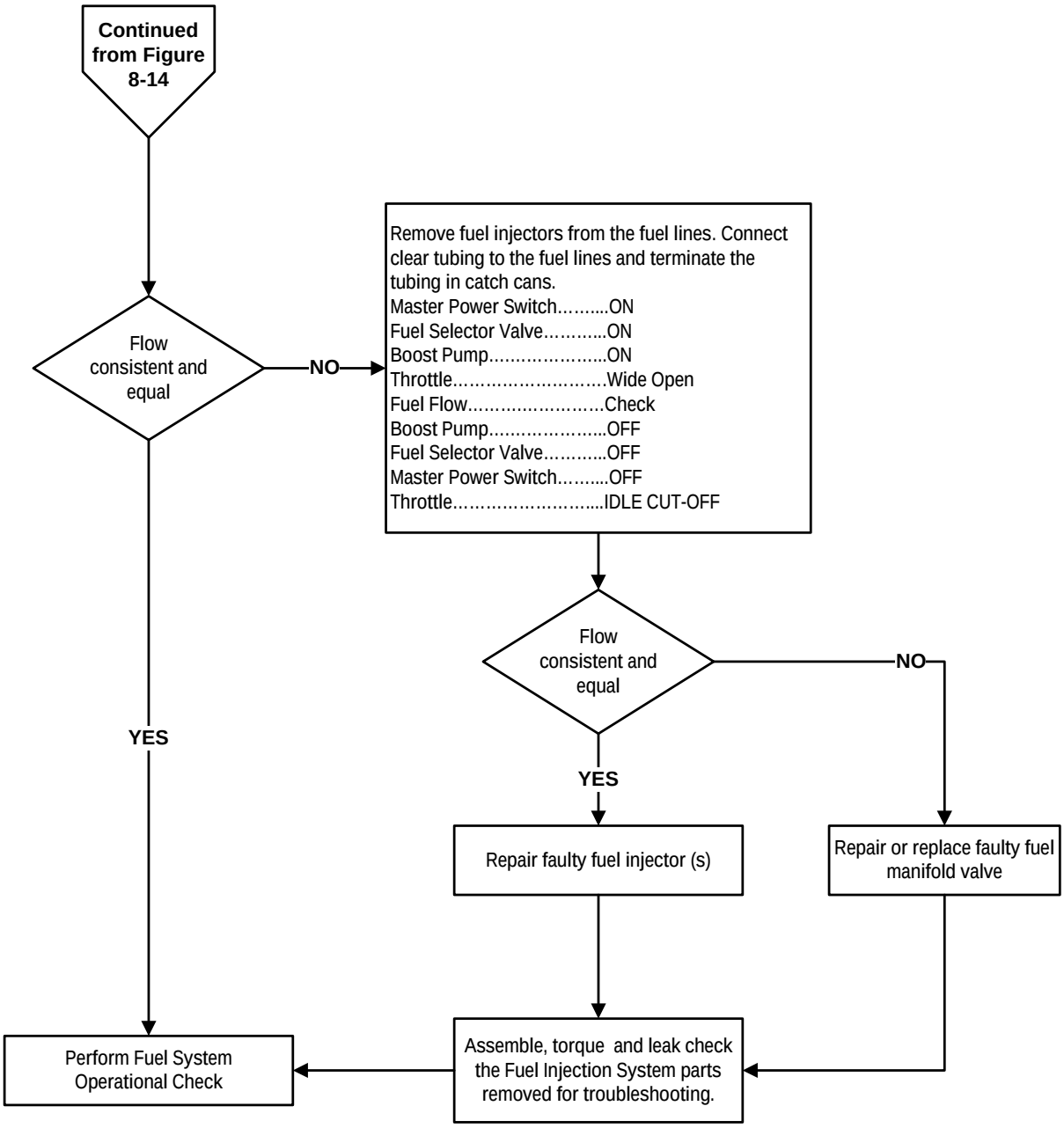


Figure 8-15. Fuel Injector Operational Check (continued)

8-4. Charging System

Refer to the aircraft and alternator manufacturer's applicable charging system troubleshooting instructions.

8-5. Starting System

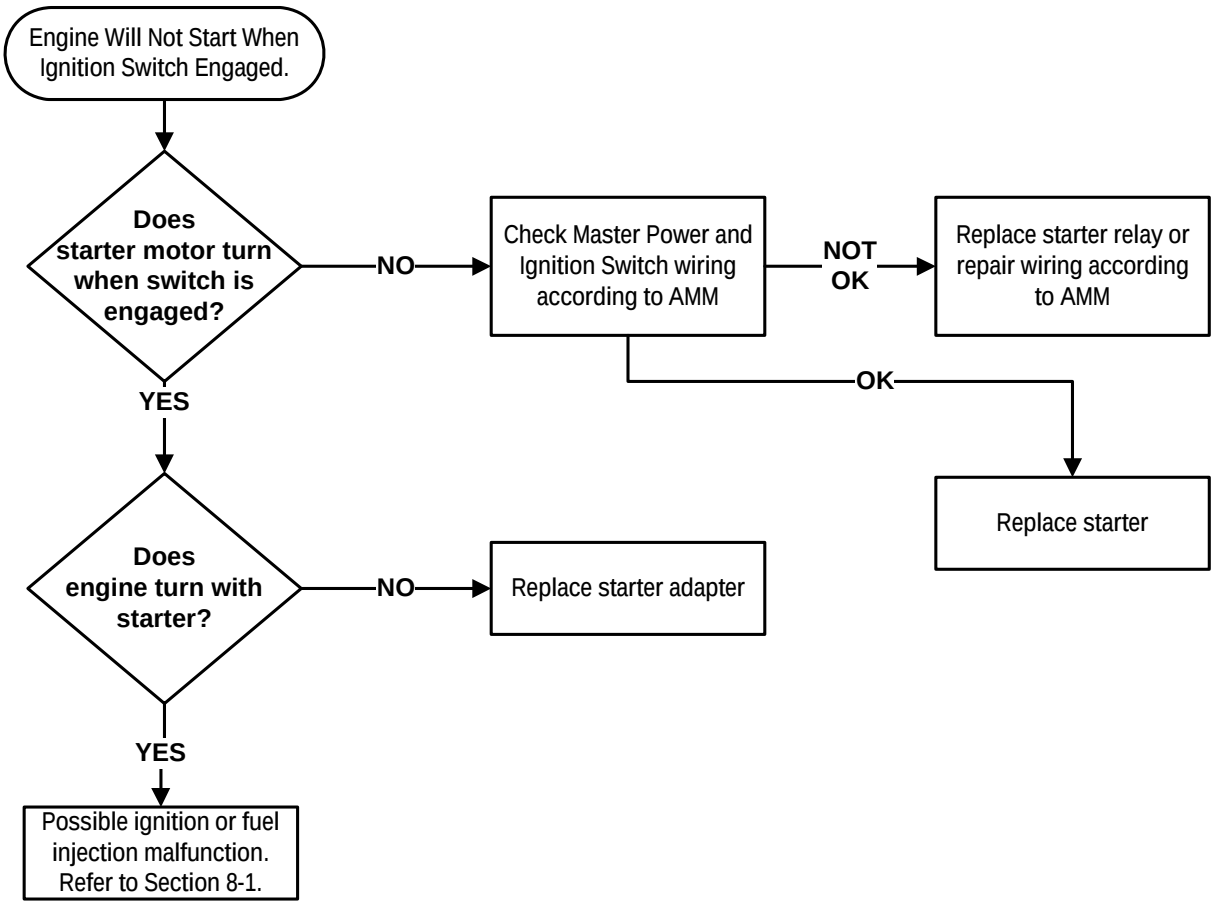


Figure 8-16. Engine Will Not Start When Ignition Switch Engaged (Except AF)

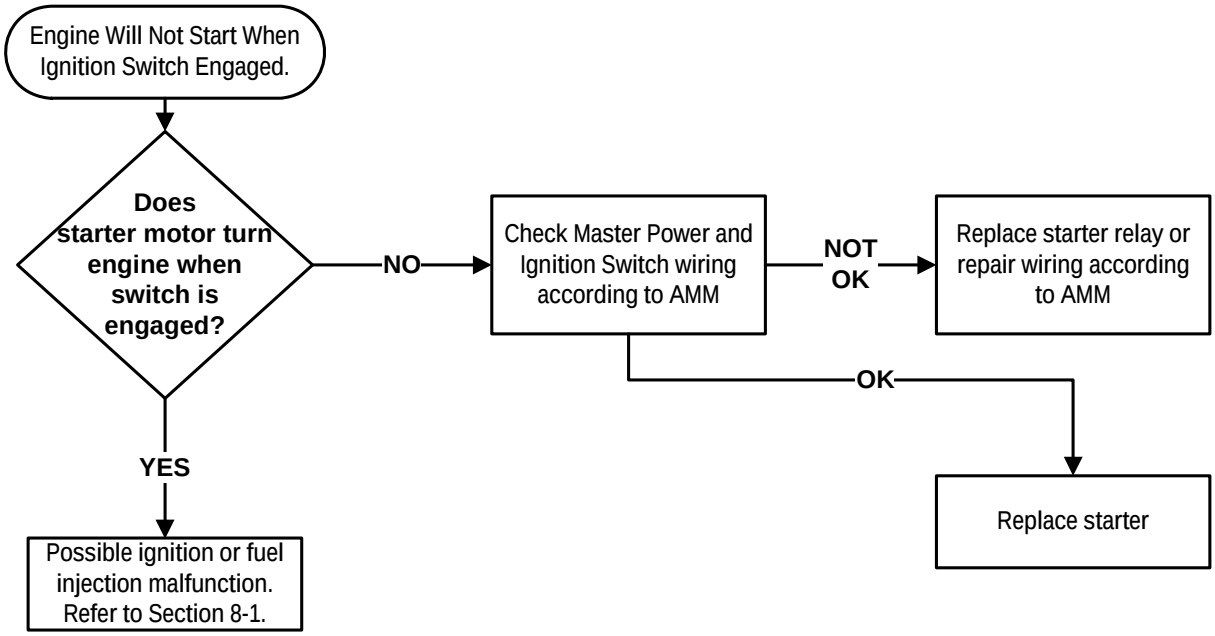


Figure 8-17. Engine Will Not Start When Ignition Switch Engaged (AF)

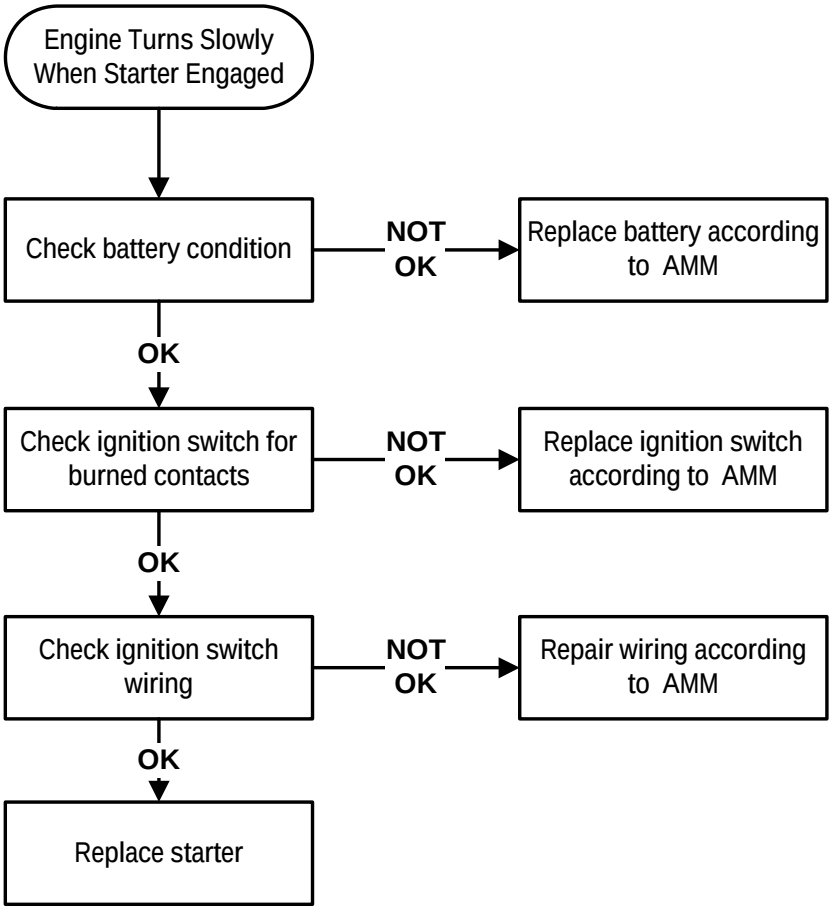


Figure 8-18. Engine Turns Slowly When Starter Engaged

8-6. Ignition System

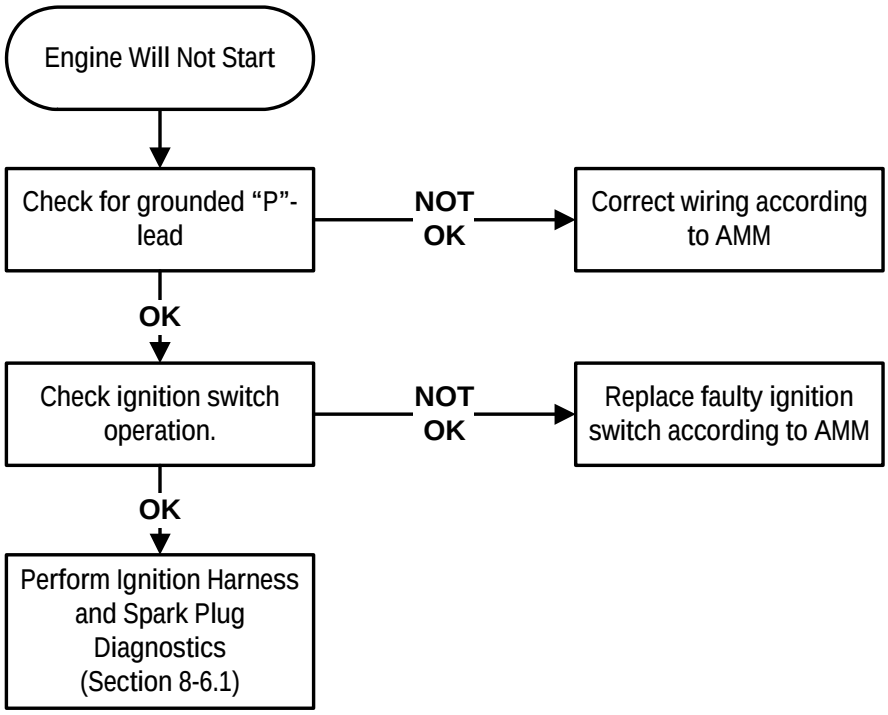


Figure 8-19. Ignition - Engine Will Not Start

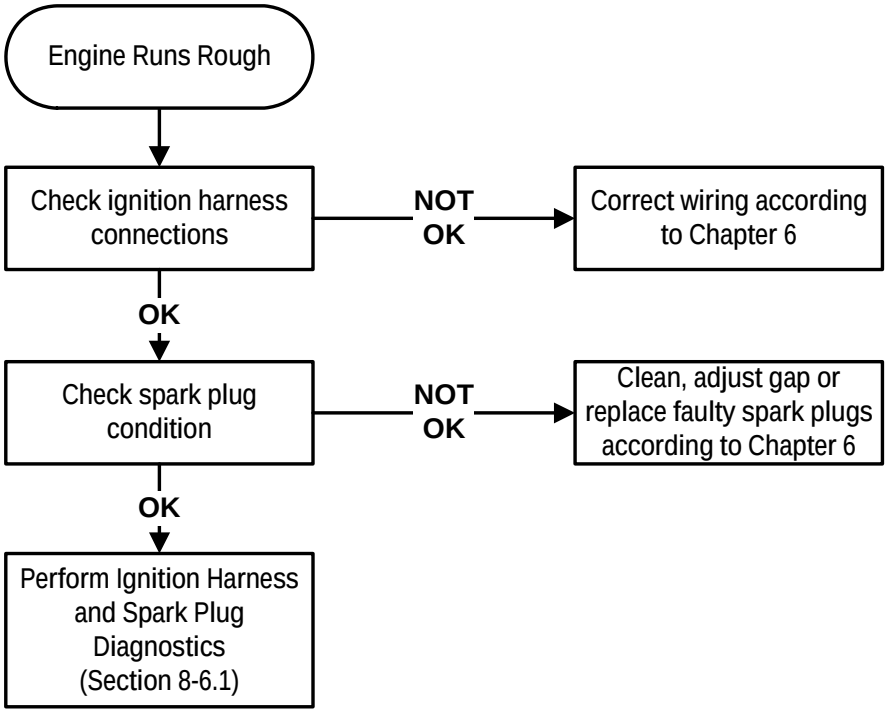


Figure 8-20. Ignition - Engine Runs Rough

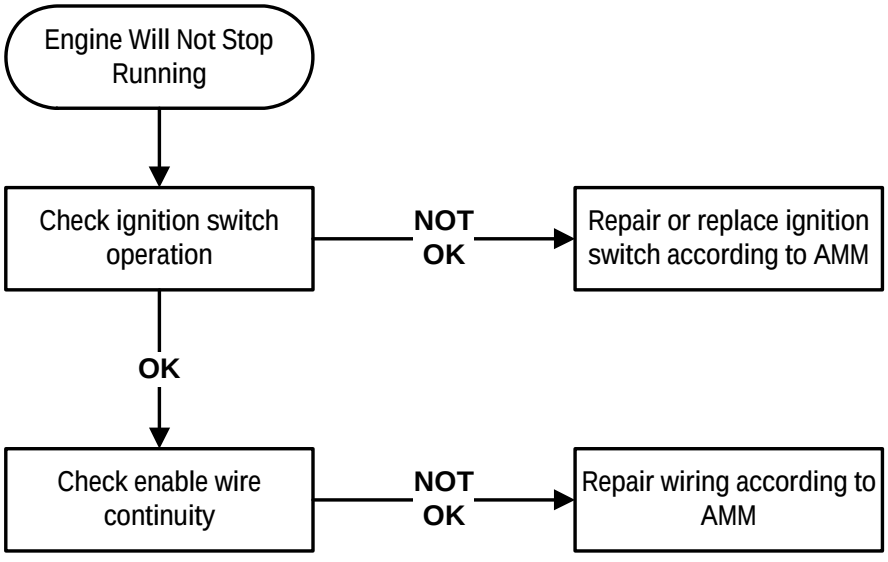


Figure 8-21. Engine Will Not Stop Running

8-6.1. Ignition Harness and Spark Plug Diagnostics

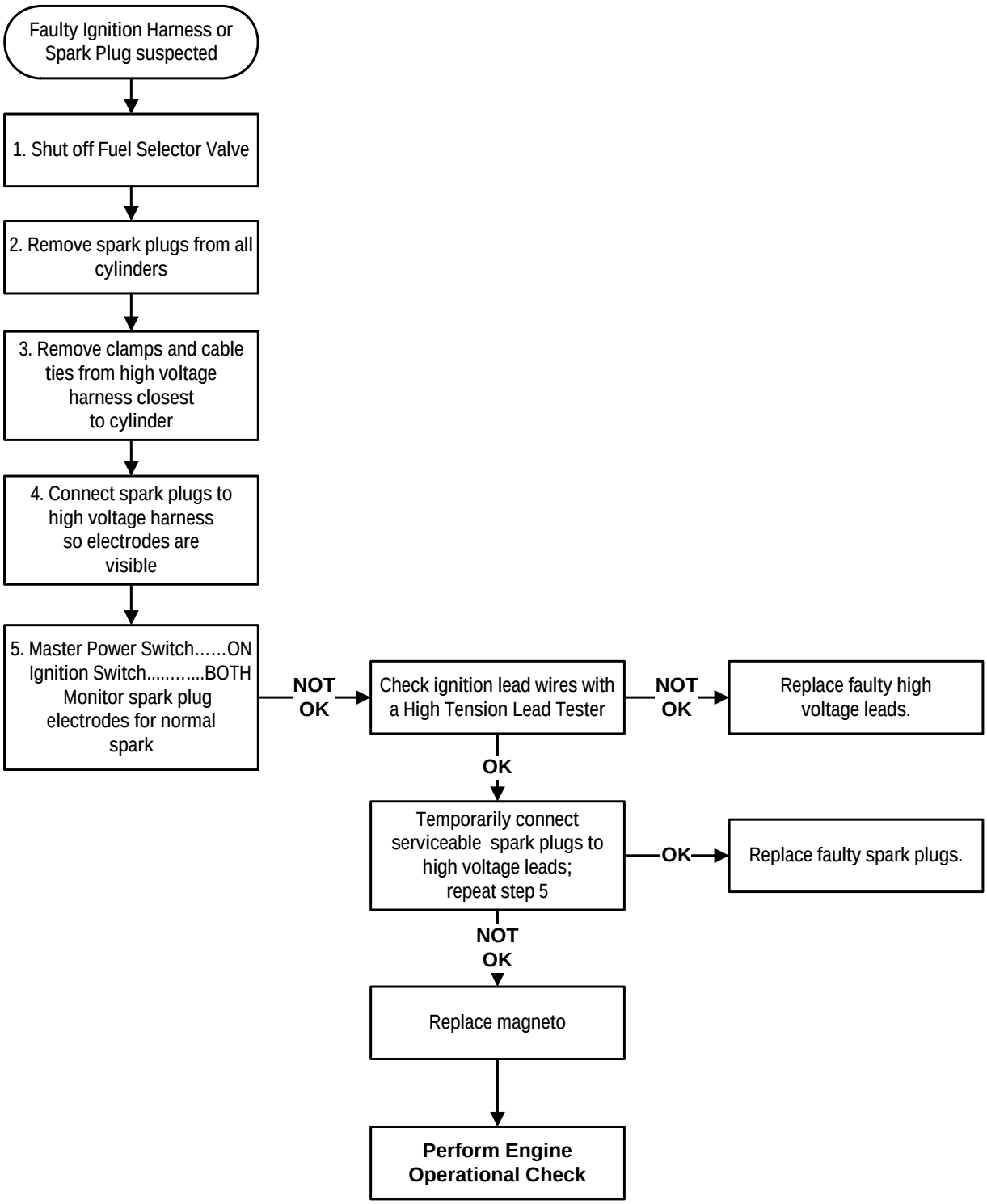


Figure 8-22. Faulty Ignition Harness or Spark Plug

8-7. Lubrication System

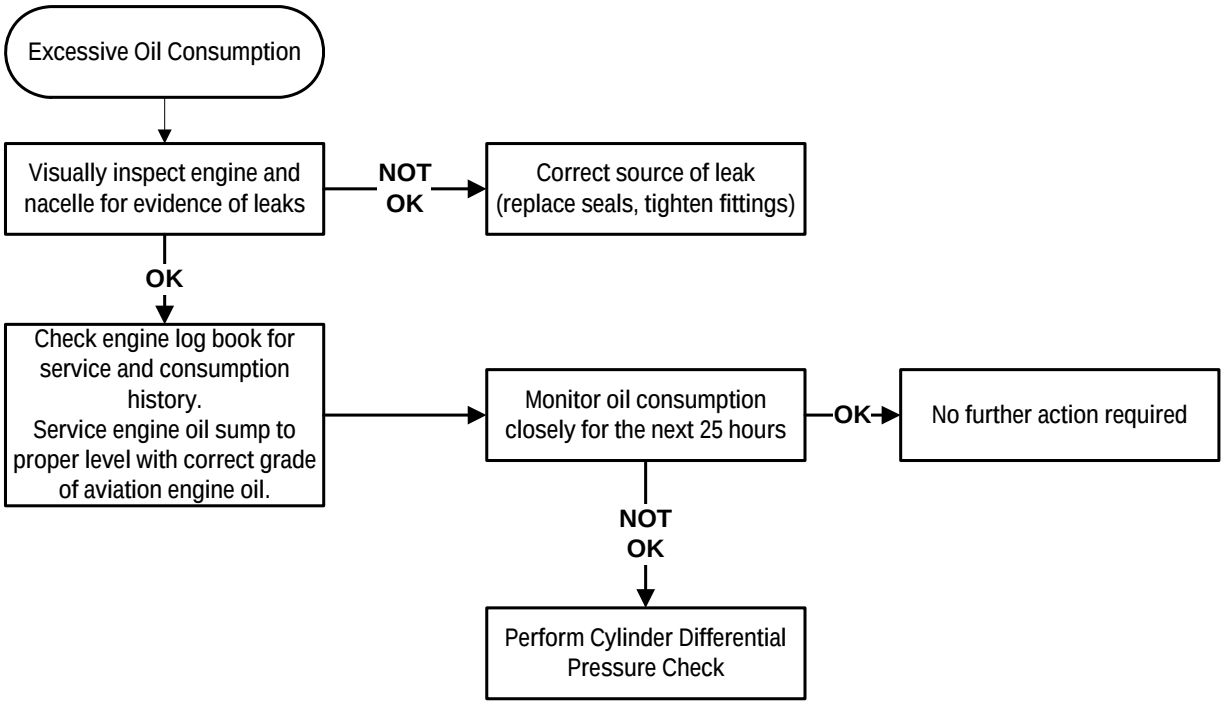


Figure 8-23. Excessive Oil Consumption

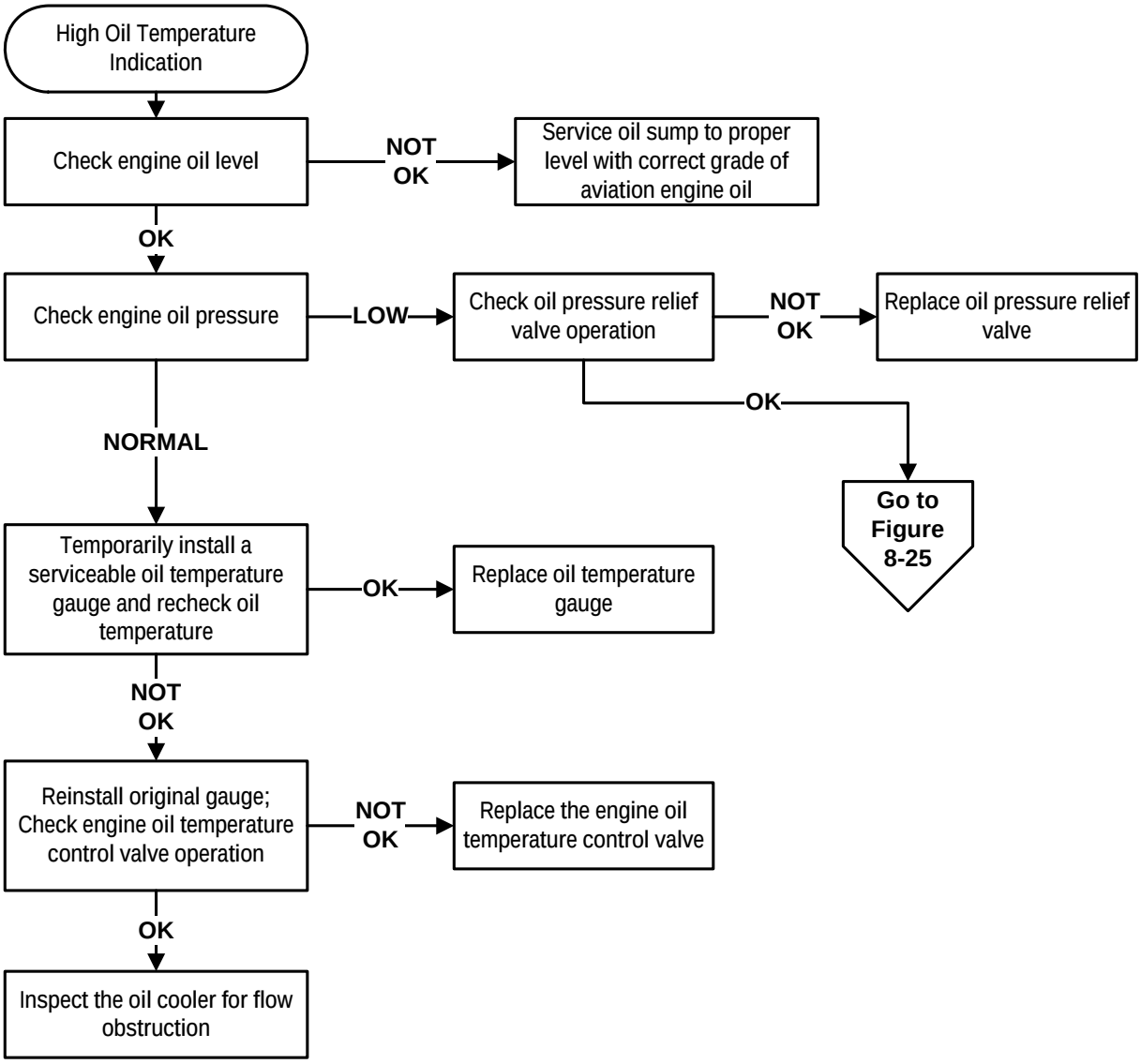


Figure 8-24. High Oil Temperature

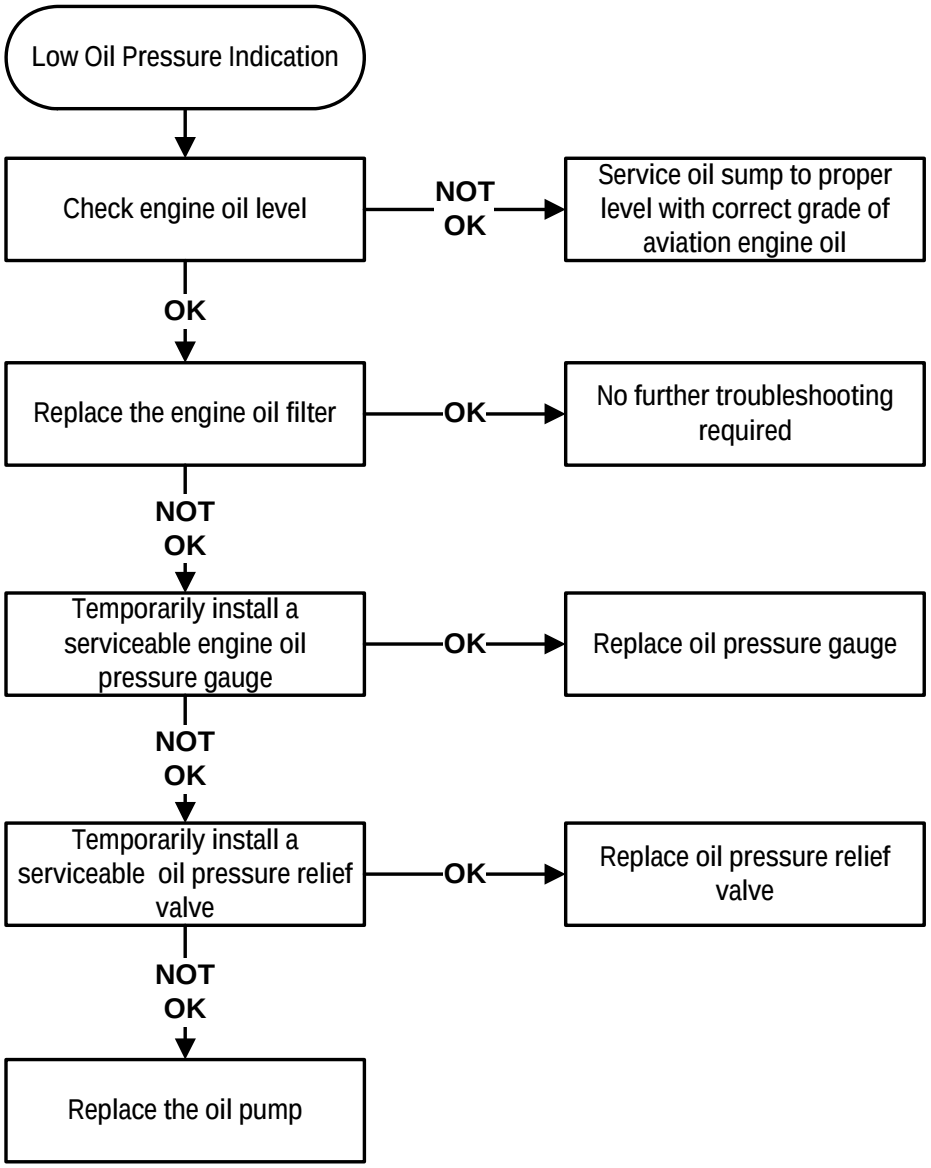


Figure 8-25. Low Oil Pressure

8-8. Engine Cylinders

Items in the figures are listed in sequence of approximate ease of checking, not in the order of probability.

In addition, refer to the following:

- Cylinder Visual Inspection in Chapter 6
- Cylinder Differential Pressure Test in Chapter 6
- Cylinder Borescope Inspection in Chapter 6
- Cylinder Repair vs. Replacement Guidelines in Chapter 15

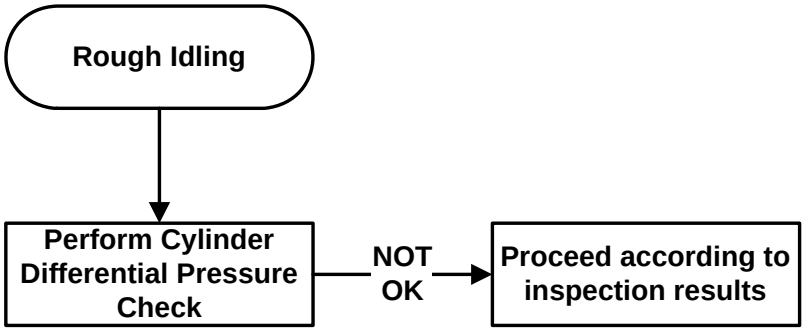


Figure 8-26. Rough Idling

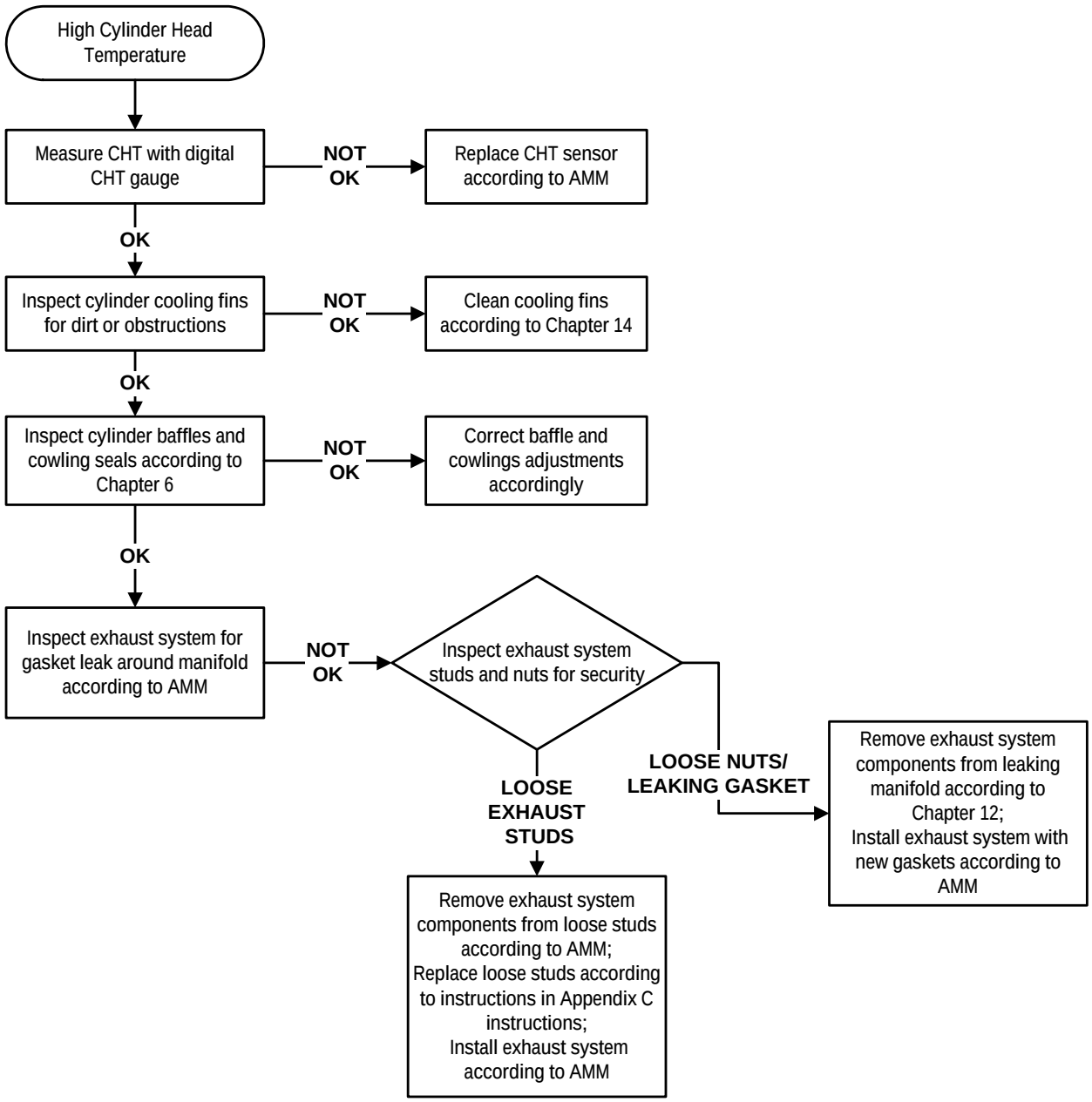


Figure 8-27. High Cylinder Head Temperature

8-9. Crankcase

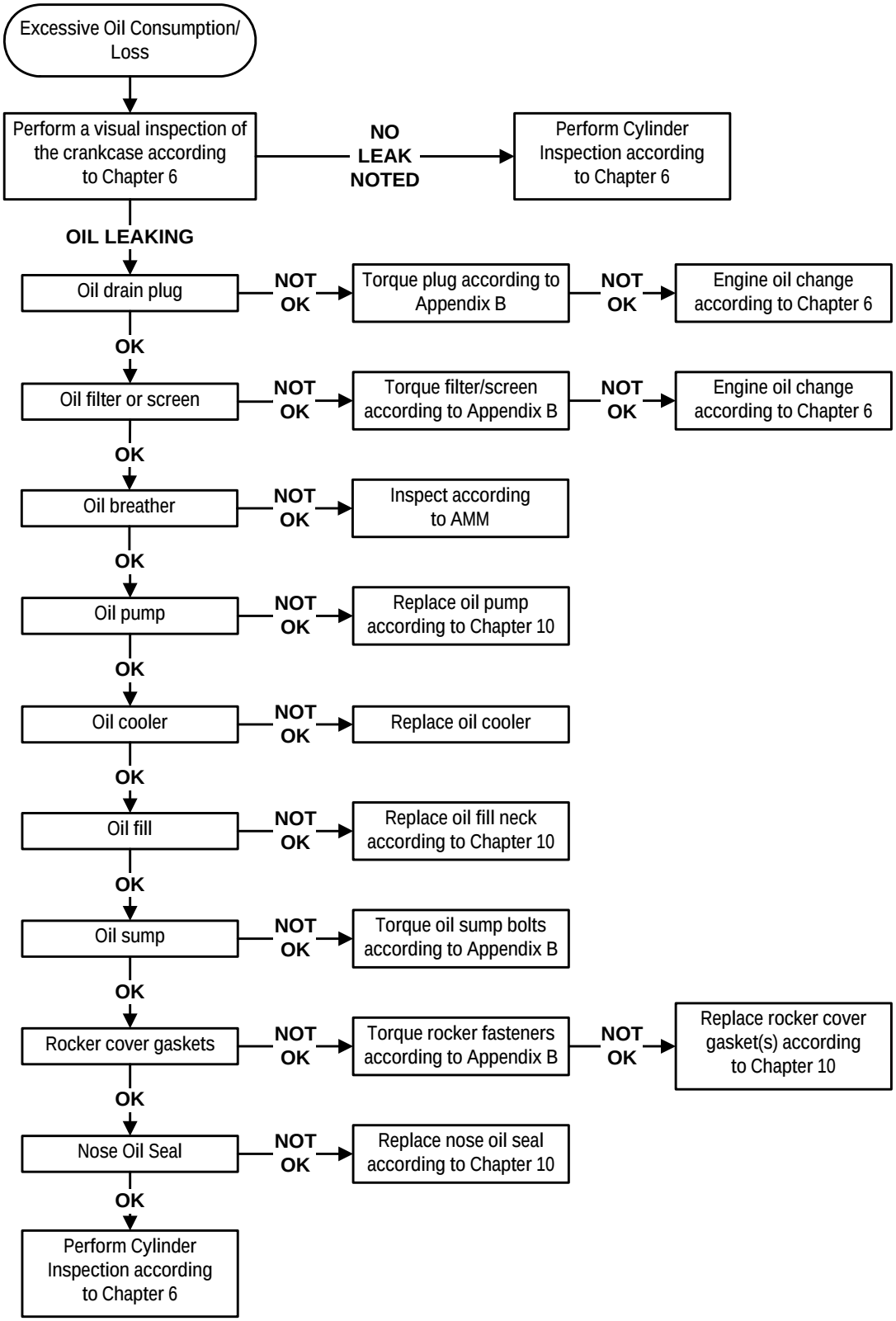


Figure 8-28. Excessive Oil Consumption/Loss

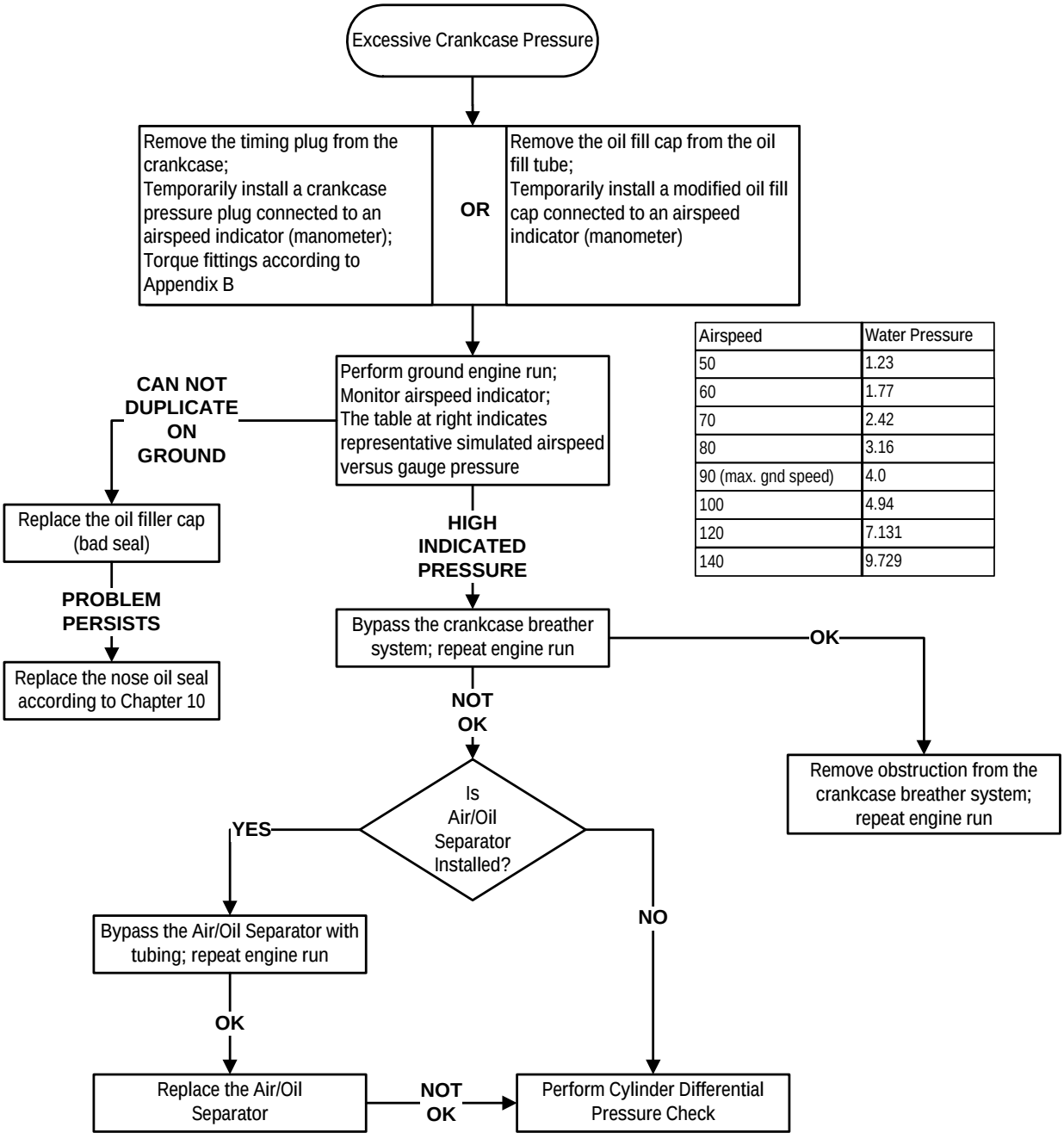


Figure 8-29. Excessive Crankcase Pressure

8-10. Exhaust System

Troubleshoot exhaust system malfunctions according to the aircraft manufacturer's instructions.

Chapter 9. Engine Preservation and Storage

9-1. Preserving and Storing an Engine

Refer to the “Preserving and Storing an Engine” instructions in Chapter 9-1 of M-0, Standard Practice Maintenance Manual.

9-1.1. Engine Preservation Checklist

Make a copy of the “Engine Preservation Checklist” on page 9-5 of M-0, Standard Practice Maintenance Manual, and record the serial number, date placed in storage and projected inspection dates for each engine placed in storage. The checklist covers a 90-day storage cycle. Complete a new checklist for each 90-day storage cycle and attach to the previous checklist to record inspections until the engine is returned to service.

9-1.2. New or Unused Engine Storage

Refer to the “New or Unused Engine Storage” instructions in Chapter 9-1.2 of M-0, Standard Practice Maintenance Manual.

9-1.3. Temporary Storage

Refer to the “Temporary Storage” instructions in Chapter 9-1.3 of M-0, Standard Practice Maintenance Manual.

9-1.4. Indefinite Storage

Refer to the “Indefinite Storage” instructions in Chapter 9-1.4 of M-0, Standard Practice Maintenance Manual.

9-1.5. Return an Engine to Service after Storage

Refer to the “Return an Engine to Service after Storage” instructions in Chapter 9-1.5 of M-0, Standard Practice Maintenance Manual.

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Chapter 10. Non-Overhaul Repair and Replacement

10-1. Parts Replacement

Procedures in this section apply to instances outside of overhaul when parts can be repaired or replaced as a maintenance practice; some parts cannot be repaired and must be replaced. Table 10-1, "Non-Overhaul Parts Replacement Reference" indicates items that can be replaced along with respective references for replacement instructions. Table 10-2, the "Parts Repair Reference" indicates the items that can be repaired along with corresponding references to the repair instructions. Unless otherwise indicated, instructions are in this chapter.

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

NOTE: When replacing components according to the maintenance procedures in this section, adhere to the *service limits,* in line with the procedure as a guide for part re-use for each component. Use the overhaul dimensional limits in Appendix D when performing maintenance repairs if service limits are not provided.

S*ervice limits* in this section apply only to maintenance procedures and in many cases are not identical to the tolerances in Appendix D.

Table 10-1. Non-Overhaul Parts Replacement Reference

Replaceable Item	Reference
Alternator	Section 10-5, “Alternator Replacement”
Camshaft Plugs	Section 13-6.1, “Camshaft Disassembly” Section 16-8.1, “Camshaft Assembly”
Crankcase And Cylinder Studs	Section 15-8.10.5, “Crankcase Cylinder Deck Stud Replacement”
Crankcase Helical Coils	Section 15-8.10.5, “Crankcase Cylinder Deck Stud Replacement”
Crankshaft Nose Oil Seal	Section 10-9, “Crankshaft Nose Oil Seal Replacement”
Engine Cylinder	Section 10-8, “Engine Cylinder Maintenance”
Fuel Injectors	Section 10-3, “Fuel Injector Replacement”
Fuel Manifold Valve	Section 12-3, “Fuel Injection System Removal” Section 17-10, “Fuel Injection System Installation”
Fuel Pump	Section 10-2, “Fuel Pump Replacement”
Hydraulic Lifters	Section 10-8.2, “Hydraulic Lifter Removal” and Section 10-8.7, “Hydraulic Lifter Installation”
Magneto	Section 10-6, “Magneto Replacement”
Oil Cooler	Section 10-7.4, “Oil Cooler Repair and Replacement”
Oil Filter	Section 6-3.8, “Engine Oil Servicing”
Oil Filter Adapter Stud	Section 10-7.1, “Oil Filter Adapter Stud Replacement”
Oil Pressure Relief Valve	Section 10-7.5, “Oil Pressure Relief Valve Repair and Replacement”
Oil Pump	Section 10-7.2, “Oil Pump Repair and Replacement”
Oil Sump and Oil Suction Tube	Section 10-7.3, “Oil Sump and Oil Suction Tube Repair and Replacement”
Oil Temperature Control Valve	Section 10-7.6, “Oil Temperature Control Valve Inspection and Replacement”
Starter Adapter	Section 10-4, “Starter Motor and Starter Adapter Replacement”
Starter Motor	Section 10-4, “Starter Motor and Starter Adapter Replacement”
Starter Needle Bearing	Section 10-4, “Starter Motor and Starter Adapter Replacement” Section 13-3.1, “Starter Adapter Disassembly” Section 13-3.2, “Starter Adapter with Accessory Drive Adapter Disassembly” Section 13-5.3, “Crankcase Studding Disassembly” Section 15-8.4.1, “Starter Adapter Housing Worm Shaft Needle Bearing Replacement”
Throttle Body	Section 12-3, “Fuel Injection System Removal” Section 17-10, “Fuel Injection System Installation”

Table 10-2. Parts Repair Reference

Repairable Item	Reference
Engine Cylinder	Section 10-8, “Engine Cylinder Maintenance”
Crankcase Cracks	Section 15-8.10, “Crankcase Overhaul Repair”
Oil Pump	Section 10-7.2, “Oil Pump Repair and Replacement”
Oil Sump and Oil Suction Tube	Section 10-7.3, “Oil Sump and Oil Suction Tube Repair and Replacement”
Oil Cooler	Section 10-7.4, “Oil Cooler Repair and Replacement”
Oil Pressure Relief Valve	Section 10-7.5, “Oil Pressure Relief Valve Repair and Replacement”
Starter Motor	Section 10-4, “Starter Motor and Starter Adapter Replacement”

Table 10-3. Parts Handling Guidelines

Parts/Components	Handling Instructions
Wrapped new or rebuilt parts	Parts that require protection from atmospheric dust and moisture should be wrapped or boxed after acceptance inspection and remain wrapped until time of installation
Spark plugs	Handle spark plugs with clean, dry hands. Avoid dropping a spark plug. If a spark plug is either dropped or damaged, discard it. Do not install any spark plug that has been dropped or damaged.

10-2. Fuel Pump Replacement

New and rebuilt fuel pumps are available for IO-360 series engines. Continental Motors fuel pumps may be repaired by FAA Part 145 Authorized Repair Stations. Continental Motors does not control Repair Station certification; verify the Repair Station possesses the proper certification before contracting repairs.

10-2.1. Fuel Pump Removal

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.

   NOTE: Mark or tag hose connections as they are removed to eliminate confusion during installation.

2. Disconnect the hoses from the fuel pump inlet fitting (Figure 10-1)(A), fuel pump outlet fitting (B), fuel pump vapor return fitting (C), fuel pump drain fitting (D) and fuel pump aneroid pressure reference fitting (E)(D 34, DB 34 and ES models only). Place protective caps on the fuel pump fittings and insert protective plugs in the open fuel hoses.

3. Remove the nuts (Figure 10-2)(6), lock washers (5), and washers (4), from the base of the fuel pump (3). Remove the fuel pump (3) from the crankcase. Remove and discard the gasket (2).

4. Remove the fuel pump drive shaft (Figure 10-3)(6) from the governor gear. Inspect the drive shaft for evidence of excessive wear or damage. Inspect the fuel pump drive shaft according to the dimensional limits in Table 10-4.

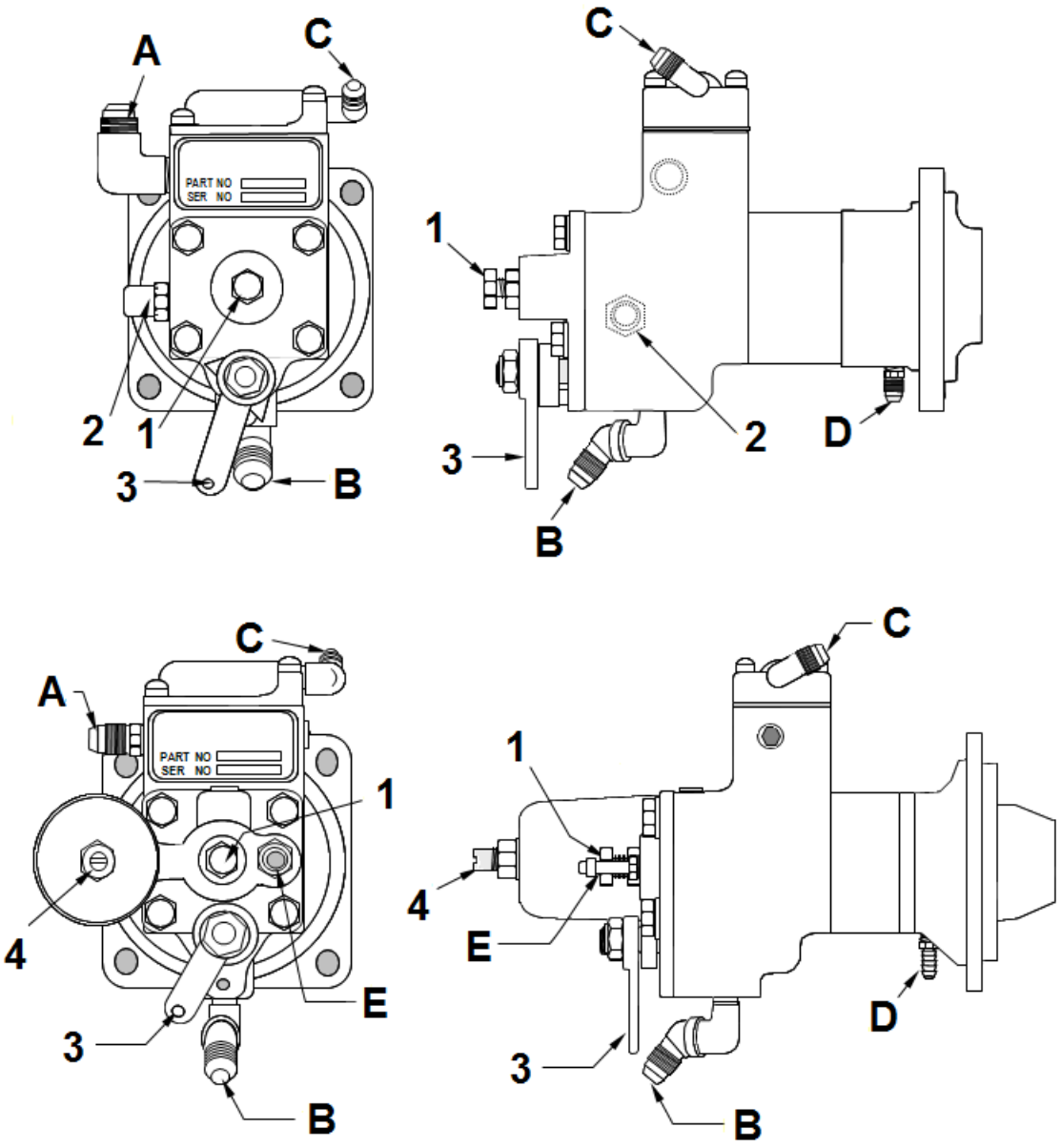


Figure 10-1. IO-360 Fuel Pump Adjustments & Fittings

Fittings	
A	Fuel Inlet
B	Fuel Outlet (Unmetered Pressure)
C	Vapor Return
D	Drain
E	Aneroid Pressure Reference

Adjustments	
1	Low Pressure Relief Valve CW = INCREASE
2	Adjustable Orifice CW = INCREASE
3	Mixture Control CCW = INCREASE
4	Aneroid Adjustment CCW = INCREASE

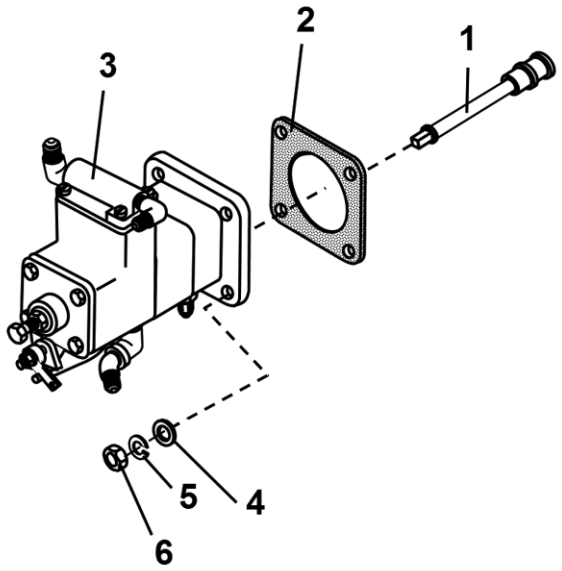


Figure 10-2. Fuel Pump Assembly

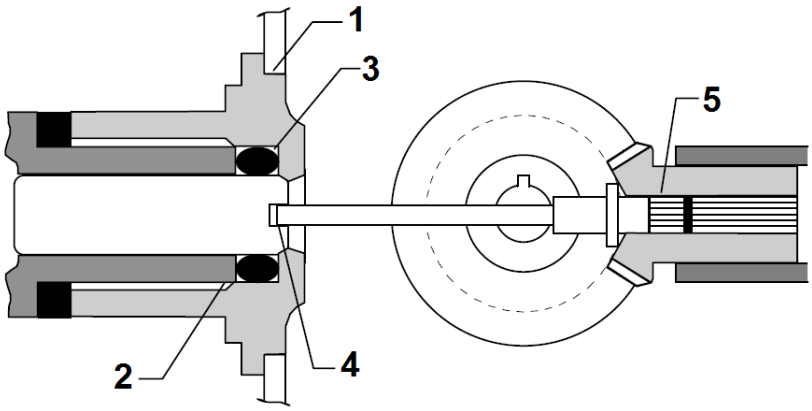


Figure 10-3. Fuel Pump Dimension Limits

Table 10-4. Fuel Pump Service Limits

Index	Description	Serviceable Limits	New Part Dimensions (inches)	
			Minimum	Maximum
1	Fuel pump adapter pilot in crankcase.....diametric clearance	---	0.001L	0.006L
2	Fuel pump body pilot in adapter.....diametric clearance	---	0.0002L	0.0045L
3	Oil seal in adapter.....diametric clearance	---	0.003T	0.009T
4	Fuel pump drive shaft in impeller shaft.....total clearance	0.011L	0.002L	0.008L
5	Fuel pump drive shaft in governor gear.....tooth clearance	0.0055	0.0015	0.0039
T = Tight L = Loose				

10-2.2. Fuel Pump Installation

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.
2. Remove aircraft cowling, as required, to access the fuel pump.
3. Install the new gasket (Figure 10-2)(2) on the studs of the crankcase fuel pump bore.
4. Apply Molyshield Grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the fuel pump drive shaft (1).
5. Install the fuel pump drive shaft (1) in the fuel pump (3).
6. Lubricate the fuel pump cavity with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
7. Install the fuel pump on the crankcase with washers (4), new lock washers (5) and nuts (6). Torque the nuts to Appendix B.
8. Connect the appropriate hoses to the fuel pump inlet (Figure 10-1)(A), fuel pump outlet (B), fuel vapor return (C), fuel pump drain (D) and fuel pump aneroid pressure reference (E)(D 34, DB 34 and ES models only) according to "Hose and Tubing Installation" instructions in Appendix C-11. Torque the hoses to Appendix B specifications.
9. Perform a static leak check of the fuel system
   a. Position the Ignition Switch to OFF.
   b. Turn on the fuel supply and boost pump according to the AFM/POH.
   c. Position the throttle to WIDE OPEN.
   d. Position the mixture control to FULL RICH.
   e. Check the fuel lines for leaks and correct any leaks if detected.
   f. Turn the boost pump and fuel supply OFF.
   g. Position the throttle to CLOSED.
   h. Position the mixture control to IDLE CUT-OFF.
   i. Install any aircraft components removed to facilitate repairs.
   j. Allow excess fuel to drain from the cylinder/induction system drains.
10. Perform an "Engine Operational Check" according to Section 6-3.7 instructions.

10-3. Fuel Injector Replacement

Refer to the "Fuel Injector Replacement" instructions in Chapter 10-2 of M-0, Standard Practice Maintenance Manual.

10-3.1. Nozzle Identification

Refer to the "Nozzle Identification" instructions in Chapter 10-2.1 of M-0, Standard Practice Maintenance Manual.

10-3.2. Fuel Injector Removal

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.
2. Turn the aircraft fuel supply to the OFF position.
3. Loosen and remove the fuel line "B" nuts.
4. Remove fuel injector nozzles with an Ideal Aviation P/N 8168-IA Injector Nozzle Removal/Insertion Tool (Chapter 2-1 of M-0, Standard Practice Maintenance Manual).
5. Place protective caps or plugs over the open fuel connections.
6. Record the nozzle identification and cylinder position for re-installation or replacement.

10-3.3. Fuel Injector Installation

CAUTION: Ensure nozzle position numbers are matched to the appropriate cylinder. Installing incorrect nozzles or nozzles in the improper position will adversely affect engine performance.

1. Verify the cylinder position number (Refer to Section 10-3.1) engraved on the nozzle wrench flat matches the intended cylinder. If the nozzle is a replacement, the cylinder position number and nozzle flow must be a suitable for the intended cylinder position.
2. Apply a small amount of anti-seize lubricant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the nozzle according to Figure 10-4.
3. Install and hand tighten the nozzle in the cylinder head; torque the nozzle to Appendix B specifications with a Ideal Aviation P/N 8168-IA Injector Nozzle Removal/Insertion Tool (Chapter 2-1 of M-0, Standard Practice Maintenance Manual).

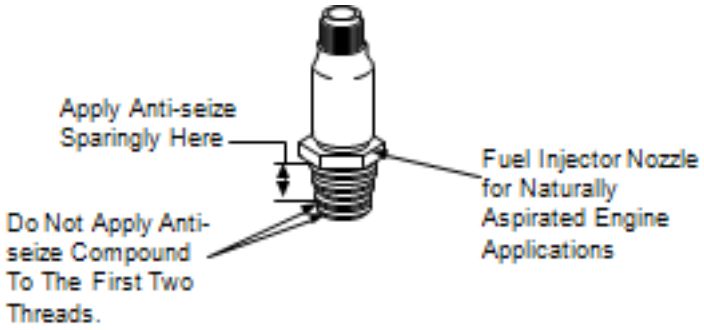


Figure 10-4. Apply Anti-Seize To Fuel Injector Nozzle

4. Connect the fuel lines to the fuel injectors at each cylinder and torque the "B" nuts to Appendix B specifications.
5. Perform an "Engine Operational Check" according to the instructions in Section 6-3.7.

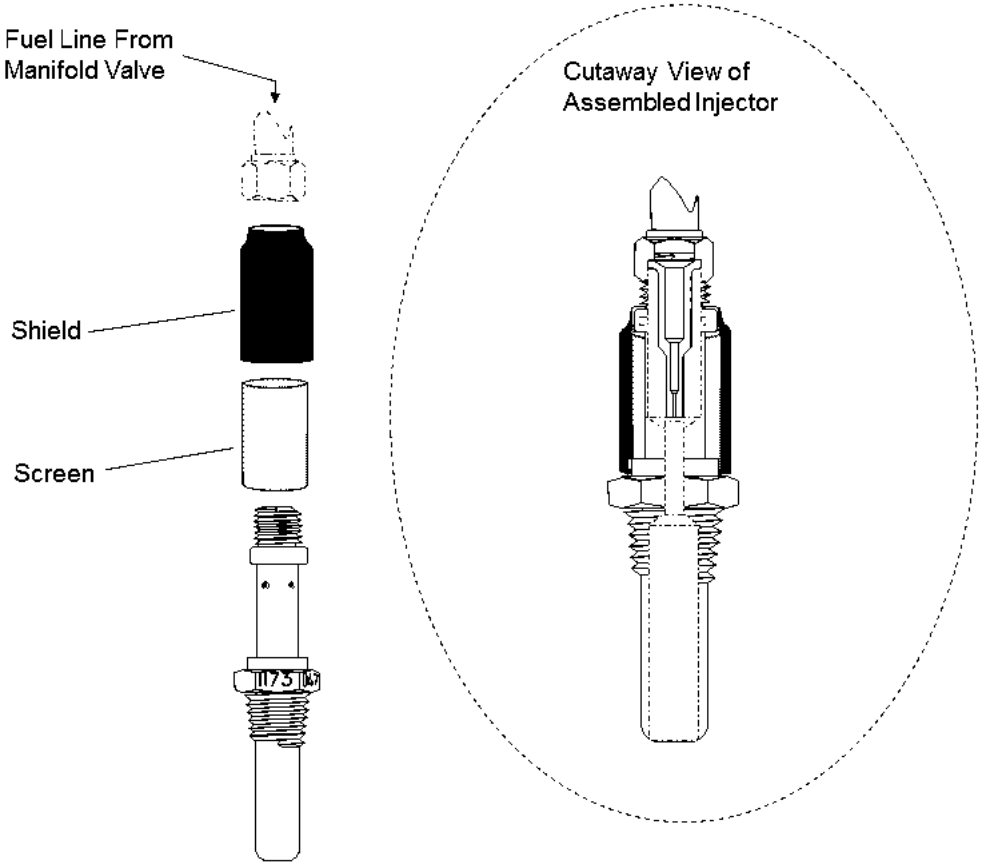


Figure 10-5. Fuel Injector Assembly

10-4. Starter Motor and Starter Adapter Replacement

Repair or replace the starter motor if it will not turn the starter adapter or engine (AF). Repair the Energizer starter motor according to the Continental Motors Starter Service Manual (X30592). No field repair is authorized for the SkyTec starters; replacement is the only remedy for a SkyTec starter motor failure.

Replace the starter adapter if the starter motor turns but the starter adapter does not engage the engine or the starter adapter is malfunctioning.

10-4.1. Starter Motor Removal

10-4.1.1. Starter Motor Removal (Except AF)

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.
2. Disconnect the aircraft battery and electrical cable from the starter motor in accordance with the aircraft maintenance manual.
3. Remove the two nuts (Figure 10-6 or Figure 10-7)(3) and two washers (4) from the starter motor mounting studs.
4. Carefully remove the starter motor (2) without damaging the mounting stud threads.
5. Remove and discard the o-ring (5).
6. Inspect the starter using the service limits in Section 10-4.4. Repair or replace parts which fail to meet the dimensional inspection criteria according to instructions in the Starter Service Manual (X30592).

10-4.1.2. Starter Motor Removal (AF)

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.
2. Disconnect the aircraft battery and electrical cable from the starter motor in accordance with the aircraft maintenance manual
3. Remove screws (Figure 10-8)(10 and 13), lock washers (12) and washers (11) from the starter motor (3). Discard the lock washers.

4. Remove nuts (9), lock washers (5), washers (8) and lifting eye (7) from bolts (4). Discard the lock washers.
5. Remove the starter motor (3).
6. Remove and discard the gasket (2).
7. Remove bolts (4), lock washers (5), washers (8) and spacers (6) from accessory case (1) and crankcase. Discard the lock washers.
8. Clean the gasket (2) residue from the accessory case mating surface.
9. Inspect the starter according to Section 15-3. Replace starter motor which fails to meet the inspection criteria.

10-4.2. Starter Adapter Removal

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.
2. Remove the starter motor according to the “Starter Motor Removal” instructions in Section 10-4.1.
3. If necessary, remove any accessories installed on starter adapter assembly (Figure 10-6)(1) according to the aircraft maintenance manual.

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

4. Cut and remove safety wire from bolts (9 and 10).
5. Remove four bolts (8, 9 and 10), four lock washers (7), five washers, (6), and one nut (12); discard the lock washers.
6. Remove the starter adapter assembly (1) from the accessory case.
7. Remove and discard the starter adapter gasket (11). Clean the gasket residue from the accessory case mating surface.
8. Inspect the starter and starter adapter parts using the service limits in Section 10-4.4. Ensure the appropriate plugs or fittings are installed in the accessory drive adapter prior to re-installation. Repair or replace parts which fail to meet the dimensional inspection criteria according to instructions in the Starter Service Manual (X30592).

10-4.3. Starter Adapter with Accessory Drive Adapter Removal

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.
2. Remove the starter motor according to the "Starter Motor Removal" instructions in Section 10-4.1.
3. If necessary, remove any accessories installed on accessory drive adapter (Figure 10-7)(13) according to the aircraft maintenance manual.
4. If no accessories were removed, remove four nuts (16), four lock washers (15), four washers (14), accessory cover (17) and gasket from both sides of accessory drive adapter (13) to facilitate removing the two bolts (10).

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

5. Cut and remove safety wire from bolts (9 and 10).
6. Remove four bolts (8, 9 and 10), four lock washers (7), five washers, (6), and one nut (12). Discard the lock washers.
7. Remove the starter adapter assembly (1) from the accessory case.
8. Remove and discard the starter adapter gasket (11). Clean the gasket residue from the accessory case mating surface.
9. Inspect the starter and starter adapter parts using the service limits in Section 10-4.4. Ensure the appropriate plugs or fittings are installed in the accessory drive adapter prior to re-installation. Repair or replace parts which fail to meet the dimensional inspection criteria according to instructions in the Starter Service Manual (X30592).

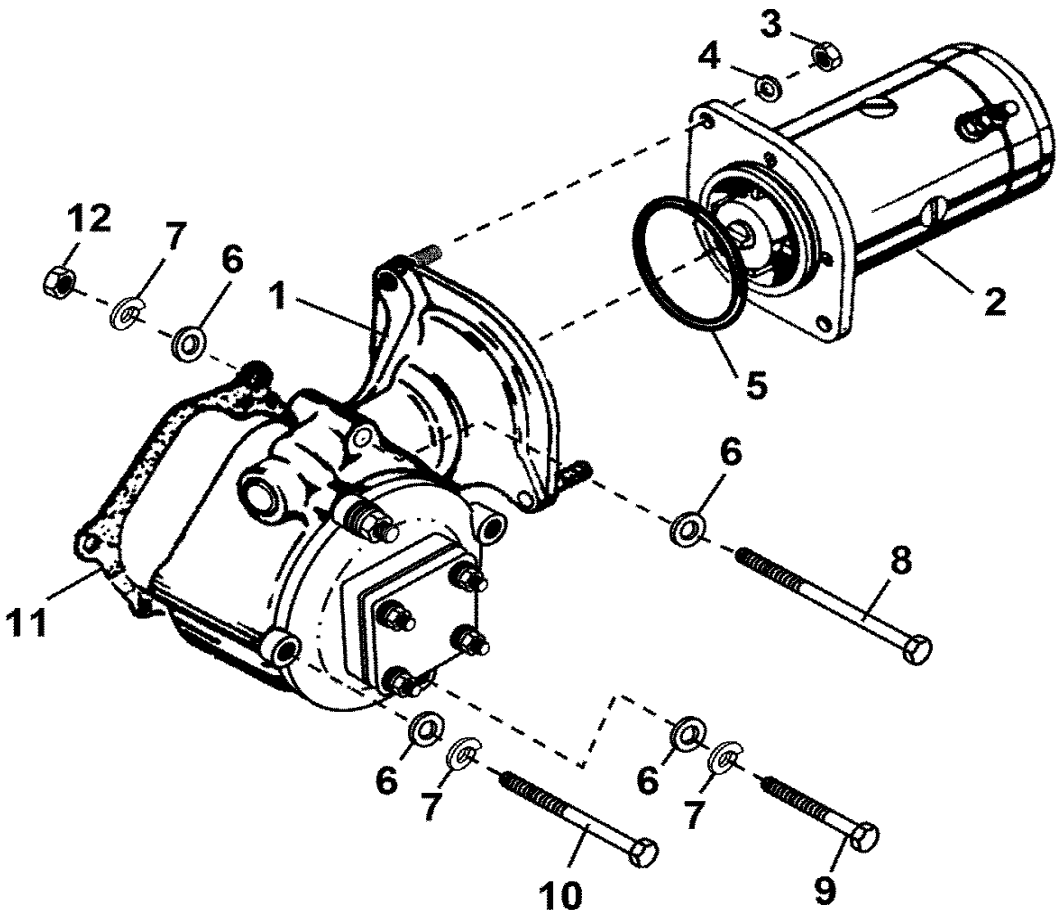


Figure 10-6. Starter Motor and Starter Adapter

1	Starter Adapter	4	Washer	7	Lock Washer	10	Bolt
2	Starter Motor	5	O-ring	8	Bolt	11	Gasket
3	Nut	6	Washer	9	Bolt	12	Nut

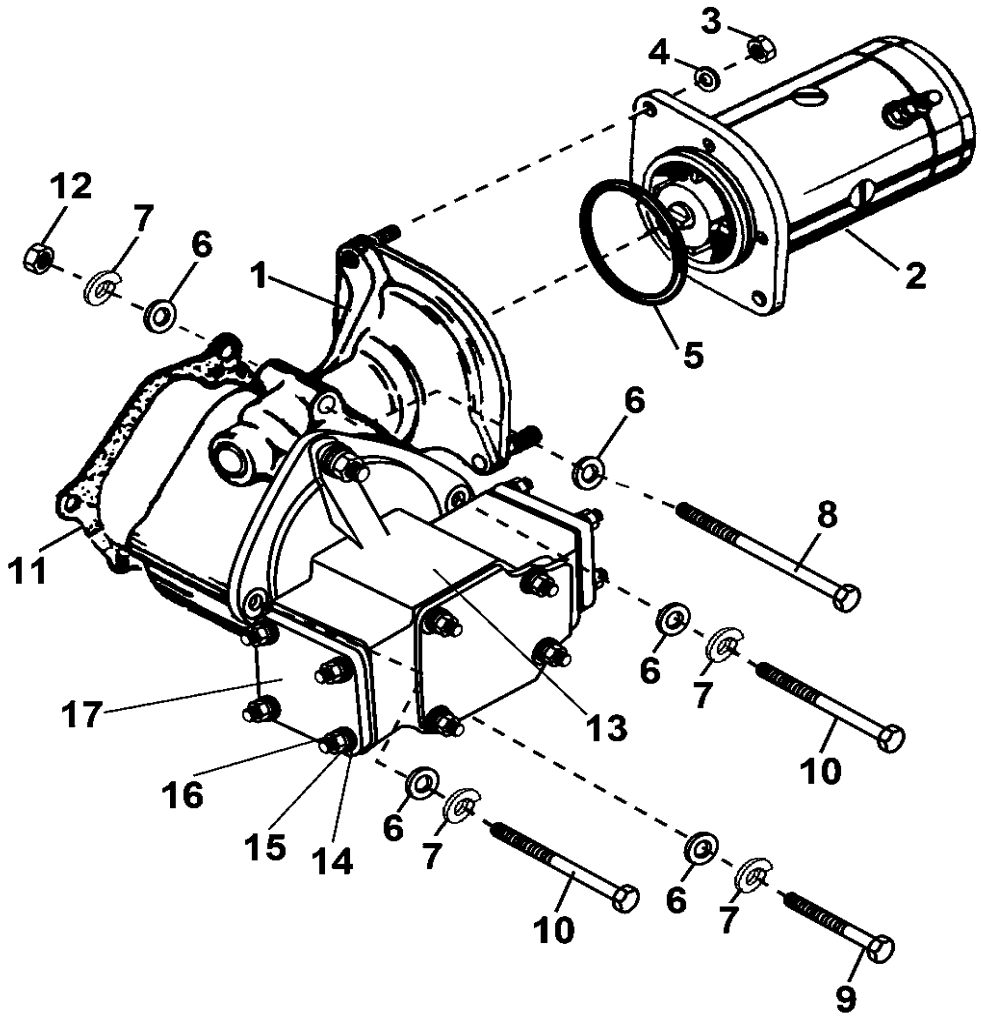


Figure 10-7. Starter Motor and Starter Adapter with Accessory Drive Adapter

1	Starter Adapter	6	Washer	11	Gasket	16	Nut
2	Starter Motor	7	Lock Washer	12	Nut	17	Accessory Cover
3	Nut	8	Bolt	13	Accessory Drive Adapter		
4	Washer	9	Bolt	14	Washer		
5	O-ring	10	Bolt	15	Lock Washer		

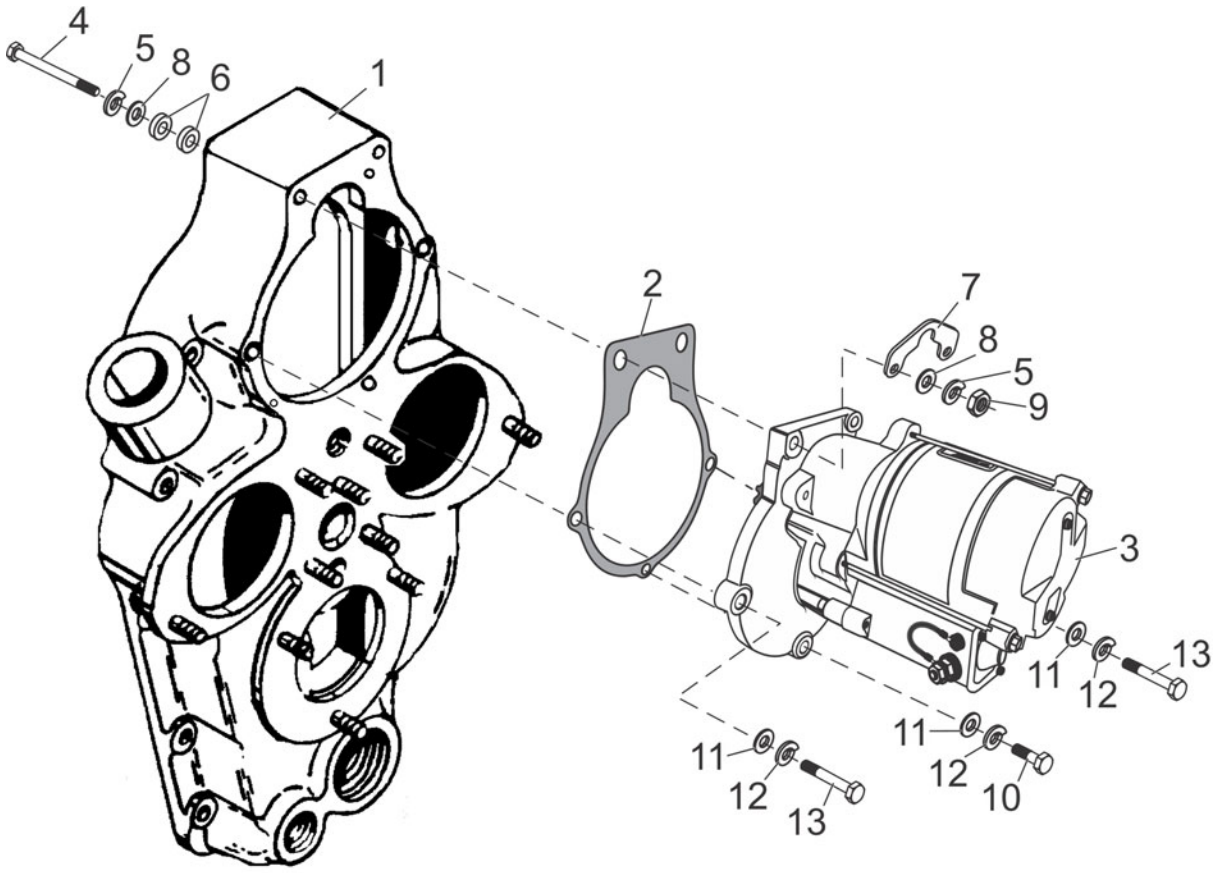


Figure 10-8. Starter Motor (AF)

1	Accessory Case	5	Lock Washer	9	Nut	13	Screw
2	Gasket	6	Spacer	10	Screw		
3	Starter Motor	7	Lifting Eye	11	Washer		
4	Bolt	8	Washer	12	Lock Washer		

10-4.4. Starter Adapter Service Limits

Service limits for the basic starter adapter are in Table 10-5 and Figure 10-9. The starter adapter with accessory drive service limits are in Table 10-6 and Figure 10-10. The starter adapter with accessory drive with gear shaft housing service limits are in Table 10-7 and Figure 10-13. Index numbers in the first column of the Table correspond to the numbers in the illustrations.

Table 10-5. Basic Starter Adapter Service Limits

Index	Description	Service Limit	New Part Minimum (Inches)	New Part Maximum (inches)
1	Starter adapter shaft gear in bushing ..... diametric clearance	0.0045L	0.002L	0.004L
2	Starter adapter shaft gear front journal ..... diameter	1.058	1.059	1.060
3	Starter shaft gear to crankshaft gear ..... backlash	0.016	0.008	0.012
4	Starter gear and worm shaft gear ..... backlash	0.020	0.009	0.013
5	Starter shaft gear ..... diameter	---	0.9995	1.0000
	Ra Surface Finish	---	---	32 Ra
6	Starter clutch spring outside[1] ..... diameter	---	2.267	2.282
7	Starter clutch spring inside[1] ..... diameter	---	1.938	1.940
8	Starter shaft gear drum outside ..... diameter	See Figure 10-11		
9	Starter gear drum outside ..... diameter	See Figure 10-12		
10	Starter gear inside ..... diameter	---	1.3115	1.3125
11	Clutch spring on starter shaft gear drum 0.50-0.56 from drum end ..... diametric clearance	0.004T	0.008T	0.012T
12	Clutch spring on gear drum 0.40 from drum end ..... diametric clearance	0.012T	0.015T	0.022T
13	Needle bearing bore in adapter ..... diameter	---	0.7485	0.7495
14	Worm gear shaft in needle bearing ..... shaft diameter	0.5600	0.5620	0.5626
15	Worm gear shaft in ball bearing ..... diametric clearance	---	0.0000	0.0008T
16	Ball bearing in adapter housing ..... diametric clearance	---	0.001L	0.0001T
17	Starter in adapter pilot ..... diametric clearance	---	0.001L	0.0065L
18	Starter drive tongue to worm shaft drive slot ..... total side clearance	---	0.012L	0.034L
19	Adapter cover in adapter housing pilot ..... diametric clearance	---	0.001L	0.004L
20	Starter gear ..... end clearance	0.015L	0.0025L	0.0115L
21	Shaft gear in adapter cover bushing ..... diametric clearance	0.0035L	0.001L	0.0025L
22	Oil seal in adapter cover ..... diametric clearance	---	0.001T	0.007T
23	Adapter cover bore ..... diameter		1.500	1.502
T= Tight L= Loose				

1. Reduced in diameter nominally 0.015 for M015 spring.

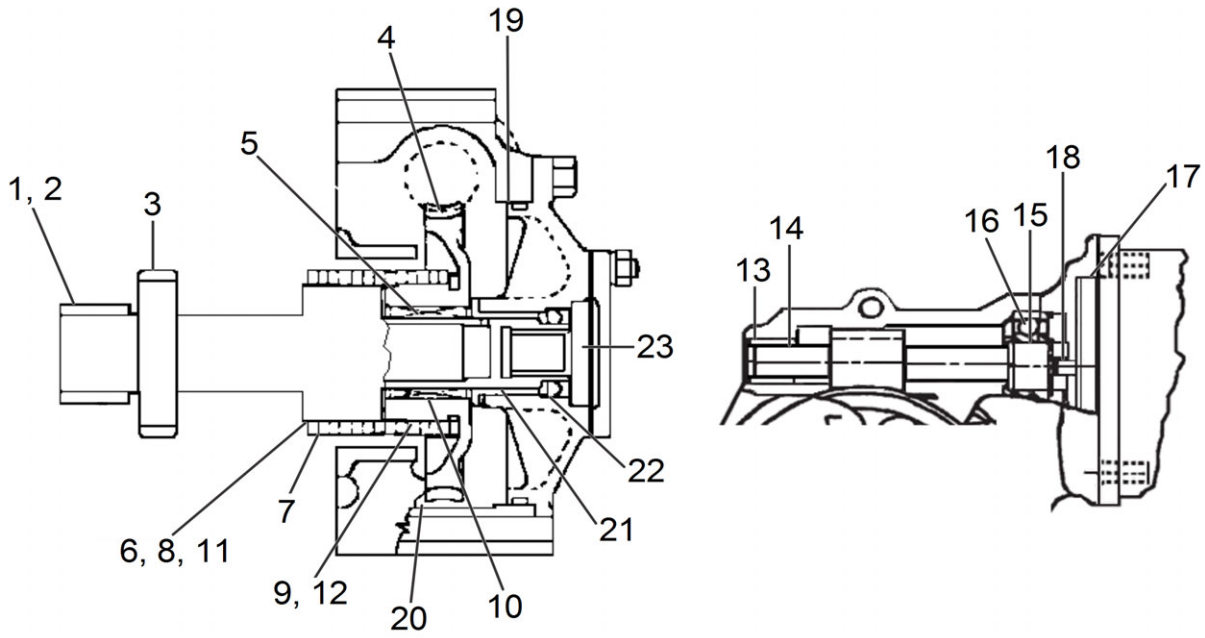


Figure 10-9. Basic Starter Adapter

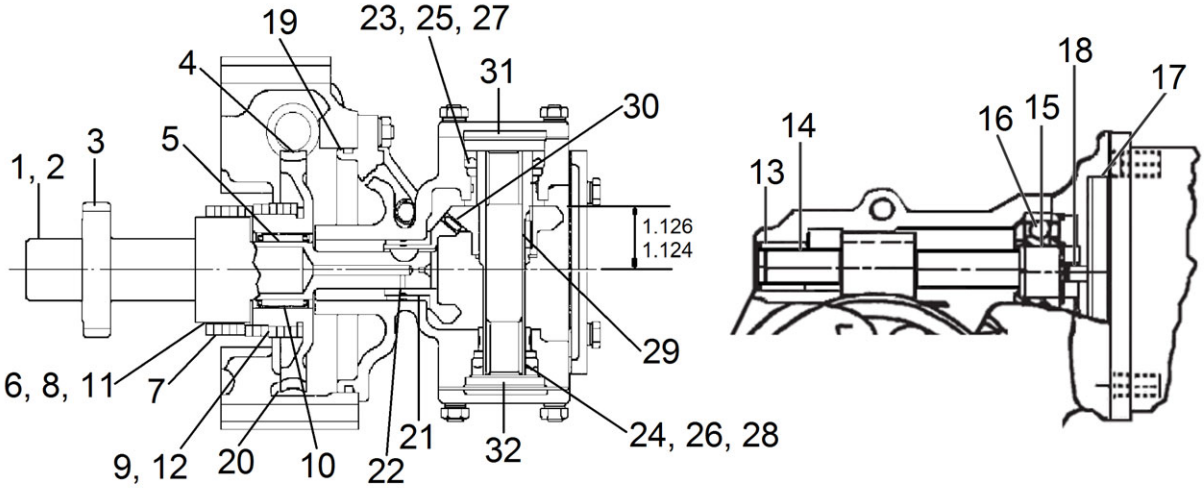


Figure 10-10. Starter Adapter with Accessory Drive Adapter

Table 10-6. Starter Adapter with Accessory Drive Adapter Service Limits

Index	Description	Service Limit	New Part Minimum (inches)	New Part Maximum (inches)
1	Starter adapter shaft gear in bushing.....diametric clearance	0.0045L	0.002L	0.004L
2	Starter adapter shaft gear front journal.....diameter	1.058	1.059	1.060
3	Starter shaft gear to crankshaft gear ..... backlash	0.016	0.008	0.012
4	Starter gear and worm shaft gear ..... backlash	0.020	0.009	0.013
5	Starter shaft gear .....diameter	---	0.9995	1.0000
	Ra Surface Finish	---	---	32 Ra
6	Starter clutch spring outside[1].....diameter	---	2.267	2.282
7	Starter clutch spring inside[1].....diameter	---	1.938	1.940
8	Starter shaft gear drum outside .....diameter	See Figure 10-11		
9	Starter gear drum outside .....diameter	See Figure 10-12		
10	Starter gear inside.....diameter	---	1.3115	1.3125
11	Clutch spring on starter shaft gear drum 0.50-0.56 from drum end .....diametric clearance	0.004T	0.008T	0.012T
12	Clutch spring on gear drum 0.40 from drum end .....diametric clearance	0.012T	0.015T	0.022T
13	Needle bearing bore in adapter .....diameter	---	0.7485	0.7495
14	Worm gear shaft in needle bearing.....shaft diameter	0.5600	0.5620	0.5626
15	Worm gear shaft in ball bearing.....diametric clearance	---	0.0000	0.0008T
16	Ball bearing in adapter housing .....diametric clearance	---	0.001L	0.0001T
17	Starter in adapter pilot.....diametric clearance	---	0.001L	0.0065L
18	Starter drive tongue to worm shaft drive slot .....total side clearance	---	0.012L	0.034L
19	Adapter cover in adapter housing pilot .....diametric clearance	---	0.001L	0.004L
20	Starter gear..... end clearance	0.015L	0.0025L	0.0115L
21	Driver bevel gear in bushing .....diametric clearance	0.0045L	0.001L	0.003L
22	Driver bevel gear on starter shaft gear .....diametric clearance	0.004L	0.0002L	0.002L
23	RHS accessory drive shaft end in bushing .....diametric clearance	0.0045L	0.001L	0.003L
24	LHS accessory drive shaft end in bushing.....diametric clearance	0.0045L	0.001L	0.003L
25	RHS seal bore.....diameter	---	1.500	1.502
26	LHS seal bore .....diameter	---	1.249	1.251
27	Accessory drive shaft.....diameter	---	1.0600	1.0610
28	Accessory drive shaft.....diameter	---	0.8100	0.8110
29	Driven bevel gear on accessory drive shaft.....diametric clearance	0.004L	0.000	0.002L
30	Driven and driver bevel gears..... backlash	0.016	0.008	0.012
31	RHS accessory bore .....diameter	---	1.500	1.502
32	LHS accessory bore.....diameter	---	1.500	1.502
T = Tight L = Loose				

1. Reduced in diameter nominally 0.015 for M015 spring.

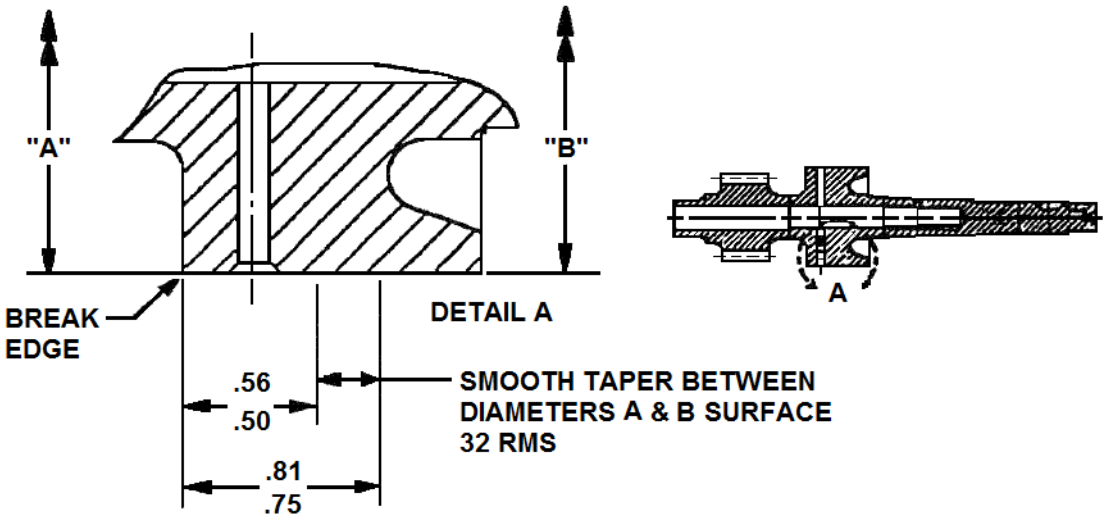


Figure 10-11. Starter Shaft Gear Drum

DESCRIPTION	"A" Diameter (Inches)		"B" Diameter (Inches)	
	Minimum	Maximum	Minimum	Maximum
Starter Shaft Gear Drum	1.948	1.950	1.9365	1.9385
0.015 Undersize	1.933	1.935	1.9215	1.9235

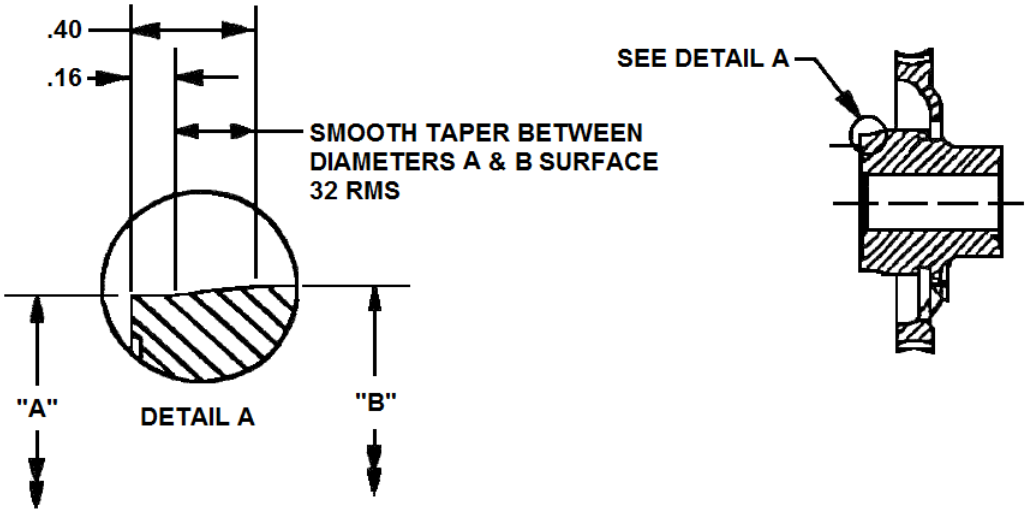


Figure 10-12. Starter Gear Drum

DESCRIPTION	"A" Diameter (Inches)		"B" Diameter (Inches)	
	Minimum	Maximum	Minimum	Maximum
Starter Gear Drum	1.9365	1.9385	1.955	1.960
0.015 Undersize	1.9215	1.9235	1.940	1.945

Table 10-7. Starter Adapter with Accessory Drive Adapter with Gear Shaft Housing Service Limits

Index	Description	Service Limit	New Part Minimum (Inches)	New Part Maximum (inches)
1	Starter adapter shaft gear in bushing ..... diametric clearance	0.0045L	0.002L	0.004L
2	Starter adapter shaft gear front journal ..... diameter	1.058	1.059	1.060
3	Starter shaft gear to crankshaft gear ..... backlash	0.016	0.008	0.012
4	Starter gear and worm shaft gear ..... backlash	0.020	0.009	0.013
5	Starter shaft gear ..... diameter	---	0.9995	1.0000
	Ra Surface Finish	---	---	32 Ra
6	Starter clutch spring outside[1] ..... diameter	---	2.267	2.282
7	Starter clutch spring inside[1] ..... diameter	---	1.938	1.940
8	Starter shaft gear drum outside ..... diameter	See Figure 10-11		
9	Starter gear drum outside ..... diameter	See Figure 10-12		
10	Starter gear inside ..... diameter	---	1.3115	1.3125
11	Clutch spring on starter shaft gear drum 0.50-0.56 from drum end ..... diametric clearance	0.004T	0.008T	0.012T
12	Clutch spring on gear drum 0.40 from drum end ..... diametric clearance	0.012T	0.015T	0.022T
13	Needle bearing bore in adapter ..... diameter	---	0.7485	0.7495
14	Worm gear shaft in needle bearing ..... shaft diameter	0.5600	0.5620	0.5626
15	Worm gear shaft in ball bearing ..... diametric clearance	---	0.0000	0.0008T
16	Ball bearing in adapter housing ..... diametric clearance	---	0.001L	0.0001T
17	Starter in adapter pilot ..... diametric clearance	---	0.001L	0.0065L
18	Starter drive tongue to worm shaft drive slot ..... total side clearance	---	0.012L	0.034L
19	Adapter cover in adapter housing pilot ..... diametric clearance	---	0.001L	0.004L
20	Starter gear ..... end clearance	---	0.0105L	0.0215L
21	Needle bearing bore in cover ..... diameter	---	1.2485	1.2495
22	Starter shaft gear in adapter cover bushing ..... diametric clearance	0.0025L	0.0005L	0.002L
23	Scavenge pump driven gear on shaft ..... diametric clearance	0.004L	0.0005L	0.0025L
24	Scavenge pump gears in adapter cover[2] ..... diametric clearance	0.0085L	0.0055L	0.0080L
	..... end clearance	0.005L	0.001L	0.0035L
25	Scavenge pump drive gear on starter shaft gear[2] ... diametric clearance	---	0.0002L	0.0017L
26	Scavenge pump driven gear to drive gear[2] ..... backlash	0.027	0.014	0.0218
27	Driver bevel gear on starter shaft gear ..... diametric clearance	---	0.0002L	0.0017L
	..... total side clearance	---	0.0002L	0.0042L
28	RHS accessory drive shaft end in bushing ..... diametric clearance	0.0045L	0.001L	0.003L
29	LHS accessory drive shaft end in bushing ..... diametric clearance	0.0045L	0.001L	0.003L
30	RHS seal bore ..... diameter	---	1.498	1.500
31	LHS seal bore ..... diameter	---	1.249	1.251
32	Accessory drive shaft ..... diameter	---	1.0600	1.0610

Table 10-7. Starter Adapter with Accessory Drive Adapter with Gear Shaft Housing Service Limits

Index	Description	Service Limit	New Part Minimum (Inches)	New Part Maximum (inches)
33	Accessory drive shaft.....diameter	---	0.8100	0.8110
34	Driven bevel gear on accessory drive shaft.....diametric clearance	0.004L	0.000	0.002L
35	Driven and driver bevel gears.....backlash	0.016	0.008	0.012
36	Gear shaft bearing bore in housing .....diameter	---	1.0610	1.0620
37	Gear shaft oil seal bore in housing .....diameter	---	1.574	1.576
38	Gear shaft.....diameter	0.8117	0.8120	0.8125
39	RHS accessory bore.....diameter	---	1.498	1.500
40	LHS accessory bore .....diameter	---	1.500	1.502
T= Tight L= Loose				

1. Reduced in diameter nominally 0.015 for M015 spring.
2. The scavenge pump driver gear is only used in the starter adapter configuration for the I0360ES26B and 28B. Measurements for fits and limits of the driver gear only apply to I0360ES26B and 28B.

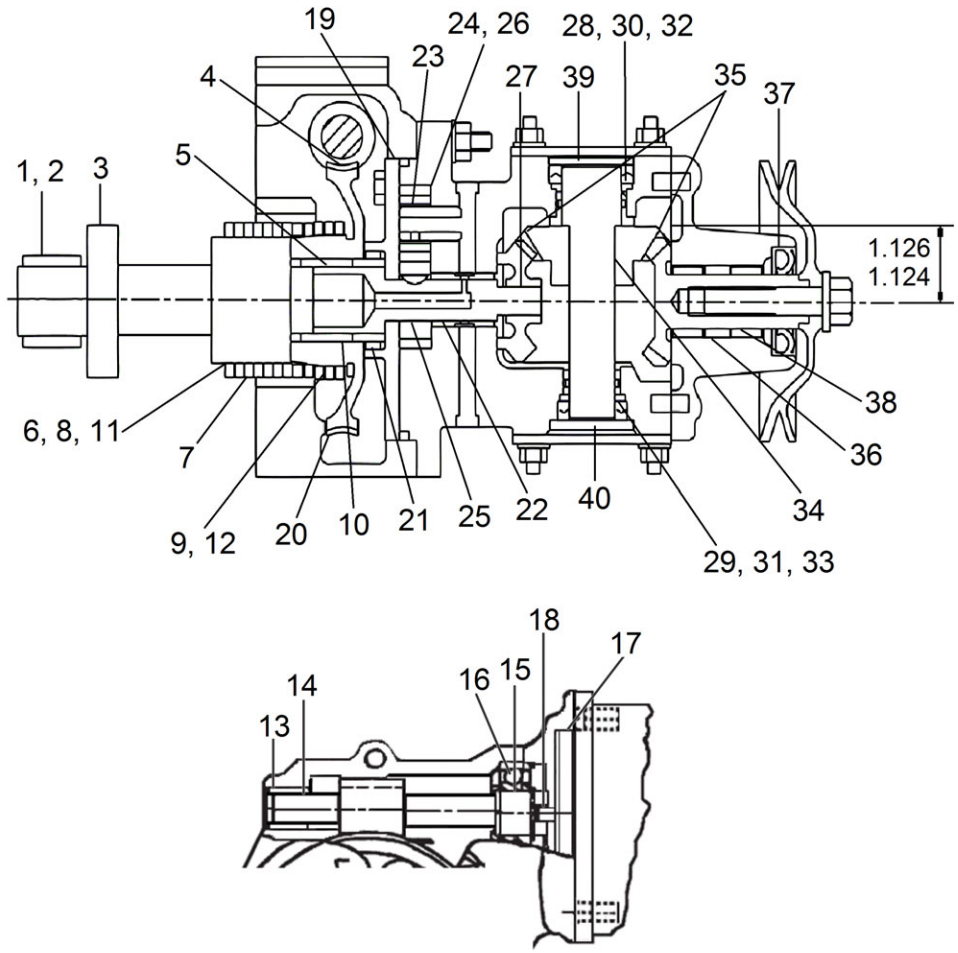


Figure 10-13. Starter Adapter with Accessory Drive Adapter with Gear Shaft Housing

10-4.5. Starter Adapter Installation

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Thoroughly clean the accessory case mounting surface to remove any gasket residue.
2. Inspect the starter adapter to ensure it is assembled according to the instructions in Chapter 16.
3. Install the new gasket (Figure 10-6)(11) on the accessory case.
4. Lubricate the teeth on the shaftgear with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
5. Mesh the teeth with the crankshaft gear while placing the starter adapter (1) into position.
6. Seat the starter adapter (1) against the gasket (11).
7. Lubricate bolt (8) threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
8. Install bolt (8), washers (6), new lock washer (7) and nut (12).
9. Lubricate right side bolt (10) threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
10. Install right side bolt (10), new lock washer (7) and washer (6).
11. Apply Loctite 592 PS/T Pipe Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to bolt (9) threads.
12. Install bolt (9), new lock washer (7) and washer (6).
13. If engine model has rear lifting eye mounted to starter adapter (1), do the following, otherwise skip to step 14:

    NOTE: Some lifting eyes are mounted on opposite side of starter adapter (1) if optional rear mounted alternator is installed. Refer to the Illustrated Parts Catalog.

    a. Remove nut and lock washer from starter adapter cover. Refer to Figure 10-14.
    b. Lubricate the stud and left side bolt (10) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
    c. Install washer, rear lifting eye, new lock washer and nut on stud.
    d. Install washers (6), new lock washer (7) and left side bolt (10) as depicted in Figure 10-14.
14. If engine model has no lifting eye mounted on starter adapter, do the following:
    a. Lubricate left side bolt (10) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

b. Install left side bolt (10), new lock washer (7) and washer (6).

15. Torque bolts (8, 9 and 10) and nuts (12 and stud nut, if removed) to Appendix B specifications.
16. Safety wire bolts (9 and 10) together according to the safety wiring instructions in Appendix C-3.
17. If necessary, install any accessories back onto starter adapter assembly (1) according to the aircraft maintenance manual.
18. Install the starter motor according to the “Starter Motor Installation” instructions in Section 10-4.7.
19. Perform an “Engine Start” according to the instructions in Section 7-3.2 to verify starter operation.

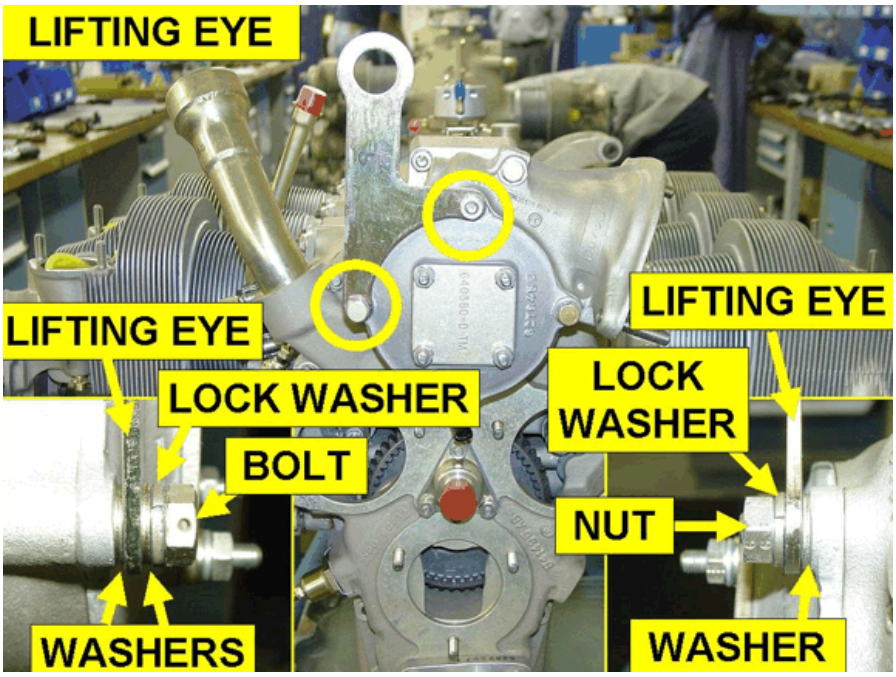


Figure 10-14. Rear Lifting Eye on Starter Adapter

10-4.6. Starter Adapter with Accessory Drive Adapter Installation

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

CAUTION: Fittings (or plugs) installed in the starter adapter with accessory drive assembly are critical to engine function. Failure to install fittings (or plugs) and reconnect accessory hoses will result in loss of engine oil and catastrophic engine failure.

1. Thoroughly clean the accessory case mounting surface to remove any gasket residue.
2. Inspect the starter adapter to ensure it is assembled according to the instructions in Chapter 16. Ensure the plugs and fittings are installed in the accessory drive adapter. Leave off or remove both side accessory covers to facilitate installation of two bolts (Figure 10-7)(10).
3. Install the new gasket (11) on the accessory case.
4. Lubricate the teeth on the shaftgear with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
5. Mesh the teeth with the crankshaft gear while placing the starter adapter (1) into position.
6. Seat the starter adapter (1) against the gasket (11).
7. Lubricate bolt (8) threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
8. Install bolt (8), washers (6), new lock washer (7) and nut (12).
9. Lubricate right side bolt (10) threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
10. Install right side bolt (10), new lock washer (7) and washer (6).
11. Apply Loctite 592 PS/T Pipe Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to bolt (9) threads.
12. Install bolt (9), new lock washer (7) and washer (6).
13. If engine model has rear lifting eye mounted to starter adapter, do the following, otherwise skip to step 14:

    NOTE: Some lifting eyes are mounted on opposite side of starter adapter if optional rear mounted alternator is installed. Refer to the Illustrated Parts Catalog.

    a. Remove nut and lock washer from starter adapter cover. Refer to Figure 10-14.

b. Lubricate the stud and left side bolt (10) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

c. Install washer, rear lifting eye, new lock washer and nut on stud.

d. Install washers (6), new lock washer (7) and left side bolt (10) as depicted in Figure 10-14.

14. If engine model has no lifting eye mounted on starter adapter, do the following:

    a. Lubricate left side bolt (10) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

    b. Install left side bolt (10), new lock washer (7) and washer (6).

15. Torque bolts (8, 9 and 10) and nuts (12 and stud nut, if removed) to Appendix B specifications.

16. Safety wire bolts (9 and 10) together according to the safety wiring instructions in Appendix C-3.

17. If necessary, install any accessories onto starter adapter assembly (1) according to the aircraft maintenance manual.

18. If no accessories were installed, install new gaskets and side accessory covers (17). Secure with four washers (14), four new lock washers (15) and four nuts (16). Torque the nuts to Appendix B specifications.

19. Install the starter motor according to the “Starter Motor Installation” instructions in Section 10-4.7.

20. Perform an “Engine Start” according to the instructions in Section 7-3.2 to verify starter operation.

10-4.7. Starter Motor Installation

10-4.7.1. Starter Motor Installation (Except AF)

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.
2. Inspect the new o-ring (Figure 10-6 or Figure 10-7) (5) for the starter motor and verify the o-ring is free of cracks and is not deformed or brittle. Do not install a deformed, brittle, or cracked o-ring.
3. Coat the new o-ring (5) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
4. Install o-ring (5) on the starter motor (2).
5. Apply Molyshield Grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the starter motor drive lug.
6. Install the starter motor (2) on the mounting studs; ensuring the drive lug aligns with the slot. Secure the starter motor with two sets of washers (4) and nuts (3).
7. Torque the mounting nuts (3) to Appendix B specifications.
8. Verify the integrity of the electrical cable. Replace frayed or cracked wiring.
9. Connect the electrical cable and aircraft battery in accordance with the aircraft maintenance manual.
10. Perform an “Engine Start” according to the instructions in Section 7-3.2 to verify starter operation.

10-4.7.2. Starter Motor Installation (AF)

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.
2. Inspect the new gasket (Figure 10-8)(2) for the starter motor and verify the gasket is free of cracks and is not deformed or brittle. Do not install a deformed, brittle, or cracked gasket.
3. Install new lock washers (5), washers (8) and spacers (6) on bolts (4).
4. Install bolts (4) through crankcase and accessory case.

5. Apply P/N 642188 CRC Copper Coat Gasket Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the accessory case mating surface of the gasket (2).
6. Install gasket (2) on the accessory case (1).
7. Apply Molyshield Grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the starter motor (3) drive lug.
8. Install starter motor (3) on accessory case (1).
9. Install lifting eye (7), washers (8), new lock washers (5) and nuts (9) on bolts (4).
10. Install washers (11) and new lock washers (12) on screws (10 and 13).
11. Install screws (10 and 13) through starter motor (3) and into accessory case (1).
12. Torque the screws (10 and 13) and nuts (9) to Appendix B specifications.
13. Verify the integrity of the electrical cable. Replace frayed or cracked wiring.
14. Connect the electrical cable and aircraft battery in accordance with the aircraft maintenance manual.
15. Perform an “Engine Start” according to the instructions in Section 7-3.2 to verify starter operation.

10-5. Alternator Replacement

Replace the alternator if it fails to deliver the correct voltage and amperage to the aircraft electrical system. The engine may be equipped with a direct drive alternator, a belt-driven alternator, or both. Refer to Table 1-1 for the appropriate instructions to service or overhaul Continental Motors alternators. For alternators not manufactured by Continental Motors, replace the suspect unit with a new, rebuilt, or serviceable alternator.

10-5.1. Direct Drive Alternator Removal

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.
2. Disconnect the aircraft battery according to the aircraft maintenance manual.
3. If the alternator has a grounding strap, remove grounding strap according to the aircraft maintenance manual.
4. If the alternator has a cooling hose, remove cooling hose according to the aircraft maintenance manual.
5. Disconnect electrical connections from the alternator according to the aircraft maintenance manual.
6. Remove the three lock nuts (Figure 10-15)(12) and washers (11) from the alternator mounting studs. Discard the lock nuts.
7. Remove the alternator (1) from the mounting studs.
8. Remove and discard the gasket (2).

10-5.1.1. Direct Drive Alternator Drive Hub Removal

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Remove alternator according to Section 10-5.1.
2. Remove the cotter pin (Figure 10-15)(10) and castellated nut (9). Discard the cotter pin.
3. If one piece coupling, remove coupling otherwise remove the gear (8), sleeve (7), bushings (6), retainer (5) and hub (4) from the alternator shaft.

   NOTE: At 500 Hours, replace the retainer and bushings regardless of condition, on multi-piece coupling.

4. Remove the woodruff key (3). Discard the woodruff key.
5. Continental Motors alternators may be serviced according to instructions in the Alternator Service Manual, X30531 (Table 1-1). Replace non-Continental alternators with a new, rebuilt, or serviceable unit.

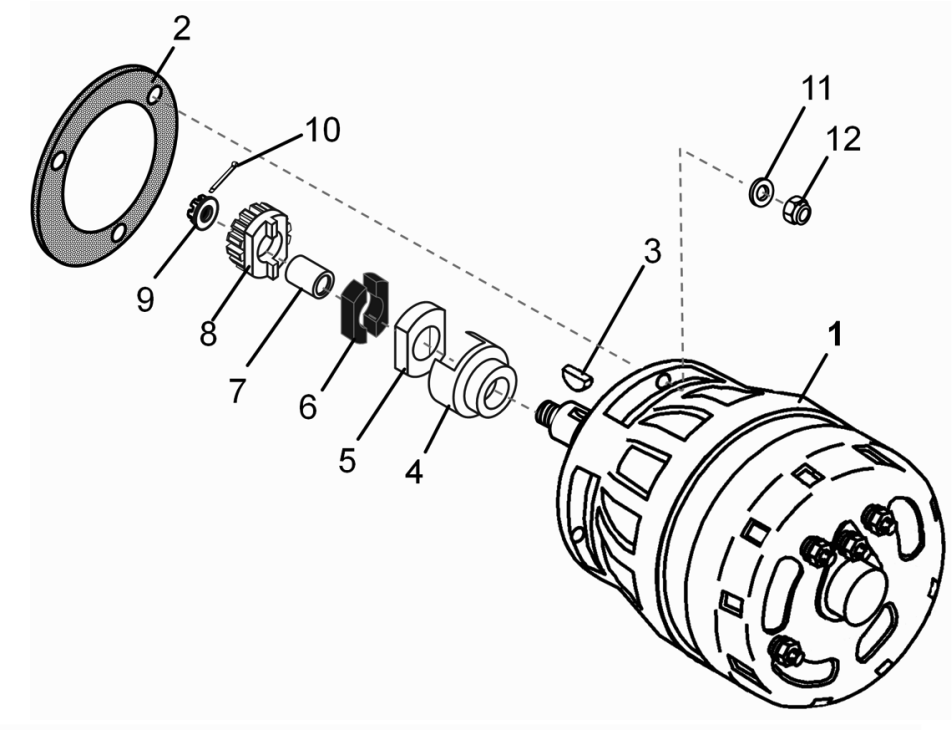


Figure 10-15. Direct Drive Alternator Assembly

1	Alternator	4	Hub	7	Sleeve	10	Cotter Pin
2	Gasket	5	Retainer	8	Gear	11	Washer
3	Woodruff Key	6	Bushing	9	Castellated Nut	12	Lock Nut

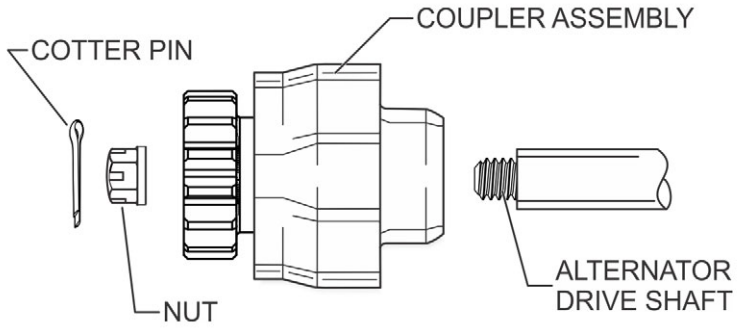


Figure 10-16. Alternator Drive Hub Coupling (1 Piece)

10-5.1.2. Direct Drive Alternator Drive Hub Installation

WARNING

If the shipping washer is not removed prior to installing the drive coupling, the shipping washer will cause interference with the face gear on the camshaft and will result in damage to the engine and alternator.

1. Remove the shipping spacer and washer from the alternator (Figure 10-15)(1) shaft to prevent interference with the face gear on the camshaft.
2. Install a new woodruff key (3) on the alternator (1) shaft.
3. For one piece coupler, inspect the drive hub coupling according to the "Alternator Drive Hub Inspection" instructions in Section 6-3.20.1. If the drive coupling passes the inspection, install the coupling on the alternator shaft and proceed to step 8. For multi-piece coupler proceed to next step.
4. Lubricate the lip of the oil seal and the polished surface of the drive coupling hub (4) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
5. Slide the hub (4) onto the shaft, over the woodruff key (3) and through the seal lip until seated against the inner race of the ball bearing.
6. Install the retainer (5), bushings (6) and sleeve (7) on the alternator (1) shaft.

   NOTE: At 500 Hours, replace the retainer and bushings regardless of condition, on multi-piece coupling.

7. Slide gear (8) onto the alternator (1) shaft so its drive lugs are inserted in the rubber bushings (6).
8. Install the castellated nut (9) on the alternator (1) shaft.
9. Clamp the alternator (1) and drive hub assembly into a set of protected vice jaws.

   NOTE: Only tight enough to torque the castellated nut (9).

10. Set the torque wrench for the minimum value published in Appendix B for the castellated nut (9) and torque the castellated nut.
11. If the slots of the castellated nut (9) do not align with the cotter pin (10) hole in the alternator (1) shaft, the castellated nut may be torqued further up to the maximum value in Appendix B. Do not back off the castellated nut to align the holes.

WARNING

Use eye protection when trimming cotter pin because flying parts can cause injury.

12. Install the new cotter pin (10) according to the "Cotter Pin Installation" instructions in Appendix C-7.
13. Install the alternator (1) according to "Direct Drive Alternator Installation" instructions in Section 10-5.2.

10-5.2. Direct Drive Alternator Installation

Prior to alternator installation, install a serviceable drive hub according to instructions in Section 10-5.1.2.

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.
2. Inspect the camshaft gear teeth according to the "Gear Tooth Inspection" in Section 15-3.1. If the camshaft gear exhibits damage, refer to the "Engine Disassembly" instructions in Chapter 12 to replace the camshaft gear.
3. Install a new gasket (Figure 10-15)(2) on the accessory case studs.
4. Install the alternator (1) on the accessory case studs using three washers (11) and three new lock nuts (12).
5. Torque the lock nuts (12) to Appendix B specifications.
6. If the alternator had a grounding strap when it was removed, install the grounding strap according to the aircraft maintenance manual.
7. If the alternator had a cooling hose when it was removed, install the cooling hose according to the aircraft maintenance manual.
8. Connect electrical connections at the alternator (1) according to the aircraft maintenance manual. Torque electrical connectors to Appendix B specifications.
9. Connect the aircraft battery according to the aircraft maintenance manual.
10. Start the engine according to the "Engine Start" instructions in Section 7-3.2 and test the alternator output according to the aircraft maintenance manual.

10-5.3. Optional Belt Driven Alternator Removal

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power
2. Remove the alternator wiring harness connections according to the aircraft maintenance manual.
3. If the alternator has a grounding strap, remove the grounding strap according to the aircraft maintenance manual.
4. To remove optional rear mounted alternator, do the following:
   a. Remove bolt (Figure 10-17)(19), lock washer (18) and two washers (17). Discard the lock washer.

      NOTE: There may be more than two washers (17) to remove as they are used for alignment purposes.

   b. Loosen bolt (13) and nut (16).
   c. Remove the V-belt (20) from the alternator sheave. Inspect the V-belt for cracks, wear, or frayed edges; replace if necessary.
   d. Remove bolt (13), four washers (14), spacer (15) and nut (16).
   e. Remove alternator (1) from between the front bracket (2) and the rear bracket (3).
5. To remove optional front mounted alternator, do the following:
   a. Remove bolt (Figure 10-18)(5), lock washer (6) and washer (7). Discard the lock washer.
   b. Loosen bolt (4) and lock nut (3).
   c. Remove the V-belt (11) from the alternator sheave. Inspect the V-belt for cracks, wear, or frayed edges; replace if necessary.
   d. Remove bolt (4), washers (2 and 14), shim(s) (16) and lock nut (3). Discard the lock nut.
   e. Remove alternator (12) from bracket assembly (1).

10-5.4. Optional Belt Driven Alternator Installation

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Inspect the bracket and hardware for excessive wear or physical damage. Check the brace for elongated holes or cracks. Replace worn or damaged bracket assembly components.
2. To install optional rear mounted alternator, do the following:
   a. Inspect the V-belt (Figure 10-17)(20) for cracks, abnormal wear, or frayed edges; replace if necessary.
   b. Place the alternator (1) between the front bracket (2) and the rear bracket (3).
   c. Install bolt (13), four washers (14), spacer (15) and nut (16).
   d. Align the rear bracket (3) top bolt hole slot with the alternator (1) mounting hole. Loosely install the bolt (19), new lock washer (18) and two washers (17) in the rear bracket (3) and into the alternator mounting hole.
   e. Check the alignment of the alternator (1) sheave to the accessory drive sheave (22) with a P/N 8082-IA Pulley Alignment Tool (Chapter 2-1 of M-0, Standard Practice Maintenance Manual). Place the alignment tool in the center of the alternator sheave and lower the opposite end of the alignment tool into the channel of the accessory drive sheave - no more than 0.010 inch deflection is permitted. If deflection is greater than 0.010 inch, remove the bolt (13), washers (14) and nut (16) from the alternator and brackets (2 and 3) and reposition washers (14), as required, to correct front to rear alignment. If deflection is greater than 0.010 inch, remove the bolt (19), lock washer (18) and washers (17) from the alternator and add extra washers (17) between bracket (3) and alternator, as required, to correct tilt alignment. When alignment is within 0.010 inch, proceed to next step.
   f. Install V-belt (20) on sheave (22) and alternator (1) sheave.
   g. Adjust the V-belt tension according to instructions in Section 6-3.10.4.
   h. If the alternator had a grounding strap when it was removed, install the grounding strap according to the aircraft maintenance manual.
   i. Connect the aircraft wiring harness to the alternator according to the aircraft maintenance manual. Torque electrical connectors to Appendix B specifications.
3. To install optional front mounted alternator, do the following:
   a. Inspect the V-belt (Figure 10-18)(11) for cracks, abnormal wear, or frayed edges; replace if necessary.

b. Install the alternator (12) on the mounting bracket with the bolt (4), washers (2 and 14), shim(s) (16) and new lock nut (3).

c. Align the adjustable brace (10) bolt hole with the alternator (1) outboard mounting hole. Loosely install the bolt (5), new lock washer (6) and washer (7) through the hole in the adjustable brace into the alternator outboard mounting hole.

d. Check the alignment of the alternator (12) sheave to the propeller flange sheave with a P/N 8082-IA Pulley Alignment Tool (Chapter 2-1 of M-0, Standard Practice Maintenance Manual). Place the alignment tool in the center of the alternator sheave and lower the opposite end of the alignment tool into the channel of the propeller flange sheave - no more than 0.010 inch deflection is permitted. If deflection is greater than 0.010 inch, remove the bolt (4), washers (2 and 14), shim(s) (16) and lock nut (3) from the alternator and bracket assembly (1) and install or remove extra shims, as required, to fill the gap between the alternator and bracket assembly. When alignment is less than 0.010 inch, proceed to next step.

e. Install V-belt (11) on propeller flange sheave and alternator (12) sheave.

f. Adjust the V-belt tension according to instructions in Section 6-3.10.4.

g. If the alternator had a grounding strap when it was removed, install the grounding strap according to the aircraft maintenance manual.

h. Connect the aircraft wiring harness to the alternator according to the aircraft maintenance manual. Torque electrical connectors to Appendix B specifications.

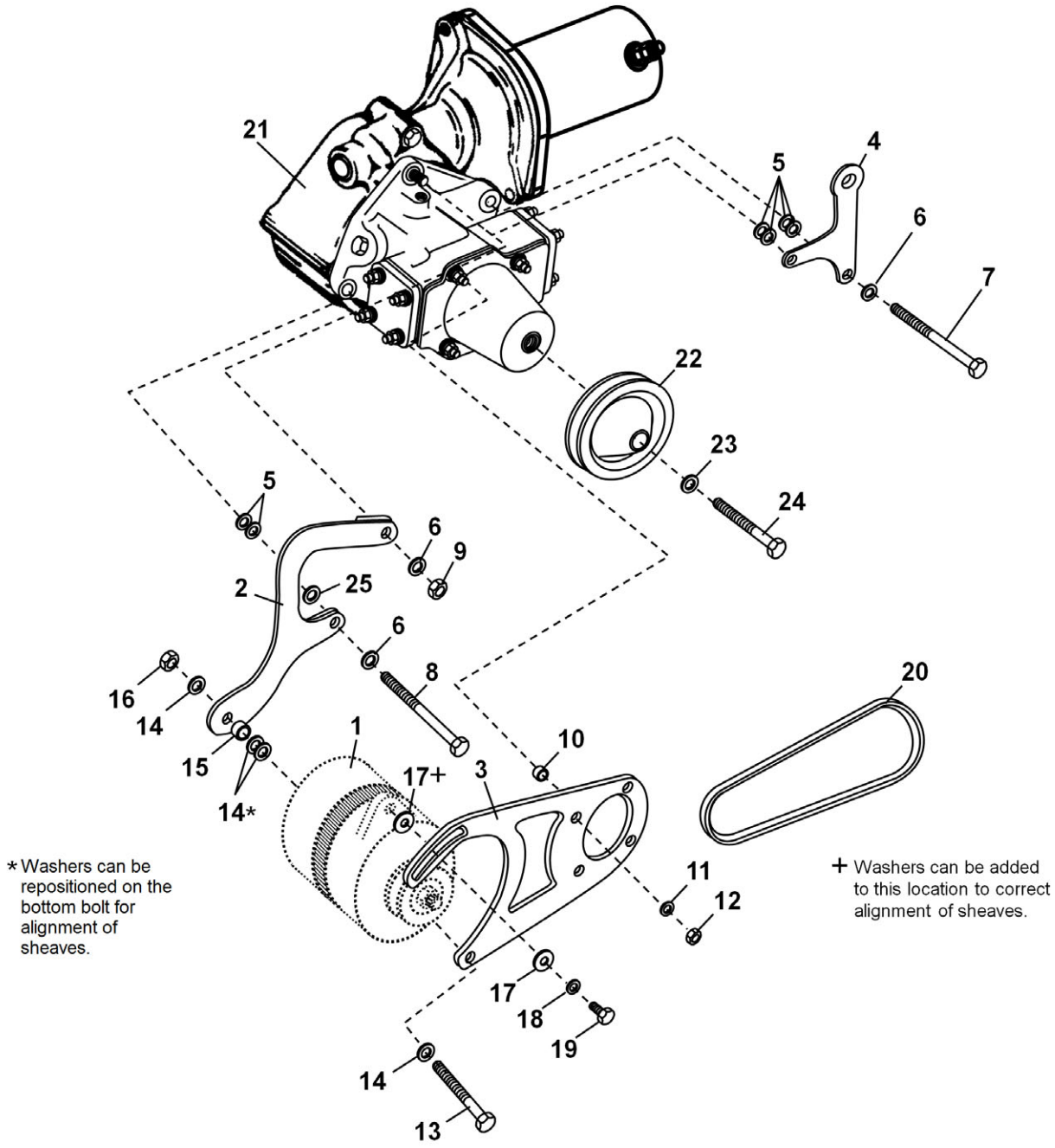


Figure 10-17. Optional Rear Mounted Alternator Assembly

1	Alternator	8	Bolt	15	Spacer	22	Sheave
2	Front Bracket	9	Nut	16	Nut	23	Washer
3	Rear Bracket	10	Spacer	17	Washer (Minimum 2)	24	Bolt
4	Lifting Eye	11	Lock Washer	18	Lock Washer	25	Washer
5	Washer	12	Nut	19	Bolt		
6	Lock Washer	13	Bolt	20	V-belt		
7	Bolt	14	Washer	21	Starter Adapter		

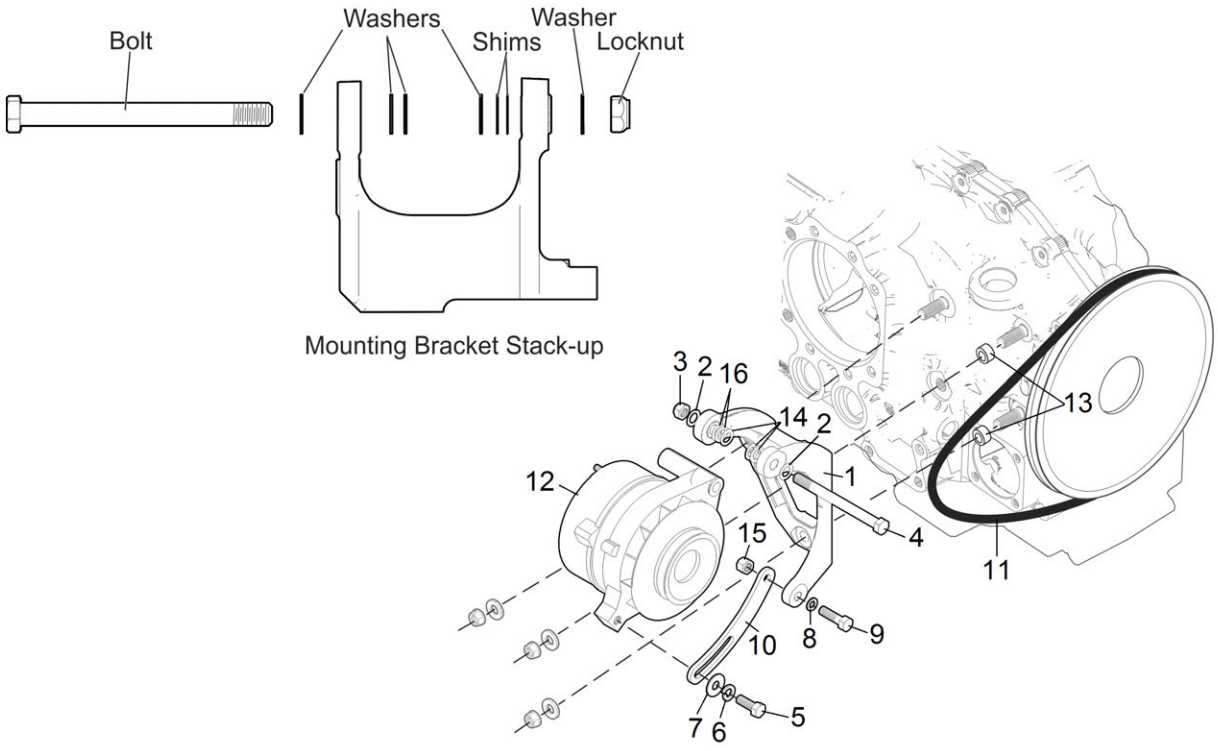


Figure 10-18. Optional Front Mounted Alternator Assembly

1	Bracket Assembly	5	Bolt	9	Bolt	13	Spacer
2	Washer	6	Lock Washer	10	Adjustable Brace	14	Washer
3	Lock Nut	7	Washer	11	V-belt	15	Lock Nut
4	Bolt	8	Washer	12	Alternator	16	Shim

10-5.5. Optional Belt Driven Alternator Sheave Removal

1. To remove sheave for optional rear mounted alternator, do the following:
   a. Remove the V-belt (Figure 10-17)(20) from the alternator (1) according to instructions in Section 10-5.3.
   b. Use a strap wrench to hold sheave (22) for bolt (24) removal.
   c. Remove the bolt (24) and washer (23) from the sheave (22).
   d. Remove the sheave (22) from the starter adapter (21).
2. To remove sheave from optional front mounted alternator, do the following:
   a. Remove the spinner and propeller according to the aircraft maintenance manual.
   b. Remove the V-belt (Figure 10-18)(11) from the alternator (12) according to instructions in Section 10-5.3.
   c. Remove sheave according to aircraft maintenance manual.

10-5.6. Optional Belt Driven Alternator Sheave Installation

1. To install sheave for optional rear mounted alternator, do the following:
   a. Install the sheave (Figure 10-17)(22) on the starter adapter (21).
   b. Install bolt (24) and washer (23). Torque the bolt to Appendix B specifications.
   c. Install the V-belt (20) and adjust tension according to instructions in Section 10-5.4.
2. To install sheave for optional front mounted alternator, do the following:
   a. Install sheave according to aircraft maintenance manual.
   b. Install the V-belt (Figure 10-18)(11) on the alternator (12) according to instructions in Section 10-5.4.
   c. Install the spinner and propeller according to the aircraft maintenance manual.

10-5.7. Optional Belt Driven Alternator Front and Rear Bracket Removal

1. Remove the optional belt driven alternator according to the “Optional Belt Driven Alternator Removal” instructions in Section 10-5.3.
2. Remove the belt driven alternator brackets according to “Optional Belt Driven Alternator Brackets and Drive Sheave Removal” instructions in Section 12-5.3.

10-5.8. Optional Belt Driven Alternator Front and Rear Bracket Installation

1. Install the brackets (Figure 10-17 or Figure 10-18) according to instructions in Section 17-7.2.
2. Install the alternator (1 or 12) according to the “Optional Belt Driven Alternator Installation” instructions in Section 10-5.4.
3. Install the V-belt (20 or 11) and adjust the belt tension according to instructions in Section 6-3.10.4.
4. Start the engine according to the “Engine Start” instructions in Section 7-3.2 and test the alternator output according to the aircraft maintenance manual.

10-6. Magneto Replacement

IO-360 series engine ignition system may feature Continental Motors magnetos or the engine ignition may be supplied by Champion (Slick). Locate the instructions that apply to the magneto installed on your engine model. Refer to the Illustrated Parts Catalog.

10-6.1. Continental Motors Magneto Removal

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.
2. Remove the nut (Figure 10-19)(8) and washer (9) and disconnect the aircraft wiring from the magneto switch terminal according to the aircraft maintenance manual.
3. Disconnect the two magneto tachometer leads from the housing, if installed.
4. Remove the four screws (3) from the harness outlet plate (part of item 2 connected to ignition wires).
5. Remove harness outlet plate and harness (2) from magneto (1).
6. Remove nuts (5), lock washers (6) and hold washers (7) from both sides of the magneto (1).

   CAUTION: Remove the magneto carefully to avoid dropping the coupling bushing into the accessory case.

7. Remove magneto (1) from accessory case.
8. Remove and discard gasket (4).
9. Perform an “Ignition System Inspection” according to Section 6-3.15 instructions.
10. Refer to the Ignition System Service Support Manual (X42002 for SC-20/SC-200 Series Magnetos) for applicable magneto maintenance instructions.

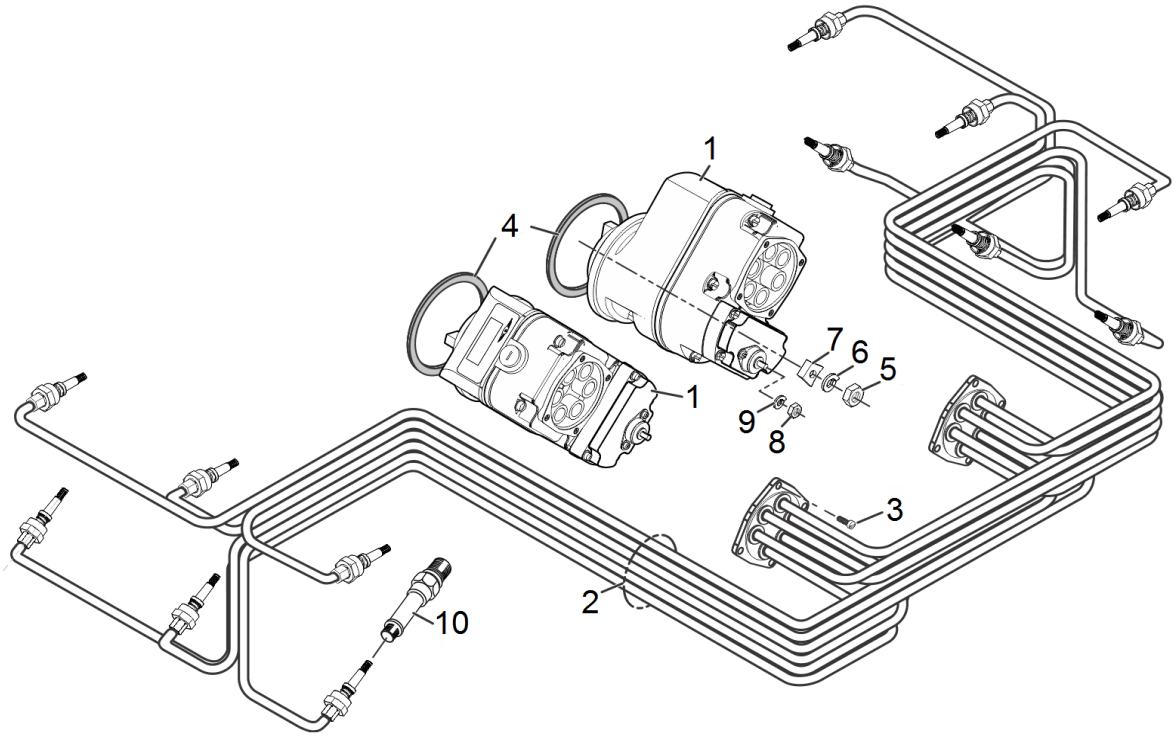


Figure 10-19. Continental Motors Ignition System

1	Magneto	4	Gasket	7	Hold Washer	10	Spark Plug
2	Harness	5	Nut	8	Nut		
3	Screw	6	Lock Washer	9	Lock Washer		

10-6.2. Champion (Slick) Magneto Removal

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.
2. Disconnect the aircraft wiring from the magneto switch terminal according to the aircraft maintenance manual.
3. Remove the three screws (Figure 10-20)(8) from the cable outlet plate (part of item 2 connected to ignition wires).
4. Remove harness outlet plate and harness (2) from magneto (1).
5. Remove nuts (4), lock washers (5) and hold washers (6) from both sides of the magneto (1).

   CAUTION: Remove the magneto carefully to avoid dropping the coupling bushing into the accessory case.
6. Remove magneto (1) from accessory case.
7. Remove and discard gasket (3).
8. Perform an “Ignition System Inspection” according to Section 6-3.15 instructions.
9. Refer to the manufacturer’s ICA for applicable magneto maintenance instructions.

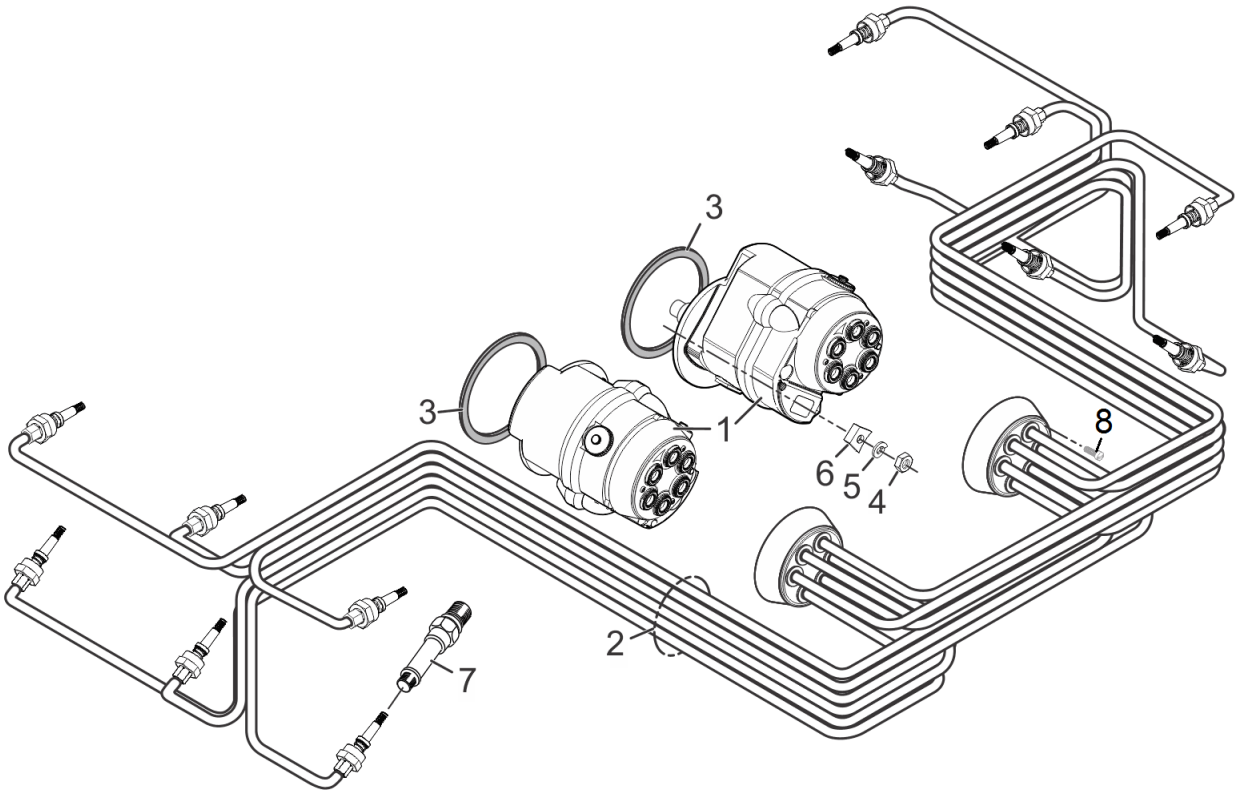


Figure 10-20. Champion (Slick) Ignition System

1	Magneto	3	Gasket	5	Lock Washer	7	Spark Plug
2	Harness	4	Nut	6	Hold Washer	8	Screw

10-6.3. Ignition System Service Limits

The ignition system component service limits are shown in Table 10-8. Index numbers in the first column correspond to the numbers in Figure 10-21.

Table 10-8. Ignition System Service Limits

Index	Description	Service Limit	New Part Minimum (inches)	New Part Maximum (inches)
1	Magneto gear support shaft to bearing .....diametric clearance	0.002L	0.0003L	0.0012L
2	Sleeve in drive gear.....diametric clearance	---	0.0015T	0.0036T
3	Washer in drive gear .....diametric clearance	---	0.0000	0.0021T
4	Magneto coupling retainer on gear sleeve .....diametric clearance	0.055L	0.025L	0.045L
5	Magneto coupling retainer in drive gear slot .....total side clearance	0.040L	0.006T	0.036L
6	Magneto coupling rubber bushings on magneto drive lugs (replace if worn).....side clearance Magneto pilot in crankcase cover.....diametric clearance	--- ---	0.052T 0.001L	0.010L 0.005L
7	Magneto gear to camshaft gear .....backlash	0.016	0.012	0.014
T = Tight L = Loose				

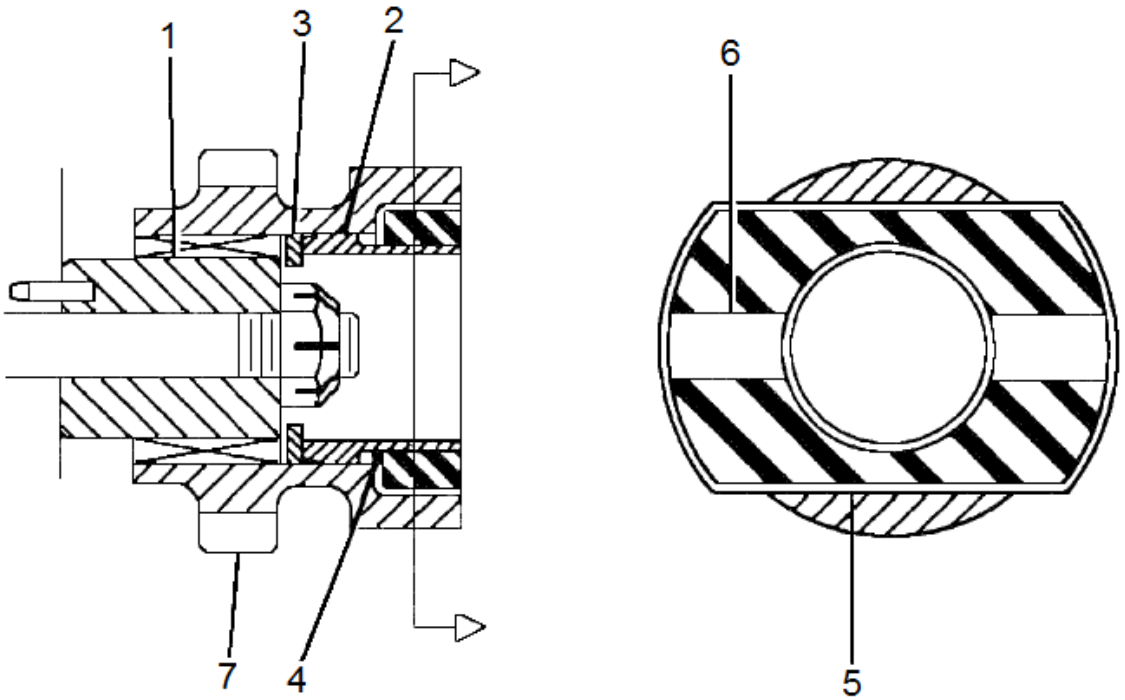


Figure 10-21. Magneto Drive Assembly Dimensions

10-6.4. Continental Motors Magneto Installation

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.
2. Complete the "Crankshaft Top Dead Center Alignment" in Section 6-3.9.1.1.
3. Verify the magneto drive coupling bushings and retainer are properly installed.
4. Perform steps 2 and 3 of the "Magneto to Engine Timing" in Section 6-3.9.1.2.
5. Remove the inspection hole plug from the magneto(s). Turn the magneto coupling backwards until the marked distributor gear tooth is centered in the window.
6. Without turning the magneto coupling, hold the magneto in the position it will occupy when installed.
   a. Align the magneto drive gear coupling slot and the magneto lugs by pulling the magneto drive gear assembly out of accessory case and turning it to the desired position.
   b. Install the magneto drive gear assembly back into the engine.

   NOTE: Ensure magneto drive gear assembly coupling bushings and retainers are properly installed.
7. Install the new gasket (Figure 10-19)(4) on the magneto (1) flange.
8. Carefully insert the magneto (1) in the accessory case, mate the magneto lugs with the magneto drive gear coupling slots.
9. Install two hold washers (7), new lock washers (6) and nuts (5). Snug down but do not tighten nuts as you must be able to rotate the magneto to make timing adjustment.
10. Install the inspection hole plug removed for the inspection.
11. Complete "Magneto to Engine Timing" in Section 6-3.9.1.2.
12. Disconnect timing light from magnetos.
13. Attach the aircraft wiring harness to the magneto switch terminal according to the aircraft maintenance manual.
14. Install the spark plugs and ignition harness according to instructions "Ignition System Maintenance" in Section 6-3.9.
15. Start the engine according to the "Engine Start" instructions in Section 7-3.2 instructions and perform a "Magneto RPM Drop Check" according to the instructions in Section 6-3.7.5.

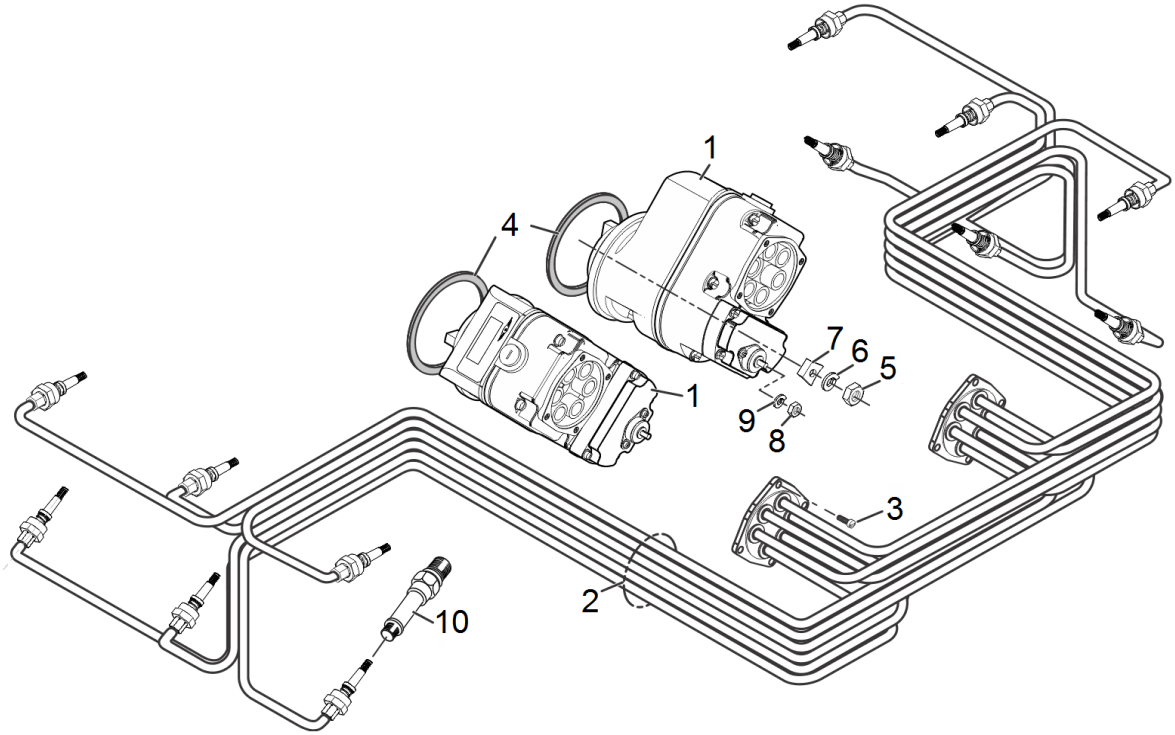


Figure 10-19 repeated for reference

10-6.5. Champion (Slick) Magneto Installation

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.
2. Complete the "Crankshaft Top Dead Center Alignment" in Section 6-3.9.1.1.
3. Perform steps 2 and 3 of the "Magneto to Engine Timing" in Section 6-3.9.1.2.
4. Insert T118 timing pin in "L" or "R" hole (depending on magneto rotation) in the distributor block. Turn rotor in the opposite direction of rotation until pin engages the gear.
5. Without turning the magneto coupling, hold the magneto in its approximate installed position.
   a. Align the magneto drive gear coupling slot and the magneto lugs by pulling the magneto drive gear assembly out of accessory case and turning it to the desired position.
   b. Install the magneto drive gear assembly back into the engine.

   NOTE: Ensure magneto drive gear assembly coupling bushings and retainers are properly installed.
6. Install the new gasket (Figure 10-20)(3) on the magneto (1) flange.
7. Carefully insert the magneto (1) in the accessory case, aligning the drive coupling lugs to mate with the drive bushing slot.
8. Install two hold washers (6), new lock washers (5) and nuts (4). Snug down but do not tighten nuts as you must be able to rotate the magneto (1) to make timing adjustment.

   CAUTION: Remove the T118 timing pin before rotating the crankshaft to prevent magneto damage.
9. Remove the T118 timing pin.
10. Complete "Magneto to Engine Timing" in Section 6-3.9.1.2.
11. Disconnect timing light from magnetos.
12. Attach the aircraft wiring to the magneto switch terminal according to the aircraft maintenance manual.
13. Install the spark plugs and ignition harness according to instructions "Ignition System Maintenance" in Section 6-3.9.
14. Start the engine according to the "Engine Start" instructions in Section 7-3.2 instructions and perform a "Magneto RPM Drop Check" according to the instructions in Section 6-3.7.5.

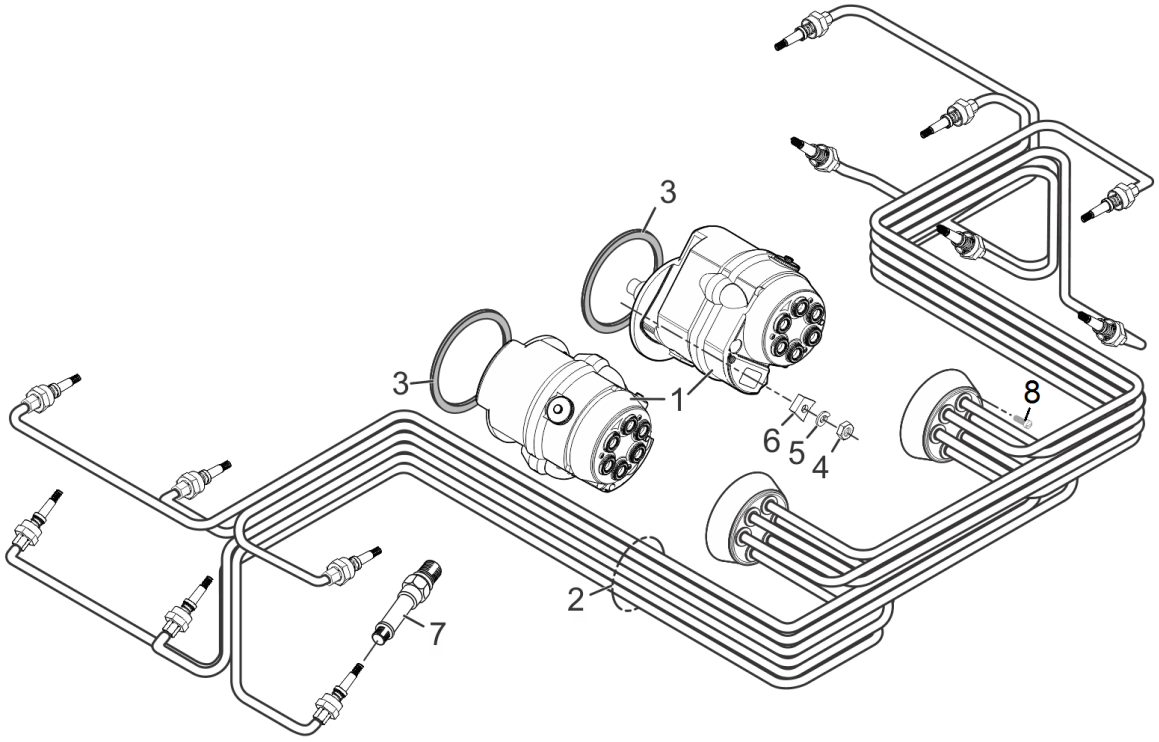


Figure 10-20 repeated for reference

10-7. Lubrication System Repair and Replacement

10-7.1. Oil Filter Adapter Stud Replacement

If the threads on the oil filter adapter stud are worn or damaged, replace the stud.

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.
2. Drain the oil and remove the oil filter according to the "Oil Change" instructions in Section 6-3.8.2 but do not refill the oil at this time.
3. Replace the oil filter adapter stud according to the instructions in Section 15-8.7.3. When stud replacement is complete, complete the oil change.
4. Perform the "Oil Pump Operational Check" according to instructions in Section 6-3.7.3.

10-7.2. Oil Pump Repair and Replacement

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.
2. Remove malfunctioning oil pump or oil pump components by removing the oil pump according to the "Oil Pump Removal" instructions in Section 12-10.
3. Inspect the oil pump components according to the "Lubrication and Accessory Case Service Limits" in Section 10-7.7. Replace parts that do not meet the dimensional specifications.
4. Install the new oil pump according to instructions in Section 17-5.

   NOTE: Repairs other than smoothing nicks on parting surfaces, replacing studs and worn parts, and refacing the oil pressure relief valve seat on the accessory case are prohibited. The pump driven gear shaft is pressed into the pump housing and is not field replaceable. The pump gear chamber must not be enlarged. If the gear chamber becomes scored or enlarged, discard and replace the accessory case. Scoring on the gear contact area of the oil pump cover renders it unserviceable unless the parting surfaces can be lapped smooth and perfectly flat.

5. Perform an "Oil Pump Operational Check" according to instructions in Section 6-3.7.3.

10-7.3. Oil Sump and Oil Suction Tube Repair and Replacement

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.

   NOTE: For most engine installations, the engine must be removed from the aircraft to remove the oil sump. Follow appropriate engine removal instructions in Chapter 5.

2. Remove the oil sump and oil suction tube according to the "Oil Sump Removal" instructions in Section 12-11.
3. Install a new oil sump and suction tube according to the "Oil Sump and Suction Tube Installation" instructions in Section 17-4.
4. Perform an "Oil Pump Operational Check" according to instructions in Section 6-3.7.3.

10-7.4. Oil Cooler Repair and Replacement

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.
2. Remove the oil cooler according to the "Oil Cooler Removal" instructions in Section 12-9.
3. Send the oil cooler to an appropriately rated FAA Part 145 Repair Station; No structural repairs are allowed on the oil cooler.
4. Replace any oil cooler exhibiting structural damage, i.e. bent/broken or cracked cooling fins, with a new or serviceable oil cooler. Weld repairs to the oil cooler mounting flange must be accomplished by an appropriately rated FAA Part 145 Repair Station.
5. Install the serviceable oil cooler according to the "Oil Cooler Installation" instructions in Section 17-8.
6. Service the engine according to "Engine Pre-oiling" instructions in Section 5-3.4.
7. Perform a normal "Engine Start" (Section 7-3.2) and "Ground Run-up" (Section 7-3.3) according to instructions in Chapter 7 to verify the lubrication system operates within the engine specifications and operating limits in Chapter 2.

10-7.5. Oil Pressure Relief Valve Repair and Replacement

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

2. Cut, remove, and discard the safety wire from the oil pressure relief valve assembly located on the LHS of the accessory case (Figure 10-22)(1).
3. Remove the stop nut (9) and copper washer (8) from the adjusting screw (6). Discard the copper washer.
4. Remove the oil pressure relief valve cap (7), adjustment screw (6), copper gasket (5), spring (4), spring (3) and plunger (2) from the accessory case (1). Discard the copper gasket.
5. Inspect the oil pressure relief valve plunger (2) and valve seat on the accessory case for scoring, nicks, and rough spots. If the plunger has scoring, nicks, or roughening, replace the oil pressure relief valve plunger. If the accessory case valve seat is nicked or the surface is rough, reface the valve seat according to instructions in Section 15-8.7.2.
6. Inspect the oil pressure relief springs using the service limits in Table 10-9. Replace the oil pressure relief springs if they do not meet the service limits.
7. Assemble and install the serviceable oil pressure relief valve components according to instructions in Section 17-5.
8. Perform an “Oil Pump Operational Check” according to instructions in Section 6-3.7.3.

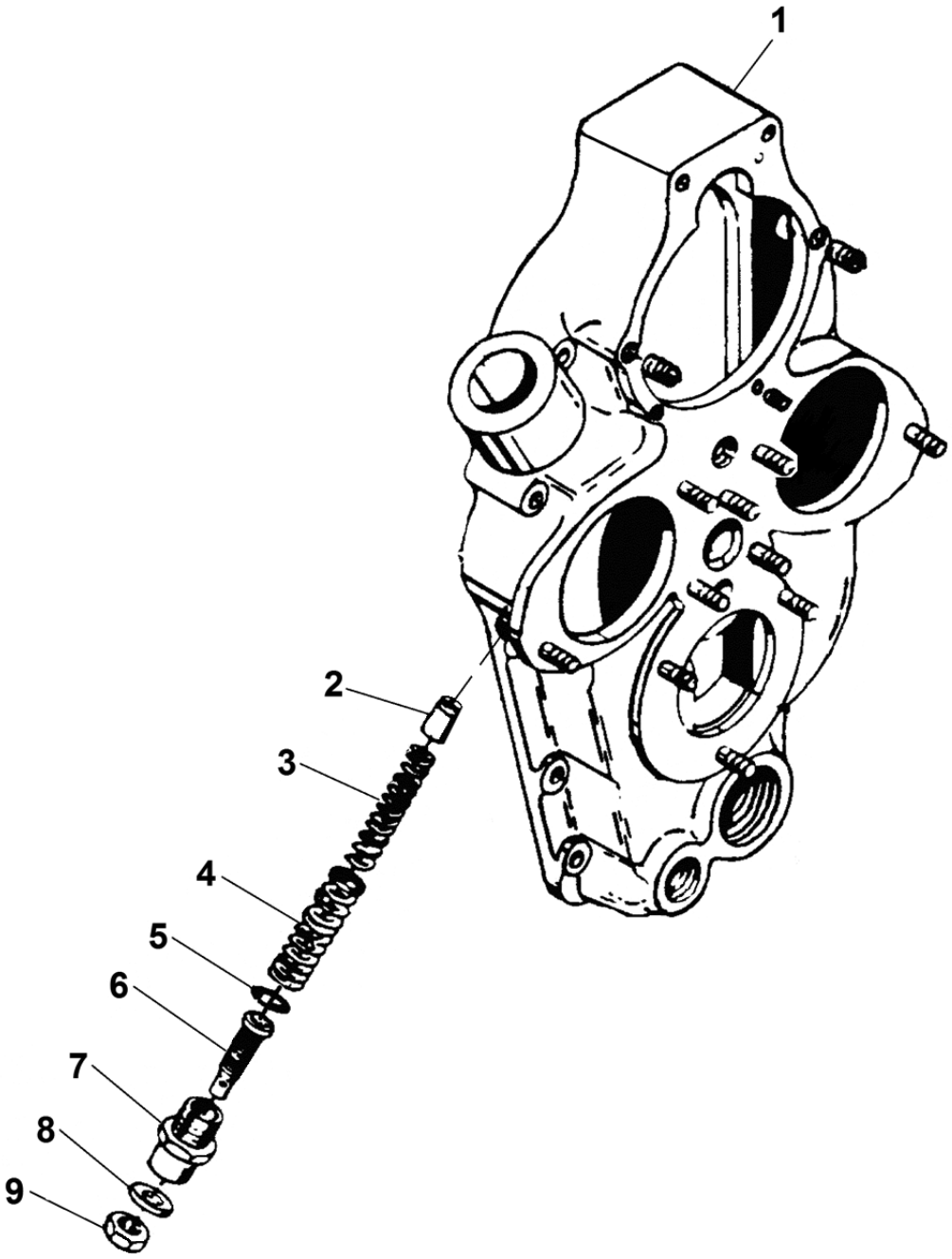


Figure 10-22. Oil Pressure Relief Valve

1	Accessory Case	4	Spring	7	Relief Valve Cap
2	Plunger	5	Copper Gasket	8	Copper Washer
3	Spring	6	Valve Adjustment Screw	9	Stop Nut

10-7.6. Oil Temperature Control Valve Inspection and Replacement

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

2. Cut, remove, and discard the safety wire from the oil temperature control valve housing located on the oil cooler.
3. Remove the oil temperature control valve and washer. Discard the washer.
4. Inspect the conical valve seat (Figure 10-23) of the oil temperature control valve for scoring and nicks. If the valve seat is nicked or scored, replace the valve.
5. Visually inspect the valve seat on the oil cooler.
6. Use service limits in Table 10-9 to verify oil temperature control valve opens and closes within limits, if suspected bad.
7. Apply P/N 646943 Anti-seize Lubricant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the threads on the oil temperature control valve where shown in Figure 10-23.
8. Install the oil temperature control valve with a new washer. Torque the oil temperature control valve to Appendix B specifications and safety wire according to the instructions in Appendix C-3.
9. Perform an “Oil Pump Operational Check” according to instructions in Section 6-3.7.3.

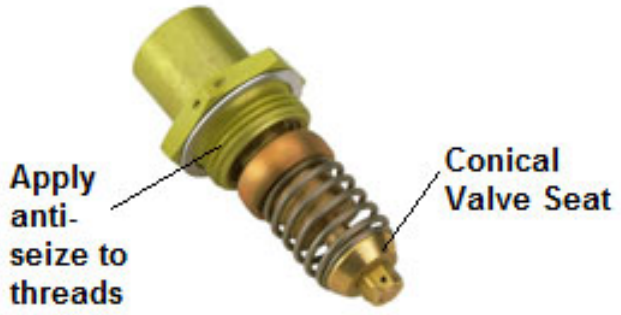


Figure 10-23. Oil Temperature Control Valve

10-7.7. Lubrication and Accessory Case Service Limits

Lubrication and Accessory Case Service Limits are shown in Table 10-9. Index numbers in the first column correspond to the item numbers in Figure 10-24.

Table 10-9. Lubrication and Accessory Case Service Limits

Index	Description	Service Limit	New Part Minimum (Inches)	New Part Maximum (Inches)
1	Oil pump gears in housing ..... diametric clearance	0.006L	0.0016L	0.004L
2	Oil pump gears in housing ..... end clearance	0.006	0.001	0.004
3	Oil pump gear shaft in housing bushing..... diametric clearance	0.004L	0.0005L	0.002L
4	Oil pump driven gear on shaft..... diametric clearance	0.004L	0.0005L	0.002L
5	Oil pump shafts in cover..... diametric clearance	0.004L	0.0005L	0.002L
6	Driver gear shaft in oil pump drive gear ..... diametric clearance	0.003L	0.0005L	0.002L
7	Alternator pilot in cover ..... diametric clearance	---	0.001L	0.005L
8	Oil seal in alternator ..... diametric clearance	---	0.001T	0.007T
9	Alternator coupling retainer on sleeve[1] ..... diametric clearance	0.032L	0.016L	0.026L
10	Alternator drive hub[2] .....torque before slippage	100 in. lbs.	---	100 in. lbs.
11	Coupling retainer in coupling hub slot[1] ..... side clearance	---	0.010T	0.025L
12	Coupling bushing on drive gear lugs[1] .....total side clearance (replace if worn)	---	0.010L	0.043T
13	Alternator gear on sleeve[1] ..... diametric clearance	---	0.001L	0.003L
14	Oil pump driver to driven gear..... backlash	0.027	0.014	0.0218
15	Alternator gear to camshaft gear..... backlash	0.0019	0.010	0.014
16	Drive gear to camshaft gear..... backlash	0.019	0.010	0.014
Oil Temperature Control Valve		Minimum PSI	Minimum Temp	Maximum Temp
0.090 inch minimum travel at ..... temperature		---	120°F	170°F
Valve must be fully closed against seat at ..... temperature		---	168°F	172°F
Valve must crack open at 180°F .....PSI		18		
Oil Pressure Relief Valve Compression Values (Troubleshooting Purposes Only)		Free Length	Load Length	Load
Spring, Inner		3.52 in.	1.49 in.	5.0 lbs.
Spring, Outer		2.7 in.	1.56 in.	7.3 lbs.
T= Tight L=Loose				

1. Tang drive only
2. One piece coupling only. No slippage is permitted below 100 in. lbs.

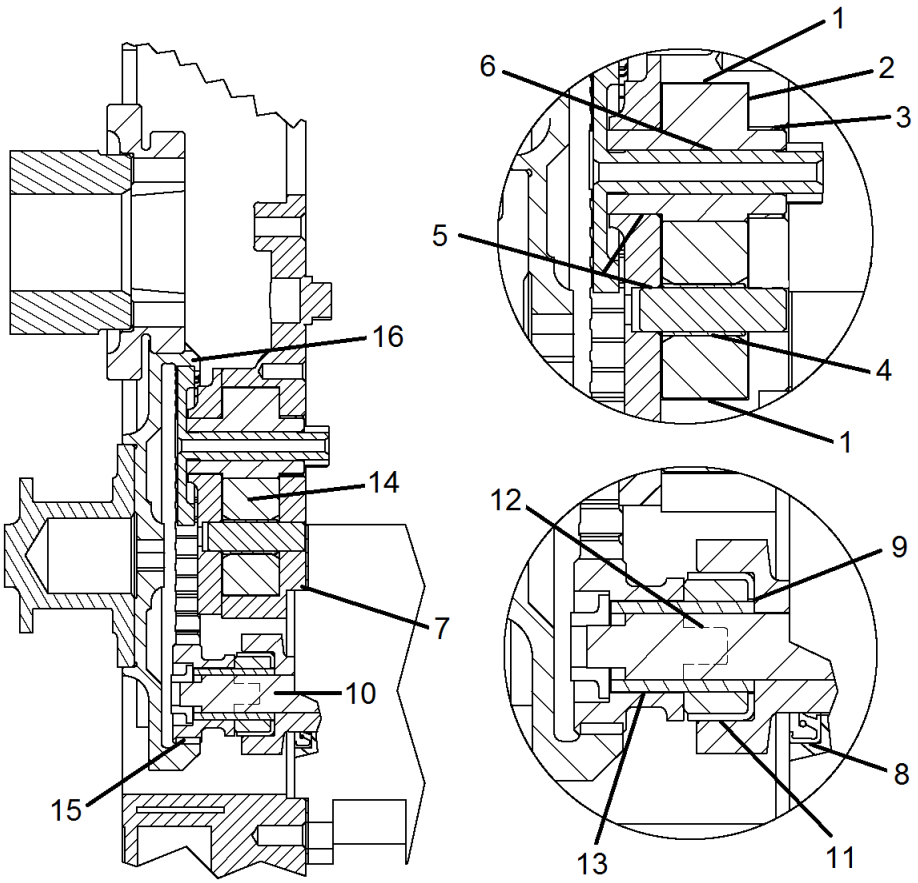


Figure 10-24. Lubrication and Accessory Case Service Limits

10-8. Engine Cylinder Maintenance

Procedures in this section apply to engine cylinder repair, service, or replacement on condition as a maintenance item and not for engine overhaul. These instructions may be used to replace one or more cylinders as a service action. Refer to instructions in Chapters 12 through 17 for multiple cylinder replacement during overhaul.

The IO-360 series engine features cross flow cylinders having individual rocker covers over the intake and exhaust valve assemblies.

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

Prior to any cylinder maintenance, perform the following:

1. Turn the Ignition Switch to the OFF position and disconnect engine electrical power.
2. Position the fuel shutoff valve to the CLOSED position.
3. Disconnect the battery in accordance with the aircraft maintenance manual.
4. Remove cowling and any aircraft supplied accessories in accordance with the aircraft maintenance manual.
5. Disconnect the ignition harness from the spark plugs on all cylinders.
6. Remove at least one spark plug from each cylinder to avoid developing compression during crankshaft rotation.

10-8.1. Rocker Arm Removal

1. Perform the preliminary steps in Section 10-8 prior to rocker arm removal.
2. Position the crankshaft so the piston is at top dead center and both intake and exhaust valves of the rocker arms to be removed are closed.
3. Remove the screws (Figure 10-25)(34), screws (35)(except A and AB), lock washers (33), and washers (32) and the rocker covers (29 and 30)(except A and AB) from the cylinder. Discard the lock washers.

   NOTE: Screws (35) and rocker cover (30) are installed on cylinder #2 only.

4. Remove and discard the rocker cover gaskets (28).
5. Bleed the hydraulic lifters (48) down by applying steady pressure to the push rod (43) end of the rocker (20) arm; hydraulic lifter pressure relief should be obvious.
6. Bend the tab washers (26) ears down and remove the nuts (27), tab washers, thrust retainers (25). Discard the tab washers.
7. Remove the rocker (20), rocker shafts (23) and thrust washers (24) from the cylinder.

8. Withdraw the push rods (43) from the push rod housing (38). Mark the location and position of removal to ensure the installation is in the same position and location.
9. Inspect the rocker assemblies and push rods according to instructions in Section 10-8.4.

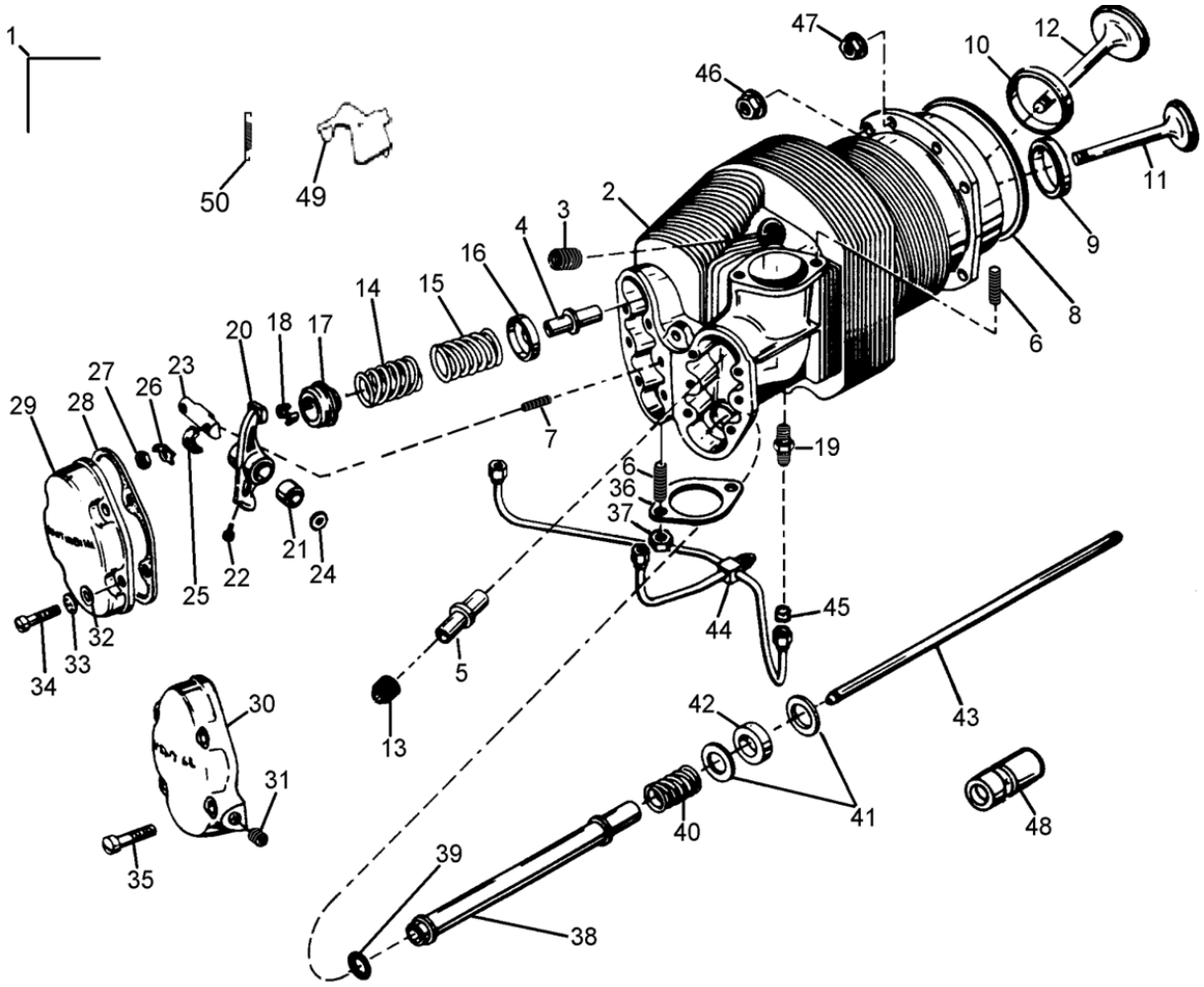


Figure 10-25. Cylinder Assembly

1	Cylinder Assembly	14	Inner Valve Spring	27	Nut	40	Spring
2	Cylinder	15	Outer Valve Spring	28	Gasket	41	Washer
3	Insert	16	Valve Spring Seat	29	Rocker Cover	42	Seal
4	Exhaust Valve Guide	17	Rotocoil	30	Rocker Cover	43	Push Rod
5	Intake Valve Guide	18	Valve Spring Key	31	Insert	44	Drain Tube Assembly
6	Stud	19	Male Connector	32	Washer	45	Compression Seal
7	Stud	20	Rocker	33	Lock Washer	46	Flanged Nut
8	Packing	21	Bushing	34	Screw	47	Flanged Nut
9	Exhaust Valve Seat Insert	22	Screw	35	Screw	48	Hydraulic Lifter
10	Intake Valve Seat Insert	23	Rocker Shaft	36	Flange Gasket	49	Baffle
11	Exhaust Valve	24	Thrust Washer	37	High Nut	50	Spring
12	Intake Valve	25	Thrust Retainer	38	Push Rod Housing		
13	Intake Valve Guide Seal	26	Tab Washer	39	O-ring		

10-8.2. Hydraulic Lifter Removal

1. Remove the rocker arm and push rod assemblies according to instructions in Section 10-8.1.
2. Grasp the push rod housing (Figure 10-26)(38) and push it inward toward the crankcase, compressing the push rod housing spring (40); lower the cylinder end of the push rod housing away from the cylinder assembly. Remove the push rod housing (38), spring (40), washers (41), o-ring (39) and seal (42). Discard the o-ring and seal. Repeat this step for the remaining push rod housings to be removed.
3. Remove the hydraulic lifter (48) from the crankcase bore by rotating the cam to lift the hydraulic lifter above the lifter bore. Use fingers or non-ferrous (copper or brass) wire to extract the hydraulic lifter from the crankcase lifter bore.
   a. Identify the location from which the lifter is removed, they must be installed (if serviceable) in the same location from which they were removed.
   b. Inspect the hydraulic lifter, lifter bore and cam lobe for nicks, scratches, gouging, spalling or galling using the inspection guidance in Chapter 15 and dimensions per Table 10-12. Replace the hydraulic lifter which exhibits face or body wear exceeding 10% of the surface area. If hydraulic lifter requires replacement, inspect the cam lobe of the associated valve for abnormal wear.

   NOTE: Hydraulic lifter assemblies are not rebuild or overhaul candidates. Replace unserviceable hydraulic lifter assemblies with new assemblies.
4. Inspect the hydraulic lifter retaining rings and push rod cups. If the spring is collapsed or the spring will not compress, replace the hydraulic lifter. Replace the hydraulic lifter which exhibits faulty retaining rings, damaged push rod cups, or appears to have collapsed or stuck spring mechanisms.

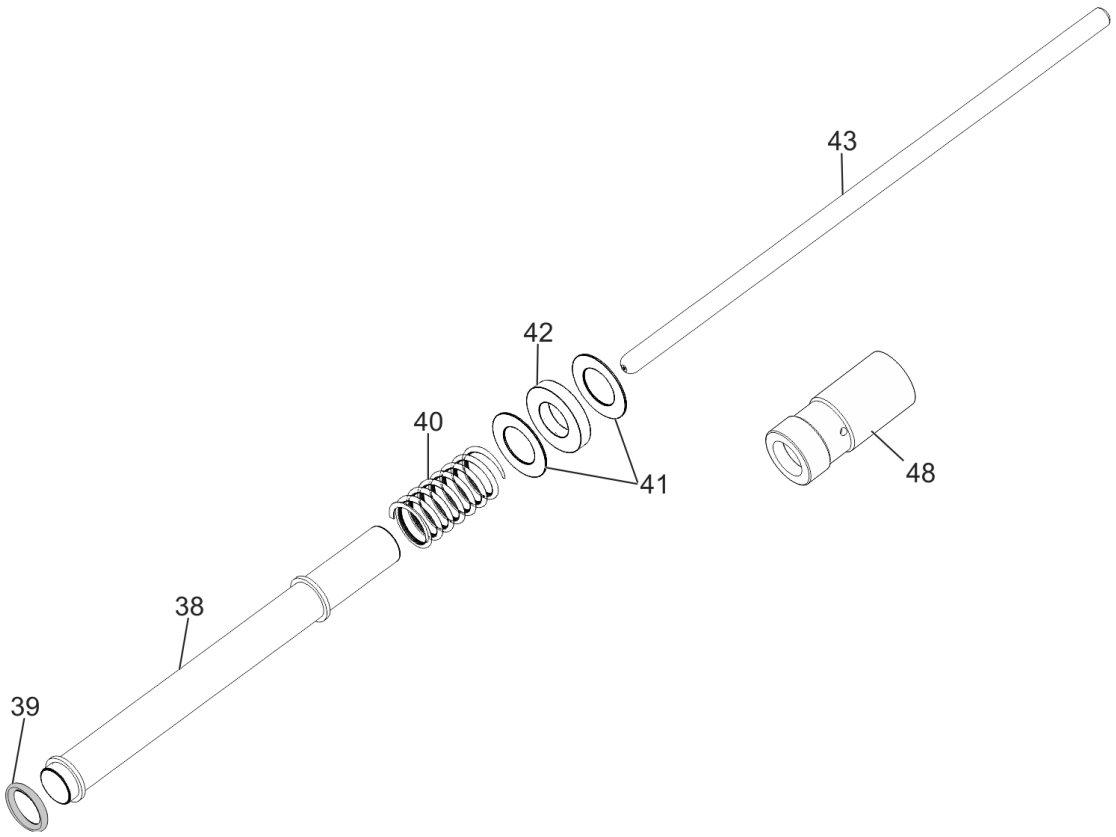


Figure 10-26. Push Rod Tube Assembly

see Figure 10-25 for index

10-8.3. Cylinder Removal

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Remove the rocker covers, rocker arms, and push rods according to the instructions in Section 10-8.1.
2. Remove the push rod tubes and hydraulic lifters according to instructions in Section 10-8.2.
3. Remove the inter-cylinder baffles adjacent to the cylinder to be removed according to instructions in Section 12-12, if applicable to engine model.
4. Disconnect spring (Figure 10-25)(50) and remove baffle (49) and spring.
5. Disconnect the Induction System components from the cylinder according to instructions in Section 12-3.
6. Remove the fuel injector from the cylinder according to instructions in Section 10-3.

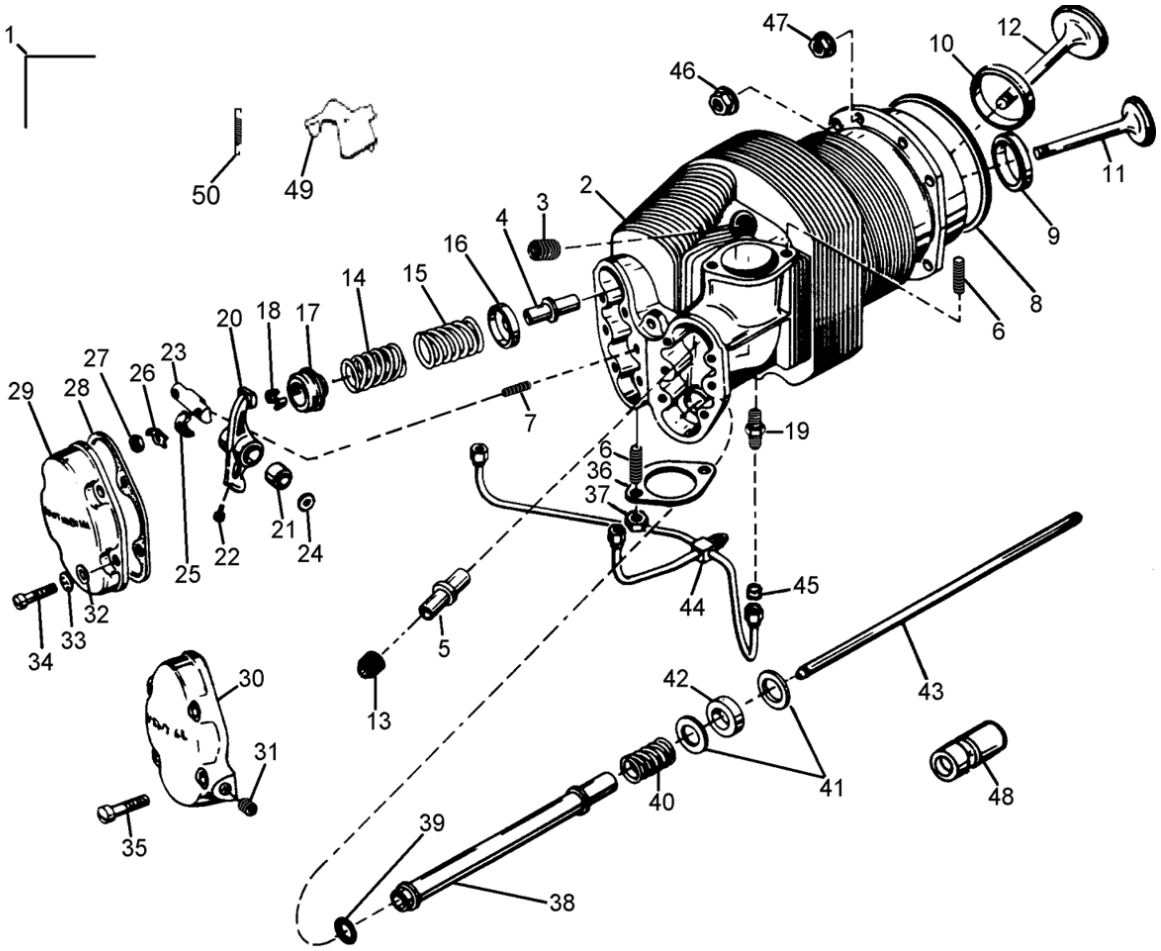


Figure 10-25 repeated for reference

7. Remove the exhaust system components according to the applicable aircraft maintenance manual.
8. Loosen and remove cylinder drain tubes (44).
9. Remove and discard the compression seals (45).
10. Remove the connectors (19).
11. While removing an engine cylinder, inspect components for wear and conformance to dimensional criteria. Replace any component based on the following:
    a. Only parts that meet *service limits* may remain in service or be re-used.
    b. If a part fails to meet a service limit tolerance, replace it with a part that meets the specified service limits.
12. Using the appropriate wrenches, carefully remove the flange nuts (46 and 47) from the cylinder base flange.
13. As the last pieces of fastening hardware are removed, cradle the cylinder in your arm for support.

    CAUTION: The crankcase flange and piston will be damaged if the connecting rod is allowed to fall against the cylinder mounting deck as the cylinder is withdrawn.

14. While supporting the cylinder, carefully pull the cylinder outward in a straight plane with one hand, keeping the other hand free to catch the piston as the cylinder is withdrawn to prevent damage to the crankcase, cylinder or piston.

    CAUTION: Remove the cylinder base packing (8) and wrap the removed packing in a figure 8 (Figure 10-27) pattern around the crankcase studs to support the connecting rod.

15. Remove the cylinder base packing (8). Install the old packing in a figure 8 pattern similar to the illustration in Figure 10-27.

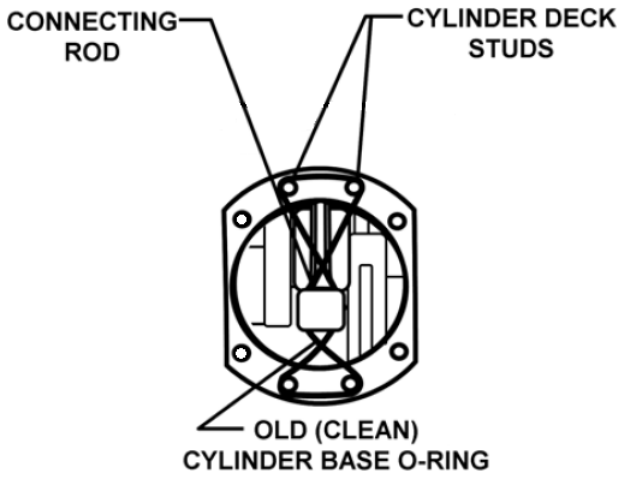


Figure 10-27. Packing Installed to Stabilize Connecting Rod

16. Remove the piston pin and plug assembly (Figure 10-28)(6) and piston (1) from the connecting rod.
17. Remove and discard the piston rings (2, 3, 4 and 5).

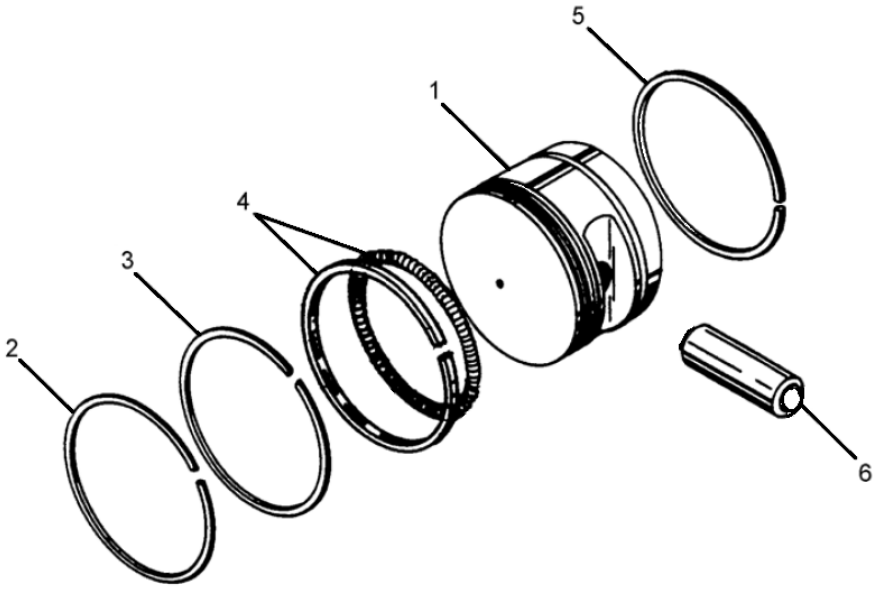


Figure 10-28. Piston, Piston Pin and Piston Rings

1	Piston	4	Oil Control Ring
2	Top Compression Ring	5	Scraper Ring
3	Second Compression Ring	6	Piston Pin and Plug Assembly

18. Refer to Chapters 13 though 15 for instructions on cylinder disassembly, cleaning, inspection and repair.
    a. Clean the cylinder according to “Cylinder Cleaning” instructions in Chapter 12-1.1 of M-0, Standard Practice Maintenance Manual.

    CAUTION: Do not use automotive-type piston scrapers to clean piston ring lands.

    b. Clean the piston according to “Piston Cleaning” instructions in Chapter 12-1.2 of M-0, Standard Practice Maintenance Manual.
    c. Perform a “Fluorescent Penetrant Inspection” and “Magnetic Particle Inspection” on the cylinder according to instructions in Chapter 11 of M-0, Standard Practice Maintenance Manual.
    d. Perform a dimensional inspection on the cylinder, the piston, and components according to the “Engine Cylinder Dimensional Inspection” instructions in Section 15-7.3, using the “Cylinder Assembly Service Limits” in Section 10-8.4.1.
19. Perform a static leak check on the cylinder
    a. Place a fiber drift on the rocker arm directly over the valve stem.

CAUTION: Do not allow the fiber drift to contact the valve spring retainer or rotocoil.

b. Tap the drift several times with a hammer to dislodge any debris that may be between the valve face and seat.

c. Invert the removed cylinder with the spark plugs installed.

d. Fill the inverted cylinder bore with nonflammable solvent.

e. Look for leaks in the static seal area (Figure 10-29) of the cylinder. Pay particular attention to the barrel to cylinder head junction. If the cylinder head and barrel seal is leaking, discard the cylinder. If the intake or exhaust seat seals or the spark plug seals are leaking, note the discrepancy and perform the appropriate repairs according to Chapter 15.

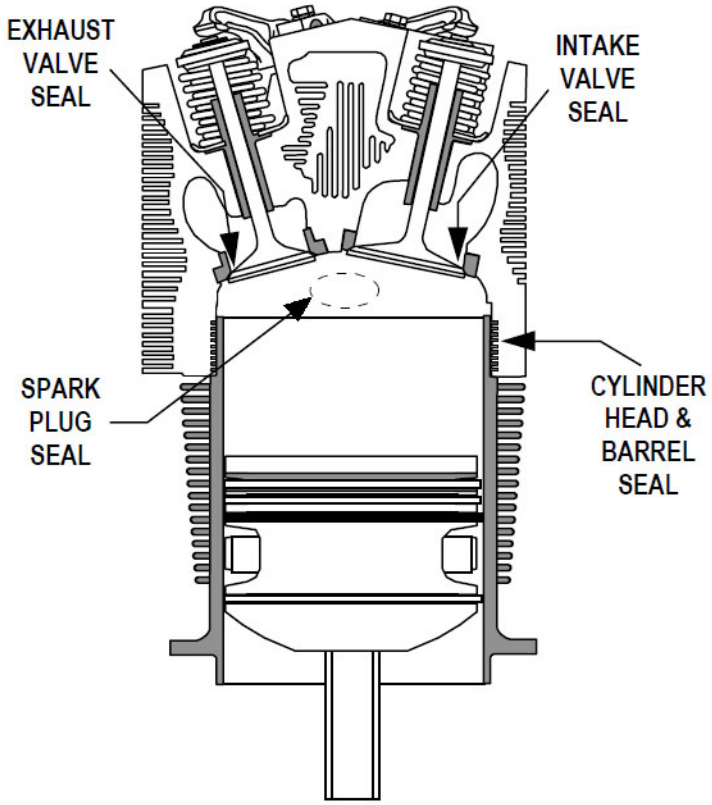


Figure 10-29. Static Seal

20. Assemble serviceable cylinder according to the “Engine Cylinder Assembly” instructions in Section 16-5.

21. Install the cylinder according to the “Cylinder Installation” instructions in Section 10-8.5.

10-8.4. Engine Cylinder Dimensional Inspection

Refer to the appropriate sections in Table 10-10 for the correct service limits.

1. Inspect the “power stroke stress areas” according to instructions in Section 6-3.11.1, “Cylinder Visual Inspections.”
2. Inspect cylinder bore dimensions according to the specifications in Table 10-10 and Table 10-11. Grind cylinder bores that do not conform to the standard size dimensions to the next oversize dimension up to 0.015 inches oversize maximum. (Refer to “Cylinder Bore Honing” in Section 15-8.8.6 for cylinder barrel grinding and honing instructions.)
3. Inspect the cylinder base flanges for flatness with a straightedge and a feeler gauge. If a flange exceeds 0.001 inches out of flat, replace the cylinder.
4. Inspect the intake and exhaust flange studs and rocker shaft hold down studs for security. If studs are loose, or bent or if the threads are damaged or disfigured, determine the appropriate oversize stud and replace according to instructions in Appendix C.
5. If cylinder studs are removed for replacement, dimensionally inspect the stud holes using a thread gauge to determine the appropriate oversize replacement stud.
6. Dimensionally inspect the inside diameter of the valve guides at locations in the upper 1/3 and center 1/3 of the valve guide length using the service limits in Table 10-10. Replace cracked, eroded, burned, or pitted valve guides or those which fail to meet the service limit dimensional specifications.
7. Inspect the intake and exhaust valve seats for evidence of burning, pitting, erosion, or cracks. Check the valve seat dimensions according to Table 10-10. Replace cracked, eroded, burned or pitted valve seats, or those which do not conform to the service limit.
8. Perform a visual inspection on the intake and exhaust valves; if the valve face is mushroomed, or if the valve face exhibits seat pounding (face angle is concave), or the valve exhibits burns, cracks, pitting, erosion, or corrosion, replace the valves.
9. Using a V-block with a surface plate and a dial indicator, inspect each intake and exhaust valve face for runout (eccentricity). Replace valves if they exceed the runout specification in Table 10-10.
10. Perform a dimensional inspection on the intake and exhaust valves using the service limits in Table 10-10. Replace the valve if they fail to meet the service limits or cannot be restored to service limits by grinding according to the instructions in Section 10-8.4.2.
    a. Clean the valves with mineral spirits and allow to dry.
    b. Use a precision valve grinding machine to restore the valve contact seat dimensions and geometry to the service limits specified in Section 10-8.4.1.
        1) Thickness from the gage line to the bottom of the valve and gage line outer diameter must not be less than the specified service limit. Discard valves if

the overall length (stem to gage line plus gage line to bottom) is less than the service limit or if the outer diameter of the valve at the gage line is less than the minimum specified.

2) After grinding the face, measure from the gage line to the tip of the valve stem. If the valve exceeds the service limit, grind material from the tip to meet the service limit stem to gage line and overall lengths.

3) Clean the valves with mineral spirits and allow to dry to remove grinding residue.

c. Inspect the valve contact seat angle with an optical comparator after grinding; if the angles fail to meet the service limits, repeat the grinding process.

d. Inspect the surface finish of the valves with a profilometer; polish as required to meet the service limits.

e. Perform a "Fluorescent Penetrant Inspection" according to instructions in Chapter 11 of M-0, Standard Practice Maintenance Manual, on the intake and exhaust valves. Discard valves if cracks, or indications of cracks are detected.

11. Clean the valves using mineral spirits and air dry. When valves have dried, coat all valve surfaces thoroughly with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

12. Measure the diameter of the removed piston pin at three equally spaced points along the length of the piston pin in comparison to the dimensions specified in Table D-10. Rotate the piston pin 90° and repeat the measurements. The piston pin must meet the dimensional limits at each point, out of round is limited to 0.0002 inch. Discard piston pins exceeding the dimensional limits or out of round tolerance.

13. Measure the piston pin bore inside diameter to verify it meets Table D-10 dimensions. Insert the piston pin in the piston bore to verify the fit meets Table 10-10 specifications.

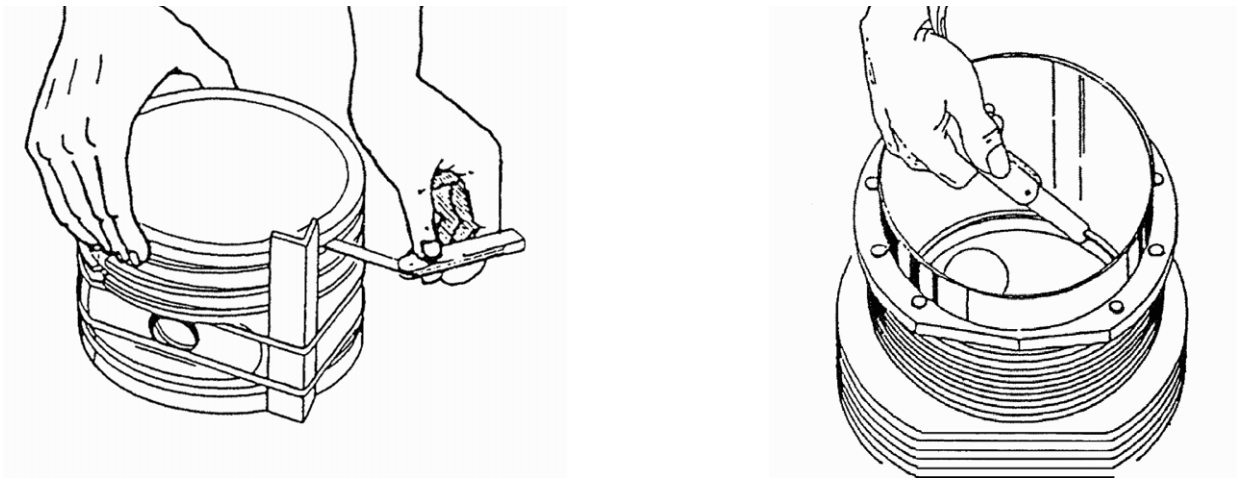


Figure 10-30. Measure Ring Side Clearance and Gap

14. Use a short length of angle stock, or a straight edge, with rubber bands (Figure 10-30) to hold the rings in the piston parallel to the piston ring land. Insert a feeler gauge below the ring, in the ring land, to measure ring side clearance. If side clearance does not meet Table 10-10 specifications, replace the piston rings. If new piston rings do not correct the situation, replace the piston.
15. Insert the piston rings in the cylinder, individually, with the ring part number to the top of the cylinder. Use the piston to position the ring to the depth specified and measure ring gap compared to Table 10-10 specifications. If ring gap exceeds the service limit, replace the piston rings.
16. Inspect the push rods for cracks, nicks, burrs, pitting or corrosion. Inspect the rod caps for cracks or erosion. Verify the rod cap oil passages are clear and the bores meet Service Limit specifications. Dimensionally inspect the push rods length and cap diameter with a micrometer and Service Limit specifications. Inspect runout with V-blocks and a dial indicator. The push rod runout service limit is 0.020” total indicator reading over the length of the push rod.

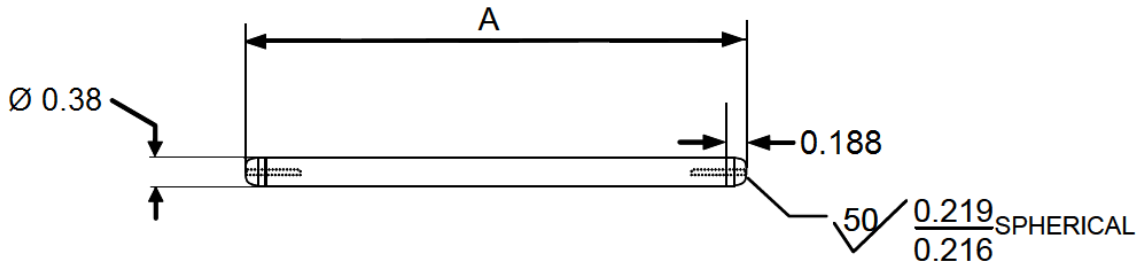


Figure 10-31. Push Rod Dimensions

“A” dimension	Min	Max
Standard	12.366	12.396
P030 Oversize	12.396	12.426

17. Inspect push rod housings for cracks, dents, bending or chafing damage; replace push rod housings exhibiting these conditions. Inspect push rod housings for rust, pitting or missing cadmium plating; replace push rod housings exhibiting these conditions.
18. Dry fit the rocker arms in the rocker arm boss to dimensionally inspect the rocker arm thrust width using dimensional specifications in Section 10-8.4.1. Replace rocker arms if they cannot be ground and polished to meet dimensional specifications.
    a. Inspect the rocker arm foot contact area for wear, galling, spalling, scoring, or grooves. Discard rocker arms exhibiting these conditions.
    b. Inspect the rocker arm ball seats for wear and smoothness. Discard rocker arms with gouged, scratched, etched, pitted or mushroomed ball seats.

c. Inspect the thrust surfaces of the rocker arm shaft bore for displaced metal, spalling, or galling. Discard rocker arms exhibiting these conditions if they cannot be smoothed to service limits.

d. Inspect rocker arm exhibiting peeling copper plating, which can be a source of contamination in oil and spectrographic oil analysis. Use a scotch-brite pad to remove loose copper plating material.

e. Inspect oil passages for obstructions. Use an oil squirt bottle with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual) to check oil passages for free flow. Discard rocker arms with blocked oil passages which cannot be cleared with solvent.

19. Inspect the intake and exhaust valve springs according to the dimensions in Section 10-8.4.1. Replace valve springs which fail the dimensional inspection or exhibit cracks, abnormal curvature or excessive wear.

20. Visually inspect the connecting rods for corrosion pitting, rust, discoloration (bluing), galling, impact damage, nicks, bending and twisting. Replace connecting rods with any of these indications.

WARNING

Removing and installing the piston pin bushing with makeshift tools will damage connecting rods.

21. Inspect the piston pin bushing for cracks, gouges or loss of material. Verify the piston pin bushing is installed with the split line at least 40 degrees away from the connecting rod centerline (see Figure D-19). Replace connecting rod piston pin bushings according to Chapter 15 instructions if these conditions exist.

10-8.4.1. Cylinder Assembly Service Limits

Refer to the "Cylinder Assembly Service Limits" in Table 10-10 and corresponding Figure 10-32 and Figure 10-33. Clean and dry the parts thoroughly according to "Engine Cleaning" instructions in Chapter 12 of M-0, Standard Practice Maintenance Manual. Remove oil and preservative material before performing the dimensional inspection. Discard and replace parts that do not conform to the specified tolerances.

WARNING

Use only parts that meet specified service limits.

Table 10-10. Cylinder Assembly Service Limits

Index	Description	Service Limit	New Part Minimum (inches)	New Part Maximum (inches)
	Cylinder Assembly			
1	Cylinder bore (lower 4-1/4 inch of barrel)....diameter	See Table 10-11		
2	Cylinder bore at "Y" location .... choke	See Table 10-11		
3	Cylinder bore at "X" location .... choke	See Table 10-11		
4	Cylinder bore out of round .... tolerance	0.003	0.000	0.001
5[1]	Cylinder bore surface cross hatch.... angle	---	22° - 32°	---
	Micro finish (measured in direction of piston travel).... Ra	---	30	55
6	Cylinder barrel in crankcase ....diametric clearance	---	0.003L	0.011L
7	Intake valve guide in cylinder head....diametric clearance	---	0.001T	0.0025T
	Intake valve guide....finished inside diameter	---	0.3745	0.3755
8	Exhaust valve guide in cylinder head....diametric clearance	---	0.001T	0.0025T
	Exhaust valve guide....finished inside diameter	---	0.3745	0.3755
9	Exhaust valve seat (to valve guide axis)....angle	---	44°30'	45°00'
10	Intake valve seat (to valve guide axis)....angle	---	59°30'	60°00'
11	Intake valve seat insert in cylinder head....diametric clearance	---	0.0055T	0.0085T
12	Exhaust valve seat insert in cylinder head....diametric clearance	---	0.0070T	0.0100T
	Valves, Rocker Arms and Shafts			
13	Rocker shaft in rocker arm bearing....diametric clearance	0.006L	0.0005L	0.0033L
14	Rocker arm bearing in rocker arm ....diametric clearance	---	0.002T	0.0065T
15	Intake valve in guide ....diametric clearance	0.006L	0.0012L	0.0030L
16	Exhaust valve in guide....diametric clearance	0.008L	0.0025L	0.0043L
17	Intake valve face (to stem axis) .... angle	---	60°00'	60°15'
18	Exhaust valve face (to stem axis) .... angle	---	46°00'	46°15'
19	Intake and exhaust valve stem to face (full indicator reading).....runout	0.004	0.000	0.002
20	Valve rocker toe to valve stem (dry lifter).....	---	0.060	0.200
21	Rocker Arm....side clearance	---	0.005	0.035
22	Rotocoil to rocker arm.... clearance	---	0.020	---

Table 10-10. Cylinder Assembly Service Limits

Index	Description	Service Limit	New Part Minimum (inches)	New Part Maximum (inches)
	Pistons, Rings, and Pins			
23[1, 2]	Piston clearance in cylinder bore.....diametric clearance	0.015	0.009	0.012
24	Top and second piston ring in groove (semi-keystone) .... side clearance (with ring flush to OD of piston; measured below ring)	0.007	0.0015	0.0055
25	Third piston ring in groove .....side clearance	0.0065	0.0025	0.005
26	Fourth piston ring in groove.....side clearance	0.0065	0.0025	0.005
27	Top piston ring at 1.00 ± 0.50 depth in cylinder barrel .....gap	0.046	0.022	0.037
28	Second piston ring at 1.00 ± 0.50 depth in cylinder barrel.....gap	0.052	0.028	0.043
29	Third piston ring at 1.00 ± 0.50 depth in cylinder barrel.....gap	0.034	0.008	0.025
30	Fourth piston ring at 1.00 ± 0.50 depth in cylinder barrel.....gap	0.036	0.010	0.027
31	Piston pin in piston .....diametric clearance	0.001L	0.0001L	0.0007L
32	Piston pin in cylinder..... end clearance	0.05L	0.007	0.029
33	Piston pin in connecting rod bushing.....diametric clearance	0.004L	0.0014L	0.0021L
34	Bushing in connecting rod .....diametric clearance	---	0.002T	0.0045T
	Spring Test Data			
35	Inner valve spring (Free Length Ref 2.00 in.)..... Load Length	1.10 inch		
	Inner valve spring.....Load	62 - 68 pounds		
36	Outer valve spring (Free Length Ref 2.20 in.).....Load Length	1.168 inch		
	Outer valve spring.....Load	77 - 83 pounds		
NOTE: T = Tight and L = Loose				

1. Repair of cylinders must be performed by a qualified FAA approved repair facility.
2. Measure clearance perpendicular to piston pin bore at “D” diameter. Measure at the piston pin centerline perpendicular to piston pin bore.

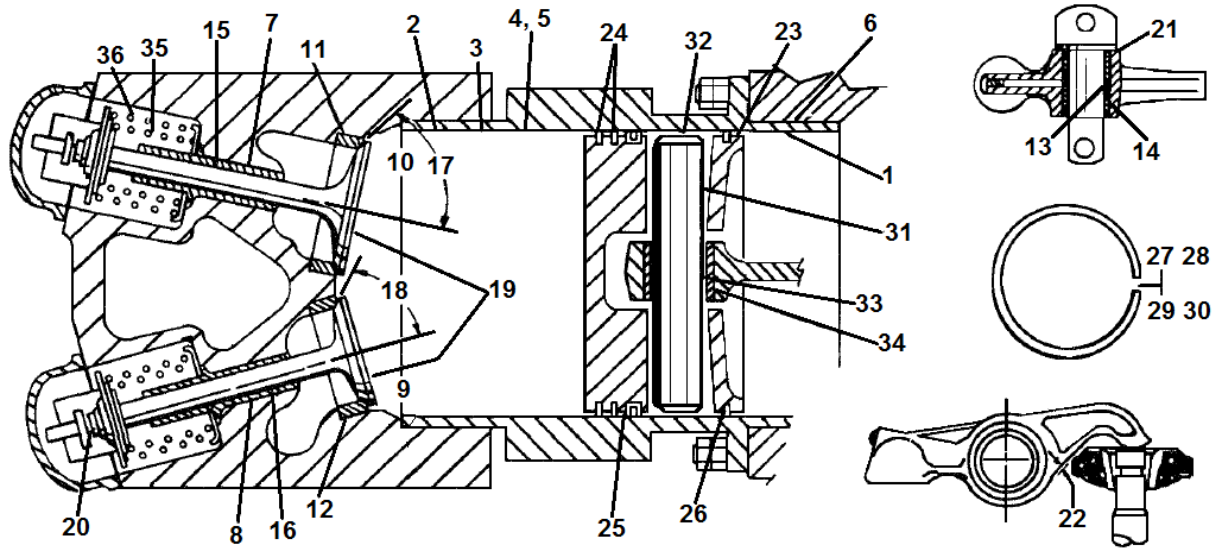


Figure 10-32. Cylinder Assembly Service Limits

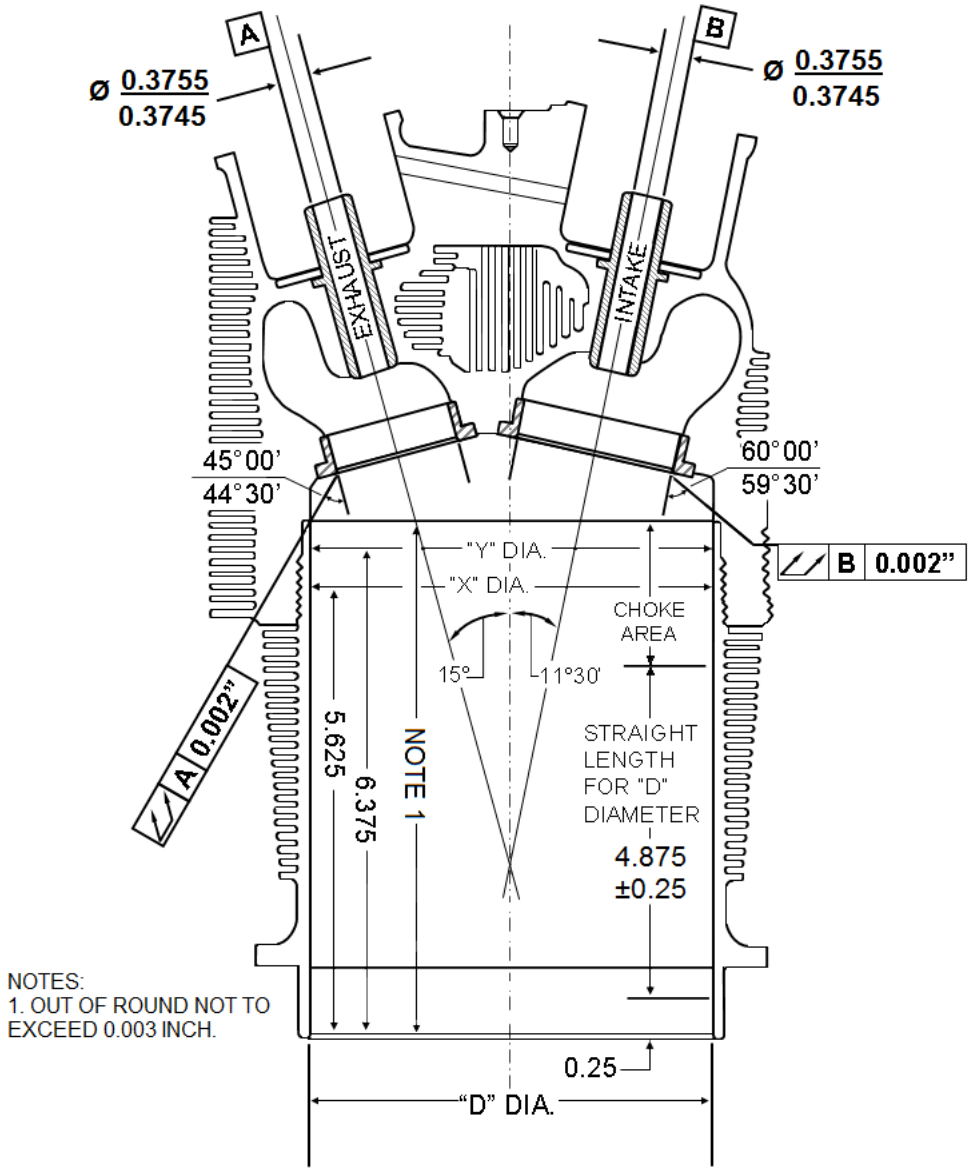


Figure 10-33. Cylinder Bore Service Limits

Table 10-11. Cylinder Bore Service Limits

Size	"D" Diameter (inches)		"X" Diameter (inches)		"Y" Diameter (inches)	
	New Part (min - max)	Service Limit	New Part (min - max)	Service Limit	New Part (min - max)	Service Limit
STD	4.437 - 4.439	4.442	4.434 - 4.437	4.444	4.431 - 4.434	N/A
.005[1]	4.442 - 4.444	4.447	4.439 - 4.442	4.449	4.436 - 4.439	N/A
.010[1]	4.447 - 4.449	4.452	4.444 - 4.447	4.454	4.441 - 4.444	N/A
.015[1]	4.452 - 4.454	4.457	4.449 - 4.452	4.459	4.446 - 4.449	N/A
NOTE: Dimensions in the table above are shown in finish size after honing. Cylinder bore out of round service limit must not exceed (service) 0.003 inches at measured diameters.						

1. Requires use of corresponding oversize pistons and rings

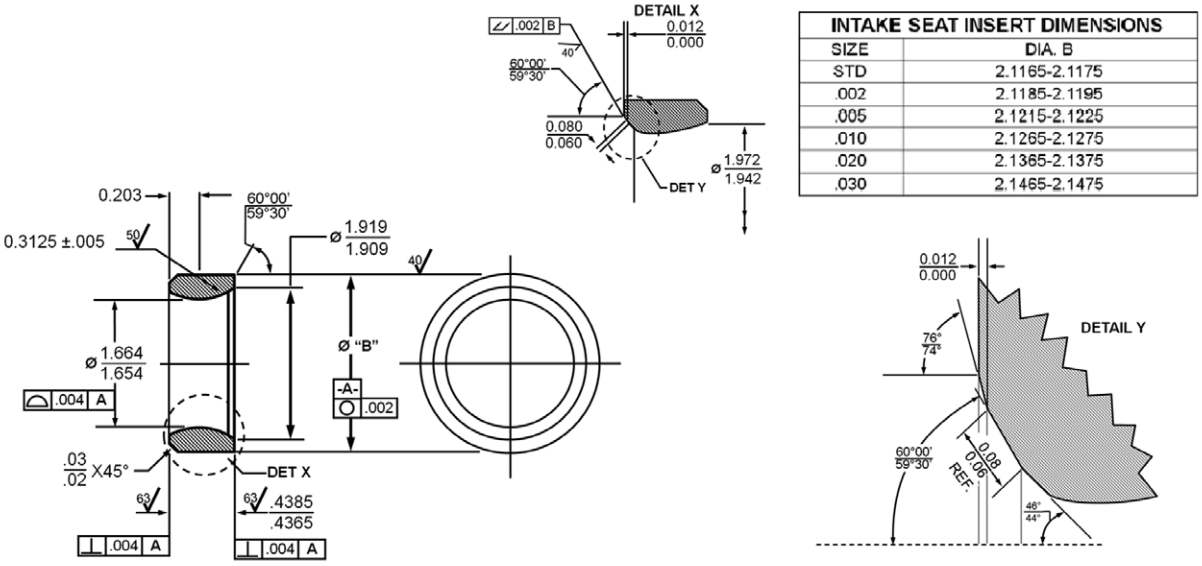
10-8.4.2. Valve and Seat Reconditioning

The IO-360 intake valve seat has a 30 degree face and the exhaust valve seat has a 45 degree face. During the manufacturing process, new intake and exhaust valve seats are ground on three angles. For service limits, the technician focuses on two angles, depicted in Figure 10-34 and Figure 10-35 to mate the valves with the valve seats.

Inspect the inside and outside diameters of the intake valve seat, depicted in Figure 10-34. If the outside diameter grind exceeds the maximum depicted in Figure 10-34, the valve seat is not suitable for repair and must be replaced. Refer to the overhaul repair instructions in Chapter 15.

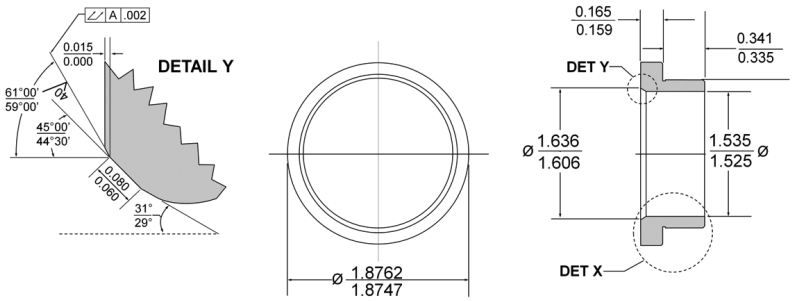
Inspect the inside and outside diameters of the exhaust valve seat, depicted in Figure 10-35. If the outside diameter grind exceeds the maximum depicted in Figure 10-35, the valve seat is not suitable for repair and must be replaced. Refer to the overhaul repair instructions in Chapter 15.

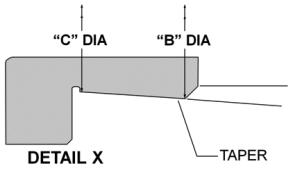
If the intake and exhaust valve seats are within the service limit, the angle of the valve seats may be reconditioned using the instructions contained within this section.



INTAKE SEAT INSERT DIMENSIONS	
SIZE	DIA. B
STD	2.1165-2.1175
.002	2.1185-2.1195
.005	2.1215-2.1225
.010	2.1265-2.1275
.020	2.1365-2.1375
.030	2.1465-2.1475

Figure 10-34. Intake Valve Seat Dimensions





EXHAUST SEAT INSERT DIMENSIONS		
SIZE	DIA. B	DIA. C
STD	1.6620-1.6630	1.6600-1.6610
.002	1.6640-1.6650	1.6620-1.6630
.005	1.6670-1.6680	1.6650-1.6660
.010	1.6720-1.6730	1.6700-1.6710
.020	1.6820-1.6830	1.6800-1.6810
.030	1.6920-1.6930	1.6900-1.6910

Figure 10-35. Exhaust Valve Seat Dimensions

10-8.4.2.1. Valve Seat Repair

1. Using the appropriate grinding stones and fixture (Chapter 2-1 of M-0, Standard Practice Maintenance Manual), grind the valve seats to the following characteristics:
   a. Intake Valve Seat (Figure 10-34)
      1) Clean up seat with 30° stone.
      2) Top off seat with 15° stone to establish seat outside diameter.
      3) Undercut seat with 45° stone to establish seat width depicted in Figure 10-34.
      4) Replace seat if maximum diameter in Figure 10-34 is exceeded.
   b. Exhaust Valve Seat (Figure 10-35)
      1) Clean up seat with 45° stone.
      2) Top off seat with 15° stone to establish seat outside diameter.
      3) Replace seat if maximum diameter in Figure 10-35 is exceeded.

10-8.4.2.2. Valve Repair

1. Using the appropriate grinding stones and fixture (Chapter 2-1 of M-0, Standard Practice Maintenance Manual), grind the valves to the following characteristics:
   a. Grind valve face to remove any indications of wear
   b. Find new gage diameter on valve face.
   c. Measure from the newly machined gauge line to stem tip. Grind the stem tip (maximum acceptable material removal is 0.015 in.) to restore valve length from stem tip to gauge line.
   d. Measure overall length of valve. If the overall length exceeds the maximum length in Table 10-10, discard the valve.

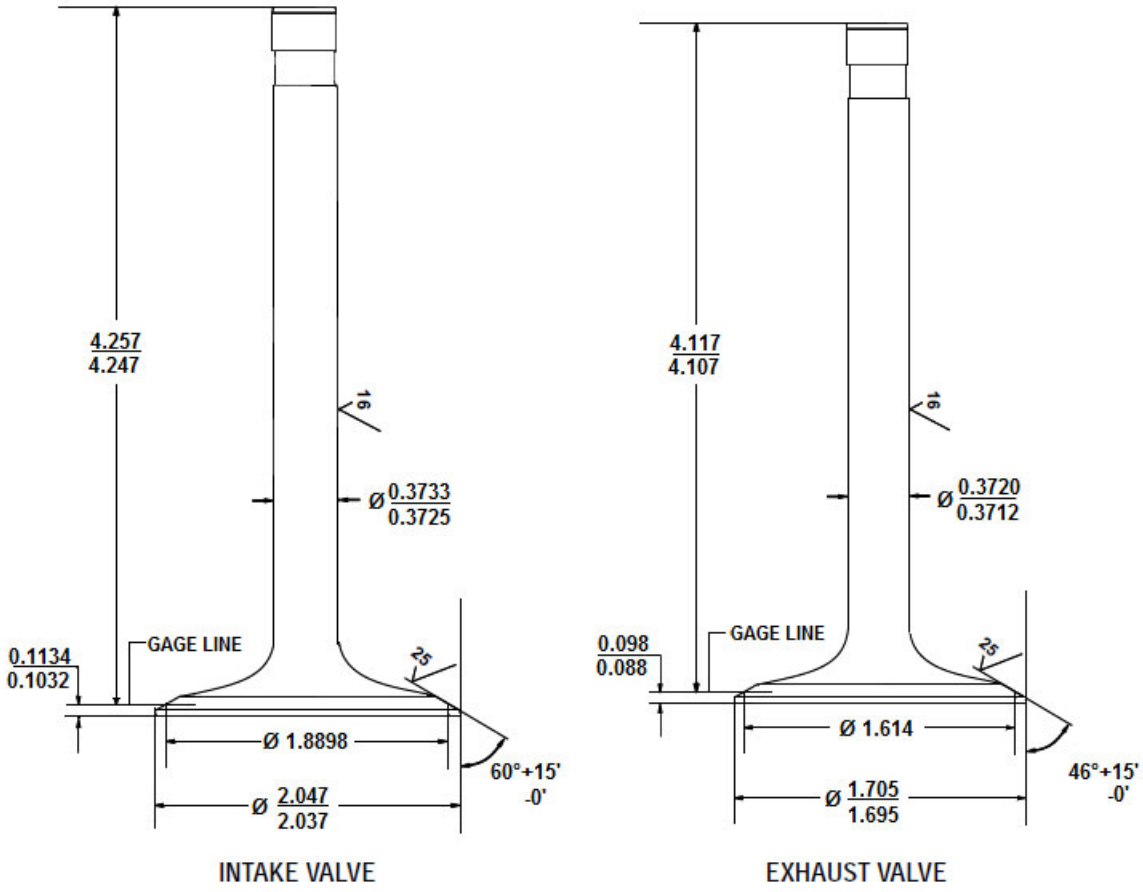


Figure 10-36. Valve Dimensions

10-8.4.2.3. Valve Face to Valve Seat Fit Inspection

Once the valve seat has been refaced (and has an even and true finished surface) the contact area between the valve face and the valve seat must be determined.

> NOTE: Prussian Blue dye (Chapter 3 of M-0, Standard Practice Maintenance Manual) is an insoluble dark, bright blue pigment, ferric ferrocyanide (equivalent to ferrous ferricyanide), used in painting and dyeing.

1. Apply Prussian Blue dye to the valve face.
2. Insert the valve into the valve guide until the valve face makes full contact with the valve seat.
3. Without rotating the valve, raise the valve off the seat. Rotate the valve 30 to 45 degrees and insert the valve in the valve guide until it again makes full contact with the valve seat.
4. Repeat the process three or four times to transfer the Prussian Blue dye from the valve face to the valve seat.

5. Remove the valve from the valve guide and cylinder and wipe the valve face clean of the residual Prussian Blue dye.
6. The transfer of the Prussian Blue dye from the valve face to the valve seat indicates the area where the valve face and valve seat make contact. The ideal contact area is in the center of the valve face.

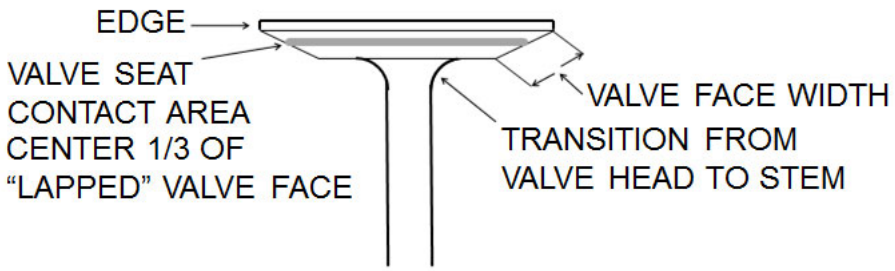


Figure 10-37. Typical Valve Face to Valve Seat Contact Area

7. If the contact area is too wide the valve seat will have to be narrowed; see Figure 10-38. Narrowing of the valve seat is accomplished with grinding stones dressed to a specific angle.
   a. Intake Valve Seat:
      Use a 15 degree grinding stone to narrow the top (outer) diameter of the intake valve seat and 45 degrees to narrow the bottom (inside) diameter of the intake valve seat.
   b. Exhaust Valve Seat:
      Use a 15 degree grinding stone to narrow the top (outer) diameter of the exhaust valve seat and 60 degree stone to narrow the bottom (inside) diameter of the exhaust valve seat.
8. If the valve face to valve seat contact area width is acceptable, but not in the center one third (1/3) of the valve face its position on the valve face may be adjusted by grinding the valve seat using the narrowing stones; see Figure 10-37.
9. Contact area too close to the outside diameter of valve face:
   a. Intake Valve Seat:
      Use a 15 degree grinding stone to narrow the top (outer) diameter of the intake valve seat.
   b. Exhaust Valve seat:
      Use a 30 degree grinding stone to narrow the top (outer) diameter of the exhaust valve seat.

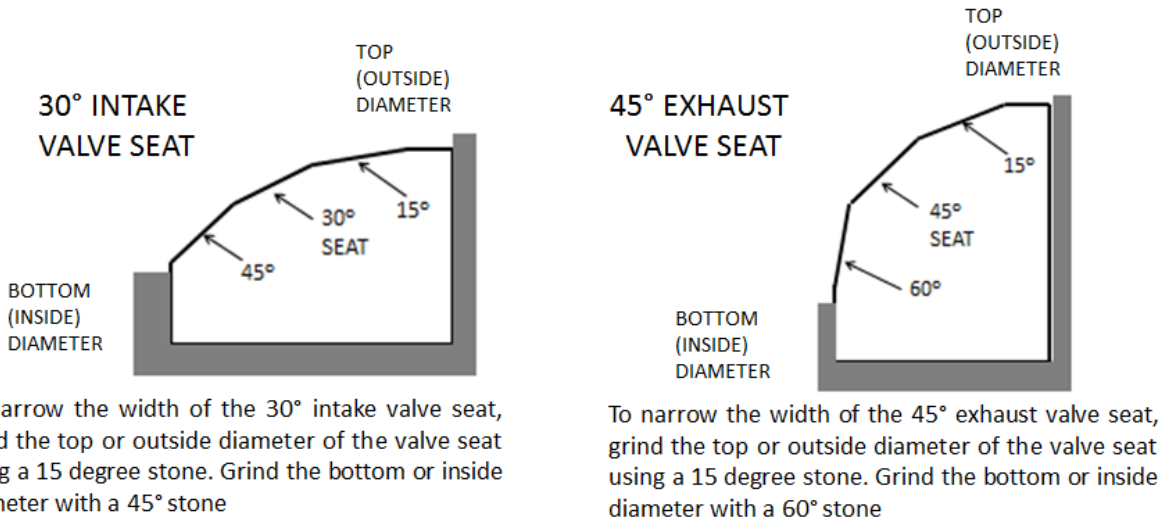


Figure 10-38. Valve Seat Narrowing

10. Contact area too close to the inside diameter of valve face:

    a. Intake Valve Seat:
    Use a 45 degree grinding stone to narrow the bottom (inside) diameter of the intake valve seat.

    b. Exhaust Valve Seat:
    Use a 60 degree grinding stone to narrow the bottom (inside) diameter of the exhaust valve seat.

11. After valve seat narrowing, repeat steps 1 through 6.

    CAUTION: Valve seats and valves may be lapped after refacing, if desired. Lapping compounds are extremely abrasive, ensure to completely remove compound residue from the valves, valve seats and cylinder by thorough cleansing with hot soapy water and a stiff bristled scrub brush. Rinse the cylinder thoroughly with hot water to remove soap residue.

12. The valves may be lapped after mating the valve face to the valve seat. If lapping is performed, remove all lapping compound residue from the cylinder and valves before assembly.

10-8.5. Cylinder Installation

Replace worn or out of tolerance components based on the following criteria:

- Only parts that meet the *service limits* may remain in service.
- If a part has reached a service limit tolerance, it must be replaced with a part that conforms to the specified new part tolerances or service limits.
- Clean the cylinders according to "Cylinder Cleaning" instructions in Chapter 12-1.1 of M-0, Standard Practice Maintenance Manual.
- Clean pistons according to "Piston Cleaning" instructions in Chapter 12-1.2 of M-0, Standard Practice Maintenance Manual.
- Perform fluorescent penetrant, magnetic particle, and dimensional inspections on specified cylinder and piston parts as described in Chapter 11 of M-0, Standard Practice Maintenance Manual.
- Install serviceable hydraulic lifters in the same location from which they were removed.
- Assemble cylinders which meet the inspection criteria and service limits according to Section 16-5, "Engine Cylinder Assembly" instructions with serviceable pistons and new piston rings.

WARNING

Do not apply <u>any</u> form of sealant to the crankcase cylinder deck, chamfer, cylinder mounting flange, cylinder base O-ring, or cylinder fastener threads. The use of RTV, silicone, Gasket Maker or <u>any</u> other sealant on the areas listed above during engine assembly will cause a loss of cylinder deck stud or through bolt torque. Subsequent loss of cylinder attachment load, loss of main bearing crush and/or fretting of the crankcase parting surfaces will occur. The result will be cylinder separation, main bearing movement, oil starvation and catastrophic engine failure. USE ONLY CLEAN 50 WEIGHT AVIATION ENGINE OIL ON SURFACES LISTED.

1. Inspect a new cylinder base packing (Figure 10-25)(8) for cracks or deformities. Lubricate the serviceable, new cylinder base packing with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
2. Install the new cylinder base packing (8) on the cylinder base flange; verify the packing is not twisted on the cylinder base flange after installation.
3. Clean the cylinder deck and stud threads with Stoddard solvent; use a narrow brush to clean threaded holes; deck and stud holes must be free of dirt and debris.
4. Lubricate cylinder through bolt and deck stud threads using clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

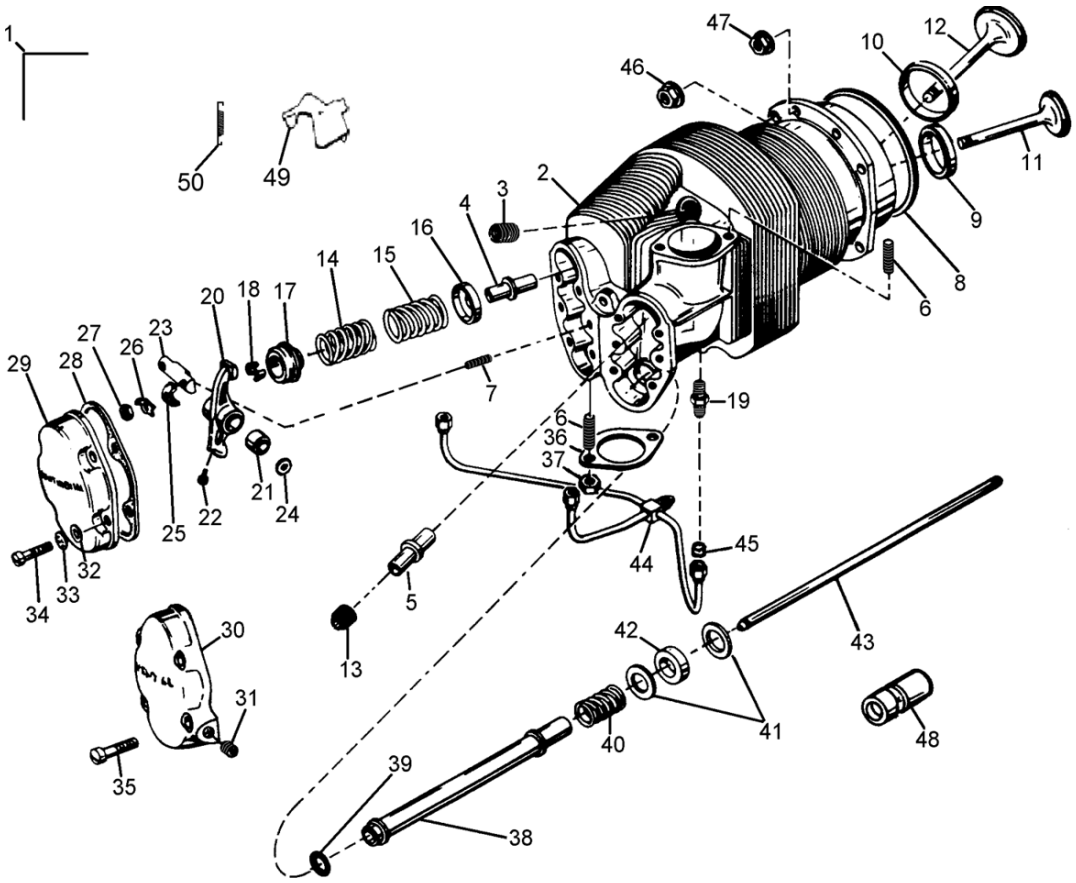


Figure 10-25 repeated for reference

5. Carefully rotate the crankshaft, placing the connecting rod of the cylinder being installed in the outermost position. Remove and discard the used packing that was installed for connecting rod support.
6. Back the piston pin (Figure 10-28)(6) out far enough to allow the piston (1) to be installed on the connecting rod.
7. Line the piston (1) up with the connecting rod and slide the piston pin (6) into the connecting rod.
8. Using a ring compressor (Chapter 2-1 of M-0, Standard Practice Maintenance Manual), compress the fourth piston ring (5) and push the cylinder assembly towards the crankcase until the fourth piston ring is positioned inside the cylinder barrel.
9. Remove the ring compressor and push the cylinder assembly against the crankcase cylinder deck with the stud holes aligned.
10. While supporting the cylinder, install, but do not torque, the cylinder flange nuts (Figure 10-25)(46 and 47).

11. For single cylinder replacement, torque the cylinder fastening hardware according to the "Cylinder Torque" instructions in Section 10-8.6. For multiple cylinder replacement, torque the cylinder fastening hardware for each cylinder being installed according to the "Cylinder Torque" instructions in Chapter 10-6.1.3 of M-0, Standard Practice Maintenance Manual, steps 1 and 2. When all cylinders are installed, torque all cylinder and crankcase fasteners according to the instructions in Section 17-3.2. If re-torquing fasteners that were not removed during this maintenance action, apply torque to the specified torque value.
12. Rotate the crankshaft through multiple revolutions to verify smooth rotation of the crankshaft. If rotation is not smooth or binding is evident, disassemble the engine to determine the cause. Verify crankshaft end play (end clearance) is within the tolerance specified in Appendix D-7. If no end play is present, disassemble the engine to determine the cause.
13. Install the hydraulic lifters (48) and push rod housings (38) according to instructions in Section 10-8.7.

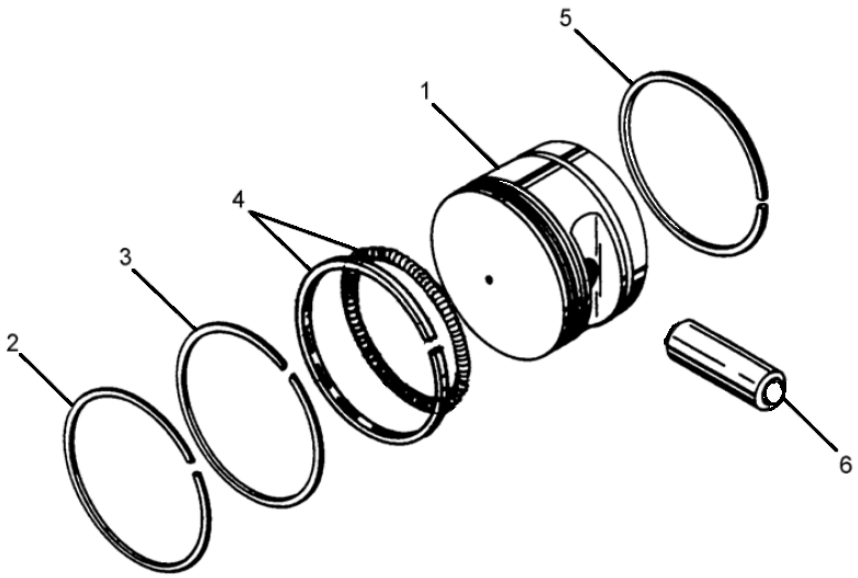


Figure 10-28 repeated for reference

14. Install the rockers (20) according to instructions in Section 10-8.8.
15. Install baffle (49) and spring (50).
16. Install the inter-cylinder baffles according to instructions in Section 17-3.6, if applicable to engine model.
17. Lightly coat the male threads of drain tube connectors (19) with P/N 646940 F/I sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual).
18. Install the drain tube connectors (19). Torque drain tube connectors to Appendix B specifications.

19. Install new drain tube compression seals (45) and cylinder drain tubes (44). Torque the “B” nuts to Appendix B specifications.
20. Install the spark plugs and ignition harness according to the “Ignition System Maintenance” instructions in Section 6-3.9.
21. Install the Induction System components according to instructions in Section 17-11.
22. Install the Exhaust System according to the aircraft maintenance manual.
23. Install the fuel injectors according to instructions in Section 10-3.3.
24. Set the aircraft Fuel Selector Valve to the ON position and activate the fuel boost pump to leak check the fuel delivery system, including fuel lines and fittings.

    CAUTION: Service the engine with SAE J-1966 mineral oil for engine break-in.

25. Service the engine with mineral oil according to instructions in Section 6-3.8.
26. Install the aircraft cowling and aircraft-supplied accessories according to the aircraft maintenance manual
27. Perform an “Engine Operational Check” according to instructions in Section 6-3.7.
28. Perform the “25-Hour Initial Operation Inspection” in Section 6-3.2 after the first 25 hours of engine operation. When oil consumption has stabilized, replace the mineral oil with ashless dispersant aviation engine oil according to Section 6-3.8.

10-8.6. Cylinder Torque

Refer to the “Cylinder Torque” instructions in Chapter 10-6.1.3 of M-0, Standard Practice Maintenance Manual.

10-8.7. Hydraulic Lifter Installation

1. Perform the dimensional inspections applicable to the hydraulic lifters (Section 10-10.1) and push rods (Section 10-8.4). Replace parts which fail to meet the service limits.
2. Collect the replacement parts necessary to satisfy the "100% Parts Replacement Requirements" using the criteria in Appendix C-2.3.
3. Lubricate all lifter faces using Dow Corning G-N Paste, or equivalent (Chapter 3 of M-0, Standard Practice Maintenance Manual).
4. Lubricate the lifters with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
5. Install the serviceable hydraulic valve lifters in the bores from which they were removed. Install new hydraulic lifters to replace those which failed inspection.
6. Using a Kent Moore P/N 68-3 Push Rod Spring Compressor (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) or equivalent, compress the push rod housing spring (Figure 10-26)(40).

   NOTE: Install the push rod housings nearest to engine mount brackets first. The Push Rod Spring Compressor Tool must lie close to horizontal to clear the crankcase flange.

7. Place a new seal (42) between the two washers (41), and install on the *crankcase* end of the push rod housing (38).
8. Position the push rod housings (38) into the respective crankcase lifter bores.
9. While the spring (40) is compressed insert the *crankcase* end of the push rod housing (38) in the crankcase bore and slide a new o-ring seal (39) on the *cylinder* end of the push rod housing.
10. Guide the *cylinder* end of the push rod housing (38) into the cylinder head bore while releasing the tension on the push rod spring (40) with the Push Rod Spring Compressor Tool (Figure 10-39).
11. Remove the Push Rod Spring Compressor Tool from the push rod housing (38) and verify the o-ring (39), seal (42) and washers (41) are properly positioned.
12. Lubricate the push rods (43) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual) and insert the push rods through the cylinder openings into the push rod housings (38).
13. Install the rockers and rocker covers according to instruction in Section 10-8.8.
14. Install any aircraft equipment, accessories, and cowling removed to facilitate hydraulic lifter replacement according to the aircraft maintenance manual.
15. Perform an "Engine Operational Check" according to instructions in Section 6-3.7.

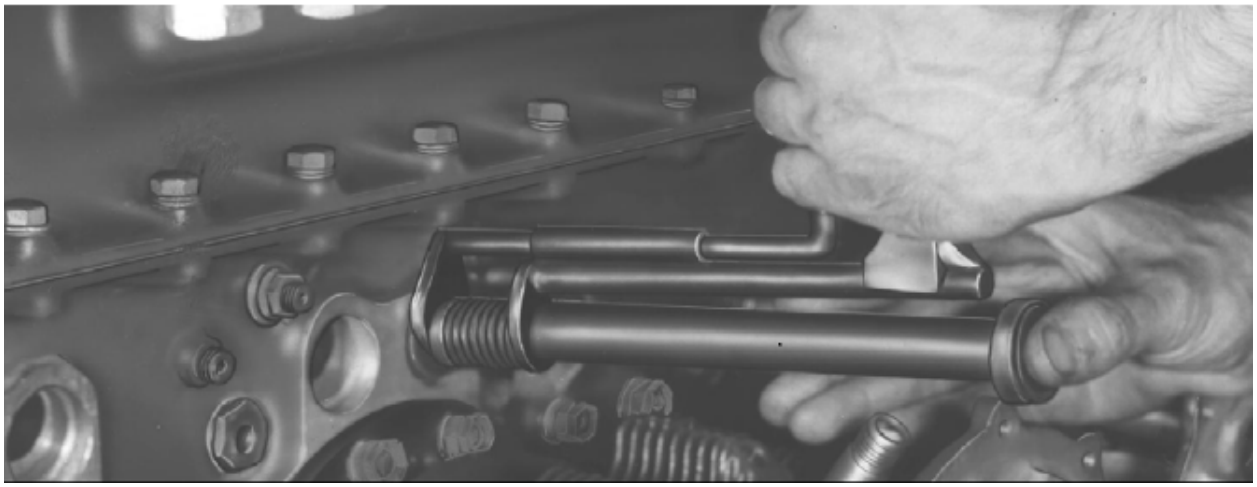


Figure 10-39. Push Rod Spring Compressor

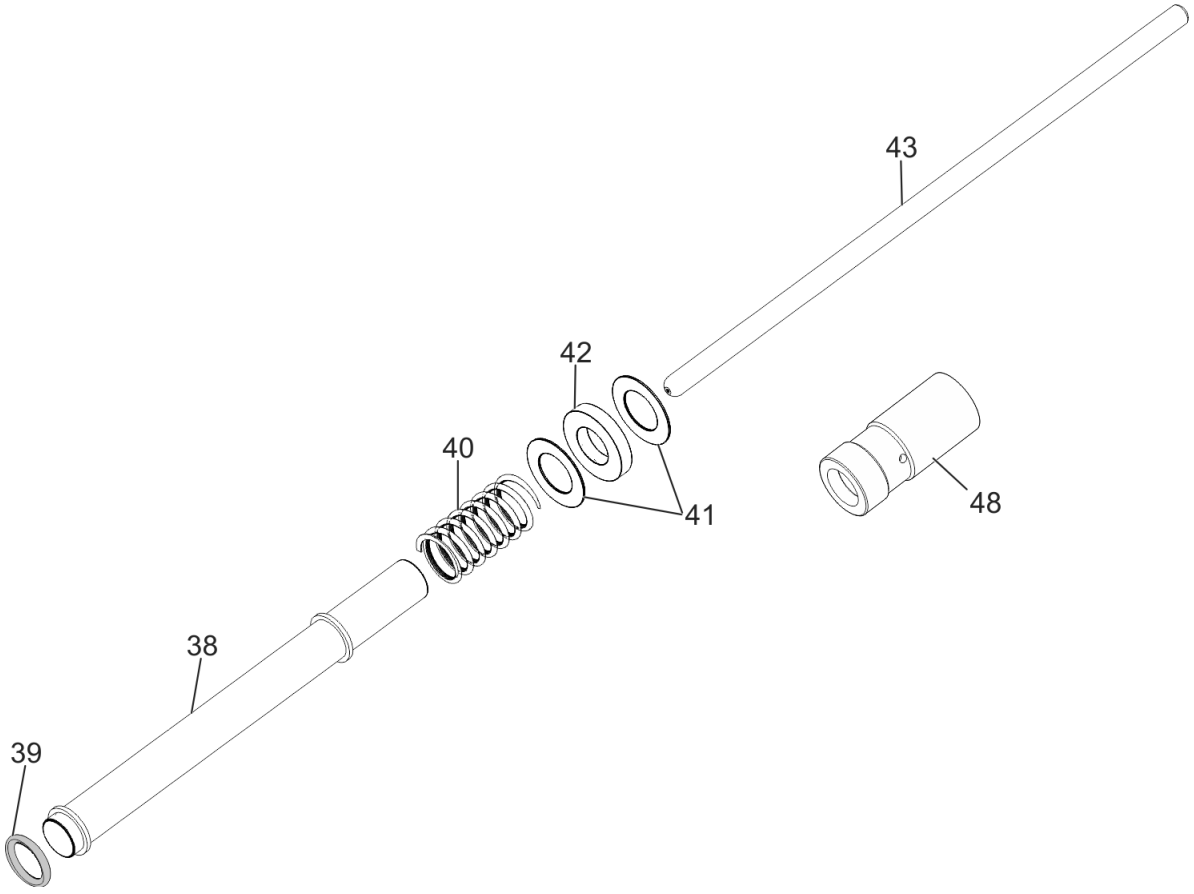


Figure 10-26 repeated for reference

10-8.8. Rocker Arm Installation

1. With the engine upright, lubricate the push rods (Figure 10-25)(43) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual) and install the push rods through the cylinder openings into the push rod housings (38).
2. Before installing the valve actuating parts on each cylinder, turn the crankshaft until the push rods (43) are at their lowest position in the cylinder (2).
3. Lubricate the rockers (20), new thrust washers (24) and new rocker shafts (23) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
4. Slide the shaft (23) into the rocker arm (20) assembly with a new thrust washer (24) on each side of the rocker shaft.
5. Install the rocker (20) and shaft (23) assemblies on the rocker arm boss with the thrust retainers (25), new tab washers (26) and nuts (27). Verify clearance of 0.020 inches between the rocker arm (Figure 10-40) and rotocoil. The underside of the rocker arm may be smoothly ground to attain the 0.020-inch minimum clearance using "Rocker Arm to Rotocoil Clearance" instructions in Section 15-8.8.18.

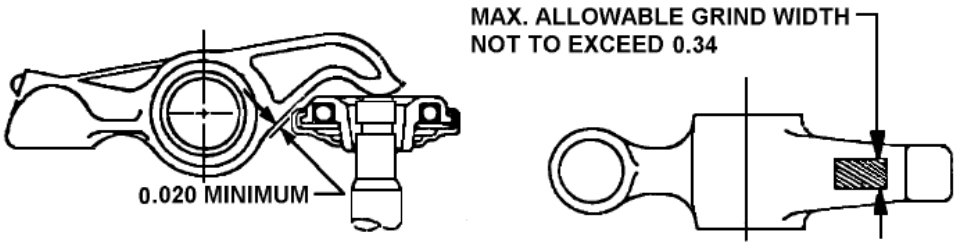


Figure 10-40. Rocker Arm to Rotocoil Clearance

6. Check rocker arm to rotocoil side clearance (Figure 10-41) with a feeler gauge; the side clearance must be meet the specification stated in Table 10-10. If side clearance exceeds the allowable amount, replace the thrust washers with a thicker (oversize) thrust washer to reduce side clearance to the allowable tolerance.
7. Measure and compare the dry valve gear lash between the valve tip and the rocker foot at the ball (push rod) end. Insert a feeler gauge between the rocker arm foot and valve tip; valve lash must not exceed the service limits in Section 10-8.4.1. Replace the push rods with authorized over size push rods (P030) if dry valve gear lash exceeds the maximum limit.

   CAUTION: Do not over- or under-torque nuts to align tab washers; replace nut and re-torque to obtain proper alignment.

8. Torque the nuts (Figure 10-25)(27) to Appendix B specifications and secure the rocker (20) assembly with the tab washers (26) according to "Tab Washer Installation" instructions in Appendix C-4. Do not re-align the nut to the tab washer.

9. Install the rocker covers (29 and 30)(except A and AB) with new rocker cover gaskets (28) (beaded side of the gasket toward the rocker cover); secure the rocker covers with screws (34), screws (35)(except A and AB), new lock washers (33) and washers (32). Torque the rocker cover screws to Appendix B specifications.

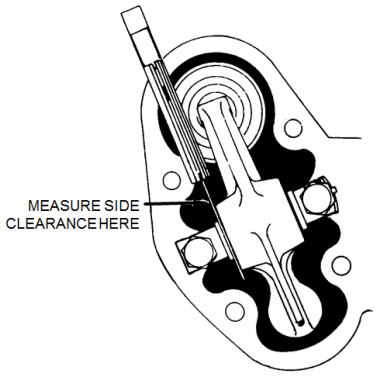


Figure 10-41. Rocker Arm Side Clearance

10. Install aircraft equipment, accessories, and cowling removed to facilitate part(s) replacement according to the aircraft maintenance manual.
11. Perform an "Engine Operational Check" according to instructions in Section 6-3.7.

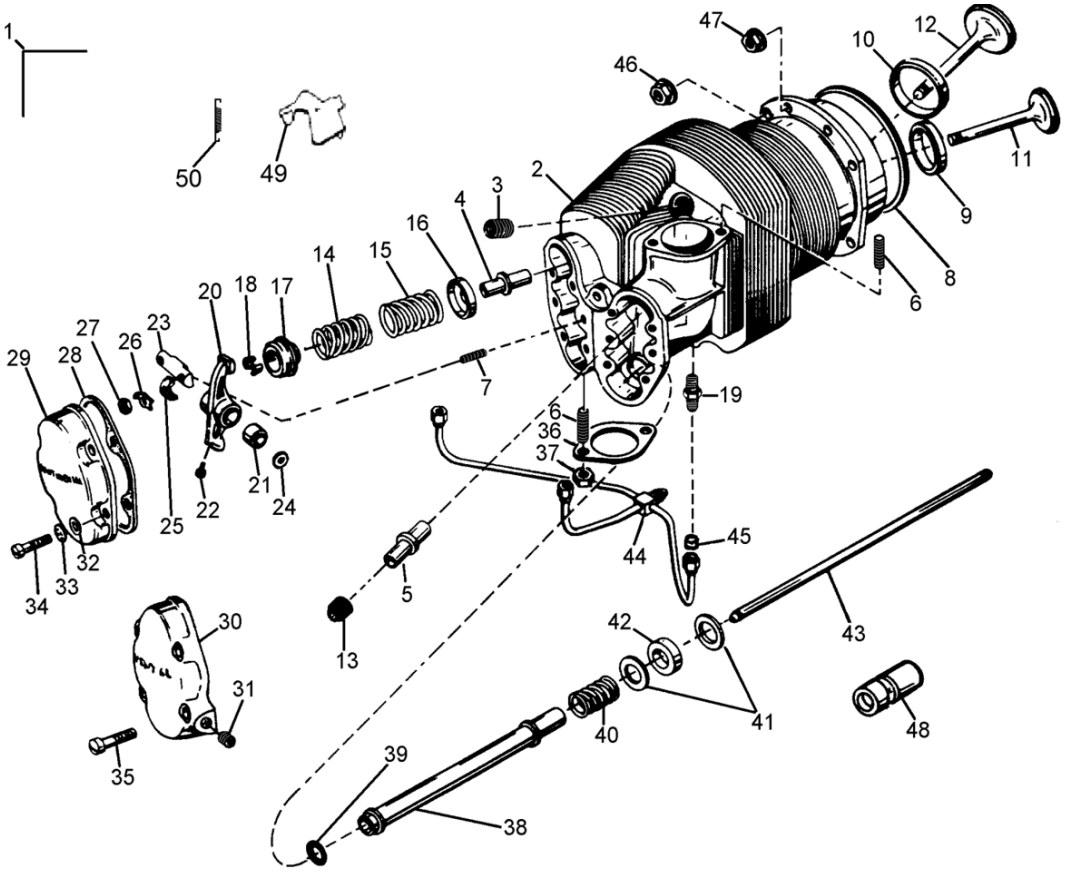


Figure 10-25 repeated for reference

10-9. Crankshaft Nose Oil Seal Replacement

Replace the crankshaft nose oil seal if it is damaged or if the following conditions exist:

- Ram air is entering the engine interior
- Oil leaks from the nose seal or nose seal retainers

10-9.1. Crankshaft Nose Oil Seal Removal

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Turn the Ignition Switch to the OFF and disconnect engine electrical power.
2. Disconnect all spark plug leads.
3. Remove the propeller in accordance with the propeller manufacturer's and aircraft maintenance manual.

   CAUTION: Do not scratch, mar, or damage the crankshaft or crankcase while removing the crankshaft nose oil seal.

4. Remove the bolts (Figure 10-42) and the retainer plates from the crankcase.

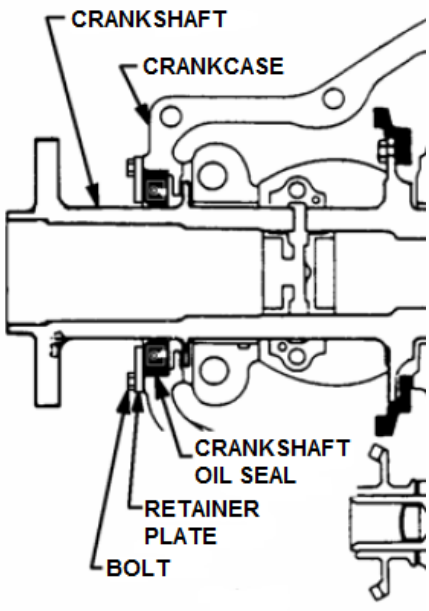


Figure 10-42. Retainer Plate and Bolts on Front of Crankcase

5. Remove the crankshaft nose oil seal, (made up of two components; a seal and a spring as shown in Figure 10-43). Gentle force may be required to remove the nose oil seal parts from the counterbore.

6. Clean the Gasket Maker residue out of the counterbore recess using a chlorinated solvent such as Loctite Chisel or methylene chloride followed by a naphtha solvent such as Loctite ODC-Free Cleaner and Degreaser. Remove all residue and debris from the bore.

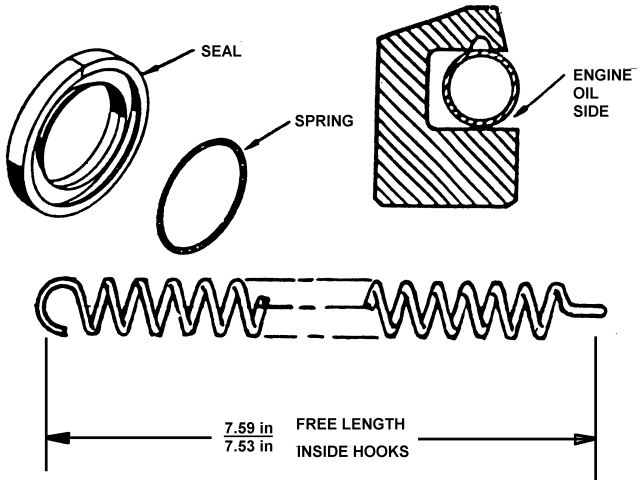


Figure 10-43. Crankshaft Nose Oil Seal Parts

7. Remove the tin plating in the 1-inch area of the crankshaft shown in Figure 10-44 with a strip of very fine emery cloth, buffing the shaft to attain a smooth uniform finish without any scratches.

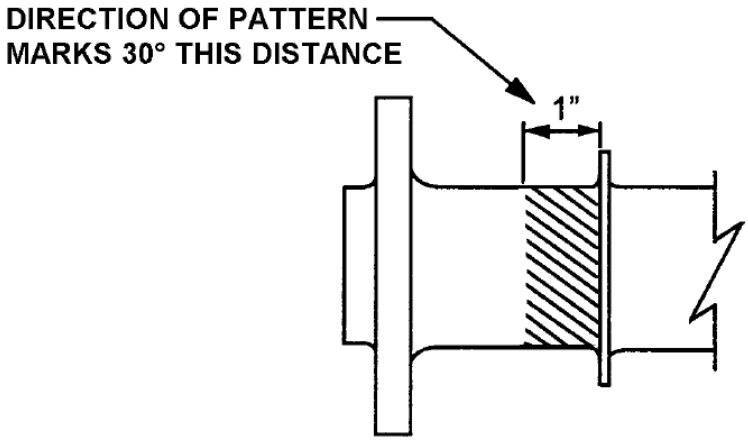


Figure 10-44. Crankshaft Plated Area

8. Apply a 1/2-inch wide strip of 180 grit emery cloth against the newly polished 1-inch area on the crankshaft with a firm pressure to lightly scratch (not score or gouge) a new helix design in a 30° pattern in the plated area as shown in Figure 10-44. Rub the emery cloth in the plated area outward toward the propeller flange, counter-clockwise. Rotate crankshaft by hand and continue rubbing with the 180 grit emery cloth until the entire 1-inch plated area (Figure 10-44) around the exposed portion of the crankshaft is lightly scratched with the helical design.

   NOTE: Lightly scratching the surface of the crankshaft that contacts the oil seal promotes a better seal and prevents leakage.

9. Wipe the plated area (Figure 10-44) with acetone. Ensure the crankshaft is free of any debris and particulate matter to facilitate a clean seal.

10-9.2. Crankshaft Nose Oil Seal Installation

WARNING

Turn the Ignition Switch OFF, disconnect engine electrical power and confirm continuity between the magneto capacitor and aircraft ground before commencing maintenance to avoid uncommanded engine starts during maintenance. Do not stand or place equipment within the arc of the propeller.

1. Prepare the exposed portion of the crankshaft with a fresh helix pattern according to instructions in Section 10-9.1.
2. Remove the spring from the crankshaft nose oil seal.
3. Unhook the spring ends using an unwinding motion.
4. Verify the seal spring length is 7.53” to 7.59” as illustrated in Figure 10-43. If the spring length is not within this tolerance, replace it.
5. Place the spring around the crankshaft in the helix area.
6. Turn the spring ends in an unwinding direction and allow one end to wind into the other end.
7. Apply P/N 654561 grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the lip of the new seal and the propeller flange.
8. Twist the split seal and slide over the crankshaft. Bring the ends of the seal back together.
9. After the oil seal is installed on the crankshaft, wipe the grease from the oil seal and crankshaft. Verify the outer diameter of the oil seal is clean and dry.
10. Press the spring into the oil seal recess cavity. Ensure the spring is in the deepest part of the oil seal recess cavity all the way around and the hooked ends of the spring are opposite of the seal split.
11. Apply P/N 654663 Gasket Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the mating crankcase flange.
12. Spray P/N 653692 Primer (Chapter 3 of M-0, Standard Practice Maintenance Manual) on the oil seal counterbore and allow it to dry for 1 to 2 minutes.
13. Apply a translucent coat of P/N 646942 Gasket Maker (Chapter 3 of M-0, Standard Practice Maintenance Manual) on the wall of the oil seal counterbore. Refer to Gasket Maker application instructions in Appendix C.
14. Using thumb pressure, work the seal into the crankcase counterbore.
15. After the seal is in place, wipe any remaining oil from the seal and crankshaft.
16. Spray the exposed portion of the lightly scratched crisscross area with aluminum paint and allow it to dry.

17. Apply P/N 646941 High Strength Adhesive/Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the oil seal retainer bolts.
18. Apply P/N 653693 Loctite 7471 Primer (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the crankcase oil seal retainer bolt holes.
19. Install the crankshaft nose oil seal retainer plates and secure them with the nose oil seal retainer bolts. Torque the bolts to Appendix B specifications.
20. Inspect the propeller according to the propeller manufacturer's and aircraft maintenance manual.
21. Install the propeller according to the propeller manufacturer's and aircraft maintenance manual.
22. Perform a normal "Engine Start" (Section 7-3.2) and "Ground Run-up" (Section 7-3.2). Run the engine for a minimum of five minutes to reach normal operating temperatures. Shut down the engine according to the "Engine Shutdown" (Section 7-3.4) instructions and inspect the crankcase nose oil seal area for leaks.

10-10. Crankcase Repair

See Section 15-8.10, “Crankcase Overhaul Repair.”

10-10.1. Crankcase, Crankshaft, Connecting Rods, Bearings and Camshaft Service Limits

Service limits are in Table 10-12 and Figure 10-45. Index numbers in the first column of the Table correspond to the numbers in the illustrations.

Table 10-12. Crankcase, Crankshaft, Connecting Rods, Bearings and Camshaft Service Limits

Index	Description	Service Limit	New Part Minimum (Inches)	New Part Maximum (inches)
1	Through bolts in crankcase.....diametric clearance	---	0.000	0.0015L
2	Hydraulic valve lifter in crankcase .....diametric clearance	0.0035L	0.001L	0.0025L
3	Hydraulic valve lifter bore in crankcase .....diameter	---	1.0005	1.0015
4	Governor driven gear in crankcase.....diametric clearance	0.005L	0.0014L	0.0034L
5	Governor driven gear bore in crankcase .....diameter	---	0.875	0.876
6	Starter shaft bushing in crankcase .....diametric clearance	---	0.0005L	0.001T
	Rear plug in crankcase (AF only).....diametric clearance	---	0.001L	0.001T
7	Crankcase main bearing bore.....diameter	---	2.437	2.438
8[1]	Crankcase rear and intermediate main bearing bore .....diameter	---	2.5625	2.5635
9[1]	Crankcase front main bearing bore .....diameter	---	2.437	2.438
10	Crankcase camshaft bearing bore.....diameter	---	1.3745	1.3755
11	Fuel pump adapter pilot in crankcase.....diametric clearance	---	0.001L	0.005L
12	Fuel pump body pilot in adapter .....diametric clearance	---	0.0005L	0.0045L
13	Oil seal in adapter.....diametric clearance	---	0.003T	0.009T
14	Fuel pump drive shaft in impeller shaft.....diametric clearance	0.011L	0.002L	0.008L
15	Fuel pump drive shaft in governor gear..... tooth clearance	0.0055	0.0015	0.0039
16	Crankcase (each half).....width	4.554	4.559	4.565
17	Crankshaft in thrust bearing..... end clearance	0.021	0.008	0.018
18	Crankshaft in main bearings.....diametric clearance	0.006L	0.001L	0.004L
19	Crankpin .....out of round	0.0015[2]	0.000	0.0005
20	Main journals .....out of round	0.0015[2]	0.000	0.0005
21	Crankshaft main and thrust journals.....diameter	2.2445[2]	2.2475	2.2485
22[1]	Crankshaft thrust journal.....diameter	2.2445[2]	2.2475	2.2485
23[1]	Crankshaft rear and intermediate journals.....diameter	2.3715[2]	2.373	2.374
24	Crankpin journals.....diameter	1.9335[2]	1.936	1.937
25	Crankshaft run out at center main journals (shaft supported at thrust and rear journals)..... full reading	0.015[2]	0.000	0.015
	Taper over full crankshaft bearing length.....	0.0015[2]	0.000	0.0005

Table 10-12. Crankcase, Crankshaft, Connecting Rods, Bearings and Camshaft Service Limits

Index	Description	Service Limit	New Part Minimum (Inches)	New Part Maximum (inches)
26[1]	Crankshaft run out at propeller flange when supported at front and rear main journals ..... full reading	0.005	0.000	0.005
27	Damper pin bushing in crankcheek ..... diametric clearance	---	0.0015T	0.003T
28	Damper pin bushing in counterweight ..... diametric clearance	---	0.001	0.0025
29	Damper pin			
	643626-109 ..... diameter	---	0.545	0.546
	643626-110 ..... diameter	---	0.498	0.499
	643626-111 ..... diameter	---	0.552	0.553
30	Damper pin ..... length	---	0.819	0.821
31	Damper pin ..... end clearance	0.040	0.011	0.037
32	Counterweight on crankcheek ..... side clearance	0.020	0.004	0.014
33	Crankshaft gear on crankshaft ..... diametric clearance	---	0.000	0.0025T
34	Connecting rod bearing and bushing twist or convergence per inch length	0.001	0.000	0.0005
35	Connecting rod beam section at narrowest point	0.625	0.630	0.660
36	Connecting rod bearing on crankpin ..... diametric clearance	0.006L	0.0005L	0.003L
37	Connecting rod bolt in connecting rod ..... diametric clearance	---	0.0005L	0.0023L
38	Camshaft in crankcase ..... diametric clearance	0.005L	0.001L	0.003L
39	Camshaft in crankcase ..... end clearance	0.014	0.005	0.009
40	Camshaft run out at center journals (shaft supported at end journal) ..... full reading	0.003[3]	0.000	0.001[3]
41	Camshaft gear on camshaft ..... diametric clearance	---	0.0005T	0.0015L
42	Governor drive gear on camshaft ..... diametric clearance	0.004L	0.0002L	0.002L
43	Crankshaft gear to camshaft gear ..... backlash	0.013	0.006	0.009
44	Governor drive gear to camshaft gear ..... backlash	0.012	0.004	0.008
45	Connecting rod on crank pin ..... side clearance	---	0.006	0.013
46	Crankcase width ..... deck to deck	9.108	9.118	9.130
T= Tight L= Loose				

1. These limits refer to the “B” (i.e. IO-360-DB) configurations, IO-360-ES and IO-360-AF models.
2. If crankshaft is worn beyond these limits they may be repaired by grinding journals to 0.010 inch under new shaft limits and re-nitriding journals.
3. Straightening of the camshaft is permissible if run out does not exceed 0.005 inch.

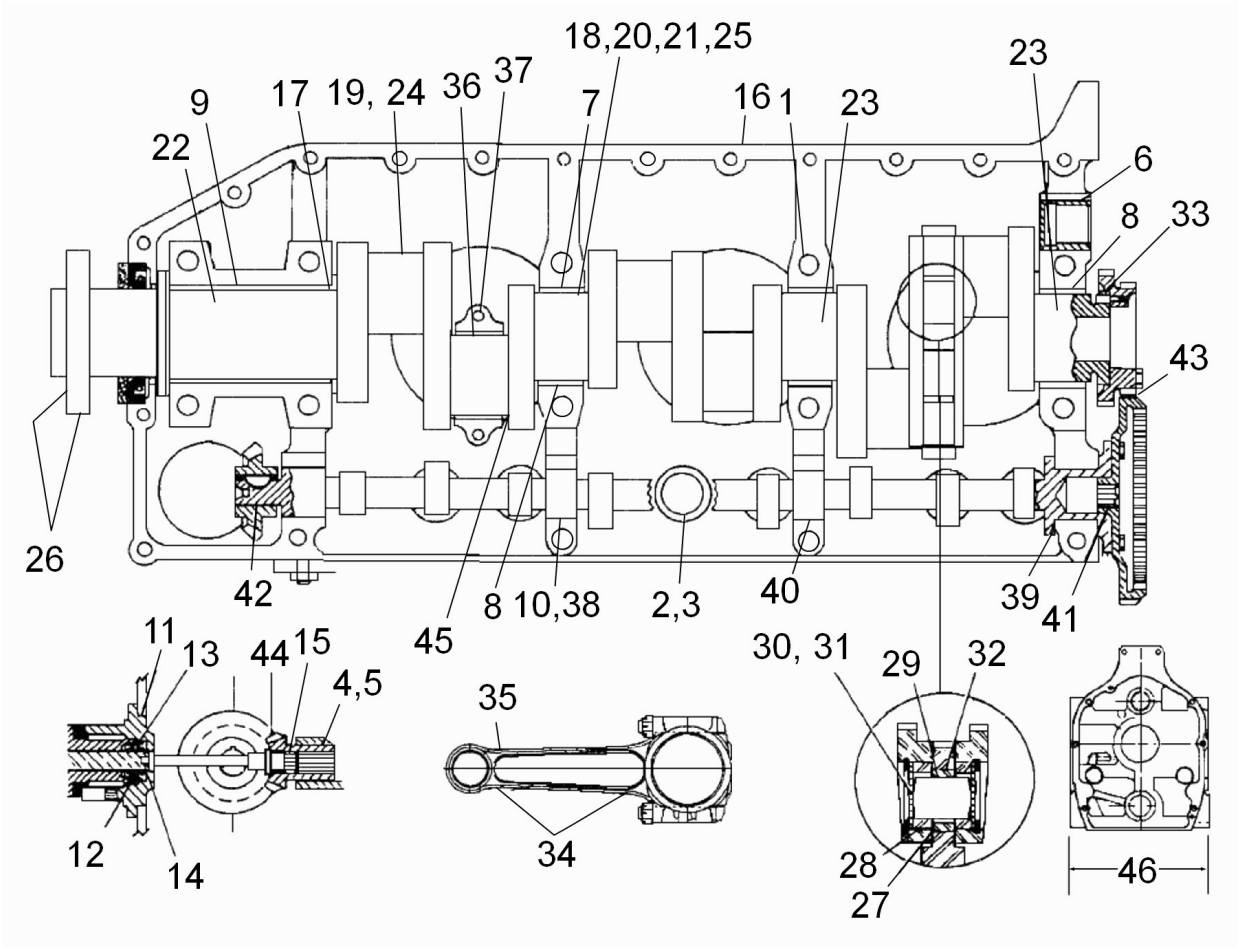


Figure 10-45. Crankcase, Crankshaft, Connecting Rods, Bearings and Camshaft Service Limits

10-11. Exhaust System Repairs

Refer to the aircraft maintenance manual for exhaust system repair instructions.

> NOTE: All IO-360 engines use two gaskets with concave sides together. After ground run-up and prior to flight service, torque all exhaust nuts to Appendix B specifications.

10-12. Engine Preservation and Storage

"Engine Preservation and Storage" instructions are in Chapter 9 of M-0, Standard Practice Maintenance Manual.

Chapter 11. Engine Overhaul Introduction

11-1. Engine Overhaul

During overhaul, all engine parts and accessories are removed and inspected. Specified parts are replaced while others may be restored to a condition equal to new product specifications. All engine parts and accessories must conform with the engine and accessory manufacturer's specifications prior to being re-installed on the engine. The intent of overhaul is to restore the engine to an airworthy condition. To be considered “airworthy,” the engine must conform to its type certificate and be in a condition for safe operation.

Information in this manual defines practices for overhauling engines. Chapters are arranged in sequential order of tasks to be performed during overhaul starting with engine removal and disassembly, followed by component disassembly, cleaning, inspection and repair, component assembly, engine assembly and installation, and post-overhaul testing.

Overhaul procedures in this manual apply only to the engines for which it is written and not the aircraft. Overhaul procedures described herein must be complied with in addition to all aircraft manufacturer and accessory manufacturer overhaul requirements.

New part limits essential to performing an engine overhaul applicable to engines covered in this manual are provided in Appendix D. Torque Specifications for all fasteners on the engine are located in Appendix B. Appendix C contains standard practices for recurring common procedures, like cotter pin and safety wire installation, and helical coil replacement. These sections will be referred to often throughout the procedures.

This manual does not contain overhaul requirements for supplemental type certificated engines, components or systems.

11-2. Overhaul Schedule

Engine time between overhaul (TBO) is determined by the engine model type certification data submitted to and approved by the FAA. Refer to the “Recommended Time Between Overhaul” entry under the “General” heading for the engine model in Section 2-3, “Engine Specifications” to determine when to overhaul your engine model.

11-3. Overhaul Sequence

Perform engine overhaul in the sequence described in Table 11-1.

Table 11-1. Overhaul Sequence

Action	Reference
1. Remove the engine from the aircraft.	Section 5-1, “Engine Removal”
2. Disassemble the engine.	Chapter 12, “Engine Disassembly”
3. Disassemble engine components.	Chapter 13, “Component Disassembly”
4. Clean engine parts.	Chapter 14, “Engine Cleaning”
5. Inspect engine parts for serviceability.	Perform inspections and complete the Overhaul Inspection Checklist: Chapter 15, “Overhaul Inspection and Repair” Appendix D, “Overhaul Dimensional Limits”
6. Repair or replace unserviceable parts or parts identified as 100% replacement parts or mandatory overhaul replacement parts.	Repair or replace parts as specified in Section 15-8, “Overhaul Repair” and Appendix C-2, “Replacement Parts”.
7. Apply protective coating to engine parts.	Section 12-4, “Protective Coatings” of M-0, Standard Practice Maintenance Manual
8. Assemble the engine components.	Chapter 16, “Component Assembly”
9. Assemble the engine.	Chapter 17, “Engine Assembly”
10. Install the engine in the aircraft.	“Section 5-2, “Engine Installation”
11. Test the overhauled engine.	Chapter 18, “Post-Overhaul Test and Adjustments”

11-4. Overhaul Checklists

Overhaul Checklists serve as guides during the overhaul process of disassembly, inspection, mandatory component replacement, refurbishing and assembly. Checklists provide a comprehensive record of the overhaul procedures:

- “Engine Removal and Disassembly Checklist”, Table 11-2
- “Engine Overhaul Visual Inspection Checklist”, Table 11-3
- “Fluorescent Penetrant Inspection Checklist”, Table 11-4
- “Magnetic Particle Inspection Checklist”, Table 11-5
- “Ultrasonic Inspection Checklist”, Table 11-6
- “Dimensional Inspection Checklist”, Table 11-7
- “Engine Cylinder Overhaul Inspection Checklist”, Table 11-8
- “Engine Drive Train Inspection Checklist”, Table 11-9
- “Replacement Parts Inventory”, Table 11-10

Overhaul inspection items listed in the checklists contain references to the procedures containing the overhaul actions required when overhauling engines covered by this manual. For convenient reference, make a copy of the checklists and complete them during engine overhaul.

Perform items listed in the checklists, according to the referenced procedures to remove, disassemble, and repair components on an engine which has reached TBO:

- Section 5-1, “Engine Removal”
- Chapter 12, “Engine Disassembly”
- Chapter 13, “Component Disassembly”
- Chapter 14, “Engine Cleaning”
- Chapter 15, “Overhaul Inspection and Repair”

During the overhaul process, assemble, install, and test the overhauled engine according to instruction in the following chapters:

- Chapter 16, “Component Assembly”
- Chapter 17, “Engine Assembly”
- Section 5-2, “Engine Installation”
- Chapter 18, “Post-Overhaul Test and Adjustments”

Table 11-2. Engine Removal and Disassembly Checklist

Overhaul Step	Initials	Findings
Complete a Cylinder Visual Inspection (Section 6-3.11.1) Document results on the "Cylinder Inspection Checklist"(Table 6-10).		
Complete a Cylinder Differential Pressure Test. (Section 6-3.11.2). Document results on the "Cylinder Inspection Checklist"(Table 6-10).		
Remove the engine from the aircraft (Section 5-1).		
Remove the Ignition System (Section 12-2).		
Remove the Fuel Injection System (Section 12-3).		
Remove the Induction System (Section 12-4).		
Remove the Alternator(s) (Section 12-5).		
Remove the Starter and Starter Adapter (Section 12-6).		
Remove the Accessory Case (Section 12-7).		
Remove the Exhaust System (Section 12-8).		
Remove the Oil Cooler (Section 12-9).		
Remove the Oil Pump (Section 12-10).		
Remove the Oil Sump (Section 12-11).		
Remove Intercylinder Baffles (Section 12-12), if equipped.		
Remove the Engine Cylinders and Pistons (Section 12-13).		
Disassemble the Ignition System (Section 13-1).		
Disassemble the Fuel Injection System (Section 13-2).		
Disassemble the Starter and Starter Adapter (Section 13-3).		
Disassemble the Engine Cylinders (Section 13-4).		
Disassemble the Crankcase (Section 13-5).		
Disassemble the Drive Train (Section 13-6)		
Perform a visual inspection prior to cleaning the engine parts (Section 15-3)		
Clean engine parts (Section 14-1).		
Perform detailed visual parts inspection (Section 15-3 and Table 11-3).		
Perform Fluorescent Penetrant Inspections (Section 15-4).		
Perform Magnetic Particle Inspections (Section 15-5).		
Perform Ultrasonic Inspections (Section 15-6)		
Perform Dimensional Inspections (Section 15-7).		
Perform Overhaul Repairs (Section 15-8).		
Assemble engine components (Chapter 16).		
Assemble engine (Chapter 17).		
Install engine (Section 5-2).		
Complete Post-Overhaul Test and Adjustments (Chapter 18).		

Table 11-3. Engine Overhaul Visual Inspection Checklist

Inspection Item	Initials	Findings
Complete the cursory visual inspection according to Section 15-3 during disassembly to avoid cleaning parts which ultimately will be replaced. After disassembly and cleaning, complete a thorough inspection of all parts which are not identified as 100% replacement items (Ref. Appendix C-2.3) or mandatory replacement items during overhaul (Ref. Appendix C-2.4). Collect faulty part (not required overhaul replacements) information at the end of each subsystem for a replacement parts list.		
Fuel Injection System		
Inspect the fuel injection system tubes and fittings for cracks, dents, chafing, flared end erosion, and deformation.		
Inspect fittings and hardware on the fuel injection system for damaged threads or stripped heads.		
Inspect fuel injection system brackets for cracks, dents, or wear.		
Obtain new, rebuilt, or overhauled fuel pump, manifold valve, and throttle and control assembly/integrated throttle and metering unit.		
Inspect tapped holes and helical coils on the fuel injection system for distorted or stripped threads, cracks or dents.		
Using a flashlight and 10X magnifying glass, inspect the fuel pump and manifold housing, and bracket exterior for cracks.		
Replacement Part Description	Part Number	Reason

Table 11-3. Engine Overhaul Visual Inspection Checklist

Inspection Item	Initials	Findings
Induction System		
Inspect induction tubes, risers, clamps and induction manifold for cracks, dents, and chafing.		
Check tube ends and flanges on the surface plate for warpage or deformities.		
Inspect fittings and hardware on the induction system for damaged threads or stripped heads.		
Inspect tapped holes and helical coils on the induction system for distorted or stripped threads, cracks or dents.		
Inspect the induction system brackets, manifold, clamps and tubes with a 10X magnifying glass.		
Replacement Part Description	Part Number	Reason
Alternator		
Obtain new, rebuilt, or overhauled alternator.		
Perform a visual inspection of the alternator components.		
Inspect fasteners for damaged or stripped heads.		
Check the alternator drive hub per instructions in “Alternator Drive Hub (1 Piece) Slippage Inspection” in Section 15-7.6		
Inspect the alternator brackets, and associated hardware with a 10X magnifying glass.		
Replacement Part Description	Part Number	Reason

Table 11-3. Engine Overhaul Visual Inspection Checklist

Inspection Item	Initials	Findings
Starter/Starter Adapter		
Obtain new, rebuilt, or overhauled starter motor.		
Perform a visual inspection of the starter and starter adapter components. (AF Starter Only)		
Inspect the exterior of the starter adapter housing and cover for cracks with a 10X magnifying glass except AF.		
Inspect the starter adapter housing and accessory drive adapter housing studs for distorted or stripped threads, corrosion, or pitting, or looseness except AF.		
Check the shaft gears, drive gear, starter gear, accessory gear, or worm shafts for cracks except AF.		
Check for damaged or loose studs on the starter and accessory drive adapter except AF.		
Replacement Part Description	Part Number	Reason
Ignition System		
Obtain new, rebuilt magneto or overhaul the magnetos according to the Magneto Service Manual.		
Inspect magneto for serviceability		
Inspect magneto drive gear assembly for serviceability		
Replace the ignition harness.		
Replacement Part Description	Part Number	Reason

Table 11-3. Engine Overhaul Visual Inspection Checklist

Inspection Item	Initials	Findings
Lubrication System		
Inspect the exterior and cavity of the oil pump housing with a 10X magnifying glass.		
Inspect the oil pump cover, tach drive housing, and oil filter adapter with a 10X magnifying glass.		
Inspect the oil pump cover for scoring at gear contact surfaces.		
Using a flashlight and 10X magnifying glass, inspect all remaining Lubrication System components.		
Inspect all oil passages, especially in the oil pump housing and tach drive housings, for flow restrictions.		
Inspect the oil pump housing gear shaft for security and scoring.		
Inspect the oil pressure relief valve plunger for scoring and nicks and the face for roughness.		
Check the oil pump drive gear shaft and shaft splines for wear or damage.		
Inspect the oil sump and sump bolt holes.		
Inspect the oil drain plug boss and drain plug for damaged threads and damaged wrench flats.		
Inspect the oil suction tube assembly for dents, cracks, distorted or restricted openings.		
Inspect the oil pump housing and tach drive housing studs for distorted or stripped threads.		
Inspect the lubrication system fastening studs.		
Replacement Part Description	Part Number	Reason

Table 11-3. Engine Overhaul Visual Inspection Checklist

Inspection Item	Initials	Findings
Engine Cylinders		
Inspect for obvious cracks, missing or bent fins. Inspect the studs for corrosion, distortion, stripped or incomplete threads, or looseness.		
Inspect the cylinders using Table 11-8, “Engine Cylinder Overhaul Inspection Checklist”.		
Replacement Part Description	Part Number	Reason

Table 11-3. Engine Overhaul Visual Inspection Checklist

Inspection Item	Initials	Findings
Crankcase		
Inspect for obvious cracks, missing or bent hardware.		
Inspect fasteners for loose or bent studs and damaged threads.		
Inspect interior after disassembly for worn, scored, or otherwise damaged journals.		
Replacement Part Description	Part Number	Reason
Engine Drive Train		
Inspect the drive train components using the “Engine Drive Train Inspection Checklist”(Table 11-9)		
Replacement Part Description	Part Number	Reason

Table 11-3. Engine Overhaul Visual Inspection Checklist

Inspection Item	Initials	Findings
Air Conditioning Compressor (Optional Part) Mounting Kit		
Inspect the air conditioning compressor mounting brackets for cracks and elongated holes.		
Inspect the idler sheave for warpage, cracks, and wear in belt grooves and bearing seats.		
Check the mounting bracket flange for wear; place it on a surface plate and check for warpage.		
Inspect the idler sheave support bolt for wear on the support shank.		
Inspect the hardware for distorted or stripped threads.		
Replacement Part Description	Part Number	Reason

Table 11-4. Fluorescent Penetrant Inspection Checklist

Perform this inspection on clean, aluminum or non-ferrous metal parts IAW ASTM E1417, E1208, E1209, and E1219. Use Type I, Penetrant Method A, B, C, or D and the "Fluorescent Penetrant Inspection" instructions in Section 15-4.		
Inspection Item	Focus	Initials
General Look for discontinuities such as: • Cracks • Grinding • Seams • Laps or ruptures	Pay particular attention to: • Bearing bosses • Mounting flanges • Shaft bores • Mating surfaces where hardware has been previously torqued • Areas where oil seals or bushings are pressed in or seated • Look for indications of weakness in corners, edges, holes, or fillets. Identify parts that contain linear indications that cannot be reworked	
Cylinder heads	Pay particular attention to: • Rocker boss areas • Valve seat insert areas • Valve guide areas • Intake and exhaust flanges • Intake and exhaust ports • Between cylinder head cooling fins • Cylinder-to-barrel mating area • Mounting flanges	
Aluminum alloy fuel injection components	• Fuel pump body • Vapor separator • Fuel manifold valve body • Covers • Flanges	
Aluminum air conditioning compressor mounting components	• Mounting flanges • Bolt holes	
Starter Adapter housing	• Mounting flanges • Bolt holes	
Accessory case	• Mounting flanges • Bolt holes • Oil pump cavity	
Oil pump cover	• Mounting flange • Bolt holes	
Crankcase halves	Pay particular attention to: • Cylinder-to-barrel mating area • Bearing bosses • Mounting flanges • Shaft bores • Through bolt hole areas • Crankcase/crankshaft exit area • oil seals or bushing seats	
Aluminum alloy brackets	• Mounting flanges • Bolt holes	

Table 11-4. Fluorescent Penetrant Inspection Checklist

Perform this inspection on clean, aluminum or non-ferrous metal parts IAW ASTM E1417, E1208, E1209, and E1219. Use Type I, Penetrant Method A, B, C, or D and the "Fluorescent Penetrant Inspection" instructions in Section 15-4.		
Inspection Item	Focus	Initials
Aluminum alloy Induction System components	• Mounting flanges • Bolt holes	
Scavenge pump body and adapter covers	• Oil pump cavity • Mounting flanges • Oil seal or bushing seats	
Oil cooler mount	• Mounting flanges • Oil seal or bushing seats	
Oil filter adapter	• Mounting flanges • Oil seal or bushing seats	
Cast aluminum oil sump	• Mounting flanges • Bolt holes	
Record parts which do not pass the inspection on Table 11-10, "Replacement Parts Inventory," on page 27 for an accurate inventory of required parts to rebuild. Mark the faulty parts as defective and discard.		

Table 11-5. Magnetic Particle Inspection Checklist

Use the fluorescent method wet continuous procedure on all ferrous parts. Follow the latest ASTM E1444 procedure and the “Magnetic Particle Inspection” instructions in Section 15-5.		
Inspection Item	Initials	Inspector Notes
Crankshaft • Journals • Fillets • Oil holes • Thrust flanges • Prop flange		
Cylinder Barrels • Fin tips • Fin roots • Mounting flange • Mounting flange holes		
Camshaft • Lobes • Journals • Drilled hole edges		
Rocker arms • Pad • Socket under side arms and boss		
Piston Pin • Shear planes • Ends • Center		
Starter Adapter • Shaft gear • Worm shaft • Worm gear		
Lubrication System: • Oil pump gears • Bevel gears • Tach drive shaft		
• Counterweights (after bushings installed) • Crankshaft gears • Camshaft gear • Governor drive gear		
Connecting rods (Section 15-5.1)		
Record parts which do not pass the inspection on Table 11-10, “Replacement Parts Inventory,” on page 27 for an accurate inventory of required parts to rebuild. Mark the faulty parts as defective and discard.		

Table 11-6. Ultrasonic Inspection Checklist

Only certified, trained personnel can perform this inspection Ref: “Ultrasonic Inspection Certification” instructions in Section 15-6.1 and “Ultrasonic Inspections” instructions in Section 15-6.		
Inspection Item	Result	Remedy
Crankshaft (Section 15-6.2)		
Crankshaft Main Journal #1		
Crankshaft Main Journal #2		
Crankshaft Main Journal #3		
Crankshaft Main Journal #4		
Vibroetch Passing Crankshaft with Inspection Results		
Record parts which do not pass the inspection on Table 11-10, “Replacement Parts Inventory,” on page 27 for an accurate inventory of required parts to rebuild. Mark the faulty parts as defective and discard.		

Table 11-7. Dimensional Inspection Checklist

Reference “Dimensional Inspection” (Section 15-7) and “Overhaul Dimensional Limits” in Appendix D		
Inspection Item	Dimension	Initials
Crankcase, Crankshaft, Connecting Rods, Bearings and Camshaft (Section 15-7)		
Through bolt in crankcase		
Hydraulic valve lifter in crankcase		
Hydraulic valve lifter bore in crankcase		
Governor driven gear in crankcase		
Governor driven gear bore in crankcase		
Starter shaft bushing in crankcase		
Crankcase main bearing bore		
Crankcase rear and intermediate main bearing bore[1]		
Crankcase front main bearing bore[1]		
Crankcase camshaft bearing bore		
Fuel pump adapter pilot in crankshaft		
Fuel pump body pilot in adapter		
Oil seal in adapter		
Fuel pump drive shaft in impeller shaft		
Fuel pump drive shaft in governor gear - tooth clearance		
Crankcase (each half)		
Crankcase width		
Crankshaft in thrust bearings - end clearance		
Crankshaft in main bearings		
Crankpin - out of round		
Main journals - out of round		
Crankshaft main and thrust journals		
Crankshaft thrust journal[1]		
Crankshaft rear and intermediate journals[1]		
Crankpin journals		
Crankshaft runout at center main journals (shaft supported at thrust and rear journals)		
Taper over full crankshaft bearing		
Crankshaft run out at propeller flange when supported at front and rear main journals		

Table 11-7. Dimensional Inspection Checklist

Reference “Dimensional Inspection” (Section 15-7) and “Overhaul Dimensional Limits” in Appendix D							
Inspection Item	Dimension						Initials
Crankcase, Crankshaft, Connecting Rods, Bearings and Camshaft (Section 15-7) (cont.)							
Damper pin bushing in crank cheek							
Damper pin bushing in counterweight							
Damper pin 643626-109							
Damper pin 643626-110							
Damper pin 643626-111							
Damper pin							
Damper pin - end clearance							
Counterweight on crank cheek - side clearance							
Crankshaft gear on crankshaft							
Camshaft in crankcase							
Camshaft in crankcase - end clearance							
Camshaft run out at center journals (shaft supported at end journal)[2]							
Camshaft gear on camshaft							
Governor drive gear on camshaft							
Crankshaft gear to camshaft gear - backlash							
Governor drive gear to camshaft gear - backlash							
Connecting rod bearing - side clearance							
Connecting Rods (Section 15-7.2.1)	1	2	3	4	5	6	--
Connecting rod bearing and bushing twist or convergence per inch length							
Connecting rod beam section at narrowest point							
Connecting rod bearing on crankpin							
Connecting rod bolt in connecting rod							
Engine Cylinders (Section 15-7.3)	1	2	3	4	5	6	--
Cylinder bore (lower 4-1/4 inch of barrel)							
Cylinder bore at “Y” location							
Cylinder bore at “X” location							
Cylinder bore out of round - tolerance							

Table 11-7. Dimensional Inspection Checklist

Reference “Dimensional Inspection” (Section 15-7) and “Overhaul Dimensional Limits” in Appendix D							
Inspection Item	Dimension						Initials
Engine Cylinders (cont.)	1	2	3	4	5	6	--
Cylinder bore (reground 0.015 inch) allowable oversize							
Cylinder bore surface roughness (Nitrided Barrels) cross hatch							
Micro finish (measured in direction of piston travel)							
Cylinder barrel in crankcase							
Intake valve guide in cylinder head							
Exhaust valve guide in cylinder head							
Exhaust valve seat (to valve guide axis)							
Intake valve seat (to valve guide axis)							
Intake valve seat insert in cylinder head							
Exhaust valve seat insert in cylinder head							
Rocker shaft in rocker arm bearing							
Rocker arm bearing in rocker arm							
Intake valve in guide							
Exhaust valve in guide							
Intake valve face (to stem axis)							
Intake valve (maximum tip regrind 0.015 inch)							
Intake valve (full indicator reading)							
Exhaust valve (full indicator reading)							
Valve rocker toe to valve stem (dry lifter)							
Rocker arm - side play							
Rotocoil to rocker arm							
Piston clearance in cylinder bore							
Top piston ring (semi-keystone) in groove							
Second piston ring (semi-keystone) in groove							
Third piston ring in groove							
Fourth piston ring in groove							
Top piston ring at 1.00 ±0.50 depth in cylinder barrel							
Second piston ring at 1.00 ±0.50 depth in cylinder barrel							

Table 11-7. Dimensional Inspection Checklist

Reference “Dimensional Inspection” (Section 15-7) and “Overhaul Dimensional Limits” in Appendix D							
Inspection Item	Dimension						Initials
Engine Cylinders (cont.)	1	2	3	4	5	6	--
Third piston ring at 1.00 ±0.50 depth in cylinder barrel							
Fourth piston ring at 1.00 ±0.50 depth in cylinder barrel							
Piston pin in STD or 0.005 inch oversized piston							
Piston pin in cylinder - end clearance							
Piston pin in connecting rod bushing							
Bushing in connecting rod							
Inner valve spring compressed to 1.10 inch - load length							
Outer valve spring compressed to 1.17 inch - load length							
Inner valve spring - free length							
Outer valve spring - free length							
Cylinder dimension STD D							
Cylinder dimension 0.005 D							
Cylinder dimension 0.010 D							
Cylinder dimension 0.015 D							
Cylinder dimension STD X							
Cylinder dimension 0.005 X							
Cylinder dimension 0.010 X							
Cylinder dimension 0.015 X							
Cylinder dimension STD Y							
Cylinder dimension 0.005 Y							
Cylinder dimension 0.010 Y							
Cylinder dimension 0.015 Y							
Starter Adapter (Section 15-7.4)							
Starter adapter shaft gear in bushing							
Starter adapter shaft gear front journal							
Starter shaft gear to crankshaft gear							
Starter gear and worm shaft gear							
Starter shaft gear							
Starter clutch spring outside							
Starter clutch spring inside							
Starter shaft gear drum outside							

Table 11-7. Dimensional Inspection Checklist

Reference “Dimensional Inspection” (Section 15-7) and “Overhaul Dimensional Limits” in Appendix D		
Inspection Item	Dimension	Initials
Starter Adapter (cont.)		
Starter gear drum outside		
Starter gear inside		
Clutch spring on starter shaft gear drum 0.50-0.56 from drum end		
Clutch spring on gear drum 0.40 from drum end		
Needle bearing bore in adapter		
Worm gear shaft in needle bearing		
Worm gear shaft in ball bearing		
Ball bearing in adapter housing		
Starter in adapter pilot		
Starter drive tongue to worm shaft drive slot		
Adapter cover in adapter housing pilot		
Starter gear		
Shaft gear in adapter cover bushing		
Oil seal in adapter cover		
Adapter cover bore		
Starter Adapter with Accessory Drive (Section 15-7.4)		
Driver bevel gear in bushing		
Driver bevel gear on starter shaft gear		
RHS accessory drive shaft end in bushing		
LHS accessory drive shaft end in bushing		
RHS seal bore		
LHS seal bore		
Accessory drive shaft		
Accessory drive shaft		
Driven bevel gear on accessory drive shaft		
Driven and driver bevel gears		
RHS accessory bore		
LHS accessory bore		

Table 11-7. Dimensional Inspection Checklist

Reference “Dimensional Inspection” (Section 15-7) and “Overhaul Dimensional Limits” in Appendix D		
Inspection Item	Dimension	Initials
Starter Adapter with Accessory Drive Adapter w/ Gear Shaft Housing (Section 15-7.4)		
Needle bearing bore in cover		
Starter shaft gear in adapter cover bushing		
Scavenge pump driven gear on shaft		
Scavenge pump gears in adapter cover		
Scavenge pump drive gear on starter shaft gear		
Scavenge pump driven gear to drive gear		
Driver bevel gear on starter shaft gear		
RHS accessory drive shaft end in bushing		
LHS accessory drive shaft end in bushing		
RHS seal bore		
LHS seal bore		
Accessory drive shaft		
Accessory drive shaft		
Driven bevel gear on accessory drive shaft		
Driven and driver bevel gears		
Gear shaft bearing bore in housing		
Gear shaft oil seal bore in housing		
Gear shaft		
RHS accessory bore		
LHS accessory bore		
Lubrication and Accessory Case (Section 15-7.5)		
Oil pump gears in housing		
Oil pump gears in housing - end clearance		
Oil pump gear shaft in housing bushing		
Oil pump driven gear on shaft		
Oil pump shafts in cover		
Driver gear shaft in oil pump drive gear		
Alternator pilot in cover		
Oil seal in alternator		
Alternator coupling retainer on sleeve		

Table 11-7. Dimensional Inspection Checklist

Reference “Dimensional Inspection” (Section 15-7) and “Overhaul Dimensional Limits” in Appendix D		
Inspection Item	Dimension	Initials
Lubrication and Accessory Case (cont.)		
Coupling retainer in coupling hub slot - side clearance		
Coupling bushings on drive gear lugs - total side clearance		
Alternator gear on sleeve		
Oil pump driver to driven gear - backlash		
Alternator gear to camshaft gear - backlash		
Drive gear to camshaft gear - backlash		
Oil pressure relief valve inner spring compressed to 1.50 inch load length		
Oil pressure relief valve outer spring compressed to 1.50 inch load length		
Oil temperature control valve 0.090 inches minimum travel at		
Oil temperature control valve must be fully close against seat at		
Oil temperature control valve must crack open at 180°F with 18 PSI		
Magneto Drive Assembly (Section 15-8.5)		
Magneto gear support shaft to bearing		
Sleeve in drive gear		
Washer in drive gear		
Magneto coupling retainer on gear sleeve		
Magneto coupling retainer in drive gear slot - total side clearance		
Magneto coupling rubber bushings on magneto drive lugs - side clearance		
Magneto pilot in crankcase cover		
Magneto gear to camshaft gear - backlash		
Alternator (Section 15-7.7)	Overhaul according to manufacturer’s instructions	

Table 11-7. Dimensional Inspection Checklist

Reference “Dimensional Inspection” (Section 15-7) and “Overhaul Dimensional Limits” in Appendix D							
Inspection Item	Dimension						Initials
Stud Height Settings (Section 15-7.9)							
Starter Adapter to Starter							
Starter Adapter to Accessory Adapter							
Accessory Adapter to Covers							
Oil Sump to Crankcase							
Oil Cooler Adapter to Crankcase							
Fuel Pump to Crankcase							
Oil Pump Cover to Accessory Case							
Magnetos to Accessory Case							
Alternator to Accessory Case							
Oil Filter Adapter to Accessory Case							
Cylinder	1	2	3	4	5	6	
Exhaust flange studs							
Rocker shaft studs							
Intake flange studs							
Crankcase studs according to Section 15-7.9 and Appendix D.							
Record parts which do not pass the inspection on Table 11-10, “Replacement Parts Inventory,” on page 27 for an accurate inventory of required parts to rebuild. Mark the faulty parts as defective and discard.							

1. These limits refer to the “B” (i.e IO-360-DB) configurations, IO-360-ES and IO-360-AF models.
2. Straightening of the camshaft is permissible if run out does not exceed 0.005 inch.

Table 11-8. Engine Cylinder Overhaul Inspection Checklist

Fluorescent Penetrant Inspection (on all non-ferrous metal parts) Perform the inspection in accordance with ASTM E1417, 1208, E1209, and E1219. Use Type I, Penetrant Method A, B, C, or D. and the “Fluorescent Penetrant Inspection” in Section 15-4.						
Cylinder	1	2	3	4	5	6
Cylinder Heads						
Cylinder Heads after Valve Seat or Valve Guide Installation						
Magnetic Particle Inspection (on all ferrous parts) Use the fluorescent wet continuous method and follow the latest ASTM E1444 procedure. Also refer to the section “Magnetic Particle Inspection” in Section 15-5.						
Cylinder barrel inner and outer surfaces.						
Rocker arms						
Dimensional Inspection Refer to the sections “Dimensional Inspection” and “Engine Cylinder Dimensional Inspection”						
Cylinders						
Cylinder Components						

Table 11-9. Engine Drive Train Inspection Checklist

Item to Check	Initials	Action
Inspect the crankshaft, camshaft, connecting rods, and engine drive train components for rusting, pitting, and cracks.		
Using a 10X magnifying glass, inspect the camshaft journals and lobes for scoring, pitting, corrosion, or any other indication of wear.		
Inspect the camshaft gear splines for wear.		
Inspect the camshaft gear flange for nicks, peening, and other irregularities. (This flange must be smooth to align gears.)		
Inspect the bolt holes on the camshaft gear flange for distorted or stripped threads.		
Using Borroughs 8087A polishing tool or equivalent, rotate the crankshaft in a lathe and polish the mains and crank pins to a finish of 8 R_a maximum. Inspect the finish using a profilometer. Then perform a dimensional inspection on the crankshaft mains and crankshaft pins according to the "Drive Train Dimensional Inspection" in Section 15-7.2.		
Inspect the crankshaft main journals, crank pins, and oil seal area for scoring and burning.		
Inspect the crankshaft gear bolt holes for distorted or stripped threads.		
Check the oil passages on the crankshaft for obstruction or loose oil tubes.		
Check the gear dowel for the desired snug fit.		
Inspect the oil control plug for obstructions in the oil hole and loose fit.		
Inspect the crankshaft and counterweights for cracks, nicks, or evidence of contact between the bottom of the counterweight and the crankshaft according to: Section 15-7.2, "Drive Train Dimensional Inspection" and Section 15-7.2.2, "Crankshaft Counterweight Inspection" Use tags to identify these parts. Do not use a scribe or punch to mark on these parts.		
Using a 10X magnifying glass, inspect the crankshaft gear and idler gear drive teeth for signs of overheating and wear according to instructions in Section 15-3.1, "Gear Tooth Inspection." Normal wear produces a fine polish on the tooth thrust faces.		
Verify that the crankshaft connecting rod and cap mate marks are adjacent to each other and that the position numbers are stamped on or adjacent to the bolt boss match.		

Table 11-9. Engine Drive Train Inspection Checklist

Item to Check	Initials	Action
Inspect the connecting rod for corrosion, pitting, rust, discoloration (blue), galling, impact damage, nicks, bending, or twisting.		
Remove the nuts and bolts from the connecting rod and separate the rod and the cap (if not already done during disassembly). Inspect the connecting rod and cap parting surface. Contact signatures resulting from assembly forces are normal and acceptable. Fretting signatures resulting in the loss of metal indicated by removal of original machining marks are not acceptable.		
Inspect the nut seat area on the connecting rod; check for loss of material or signatures of edge loading of the bolt under the head surface contact area. Inspect dowel surfaces at the connecting rod and cap bolt holes for distortion or scoring.		
Assemble the connecting rod and caps by installing one bolt through the cap and rod. Verify that the mate marks adjacent to each other match. With the cap seated firmly against the connecting rod, a bolt should be easily installed using hand pressure.		
Inspect the connecting rods according to Section 15-7.2.1, “Connecting Rod Dimensional Inspection.”		
Remove the piston pin bushing from the connecting rod; inspect the piston pin bushing bore and surrounding area for nicks, gouges and mechanical damage.		
Inspect the rod channel rails for nicks, gouges or mechanical damage.		

Table 11-10. Replacement Parts Inventory

Part Description	Part Number	Reason/Comment

Table 11-10. Replacement Parts Inventory

Part Description	Part Number	Reason/Comment

Chapter 12. Engine Disassembly

12-1. Engine Disassembly Sequence

Disassemble the engine following the procedures in the sequential steps listed below. Once the engine is disassembled as described herein, disassemble components, clean, and inspect them as described in subsequent chapters. Refer to the corresponding sections in this chapter for detailed instructions for each step:

1. Ignition System Removal
2. Fuel Injection System Removal
3. Induction System Removal
4. Alternator Removal (and optional alternator and bracket assembly)
5. Starter and Starter Adapter Removal
6. Accessory Case Removal
7. Exhaust System Removal
8. Oil Cooler Removal
9. Oil Pump Removal
10. Oil Sump Removal
11. Intercylinder Baffles Removal
12. Engine Cylinder and Piston Removal

12-2. Ignition System Removal

IO-360 series engine ignition systems may be the Continental Motors magnetos or Champion (Slick) magnetos depending on model and specification. Magnetos may feature retard breakers coupled with a starting vibrator or impulse couplings. Some IO-360 magnetos are fitted with tachometer breakers. Removal and installation procedures are similar, with only minor differences. Separate instructions are provided for Continental Motors and Champion (Slick) Magnetos. Refer to the Illustrated Parts Catalog.

12-2.1. Continental Motors Ignition System Removal

1. Remove ignition leads from each spark plug (Figure 12-2)(10).
2. Remove and discard the spark plugs (10).
3. On each magneto, remove the four screws (3) from the cable outlet plate; disconnect the cable outlet plates from magnetos (1).
4. Remove clamps and cable ties; remove the ignition harness assembly (2) from the engine and discard.
5. Disconnect the two magneto tachometer leads from the housing, if installed.
6. Remove nuts (5), lock washers (6), and hold washers (7) from both sides of the magneto (1). Discard the lock washers.

   CAUTION: Remove the magneto carefully to avoid dropping the coupling bushing into the accessory case.

7. Carefully remove the magneto (1) from the accessory case.
8. Remove and discard the gasket (4).

   CAUTION: Remove magneto drive gear assembly carefully to avoid dropping coupling bushing into the accessory case.

9. Remove magneto drive gear assembly from engine and discard the coupling bushings. Refer to Figure 12-1.
10. Place the parts in a clean, protected area until ready for overhaul inspection.
11. Replace and/or overhaul the magneto according to the instructions in Ignition System Service Support Manual (X42002 for S-20/200 Series Magnetos).



Figure 12-1. Magneto Drive Gear Assembly Removal

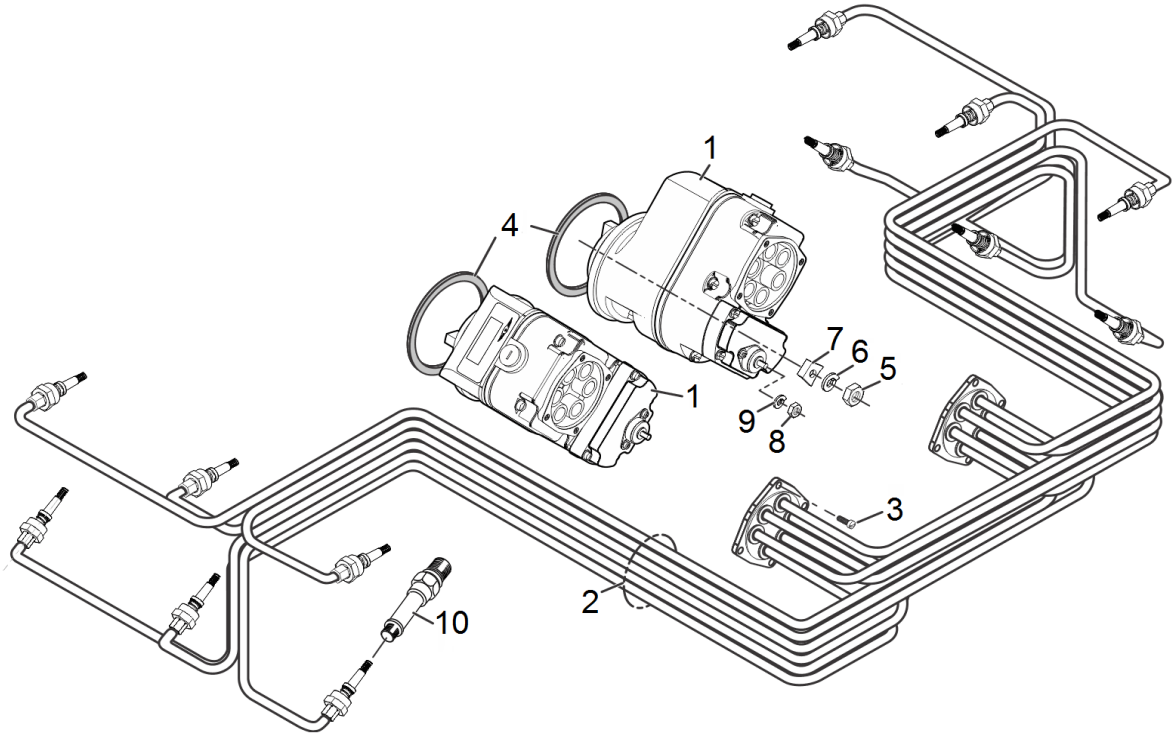


Figure 12-2. Continental Ignition System Removal

1	Magneto	4	Gasket	7	Hold Washer	10	Spark Plug
2	Harness	5	Nut	8	Nut		
3	Screw	6	Lock Washer	9	Lock Washer		

12-2.2. Champion (Slick) Ignition System Removal

1. Disconnect the ignition leads from each spark plug (Figure 12-3)(7).
2. Remove and discard the spark plugs (7).
3. On each magneto, remove the three screws (8) from the cable outlet plate; disconnect the cable outlet plate from the magneto (1).
4. Remove clamps and cable ties; remove the ignition harness assembly (2) from the engine and discard.
5. Remove nuts (4), lock washers (5), and hold washers (6) from both sides of magneto (1). Discard the lock washers.

   CAUTION: Remove the magneto carefully to avoid dropping the coupling bushing into the accessory case.

6. Remove the magneto (1) from the accessory case.
7. Remove and discard the gasket (3).

   CAUTION: Remove magneto drive gear assembly carefully to avoid dropping coupling bushing into the accessory case.

8. Remove magneto drive gear assembly from engine and discard the coupling bushings. Refer to Figure 12-1.
9. Place the parts in a clean, protected area until ready for overhaul inspection.
10. Replace and/or overhaul the magneto according to the manufacturer's ICA for applicable magneto maintenance instructions.

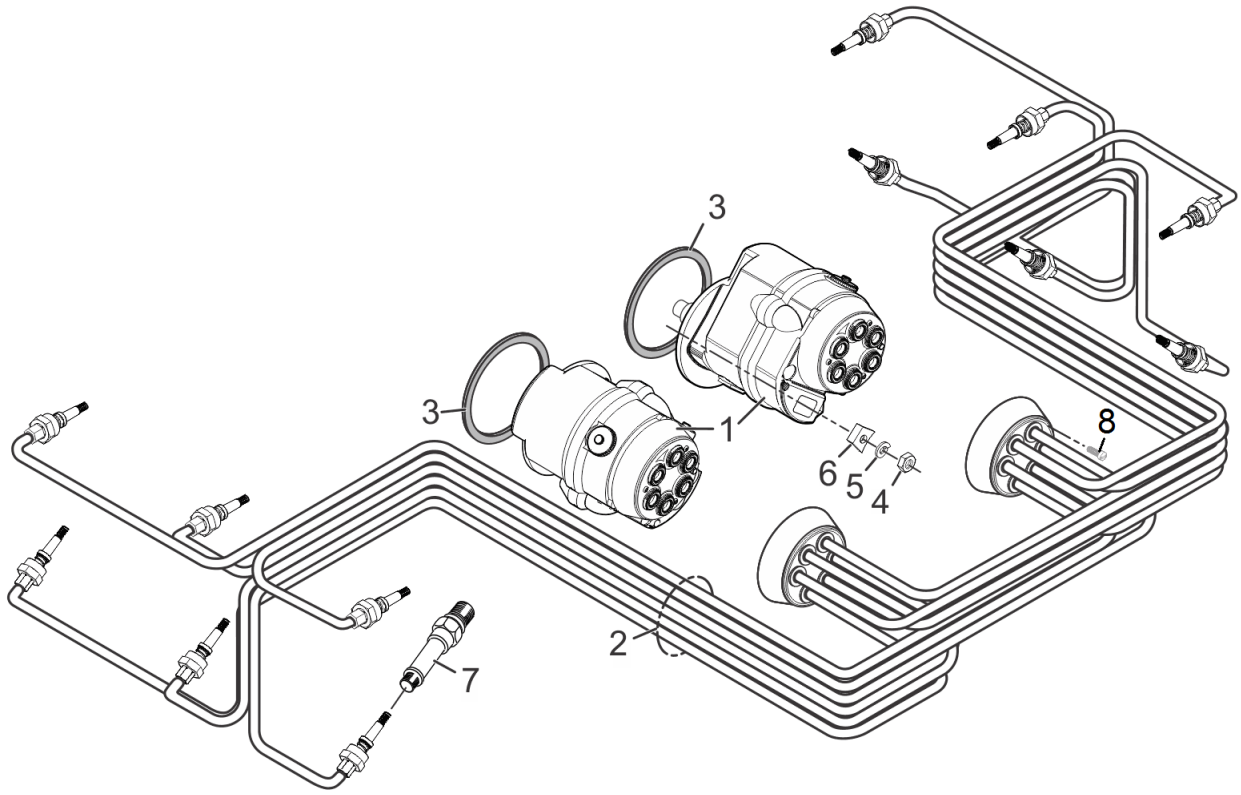


Figure 12-3. Champion (Slick) Ignition System Removal

1	Magneto	3	Gasket	5	Lock Washer	7	Spark Plug
2	Harness	4	Nut	6	Hold Washer	8	Screw

12-3. Fuel Injection System Removal

Fuel injection systems vary significantly between engine models; refer to the instructions which apply to the engine model being overhauled. Also refer to the Illustrated Parts Catalog.

12-3.1. Fuel Injection System Removal (Except AF and ES)

1. Mark each fuel injection tube (Figure 12-4)(10 through 15) with its cylinder number to facilitate re-installation.

WARNING

Fuel injection tubes must not be bent or deformed. Discard and replace bent, chafed or deformed fuel injection tubes.

2. Fuel injection tube removal:
   a. Disconnect fuel injection tubes (10 through 15) from fuel nozzles (16).
   b. Disconnect fuel injection tubes (10 through 15) from the fuel manifold valve assembly (4).
   c. Remove fuel injection tubes (10 through 15) from engine.
3. Remove and discard the fuel nozzles (16A-F) from each cylinder.
4. Remove fuel hose (17) from throttle and metering assembly (8) inlet tee fitting (Figure 12-5)(10) and fuel pump (Figure 12-4)(3) outlet fitting. Discard the fuel hose.
5. Remove fuel hose (18) from the throttle and metering assembly (8) fuel outlet elbow (Figure 12-5)(12) and manifold valve (Figure 12-4)(4) inlet fitting. Discard the fuel hose.
6. Remove nuts (21) and screws (20) securing throttle and metering assembly (8) to bracket (19) on crankcase backbone.
7. Loosen clamps and remove hardware to remove the throttle and metering assembly (8) and gasket (22) from the induction system. Place the throttle and metering assembly in a clean, protected area until it is overhauled and discard the gasket.
8. Remove the crankcase backbone hardware that secures the manifold valve (4) to the engine and remove the manifold valve. Place the manifold valve in a clean, protected area until it is overhauled.
9. Temporarily re-install the crankcase backbone hardware removed in step 8.
10. Remove nuts (9), lock washers (7) and washers (6). Discard the lock washers.
11. Remove fuel pump (3) and gasket (5). Place the fuel pump in a clean, protected area until it is overhauled and discard the gasket.
12. Remove the drive shaft (2) from crankcase fuel pump cavity. Place the drive shaft in a clean, protected area until ready for overhaul inspection.

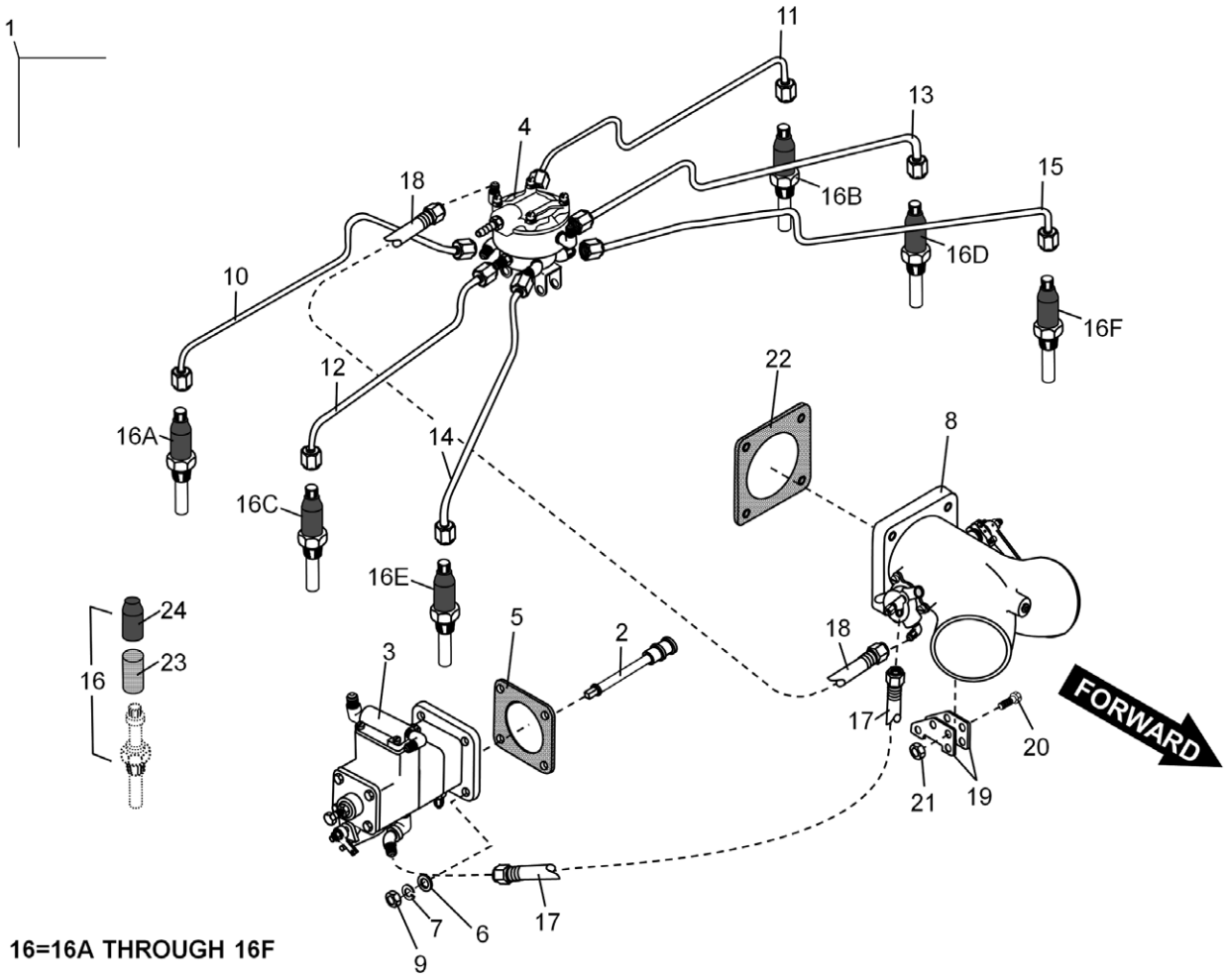


Figure 12-4. Fuel Injection Assembly Removal (Except AF and ES)

1	Fuel Injection Assembly	9	Nut	16A	Nozzle - Cylinder #1	19	Bracket
2	Drive Shaft	10	Tube	16B	Nozzle - Cylinder #2	20	Screw
3	Fuel Pump	11	Tube	16C	Nozzle - Cylinder #3	21	Nut
4	Manifold Valve	12	Tube	16D	Nozzle - Cylinder #4	22	Gasket
5	Gasket	13	Tube	16E	Nozzle - Cylinder #5	23	Nozzle Screen
6	Washer	14	Tube	16F	Nozzle - Cylinder #6	24	Dust Shield
7	Lock Washer	15	Tube	17	Hose		
8	Throttle & Metering Assembly	16	Tuned Nozzle	18	Hose		

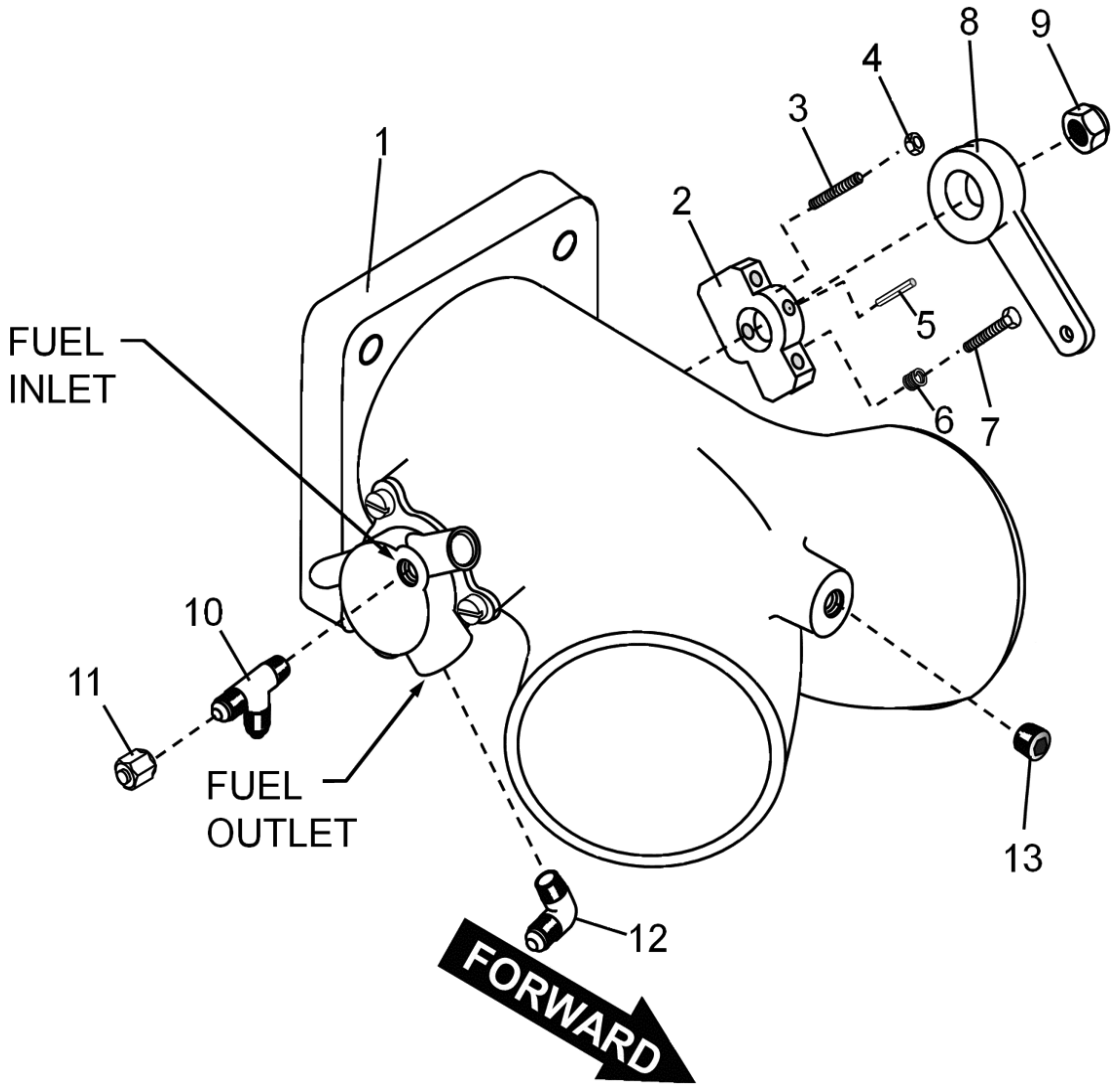


Figure 12-5. Throttle and Metering Assembly Removal (Except AF and ES)

1	Throttle	5	Pin	9	Lock Nut	13	Plug
2	Idle Control Lever	6	Spring	10	Tee Fitting		
3	Set Screw	7	Adjustment Screw	11	Cap		
4	Nut	8	Throttle Control Lever	12	Elbow		

12-3.2. IO-360-AF, ES Fuel Injection System Removal

1. Mark each fuel injection tube (Figure 12-6)(10 through 15) with its cylinder number to facilitate re-installation.

WARNING

Fuel injection tubes must not be bent or deformed. Discard and replace bent, chafed or deformed fuel injection tubes.

2. Remove bolts (18), washers (19) and lock nuts (20). Discard the lock nuts.
3. Remove clamps (17) from fuel injection tubes (10 through 15).
4. Remove clamps (21) from induction tubes.
5. Fuel injection tube removal:
   a. Disconnect fuel injection tubes (10 through 15) from fuel nozzles (16A-F).
   b. Disconnect the fuel injection tubes (10 through 15) from fuel manifold valve assembly (4).
   c. Remove fuel injection tubes (10 through 15) from engine.
6. Remove and discard fuel nozzles (16A-F) from each cylinder.
7. Remove fuel hose (22) from throttle and metering assembly (8) inlet tee fitting (Figure 12-7)(15) and fuel pump (Figure 12-6)(3) outlet fitting. Discard the fuel hose.
8. Remove fuel hose (23) from throttle and metering assembly (8) fuel outlet elbow (Figure 12-7)(17) and manifold valve (Figure 12-6)(4) inlet fitting. Discard the fuel hose.

   NOTE: Some models may have two hoses and a fitting in between them instead of the hose (23) depicted in Figure 12-6.

9. Remove screws (Figure 12-9)(20), lock washers (21) and washers (22). Discard the lock washers.
10. Remove the throttle and metering assembly (Figure 12-6)(8) and gasket (26) from the induction manifold. Place the throttle and metering assembly in a clean, protected area until it is overhauled and discard the gasket.
11. Remove the crankcase backbone hardware that secures the manifold valve (4) to the engine and remove the manifold valve. Place the manifold valve in a clean, protected area until it is overhauled.
12. Temporarily re-install the crankcase backbone hardware removed in step 11.
13. Remove nuts (9), lock washers (7) and washers (6). Discard the lock washers.
14. Remove fuel pump (3) and gasket (5). Place the fuel pump in a clean, protected area until it is overhauled and discard the gasket.
15. Remove the drive shaft (2) from crankcase fuel pump cavity. Place the drive shaft in a clean, protected area until ready for overhaul inspection.

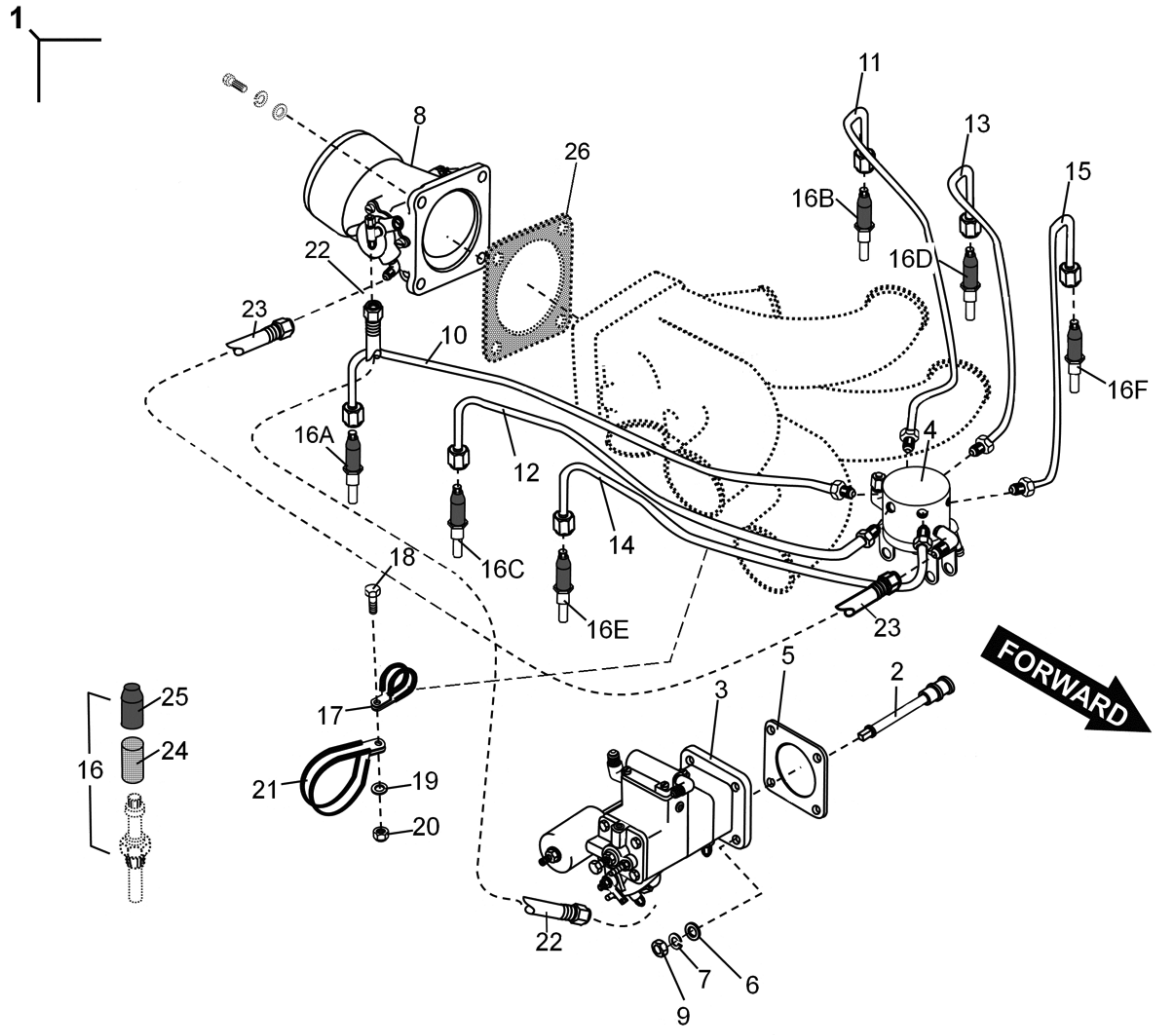


Figure 12-6. IO-360-AF, ES Fuel Injection Assembly Removal

1	Fuel Injection Assembly	9	Nut	16A	Nozzle - Cylinder #1	19	Washer
2	Drive Shaft	10	Tube	16B	Nozzle - Cylinder #2	20	Lock Nut
3	Fuel Pump (ES Aneroid Pump Shown)	11	Tube	16C	Nozzle - Cylinder #3	21	Clamp
4	Manifold Valve	12	Tube	16D	Nozzle - Cylinder #4	22	Hose
5	Gasket	13	Tube	16E	Nozzle - Cylinder #5	23	Hose
6	Washer	14	Tube	16F	Nozzle - Cylinder #6	24	Nozzle Screen
7	Lock Washer	15	Tube	17	Clamp	25	Dust Shield
8	Throttle & Metering Assembly	16	Tuned Nozzle	18	Bolt	26	Gasket

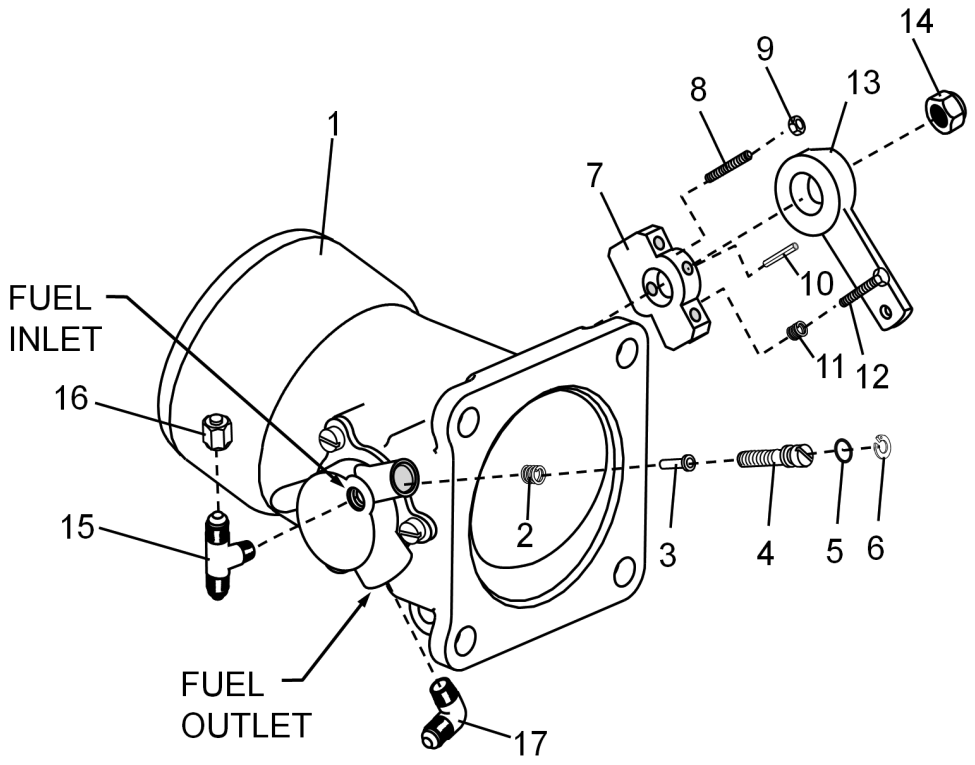


Figure 12-7. IO-360-AF, ES Throttle and Metering Assembly Removal

1	Throttle	6	Retaining Ring	11	Spring	16	Cap
2	Spring	7	Idle Control Lever	12	Adjustment Screw	17	Elbow
3	Bushing	8	Set Screw	13	Throttle Control Lever		
4	Idle Adjustment Screw	9	Nut	14	Lock Nut		
5	O-ring	10	Pin	15	Tee Fitting		

12-4. Induction System Removal

Induction systems vary by engine models. Refer to the instructions which apply to the engine model being overhauled. Also refer to the Illustrated Parts Catalog.

12-4.1. Induction System Removal (Except AF and ES)

1. Remove nuts (Figure 12-8)(9), lock washers (8) and washers (7) from cylinders 2-4-6. Discard the lock washers.
2. Loosen the six clamps (10) and remove the three hoses (11) from manifold tubes (3 and 5) and riser tube (6). Discard the hoses.
3. Remove manifold tubes (3 and 5) and riser tube (6) from cylinders 2-4-6.
4. Remove the manifold gaskets (1) and discard.
5. Remove nuts (9), lock washers (8) and washers (7) from cylinders 1-3-5. Discard the lock washers.
6. Loosen the six clamps (10) and remove the three hoses (11) from manifold tubes (2 and 3) and riser tube (4). Discard the hoses.
7. Remove manifold tubes (2 and 3) and riser tube (4) from cylinders 1-3-5.
8. Remove the manifold gaskets (1) and discard.
9. Place the manifold tubes, manifold risers, clamps, and fasteners in a clean, protected area until ready for overhaul inspection.

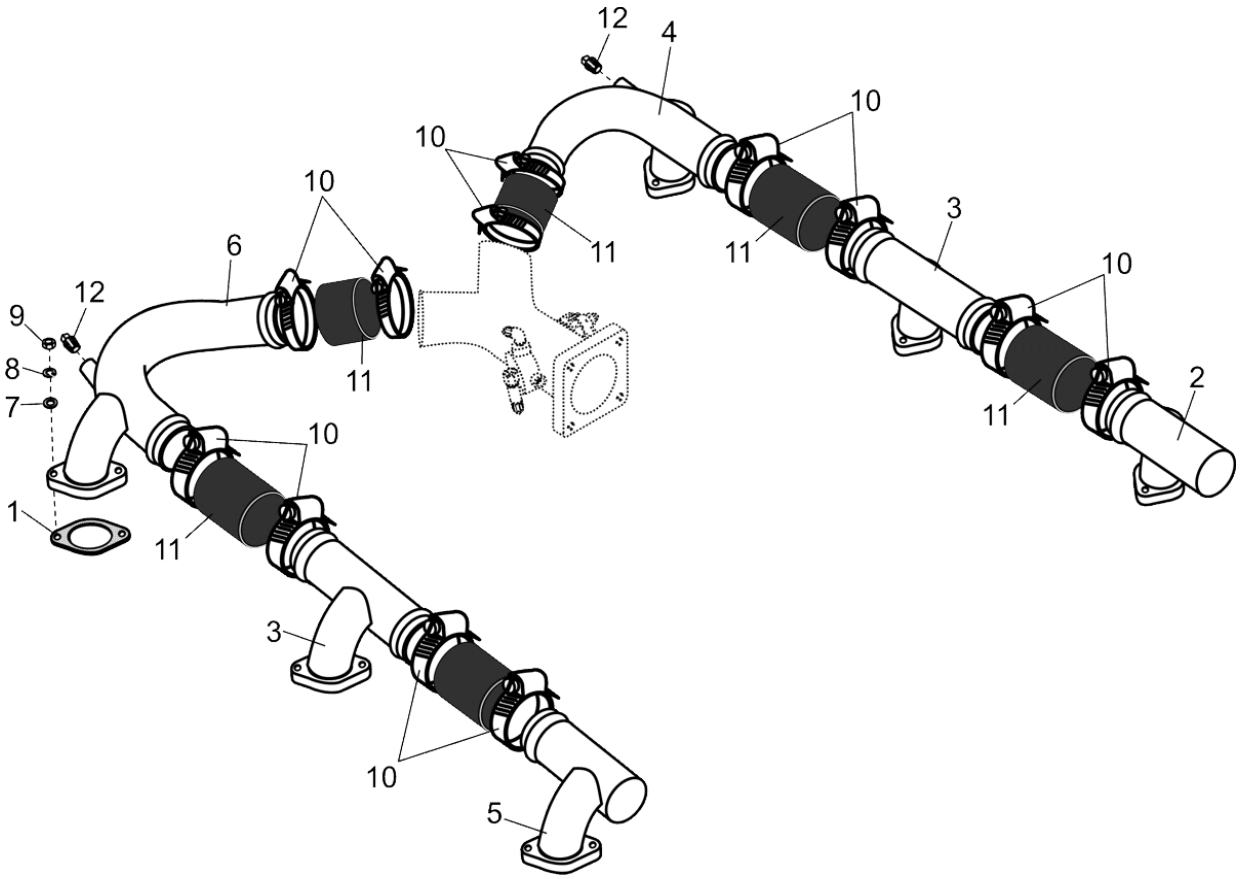


Figure 12-8. Induction Assembly Removal (Except AF and ES)

1	Manifold Gasket	4	Riser Tube	7	Washer	10	Clamp
2	Manifold Tube	5	Manifold Tube	8	Lock Washer	11	Hose
3	Manifold Tube	6	Riser Tube	9	Nut	12	Plug

12-4.2. IO-360-AF, ES Induction System Removal

1. Loosen six clamps (Figure 12-9)(18) and remove the manifold (2).
2. Loosen clamps (18) and remove two hoses (19) and cylinder #1 tube (4). Discard the hoses.
3. Loosen clamps (18) and remove two hoses (19) and cylinder #3 tube (7). Discard the hoses.
4. Loosen clamps (18) and remove two hoses (19) and cylinder #5 tube (10). Discard the hoses.
5. Loosen clamps (18) and remove two hoses (19) and cylinder #6 tube (12). Discard the hoses.
6. Loosen clamps (18) and remove hose (19) from cylinder #4 tube (8). Discard the hose.
7. Loosen clamps (18) and remove hose (19) from cylinder #2 tube (5). Discard the hose.
8. Remove twelve nuts (17), lock washers (16) and washers (15). Discard the lock washers.
9. Remove tubes (3, 5, 6, 8, 9 and 11) from cylinders.
10. Remove six flanges (13) from tubes (3, 5, 6, 8, 9 and 11).
11. Remove six gaskets (14) from cylinder intakes. Discard the gaskets.
12. Place the plenum manifold, ten tubes, twenty clamps, six flanges and fasteners in a clean, protected area until ready for overhaul inspection.

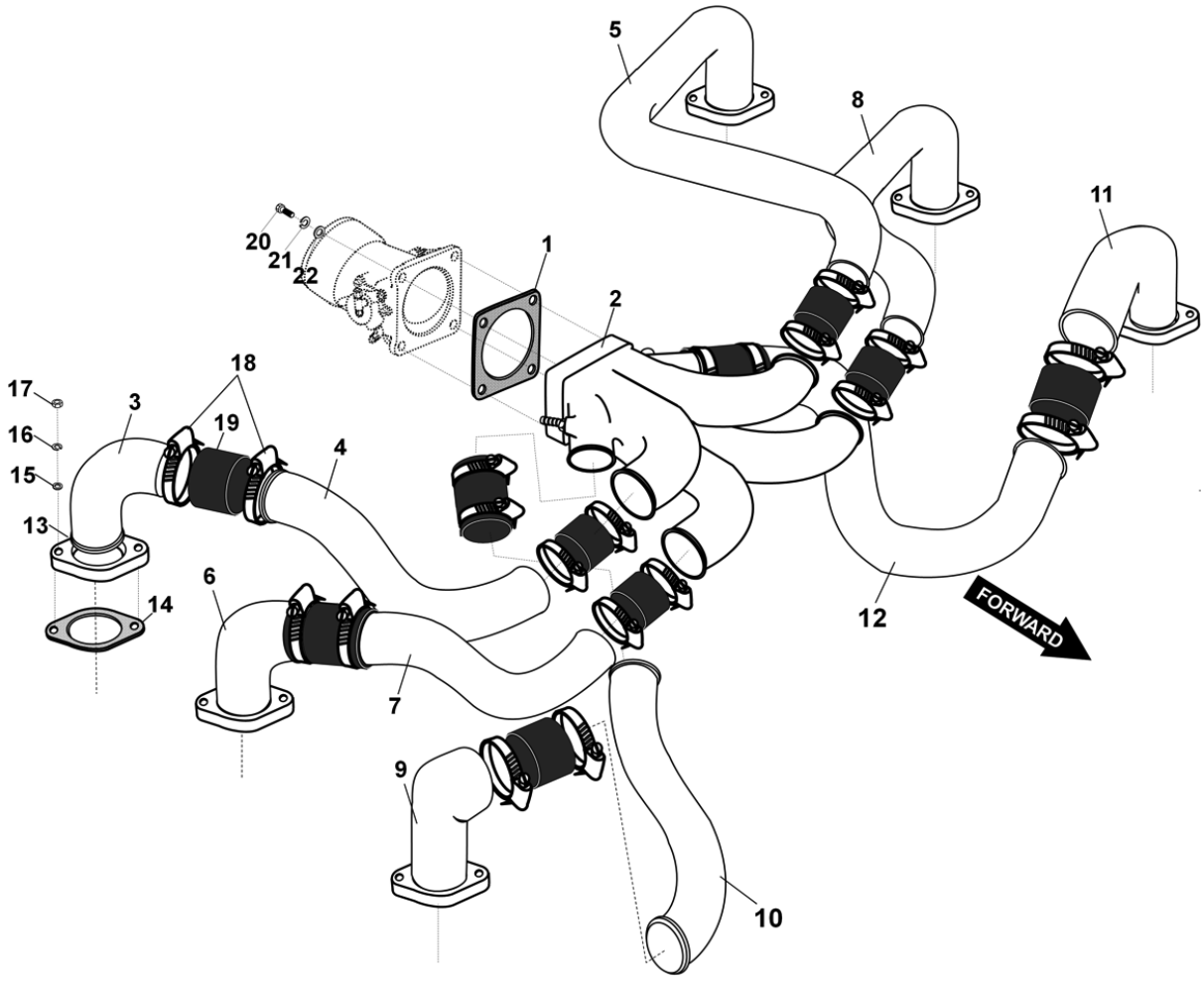


Figure 12-9. IO-360-AF, ES Induction Assembly Removal

1	Gasket	7	Tube - Cylinder #3	13	Flange	19	Hose
2	Manifold	8	Tube - Cylinder #4	14	Gasket	20	Screw
3	Tube - Cylinder #1	9	Tube - Cylinder #5	15	Washer	21	Lock Washer
4	Tube - Cylinder #1	10	Tube - Cylinder #5	16	Lock Washer	22	Washer
5	Tube - Cylinder #2	11	Tube - Cylinder #6	17	Nut		
6	Tube - Cylinder #3	12	Tube - Cylinder #6	18	Clamp		

12-5. Alternator Removal

Most IO-360 engine models are fitted with a direct drive alternator as standard equipment. The alternator voltage and amperage output varies, depending on the engine model and specification. Optional belt driven alternators are also available. Remove the alternator from the engine according to the appropriate instructions that match the installed engine configuration.

12-5.1. Direct Drive Alternator Removal

1. If the alternator has a grounding strap, remove grounding strap according to the aircraft maintenance manual.
2. Remove the three lock nuts (Figure 12-10)(12) and washers (11) from the alternator mounting studs. Discard the lock nuts.
3. Remove the alternator (1) from the mounting studs.
4. Remove and discard the gasket (2).
5. Remove the cotter pin (10) and castellated nut (9). Discard the cotter pin.
6. If one piece coupling, remove and discard the coupling; otherwise, remove the gear (8), sleeve (7), bushings (6), retainer (5) and hub (4) from the alternator shaft. Discard the bushings and retainer.

   NOTE: At overhaul, replace the retainer and bushings regardless of condition on multi-piece coupling.

7. Remove the woodruff key (3). Discard the woodruff key.
8. Place the alternator in a clean, protected area awaiting overhaul or core exchange.

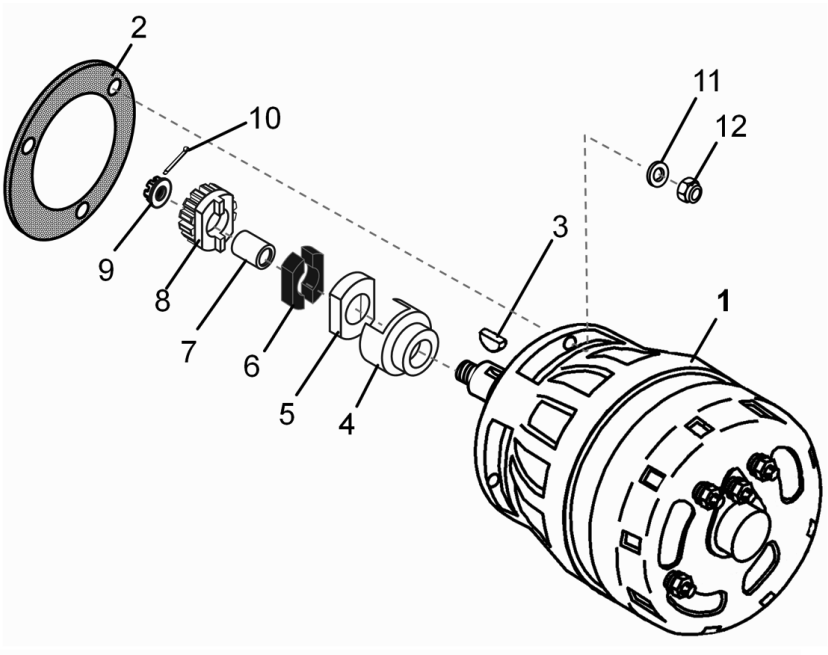


Figure 12-10. Direct Drive Alternator Removal

1	Alternator	4	Hub	7	Sleeve	10	Cotter Pin
2	Gasket	5	Retainer	8	Gear	11	Washer
3	Woodruff Key	6	Bushing	9	Castellated Nut	12	Lock Nut

12-5.2. Optional Belt Driven Alternator Removal

1. If the alternator has a grounding strap, remove grounding strap according to the aircraft maintenance manual.
2. To remove optional rear mounted alternator, do the following:
   a. Remove bolt (Figure 12-11)(19), lock washer (18) and two washers (17). Discard the lock washer.

      NOTE: There may be more than two washers (17) to remove as they are used for alignment purposes.

   b. Loosen bolt (13) and nut (16).
   c. Remove the V-belt (20) from the alternator sheave. Discard the V-belt.
   d. Remove bolt (13), four washers (14), spacer (15) and nut (16).
   e. Remove alternator (1) from between the front bracket (2) and the rear bracket (3).
   f. Place the alternator in a clean, protected area awaiting overhaul or core exchange.
3. To remove optional front mounted alternator, do the following:
   a. Remove bolt (Figure 12-12)(5), lock washer (6) and washer (7). Discard the lock washer.
   b. Loosen bolt (4) and lock nut (3).
   c. Remove the V-belt (11) from the alternator sheave. Discard the V-belt.
   d. Remove bolt (4), washers (2 and 14), shim(s) (16) and lock nut (3). Discard the lock nut.
   e. Remove alternator (12) from bracket assembly (1).
   f. Place the alternator in a clean, protected area awaiting overhaul or core exchange.

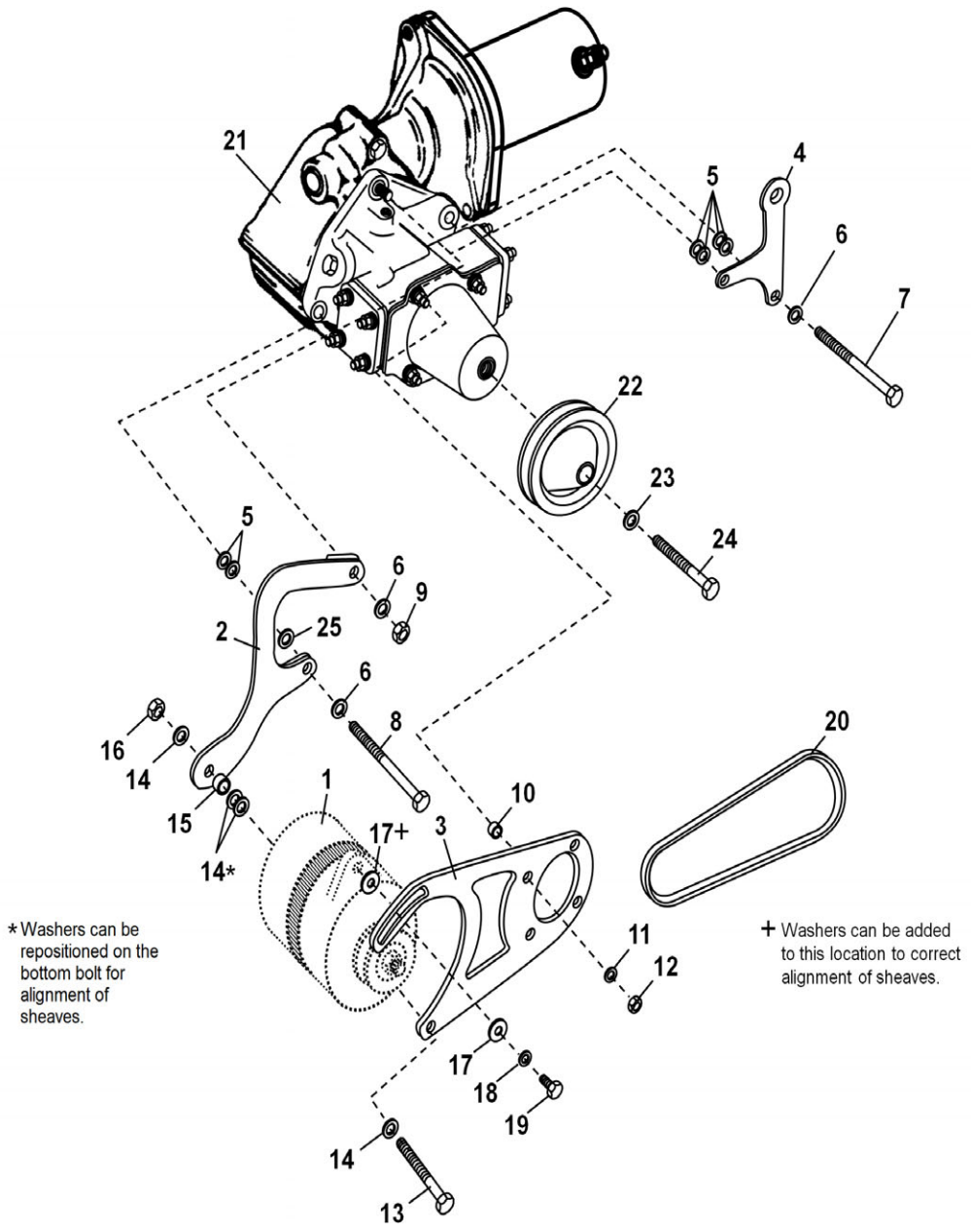


Figure 12-11. Optional Rear Mounted Alternator Assembly Removal

1	Alternator	8	Bolt	15	Spacer	22	Sheave
2	Front Bracket	9	Nut	16	Nut	23	Washer
3	Rear Bracket	10	Spacer	17	Washer (Minimum 2)	24	Bolt
4	Lifting Eye	11	Washer	18	Lock Washer	25	Washer
5	Washer	12	Nut	19	Bolt		
6	Lock Washer	13	Bolt	20	V-belt		
7	Bolt	14	Washer	21	Starter Adapter		

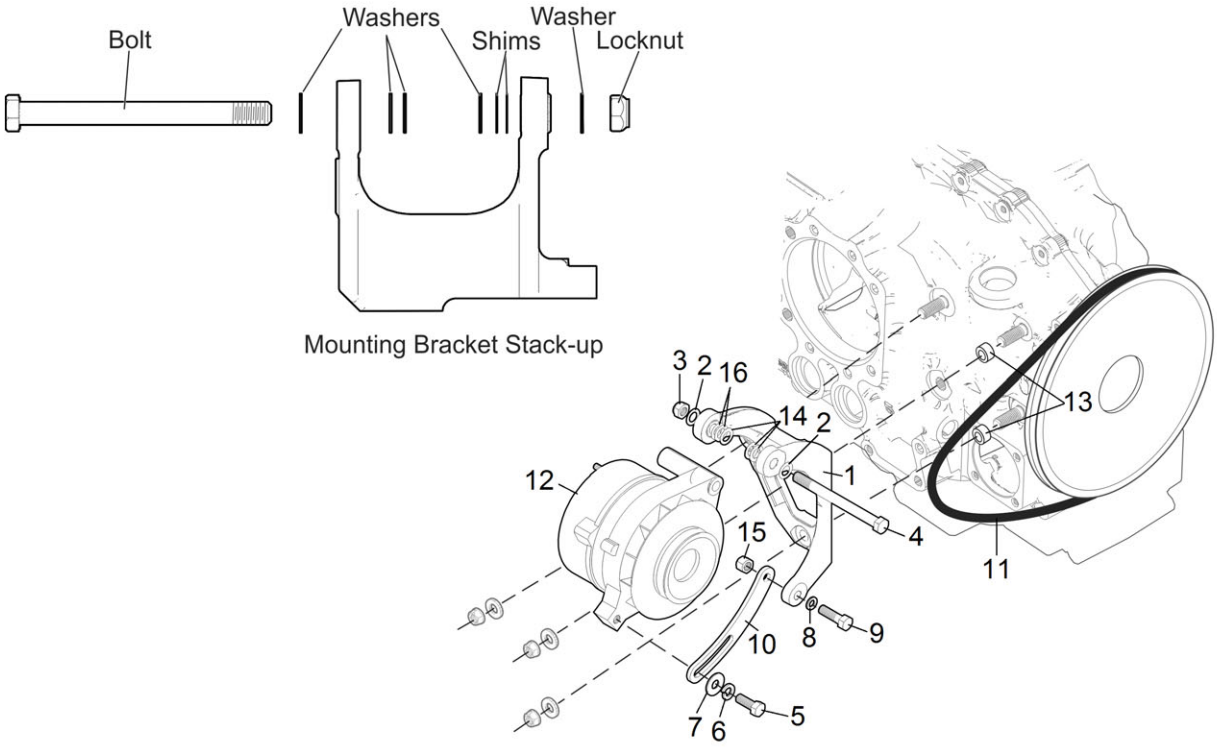


Figure 12-12. Optional Front Mounted Alternator Assembly Removal

1	Bracket Assembly	5	Bolt	9	Bolt	13	Spacer
2	Washer	6	Lock Washer	10	Adjustable Brace	14	Washer
3	Lock Nut	7	Washer	11	V-belt	15	Lock Nut
4	Bolt	8	Washer	12	Alternator	16	Shim

12-5.3. Optional Belt Driven Alternator Brackets and Drive Sheave Removal

1. Remove the optional belt driven alternator according to Section 12-5.2.
2. To remove the brackets and sheave for the optional rear mounted alternator, do the following:
   a. Remove the bolt (Figure 12-11)(24) and washer (23) from the sheave (22).

      NOTE: Use a strap wrench to hold sheave (22) for bolt (24) removal.

   b. Remove the sheave (22) from the starter adapter (21).

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

   c. Cut and remove safety wire from nuts (12).
   d. Remove four nuts (12), four washers (11), rear bracket (3) and four spacers (10). Reinstall nuts and washers temporarily until overhaul of starter adapter (21).

e. Remove nut (9) and lock washer (6). Discard the lock washer.

f. Remove four nuts, lock washers, washers, accessory cover and gasket from left side of accessory drive adapter to facilitate removing bolt (8). Refer to Section 10-4.3.

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

g. Cut and remove safety wire from bolt (8) and the two other bolts securing starter adapter to accessory case. Refer to Section 10-4.3.

h. Remove bolt (8), lock washer (6), front bracket (2), washer (25) and washers (5). Reinstall lock washers (6), washer (25), nut (9) and bolt (8) temporarily until overhaul of starter adapter (21).

i. Place the brackets, sheave and fasteners in a clean, protected area awaiting overhaul inspection.

3. To remove the bracket and sheave for the optional front mounted alternator, do the following:

a. Remove sheave according to the aircraft maintenance manual.

b. Remove the three through bolt nuts and washers holding the bracket (Figure 12-12)(1) to the crankcase.

c. Remove the bracket (1) and two spacers (13) from the crankcase. Reinstall nuts and washers temporarily until overhaul of crankcase.

d. Place the bracket, sheave, spacers and fasteners in a clean, protected area awaiting overhaul inspection.

12-6. Starter and Starter Adapter Removal

12-6.1. Starter and Starter Adapter Removal (Except AF)

Different starter motors and starter adapters are used on the IO-360 series engine models; the primary physical difference is an accessory drive on the back of the housing or a flat cover. Figure 12-13 shows one possible starter adapter option.

1. Remove two nuts (Figure 12-13)(3) and washers (4).
2. Remove the starter motor (2) from the starter adapter (1).
3. Remove and discard the o-ring (5).
4. Remove the bolt (8), two washers (6), lock washer (7) and nut (12) from the top of the starter adapter (1). Discard the lock washer.

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

5. Cut and remove safety wire from bolts (9 and 10).
6. Remove three bolts (9 and 10), lock washers (7) and washers (6) from the starter adapter (1) cover. Discard the lock washers.
7. Remove the starter adapter (1) and gasket (11) from the accessory case. Discard the gasket.
8. Place the starter motor in a clean, protected area awaiting overhaul instructions. Disassemble the starter adapter according to the "Starter and Starter Adapter Disassembly" instructions in Section 13-3.

NOTE: If you have an "old style" starter adapter, they are no longer supported and you must replace with a new, rebuilt or overhauled "new style" starter adapter. Refer to Figure 12-14 for identification purposes.

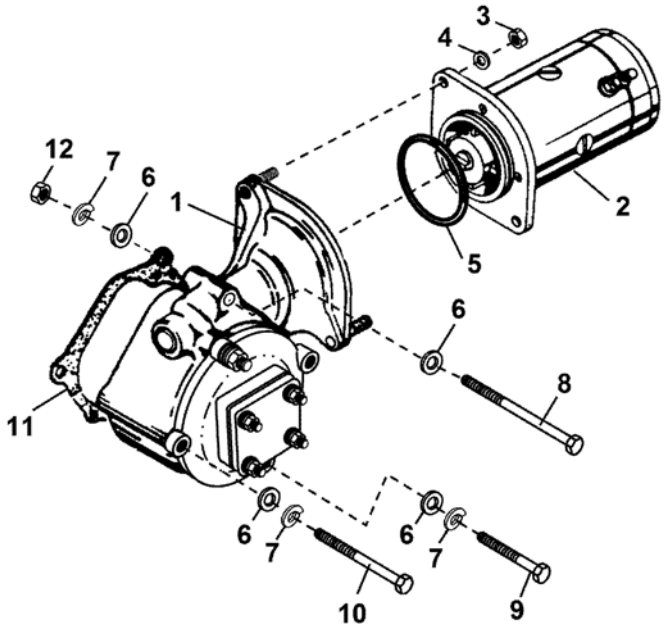


Figure 12-13. Starter and Adapter Removal (Except AF)

1	Starter Adapter	4	Washer	7	Lock Washer	10	Bolt
2	Starter Motor	5	O-ring	8	Bolt	11	Gasket
3	Nut	6	Washer	9	Bolt	12	Nut

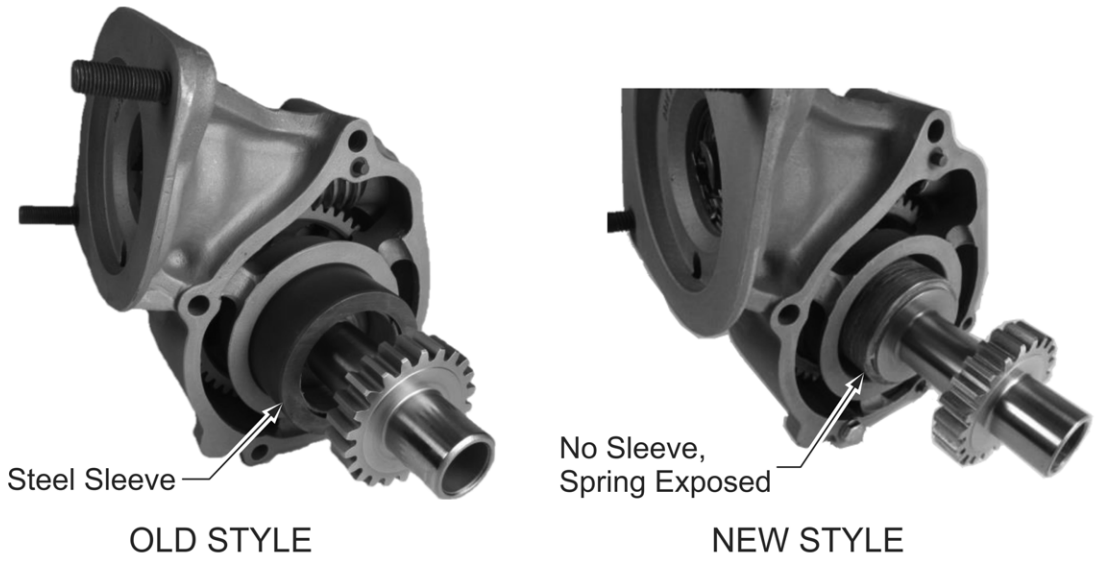


Figure 12-14. Starter Adapter Identification

12-6.2. Starter Removal (AF)

1. Remove the screws (Figure 12-15)(10 and 13), lock washers (12) and washers (11) from starter motor (3). Discard the lock washers.
2. Remove nuts (9), lock washers (5), washers (8) and lifting eye (7) from bolts (4). Discard the lock washers.
3. Remove the starter motor (3).
4. Remove and discard the gasket (2).
5. Remove bolts (4), lock washers (5), washers (8) and spacers (6) from accessory case (1) and crankcase. Discard the lock washers.
6. Clean the gasket (2) residue from the accessory case (1) mating surface.
7. Replace starter motor and place the new starter motor in a clean, protected area.
8. Place the lifting eye and fasteners in a clean, protected area until ready for overhaul inspection.

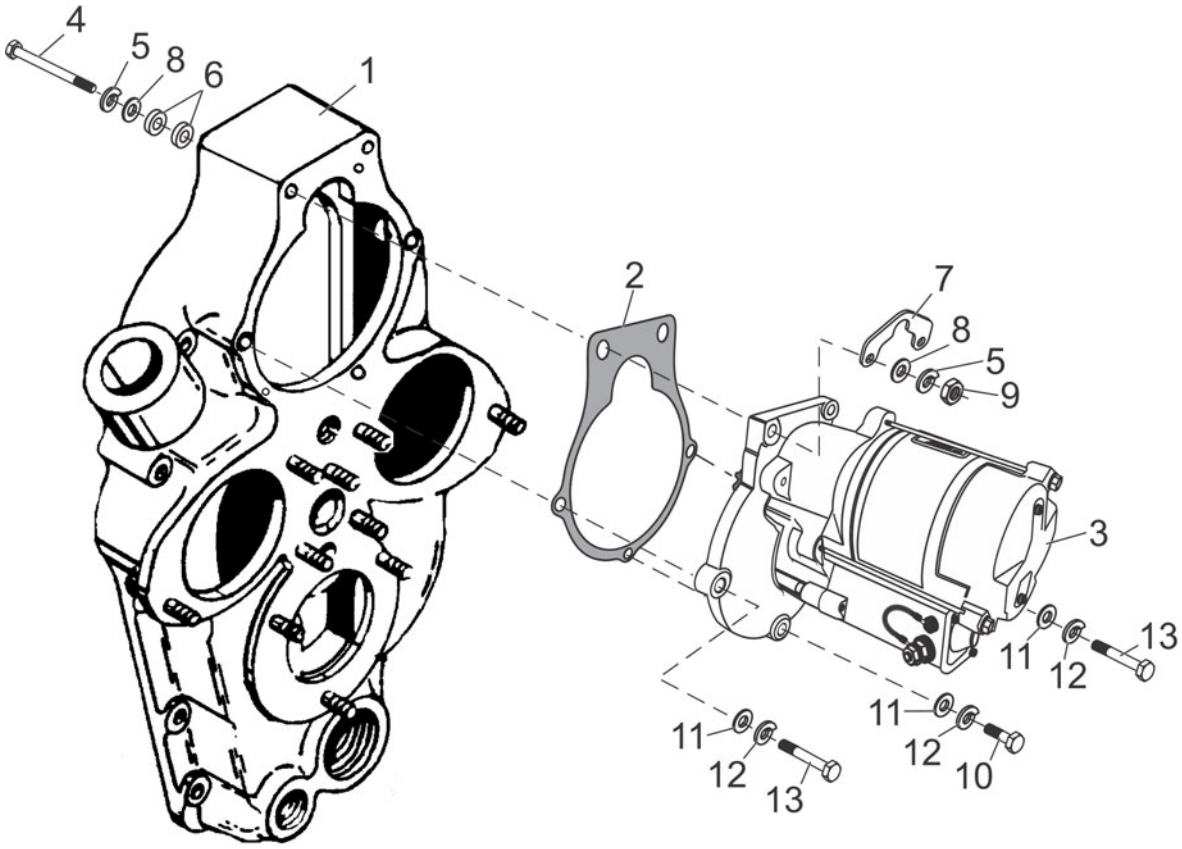


Figure 12-15. Starter Removal (AF)

1	Accessory Case	5	Lock Washer	9	Nut	13	Screw
2	Gasket	6	Spacer	10	Screw		
3	Starter Motor	7	Lifting Eye	11	Washer		
4	Bolt	8	Washer	12	Lock Washer		

12-7. Accessory Case Removal

The IO-360 series accessory case has many different variations of parts attached depending on the engine model and specification. Some have extended oil filler necks, some have a tach drive unit installed and some have oil filters and adapters instead of an pressure oil screen. Use the following instructions according to the appropriate instructions that match the installed engine configuration. Refer to the Illustrated Parts Catalog for engine configuration.

Oil pump will be removed from accessory case in Section 12-10.

12-7.1. Accessory Case with No Tach Drive Removal (Except AF and ES)

1. Remove filler cap assembly (Figure 12-16)(33).
2. Loosen clamps (36) and remove clamps, hose (35) and filler neck (34). Discard the hose.

   NOTE: Some models without a tach drive do not have a filler neck (34), clamps (36) or hose (35).

3. Remove nuts (28), lock washers (27), washers (38), cover (26) and gasket (25). Discard the lock washers and gasket.

   WARNING

   Use eye protection when cutting safety wire because flying parts can cause injury.

4. Remove safety wire from plugs (10).
5. Remove plugs (10) and copper gaskets (9). Discard the copper gaskets.

   WARNING

   Use eye protection when cutting safety wire because flying parts can cause injury.

6. Remove safety wire from between pressure oil screen (32) and scavenge oil screen (30).
7. Remove pressure oil screen (32) and copper gasket (31). Discard the copper gasket.
8. Remove scavenge oil screen (30) and copper gasket (29). Discard the copper gasket.

   WARNING

   Use eye protection when cutting safety wire because flying parts can cause injury.

9. Remove safety wire from cap (21).
10. Remove stop nut (23), copper washer (22), cap (21), copper gasket (20), adjustment screw (19), springs (17 and 18) and plunger (16). Discard the copper gasket, copper washer and springs.
11. Remove screw (37), washers (12), lock washer (13) and nut (14). Discard the lock washer.
12. Remove nuts (14), lock washers (13) and washers (12). Discard the lock washers.
13. Remove screws (15), lock washers (13) and washers (12). Discard the lock washers.
14. Remove accessory case (1) and gasket (2) from the crankcase. Discard the gasket.

15. Place the accessory case, relief valve assembly, plugs, cover, scavenge oil screen, pressure oil screen, filler neck, filler cap assembly and fasteners in a clean, protected area until ready for overhaul inspection.

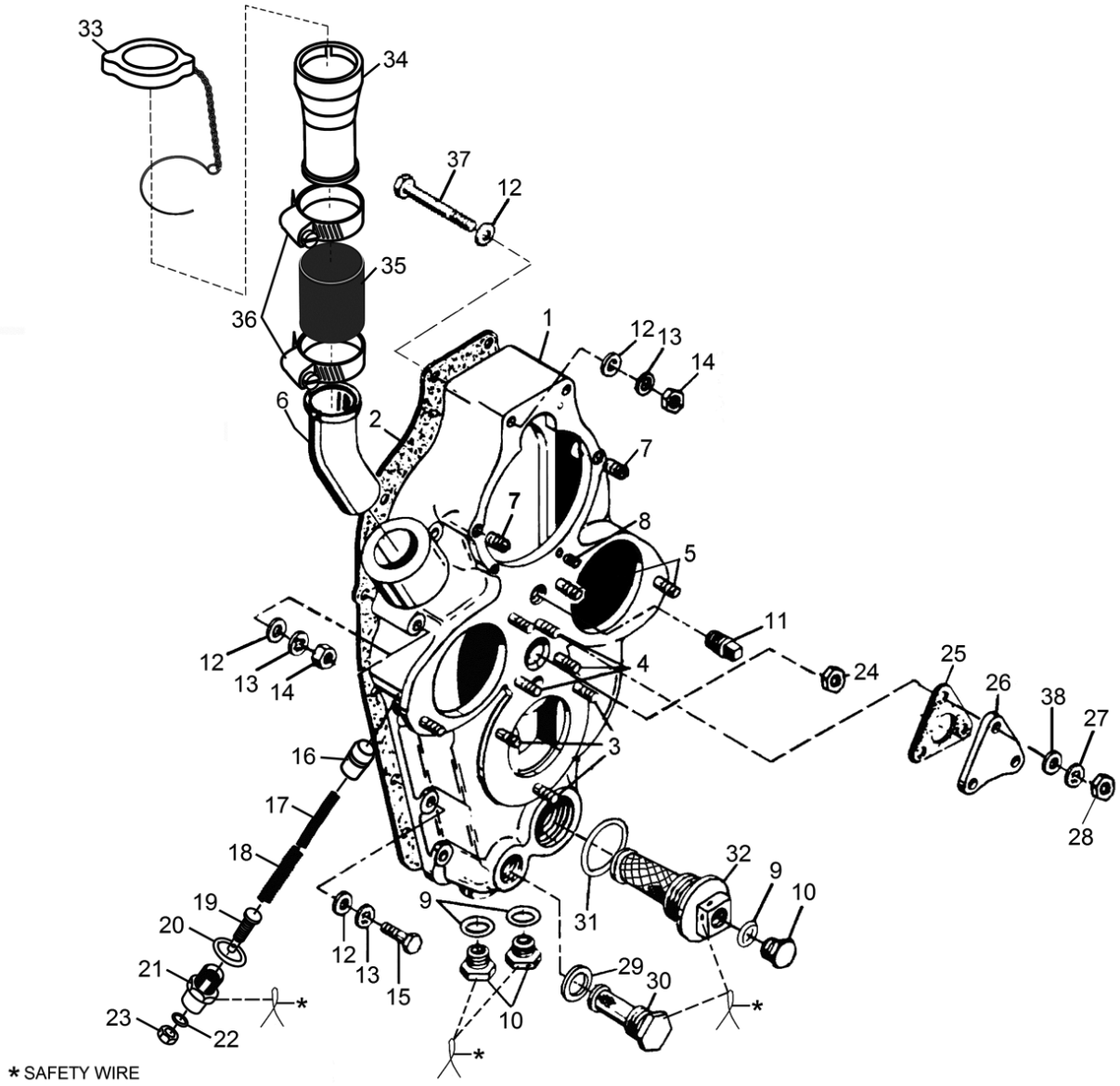


Figure 12-16. Accessory Case with No Tach Drive Removal (Except AF and ES)

1	Accessory Case	11	Plug	21	Cap	31	Copper Gasket
2	Gasket	12	Washer	22	Copper Washer	32	Pressure Oil Screen
3	Stud	13	Lock Washer	23	Stop Nut	33	Filler Cap Assembly
4	Stud	14	Nut	24	Nut	34	Filler Neck
5	Stud	15	Screw	25	Gasket	35	Hose
6	Filler Neck Tube	16	Plunger	26	Cover	36	Clamp
7	Insert	17	Spring	27	Lock Washer	37	Screw
8	Insert	18	Spring	28	Nut	38	Washer
9	Copper Gasket	19	Adjustment Screw	29	Copper Gasket		
10	Plug	20	Copper Gasket	30	Scavenge Oil Screen		

12-7.2. Accessory Case with Tach Drive Removal (Except AF and ES)

1. Remove filler cap assembly (Figure 12-17)(37).
2. Loosen clamps (39) and remove clamps, hose (40) and filler neck (36). Discard the hose.

   NOTE: Some models with a tach drive do not have a filler neck (36), clamps (39) or hose (40).

3. Remove nuts (34), lock washers (33) and washers (32). Discard the lock washers.
4. Remove tach reduction adapter (35), tach drive adapter (31), seal (30), gasket (29) and tach drive connector (28). Discard the seal and gasket.

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

5. Remove safety wire from plugs (10).
6. Remove plugs (11) and copper gaskets (10). Discard the copper gaskets.

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

7. Remove safety wire from between pressure oil screen (27) and scavenge oil screen (25).
8. Remove pressure oil screen (27) and copper gasket (26). Discard the copper gasket.
9. Remove scavenge oil screen (25) and copper gasket (24). Discard the copper gasket.

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

10. Remove safety wire from cap (21).
11. Remove stop nut (23), copper washer (22), cap (21), copper gasket (20), adjustment screw (19), springs (17 and 18) and plunger (16). Discard the copper gasket, copper washer and springs.
12. Remove screw (38), washers (12), lock washer (13) and nut (14). Discard the lock washer.
13. Remove nuts (14), lock washers (13) and washers (12). Discard the lock washers.
14. Remove screws (15), lock washers (13) and washers (12). Discard the lock washers.
15. Remove accessory case (1) and gasket (2) from the crankcase. Discard the gasket.
16. Place the accessory case, relief valve assembly, plugs, tach reduction adapter, tach drive adapter, tach drive connector, scavenge oil screen, pressure oil screen, filler neck, hose, clamps, filler cap assembly and fasteners in a clean, protected area until ready for overhaul inspection.

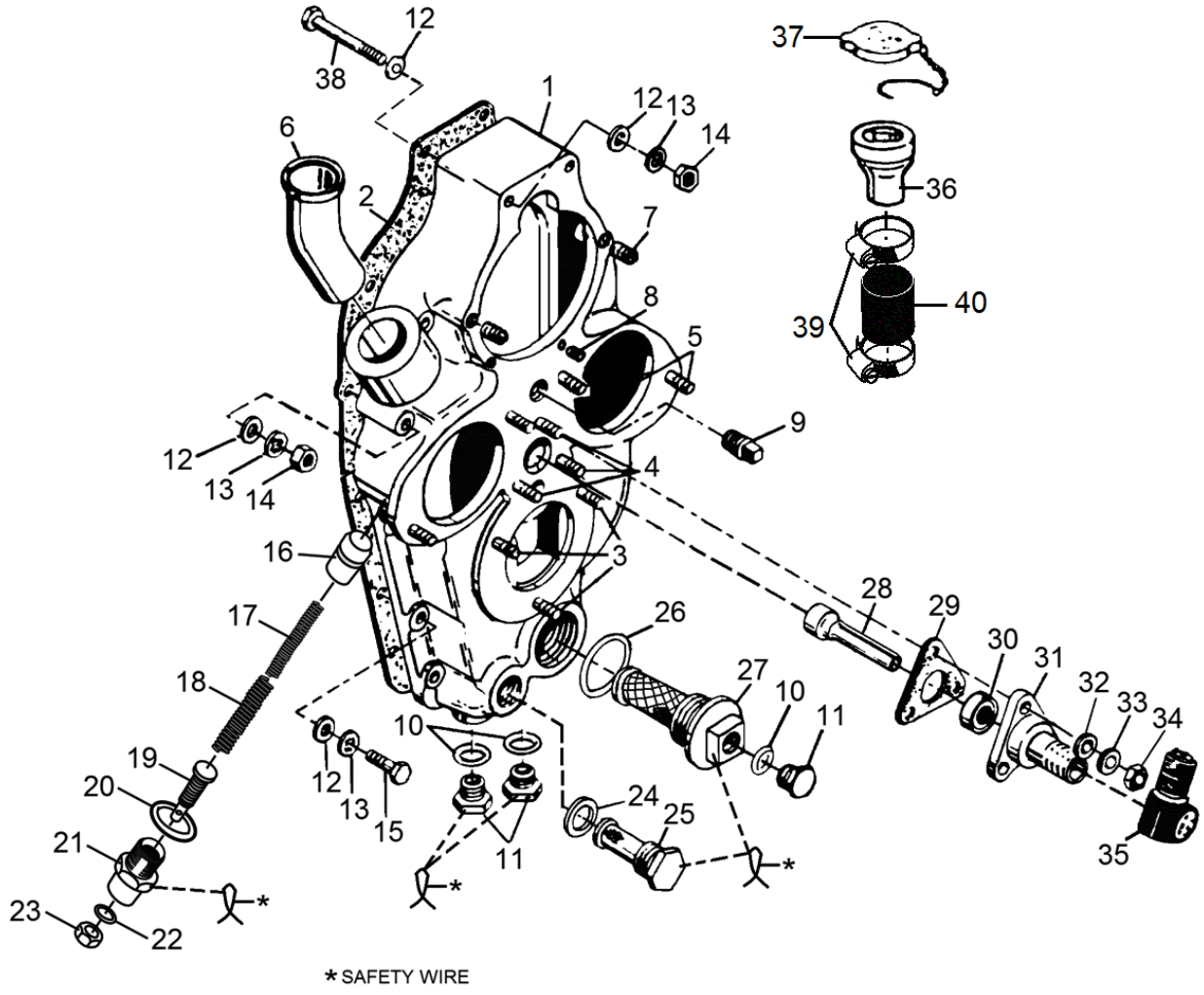


Figure 12-17. Accessory Case with Tach Drive Removal (Except AF and ES)

1	Accessory Case	11	Plug	21	Cap	31	Tach Drive Adapter
2	Gasket	12	Washer	22	Copper Washer	32	Washer
3	Stud	13	Lock Washer	23	Stop Nut	33	Lock Washer
4	Stud	14	Nut	24	Copper Gasket	34	Nut
5	Stud	15	Screw	25	Scavenge Oil Screen	35	Tach Reduction Adapter
6	Filler Neck Tube	16	Plunger	26	Copper Gasket	36	Filler Neck
7	Insert	17	Spring	27	Pressure Oil Screen	37	Filler Cap Assembly
8	Insert	18	Spring	28	Tach Drive Connector	38	Screw
9	Plug	19	Adjustment Screw	29	Gasket	39	Clamp
10	Copper Gasket	20	Copper Gasket	30	Seal	40	Hose

12-7.3. Accessory Case with Oil Filter and Adapter Removal (Includes HB9, ES3B and ES14B)

1. Remove filler cap assembly (Figure 12-18)(40).
2. Remove filler neck. Refer to Section 12-7.1 for removal procedure.

   NOTE: Some models with oil filter and adapter will have filler neck extensions.

3. Remove nuts (36), lock washers (35) and washers (34). Discard the lock washers.
4. Remove tach reduction adapter (37), tach drive adapter (33), seal (32), gasket (31) and tach drive connector (30). Discard the seal and gasket.

   NOTE: Some models with oil filter and adapter will not have a tach drive unit but a cover. Refer to Section 12-7.1 for cover removal procedure.

   WARNING

   Use eye protection when cutting safety wire because flying parts can cause injury.

5. Remove safety wire from plugs (10).
6. Remove plugs (10) and copper gaskets (9). Discard the copper gaskets.

   WARNING

   Use eye protection when cutting safety wire because flying parts can cause injury.

7. Remove safety wire from oil filter (39).
8. Remove oil filter (39) from oil filter adapter (29). Discard the oil filter.

   WARNING

   Use eye protection when cutting safety wire because flying parts can cause injury.

9. Remove safety wire from between oil filter adapter (29) nut (14) and adapter (25).
10. Remove nuts (14), lock washers (13) and washers (12) from oil filter adapter (29). Discard the lock washers.
11. Remove oil filter adapter (29), o-ring (28) and gasket (27) from studs (26). Discard the o-ring and gasket.

    NOTE: Refer to the Illustrated Parts Catalog for correct oil filter adapter to engine application, adapter to engine angle orientations may vary according to engine model.

12. Remove adapter (25) and copper gasket (24). Discard the copper gasket.

    NOTE: This applies to HB9, ES3B and ES14B models only, other models will have scavenge oil screen. Refer to Section 12-7.1 for scavenge oil screen removal procedure.

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

13. Remove safety wire from cap (21).
14. Remove stop nut (23), copper washer (22), cap (21), copper gasket (19), adjustment screw (20), springs (17 and 18) and plunger (16). Discard the copper gasket, copper washer and springs.
15. Remove screw (44), washers (12), lock washer (13) and nut (14). Discard the lock washer.
16. Remove nuts (14), lock washers (13) and washers (12). Discard the lock washers.
17. Remove screws (15), lock washers (13) and washers (12). Discard the lock washers.
18. Remove accessory case (1) and gasket (2) from the crankcase. Discard the gasket.
19. Remove bolts (42), washers (43) and top screen (41) from accessory case (1).

    NOTE: This applies to HB9, ES3B and ES14B models only.

20. Place the accessory case, relief valve assembly, plugs, tach reduction adapter, tach drive adapter, tach drive connector, scavenge oil screen, oil filter adapter, filler neck, filler cap assembly, top screen and fasteners in a clean, protected area until ready for overhaul inspection.

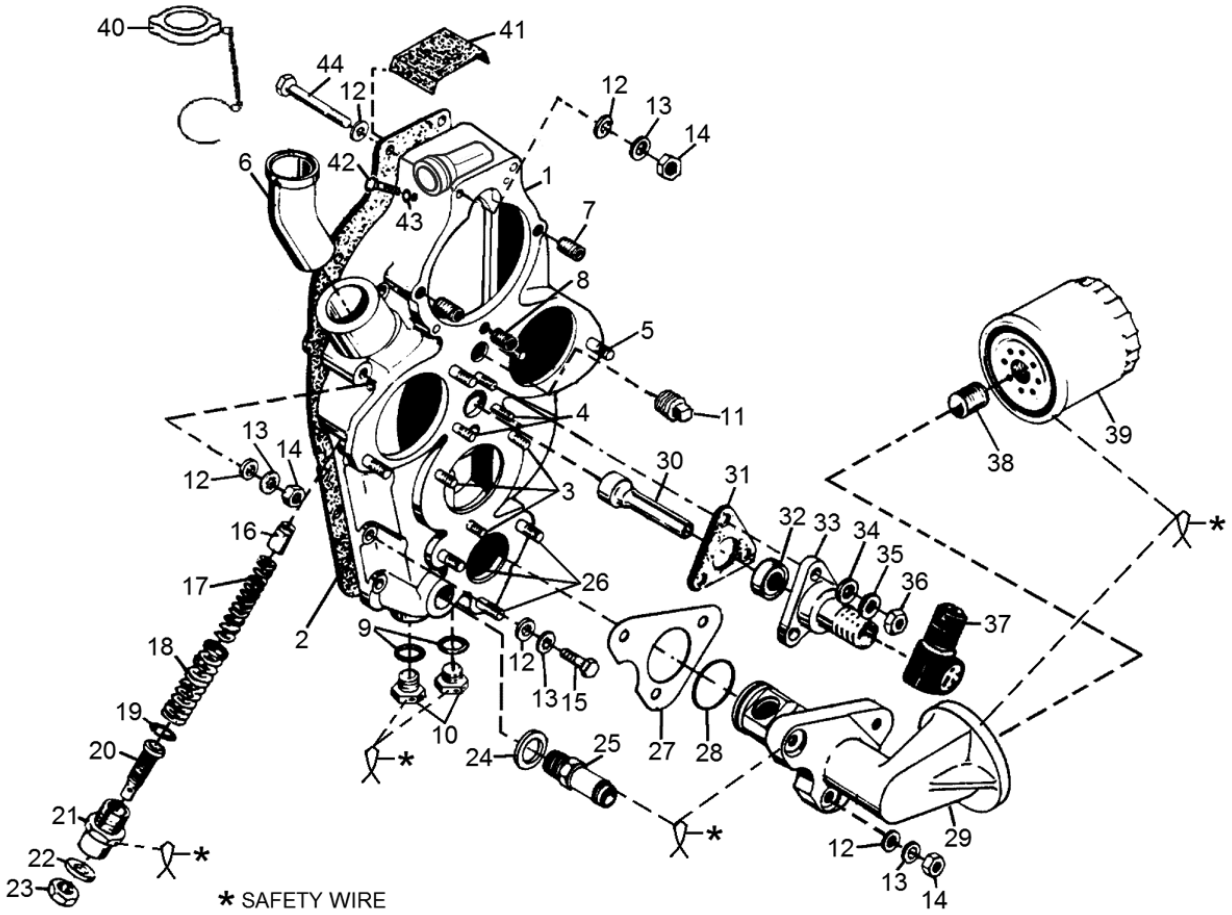


Figure 12-18. Accessory Case with Oil Filter and Adapter Removal (Includes HB9, ES3B and ES14B)

1	Accessory Case	13	Lock Washer	25	Adapter (HB9,ES3B, ES14B)	37	Tach Reduction Adapter
2	Gasket	14	Nut	26	Stud	38	Adapter Stud
3	Stud	15	Screw	27	Gasket	39	Oil Filter
4	Stud	16	Plunger	28	O-ring	40	Filler Cap Assembly
5	Stud	17	Spring	29	Filter Adapter	41	Top Screen (HB9,ES3B, ES14B)
6	Filler Neck Tube	18	Spring	30	Tach Drive Connector	42	Bolt (HB9,ES3B, ES14B)
7	Insert	19	Copper Gasket	31	Gasket	43	Washer (HB9,ES3B, ES14B)
8	Insert	20	Adjustment Screw	32	Seal	44	Screw
9	Copper Gasket	21	Cap	33	Tach Drive Adapter		
10	Plug	22	Copper Washer	34	Washer		
11	Plug	23	Stop Nut	35	Lock Washer		
12	Washer	24	Copper Gasket	36	Nut		

12-7.4. Accessory Case with Oil Filter and Adapter Removal

1. Remove filler cap assembly (Figure 12-19)(43).
2. Remove nuts (41), lock washers (40) and washers (39) from tach drive adapter (38). Discard the lock washers.
3. Remove tach reduction adapter (42), tach drive adapter (38), seal (37), gasket (36) and tach drive connector (35). Discard the seal and gasket.

   NOTE: Some models with oil filter and adapter will not have a tach drive unit but a cover. Refer to Section 12-7.1 for cover removal procedure.

   WARNING

   Use eye protection when cutting safety wire because flying parts can cause injury.

4. Remove safety wire from plugs (10).
5. Remove plugs (10) and copper gaskets (9). Discard the copper gaskets.

   WARNING

   Use eye protection when cutting safety wire because flying parts can cause injury.

6. Remove safety wire from oil filter (31).
7. Remove oil filter (31) from oil filter adapter (29). Discard the oil filter.

   WARNING

   Use eye protection when cutting safety wire because flying parts can cause injury.

8. Remove safety wire from between oil filter adapter (29) and scavenge oil screen (22).
9. Remove nuts (25), lock washers (24) and washers (23) from oil filter adapter (29). Discard the lock washers.
10. Remove oil filter adapter (29), o-ring (28) and gasket (27). Discard the o-ring and gasket.
11. Remove scavenge oil screen (22) and copper gasket (21). Discard the copper gasket.
12. Remove adapter (12) and bushing (11).

    NOTE: Some models will have a plug at this location instead of the adapter and bushing. It is not necessary to remove the plug.

13. Remove lock nuts (34), washers (23), alternator pad cover (33) and gasket (32). Discard the gasket.

    NOTE: This applies to only those models with the optional belt driven alternator.

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

14. Remove safety wire from cap (18).
15. Remove stop nut (20), copper washer (19), cap (18), copper gasket (16), adjustment screw (17), springs (14 and 15) and plunger (13). Discard the copper gasket, copper washer and springs.
16. Remove screw (44), washers (23), lock washer (24) and nut (25). Discard the lock washer.
17. Remove nuts (25), lock washers (24) and washers (23). Discard the lock washers.
18. Remove screws (26), lock washers (24) and washers (23). Discard the lock washers.
19. Remove accessory case (1) and gasket (2) from the crankcase. Discard the gasket.
20. Place the accessory case, relief valve assembly, plugs, tach reduction adapter, tach drive adapter, tach drive connector, scavenge oil screen, oil filter adapter, alternator pad cover, manifold drain adapter, bushing, filler cap assembly and fasteners in a clean, protected area until ready for overhaul inspection.

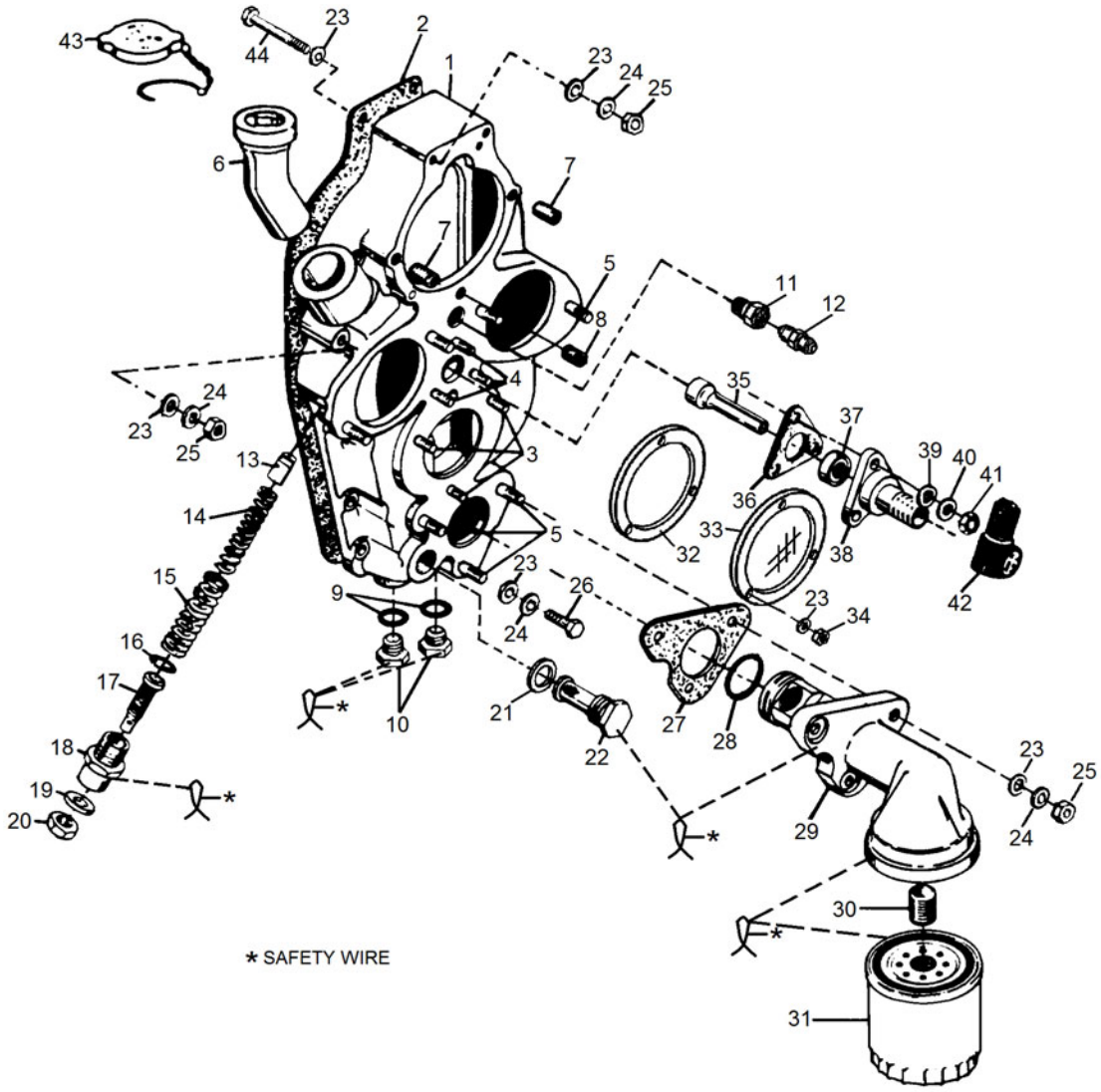


Figure 12-19. Accessory Case with Oil Filter and Adapter Removal

1	Accessory Case	12	Adapter	23	Washer	34	Lock Nut
2	Gasket	13	Plunger	24	Lock Washer	35	Tach Drive Connector
3	Stud	14	Spring	25	Nut	36	Gasket
4	Stud	15	Spring	26	Screw	37	Seal
5	Stud	16	Copper Gasket	27	Gasket	38	Tach Drive Adapter
6	Filler Neck Tube	17	Adjustment Screw	28	O-ring	39	Washer
7	Insert	18	Cap	29	Filter Adapter	40	Lock Washer
8	Insert	19	Copper Washer	30	Adapter Stud	41	Nut
9	Copper Gasket	20	Stop Nut	31	Oil Filter	42	Tach Reduction Adapter
10	Plug	21	Copper Gasket	32	Gasket	43	Filler Cap Assembly
11	Bushing	22	Scavenge Oil Screen	33	Alternator Pad Cover		

12-7.5. Accessory Case with Oil Filter and Adapter Removal (AF and ES)

1. Remove filler cap assembly (Figure 12-20)(9).
2. Remove nuts (25), lock washers (24) and washers (23) from cover (22). Discard the lock washers.
3. Remove cover (22) and gasket (21). Discard the gasket.

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

4. Remove safety wire from plugs (10).
5. Remove plugs (10) and copper gaskets (11). Discard the copper gaskets.

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

6. Remove safety wire from oil filter (32).
7. Remove oil filter (32) from oil filter adapter (30). Discard the oil filter.

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

8. Remove safety wire from between oil filter adapter (30) and scavenge oil screen (29).
9. Remove nuts (35), lock washers (34) and washers (33) from oil filter adapter (30). Discard the lock washers.
10. Remove oil filter adapter (30), o-ring (27) and gasket (26). Discard the o-ring and gasket.
11. Remove scavenge oil screen (29) and copper gasket (28). Discard the copper gasket.

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

12. Remove safety wire from cap (18).
13. Remove stop nut (20), copper washer (19), cap (18), copper gasket (16), adjustment screw (17), springs (14 and 15) and plunger (13). Discard the copper gasket, copper washer and springs.
14. Remove nuts (35), lock washers (34) and washers (33). Discard the lock washers.
15. Remove screws (36), lock washers (34) and washers (33). Discard the lock washers.
16. Remove accessory case (1) and gasket (37) from the crankcase. Discard the gasket.
17. Place the accessory case, relief valve assembly, plugs, scavenge oil screen, oil filter adapter, filler cap assembly and fasteners in a clean, protected area until ready for overhaul inspection.

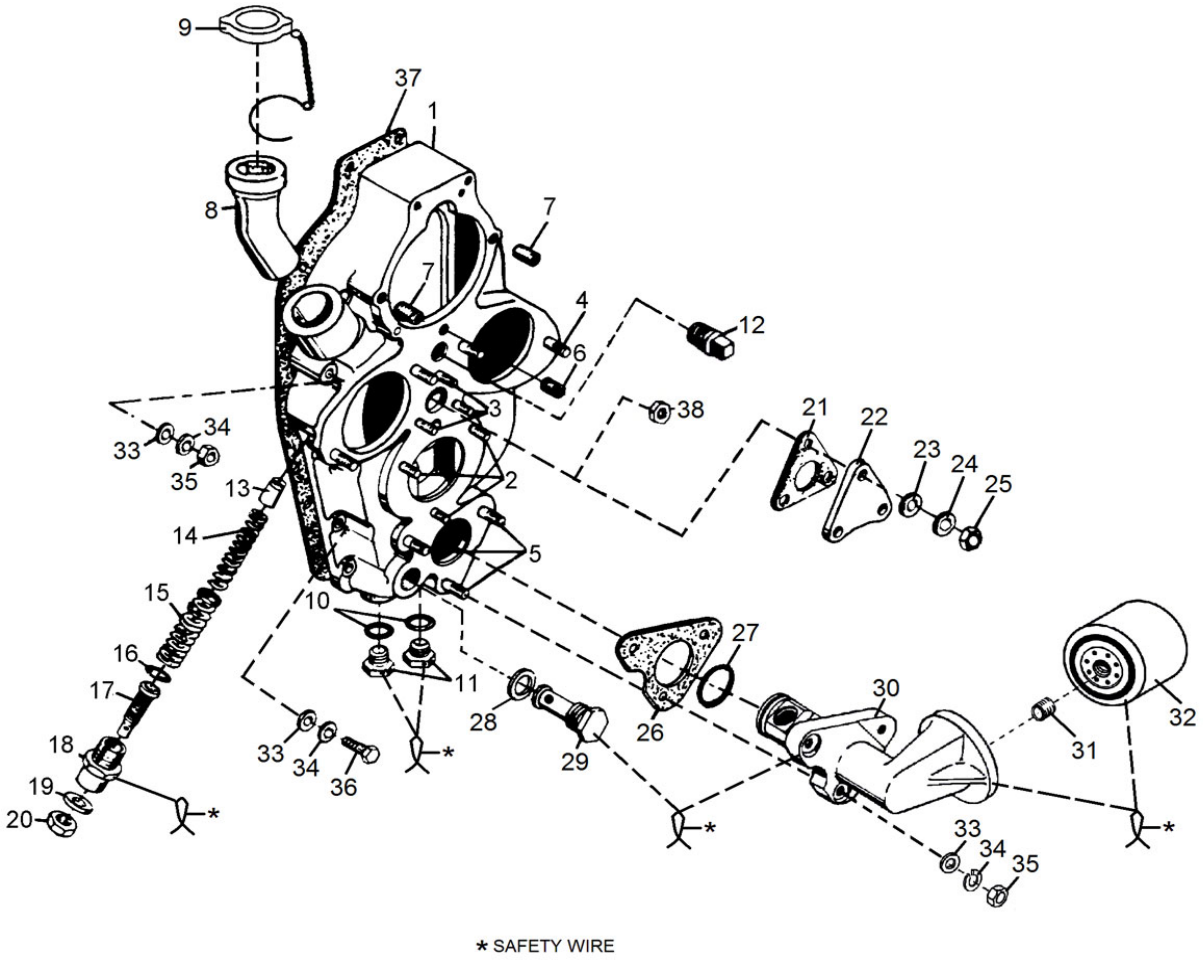


Figure 12-20. Accessory Case with Oil Filter and Adapter Removal (AF and ES)

1	Accessory Case	11	Plug	21	Gasket	31	Adapter Stud
2	Stud	12	Plug	22	Cover	32	Oil Filter
3	Stud	13	Plunger	23	Washer	33	Washer
4	Stud	14	Spring	24	Lock Washer	34	Lock Washer
5	Stud	15	Spring	25	Nut	35	Nut
6	Insert	16	Copper Gasket	26	Gasket	36	Screw
7	Insert	17	Adjustment Screw	27	O-ring	37	Gasket
8	Filler Neck Tube	18	Cap	28	Copper Gasket	38	Nut
9	Filler Cap Assembly	19	Copper Washer	29	Scavenge Oil Screen		
10	Copper Gasket	20	Stop Nut	30	Filter Adapter		

12-8. Exhaust System Removal

Refer to the aircraft maintenance manual for exhaust system removal and overhaul instructions.

12-9. Oil Cooler Removal

NOTE: Replace any oil cooler exhibiting structural damage, bent/broken or cracked cooling fins with a new or serviceable oil cooler. Oil cooler mounting flange weld repairs are permitted only at approved FAA Part 145 Repair Stations.

1. Loosen nut (Figure 12-21)(1) and back off bolt (2); remove shoe (3).

   NOTE: Engine models and specifications which use the 7.88 inch oil cooler do not have these parts.

2. Remove screws (4), lock washers (5) and washers (6). Discard the lock washers.
3. Remove the oil cooler (7) and gasket (8) from the oil cooler adapter (9). Discard the gasket.
4. Remove bolt (2) and nut (1) from the rocker cover.
5. Remove the vernatherm valve (11) and gasket (10) from oil cooler adapter (9). Discard the gasket.
6. Place the shoe, vernatherm valve and fasteners in a clean, protected area until ready for overhaul inspection.
7. Send the oil cooler to an approved FAA Part 145 Repair Station for overhaul.

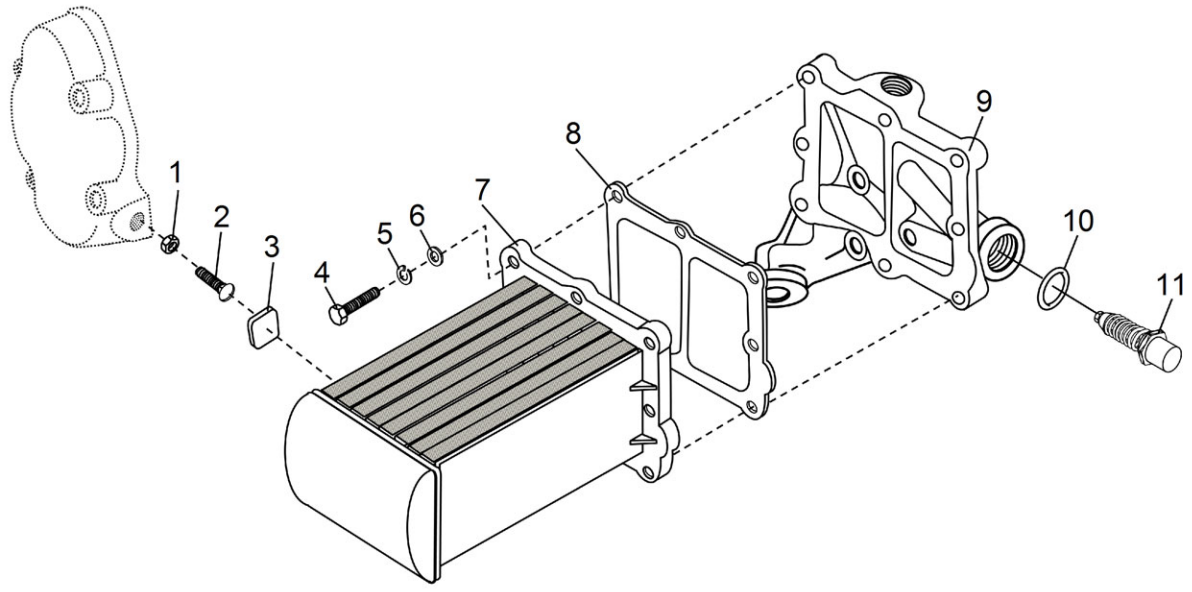


Figure 12-21. Oil Cooler Removal

1	Nut	4	Screw	7	Oil Cooler	10	Gasket
2	Bolt	5	Lock Washer	8	Gasket	11	Vernatherm Valve
3	Shoe	6	Washer	9	Oil Cooler Adapter		

12-10. Oil Pump Removal

1. Remove nut (Figure 12-22)(9) from oil pump drive gear (6).

   NOTE: Accessory case (1) with a tach drive connector removed will have no nut (9) to remove.

2. Remove oil pump drive gear (6) from out of oil pump gear (3) and pump cover (5).
3. Bend ears on tab washers (7) and remove bolts (8) and tab washers. Discard the tab washers.
4. Remove pump cover (5).
5. Remove oil pump gear (3) and oil pump driven gear assembly (4) out of accessory case (1).
6. Mount accessory case (1) in fixture and use arbor press to remove bushing (2). Discard the bushing.
7. Place the oil pump components in a clean, protected area until ready for overhaul inspection.

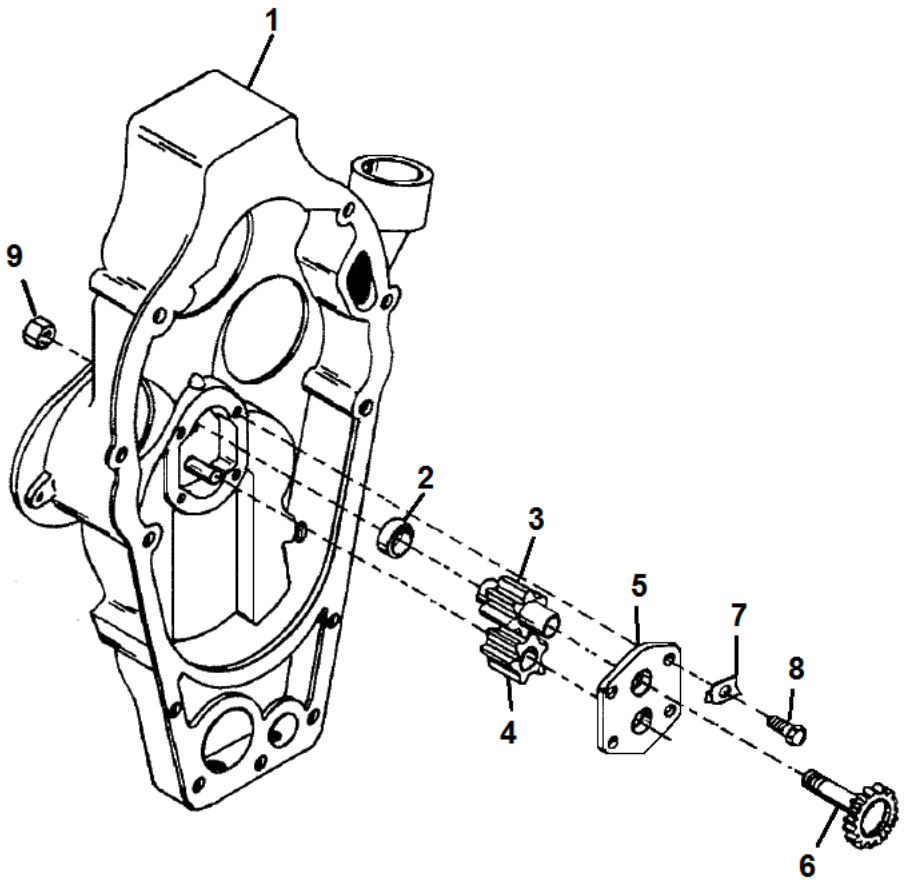


Figure 12-22. Oil Pump Removal

1	Accessory Case	4	Oil Pump Driven Gear Assembly (6T)	7	Tab Washer
2	Bushing	5	Pump Cover	8	Bolt
3	Oil Pump Gear (6T)	6	Oil Pump Drive Gear (23T)	9	Nut

12-11. Oil Sump Removal

Use the following instructions according to the appropriate instructions that match the installed engine configuration. Refer to the Illustrated Parts Catalog for engine configuration.

12-11.1. IO-360 Oil Sump Removal

1. Remove magnetic drain plug (Figure 12-23)(5) and copper gasket (4), if not already removed. Discard the copper gasket.
2. Remove nuts (8), lock washers (7) and washers (6) from oil sump (2) perimeter. Discard the lock washers.
3. Lightly tap the perimeter of the oil sump (2) using a soft mallet to loosen the gasket (1) from the crankcase; remove the oil sump from the crankcase.
4. Remove gasket (1) from the crankcase/oil sump and discard.
5. Remove suction tube (9) from oil sump (2).
6. Place the oil sump components in a clean, protected area until ready for overhaul inspection.

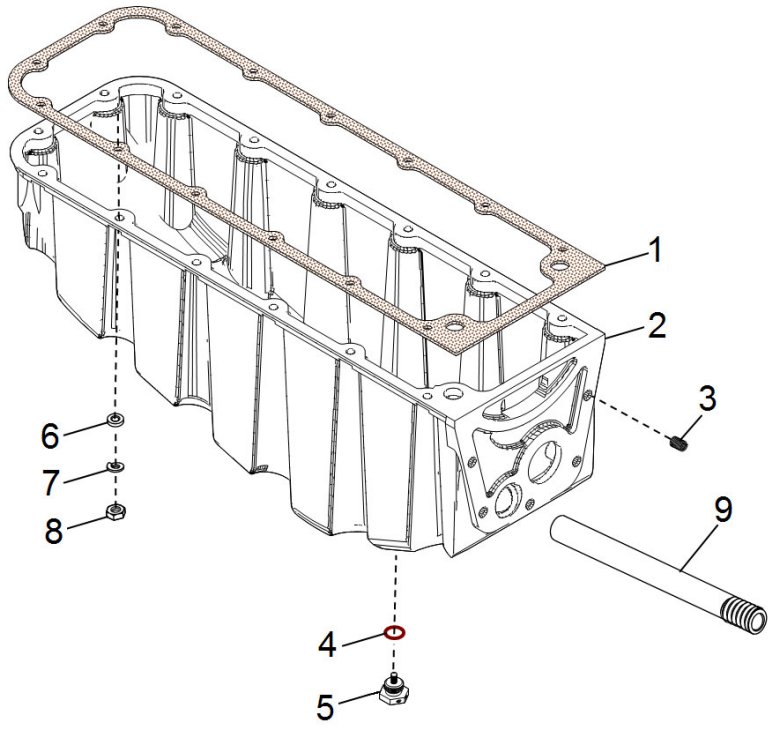


Figure 12-23. IO-360 Oil Sump Removal

1	Gasket	4	Copper Gasket	7	Lock Washer
2	Oil Sump	5	Magnetic Drain Plug	8	Nut
3	Insert	6	Washer	9	Suction Tube

12-11.2. IO-360 Oil Sump with Quick Drain Removal

1. Remove quick drain coupling (Figure 12-24)(5) and copper gasket (4), if not already removed. Discard the copper gasket.
2. Remove nuts (8), lock washers (7) and washers (6) from oil sump (2) perimeter. Discard the lock washers.
3. Lightly tap the perimeter of the oil sump (2) using a soft mallet to loosen the gasket (1) from the crankcase; remove the oil sump from the crankcase.
4. Remove gasket (1) from the crankcase/oil sump and discard.
5. Remove suction tube (9) from oil sump (2).
6. Place the oil sump components in a clean, protected area until ready for overhaul inspection.

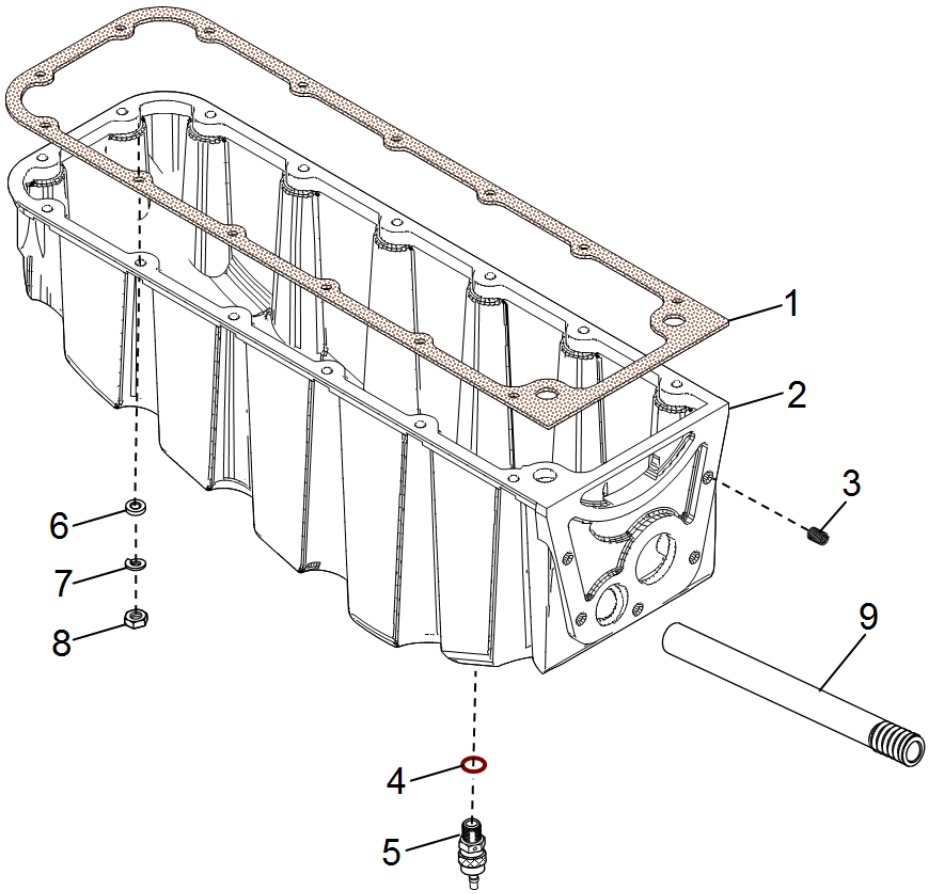


Figure 12-24. IO-360 Oil Sump with Quick Drain Removal

1	Gasket	4	Copper Gasket	7	Lock Washer
2	Oil Sump	5	Quick Drain Coupling	8	Nut
3	Insert	6	Washer	9	Suction Tube

12-11.3. IO-360-HB9, ES3, ES14 Oil Sump Removal

1. Remove magnetic drain plug (Figure 12-25)(5) and copper gasket (4), if not already removed. Discard the copper gasket.
2. Remove nuts (8), lock washers (7) and washers (6) from the oil sump (2) perimeter. Discard the lock washers.
3. Lightly tap the perimeter of the oil sump (2) using a soft mallet to loosen the gasket (1) from the crankcase; remove the oil sump from the crankcase.
4. Remove gasket (1) from the crankcase/oil sump and discard.
5. Remove pickup tube (9) from the oil sump (2).
6. Remove return fitting (10) from the oil sump (2).
7. Remove bolt (12), lock nut (14) and washer (13) from sump valve (11). Discard the lock nut.
8. Remove sump valve (11) from the oil sump (2).
9. Place the oil sump components in a clean, protected area until ready for overhaul inspection.

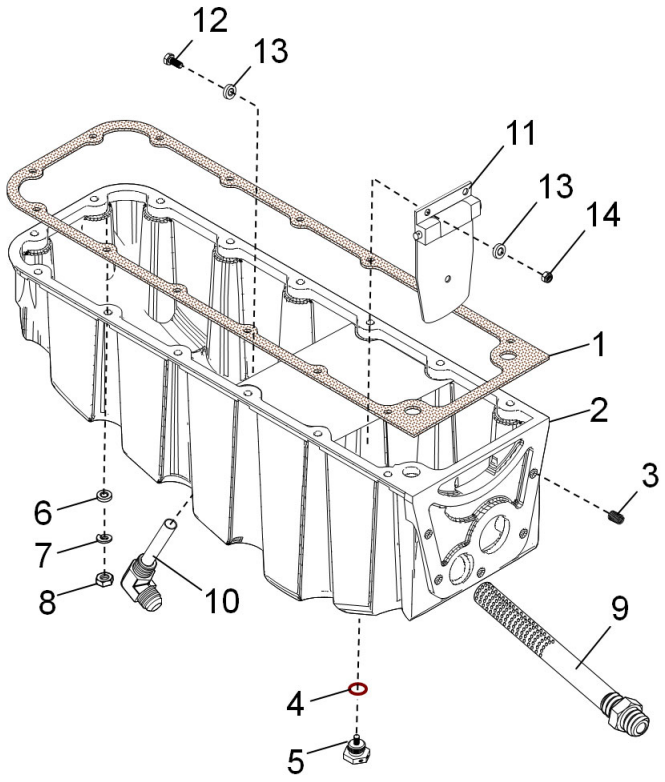


Figure 12-25. IO-360-HB9, ES3, ES14 Oil Sump Removal

1	Gasket	5	Magnetic Drain Plug	9	Pickup Tube	13	Washer
2	Oil Sump	6	Washer	10	Return Fitting	14	Lock Nut
3	Insert	7	Lock Washer	11	Sump Valve		
4	Copper Gasket	8	Nut	12	Bolt		

12-12. Intercylinder Baffles Removal

The intercylinder baffles are only installed on the IO-360-AF and ES engines.

1. Remove four bolts (Figure 12-26)(6), four washers (16), support brackets (1 and 7) and four spacers (2).

   NOTE: Fuel line clamps (17) need not be removed from support brackets (1 and 7) unless damaged.

2. Remove four screws (4) and washers (18) from baffle supports (5).
3. Remove baffle supports (5).
4. Push on baffle fasteners (10) to compress spring (11) and disengage baffle fasteners from baffle supports (3).
5. Remove baffle assemblies (8, 9, 12, 13, 14 and 15) from cylinders.
6. Remove baffle supports (3) from between cylinder fins.
7. Place the intercylinder baffle components in a clean, protected area until ready for overhaul inspection.

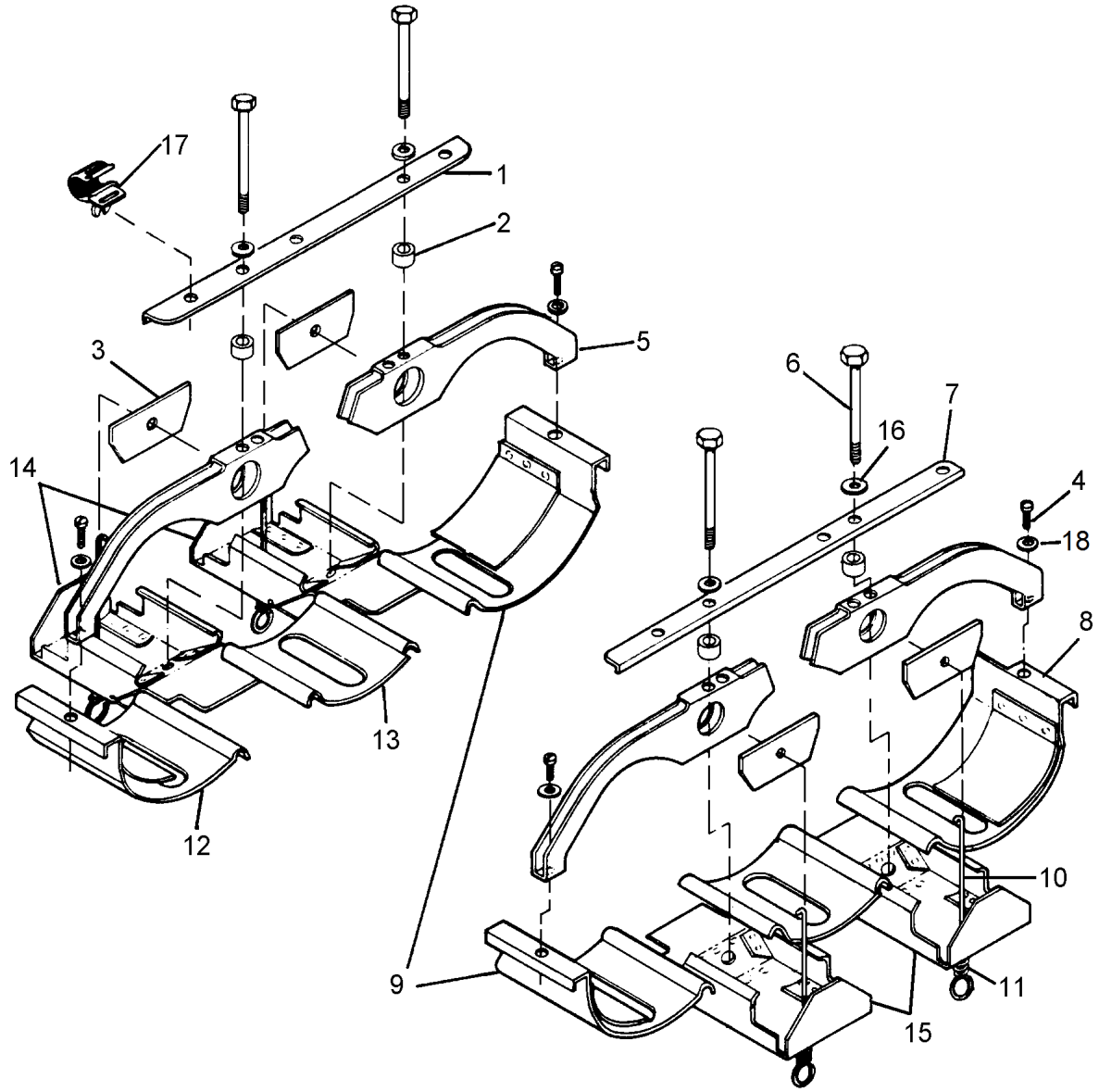


Figure 12-26. Intercylinder Baffles Removal

1	Support Bracket	6	Bolt	11	Spring	16	Washer
2	Spacer	7	Support Bracket	12	Baffle Assembly	17	Clamp
3	Baffle Support	8	Baffle Assembly	13	Baffle Assembly	18	Washer
4	Screw	9	Baffle Assembly	14	Baffle Assembly		
5	Baffle Support	10	Baffle Fastener	15	Baffle Assembly		

12-13. Engine Cylinder and Piston Removal

The IO-360 series engine features cross flow cylinders having individual rocker covers over the intake and exhaust valve assemblies.

1. With engine in the inverted position, remove the screws (Figure 12-27)(34), screw (35)(except A and AB), lock washers (33), and washers (32) and the rocker covers (29 and 30)(except A and AB) from the cylinder. Discard the lock washers.

   NOTE: Screw (35) and rocker cover (30) are installed on cylinder #2 only.

2. Remove and discard the rocker cover gaskets (28).
3. Position the crankshaft so the piston is at top dead center on the compression stroke and both intake and exhaust valves of the cylinder to be removed are closed.
4. Bleed the hydraulic lifters (48) down by applying steady pressure to the push rod (43) end of the rocker (20) arm; hydraulic lifter pressure relief should be obvious.
5. Bend the tab washers (26) ears down and remove the nuts (27), tab washers, thrust retainers (25). Discard the tab washers.
6. Remove the rockers (20), rocker shafts (23) and thrust washers (24) from the cylinder. Discard the rocker shafts and thrust washers.
7. Withdraw the push rods (43) from the push rod housing (38); there are two push rods per cylinder. Mark the location and position of removal to ensure the installation is in the same position and location.
8. Repeat steps 1 through 7 for the remaining cylinders.
9. Grasp the push rod housing (38) and push it inward toward the crankcase, compressing the push rod housing spring (40); lower the cylinder end of the push rod housing away from the cylinder assembly. Remove the push rod housing (38), spring (40), washers (41), o-ring (39) and seal (42). Discard the o-ring and seal. Repeat this step for the remaining push rod housings to be removed.
10. Remove cylinder drain tubes (44).
11. Remove and discard the compression seals (45).
12. Remove the connectors (19).
13. Disconnect spring (50) and remove baffle (49) and spring.
14. Repeat steps 10 through 13 for the remaining cylinders.
15. Rotate the engine to an upright position. Ensure that the piston in the cylinder to be removed is at the top dead center position on the compression stroke.
16. Using the appropriate wrenches, carefully remove the flange nuts (46 and 47) from the cylinder base flange. Discard the flange nuts.
17. As the last pieces of fastening hardware are removed, cradle the cylinder in your arm for support.

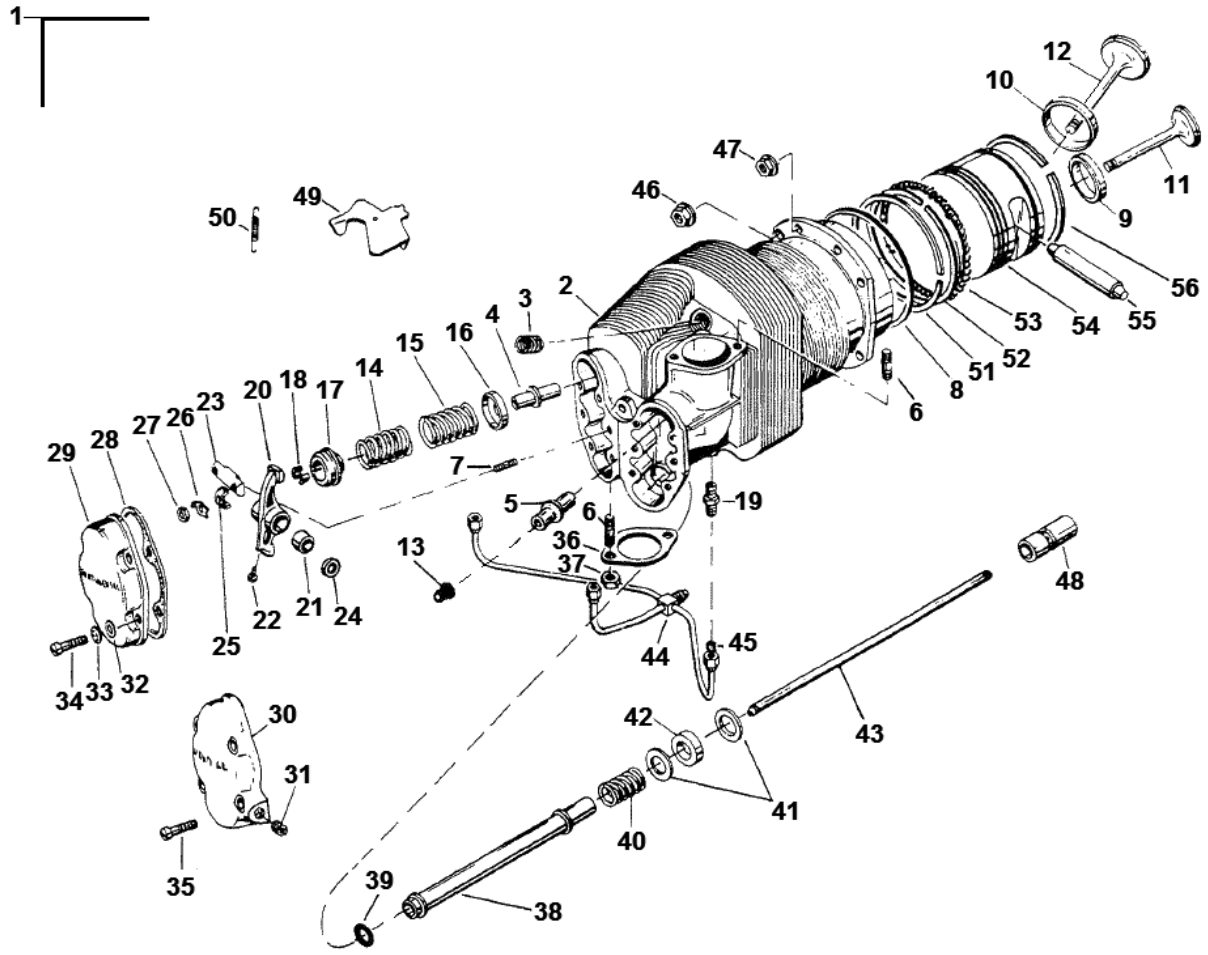


Figure 12-27. IO-360 Engine Cylinder and Piston Assembly Removal

1	Cylinder Assembly	15	Outer Valve Spring	29	Rocker Cover	43	Push Rod
2	Cylinder	16	Valve Spring Seat	30	Rocker Cover	44	Drain Tube Assembly
3	Insert	17	Rotocoil	31	Insert	45	Compression Seal
4	Exhaust Valve Guide	18	Valve Spring Key	32	Washer	46	Flanged Nut
5	Intake Valve Guide	19	Male Connector	33	Lock Washer	47	Flanged Nut
6	Stud	20	Rocker	34	Screw	48	Hydraulic Lifter
7	Stud	21	Bushing	35	Screw	49	Baffle
8	Packing	22	Screw	36	Flange Gasket	50	Spring
9	Exhaust Valve Seat Insert	23	Rocker Shaft	37	High Nut	51	Top Piston Ring
10	Intake Valve Seat Insert	24	Thrust Washer	38	Push Rod Housing	52	Second Piston Ring
11	Exhaust Valve	25	Thrust Retainer	39	O-ring	53	Oil Control Ring
12	Intake Valve	26	Tab Washer	40	Spring	54	Piston
13	Intake Valve Guide Seal	27	Nut	41	Washer	55	Piston Pin
14	Inner Valve Spring	28	Gasket	42	Seal	56	Scraper Ring

CAUTION: The crankcase flange and piston will be damaged if the connecting rod is allowed to fall against the cylinder mounting deck as the cylinder is withdrawn.

18. While supporting the cylinder (2), carefully pull the cylinder outward in a straight plane with one hand, keeping the other hand free to catch the piston (54) as the cylinder is withdrawn to prevent damage to the crankcase, cylinder or piston.

    CAUTION: Remove the cylinder base packing (8) and wrap the removed packing in a figure 8 (Figure 12-29) pattern around the crankcase studs to support the connecting rod.

19. Remove the cylinder base packing (8). Install the old packing in a figure 8 pattern similar to the illustration in Figure 12-29.

20. Remove the piston pin and plug assembly (Figure 12-28)(6) and piston (1) from the connecting rod. Discard the piston (1), piston rings (2 through 5) and piston pin and plug assembly (6).

21. Remove and discard the hydraulic lifters (48) by rotating the cam to lift the hydraulic lifter above the lifter bore. Use fingers or non-ferrous (copper or brass) wire to extract the hydraulic lifters from the crankcase lifter bores.

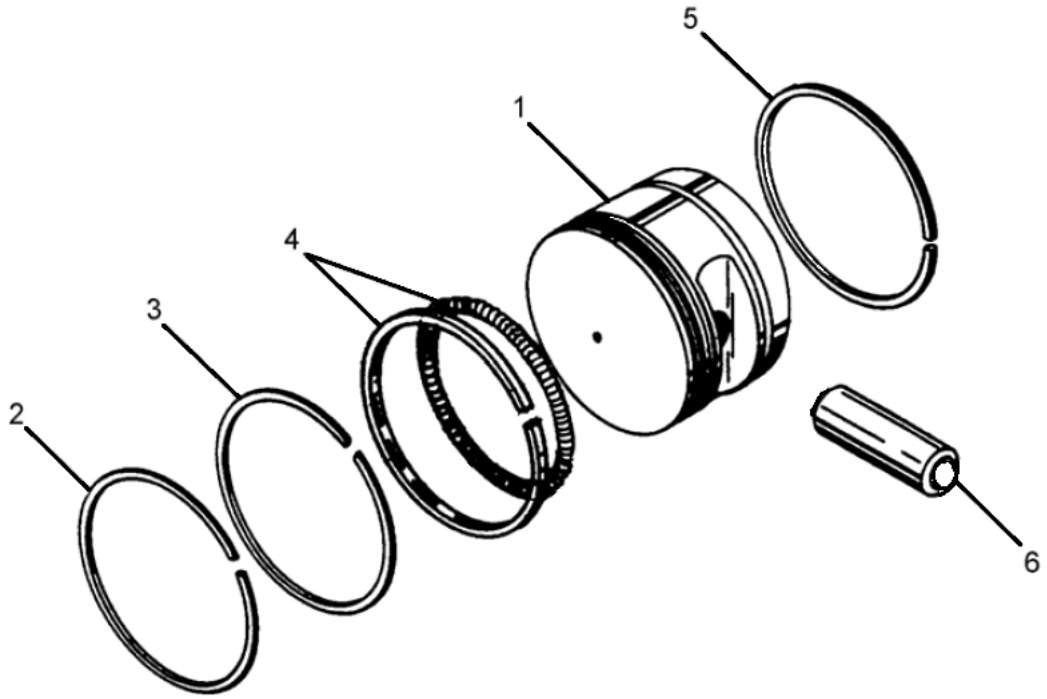


Figure 12-28. Piston Disassembly

1	Piston	4	Oil Control Ring
2	Top Compression Ring	5	Scraper Ring
3	Second Compression Ring	6	Piston Pin and Plug Assembly

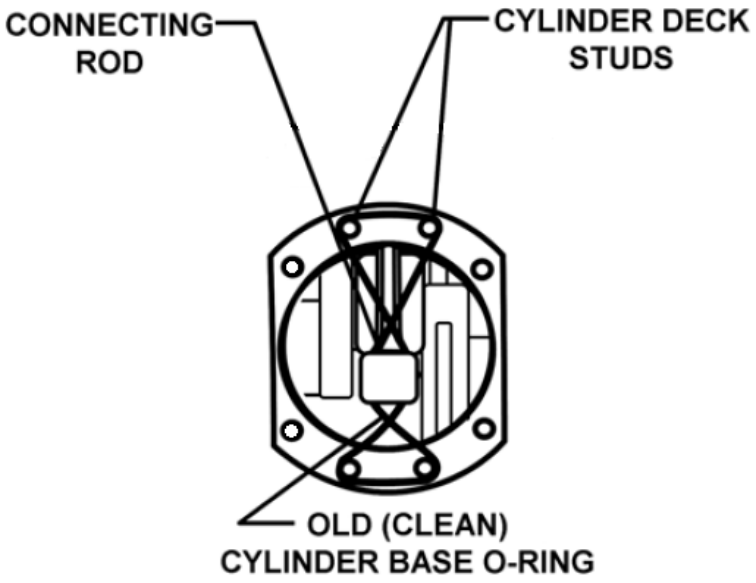


Figure 12-29. Packing Installed to Stabilize Connecting Rod

22. Place the cylinder upright on a work bench.
23. Repeat steps 15 through 22 to remove and prepare the remaining cylinders for overhaul.
24. Place the engine cylinders in a clean, protected area until they are disassembled as described in Chapter 13, “Component Disassembly.”
25. Place rest of the components and fasteners in a clean, protected area until ready for overhaul inspection.

Chapter 13. Component Disassembly

13-1. Ignition System

Overhaul magnetos according to the magneto manufacturer's instructions. For Continental Motors (Bendix) magnetos, refer to the Ignition System Service Support Manual (X42002) for applicable maintenance and overhaul instructions. Replace magnetos from manufacturer other than Continental Motors with new or rebuilt units or have the units overhauled by an FAA Part 145 Repair Station certified to overhaul the component.

13-2. Fuel Injection System

Continental Motors does not provide overhaul instructions for the fuel pump, manifold valve or throttle control assembly due to the precise calibration requirements after assembly. Continental Motors offers new and rebuilt fuel pump assemblies, manifold valves, throttle and control assemblies, or the assemblies may be rebuilt by an FAA Part 145 Repair Station authorized to overhaul the assemblies. Check for evidence of leakage or wear; clean, inspect, and replace the remaining fuel injection system parts according to the overhaul instructions in this and subsequent chapters of this manual.

> NOTE: Continental Motors offers new and rebuilt fuel pumps, fuel manifold valve assemblies, integral throttle assemblies and throttle and control assembles which meet new part specifications. Continental Motors does not control FAA Part 145 Repair Station activities; verify the repair station qualifications before contracting fuel injection system component overhaul. Fuel injection system component overhaul must be accomplished under carefully controlled conditions in compliance with FAA regulations.

Fittings selection and orientation differs significantly between engine model specifications for fuel pumps, manifold valves, throttle bodies, mixture control assemblies and priming assemblies. Using the illustration in Figure 13-1 as a guide, record the orientation of the fitting in relationship to the bore prior to removal. Refer to the recorded fitting orientation during assembly.

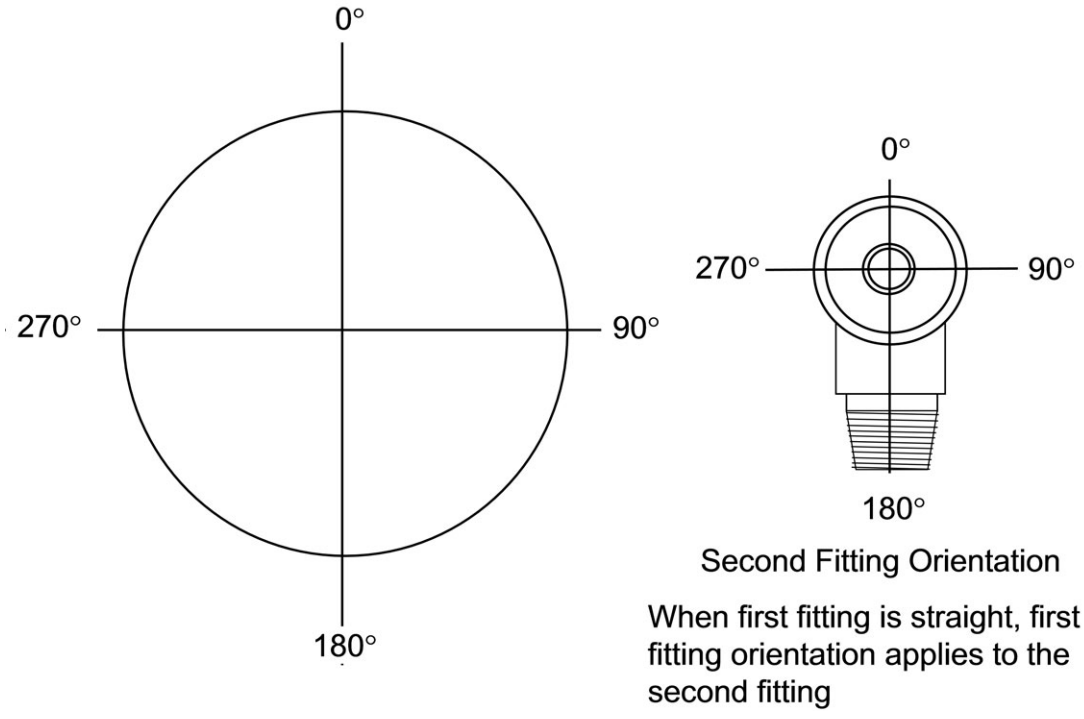


Figure 13-1. Fitting Orientation Guide

13-3. Starter and Starter Adapter Disassembly

Three starter adapters are available for IO-360 series engine models, two incorporate an accessory drive adapter at the end of the starter adapter. Refer to Section 13-3.1, Section 13-3.2 or Section 13-3.3 for starter adapter disassembly instructions.

NOTE: To identify the starter adapter installed on your engine, refer to Figure 13-2, Figure 13-3 or Figure 13-4 and follow the corresponding procedure in the subsequent sub-sections.

13-3.1. Starter Adapter Disassembly

1. Remove retaining ring (Figure 13-2)(7), using snap ring pliers. Discard the retaining ring.
2. With proper size drift and soft mallet, tap on needle bearing (4) to drive ball bearing (6), worm shaft (5) and needle bearing out of starter adapter (1).
3. Remove retaining ring (8), using snap ring pliers. Discard the retaining ring.
4. Remove ball bearing (6) and needle bearing (4) from worm shaft (5). Discard the bearings.
5. Remove nuts (21), lock washers (20) and washers (19) from accessory cover (18). Discard the lock washers.
6. Remove accessory cover (18), gasket (17) and seal (16) from pump cover (15). Discard the gasket and seal.
7. Remove nut (24), lock washer (23) and washer (22) from pump cover (15). Discard the lock washer.
8. Remove pump cover (15) and o-ring (14) from starter adapter (1). Discard the o-ring.
9. Install starter adapter (1) in a shielded vise.
10. Remove starter gear (11) by turning starter gear counterclockwise and pulling outward simultaneously to release clutch spring (9).
11. Install starter gear (11) in a shielded vise.
12. Bend back tabs on tab washer (12) and remove screw (13) and tab washer. Discard the tab washer.
13. Turn flat spot on clutch spring (9) which was being held by screw (13), 180° on starter gear (11) until it lines up with opposite hole.
14. Using a small screwdriver through hole, pry clutch spring (9) outward until it is disengaged from starter gear (11).
15. Separate starter gear (11), roller bearing (10), clutch spring (9) and starter shaft gear (3). Discard the clutch spring and roller bearing.
16. Examine the components for evidence of wear; clean the components according to instructions in Chapter 12 of M-0, Standard Practice Maintenance Manual, and inspect the components according to instructions in Chapter 15, “Overhaul Inspection and Repair.”
17. Replace the SkyTec starter with a new or rebuilt starter at overhaul. The Continental Motors starter motor may be replaced with a new or rebuilt unit or the starter may be overhauled according to the instructions in appropriate Starter Service Manual (X30592).

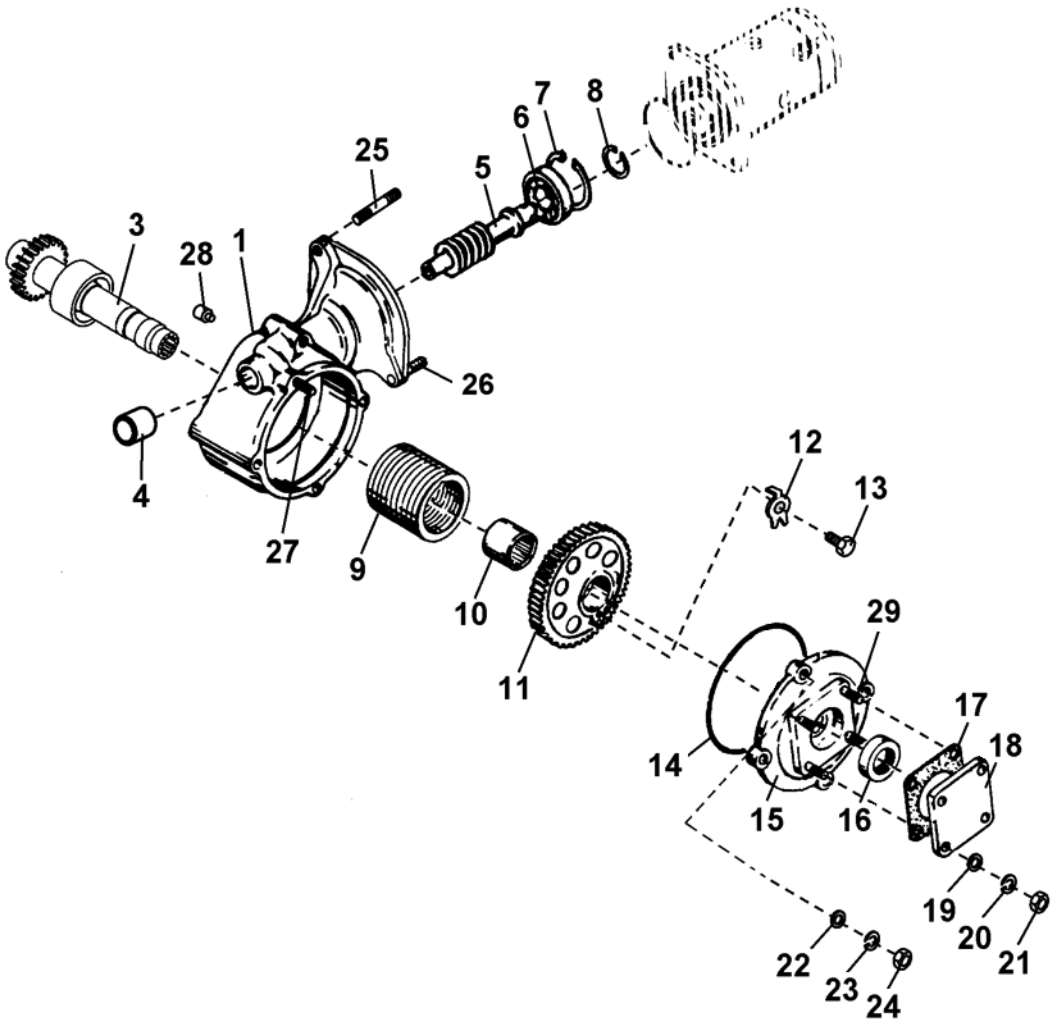


Figure 13-2. Starter Adapter Disassembly

1	Starter Adapter	9	Clutch Spring	17	Gasket	25	Stud
2	Dowel	10	Roller Bearing	18	Accessory Cover	26	Stud
3	Starter Shaft Gear	11	Starter Gear	19	Washer	27	Stud
4	Needle Bearing	12	Tab Washer	20	Lock Washer	28	Dowel
5	Worm Shaft	13	Screw	21	Nut	29	Stud
6	Ball Bearing	14	O-ring	22	Washer		
7	Retaining Ring	15	Pump Cover	23	Lock Washer		
8	Retaining Ring	16	Seal	24	Nut		

13-3.2. Starter Adapter with Accessory Drive Adapter Disassembly

1. Remove retaining ring (Figure 13-3)(7), using snap ring pliers. Discard the retaining ring.
2. With proper size drift and soft mallet, tap on needle bearing (4) to drive ball bearing (6), worm shaft (5) and needle bearing out of starter adapter (1).
3. Remove retaining ring (8), using snap ring pliers. Discard the retaining ring.
4. Remove ball bearing (6) and needle bearing (4) from worm shaft (5). Discard the bearings.
5. Remove nut (40), lock washer (39) and washer (38) from accessory drive adapter (17). Discard the lock washer.
6. Remove accessory drive adapter (17) and o-ring (15) from starter adapter (1). Discard the o-ring.
7. Remove nuts (27), lock washers (26) and washers (25) from accessory covers (24). Discard the lock washers.
8. Remove accessory covers (24), gasket (23) and seals (22 and 30) from accessory drive adapter (17). Discard the gaskets and seals.
9. Remove screws (37), lock washers (36) and washers (35) from drive adapter cover (29). Discard the lock washers.
10. Remove drive adapter cover (29) and gasket (28) from accessory drive adapter (17). Discard the gasket.
11. Disengage retaining ring (21), using snap ring pliers, and slide it back on shaft gear (19).
12. Press shaft gear (19) through left accessory drive pad opening. Square key (41) should come out with shaft gear. Discard the square key.

    NOTE: As shaft gear (19) is pressed out, the retaining ring (21) and driven gear (20) will fall free inside accessory drive adapter (17).

13. Remove retaining ring (21) and driven gear (20) from inside of accessory drive adapter (17). Discard the retaining ring.
14. Remove accessory gear (18).
15. Install starter adapter (1) in a shielded vise.
16. Remove starter gear (11) by turning starter gear counterclockwise and pulling outward simultaneously to release clutch spring (9).
17. Install starter gear (11) in a shielded vise.
18. Bend back tabs on tab washer (12) and remove screw (13) and tab washer. Discard the tab washer.

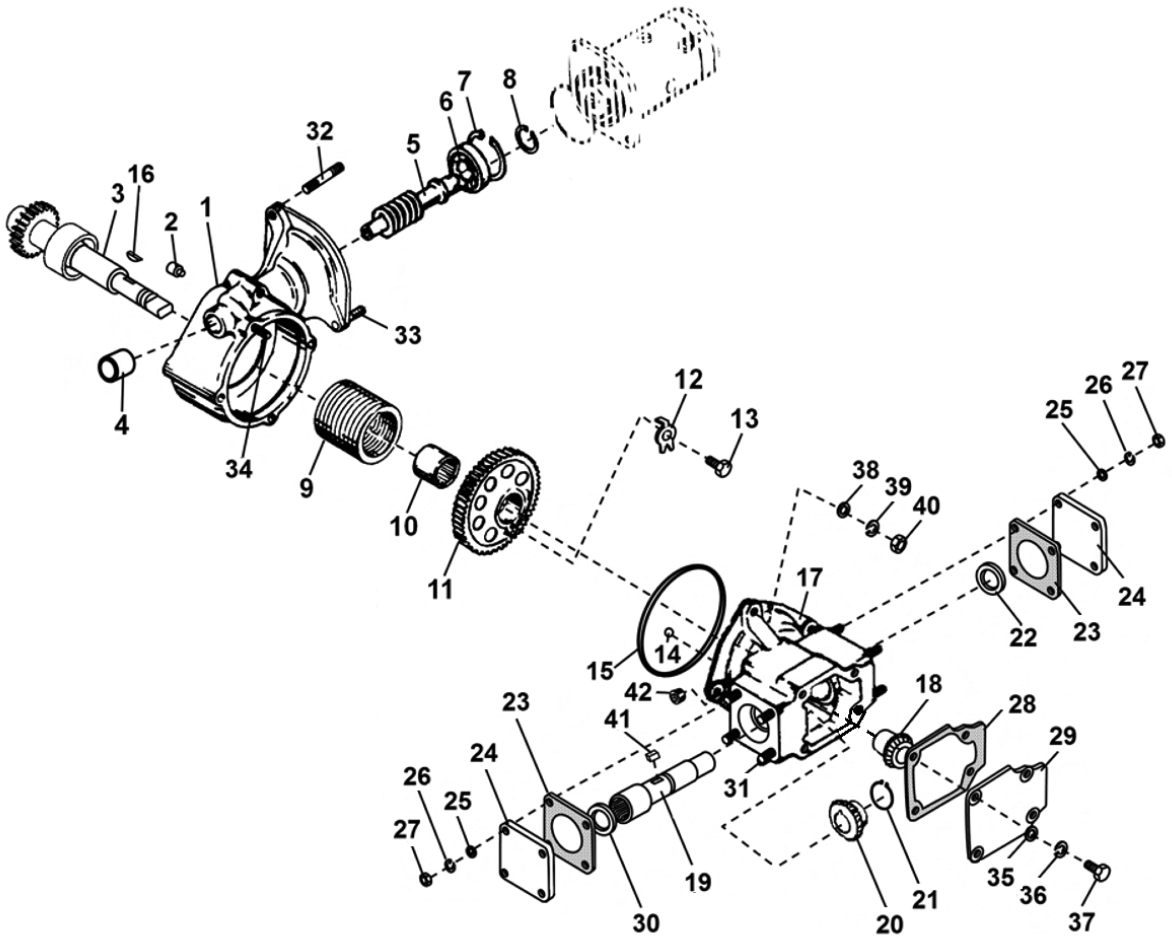


Figure 13-3. Starter Adapter with Accessory Drive Adapter Disassembly

1	Starter Adapter	12	Tab Washer	23	Gasket	34	Stud
2	Dowel	13	Screw	24	Accessory Cover	35	Washer
3	Starter Shaft Gear	14	Ball	25	Washer	36	Lock Washer
4	Needle Bearing	15	O-ring	26	Lock Washer	37	Screw
5	Worm Shaft	16	Woodruff Key	27	Nut	38	Washer
6	Ball Bearing	17	Accessory Drive Adapter	28	Gasket	39	Lock Washer
7	Retaining Ring	18	Accessory Gear	29	Drive Adapter Cover	40	Nut
8	Retaining Ring	19	Shaft Gear	30	Oil Seal	41	Square Key
9	Clutch Spring	20	Driven Gear	31	Stud	42	Plug
10	Roller Bearing	21	Retaining Ring	32	Stud		
11	Starter Gear	22	Seal	33	Stud		

19. Turn flat spot on clutch spring (9) which was being held by screw (13), 180° on starter gear (11) until it lines up with opposite hole.

20. Using a small screwdriver through hole, pry clutch spring (9) outward until it is disengaged from starter gear (11).

21. Separate starter gear (11), roller bearing (10), clutch spring (9), starter shaft gear (3) and woodruff key (16). Discard the woodruff key, clutch spring and roller bearing.

22. Examine the components for evidence of wear; clean the components according to instructions in Chapter 12 of M-0, Standard Practice Maintenance Manual, and inspect the components according to instructions in Chapter 15, “Overhaul Inspection and Repair.”

23. Replace the SkyTec starter with a new or rebuilt starter at overhaul. The Continental Motors starter motor may be replaced with a new or rebuilt unit or the starter may be overhauled according to the instructions in appropriate Starter Service Manual (X30592).

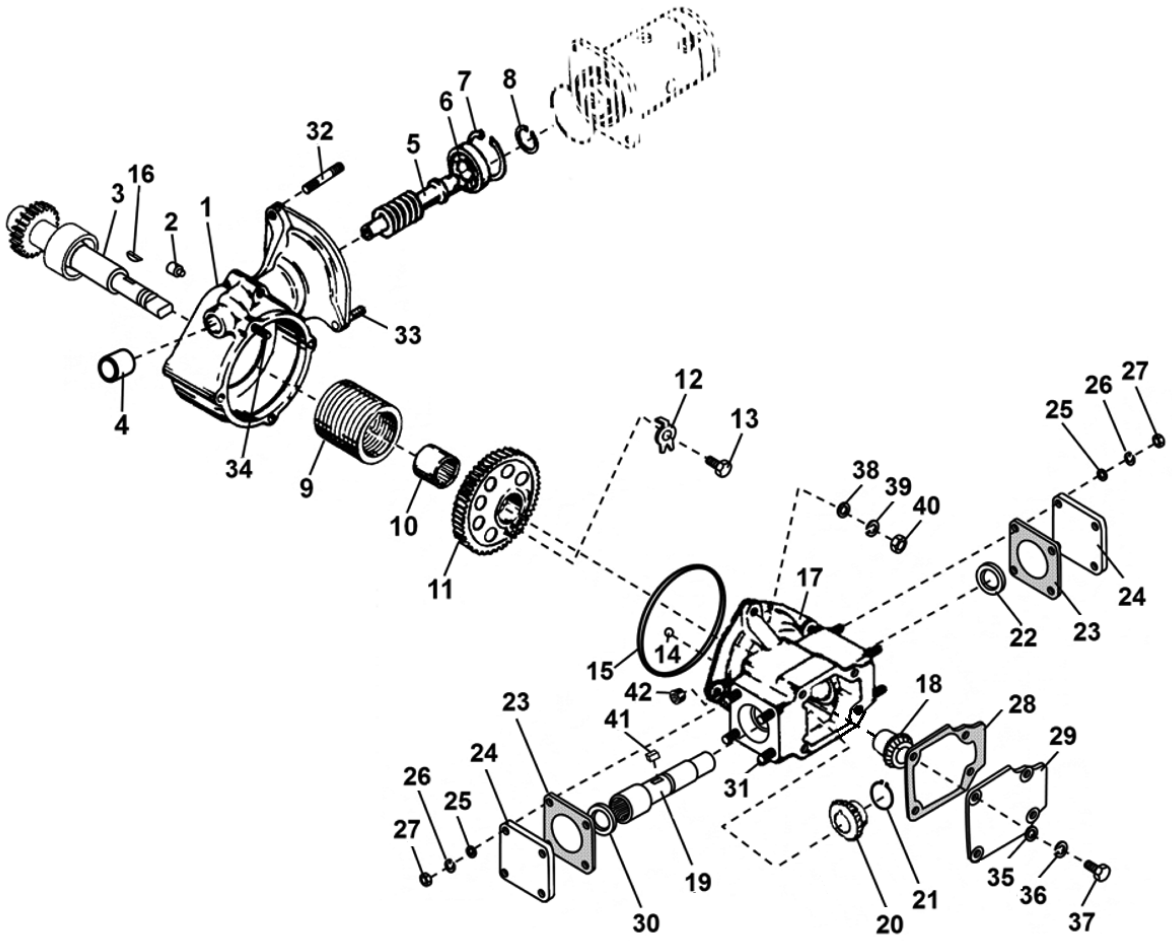


Figure 13-3 repeated for reference

13-3.3. Starter Adapter with Accessory Drive Adapter with Gear Shaft Housing Disassembly

1. Remove retaining ring (Figure 13-4)(7), using snap ring pliers. Discard the retaining ring.
2. With proper size drift and soft mallet, tap on needle bearing (4) to drive ball bearing (6), worm shaft (5) and needle bearing out of starter adapter (1).
3. Remove retaining ring (8), using snap ring pliers. Discard the retaining ring.
4. Remove ball bearing (6) and needle bearing (4) from worm shaft (5). Discard the bearings.
5. Remove nut (39), lock washer (38) and washer (37) from accessory drive adapter (17). Discard the lock washer.
6. Remove accessory drive adapter (17) and o-ring (15) from starter adapter (1). Discard the o-ring.
7. Remove nuts (27), lock washers (26) and washers (25) from accessory covers (24). Discard the lock washers.
8. Remove accessory cover (24), gasket (23) and seals (22 and 30) from accessory drive adapter (17). Discard the gaskets and seals.

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

9. Cut and remove the safety wire from the nuts (39).
10. Remove nuts (39) and washers (37) from gear shaft housing (46).
11. Remove gear shaft housing (46) from accessory drive adapter (17).
12. Remove driven gear (43), needle bearings (44) and oil seal (45) from gear shaft housing (46). Discard the needle bearings and oil seal.
13. Disengage retaining ring (21), using snap ring pliers, and slide it back on shaft gear (19).
14. Press shaft gear (19) through left accessory drive pad opening. Square key (40) should come out with shaft gear. Discard the square key.

    NOTE: As shaft gear (19) is pressed out, the retaining ring (21) and driven gear (20) will fall free inside accessory drive adapter (17).

15. Remove retaining ring (21) and driven gear (20) from inside of accessory drive adapter (17). Discard the retaining ring.
16. Remove accessory gear (18).
17. Bend back tabs on tab washer (12) and remove bolts (14) and tab washers from scavenge pump cover (35).

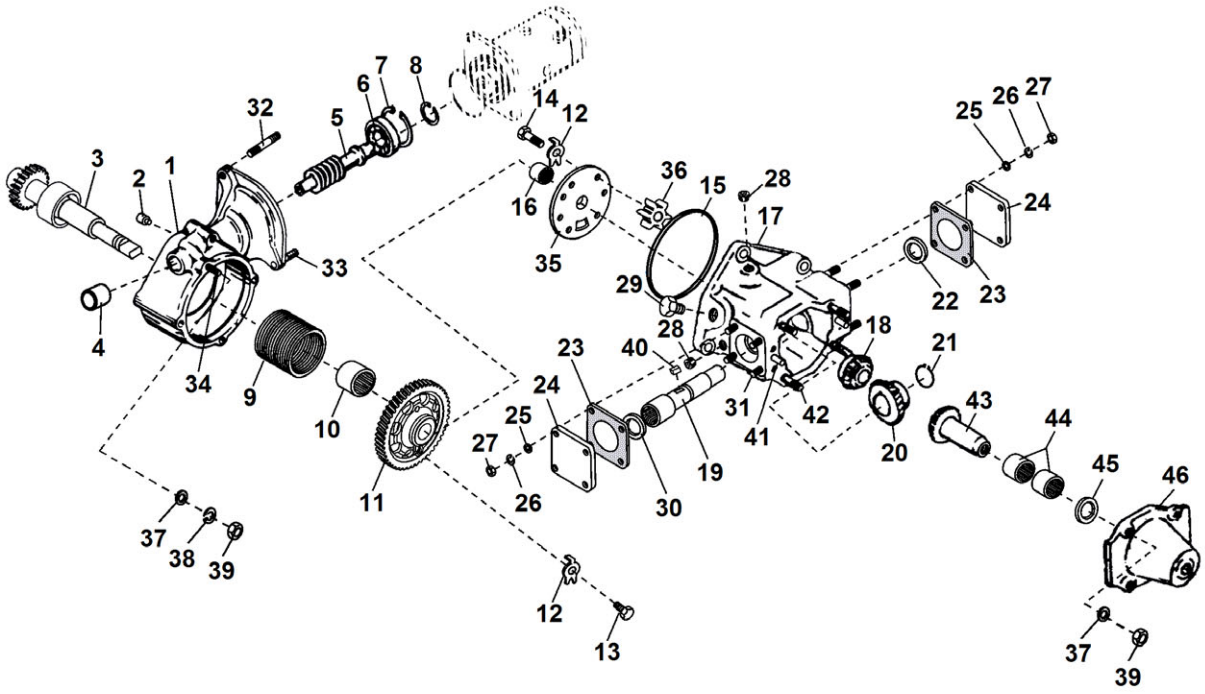


Figure 13-4. Starter Adapter with Accessory Drive Adapter with Gear Shaft Housing Disassembly

1	Starter Adapter	13	Screw	25	Washer	37	Washer
2	Dowel	14	Bolt	26	Lock Washer	38	Lock Washer
3	Starter Shaft Gear	15	O-ring	27	Nut	39	Nut
4	Needle Bearing	16	Needle Bearing	28	Plug	40	Square Key
5	Worm Shaft	17	Accessory Drive Adapter	29	Plug	41	Dowel
6	Ball Bearing	18	Accessory Gear	30	Oil Seal	42	Stud
7	Retaining Ring	19	Shaft Gear	31	Stud	43	Driven Gear
8	Retaining Ring	20	Driven Gear	32	Stud	44	Needle Bearing
9	Clutch Spring	21	Retaining Ring	33	Stud	45	Oil Seal
10	Roller Bearing	22	Seal	34	Stud	46	Gear Shaft Housing
11	Starter Gear	23	Gasket	35	Scavenge Pump Cover		
12	Tab Washer	24	Accessory Cover	36	Driven Gear Assembly		

18. Remove scavenge pump cover (35) and needle bearing (16). Discard the needle bearing.
19. Remove driven gear assembly (36) and discard.
20. Install starter adapter (1) in a shielded vise.
21. Remove starter gear (11) by turning starter gear counterclockwise and pulling outward simultaneously to release clutch spring (9).
22. Install starter gear (11) in a shielded vise.
23. Bend back tabs on tab washer (12) and remove screw (13) and tab washer from starter gear (11). Discard the tab washer.

24. Turn flat spot on clutch spring (9) which was being held by screw (13), 180° on starter gear (11) until it lines up with opposite hole.
25. Using a small screwdriver through hole, pry clutch spring (9) outward until it is disengaged from starter gear (11).
26. Separate starter gear (11), roller bearing (10), clutch spring (9), starter shaft gear (3) and woodruff key (16). Discard the woodruff key, clutch spring and roller bearing.
27. Examine the components for evidence of wear; clean the components according to instructions in Chapter 12 of M-0, Standard Practice Maintenance Manual, and inspect the components according to instructions in Chapter 15, “Overhaul Inspection and Repair.”
28. Replace the SkyTec starter with a new or rebuilt starter at overhaul. The Continental Motors’ starter motor may be replaced with a new or rebuilt unit or the starter may be overhauled according to the instructions in appropriate Starter Service Manual (X30592).

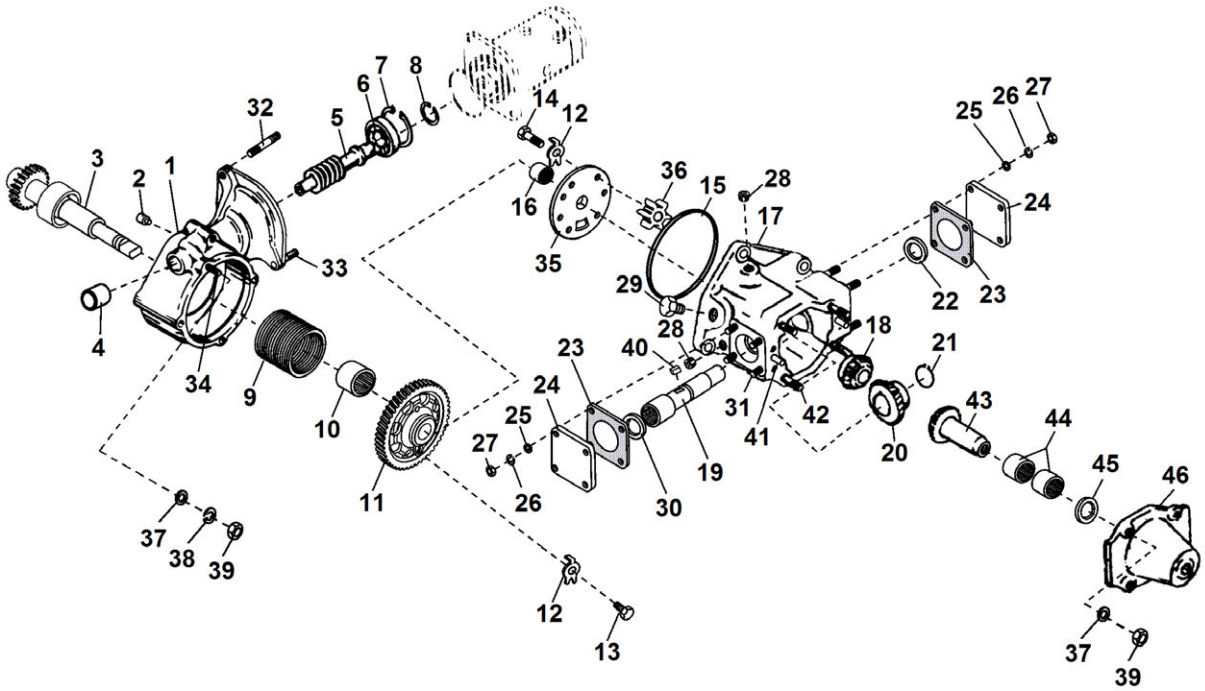


Figure 13-4 repeated for reference

13-4. Engine Cylinder Disassembly

1. Place the cylinder assembly (Figure 13-5) on a cylindrical block of wood anchored to a workbench.
2. Use a Valve Spring Compressor Tool (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) to carefully compress the valve springs. Do not cock the rotocoils (14) or valve spring keys (15) which could score the valve stem.
3. Use needle nose pliers to remove and discard the valve spring keys (15).
4. Remove and discard the rotocoils (14).
5. Remove the valve spring seats (11), outer springs (12), and inner springs (13). Discard the springs.
6. Remove and discard the intake valve guide seal (9).
7. Hold the valve stems while lifting the cylinder (1) from its support and place the cylinder on its side.
8. Remove and discard the intake (2) and exhaust (3) valves.

   CAUTION: To prevent damage to the engine cylinder, take the necessary precautions indicated in the "Stud Replacement" instructions in Appendix C-6.

9. Remove and discard the exhaust flange studs (6), regardless of condition, according to the instructions in Appendix C-6.
10. Perform a "Visual Inspection" according to instructions in Section 15-3 to determine if the cylinder may be a candidate for overhaul inspection and repair.

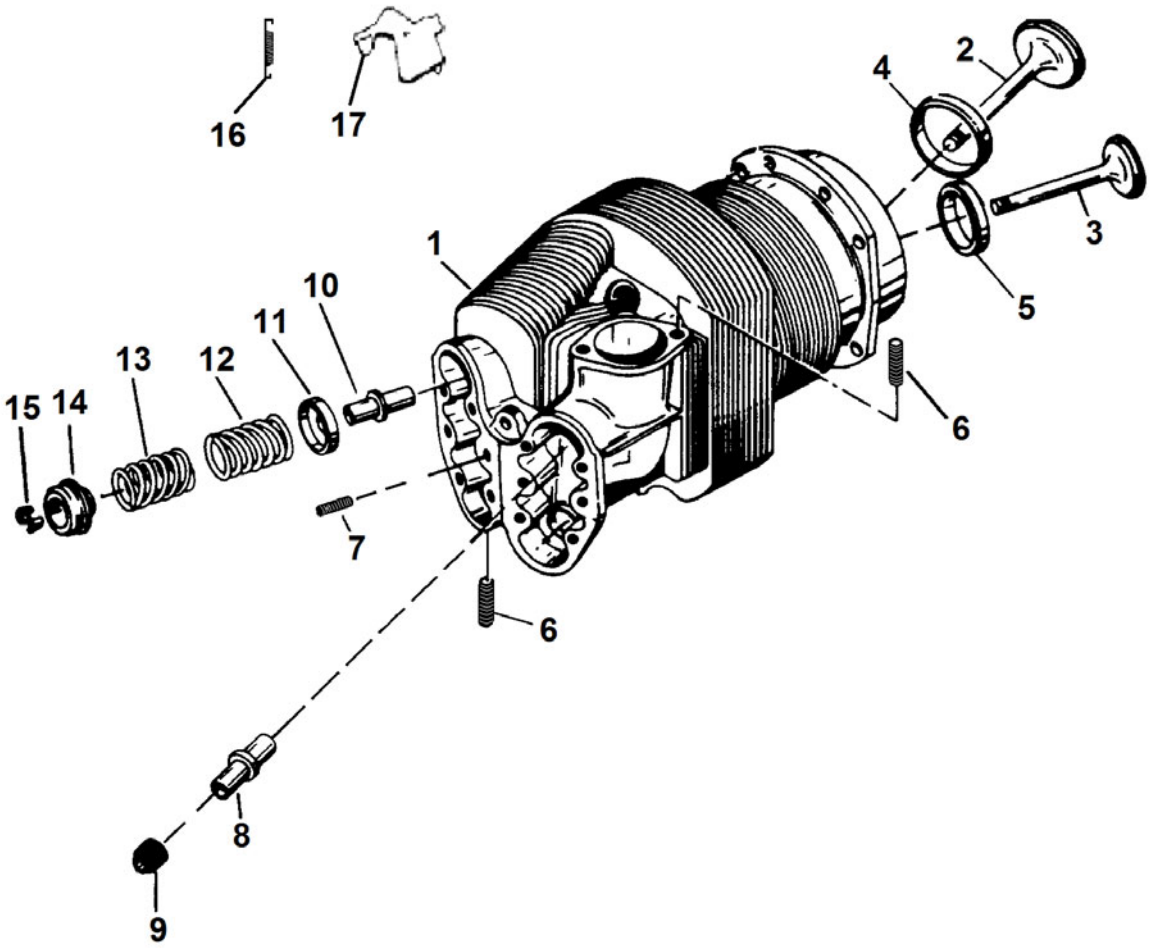


Figure 13-5. Cylinder Disassembly

1	Cylinder	6	Stud	11	Valve Spring Seat	16	Spring
2	Intake Valve	7	Stud	12	Outer Valve Spring	17	Baffle
3	Exhaust Valve	8	Intake Valve Guide	13	Inner Valve Spring		
4	Intake Valve Seat Insert	9	Intake Valve Guide Seal	14	Rotocoil		
5	Exhaust Valve Seat Insert	10	Exhaust Valve Guide	15	Valve Spring Key		

13-5. Crankcase Disassembly

13-5.1. Crankcase Associated Parts Removal

The IO-360 series crankcase associated parts vary slightly depending on the engine model and specification. Some have oil gage rod housing extensions and clamp variations. Figure 13-8 is one example. Use the following instructions according to the appropriate instructions that match the installed engine configuration. Refer to the illustrated parts catalog for engine configuration.

1. Remove bolts (Figure 13-8)(4) and seal retainer plates (3).
2. If installed, remove nuts (10), lock washers (9), washers (8), spacers (7), cover (6) and gasket (5) from governor pad. Discard the lock washers and gasket.
3. Remove oil gage rod (15) and o-ring (16). Discard the o-ring.
4. Remove screw (21), nut (24), washer (23), clamps (22 and 26) and support bracket (25) from housing extension (20).
5. Loosen clamps (18) and remove housing extension (20), extension hose (19) and clamps. Discard the extension hose.
6. Remove and discard the retaining ring (31).
7. Remove nuts (14), washers (13), mount brackets (12, 29 and 30), spacer (IO-360-AF, ES series only) and o-rings (11). Discard the o-rings.
8. Remove lock nuts and mag gear shafts. Discard the lock nuts. Refer to Figure 13-6.
9. If applicable to your model, do the following:
   a. Remove bolts, lock washers, cam hole cover and gasket. Discard the lock washers and gasket. Refer to Figure 13-7.
10. Place the seal retainer plates, cover, oil gage rod, support bracket, housing extension, mag gear shafts, cam hole cover (if applicable), mount brackets and fasteners in a clean, protected area until ready for overhaul inspection.

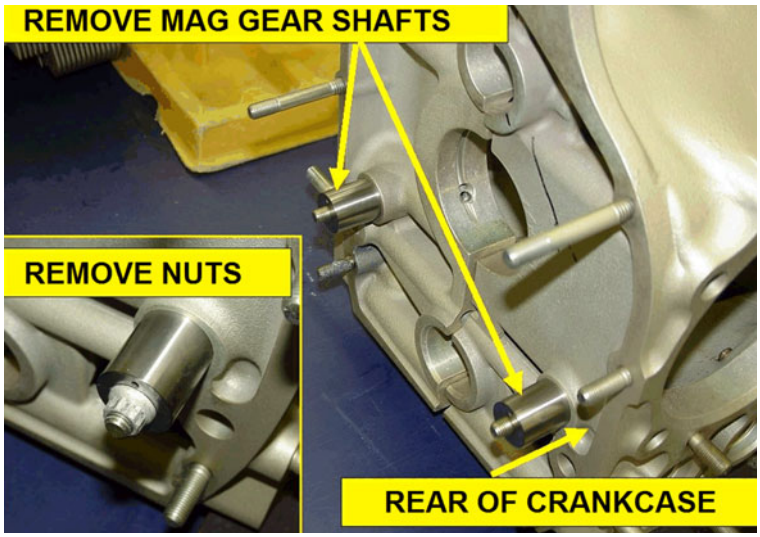


Figure 13-6. Mag Gear Shafts Removal

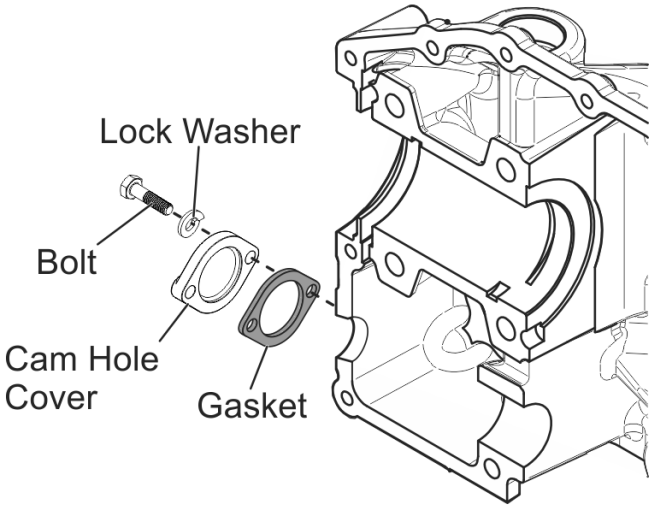


Figure 13-7. Camshaft Hole Cover Removal

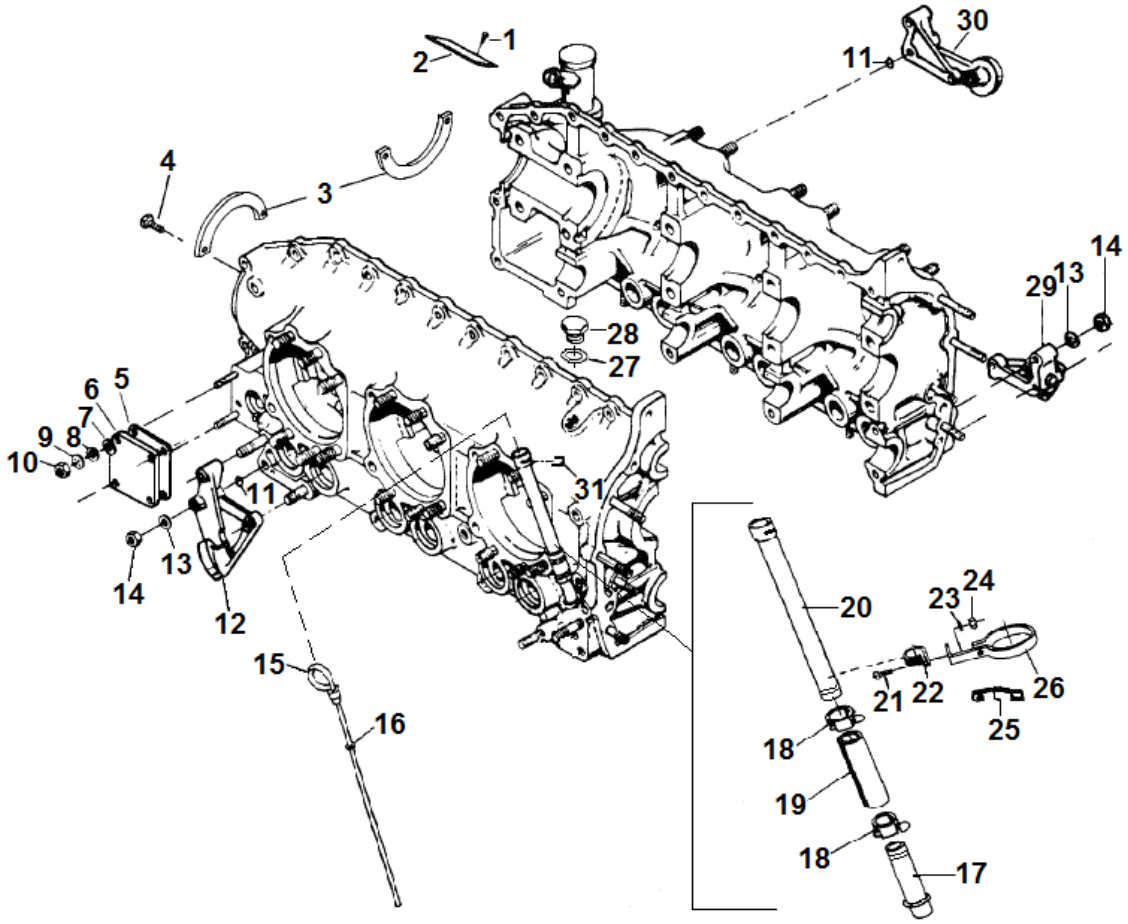


Figure 13-8. Crankcase Associated Parts Disassembly

1	Drive Screw	9	Lock Washer	17	Oil Rod Housing	25	Support Bracket
2	Plate	10	Nut	18	Clamp	26	Clamp
3	Seal Retainer Plate	11	O-ring	19	Extension Hose	27	Gasket
4	Bolt	12	Mount Bracket	20	Housing Extension	28	Plug
5	Gasket	13	Washer	21	Screw	29	Mount Bracket
6	Cover	14	Nut	22	Clamp	30	Mount Bracket
7	Spacer	15	Oil Gage Rod	23	Washer	31	Retaining Ring
8	Washer	16	O-ring	24	Lock Nut		

13-5.2. Crankcase Attaching Parts Removal

The IO-360 series crankcase attaching parts vary slightly depending on the engine model and specification. Placement of lifting eyes, throttle bracket and manifold bracket will vary. Figure 13-9 is one example. Use the following instructions according to the appropriate instructions that match the installed engine configuration. Refer to the illustrated parts catalog for engine configuration.

1. Rotate engine stand to place 2-4-6 (left) side of crankcase downward.
2. Place a suitable support of proper length (wood or pipe using soft shield to prevent damage to crankcase) under 2-4-6 (left) side of crankcase to help support during disassembly.
3. Remove bolts (Figure 13-9)(23), washers (22), nuts (24) and throttle bracket (21).
4. Remove bolts (18 and 19), washers (17), special washer (16), nuts (14) and lifting eye (15).
5. Remove bolts (10 and 13), washers (9 and 12) and nuts (11 and 20).
6. Remove bolt (29), washers (28) and nut (27).
7. Remove bolt (35), washers (36) and nut (37).
8. Remove nuts (30) and washers (31) from both ends of through bolt (1). Discard the nuts.
9. Remove nuts (30) and washers (25) from both ends of through bolts (6, 7 and 26). Discard the nuts.
10. Remove nuts (32), washers (33) and bushing (38) from both ends of through bolt (8). Discard the nuts.
11. Remove nuts (30 and 34) and washers (31 and 33) from both ends of through bolts (3 and 4). Discard the nuts.
12. Very carefully using a brass or fiber drift, drive all through bolts and their o-rings (5) except through bolt (7) downward and out of 2-4-6 (left) side of crankcase. Discard the through bolts and o-rings.
13. Very carefully using a brass or fiber drift, drive through bolt (7) upward and out of 1-3-5 (right) side of crankcase to prevent damage to adapter pad. Discard the through bolt.
14. Remove and discard old cylinder base packings from the 1-3-5 connecting rods.
15. Stand the 1-3-5 (right) connecting rods upright and lift off the 1-3-5 (right) crankcase half. Place the 1-3-5 (right) crankcase half in a clean, protected area until ready for overhaul inspection.
16. Remove and discard old cylinder base packings from the 2-4-6 connecting rods.
17. Remove the camshaft assembly (Figure 13-10) and governor driven gear (1) from the crankcase and place camshaft assembly in a holding fixture for disassembly and inspection.
18. Remove the crankshaft assembly (Figure 13-11) with connecting rods (19), thrust washer (14) and main bearings (11 and 12) and place crankshaft assembly in a holding fixture for disassembly and overhaul inspection.
19. Remove starter bushing (Figure D-31)(1) from the crankcase. Discard the starter bushing.

20. Remove the 2-4-6 (left) crankcase half from stand. Place the 2-4-6 (left) crankcase half in a clean, protected area until ready for overhaul inspection.

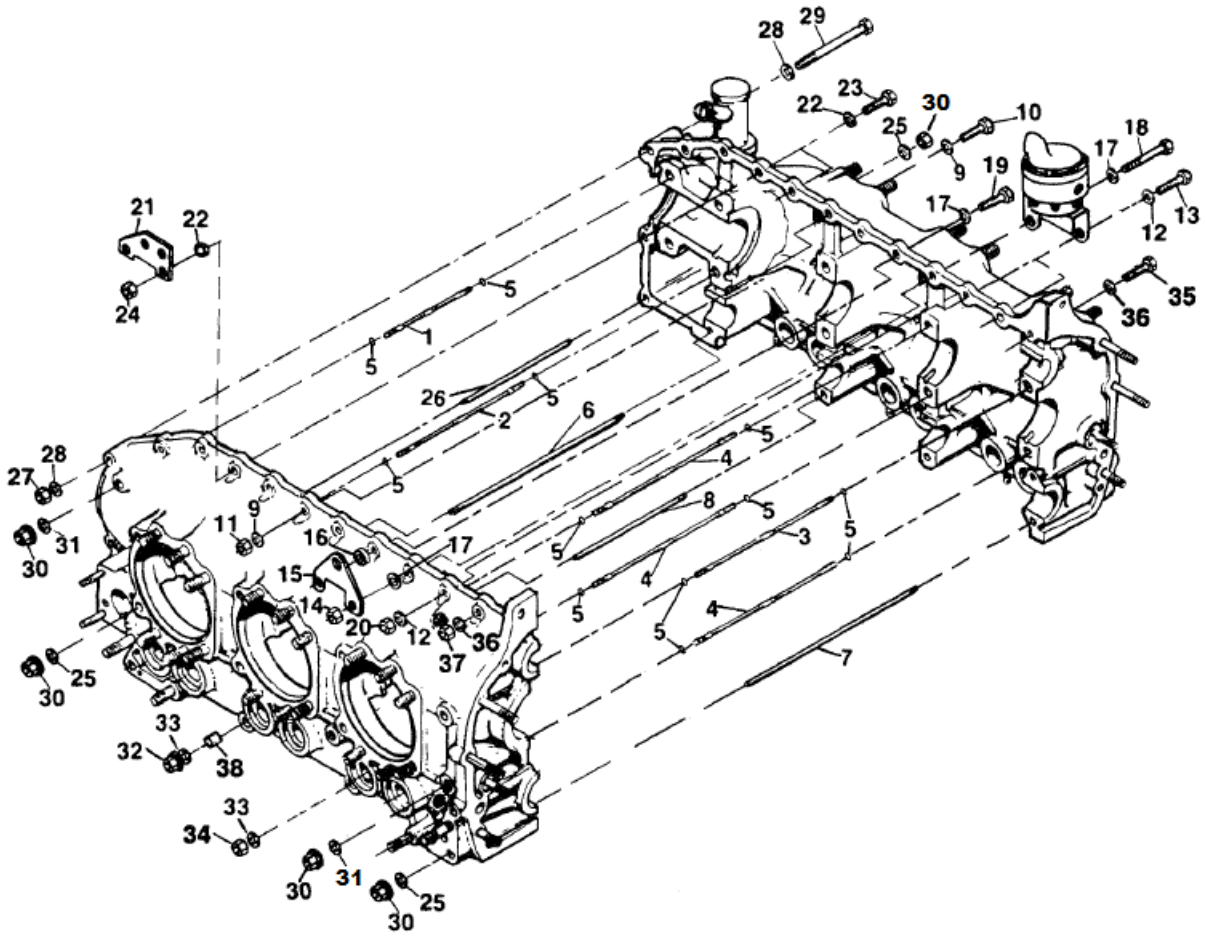


Figure 13-9. Crankcase Attaching Parts Disassembly

1	Through Bolt	11	Nut	21	Throttle Bracket	31	Washer
2	Through Bolt	12	Washer	22	Washer	32	Nut
3	Through Bolt	13	Bolt	23	Bolt	33	Washer
4	Through Bolt	14	Nut	24	Nut	34	Nut
5	O-ring	15	Lifting Eye	25	Washer	35	Bolt
6	Through Bolt	16	Special Washer	26	Through Bolt	36	Washer
7	Through Bolt	17	Washer	27	Nut	37	Nut
8	Through Bolt	18	Bolt	28	Washer	38	Bushing
9	Washer	19	Bolt	29	Screw		
10	Bolt	20	Nut	30	Nut		

13-5.3. Crankcase Studding Disassembly

CAUTION: Do not attempt to remove the crankcase oil squirt nozzles, field replacement is not possible.

Studs, dowels and helical inserts should not be removed unless they are found to be damaged. Refer to Appendix C and D for replacement.

1. Remove the applicable plugs and bushing listed in the Appendix D-8.5 to allow pressure flushing of the crankcase. Inspect the plugs for wear; replace worn plugs. Tag the plugs to identify their respective locations for accurate identification during reassembly.

   NOTE: Tag removed crankcase plugs with a label to identify removed location. During crankcase assembly, all plugs must be installed in the same crankcase location from which they were removed to prevent oil pressure loss.

2. Clean the plugs and bushing according to instructions in Chapter 12 of M-0, Standard Practice Maintenance Manual, and perform the inspections specified in Chapter 15.

13-6. Engine Drive Train Disassembly

The engine drive train consists of the camshaft and crankshaft.

13-6.1. Camshaft Disassembly

1. Remove the governor drive gear (Figure 13-10)(2) and woodruff key (3). Discard the woodruff key.

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

2. Cut and remove the safety wire from the bolts (6).
3. Remove the four bolts (6) and the camshaft gear (5). Discard the bolts.
4. Examine the components for evidence of wear; clean the components according to instructions in Chapter 12 of M-0, Standard Practice Maintenance Manual, and perform the inspections specified in Chapter 15.

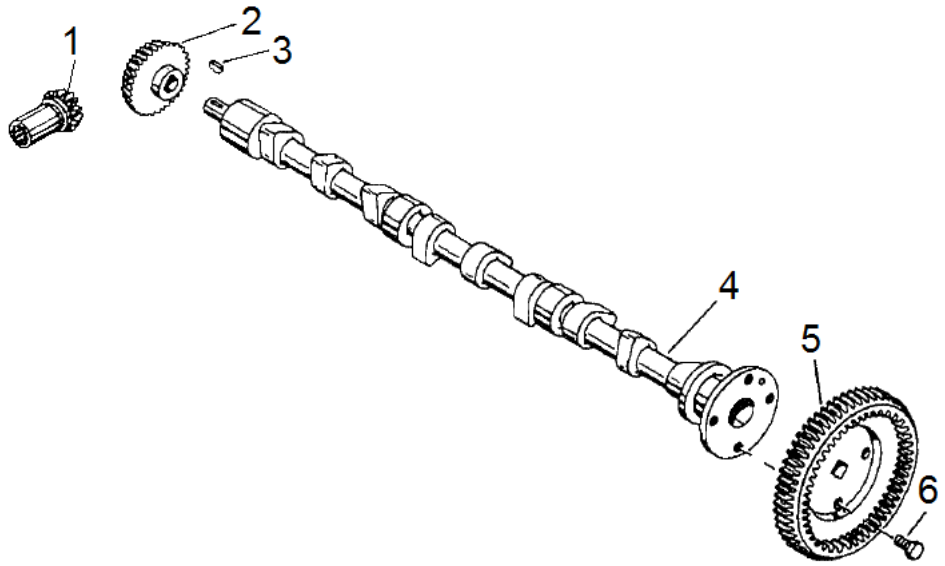


Figure 13-10. Camshaft Disassembly

1	Governor Driven Gear	3	Woodruff Key	5	Camshaft Gear
2	Governor Drive Gear	4	Camshaft	6	Bolt

13-6.2. Crankshaft Disassembly

CAUTION: When disassembling the crankshaft, do not scribe or punch the counterweights and crankshaft to identify locations. Use only tags or ink to identify locations.

NOTE: Leave the counterweights intact. Detailed counterweight removal and disassembly instructions are included in Chapter 15, "Overhaul Inspection and Repair."

1. Place wooden support blocks under the crankshaft (Figure 13-11)(1) front and rear main journals.
2. If equipped, remove cotter pins from nuts (23). Discard the cotter pins.

   NOTE: Some older models use castellated nuts with cotter pins.
3. Remove nuts (23) and bolts (22) from connecting rod assemblies (19). Discard the nuts and bolts.
4. Remove the connecting rod assemblies (19).
5. Remove the connecting rod bearings (20). Discard the bearings.
6. Set the connecting rods and caps aside with the position numbers matched as sets.

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

7. Cut and remove the safety wire from the four bolts (16).
8. Remove and discard the four bolts (16).
9. Remove cluster gear (15) from crankshaft (1).
10. Remove thrust washers (14).
11. Remove bearings (11 and 12). Discard the bearings.

    CAUTION: Do not scratch, mar, or damage the crankshaft while removing the crankshaft nose oil seal.
12. Remove the seal spring (18) from the oil seal (17) groove. Unhook the spring ends using an unwinding motion and discard the oil seal spring.
13. Twist and remove the oil seal (17) from the crankshaft (1). Discard the oil seal.
14. Clean the Gasket Maker residue from the crankshaft (1) using a chlorinated solvent Loctite Chisel or methylene chloride followed by a naphtha solvent such as Loctite ODC-Free Cleaner and Degreaser. Remove all debris to render the crankshaft clean, without any trace debris.
15. Examine the components for evidence of wear; clean the components according to instructions in Chapter 12 of M-0, Standard Practice Maintenance Manual, and perform the inspections specified in Chapter 15.

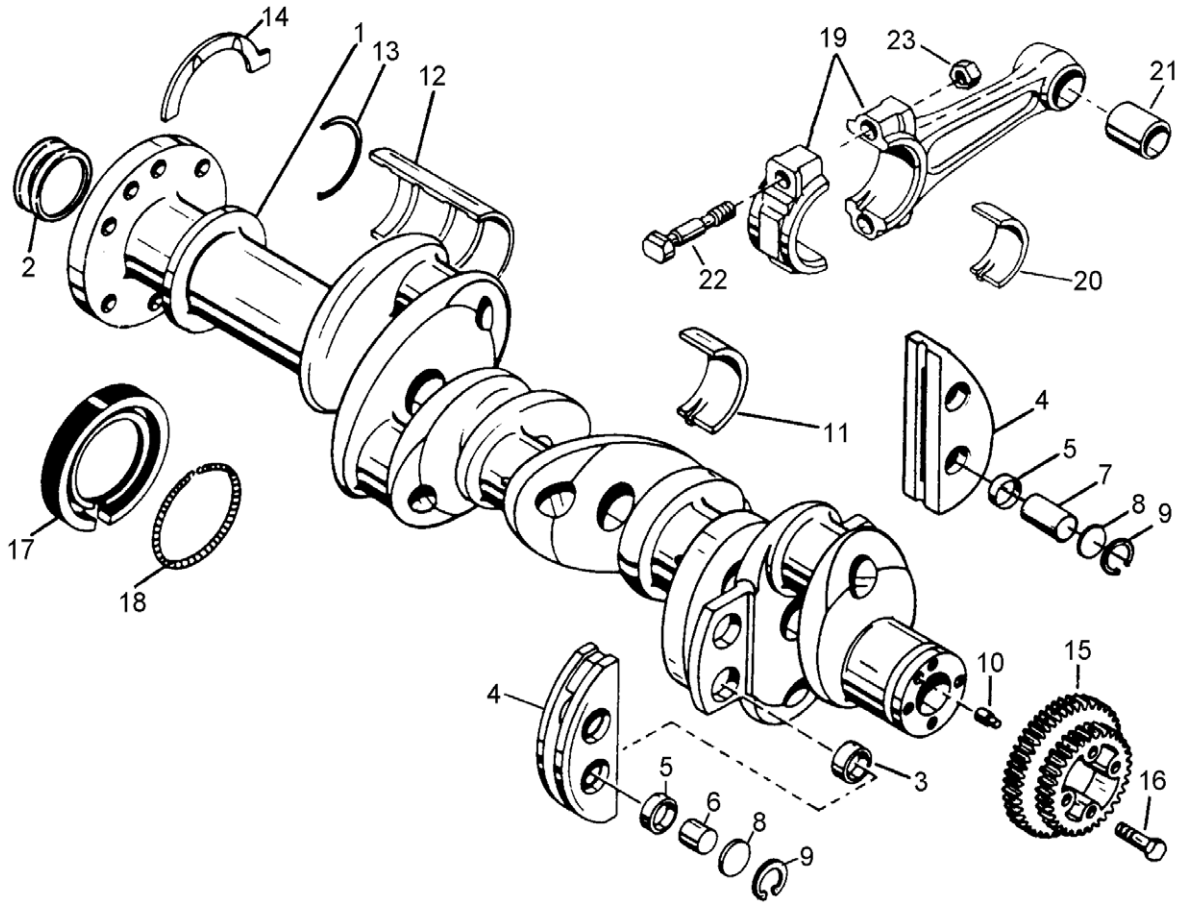


Figure 13-11. Crankshaft Disassembly

1	Crankshaft Assembly	7	Pin - G, H, J and K Models	13	Packing	19	Connecting Rod Assembly
2	Plug	8	Retainer Plate	14	Thrust Washer	20	Bearing
3	Bushing	9	Retaining Ring	15	Cluster Gear	21	Bushing
4	Counterweight	10	Dowel	16	Bolt	22	Bolt
5	Bushing	11	Bearing	17	Oil Seal	23	Nut
6	Pin	12	Bearing	18	Seal Spring		

Chapter 14. Engine Cleaning

14-1. Engine and Component Cleaning

Refer to the "Engine Cleaning" instructions in Chapter 12 of M-0, Standard Practice Maintenance Manual.

WARNING

Consult the manufacturer's Safety Data Sheet (SDS) (formally Material Safety Data Sheet (MSDS)) for specific handling, storage and disposal instructions, including personal protective equipment requirements.

To prevent death or injury, do not smoke or introduce sources of ignition or flame to the work area when using flammable cleaning fluids such as mineral spirits.

Do not use gasoline, kerosene, abrasive cleaning paste, or cleansing powder to clean the engine or engine parts.

Do not pressure blast gears with abrasive media. Blasting will remove surface hardening.

When cleaning with alkaline solutions, remove all traces of alkaline residue to prevent corrosion. Alkaline cleaning solutions induce corrosion if not completely removed.

NOTE: Prior to cleaning engine parts, visually inspect for leakage and metal shavings, rust or other obvious signs of wear.

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Chapter 15. Overhaul Inspection and Repair

15-1. Engine Overhaul Inspection

The Engine Overhaul Inspection consists of inspection procedures in this chapter and checklists in Chapter 11. This inspection applies only to the engines covered in this manual and is intended to support the continued airworthiness of the engine.

15-2. Engine Overhaul Inspection Checklists

Use the Engine Overhaul Inspection Checklists in Chapter 11 as guides for performing the inspections required during engine overhaul. Print a copy of the checklist to record inspection progress and document actions taken during overhaul.

Perform the items on the checklists (in the order listed) on an engine which has been removed from the aircraft, disassembled, and cleaned according to the instructions provided.

15-3. Visual Inspection

Perform a visual inspection on all parts not specified as 100% replacement (Appendix C-2.3 or Appendix C-2.4) at overhaul. Examine parts prior to being cleaned for obvious evidence of wear or leakage. Reject obviously damaged parts during the preliminary visual inspection, there is no need to clean and perform non-destructive inspection on parts which cannot be used. If condition is uncertain, clean with remaining parts after the preliminary exam, according to the "Engine Cleaning" instructions in Chapter 12 of M-0, Standard Practice Maintenance Manual. Verify the parts are clean and free of all dirt, carbon, varnish and gum.

1. Visually inspect the parts according to the "Visual Inspection" instructions in Chapter 11-1 of M-0, Standard Practice Maintenance Manual.
2. Record inspection findings on a copy of the "Engine Overhaul Visual Inspection Checklist" (Table 11-3).

15-3.1. Gear Tooth Inspection

Inspect gears according to the "Gear Tooth Inspection" instructions in Chapter 11-1.1 of M-0, Standard Practice Maintenance Manual.

Discard and replace unacceptable gears. Indicate the need to replace the gear(s) on the "Engine Overhaul Visual Inspection Checklist" (Table 11-3).

15-4. Fluorescent Penetrant Inspection

1. Inspect non-ferrous parts according to the "Fluorescent Penetrant Inspection" instructions in Chapter 11-2 of M-0, Standard Practice Maintenance Manual. Unless Section 15-8 contains specific instructions to remedy unsatisfactory conditions discovered during the inspection, discard parts which exhibit unacceptable conditions.
2. Record inspection findings on a copy of the "Fluorescent Penetrant Inspection Checklist" (Table 11-4).

15-5. Magnetic Particle Inspection

1. Follow the “Magnetic Particle Inspection” instructions in Chapter 11-3 of M-0, Standard Practice Maintenance Manual. Unless Section 15-8 contains specific instructions to remedy unsatisfactory conditions discovered during the inspection, discard parts which exhibit unacceptable conditions.
2. Record repair or replacement requirements on a copy of the “Engine Overhaul Visual Inspection Checklist” (Table 11-3).

15-5.1. Connecting Rod Magnetic Particle Inspection

Perform “Connecting Rod Magnetic Particle Inspection” on connecting rods removed for repair or overhaul according to the instructions in Chapter 11-3.1 of M-0, Standard Practice Maintenance Manual.

15-6. Ultrasonic Inspections

Refer to the “Ultrasonic Inspection” instructions in Chapter 11-4 of M-0, Standard Practice Maintenance Manual.

15-6.1. Ultrasonic Inspection Certification

Refer to the “Ultrasonic Inspection Certification” instructions in Chapter 11-4.1 of M-0, Standard Practice Maintenance Manual.

15-6.2. Crankshaft Ultrasonic Inspection

Refer to “Special Tools” in Chapter 2-1 of M-0, Standard Practice Maintenance Manual, for test equipment requirements and availability.

1. Perform a “Crankshaft Ultrasonic Inspection” on the crankshaft according to the instructions in Chapter 11-4.2 of M-0, Standard Practice Maintenance Manual.
2. Record inspection results on a copy of the “Ultrasonic Inspection Checklist” (Table 11-6).

15-7. Dimensional Inspection

Continental Motors uses new parts dimensions and assembly clearances for engine overhaul. New part dimensions listed in Appendix D are based on product engineering drawings in effect at the time of publication. When authorized oversize or undersize parts are used, the corresponding mating part must also be used to maintain specified clearances.

Clearances in the new part limits apply to mating parts.

WARNING

Only use the Appendix D dimensions during engine overhaul.

CAUTION: Prior to dimensional inspection, ensure the part conforms to all Visual, Fluorescent Penetrant, Magnetic Particle, and Ultrasonic Inspection requirements.

Ensure the parts have been throughly cleaned and dried according to the "Engine Cleaning" instructions in Chapter 12 of M-0, Standard Practice Maintenance Manual.

1. Measure part dimensions in comparison to the dimensional limits specified in Appendix D. Record the measurements on a copy of the "Dimensional Inspection Checklist" (Table 11-7).
2. If the part dimension fits within the minimum and maximum range specified in Appendix D, the part may be re-used during overhaul provided it meets all other inspection requirements.
3. Label each part's inspection status and required action.
4. Record inspection results on a copy of the "Dimensional Inspection Checklist" (Table 11-7).

15-7.1. Crankcase Dimensional Inspection

This inspection verifies the crankcase structural and dimensional integrity.

Equipment Required

- Mechanic's hand tools and calibrated torque wrench
- Inspection light
- Mirror

1. Inspect the exterior of the crankcase halves for cracks. Carefully inspect the entire external surface of the crankcase using an inspection light and mirror. Pay particular attention to areas adjacent to the cylinder mount flanges, lifter guides, case flange, nose seal land and bearing bosses.
2. Look for scoring on the old crankshaft bearings, lifter guides, and camshaft bearings and journals.
3. Inspect the main bearing boss parting surfaces for fretting.
4. Inspect the bearing saddles for elongation of the bearing lock slot and for any indication of bearing movement.
5. Inspect all machined surfaces for nicks and roughness.
6. Perform a “Crankcase Inspection” according to the instructions in Chapter 6-4.12 of M-0, Standard Practice Maintenance Manual.
7. Inspect all crankcase heli-coils and studs for stripped or distorted threads.
8. Inspect studs for corrosion, rusting, pitting, incomplete threads and looseness.
9. Inspect crankcase studs with a tool maker's square for alignment. Check studs for looseness. Check crankcase stud height settings versus Appendix D specifications. Remove, discard and replace non-conforming studs with new studs.

Prerequisites

Prior to the completing the dimensional inspection of the crankcase, crankshaft, and camshaft bores, temporarily assemble and torque the crankcase specifically for this inspection using the torque sequence shown in Figure 15-1.

10. For the preliminary torque, torque the crankcase fasteners in Figure 15-1 to ½ the value specified in Appendix B.
11. Repeat the torque sequence in Figure 15-1 using the full value for the fastener indicated in Appendix B.
12. Measure dimensional clearances for the assembled crankcase in Appendix D, inside and outside dimensions, with bearings out and repeat with bearings installed to check running clearance.
13. Record inspection results on a copy of the “Dimensional Inspection Checklist” (Table 11-7).

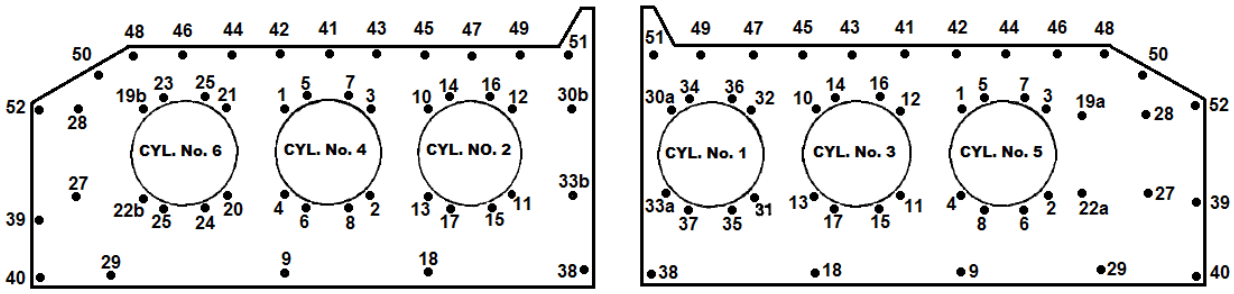


Figure 15-1. Crankcase Dimensional Inspection Torque Sequence

15-7.2. Drive Train Dimensional Inspection

Equipment Required

- A surface plate
- Metal working lathe or two matched V-blocks
- Dial indicator
- Two blocks of ground flat steel stock of equal height
- Leaf-type feeler gauge
- 8-inch long arbors

NOTE: Precise setup is critical for the crankshaft and camshaft dimensional inspections. Pass/fail criteria is measured in thousandths of an inch (0.001”).

1. Center the crankshaft between the headstock and tailstock of a lathe (or place the crankshaft on matched V-blocks, mounted on a surface plate, supporting the front and rear main journals). Check the parallelism at the front and rear main journals with the dial indicator before inspecting runout.
2. Inspect the crankshaft journals and crankpins diameter compared to the new part dimensions in Appendix D. Inspect the circumference of the crankshaft journals and crankpins to ensure the out of round limits in Appendix D are not exceeded.
3. Rotate the crankshaft under a dial indicator placed on the center main journal to detect runout (bending).
4. Rotate the crankshaft propeller flange under a dial indicator to detect runout (bending) at the face and outside diameter of the flange.
5. Inspect the crankshaft hanger blade bushing bore diameter and finish; bushing bores must be smooth and cylindrical. Discard crankshafts with worn, pitted, fretted, or out-of-round bushing bores. Verify the hanger blade bushing bores meet Appendix D-7.3 dimensional specifications.
6. Inspect the camshaft using Appendix D specifications, paying particular attention to lobe and journal dimensions and surface finish. Discard the camshaft if it exhibits nicks, gouges, or excessive wear.
7. Mount the camshaft front and rear main journals on matched V-blocks.
8. Rotate the camshaft under a dial indicator placed on the center main journal to detect runout (bending).

15-7.2.1. Connecting Rod Dimensional Inspection

Refer to "Connecting Rod Dimensional Inspection" instructions in Chapter 10-9.4.1 of M-0, Standard Practice Maintenance Manual.

15-7.2.2. Crankshaft Counterweight Inspection

Equipment Required

- 4% copper sulfate ($CuSO_4$) and water solution (by volume)
- A surface plate
- Two matched V-blocks
- Borroughs P/N 8077C Counterweight Bushing Removal/Installation Fixture, or equivalent

1. Inspect the bump surface as shown in Figure 15-2; bump surface contact marks must not exceed 0.005 inches in depth.
2. Remove and discard counterweight bushings, using the P/N 8077C Counterweight Bushing Removal/Installation Fixture (Chapter 2-1 of M-0, Standard Practice Maintenance Manual).
3. Thoroughly clean the counterweight bushing bore.
4. Verify tuftriding is present on the counterweight assemblies by placing one drop of a 4% copper sulfate ($CuSO_4$) and water solution (by volume) on the cleaned surface of the counterweight bushing bore.
5. Allow at least 15 seconds for the chemical reaction to take place.
6. Formation of red deposits indicates the absence of tuftriding. Discard any counterweight that does not exhibit tuftriding and replace with new counterweights.
7. If no reaction occurs, wipe off copper sulfate/water solution. The counterweight may be re-used during overhaul provided it meets all other inspection requirements.

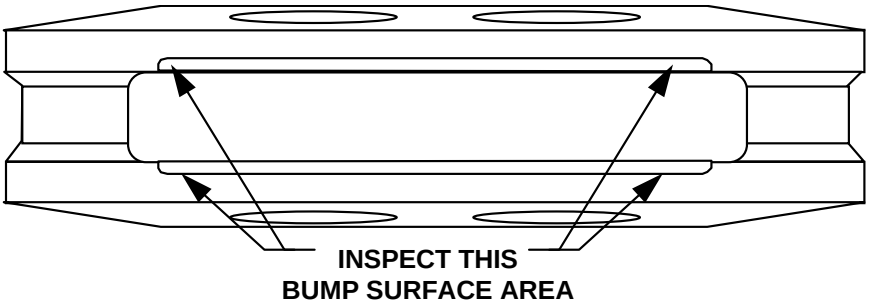


Figure 15-2. Crankshaft Counterweight Bump Surface Inspection

15-7.2.2.1. Crankshaft Counterweight Bushing Bore Inspection

Equipment Required

- Federal Dimension Air Gauge (with appropriate setting ring and air plug) or
- Starrett No. 78 series 3-point contact inside micrometer

1. Verify the counterweight bushing bores are smooth. Discard counterweights with worn, pitted, fretted or out-of-round bushing bores.
2. Use a Federal Dimension Air Gauge (with appropriate setting ring and air plug) or Starrett No. 78 series 3-point contact inside micrometer (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) to measure the bushing bores. Compare the bushing bores specified total indicator reading (T.I.R.) to the dimensional specifications in Appendix D-7. Discard counterweights with bushing bores exceeding the specified dimensions.
3. Carefully inspect the counterweight counterbores for signs of wear in the wall that retains the counterweight pin retaining plates. This area is adjacent to the inside edge of the retaining ring groove. It may appear as an additional step and/or taper of the hole into the retaining ring groove. If wear is evident, discard the counterweight.
4. If no plate wear is evident, check the retaining ring groove in each hole for wear patterns that can affect the retaining ring seating. Any worn condition that may affect retaining ring seating will require replacement of the counterweight.
5. Crankshaft counterweights are matched in pairs with a maximum weight variation of two grams. If either counterweight is damaged, replace the counterweights as a matched pair.
6. Record inspection findings on a copy of the “Engine Drive Train Inspection Checklist” (Table 11-9).

15-7.3. Engine Cylinder Dimensional Inspection

Refer to Appendix D for dimensional limits.

1. Perform the "Cylinder Visual Inspections" according to instructions in Section 6-3.11.1. Replace cylinders that fail the inspection criteria.
2. Inspect the cylinder base flanges for flatness. If a flange exceeds 0.001 inches out-of-flat, replace the cylinder.
3. Inspect cylinder bore dimensions using the appropriate illustrations and tables in Appendix D-6, "Engine Cylinders." Cylinders may be bored and honed (see Section 15-8.8.5, "Cylinder Overhaul Repair"and Section 15-8.8.6, "Cylinder Bore Honing") to meet the standard size dimensions in Appendix D to the next authorized oversize dimension.
4. Dimensionally inspect the intake flange studs, exhaust flange studs and rocker hold down studs using a thread gauge. Determine the appropriate oversize stud if replacement is required.
5. If the intake flange studs have been removed, dimensionally inspect the stud holes using a thread gauge. Determine the appropriate oversize stud for replacement.
6. Dimensionally inspect the inside diameter and geometry of the valve guides. Valve guide dimensions must be within specifications the entire length of the guide. Replace worn or non-conforming valve guides.
7. Inspect the intake and exhaust valve seats for indications of burning, pitting, erosion or cracks. Check the valve seat dimensions according to Appendix D specifications. Regrind or replace valve seats which do not conform to Appendix D specifications or are cracked, eroded, burned or pitted.
8. Inspect the push rods for cracks, nicks, burrs, pitting or corrosion. Inspect the push rod caps for cracks or erosion. Verify the push rod cap oil passages are clear and the bores meet Appendix D specifications. Dimensionally inspect the push rods length and cap diameter with a micrometer and Appendix D specifications. Inspect runout with V-blocks and an air gauge according to Appendix D specifications.
9. Inspect push rod housings for cracks, dents, bends or chafing damage. Discard push rod housings exhibiting these conditions.
10. Inspect push rod housings for rust, pitting or missing cadmium plating. Discard push rod housings exhibiting these conditions.
11. Dry fit the rocker arms in the rocker arm boss to dimensionally inspect the rocker arm thrust width. Refer to the overhaul tolerances in Appendix D and verify that the thrust width specified for the engine being overhauled conforms to Appendix D specifications.
    a. Inspect the rocker arm foot contact area for wear, galling, spalling, scoring or grooves. Discard rocker arms exhibiting these conditions.
    b. Inspect the rocker arm ball seats for wear and smoothness. Discard rocker arms with gouged, scratched, etched, pitted or mushroomed ball seats.

c. Inspect the thrust surfaces of the rocker arm shaft bore for displaced metal, spalling or galling. Discard rocker arms exhibiting these conditions.

d. Inspect rocker arm exhibiting peeling copper plating, which can be a source of contamination in oil and spectrographic oil analysis. Use a scotch-brite pad to remove loose copper plating material.

e. Inspect for and discard rocker arms with loose or missing oil passage drive screws. Inspect oil passages for obstructions. Use an oil squirt bottle with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual) to check oil passages for free flow. Discard rocker arms with blocked oil passages which cannot be cleared with solvent.

12. Record inspection results on a copy of the "Engine Cylinder Overhaul Inspection Checklist" (Table 11-8).

15-7.4. Starter Adapter Dimensional Inspection

Inspect the starter adapter and accessory drive adapter for wear and damage. Replace worn or damaged parts in addition to the items listed in the "Mandatory Overhaul Replacement Parts" in Appendix C-2.4. Inspect the starter, starter adapter and accessory drive adapter parts using the dimensional limits in Appendix D-3.

1. Perform a "Gear Tooth Inspection" according to Section 15-3.1 on the worm gear, starter shaft gear and starter gear assembly. If the teeth are worn, broken or show evidence of excessive wear, replace the non-conforming gear.

2. Inspect the surface of the gear and shaft assembly for corrosion, nicks, gouges or pitting. Inspect the inner and outer retaining ring grooves for gouges or worn edges. If any of these conditions exist, replace the gear and shaft assembly.

3. Inspect oil passages for obstructions. Use an oil squirt bottle with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual) to check oil passages for free flow. Discard component with blocked oil passages which cannot be cleared with solvent.

4. Inspect bushings for cracks, nicks, gouging and wear. Bushing bores must be smooth. On flanged bushing ensure retaining pin is present and flush with surface. Bushings must meet dimensional limits in Appendix D-3. If bushings do not meet limits, replace component.

5. Inspect the starter adapter housing, bores, shafts and gear assemblies, using the dimensional limits in Appendix D-3.

6. Record inspection results on a copy of the "Dimensional Inspection Checklist" (Table 11-7).

15-7.5. Lubrication and Accessory Case Dimensional Inspection

1. Perform a "Gear Tooth Inspection" on the oil pump gears according to Section 15-3.1. Replace worn or damaged gears.

2. Inspect the lubrication and accessory case components according to the dimensional specifications in Appendix D-5.

3. Inspect the oil pump cavity for scoring. Verify the oil pump gears and accessory case oil pump cavity meet Appendix D dimensional specifications. Replace the accessory case if it fails to meet the dimensional limits.
4. Test the oil pressure relief valve springs and oil temperature control valve for proper tension according to Appendix D-5.
5. Record inspection results on a copy of the "Dimensional Inspection Checklist" (Table 11-7).

15-7.6. Alternator Drive Hub (1 Piece) Slippage Inspection

NOTE: This procedure only applies to the direct drive alternator. The alternator drive hub single piece coupling is designed to slip when abnormal torque is required to rotate the alternator shaft.

NOTE: Some alternators use a single piece coupling, identify the type of coupling used by alternator by referring to the illustrated parts catalog.

NOTE: Perform the drive hub slippage inspection on the *new* drive hub before installation at engine overhaul.

1. Perform a "Gear Tooth Inspection" according to instructions in Section 15-3.1 on the alternator drive hub gear. Discard and replace unacceptable drive hubs.

   CAUTION: Secure only the outer diameter of the drive hub assembly; allow the gear freedom of movement to prevent shearing the elastomer coupling.

2. Secure the outer hub of the new alternator drive coupling in the jaws of a shielded vise, leaving the gear section free.
3. Install the "Alternator Drive Hub Torque Tool" (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) over the drive hub gear and apply 100 inch-pounds of torque to the drive gear. No slippage is allowed at or below 100 inch-pounds of torque. Replace the drive coupling, if slippage is detected.
4. Inspect the alternator drive coupling assembly for shearing or tearing of the elastomeric (rubber) element. Replace coupling if damage is observed.
5. Record inspection results on a copy of the "Engine Overhaul Visual Inspection Checklist" (Table 11-3).

15-7.7. Throttle and Mixture Control Lever Inspection

1. Refer to the "Throttle and Mixture Control Lever Inspection" instructions in Chapter 6-4.18 of M-0, Standard Practice Maintenance Manual.
2. Record inspection results on a copy of the "Engine Overhaul Visual Inspection Checklist" (Table 11-3).

15-7.8. Exhaust System Inspection

NOTE: Clean parts prior to the visual inspection.

Inspect exhaust system components according to the aircraft maintenance manual.

15-7.9. Stud Height Dimensional Inspection

1. Inspect studs listed in Table 15-1 for damage, corrosion and security. Measure stud heights, using the measurements in Appendix D-8. Replace studs that fail the inspection criteria.
2. Record inspection results on a copy of the "Dimensional Inspection Checklist" (Table 11-7).

Table 15-1. Stud Height Settings

Illustration and Tables in Appendix D-8 provide stud sizes and heights for the items listed below. Items in the tables match the referenced item numbers in the illustrations.	
Inspection Item	Inspect for:
Alternator	• Inspect the studs for corrosion, distortion, stripped or incomplete threads, or looseness. • Check the stud alignment using a tool maker's square. • Studs should measure within the limits provided in Appendix D-8. • Replace unserviceable studs according to instructions in Appendix C-6. • If studs installed in heli-coil inserts are loose, the heli-coil insert may require replacement according to instructions in Appendix C-5.
Oil Filter Adapter	
Starter Adapter	
Oil Pump Cover	
Crankcase	
Cylinder	
Magneto	

15-8. Overhaul Repair

15-8.1. Fuel Injection System Overhaul Repair

NOTE: Continental Motors fuel injection system parts overhaul procedures require specialized test equipment beyond the scope of this manual. Continental Motors offers new and rebuilt fuel pumps, fuel manifold valves and throttle bodies which meet new part specifications. Fuel injection system parts overhaul must be accomplished in compliance with FAA approved procedures. Continental Motors does not control FAR Part 145 Repair Station activities; verify the Repair Station qualifications before contracting fuel injection system parts overhaul.

1. Collect the fuel injection system parts identified in Appendix C-2, “Replacement Parts”, Appendix C-2.3, “100% Parts Replacement Requirements” and Appendix C-2.4, “Mandatory Overhaul Replacement Parts” to prepare for fuel injection system assembly.
2. Install a new or factory rebuilt fuel pump, throttle and control assembly and fuel manifold valve or have the components overhauled by a FAR Part 145 Authorized Repair Station. If the components will be overhauled, replace brass throttle and mixture control levers with the stainless steel equivalents.
3. Inspect fuel injection tubes for serviceability:
   a. Inspect rigid fuel injection tubes, including the flared ends for leaks or physical damage. Inspect the length of the tubes for sharp bends, cracks, dents, gouges, chafing or corrosion which may lead to fuel leaks. Discard and replace fuel injection tubes exhibiting any of these conditions.
   b. Inspect the condition of the fuel injection tube B-nuts. The B-nut shoulders must be intact, not worn or stripped. Wrenches must fit snugly on the nut for proper torque. B-nut threads must be clearly defined; stripped threads can lead to fuel leaks. Discard and replace fuel injection tubes exhibiting damaged B-nuts.
   c. Check the condition and placement of fuel injection line protectors, if included in the engine model configuration. Line protectors align with the tube clamps to inhibit friction at the attaching points. Reposition or replace the damaged line protectors on rigid fuel injection tubes.
   d. Clean all serviceable fuel injection system components intended for reuse according to the instructions in Chapter 12 of M-0, Standard Practice Maintenance Manual, to remove debris and prevent fuel injection system contamination.

15-8.2. Induction System Overhaul Repair

Collect the induction system parts identified in Appendix C-2, “Replacement Parts”, Appendix C-2.3, “100% Parts Replacement Requirements” and Appendix C-2.4, “Mandatory Overhaul Replacement Parts” to prepare for induction system assembly.

15-8.2.1. IO-360-AF, ES Induction Manifold Overhaul Repair

1. Verify the induction manifold has been thoroughly cleaned according to Chapter 12 of M-0, Standard Practice Maintenance Manual.
2. Apply a liberal coating of P/N 658493 sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to one side of a new bumper pad (Figure 15-3)(4) and install the new bumper pad in the center of the valley on the bottom of the induction manifold 2.60” behind the flange to absorb vibration.

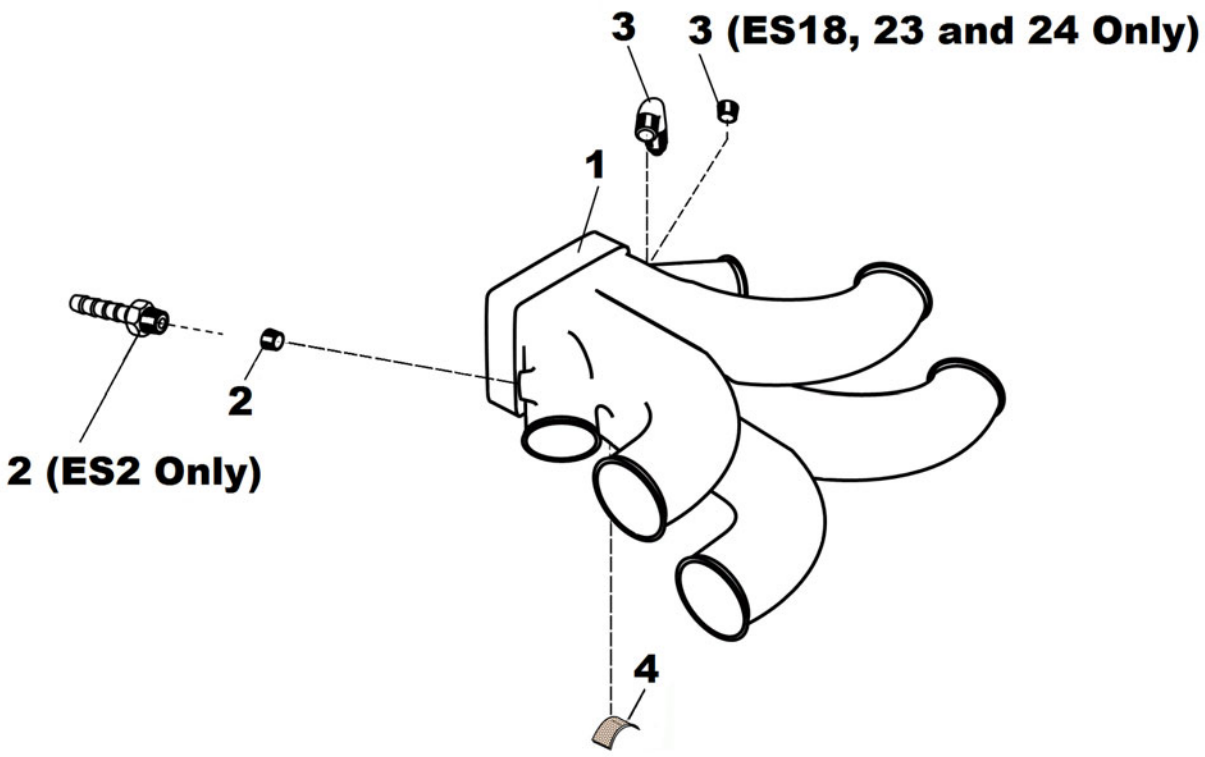


Figure 15-3. Induction Manifold Fittings

NOTE: Fitting size and orientation vary by engine model and specification. Consult the Illustrated Parts Catalog for the engine being assembled on www.continentalmotors.aero for fitting configuration.

3. Refer to the notes taken during induction manifold disassembly for fitting size and orientation. Apply P/N 646940 F/I sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to all except the first two threads of the fittings and install them in the induction manifold ports according to your notes.

15-8.3. Alternator Overhaul

1. Overhaul Continental Motors alternators according to the latest revision of the Alternator Service Manual, X30531 (see Table 1-1). Replace non-Continental Motors alternators with a new unit or a unit which has been overhauled according to FAA approved procedures.
2. Collect the alternator parts identified in Appendix C-2, “Replacement Parts”, Appendix C-2.3, “100% Parts Replacement Requirements” and Appendix C-2.4, “Mandatory Overhaul Replacement Parts” to prepare for alternator assembly.
3. If the engine is equipped with the belt-driven optional alternator brackets, collect the necessary parts specified in Appendix C-2, “Replacement Parts”, Appendix C-2.3, “100% Parts Replacement Requirements” and Appendix C-2.4, “Mandatory Overhaul Replacement Parts” to prepare for alternator assembly.

15-8.4. Starter, Starter Adapter and Accessory Drive Adapter Overhaul Repair

1. Overhaul the Continental starter motor according to the latest revision of the Continental Motors Starter Service Manual, X30592 (see Table 1-1). Replace non-Continental starters with a new unit or a unit which has been overhauled according to FAA approved procedures.
2. During overhaul, replace the following parts:
   a. Starter adapter housing worm shaft needle bearing according to instructions in Section 15-8.4.1.
   b. Shaft gears, worm wheel gears, worm gears or worm gear shafts exhibiting wear, cracks or missing material.
   c. Worm scavenge pump covers on the starter adapter/accessory drive adapter assembly.
   d. Collect the necessary starter adapter and accessory drive adapter parts identified in Appendix C-2, “Replacement Parts”, Appendix C-2.3, “100% Parts Replacement Requirements” and Appendix C-2.4, “Mandatory Overhaul Replacement Parts” to prepare for starter adapter and accessory drive adapter assembly.

15-8.4.1. Starter Adapter Housing Worm Shaft Needle Bearing Replacement

Press the new needle bearing (Figure 15-4)(4) into position until it is thirty thousandths (0.030) of an inch below the inner surface, using the Needle Bearing Installer Tool or equivalent (Chapter 2-1 of M-0, Standard Practice Maintenance Manual).

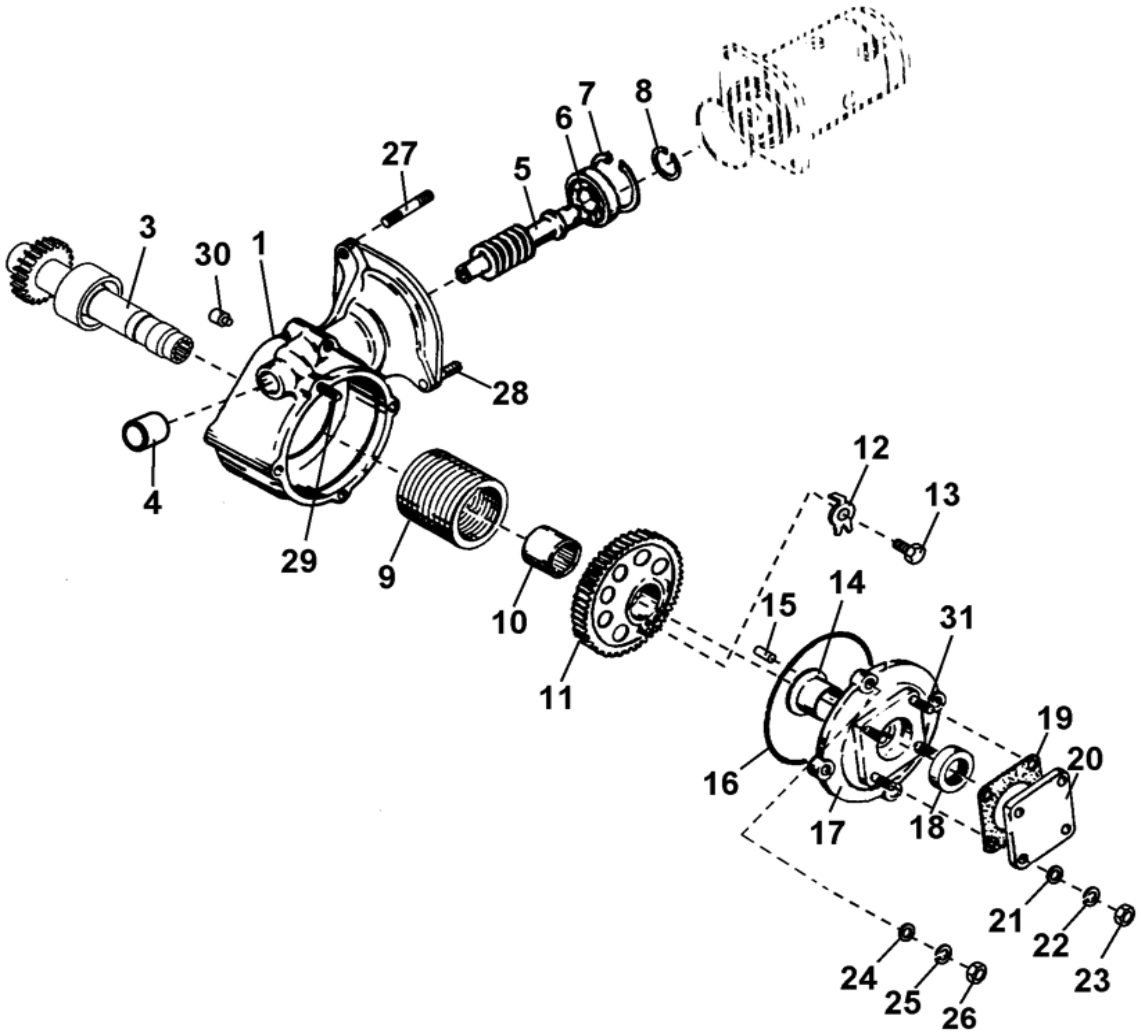


Figure 15-4. Starter Adapter

15-8.5. Ignition System Overhaul

Replace Champion (Slick) magnetos with new units, or units which have been overhauled according to FAA approved procedures. Overhaul Continental magnetos according to the latest revision of the Magneto Service Manual (X42002) (S-20/S-200 series magnetos).

15-8.5.1. Magneto Drive Gear Overhaul Repair

1. Remove coupling retainer (Figure 15-6)(6) from magneto drive gear assembly (1).
2. Press out drive gear sleeve (5), thrust washer (3) and needle bearing (2) from drive gear (4), using arbor press and correct size drift. Discard thrust washer and needle bearing.
3. Perform a "Gear Tooth Inspection" according to Section 15-3.1 on the drive gear (4). If the teeth are worn, broken or show evidence of excessive wear, replace the non-conforming gear.
4. Inspect the surface of the gear for corrosion, nicks, gouges, or pitting. If any of these conditions exist, replace the gear.
5. Inspect the drive gear (4), coupling retainer (6) and drive gear sleeve (5), using the dimensional limits in Appendix D-3. If not within dimensional limits, replace parts.
6. Record inspection results on a copy of the "Dimensional Inspection Checklist" (Table 11-7).
7. Press the new needle bearing (2) into position until it is flush with the edge of drive gear (4), using the Needle Bearing Installer Tool or equivalent (Chapter 2-1 of M-0, Standard Practice Maintenance Manual).
8. Press in new thrust washer (3) and drive gear sleeve (5) until they mate with needle bearing (2), using arbor press and correct size drift. Refer to Figure 15-5.
9. Install coupling retainer (6) onto magneto drive gear assembly (1).
10. Install coupling bushings (7) into coupling retainer (6).

    NOTE: Bushings rounded edge should be face up.

    CAUTION: Do not apply more than a thin film of Molyshield Grease.

11. Apply a thin film of Molyshield Grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the slot and top face of coupling bushings (7).
12. Apply Molyshield Grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to drive gear (1) teeth and needle bearing (2).

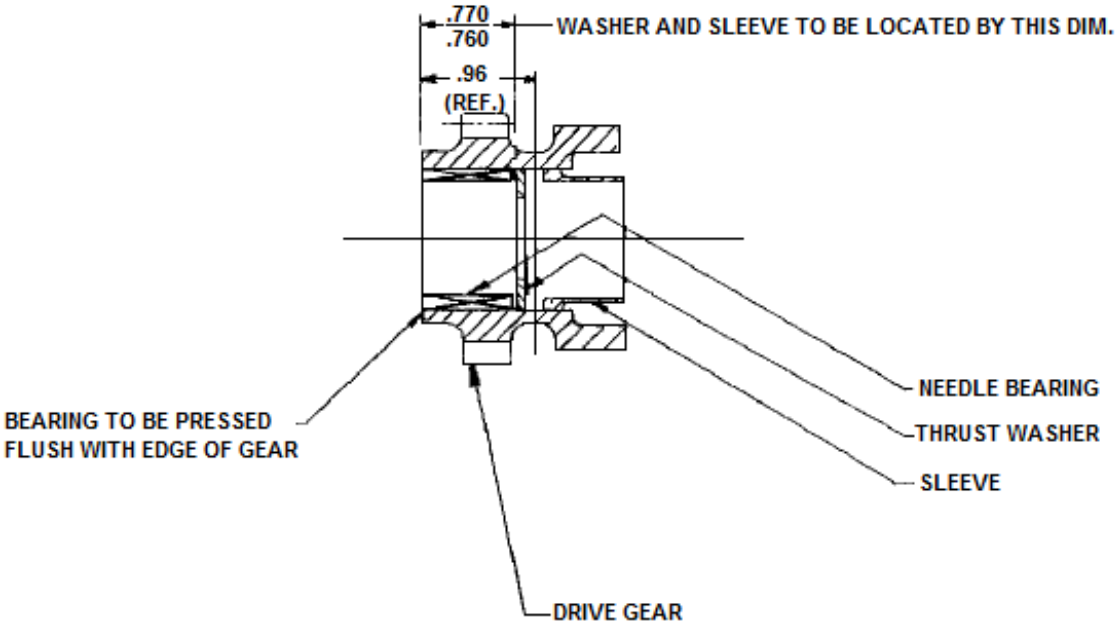


Figure 15-5. Magneto Drive Gear Press Fit

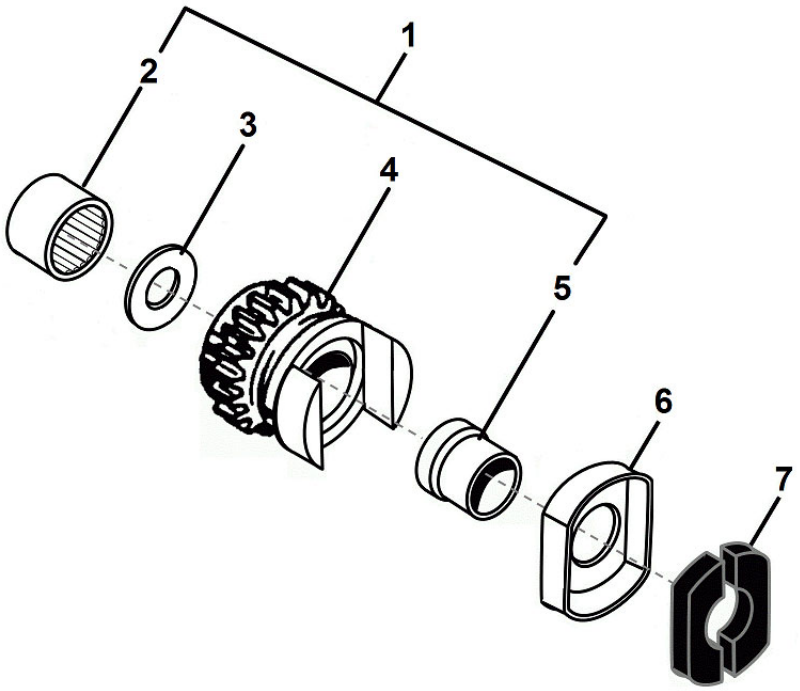


Figure 15-6. Magneto Drive Gear Assembly

1	Magneto Drive Gear Assembly	3	Thrust Washer	5	Drive Gear Sleeve	7	Coupling Bushing
2	Needle Bearing	4	Drive Gear	6	Coupling Retainer		

15-8.6. Exhaust System Overhaul

Replace exhaust manifold gaskets and nuts with new components for overhaul assembly. Overhaul the exhaust system according to the aircraft maintenance manual.

15-8.7. Lubrication System Overhaul

1. Reface the oil pressure relief valve according to instructions in Section 15-8.7.2, "Oil Pressure Relief Valve Seat Repair."
2. Collect the lubrication system parts identified in Appendix C-2, "Replacement Parts", Appendix C-2.3, "100% Parts Replacement Requirements" and Appendix C-2.4, "Mandatory Overhaul Replacement Parts" to prepare for lubrication system assembly.

15-8.7.1. Oil Cooler Overhaul Repair

NOTE: The oil cooler must be cleaned by an appropriately rated repair station (i.e. FAA Part 145 Repair Station). No structural repairs are allowed on the oil cooler. Replace an oil cooler that has structural damage, bent/broken or cracked cooling fins with a new or serviceable oil cooler. Weld repairs to the oil cooler mounting flange are permitted only by an appropriately rated repair station (i.e., FAA Part 145 Repair Station).

The oil cooler must be cleaned and overhauled by an appropriately rated repair station (i.e. FAA Part 145 Repair Station). No structural repairs are allowed on the oil cooler. Replace any cooler that has structural damage, bent/broken or cracked cooling fins with a new or serviceable oil cooler. Weld repairs to the oil cooler mounting flange are permitted only by an appropriately rated repair station (i.e. FAA Part 145 Repair Station).

15-8.7.2. Oil Pressure Relief Valve Seat Repair

Reface the accessory case oil pressure relief valve seat by applying light finger pressure with an Borroughs P/N 8048 Oil Pressure Relief Valve Spot Facer (Chapter 2-1 of M-0, Standard Practice Maintenance Manual). Do not exceed the 0.06 inch depth to maintain 1.19 inch distance shown in Figure 15-7 after refacing.

Clean the oil pressure relief cavity after refacing the oil pressure relief valve seat according to the "Engine Cleaning" instructions in Chapter 12 of M-0, Standard Practice Maintenance Manual. No debris is permitted in the oil pump housing at assembly.

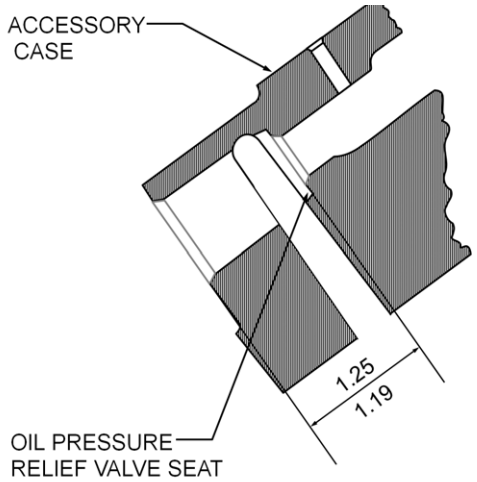


Figure 15-7. Oil Pressure Relief Valve

15-8.7.3. Oil Filter Adapter Stud Replacement

NOTE: This procedure applies only to screw-on type oil filters.

If the oil filter adapter stud is a plain steel color and is 1.440 inches long and/or if the stud is loose or below the height specified in Figure 15-8, replace the oil filter adapter stud:

1. Remove the oil filter adapter stud.
2. Inspect the adapter housing threads for damage or cracks. If thread damage or cracks are evident, replace the adapter housing.
3. Clean the adapter housing threads thoroughly to remove all adhesive or oil residue.
4. Temporarily install the new oil filter adapter stud in the oil filter adapter to check fit.
5. Verify the incomplete thread of the new stud stops at the first thread in the adapter housing and does not extend into the housing below the minimum 0.500-inch extension. If the stud extends deeper in the housing than the 0.500-inch minimum, replace the adapter housing.
6. Remove the oil filter adapter stud from the adapter housing.
7. Clean the adapter housing and stud threads with P/N 653693 Loctite 7471 Primer (Chapter 3 of M-0, Standard Practice Maintenance Manual) and allow to dry.
8. Apply a line of P/N 646941 Loctite 271 High Strength Adhesive/Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) along the large threads (0.8125-16 end) of the oil filter adapter stud.
9. Install and torque the oil filter adapter stud to Appendix B specifications.
10. Confirm the installed oil filter adapter stud matches the illustration in Figure 15-8.
11. Allow the parts to cure at least 30 minutes prior to oil filter installation. Curing times may vary depending on ambient temperature. Consult the Loctite instructions.
12. Stamp a 0.125-inch high letter “S” in the adapter housing, as shown in Figure 15-9, to indicate a new oil filter adapter stud has been installed in the adapter housing.

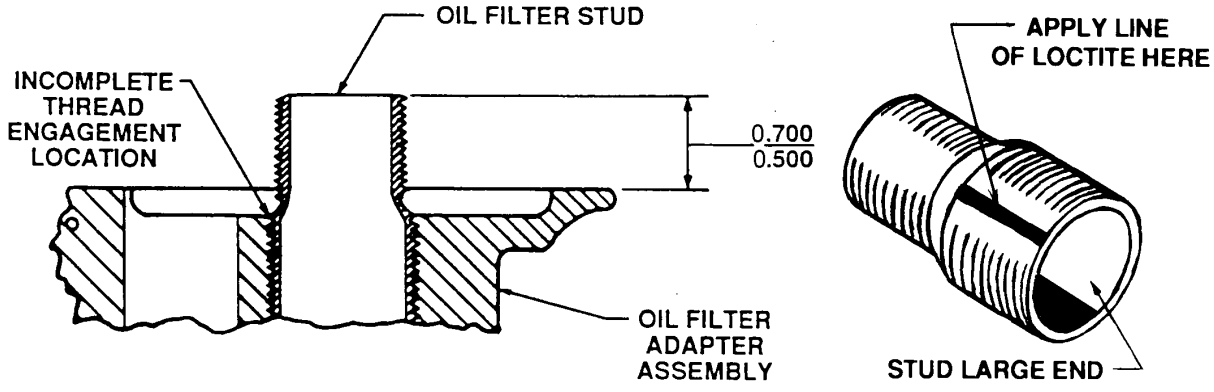


Figure 15-8. Oil Filter Adapter Stud

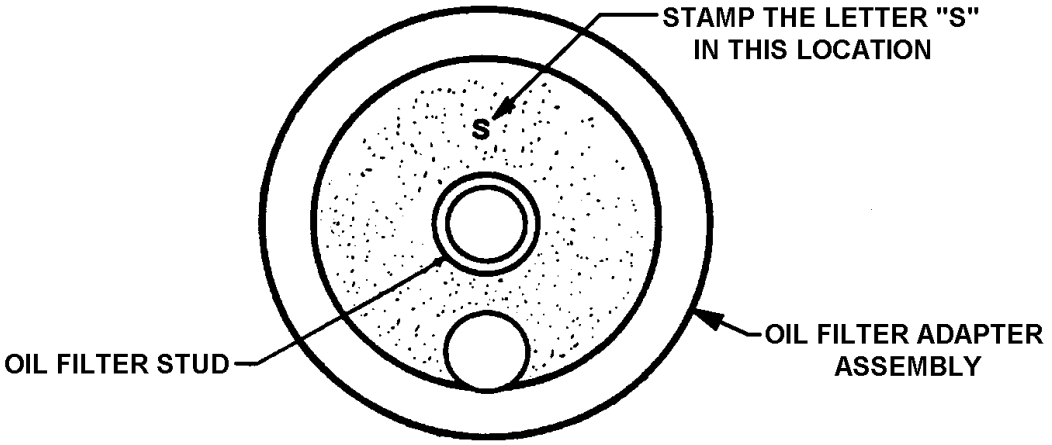


Figure 15-9. Identification of Oil Filter Adapter Stud Modification

15-8.8. Cylinder Overhaul Repair

This procedure applies to overhauling all engine cylinders at the same time while the engine is disassembled and removed from the aircraft. Engine cylinders must be leak checked, removed, cleaned and inspected.

Before performing any cylinder overhaul repair, establish a baseline inspection point for cylinder head-to-barrel movement and inspect the baseline throughout cylinder rework procedures to verify joint integrity is not compromised.

1. Mask off a ¼-inch wide X 1-inch high area across the cylinder head to the barrel junction on the intake port side of the cylinder.
2. Apply a heavy coat of high temperature paint.
3. Allow the paint to dry thoroughly.
4. Remove the masking material.
   Once the baseline inspection point is established, proceed as follows:

   WARNING

   Do not use a torch to heat the cylinder assembly. Heat the cylinder using uniform heating methods only. After heating the cylinder assembly, do not bump the head or barrel which could cause movement in this area. Inspect the cylinder assembly to ensure the cylinder head did not turn in relation to the barrel. Movement of the cylinder head in relation to the barrel destroys the assembly preload; discard the cylinder.

5. Heat soak the cylinder assembly via a uniform heating method to 450°F (232°C) for one hour.
6. Verify no cylinder head-to-barrel movement by referring to the baseline inspection point. Discard cylinder assemblies exhibiting head-to-barrel movement.

15-8.8.1. Cylinder Repair versus Replacement Guidelines

Refer to Chapter 10-6 in M-0, Standard Practice Maintenance Manual, to determine if the cylinder is repairable or requires replacement.

15-8.8.2. New Cylinder Position Numbers

Refer to "Cylinder Position Numbers" instructions in Chapter 10-6.2 of M-0, Standard Practice Maintenance Manual.

15-8.8.3. Cylinder Head Repair

Refer to "Cylinder Head Repair" instructions in Chapter 10-6.3 of M-0, Standard Practice Maintenance Manual.

15-8.8.4. Cylinder Fin Tip Repair

Refer to "Cylinder Fin Tip Repair" instructions in Chapter 10-6.4 of M-0, Standard Practice Maintenance Manual.

15-8.8.5. Cylinder Barrel Repair

Refer to "Cylinder Barrel Repair" instructions in Chapter 10-6.5 of M-0, Standard Practice Maintenance Manual.

15-8.8.6. Cylinder Bore Honing

Perform this procedure under any of the following circumstances:

- after grinding a cylinder barrel
- when replacing piston rings
- to restore the cylinder bore cross hatch pattern

1. Hone the cylinder bore using a wet honing process and hone stones that will produce a surface finish as specified in Table D-9.
2. Inspect the cylinder barrel wall for corrosion, pitting and scoring. Discard any cylinder exhibiting any of these unacceptable, non-conforming conditions.
3. Measure the surface finish using a contact profilometer.
4. After wet honing, the bore finish must show a cross hatch pattern. The included angle of the cross hatch measured perpendicular to the axis of the cylinder is 22°-32°. Inspect the hone pattern taken at 100X magnification. An acceptable cross hatch pattern must be cleanly cut and free of torn and folded metal.

   NOTE: Honed turnaround areas up to 0.5 inch from the skirt and barrel stop are exempt from cross hatch angle requirements.
5. After honing, clean the cylinder thoroughly using hot soapy water and a stiff bristled scrub brush to remove all honing material from the cylinder.
6. Rinse the cylinder with hot water to remove soap residue.
7. Dry the cylinder completely; repeat step 2 to verify serviceability. If the honed cylinder passes inspection, thoroughly coat the cylinder bare steel surfaces with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
8. The surface finish of the cylinder barrel bore must conform to the specifications listed in Table D-9.

15-8.8.7. Valve Seat Removal

Equipment Required

- Borroughs P/N 8086 Valve Seat Insert Remover and Replacer Tool, or equivalent
- Borroughs P/N 5221B Cylinder Holding Fixture, or equivalent
- Borroughs P/N 5221-13A Holding Fixture Adapter, or equivalent
- Borroughs P/N 8122A Common Drive Handle, or equivalent
- Valve stem or valve guide hole pilot of correct size
- Valve seat boss cutter equal in size to the new valve seat outside diameter
- Universal Drive from Borroughs P/N 8116 Common Parts Kit, or equivalent
- Heavy duty drill press

1. Inspect the cylinder head to barrel junction baseline (Section 15-8.8). Discard cylinders exhibiting movement.

WARNING

Do not use a torch to heat the cylinder assembly. Heat the cylinder using uniform heating methods only. After heating the cylinder assembly, do not bump the head or barrel which could cause movement in this area. Inspect the cylinder assembly to ensure the cylinder head did not turn in relation to the barrel. Movement of the cylinder head in relation to the barrel destroys the assembly preload; discard the cylinder.

2. Heat soak the cylinder assembly via a uniform heating method to 450°F (232°C) maximum for one hour.
3. While the cylinder is still hot, use the correct special tool to remove the worn valve seat(s).
4. Allow the heated cylinder to cool to room temperature.
5. Inspect the valve seat bore for cracks and erosion. Discard any cylinder with a cracked valve seat bore or a valve seat bore that has eroded beyond the allowable valve seat oversize bore repair.
6. Select the proper size valve seat bore cutter based on the new valve seat insert outside diameter (see Appendix D-6).
7. Install the cylinder in the Cylinder Holding Fixture.
8. Using the specified special tools, machine the valve seat bore(s) to the correct diameter. Do not exceed the new part (overhaul) tolerances specified in Appendix D for the respective intake and/or exhaust valve seat illustrations as applicable.
9. Deburr the valve seat bore and clean the cylinder removing all debris created during the machining procedure.
10. Inspect and record the valve seat bore inside diameter and new valve seat outside diameter on a copy of the “Engine Cylinder Overhaul Inspection Checklist” (Table 11-8). Refer to Appendix D for the valve seat dimensional limits.
11. Install a new valve seat according to Section 15-8.8.8, “Valve Seat Installation.”

15-8.8.8. Valve Seat Installation

1. Inspect the cylinder head to barrel junction baseline (Section 15-8.8). Discard cylinders exhibiting movement.

WARNING

Do not use a torch to heat the cylinder assembly. Heat the cylinder using uniform heating methods only. After heating the cylinder assembly, do not bump the head or barrel which could cause movement in this area. Inspect the cylinder assembly to ensure the cylinder head did not turn in relation to the barrel. Movement of the cylinder head in relation to the barrel destroys the assembly preload; discard the cylinder.

2. Heat soak the cylinder assembly via a uniform heating method to 450°F (232°C) maximum for one hour.
3. Install the cylinder in the Cylinder Holding Fixture.

WARNING

Misaligned or improperly installed valve seat(s) will cause valve leakage and burning.

4. While the cylinder is hot, install the valve seat firmly against the bottom of the valve seat bore using the required special tools.
5. Perform a “Fluorescent Penetrant Inspection” (Section 15-4) on the cylinder head to verify no cracks developed during valve seat installation.

15-8.8.9. Valve Guide Removal

Equipment Required

- Borroughs P/N 5221B Cylinder Holding Fixture, or equivalent
- Borroughs P/N 5221-15A Holding Fixture Adapter, or equivalent
- Borroughs P/N 4981 Valve Guide Remover, or equivalent
- Borroughs P/N 8116-1R through 15R Reamers, or equivalent
- Borroughs P/N 8116-1 through 16 Expanding Guide Bodies, or equivalent
- Borroughs P/N 3170 Floating Holder, or equivalent
- Proper size Morse adapter
- Heavy duty drill press

1. Inspect the cylinder head to barrel junction baseline (Section 15-8.8). Discard cylinders exhibiting movement.
2. Install the Cylinder Holding Fixture (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) in drill press. Index the Cylinder Holding Fixture to the proper angle.
3. Install the proper size head on the Valve Guide Remover (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) and attach the assembly to a cold water supply.

WARNING

Do not use a torch to heat the cylinder assembly. Heat the cylinder using uniform heating methods only. After heating the cylinder assembly, do not bump the head or barrel which could cause movement in this area. Inspect the cylinder assembly to ensure the cylinder head did not turn in relation to the barrel. Movement of the cylinder head in relation to the barrel destroys the assembly preload; discard the cylinder.

4. Heat soak the cylinder assembly via a uniform heating method to 450°F (232°C) maximum for one hour.
5. Install the cylinder in the Cylinder Holding Fixture.
6. Install the pilot into the valve guide.
7. Hold the Valve Guide Remover down firmly pressed into guide bore with one hand and the other hand on the water release mechanism.
8. Release the water and drive out the valve guide while water is running.
9. Repeat steps 1 through 8 to remove the remaining valve guide.
10. Allow the cylinder to cool to room temperature.
11. Measure the cylinder head valve guide bore and select the proper size reamer.

CAUTION: Always ream the guide bore to the proper size.

12. Ream the cylinder head valve guide bore to the required size.
13. Deburr the valve guide bore and clean the cylinder; remove all machining debris.

    NOTE: The guide bore must be free of grooves.

14. Inspect the new valve guide inside diameter to verify it meets Appendix D specifications.

15-8.8.10. Valve Guide Installation

1. Inspect the cylinder head to barrel junction baseline (Section 15-8.8). Discard cylinders exhibiting movement.
2. Apply a small amount of Lubriplate 930AA (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the outside diameter of the valve guide to prevent binding during installation.

WARNING

Do not use a torch to heat the cylinder assembly. Heat the cylinder using uniform heating methods only. After heating the cylinder assembly, do not bump the head or barrel which could cause movement in this area. Inspect the cylinder assembly to ensure the cylinder head did not turn in relation to the barrel. Movement of the cylinder head in relation to the barrel destroys the assembly preload; discard the cylinder.

3. Heat soak the cylinder assembly via a uniform heating method to 350°F (177°C) maximum.
4. Install the cylinder in the Cylinder Holding Fixture (Chapter 2-1 of M-0, Standard Practice Maintenance Manual).
5. While the cylinder is hot, install the new valve guides:

   CAUTION: The intake and exhaust valve guides are different and must be installed in the correct positions.

   CAUTION: Never install an oversize valve guide in a standard size valve guide bore.

   a. Install the exhaust valve guide in the side of the cylinder with the smaller diameter valve seat.

   b. Install the intake valve guide in the side of the cylinder with the larger diameter valve seat.

6. Hang the cylinder with the flange up; allow the cylinder to stabilize to room temperature.
7. Measure the valve guide inside diameter at three equally spaced locations along the length of the valve guide.
8. Ream the valve guides according to the “Valve Guide Bore Reaming” instructions in Section 15-8.8.11.
9. After reaming the valve guide to the proper inside dimension, perform a “Fluorescent Penetrant Inspection” (Section 15-4) on the new valve guide and the valve seat.

15-8.8.11. Valve Guide Bore Reaming

Equipment Required

- Borroughs P/N 5221B Cylinder Holding Fixture, or equivalent
- Borroughs P/N 5221-15A Holding Fixture Adapter, or equivalent
- Borroughs P/N 8116-1R through 15R Reamers, or equivalent
- Heavy duty drill press

CAUTION: Do not attempt reaming the valve guide bore with a hand held power tool.

1. Install the Cylinder Holding Fixture (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) in drill press.
2. Index the Cylinder Holding Fixture to the proper angle and install the cylinder in the fixture.
3. Zero in the valve guide with the dial indicator.
4. Using the proper size reamer tool bit, ream the valve guides while applying generous amounts of lubricant at 400 RPM for high speed steel reamers and 700 RPM for carbide tip reamers.
5. Inspect the finished bore inside diameter using Appendix D specifications. The intake valve guide surface finish must not exceed 63 Ra, the exhaust valve guide surface finish must not exceed 125 Ra.

15-8.8.12. Valve Seat Machining

Equipment Required

- Borroughs P/N 5221B Cylinder Holding Fixture, or equivalent
- Borroughs P/N 5221-13A Holding Fixture Adapter, or equivalent
- Sioux Brand Valve Seat Grinder Set No. 1675 or equivalent.
- Sioux Brand Valve Seat Grinder Pilot 0.437 diameter
- Grinding stones:
  - K106 roughening for intake valve seats
  - K46 finishing for intake valve seats
  - K95 roughening for exhaust valve seats
  - K25 finishing for exhaust valve seats

NOTE: Valve seats and valves may be lapped after refacing, if desired. Lapping compounds are extremely abrasive, ensure to completely remove compound residue from the valves, valve seats and cylinder by thorough cleansing with hot soapy water and a stiff bristled scrub brush. Rinse the cylinder thoroughly with hot water to remove soap residue.

1. Install the Cylinder Holding Fixture (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) in drill press.
2. Index the Cylinder Holding Fixture to the proper angle and install the cylinder in the fixture.
3. Reface the valve seats according to the specifications in Appendix D, using the valve seat grinder (Chapter 2-1 of M-0, Standard Practice Maintenance Manual). Wash the cylinder with soapy water and rinse thoroughly.
4. Dry the cylinder completely.
5. Coat all bare steel surfaces thoroughly with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

15-8.8.13. Spark Plug Heli-coil Replacement

Refer to "Spark Plug Heli-coil Replacement" instructions in Chapter 10-6.7 of M-0, Standard Practice Maintenance Manual.

15-8.8.14. Cylinder Stud Installation

Refer to "Cylinder Stud Replacement" instructions in Chapter 10-6.4 of M-0, Standard Practice Maintenance Manual.

15-8.8.15. Piston Ring Replacement

Install new piston rings on each engine cylinder piston during the engine assembly.

> NOTE: Whenever piston rings are replaced in an engine cylinder, hone the cylinder bore prior to assembly according to "Cylinder Bore Honing" in Section 15-8.8.6.

15-8.8.16. Cylinder Protective Coatings

Refer to "Cylinder Protective Coatings" instructions in Chapter 10-6.8 of M-0, Standard Practice Maintenance Manual.

15-8.8.17. Rocker Arm Bushing Replacement

Equipment Required

- Borroughs P/N 8118 Rocker Arm Bushing Remover/Installer
- Borroughs P/N 8116-1R through 15R Reamers, or equivalent
- Arbor Press

1. Remove the old bushings from the rocker arm(s) using a Borroughs P/N 8118 Rocker Arm Bushing Remover/Installer (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) or the correct size drift in an arbor press.
2. Lubricate the new bushings with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
3. Press in the new bushings to the specifications in Figure 15-10.
4. Plug the oil passages on the rocker arm with beeswax.
5. Ream the new bushings to the diameter specified in Figure 15-10.
6. Lightly break the sharp edge at each end of the new bushings.
7. Inspect the bushing bore size and surface finish to verify it meets Appendix D specifications.
8. After reaming, clean and flush the oil passages with clean mineral spirits.
9. Verify that the oil passages are clear of any debris, contamination or beeswax

   CAUTION: When utilizing compressed air, wear OSHA approved protective eye wear. Never exceed 30 psi when using compressed gases for cleaning purposes. (OSHA 1910.242(b)).
10. Clean obstructed oil passages in rocker arms by flushing with clean mineral spirits and blowing compressed air through them. Discard rocker arms with obstructed oil passages.
11. Perform a “Visual Inspection” (Section 15-3) and “Magnetic Particle Inspection” (Section 15-5) on the rocker arm assemblies.

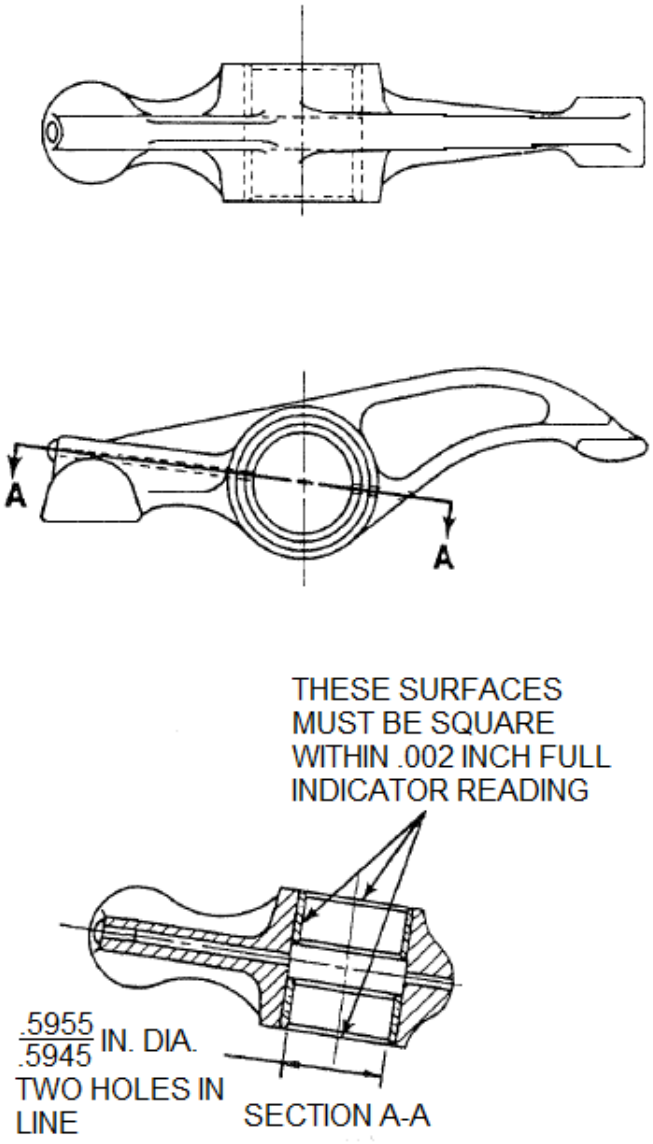


Figure 15-10. Rocker Arm Bushing Replacement

15-8.8.18. Rocker Arm to Rotocoil Clearance

Maintain a minimum clearance of 0.020 inches (0.508 mm) between the rocker arm and rotocoil. If 0.020 inches (0.508 mm) clearance is not met, proceed as follows:

WARNING

Grinding marks or cracks in the rocker arm may cause the rocker arm to fail.

1. Temporarily install the rocker arm on the cylinder to verify rocker arm to rotocoil clearance.
2. Smoothly grind across the forging flash line on the underside of the rocker arm to obtain the specified 0.020 inch (0.508 mm) clearance (see Figure 15-11). The grind must be smooth and uniform. Cover the rocker arm bushing bore and oil passage to prevent contamination. If the required clearance cannot be met without exceeding the grind width, discard and replace the rocker arm.
3. Polish the entire ground surface to remove grinding marks.
4. Remove the protective coverings from the rocker arm and clean thoroughly.
5. Perform a “Magnetic Particle Inspection” (Section 15-5) on the polished rocker arm to inspect for cracks.
6. Thoroughly clean the rocker arm(s) before final engine assembly.

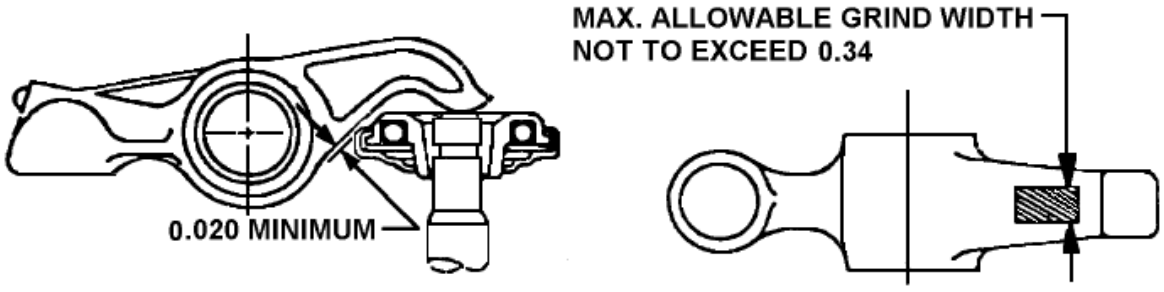


Figure 15-11. Rocker Arm to Rotocoil Clearance

15-8.9. Inter-Cylinder Baffle Repair

1. Perform a "Visual Inspection" according to instructions in Section 15-3 on the inter-cylinder baffles for condition, corrosion, loose rivets or missing material.
2. If a baffle is bent but the shape still conforms to the cylinder, minor bends may be straightened with a hammer and anvil.
3. Minor repairs, including rivet or nut plate replacement, using standard repair procedures is acceptable.
4. Clean the baffles and restore the protective finish according to instructions in Chapter 12 of M-0, Standard Practice Maintenance Manual.

15-8.10. Crankcase Overhaul Repair

1. Collect the crankcase replacement parts according to Appendix C-2, "Replacement Parts", Appendix C-2.3, "100% Parts Replacement Requirements" and Appendix C-2.4, "Mandatory Overhaul Replacement Parts" to prepare for crankcase assembly.
2. Replace crankcase or associated parts worn beyond the overhaul limits in Appendix D or failing to meet inspection criteria. Discard and replace all non-conforming components.

15-8.10.1. Crankcase Line Boring

Either discard or line-bore crankcases to the next authorized oversize dimension with crankshaft or camshaft bearing bores that exceed the specified critical new parts diameter. Only a certified repair facility for specialized crankcase repairs is authorized to perform line bore repairs. Refer to Appendix D for overhaul limits and Section 15-7.1, "Crankcase Dimensional Inspection" for information on performing a crankshaft and camshaft bore dimensional inspection.

15-8.10.2. Crankcase Machining

Discard and replace or machine crankcase halves exhibiting fretting. Crankcase machining is only permitted at a certified crankcase repair facility. The crankcase cylinder deck dimensions are listed in Appendix D. After machining, the cylinder deck height must meet Appendix D specifications. Discard crankcase halves failing to meet this dimension.

CAUTION: Gear backlashes must not be less than the specified minimum after machining.

The crankcase half-parting line surface must be flat within 0.005 inches (true indicator reading). The sum total of the parting line surface for both crankcase halves must not exceed 0.008 (true indicator reading). Discard crankcase halves that exceed these dimensions. After all machining is complete, perform a "Fluorescent Penetrant Inspection" on the crankcase halves according to instructions in Section 15-4.

15-8.10.3. Crankcase Welding

WARNING

No weld repairs are permitted in the critical (non-shaded) areas of the crankcase or the bearing support structures. An FAA Part 145 Repair Station is the only facility authorized to perform a crankcase weld repair.

Welding is only permitted on ***non-critical*** areas of the crankcase identified in Section 15-7.1, "Crankcase Dimensional Inspection." Only an FAA Part 145 Repair Station certified to perform crankcase repair may complete the weld repair. The dimensional integrity of the crankcase must be maintained.

15-8.10.4. Crankcase Cylinder Deck Stud Heli-coil Installation

WARNING

Do not attempt to repair the 2 and 4 o'clock crankcase cylinder deck stud positions by installing heli-coil inserts.

Install heli-coils in crankcase cylinder deck stud holes according to instructions in Appendix C-5 in accordance with specifications in Figure 15-12.

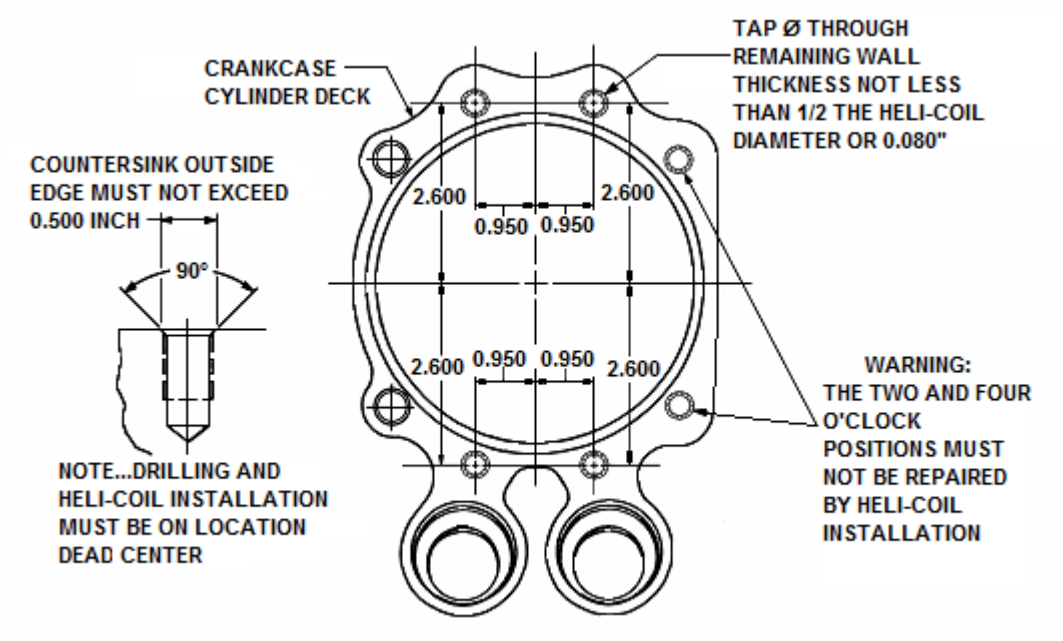


Figure 15-12. Crankcase Cylinder Deck Stud Specifications

15-8.10.5. Crankcase Cylinder Deck Stud Replacement

Crankcase cylinder deck studs (except at the two and four o'clock positions) may be replaced using these instructions. Replace any crankcase stud which is loose, damaged or fails to meet Appendix D-8 stud height specifications according to the "Stud Replacement" instructions in Appendix C-6.

WARNING

Do not attempt to repair the 2 and 4 o'clock crankcase cylinder deck stud positions by installing heli-coil inserts.

1. Verify the studs and tapped holes are clean and dry.
2. Apply P/N 653693 High Strength Adhesive Primer (Chapter 3 of M-0, Standard Practice Maintenance Manual) to stud and cylinder deck threads and allow appropriate drying time according to manufacturer's recommendations.
3. Apply P/N 646941 High Strength Adhesive/Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the stud and the cylinder deck tapped hole threads.
4. Install the studs to the appropriate stud height setting specified in Appendix D-8.
5. Wipe excess adhesive from the cylinder deck.
6. After two hours minimum cure time, test the installed stud breakaway torque. Studs must resist movement with a torque load of 100 in-lbs. If studs break away, replace with a new stud.

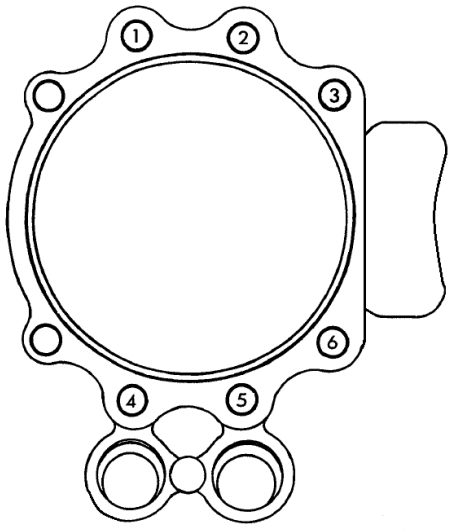


Figure 15-13. Cylinder Deck Stud Locations

15-8.10.6. Oil Gage Rod Housing Assembly Replacement

15-8.10.6.1. Oil Gage Rod Housing Assembly Removal

1. Mark crankcase and housing assembly for replacement orientation, use permanent felt tip marker.
2. Remove clamps and hardware securing housing assembly to engine.
3. If engine uses housing extension, remove housing extension from housing assembly.
4. Clamp onto the housing assembly collar, use locking pliers. Refer to Figure 15-14.
5. Rotate the pliers and housing assembly clockwise and counterclockwise to break loose the housing assembly from the adhesive.
6. Place a loop of safety wire under the housing assembly collar and securely attach the safety wire to a rod or screwdriver to assist in removal of housing assembly.
7. Rotate the pliers clockwise and counterclockwise while pulling up and outward on safety wire to remove housing assembly out of the crankcase bore.

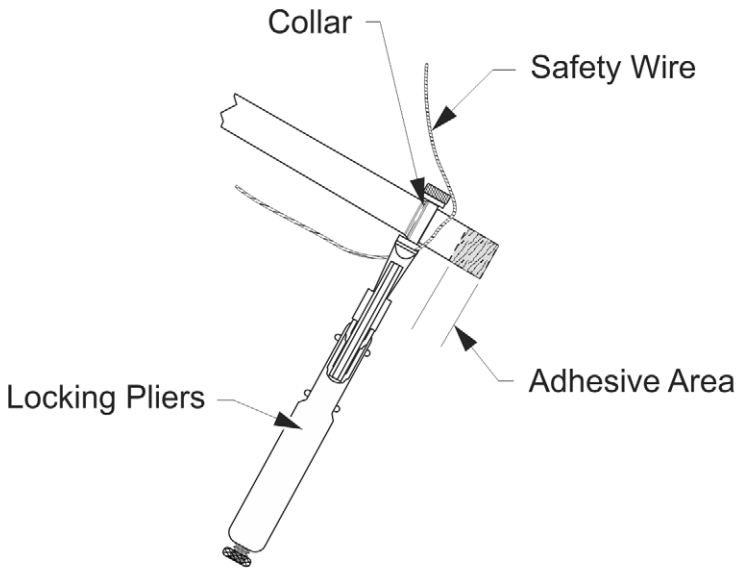


Figure 15-14. Oil Gage Rod Housing Assembly Removal/Installation

15-8.10.6.2. Oil Gage Rod Housing Assembly Installation

1. Mark new housing assembly for installation orientation, use old housing assembly for reference.
2. Throughly clean crankcase bore and housing assembly (up to collar) with P/N 653693 Loctite 7471 Primer (Chapter 3 of M-0, Standard Practice Maintenance Manual).
3. Apply a thin coat of P/N 646941 High Strength Adhesive/Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) below the collar in the indicated area on the housing assembly. Refer to Figure 15-14.
4. Drive housing assembly into crankcase bore until housing bottoms on bore stop, use collar on housing assembly.
5. Ensure marks on housing assembly and crankcase align; also ensure there is clearance for through bolt installation.
6. If engine uses housing extension, install housing extension on housing assembly.
7. Install clamps and hardware securing housing assembly to engine.

15-8.10.7. Crankcase Breather Overhaul

Examine the crankcase breather for damage and evidence of leaking.

1. Remove damaged crankcase breather tubes with a hammer and chisel or slide hammer with hook fixture.
2. Install the oil breather (Figure 15-15) depending on crankcase; refer to the instructions below to determine proper breather orientation.
   a. Apply P/N 653693 Loctite 7471 Primer (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the breather flange and breather tube and allow them time to dry.
   b. Apply P/N 646941 High Strength Adhesive/Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to both the breather flange and breather tube.
   c. Install the breather to the appropriate height and orientation specified. Wipe excess adhesive/sealant from the crankcase.

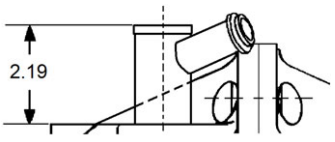
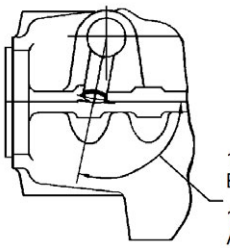
Crankcase P/N's	Breather Height	Breather Orientation
653688/658320-1 653688/658320-2 653688/658320-3 653688/658320-4 653688/658320-11 653688/658320-12 653688/658320-13 653688/658320-14 653688/658320-18 653688/658320-19 653688/658320-20 658320-21		

Figure 15-15. Crankcase Breather Height/Orientation

15-8.11. Engine Drive Train Overhaul

CAUTION: Engine drive train overhaul is beyond the scope of field repairs. Special fixtures, special tools and air gauges are required to inspect the components for serviceability after the repairs are accomplished. Overhaul repairs to the camshaft, crankshaft and connecting rods may only by performed by an FAA Part 145 Repair Station, using FAA approved repair procedures.

1. The engine drive train consists of the camshaft assembly and crankshaft assembly, including counterweights, gears and connecting rods. Overhauling the engine drive train entails disassembling, verifying the integrity of parts, replacing parts, and re-assembling these components as instructed in the subsection herein. Replace any parts worn beyond Appendix D limits or parts which do not meet inspection criteria.
2. Collect the engine drive train replacement parts specified in Appendix C-2, "Replacement Parts", Appendix C-2.3, "100% Parts Replacement Requirements" and Appendix C-2.4, "Mandatory Overhaul Replacement Parts" to prepare for engine drive train assembly.
3. Refer to the appropriate subsections to accomplish camshaft and crankshaft repairs.

Table 15-2. Engine Drive Train Parts Replacement

Part to Consider for Replacement	Discard and Replace Criteria
WARNING **Use only replacement crankshafts with the letters VAR (for vacuum arc re-melted) forged or vibro-etched in the crankshaft cheek to ensure proper engine operation. Do not replace the crankshaft with any other type.**	
Crankshaft	Discard/replace a crankshaft with any of the following conditions: • Worn, pitted, fretted or out-of-round counterweight bushing bores • Cracked counterweight hanger blades • Cracks, rust or pitting on crankshaft
Crankshaft Counterweight[1]	Discard any counterweight that is: • Cracked • Worn, pitted, fretted or out of round bushing bores • Worn pitted, fretted or out of round in the retaining plate seating area. • Worn or has distortions in the retaining ring groove that can affect the retaining ring seating
Oil Control Plugs	Discard/replace loose or leaking oil plugs
Connecting Rods	Discard/replace any connecting rods: • With a bore exhibiting nicks or gouges • If the rod and cap do not align properly

1. Replace both counterweights in the matched pair, even if only one counterweight is unserviceable.

15-8.11.1. Camshaft Repair

WARNING

Camshafts may only be repaired by an approved FAA Part 145 Repair Station. Do not attempt camshaft repair without the proper tooling and FAA required certification.

Continental Motors offers replacement camshafts with bearing journals ranging from the nominal new part specification to 0.020" oversize in 0.005" increments. Camshaft repairs must be performed by an FAA Part 145 Repair Station certified to perform the camshaft repair. Camshaft repair procedures must be accomplished in accordance with Federal Aviation Regulations to return the camshaft to the dimensional limits in Appendix D. Perform a "Magnetic Particle Inspection" (Section 15-5) on the camshaft after rework.

15-8.11.2. Crankshaft Repair

WARNING

Crankshafts may only be repaired by an approved FAA Part 145 Repair Station. Do not attempt crankshaft repair without the proper tooling and FAA required certification.

CAUTION: Do not attempt to repair a scored or overheated crankshaft. Discard and replace scored or overheated crankshafts.

CAUTION: If a crankshaft is repaired by an FAA Repair Station, the nitride treatment must be restored.

The crankshaft may be repaired by grinding the crank pins and journals to 0.010 inches (0.254 mm) under the new shaft limits per Appendix D-7 and re-nitriding. This repair is only authorized at an FAA Part 145 Repair Station certified to perform crankshaft repairs. Crankshaft repair procedures must be accomplished according to Federal Aviation Regulations. The repaired crankshaft must meet the new part (new or authorized undersize) dimensional limits specified in Appendix D-7.

1. Install the Crankshaft Oil Control Plug according to Section 15-8.11.2.1, "Oil Control Plug Replacement."

1. Install new crankshaft counterweight bushings according to Section 15-8.11.2.2, "Crankshaft Counterweight Bushing Replacement."

2. Install new crankshaft hanger blade bushings according to Section 15-8.11.2.3, "Crankshaft Hanger Blade Bushing Replacement."

3. After the oil control plug and both the hanger blade bushings and the counterweight bushings are installed, perform a "Magnetic Particle Inspection" (Section 15-5) on the crankshaft and counterweights and a "Crankshaft Ultrasonic Inspection" (Section 15-6.2) to ensure no cracks developed during the bushing or oil control plug installation process.

15-8.11.2.1. Oil Control Plug Replacement

Equipment Required

- Oil Plug Leak Test Fixture
- Oil Control Plug Installation Tool

NOTE: The 2.375-inch diameter collar at the rear of the Oil Control Plug Installation Tool (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) prevents driving the oil control plug beyond the specified depth of 4.44 to 4.46 inches. ***Do not*** use makeshift tools to install the oil control plug.

1. Remove the crankshaft oil control plug, using an eight-inch long 0.4375-20NF threaded bolt and a slide hammer.
2. Inspect the inside diameter of the crankshaft for rust or pitting. Discard crankshafts exhibiting rust or pitting. Clean the bore of the crankshaft, using a pneumatic drill and a two-inch Merrit Wheel. The inside diameter of the crankshaft must be clean and free of any sludge residue prior to installing a new oil control plug.
3. Carefully drive in the new oil control plug into the crankshaft, using an air impact tool and the Oil Control Plug Installation Tool.

   NOTE: Ensure that the threaded hole of the oil control plug is facing towards the propeller flange.

4. Leak test the oil control plug and pressure test the crankshaft by connecting the Oil Control Plug Leak Test Fixture (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) to the crankshaft, using a C-clamp with neoprene rubber pads as shown in Figure 15-16. Apply 70-80 psi air pressure and close the air supply. Monitor the pressure gauge for 15 seconds; allowable pressure loss is not to exceed 2 psi.
5. After crankshaft repairs are complete, restore the helix pattern to the exposed portion of the crankshaft according to instructions in Section 15-8.11.2.4, “Crankshaft Plating Overhaul.”

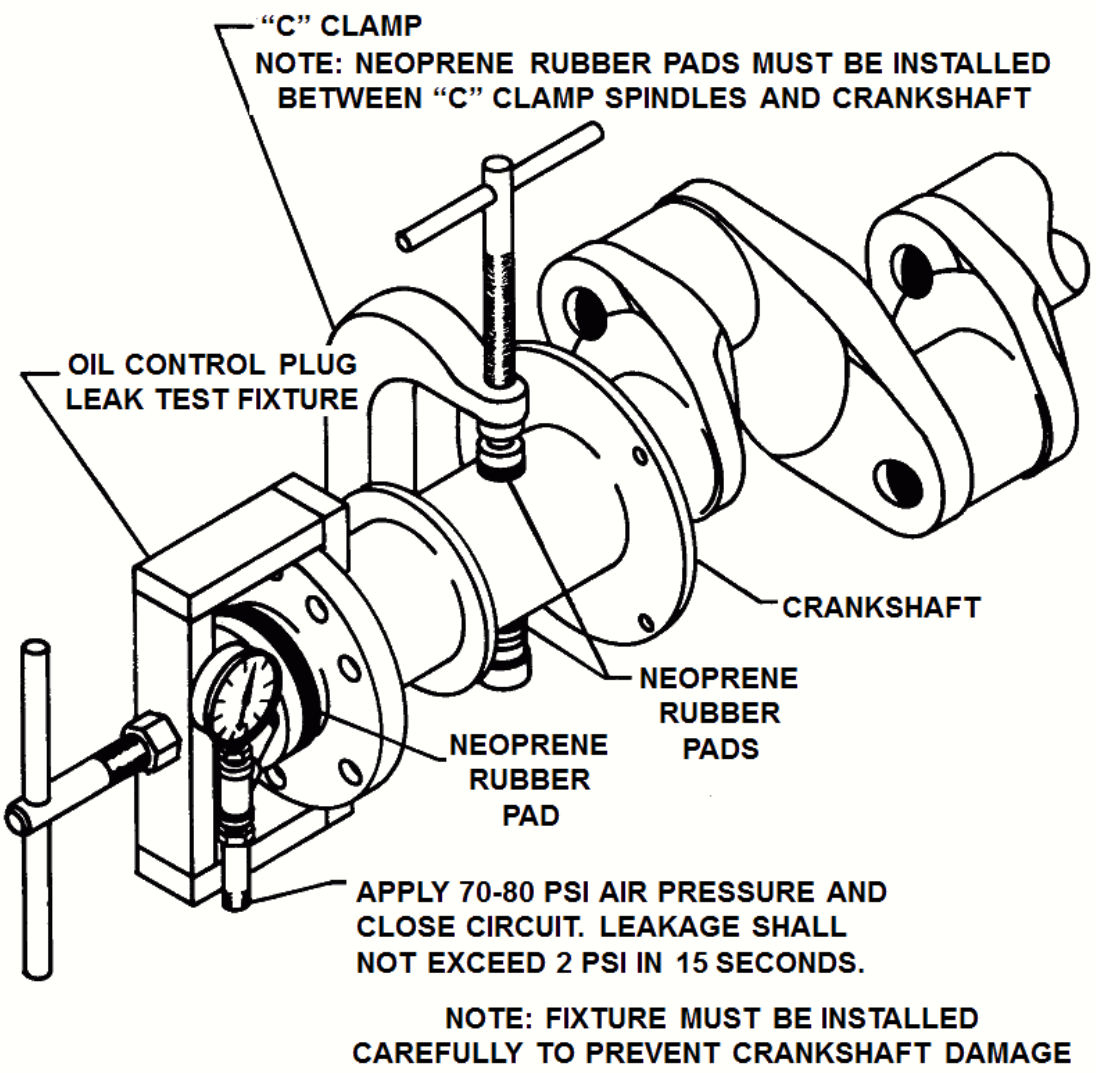


Figure 15-16. Oil Control Plug/Crankshaft Pressure Test

15-8.11.2.2. Crankshaft Counterweight Bushing Replacement

Equipment Required

- Borroughs P/N 8077C Counterweight Bushing Replacement Fixture, or equivalent
- Federal Dimension Air Gauge (with appropriate setting ring and air plug) or Starrett No. 78 series 3-point contact inside micrometers
- Snap ring pliers (with 90-degree bend)
- Arbor press

The complete crankshaft/counterweight assembly is dynamically balanced; the counterweights are matched in pairs with a maximum weight variation of two grams. If either counterweight is damaged, both counterweights must be replaced as a pair on that crankshaft cheek, even if only one counterweight is unserviceable.

WARNING

Removing the counterweight bushings with makeshift tools may cause irreparable damage which could lead to engine malfunction or failure.

1. Remove the crankshaft counterweight bushings, using a Borroughs P/N 8077C Counterweight Bushing Replacement Fixture (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) and an arbor press.
2. Measure the crankshaft counterweight bushing bore inside diameter. The bushing bores must be smooth and cylindrical (no out-of-round). New bushings must have an interference fit of 0.0015T to 0.003T inches in the bushing bores.
3. Evaluate the counterweights, using the criteria in Table 15-2, “Engine Drive Train Parts Replacement”, to determine acceptability of parts. Replace counterweights with worn, pitted, fretted or out-of-round bushing bores.

WARNING

Counterweight bushings and counterweight bushing retainer plates require an interference fit. Replace counterweight bushings or counterweight bushing retainer plates if insertion in the bushing bore is possible without resistance.

4. Counterweight bushings and counterweight bushing retainer plates require an interference fit. Replace if insertion in the bushing bore is possible without resistance.
5. Inspect counterweight bores/counterbores for signs of wear in the pin plate retainer wall (area adjacent to the inside edge of the retaining groove; it may appear as a taper of the hole into the retaining ring groove). If any wear is evident, discard and replace the counterweight.

   NOTE: Replace both counterweights in the matched pair even if only one counterweight is unacceptable.

6. If the counterweight is conforming, check the counterweight retaining ring groove for distortions in width, roundness or pattern which can affect the seating of the

retaining ring. Discard and replace the counterweight matched pair if wear or distortions are found even on one counterweight.

7. Install new bushings in the same positions as the old bushings on the counterweight assemblies (Figure 15-17), using the Borroughs P/N 8077C Counterweight Bushing Replacement Fixture. The bushing lead-in (Figure 15-17) must be positioned toward the counterweight during installation. Press the bushing flush with the surfaces as illustrated.
8. Verify the dimensions of the newly installed bushings. Replacement bushings must be dimensionally inspected according to Appendix D specifications using calibrated, accurate measuring equipment (one of the following):
   a. Federal Dimension Air Gauge (with appropriate setting ring and air plug)
   b. Starrett No. 78 series 3-point contact inside micrometers
9. Perform a "Magnetic Particle Inspection" (Section 15-5) on the counterweight assembly to ensure the counterweight is free of cracks.

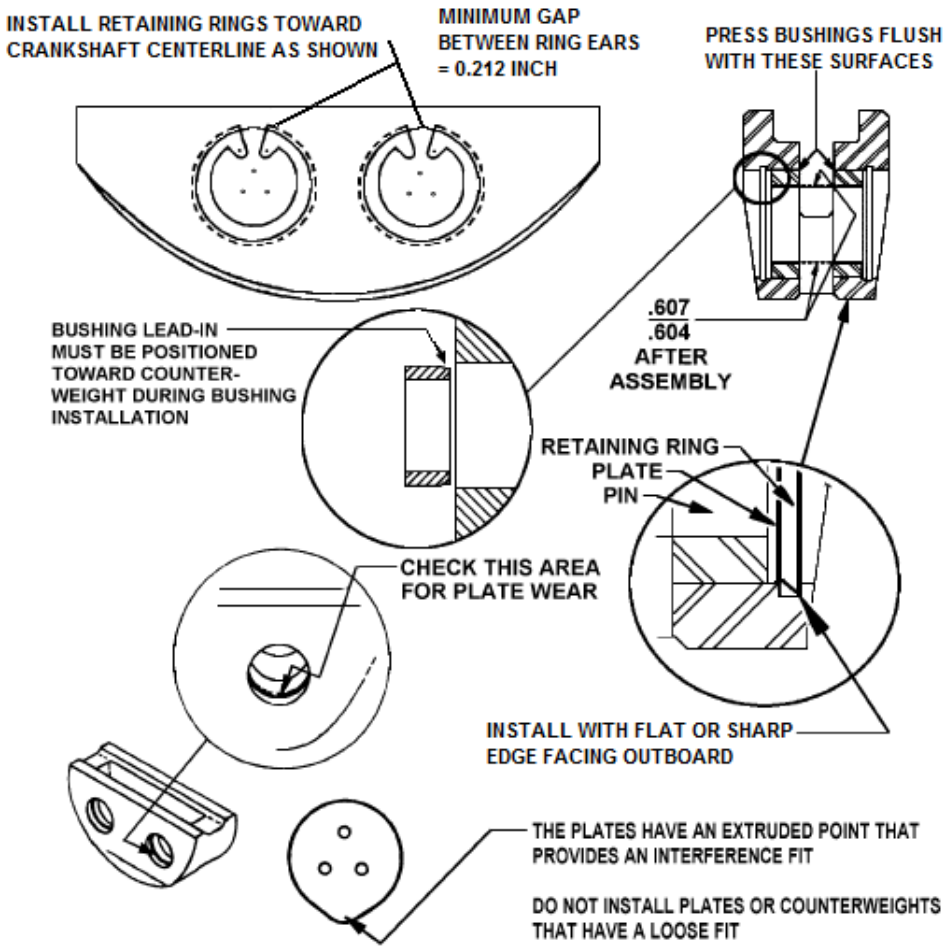


Figure 15-17. Counterweight Inspection, Repair and Installation

15-8.11.2.3. Crankshaft Hanger Blade Bushing Replacement

Crankshaft hanger blade bushings are also referred to as damper bushings. Crankshaft hanger blade bushings must meet Appendix D-7.3 specifications. Replacement of the hanger blade bushings are mandatory at overhaul.

Equipment Required

- Borroughs P/N 8068 Crankshaft Hanger Blade Bushing Replacement Tool, or equivalent
- Federal Dimension Air Gauge (with appropriate setting ring and air plug) or Starrett No. 78 series 3-point contact inside micrometers

WARNING

Removing the bushing with makeshift tools may cause irreparable damage to the crankshaft that could lead to engine malfunction.

1. Remove the old crankshaft hanger blade bushings, using Borroughs P/N 8068 Crankshaft Hanger Blade Bushing Replacement Tool (Chapter 2-1 of M-0, Standard Practice Maintenance Manual).
2. Install the new crankshaft hanger blade bushings according to Figure 15-18, using Borroughs P/N 8068 Crankshaft Hanger Blade Bushing Replacement Tool. The replacement bushings must have an interference fit of 0.0015T to 0.003T inches into the bushing bores. The bushing bores must be smooth.

   NOTE: The new bushings must be installed into the same positions as the original. Replacement crankshaft hanger blade bushings are available in standard and oversize dimensions.

3. Review Table 15-2, “Engine Drive Train Parts Replacement” to determine acceptability of parts.
4. Verify the dimensions of the newly installed bushings. Replacement bushings must be dimensionally inspected according to instructions in Figure 15-18 using calibrated, accurate measuring equipment (one of the following):
   a. Federal Dimension Air Gauge (with appropriate setting ring and air plug)
   b. Starrett No. 78 series 3-point contact inside micrometers.

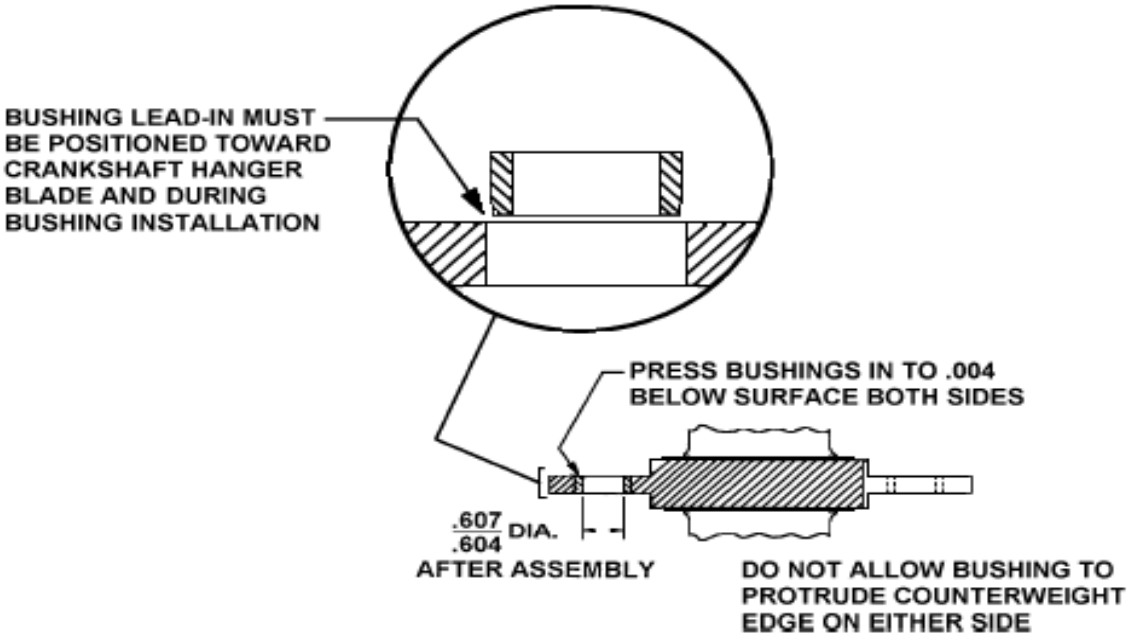


Figure 15-18. Crankshaft Hanger Blade Bushing Replacement

15-8.11.2.4. Crankshaft Plating Overhaul

Refer to “Crankshaft Plating Overhaul” instructions in Chapter 10-9.3 of M-0, Standard Practice Maintenance Manual.

15-8.11.2.5. Connecting Rod Piston Pin Bushing Replacement

Refer to “Connecting Rod Piston Pin Bushing Replacement” instructions in Chapter 10-9.4.2 of M-0, Standard Practice Maintenance Manual.

15-8.11.2.6. Connecting Rod Piston Pin Bushing Boring

Refer to “Connecting Rod Piston Pin Bushing Boring” instructions in Chapter 10-9.4.3 of M-0, Standard Practice Maintenance Manual.

15-8.11.2.7. Connecting Rod Replacement

WARNING

Never remove material from a connecting rod. Connecting rods are matched to limit engine vibration with no more than 1/2 ounce weight variance between connecting rods in opposing cylinders. Removing material from a connecting rod will destroy the shot peen treatment and may cause stress risers.

Connecting rod assemblies are selected in pairs with a maximum weight variation not to exceed ½ ounce in opposing cylinders. Connecting rods are supplied only in matched sets; replace connecting rods only in pairs.

Chapter 16. Component Assembly

Instructions in this chapter depend on compliance with the preliminary steps detailed in earlier chapters. Parts must be properly removed, cleaned, inspected and repaired according to the instructions in earlier chapters prior to assembly. Adhere to the instructions in this chapter when assembling components. Prior to assembling components, refer to the following sections of M-0, Standard Practice Maintenance Manual:

- Appendix C-1, "Handling Parts"
- Appendix C-2.2, "Acceptable Replacement Parts"
- Appendix C-2.3, "100% Parts Replacement Requirements"
- Appendix C-2.4, "Mandatory Overhaul Replacement Parts"

NOTE: The definition of "replace" in this manual is removal and disposal of the original part and substitution of a new part with the same form, fit and function of the original when it was new.

16-1. Fuel Injection System

The fuel pump, throttle/metering assembly (or throttle and control unit assembly) and fuel manifold valve must be new, factory rebuilt, or overhauled and tested by an authorized FAA Part 145 Repair Station.

16-1.1. Fuel Injection System Component Assembly

NOTE: Before re-installation of fuel system component fittings ensure they are free of any debris by screwing them into the proper size holes of a soft wood block then thoroughly flushing them with an approved solvent.

Continental Motors offers new and rebuilt fuel pumps, throttle/metering assemblies (or throttle and control unit assemblies) and fuel manifold valve assemblies which meet new part specifications. Continental Motors does not control FAA Part 145 Repair Station activities; verify the repair station qualifications before contracting fuel manifold valve overhaul. Fuel manifold valve overhaul must be accomplished under carefully controlled conditions per approved procedures in compliance with FAA regulations.

16-1.2. Fuel Injector Nozzles

NOTE: Position-tuned injector nozzles must be replaced at engine overhaul. Replacement kits are available; part numbers may vary, even from one engine model specification to the next. Refer to Section 10-3 for detailed fuel injector replacement instructions.

1. Prepare six new fuel injector nozzles matching the flow characteristics of those removed during disassembly. Position-tuned nozzles must be installed in the appropriate cylinder location for optimum performance.
2. Cap both ends of the new injector nozzles; mark them for the respective cylinders and place them in a clean storage container until ready for use.

16-2. Alternator Assembly

This procedure applies to alternators supplied by Continental Motors. For alternators procured from other manufactures or suppliers, refer to the manufacturer's instructions.

WARNING

Failure to remove the shipping washer prior to alternator installation will cause interference with the camshaft gear resulting in damage to the engine and alternator.

NOTE: All electrical charging system components must be clean and free of debris before assembly.

1. Remove the shipping spacer and washer from the alternator (Figure 16-1)(1) shaft to prevent interference with the face gear on the camshaft.
2. Install a new woodruff key (3) on alternator (1) shaft.
3. For one-piece coupler, install a new coupler, inspected in accordance with Section 15-7.6 and proceed to step 8. For multi-piece coupler proceed to next step.
4. Lubricate the lip of the oil seal in the alternator (1) and the polished surface of the drive coupling hub (4) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
5. Slide the hub (4) onto the alternator (1) shaft, over the woodruff key (3) and through the oil seal lip until seated against the inner race of the ball bearing.
6. Install the new retainer (5), new bushings (6) and sleeve (7) on the alternator (1) shaft.
7. Slide gear (8) onto alternator (1) shaft so its drive lugs are inserted in the rubber bushings (6).
8. Install the castellated nut (9) on the alternator (1) shaft.
9. Clamp the alternator (1) and hub assembly into a set of protected vice jaws.

   NOTE: Only tight enough to torque the castellated nut (9).

10. Set the torque wrench for the minimum value published in Appendix B for the castellated nut (9) and torque the castellated nut.
11. If the slots of the castellated nut (9) do not align with the cotter pin (10) hole in the alternator (1) shaft, the castellated nut may be torqued further up to the maximum value in Appendix B. If alignment can not be achieved within the torque limits, replace the castellated nut. Do not back off the nut to align the holes.

WARNING

Use eye protection when trimming cotter pin because flying parts can cause injury.

12. Install the new cotter pin (10) according to the “Cotter Pin Installation” instructions in Appendix C-7.

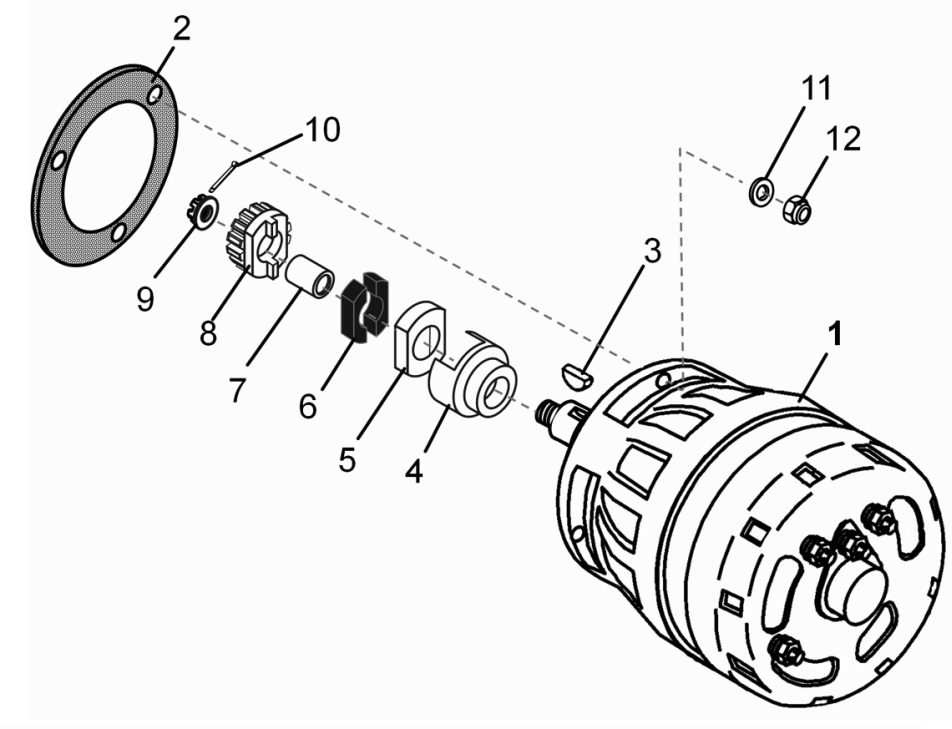


Figure 16-1. Direct Drive Alternator Assembly

1	Alternator	4	Hub	7	Sleeve	10	Cotter Pin
2	Gasket	5	Retainer	8	Gear	11	Washer
3	Woodruff Key	6	Bushing	9	Castellated Nut	12	Lock Nut

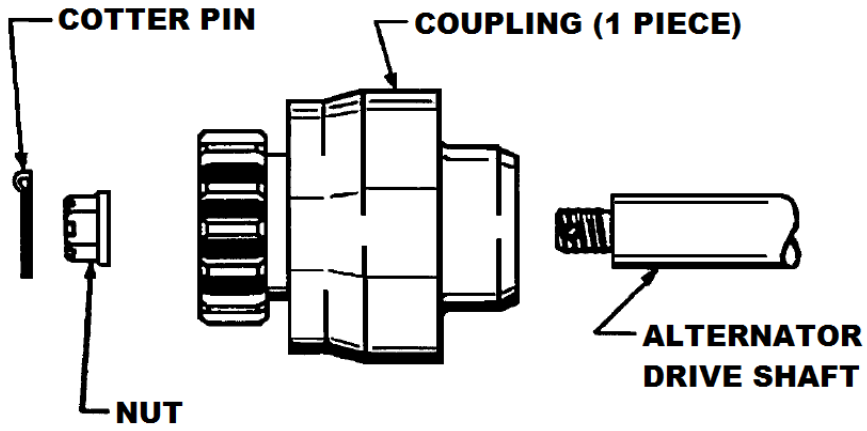


Figure 16-2. Alternator Drive Hub Coupling (1 Piece) Assembly

16-3. Starter Adapter Assembly

IO-360 series engine models offers a variety of starter adapters. Identify the starter adapter features installed on the engine and refer to the corresponding starter adapter instructions for assembly. Prior to starter adapter assembly, ensure parts have been cleaned, inspected, and overhaul repairs were accomplished according to instructions in:

- Chapter 12, “Engine Cleaning” of M-0, Standard Practice Maintenance Manual
- Chapter 15, “Overhaul Inspection and Repair”

NOTE: To identify the installed starter adapter, refer to Section 16-3.1, Section 16-3.2 and Section 16-3.3 to determine which procedure applies to the starter adapter; follow the corresponding procedure. For further assistance, consult the illustrated parts catalog for your engine model.

16-3.1. Basic Starter Adapter Assembly

1. Lubricate outside diameter (OD) of new needle bearing (Figure 16-3)(4) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
2. Press needle bearing (4) into starter adapter (1) until needle bearing is 0.03 inches below inner surface. Apply Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to inside diameter (ID) of needle bearing.
3. Apply P/N 646942 Gasket Maker (Chapter 3 of M-0, Standard Practice Maintenance Manual) to OD of seal (16).
4. Press seal (16) into pump cover (15).
5. Press new roller bearing (10) into the starter gear (11), using Bearing Installation Tool (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) and arbor press. Apply clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual) to roller bearing ID.

   NOTE: Press large radius end of roller bearing (Figure 16-3)(10) into starter gear (11).

6. Lubricate new clutch spring (9) liberally with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
7. Twist the new clutch spring (9) clockwise on to the back side of the starter gear (11) until the offset end drops into the gear land and the tang aligns with the screw hole in the gear web.
8. Install screw (13) with a new tab washer (12) in the threaded screw hole in the starter gear (11) web. Torque the screw to Appendix B specifications and secure the tab washer according to the “Tab Washer Installation” instructions in Appendix C-4.

   NOTE: Screw (13) must be inserted into clutch spring (9) notch.

9. Twist the assembled starter gear (11) and clutch spring (9) clockwise on the starter shaft gear (3) until the starter shaft gear contacts the roller bearing (10).
10. Lubricate ID of the new ball bearing (6) and the end of the worm shaft (5) with Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual).

11. Press new ball bearing (6) onto worm shaft (5) until it seats against flange.

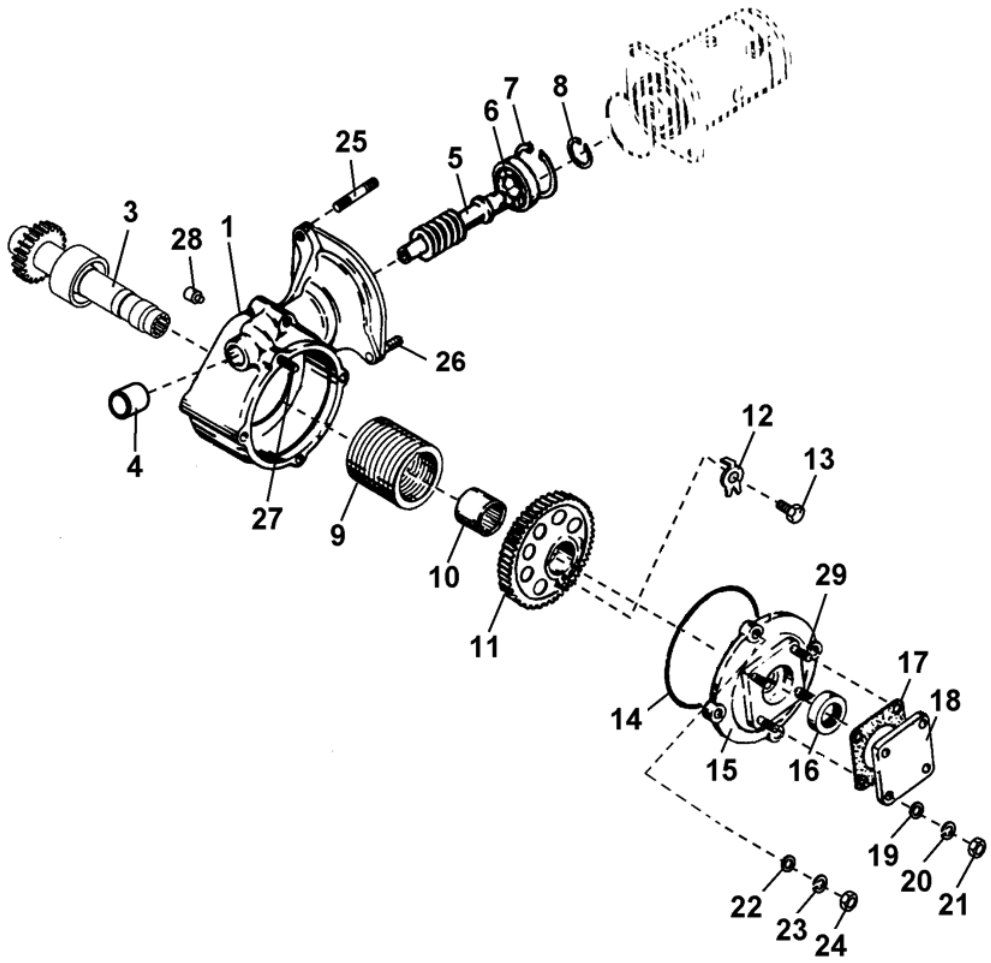


Figure 16-3. Basic Starter Adapter Assembly

1	Starter Adapter	9	Clutch Spring	17	Gasket	25	Stud
2	Dowel	10	Roller Bearing	18	Accessory Cover	26	Stud
3	Starter Shaft Gear	11	Starter Gear	19	Washer	27	Stud
4	Needle Bearing	12	Tab Washer	20	Lock Washer	28	Dowel
5	Worm Shaft	13	Screw	21	Nut	29	Stud
6	Ball Bearing	14	O-ring	22	Washer		
7	Retaining Ring	15	Pump Cover	23	Lock Washer		
8	Retaining Ring	16	Seal	24	Nut		

12. Install retaining ring (8) to secure ball bearing (6) on worm shaft (5).
13. Lubricate assembled ball bearing (6) and worm shaft (5) with Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual).
14. Insert the assembled ball bearing (6) and worm shaft (5) into the starter adapter (1).

    NOTE: Ensure worm gear and worm wheel teeth are aligned.

15. Install new retaining ring (7) to secure assembly (5 and 6) into the starter adapter (1).
16. Lubricate the starter shaft gear (3) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
17. Install starter adapter (1) in shielded vise.
18. Lubricate starter gear (11) teeth with Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual).
19. Install assembled roller bearing (10), starter gear (11), clutch spring (9) and shaft gear (3) into starter adapter (1); turning clockwise to seat clutch spring. Ensure worm shaft (5) teeth and starter shaft gear (3) teeth are aligned and mesh properly.
20. Apply Dow Corning No. 4 (Chapter 3 of M-0, Standard Practice Maintenance Manual) to new o-ring (14).
21. Install new o-ring (14) and pump cover (15) on starter adapter (1). Secure with washer (22), lock washer (23) and nut (25). Torque nut to Appendix B specifications.
22. Install gasket (17) and accessory cover (18) on pump cover (15). Secure with washers (19), lock washers (20) and nuts (21). Torque nuts to Appendix B specifications.
23. Test the starter adapter assembly for slippage by installing the adapter in a fixture and apply torque to the input shaft. The adapter must be able to withstand 300 in-lbs of torque without slippage.

16-3.2. Starter Adapter with Accessory Drive Adapter Assembly

1. Lubricate outside diameter (OD) of new needle bearing (Figure 16-4)(4) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
2. Press needle bearing (4) into starter adapter (1) until needle bearing is 0.03 inches below inner surface. Apply Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to inside diameter (ID) of needle bearing.
3. Apply P/N 646942 Gasket Maker (Chapter 3 of M-0, Standard Practice Maintenance Manual) to OD of new seals (22 and 30).
4. Press new seals (22 and 30) into the accessory drive adapter (17).

WARNING

Failure to install plug (42) in accessory drive adapter (17) during starter adapter assembly will result in engine oil starvation and subsequent catastrophic engine failure shortly after engine start.

5. Verify plug (42) is installed.
6. Press new roller bearing (10) into the starter gear (11), using Bearing Installation Tool (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) and arbor press. Apply clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual) to roller bearing ID.

   NOTE: Press large radius end of roller bearing (Figure 16-4)(10) into starter gear (11).

7. Lubricate new clutch spring (9) liberally with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
8. Twist the new clutch spring (9) clockwise on to the back side of the starter gear (11) until the offset end drops into the gear land and the tang aligns with the screw hole in the gear web.
9. Install screw (13) with a new tab washer (12) in the threaded screw hole in the starter gear (11) web. Torque the screw to Appendix B specifications and secure the tab washer according to the “Tab Washer Installation” instructions in Appendix C-4.

   NOTE: Screw (13) must be inserted into clutch spring (9) notch.

10. Lubricate the starter shaft gear (3) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
11. Twist the assembled starter gear (11) and clutch spring (9) clockwise on the starter shaft gear (3) until the starter shaft gear contacts the roller bearing (10).
12. Install new woodruff key (16) into starter shaft gear (3) key slot.
13. Insert starter shaft gear (3) assembly into accessory drive adapter (17).
14. Lubricate accessory gear (18) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
15. Install accessory gear (18) into starter shaft gear (3).

16. Lubricate shaft gear (19) and driven gear (20) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

17. Install square key (41) on shaft gear (19) and start installing shaft gear through left accessory drive pad opening.

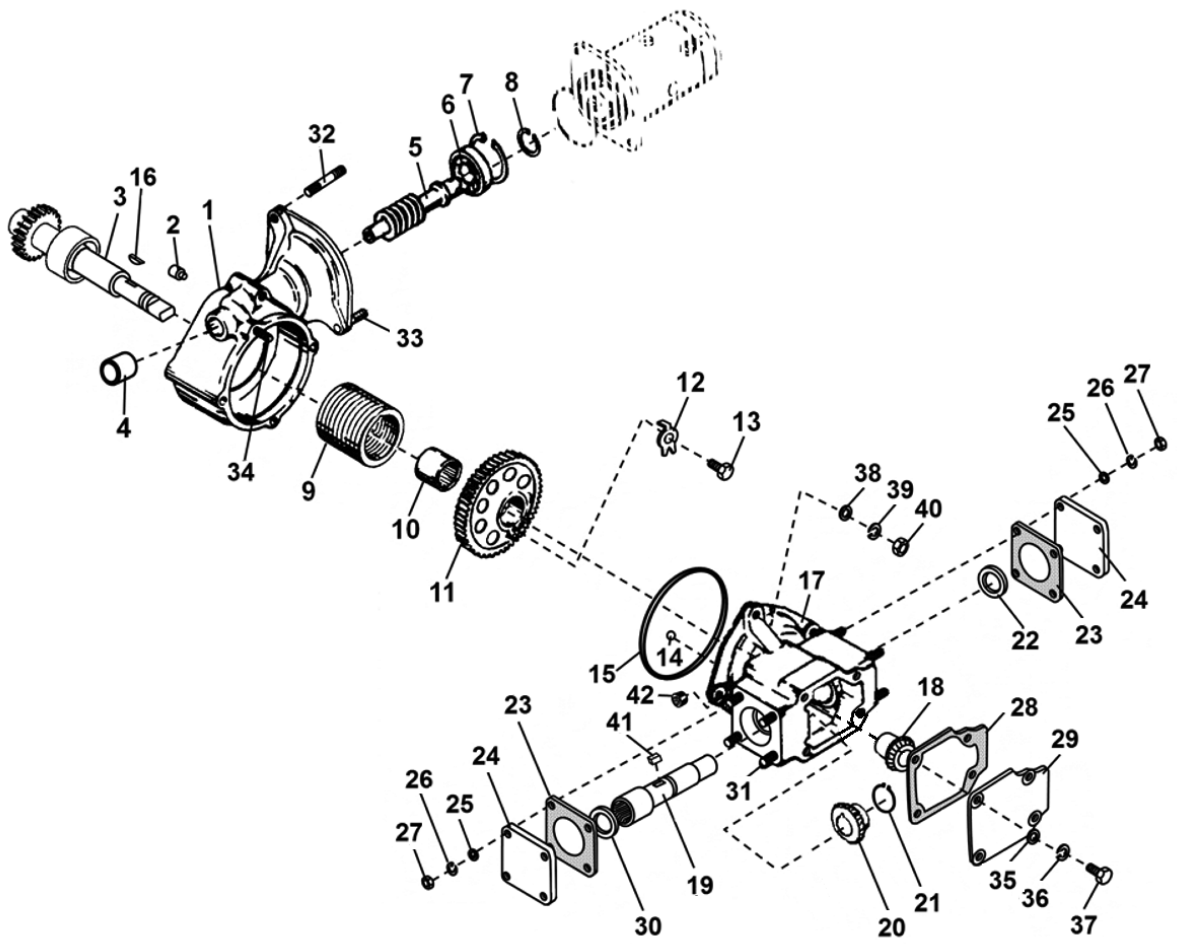


Figure 16-4. Starter Adapter with Accessory Drive Adapter Assembly

1	Starter Adapter	12	Tab Washer	23	Gasket	34	Stud
2	Dowel	13	Screw	24	Accessory Cover	35	Washer
3	Starter Shaft Gear	14	Ball	25	Washer	36	Lock Washer
4	Needle Bearing	15	O-ring	26	Lock Washer	37	Screw
5	Worm Shaft	16	Woodruff Key	27	Nut	38	Washer
6	Ball Bearing	17	Accessory Drive Adapter	28	Gasket	39	Lock Washer
7	Retaining Ring	18	Accessory Gear	29	Drive Adapter Cover	40	Nut
8	Retaining Ring	19	Shaft Gear	30	Oil Seal	41	Square Key
9	Clutch Spring	20	Driven Gear	31	Stud	42	Plug
10	Roller Bearing	21	Retaining Ring	32	Stud		
11	Starter Gear	22	Seal	33	Stud		

18. Install driven gear (20) through drive adapter cover (29) opening and onto shaft gear (19).

19. Install new retaining ring (21) on shaft gear (19) through drive adapter cover (29) opening. Continue installing shaft gear into accessory drive adapter (17).

    NOTE: Retaining ring (21) secures driven gear (20) to shaft gear. Verify seals (22 and 30) are seated correctly.

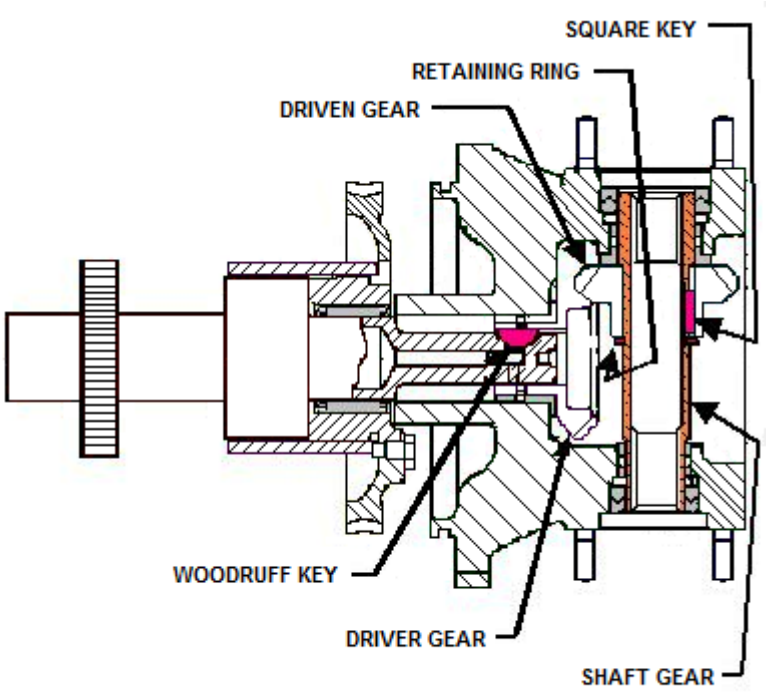


Figure 16-5. Starter Shaft Gear/Shaft Gear Assembly

20. Install new gaskets (23) and accessory covers (24). Secure with washers (25), new lock washers (26) and nuts (27). Torque nuts to Appendix B specifications.
21. Install new gasket (28) and drive adapter cover (29) on accessory drive adapter (17). Secure with washers (35), new lock washers (36) and screws (37). Torque screws to Appendix B specifications.
22. Lubricate inside diameter of the new ball bearing (6) and the end of the worm shaft (5) with Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual).
23. Press new ball bearing (6) onto worm shaft (5) until it seats against flange.
24. Install retaining ring (8) to secure ball bearing (6) on worm shaft (5).
25. Lubricate assembled ball bearing (6) and worm shaft (5) with Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual).
26. Insert the assembled ball bearing (6) and worm shaft (5) into the starter adapter (1).

    NOTE: Ensure worm gear and worm wheel teeth are aligned.

27. Install new retaining ring (7) to secure assembly (5 and 6) into the starter adapter (1).

28. Install starter adapter (1) in shielded vise.
29. Lubricate starter gear (11) teeth and starter shaft gear (3) teeth with Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual).
30. Apply Dow Corning No. 4 (Chapter 3 of M-0, Standard Practice Maintenance Manual) to new o-ring (15).
31. Install new o-ring (15) into the accessory drive adapter (17) groove.
32. Install assembled accessory drive adapter (17) onto starter adapter (1); turning clockwise to seat clutch spring. Ensure worm shaft (5) teeth and starter shaft gear (3) teeth are aligned and mesh properly. Secure with washer (38), new lock washer (39) and nut (40). Torque nut to Appendix B specifications.
33. Test the starter adapter assembly for slippage by installing the adapter in a fixture and apply torque to the input shaft. The adapter must be able to withstand 300 in-lbs of torque without slippage.

16-3.3. Starter Adapter with Accessory Drive Adapter with Gear Shaft Housing Assembly

1. Lubricate outside diameter (OD) of new needle bearing (Figure 16-6)(4) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
2. Press needle bearing (4) into starter adapter (1) until needle bearing is 0.03 inches below inner surface. Apply Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to inside diameter (ID) of needle bearing.
3. Apply P/N 646942 Gasket Maker (Chapter 3 of M-0, Standard Practice Maintenance Manual) to OD of new seals (22 and 30).
4. Press new seals (22 and 30) into the accessory drive adapter (17).

WARNING

Failure to install plugs (28 and 29) in accessory drive adapter (17) during starter adapter assembly will result in engine oil starvation and subsequent catastrophic engine failure shortly after engine start.

5. Verify plugs (28 and 29) are installed.
6. Press needle bearing (16) into scavenge pump cover (35) 0.000 to 0.010 below surface using arbor press.
7. Apply thin coat of Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to ID of needle bearing (16).
8. Apply thin coat of Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to ID of driven gear assembly (36) bushing and OD of accessory drive adapter (17) shaft.
9. Lubricate driven gear assembly (36) gear with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual) and install driven gear assembly onto accessory drive adapter shaft.
10. Install scavenge pump cover (35) into accessory drive adapter (17). Secure with six bolts (14) and new tab washers (12). Bolts to be finger tight at this time.
11. Insert starter shaft gear (3) into scavenge pump cover (35) and accessory drive adapter (17). Rotate starter shaft gear and adjust scavenge pump cover to ensure starter shaft gear rotates freely.
12. Carefully remove starter shaft gear (3) and torque bolts (14) to Appendix B specifications in a cross pattern. Reinstall starter shaft gear to verify shaft rotates freely. Secure tab washers according to instructions in Appendix C-4.
13. Press needle bearings (44) into gear shaft housing (46). Needle bearings should be 0.02 to 0.04 inches below surface. Refer to Figure 16-7.
14. Apply thin coat of Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to ID of needle bearings (44).
15. Press oil seal (45) into gear shaft housing (46).

16. Press new roller bearing (10) into the starter gear (11), using Bearing Installation Tool (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) and arbor press. Apply clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual) to roller bearing ID.

    NOTE: Press large radius end of roller bearing (Figure 16-6)(10) into starter gear (11) bore.

17. Lubricate new clutch spring (9) liberally with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

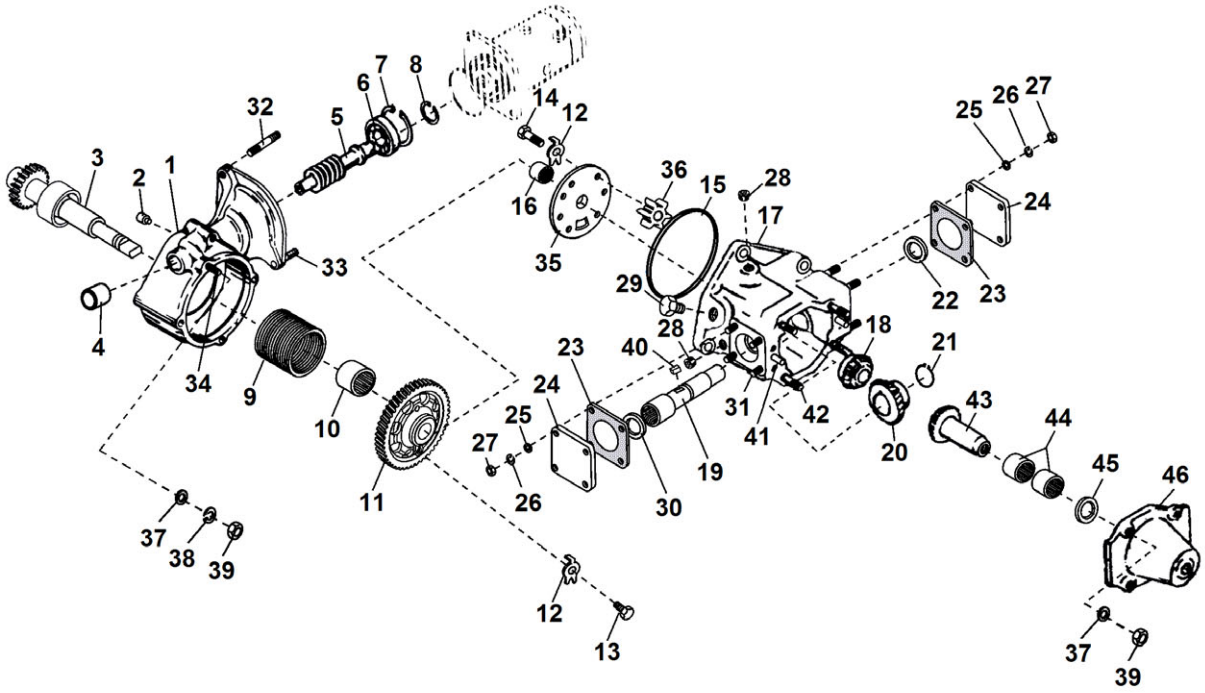


Figure 16-6. Starter Adapter with Accessory Drive Adapter with Gear Shaft Housing Assembly

1	Starter Adapter	13	Screw	25	Washer	37	Washer
2	Dowel	14	Bolt	26	Lock Washer	38	Lock Washer
3	Starter Shaft Gear	15	O-ring	27	Nut	39	Nut
4	Needle Bearing	16	Needle Bearing	28	Plug	40	Square Key
5	Worm Shaft	17	Accessory Drive Adapter	29	Plug	41	Dowel
6	Ball Bearing	18	Accessory Gear	30	Oil Seal	42	Stud
7	Retaining Ring	19	Shaft Gear	31	Stud	43	Driven Gear
8	Retaining Ring	20	Driven Gear	32	Stud	44	Needle Bearing
9	Clutch Spring	21	Retaining Ring	33	Stud	45	Oil Seal
10	Roller Bearing	22	Seal	34	Stud	46	Gear Shaft Housing
11	Starter Gear	23	Gasket	35	Scavenge Pump Cover		
12	Tab Washer	24	Accessory Cover	36	Driven Gear Assembly		

18. Twist the new clutch spring (9) clockwise on to the back side of the starter gear (11) until the offset end drops into the gear land and the tang aligns with the screw hole in the gear web.

19. Install screw (13) with a new tab washer (12) in the threaded screw hole in the starter gear (11) web. Torque the screw to Appendix B specifications and secure the tab washer according to the "Tab Washer Installation" instructions in Appendix C-4.

    NOTE: Screw (13) must be inserted into clutch spring (9) notch.

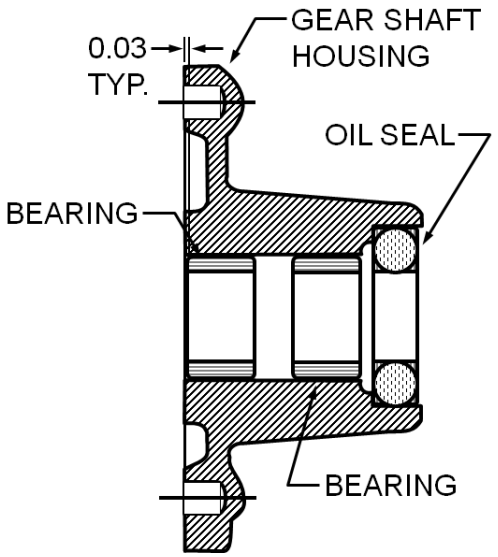


Figure 16-7. Gear Shaft Housing Bearings and Seal Assembly

20. Twist the assembled starter gear (11) and clutch spring (9) clockwise on the starter shaft gear (3) until the starter shaft gear contacts the roller bearing (10).

21. Lubricate the starter shaft gear (3) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

22. Insert starter shaft gear (3) assembly into scavenge pump cover (35) and accessory drive adapter (17).

23. Lubricate accessory gear (18) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

24. Install accessory gear (18) onto starter shaft gear (3).

25. Lubricate shaft gear (19) and driven gear (20) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

26. Install square key (40) on shaft gear (19) and start installing shaft gear through left accessory drive pad opening.

27. Install driven gear (20) through accessory drive adapter (17) opening and onto shaft gear (19).

28. Install new retaining ring (21) on shaft gear (19) through accessory drive adapter (17) opening. Continue installing shaft gear into accessory drive adapter.

    NOTE: Retaining ring (21) secures driven gear (20) to shaft gear. Verify seals (22 and 30) are seated correctly.

29. Lubricate driven gear (43) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

30. Install driven gear (43) into gear shaft housing (46).

31. Apply thin coat of P/N 654663 Gasket Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) evenly on flanged surface of gear shaft housing (46). Allow Gasket Sealant to cure until it is slightly tacky.

    NOTE: Avoid using excessive amounts of P/N 654663 Gasket Sealant.

32. Apply #50 silk thread on gear shaft housing (46) flange following the pattern in Figure 16-8.

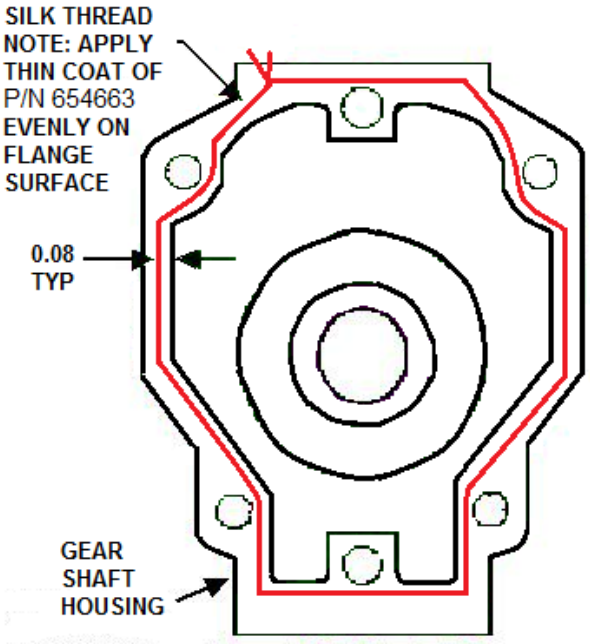


Figure 16-8. Gear Shaft Housing Silk Thread Pattern

33. Carefully install gear shaft housing (46) to accessory drive adapter (17). Secure with washers (37) and nuts (39). Torque nuts to Appendix B specifications and safety wire according to instructions in Appendix C-3.

    NOTE: Do not damage silk thread.

34. Install new gaskets (23) and accessory covers (24). Secure with washers (25), new lock washers (26) and nuts (27). Torque nuts to Appendix B specifications.

35. Lubricate ID of the new ball bearing (6) and the end of the worm shaft (5) with Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual).

36. Press new ball bearing (6) onto worm shaft (5) until it seats against flange.

37. Install retaining ring (8) to secure ball bearing (6) on worm shaft (5).
38. Lubricate assembled ball bearing (6) and worm shaft (5) with Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual).
39. Insert the assembled ball bearing (6) and worm shaft (5) into the starter adapter (1).

    NOTE: Ensure worm gear and worm wheel teeth are aligned.

40. Install new retaining ring (7) to secure assembly (5 and 6) into the starter adapter (1).
41. Install starter adapter (1) in shielded vise.
42. Apply Dow Corning No. 4 (Chapter 3 of M-0, Standard Practice Maintenance Manual) to new o-ring (15).
43. Install new o-ring (15) in accessory drive adapter (17) groove.
44. Lubricate starter gear (11) teeth and starter shaft gear (3) teeth with Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual).
45. Install assembled accessory drive adapter (17) onto starter adapter (1); turning clockwise to seat clutch spring. Ensure worm shaft (5) teeth and starter shaft gear (3) teeth are aligned and mesh properly. Secure with washer (37), new lock washer (38) and nut (39). Torque nut to Appendix B specifications.
46. Test the starter adapter assembly for slippage by installing the adapter in a fixture and apply torque to the input shaft. The adapter must be able to withstand 300 in-lbs of torque without slippage.

16-4. Exhaust System Assembly

Refer to the aircraft manufacturer's instruction for exhaust system assembly. Continental Motors engine assembly requires new exhaust flange studs, new exhaust flange gaskets and new nuts.

16-5. Engine Cylinder Assembly

Prior to engine cylinder assembly, ensure all cylinders and components were cleaned, and inspected and parts replaced according to instructions in:

- Chapter 12, “Engine Cleaning” of M-0, Standard Practice Maintenance Manual
- Chapter 15, “Overhaul Inspection and Repair”

WARNING

Do not apply <u>any</u> form of sealant to the crankcase cylinder deck, chamfer, cylinder mounting flange, cylinder base O-ring, or cylinder fastener threads. The use of RTV, silicone, Gasket Maker or <u>any</u> other sealant on the areas listed above during engine assembly will cause a loss of cylinder deck stud or through bolt torque. Subsequent loss of cylinder attachment load, loss of main bearing crush and/or fretting of the crankcase parting surfaces will occur. The result will be cylinder separation, main bearing movement, oil starvation and catastrophic engine failure. USE ONLY CLEAN 50 WEIGHT AVIATION ENGINE OIL ON SURFACES LISTED.

16-5.1. Cylinder Component Preparation

1. Thoroughly clean the new or repaired cylinder baffles, cylinders, new intake valves, new exhaust valves, new rocker arm bushings, new rotocoils, new valve spring keys, new pistons, new piston rings, new piston pin and plug assembly, push rod housings, new inner and outer springs, and washers with mineral spirits and air dry.
2. Inspect parts for damage that may have occurred during handling or shipment.
3. Clean the cylinder bore, using hot, soapy water and a hard bristle scrub brush. Thoroughly remove the soap residue by rinsing the cylinder with hot water. Dry the cylinder completely.
4. Thoroughly coat all bare steel surfaces with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

16-5.2. Piston Ring Gap Adjustment

1. Ensure the new piston and piston rings (Figure 16-9) are the correct size for the cylinder bore size. Inspect the piston-to-cylinder clearance of each matching piston and cylinder.
2. Thoroughly coat the cylinder barrel with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
3. Inspect each piston ring for the proper gap in the cylinder bore in which it will be assembled.
4. Insert one piston ring at a time in the cylinder bore; use the piston to push the piston ring to the cylinder barrel depth specified in Appendix D-6.
5. Remove the piston and inspect the ring gap using a leaf type feeler gauge. If the piston ring meets the specified gap, proceed to the next ring measurement. If the ring gap is less than specified, record the actual gap size and remove the ring from the cylinder bore.
   a. Mount a fine toothed, flat file in a vise. Hold the ring ends firmly and squarely against the file. In a deliberate back and forth motion, remove small amounts of material. Recheck the ring end gap in the cylinder until the ring meets the specified gap. Confirm the gap for the second new piston ring is at least 0.006 inch larger than the gap for the top ring.
   b. After filing, deburr the ring gap ends using crocus cloth and thoroughly clean the piston ring with mineral spirits and air dry.
   c. Discard piston rings that exceed the specified piston ring gap dimensions.

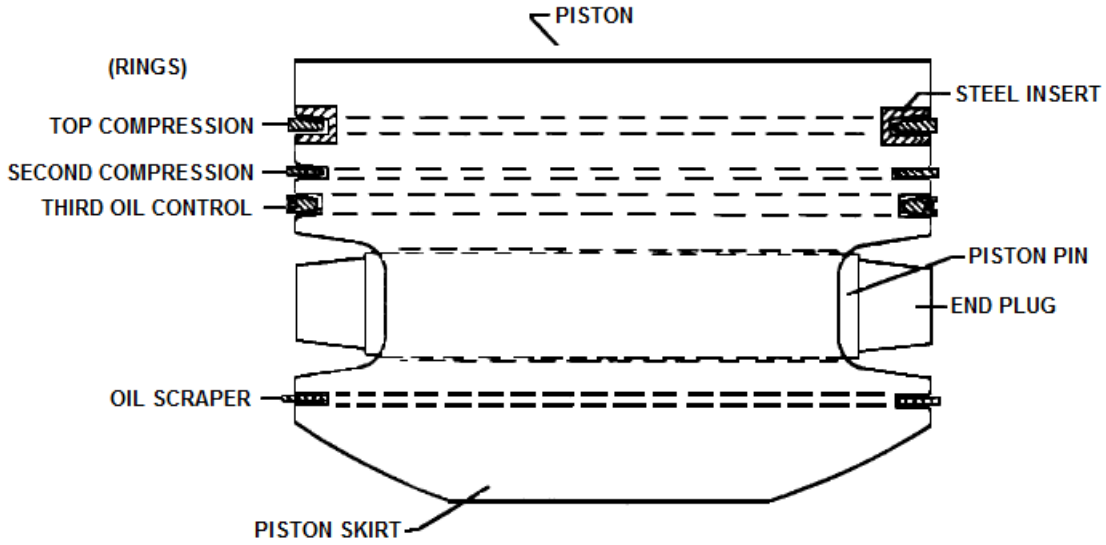


Figure 16-9. Piston Ring Installation Order

6. Install all new piston rings (Figure 16-16)(2 through 5) on the new pistons with the part number facing toward the top of the piston, using a ring expander (Chapter 2-1 of M-0, Standard Practice Maintenance Manual).

a. Install a new expander ring in the new oil control ring groove so the expander gap is 180° away from the oil control ring gap.

b. Install a #3 piston ring in the #3 ring groove of the piston with the oil control ring gap at the 12 O'clock (referenced to the piston's installed position in the cylinder) position.

c. Install a new second compression ring (3) into the #2 ring groove with the ring gap at the 3 O'clock position.

d. Install a new top compression ring (2) into the #1 ring groove with the ring gap at the 9 O'clock position.

e. Install a new oil scraper ring (5) into the fourth ring groove with the ring gap at the 6 O'clock position.

7. Inspect piston ring side clearances with the ring edge flush with the piston outside diameter. Piston ring side clearances must conform to Appendix D dimensional limits.

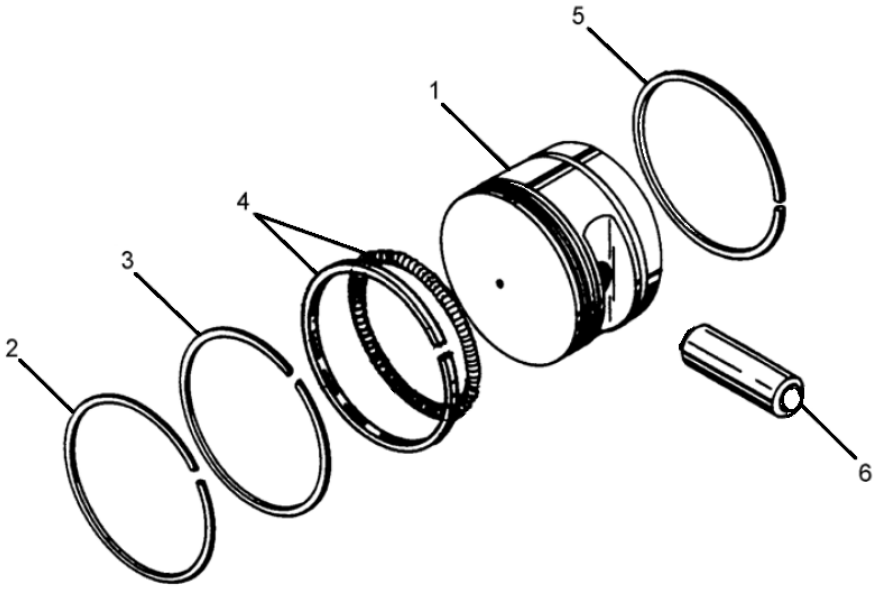


Figure 16-10. Pistons, Piston Rings and Piston Pin Assembly

NOTE: Weight differences of piston pairs in opposing cylinders must not exceed 1/2 ounce or 14.175 grams.

8. Lubricate the piston pin, piston, and ring assemblies with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

9. Place the new piston and ring assembly with the cylinder assembly for which it was previously sized and gapped. Insert the piston pin in the piston pin bore; the piston pin must slide freely in the piston pin bore.

10. Using a ring compressor (Chapter 2-1 of M-0, Standard Practice Maintenance Manual), install each piston into its cylinder until the top three rings are in the cylinder barrel and the piston pin bore is accessible for connecting rod installation.

16-5.3. Valve Train Installation

1. Apply Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) over the entire length of the valve stems and insert the new intake and exhaust valves in the cylinders for which they have been lapped.
2. Grasp the cylinders by the valve stems and install the cylinder on a cylindrical block of wood anchored to a work bench.
3. Place the inner valve spring seat (Figure 16-13)(11) over the valve guides (8 and 10), cupped side up.
4. Coat the sealing surface of a new intake valve guide seal (9) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual) and position the new intake valve guide seal on the valve guide by hand.
5. Using the Valve Guide Seal Installation Tool (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) and a plastic mallet, tap the seal (9) onto the guide until it is firmly seated.
6. Place the new inner valve spring (Figure 16-13)(13) inside the new outer valve spring (12).
7. Install the new inner and outer springs (12 and 13), with the closed coils toward the cylinder head. Refer to Figure 16-11.

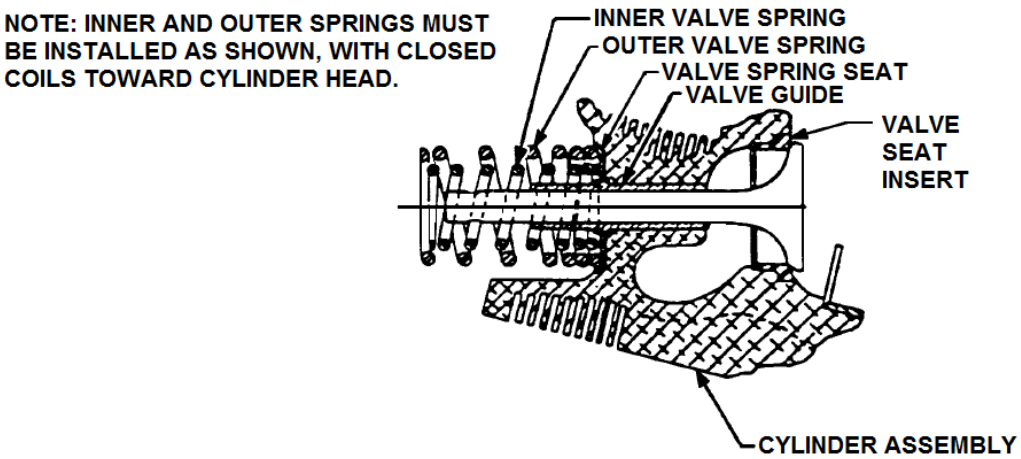


Figure 16-11. Valve and Spring Assembly

8. Place new rotocoils (14) on the intake and exhaust valve springs.

WARNING

Ensure the Valve Spring Compressor contacts the valve spring rotocoil evenly. Applying pressure to only one side of the rotocoil will damage the valve stem (or rotocoil). Before releasing pressure on the springs, ensure the keys are properly seated in the valve stem grooves.

9. Using the Valve Spring Compressor Tool (Chapter 2-1 of M-0, Standard Practice Maintenance Manual), compress the valve springs and insert the two new valve

spring keys (15). Depress the springs only enough to permit the keys to seat in the valve stem grooves. If the keys drop, they may damage the valve stem when spring tension is released.

10. Remove the cylinder from the fixture and place it upright on a workbench.
11. Place a plastic mallet squarely on the end of the valve stem and strike the plastic mallet sharply with a rawhide mallet to ensure correct seating of the valve spring keys. DO NOT STRIKE THE ROTOCOIL.
12. Verify the valve spring keys (15) are properly positioned on each valve stem, with two keys on each valve stem.
13. Install springs (16) on baffles (17) so hook end faces toward outer end of cylinder.
14. Install baffles (17) on all cylinders. Fish free end of spring (16) up through cylinder fins and hook in groove provided, use a piece of thin stiff wire. Refer to Figure 16-12.
15. Carefully position the cylinder (1) assembly with the cylinder bore facing upward and the cylinder resting on the rocker shaft mounting bosses.

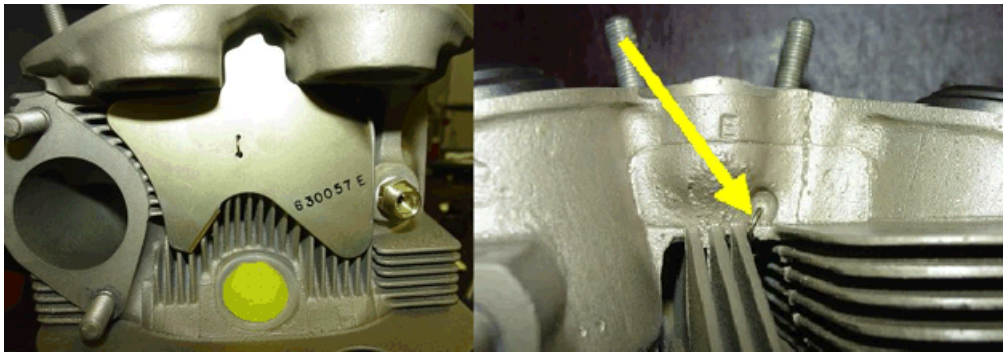


Figure 16-12. Baffle Installation

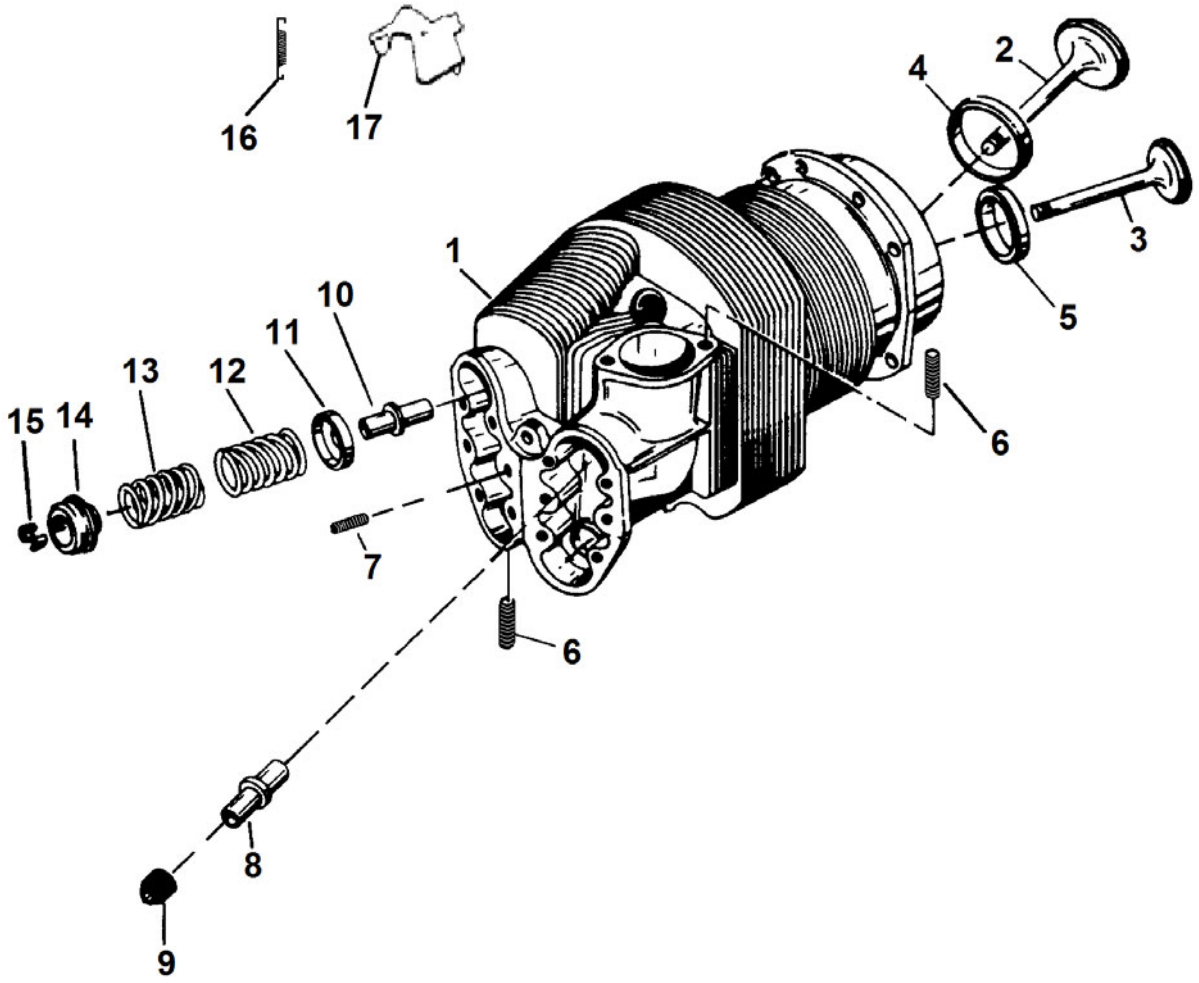


Figure 16-13. Cylinder Assembly

1	Cylinder	6	Stud	11	Valve Spring Seat	16	Spring
2	Intake Valve	7	Stud	12	Outer Valve Spring	17	Baffle
3	Exhaust Valve	8	Intake Valve Guide	13	Inner Valve Spring		
4	Intake Valve Seat Insert	9	Intake Valve Guide Seal	14	Rotocoil		
5	Exhaust Valve Seat Insert	10	Exhaust Valve Guide	15	Valve Spring Key		

16-5.4. Cylinder Component Assembly

1. Install a new o-ring (Figure 16-14)(39) on the cylinder end of the push rod housings (38).
2. Place two each, push rod housings (38), new springs (40), new seals (42) and two washers (41) with each cylinder on the workbench.

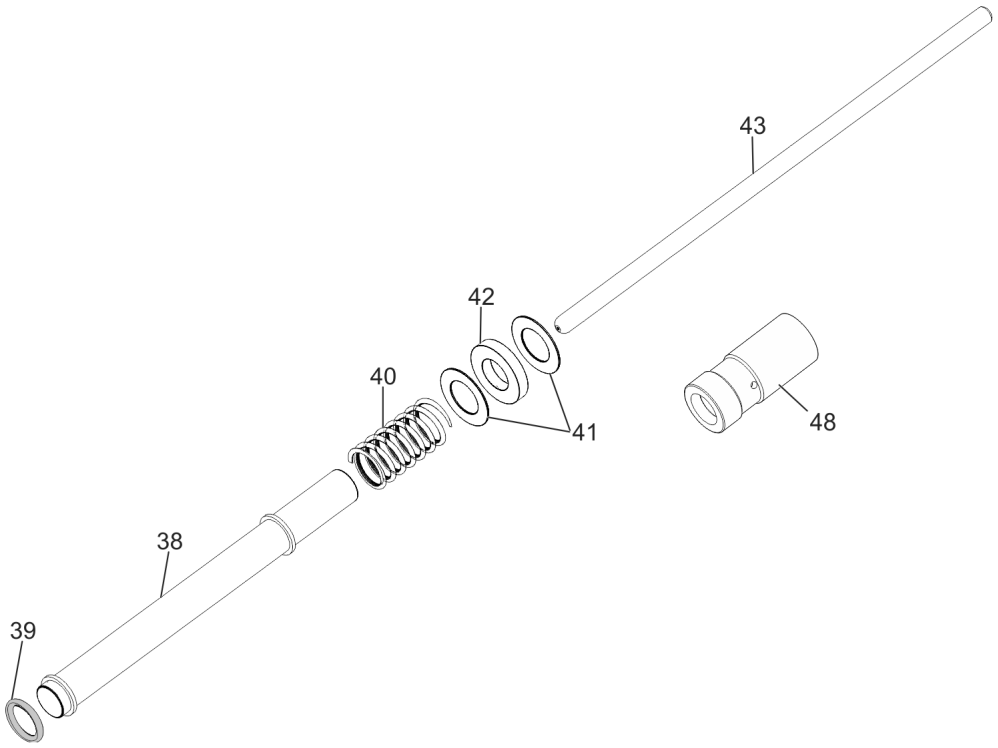


Figure 16-14. Cylinder Push Rod Tube Assembly

16-6. Oil Pump Assembly

1. Install bushing (Figure 16-15)(2) in accessory case (1), use arbor press.
2. Apply Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to bottom of oil pump cavity, oil pump gear (3) and oil pump driven gear assembly (4).
3. Install oil pump driven gear assembly (4) on shaft in oil pump cavity.
4. Install oil pump gear (3) in oil pump cavity.

   NOTE: Slotted shaft end extends out of oil pump cavity.

5. Using fingers, turn oil pump gear (3) and ensure both gears turn freely.
6. Install pump cover (5) using four tab washers (7) and bolts (8). Torque bolts to Appendix B specifications.
7. Install oil pump drive gear (6) and turn four to five complete rotations to verify gears turn freely.

   NOTE: If gears do not turn freely, remove oil pump drive gear (6), bolts (8), tab washers (7) and pump cover (5). Replace pump cover and repeat steps 6 and 7.

8. Secure tab washers (7) according to the “Tab Washer Installation” instructions in Appendix C-4.
9. If engine model does not use a tachometer drive, install nut (9) on oil pump drive gear (6). Torque nut to Appendix B specifications.

   NOTE: Cover for nut (9) will be installed with accessory case installation in Section 17-5.

10. If engine model uses a tachometer drive, install nut (9) hand tight to secure oil pump drive gear (6) until accessory case installation in Section 17-5.

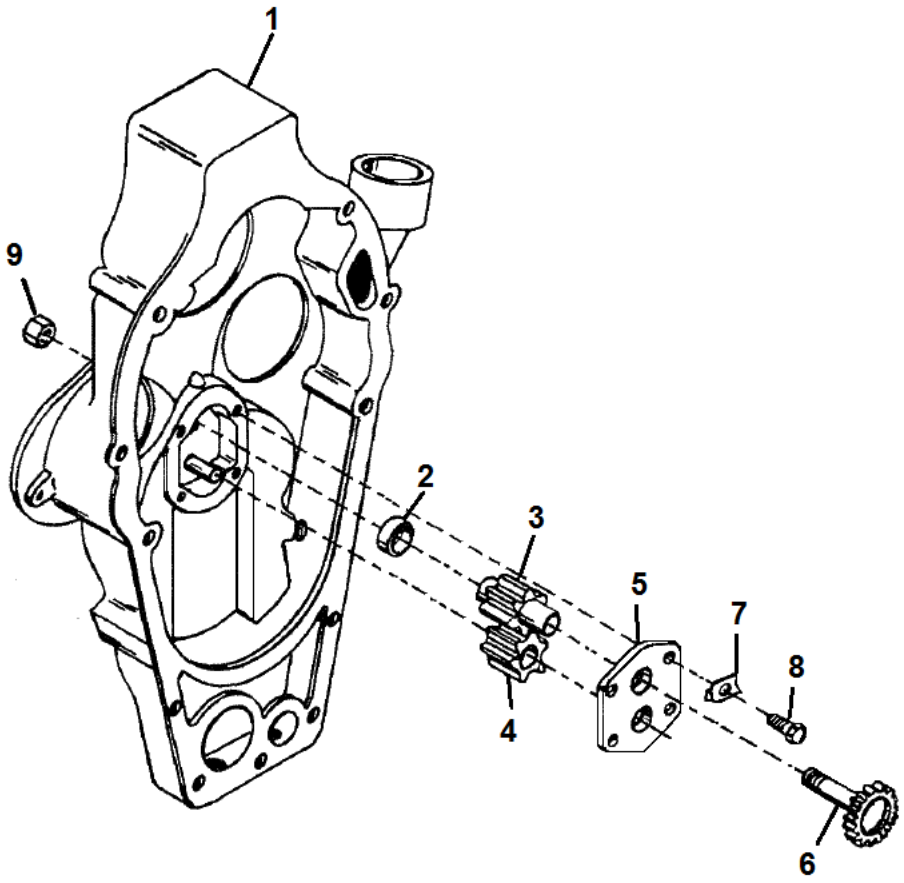


Figure 16-15. Oil Pump Assembly

1	Accessory Case	4	Oil Pump Driven Gear Assembly (6T)	7	Tab Washer
2	Bushing	5	Pump Cover	8	Bolt
3	Oil Pump Gear (6T)	6	Oil Pump Drive Gear (23T)	9	Nut

16-7. Crankcase Assembly

The IO-360 series crankcase attaching parts vary slightly depending on the engine model and specification. Some have oil gage rod housing extensions and clamp variations. Figure 16-18 is one example. Use the following instructions according to the appropriate instructions that match the installed engine configuration. Refer to the illustrated parts catalog for engine configuration.

1. Install new pipe plugs.
   a. Apply Loctite 592 Teflon PS/T Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) sparingly on the pipe plug male threads.
   b. Install the crankcase pipe plugs removed during disassembly in the locations indicated on the tags. Install the plugs identified in Appendix D-8.5, “Crankcase Plugs and Bushing”. The plugs must be installed in all of the corresponding locations to prevent oil leakage or pressure loss. Torque the plugs to Appendix B specifications.
2. Apply a film of Dow Corning No. 4 (Chapter 3 of M-0, Standard Practice Maintenance Manual) on both sides of gasket (Figure 16-18)(9).
3. Install gasket (9) on governor pad studs.
4. Install cover (10) and secure with spacers (11), washers (12), new lock washers (13) and nuts (14). Torque the nuts to Appendix B specifications.
5. Lubricate o-rings (5 and 6) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual) and install on engine mount pads.
6. On IO-360-**AF**, **ES** series, install spacer (27) on 1-3-5 side rear engine mount bracket studs.
7. Install engine mount brackets (1, 2, 3 and 4) and secure with washers (7) and nuts (8). Torque the nuts to Appendix B specifications.
8. Slide extension hose (16) and clamps (15 and 17) onto the housing extension (19) above the housing extension bead.
9. Seat housing extension (19) into the oil rod housing (18). Ensure the housing extension bead fits securely against the oil rod housing. Refer to Figure 16-17.
10. Slide extension hose (16) onto the oil rod housing (18); ensure hose is centered over connection joint. Position clamps (15 and 17) on hose; ensure a minimum of 1/4” of hose extends beyond each clamp. Torque clamps to secure hose according to Appendix B specifications. Refer to Figure 16-17.
11. Install retaining ring (26) into housing extension (19).
12. Install screw (20), nut (23), washer (22), clamps (21 and 24) and support bracket (25) onto housing extension (19).
13. Lubricate mag gear stud threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

14. Install mag gear shafts and lock nuts on studs on both crankcase halves. Torque nuts to Appendix B specifications. Refer to Figure 16-16.

NOTE: Align roll pin on mag gear shafts with hole in crankcase halves.

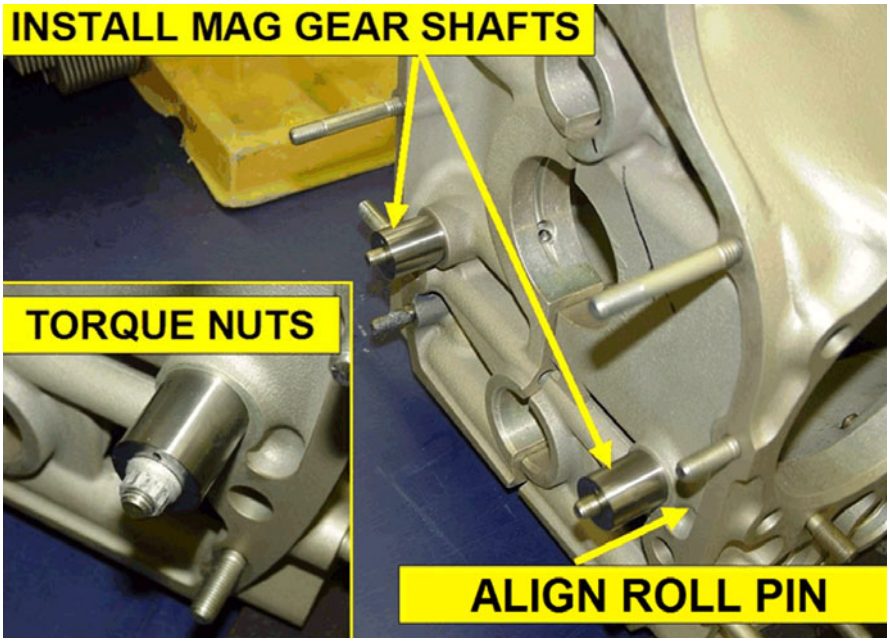


Figure 16-16. Mag Gear Shafts Installation

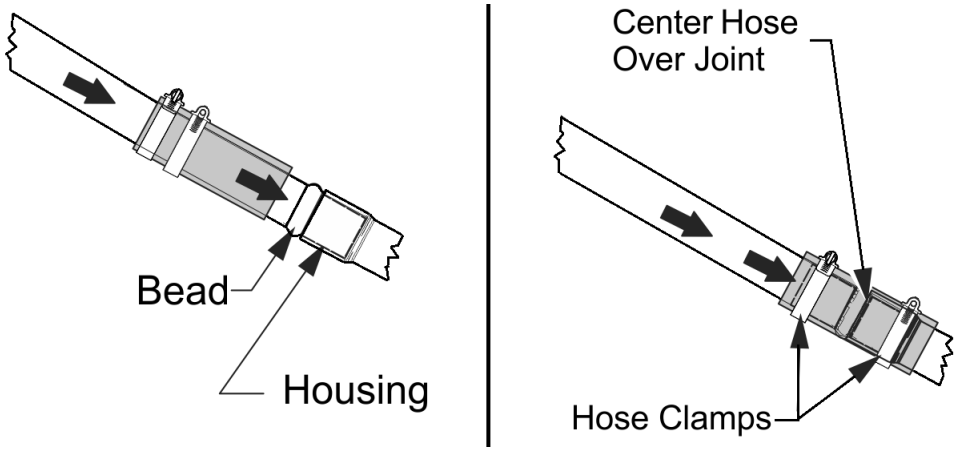


Figure 16-17. Housing Extension into Oil Rod Housing

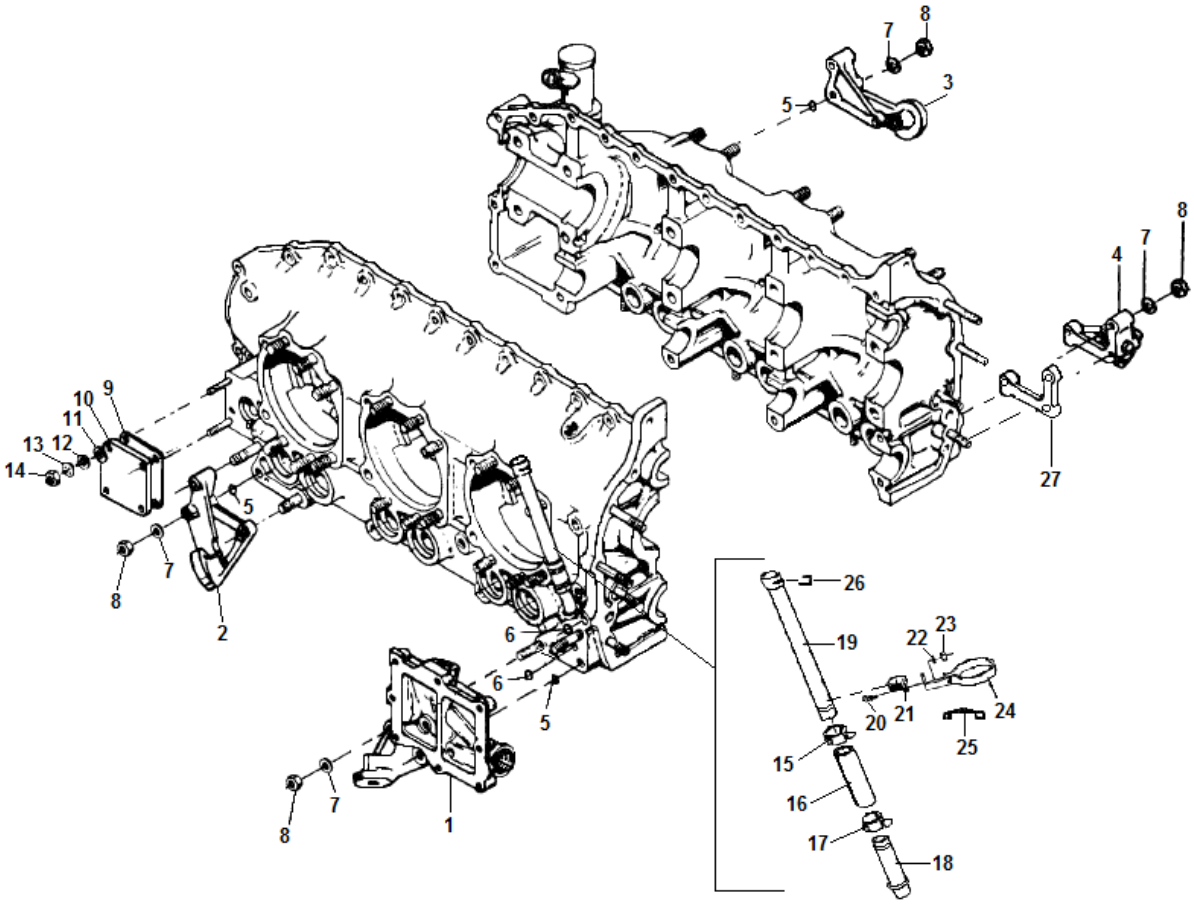


Figure 16-18. Crankcase Assembly

1	Mount Bracket	8	Nut	15	Clamp	22	Washer
2	Mount Bracket	9	Gasket	16	Extension Hose	23	Lock Nut
3	Mount Bracket	10	Cover	17	Clamp	24	Clamp
4	Mount Bracket	11	Spacer	18	Oil Rod Housing	25	Support Bracket
5	O-ring	12	Washer	19	Housing Extension	26	Retaining Ring
6	O-ring	13	Lock Washer	20	Screw	27	Spacer
7	Washer	14	Nut	21	Clamp		

16-8. Engine Drive Train Assembly

16-8.1. Camshaft Assembly

1. Coat the governor drive gear (Figure 16-19)(2), camshaft gear (5) and camshaft (4) with 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
2. Install new woodruff key (3) on the camshaft (4).

   NOTE: It may be necessary to use a brass mallet to seat the woodruff key (3).
3. Install the governor drive gear (2) onto the camshaft (4).
4. Install the camshaft gear (5) on the camshaft (4).

   NOTE: The camshaft gear (5) bolt holes are offset to allow only one correct installed position for the engine timing mark.
5. Install four new bolts (6). Torque bolts to Appendix B specifications in a cross pattern.
6. Safety wire the bolt (6) heads according to instructions in Appendix C-3.

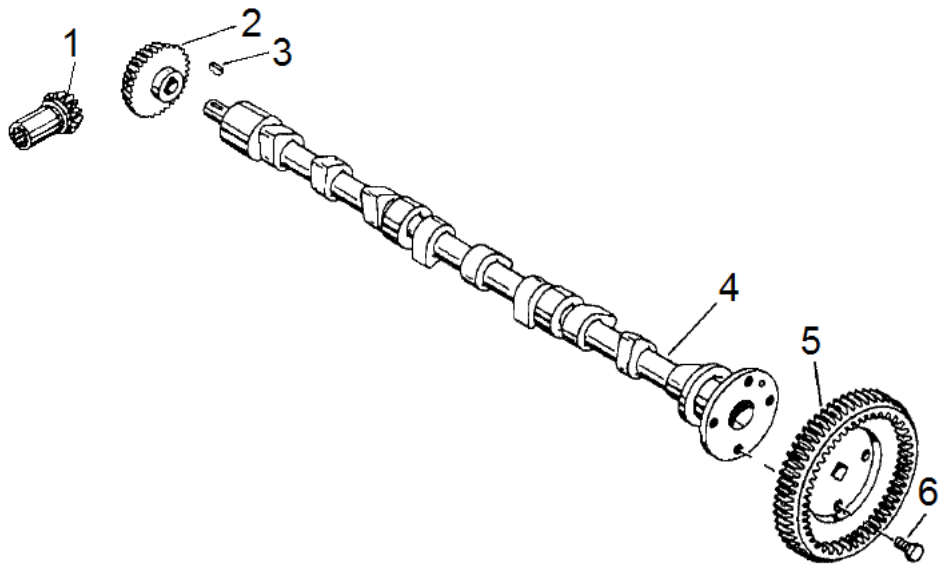


Figure 16-19. Camshaft Assembly

1	Governor Driven Gear	3	Woodruff Key	5	Camshaft Gear
2	Governor Drive Gear	4	Camshaft	6	Bolt

16-8.2. Crankshaft Assembly

WARNING

Do not assemble and install the crankshaft if the V/U etching is absent from the propeller flange. Refer to Section 15-6.2.

1. Place the crankshaft (Figure 16-20)(1) on a bench with a notched wooden block under the front and rear main journals.

   CAUTION: Do not heat the gear cluster more than 10 minutes.

2. Use a uniform heating method (not a torch), heat the cluster gear (15) to 300°F (149°C) for 5 to 10 minutes. Heating the gear is necessary for a shrink fit installation.

3. While the cluster gear (15) is still hot, align the dowel hole in the gear with the crankshaft dowel (10) and tap the cluster gear on the crankshaft (1).

4. Attach the cluster gear (15) using four new bolts (16). Torque bolts in a crisscross pattern to Appendix B specifications.

5. Safety wire bolts (16) according to instructions in Appendix C-3.

   CAUTION: The minimum gap between the retaining ring ears must be 0.212 inches (5.38 mm) for proper seating.

   CAUTION: Check the actual interference fit of the counterweight plates in the bushing bore during installation. Do not install loose fitting counterweight plates. Do not install retainer plates on counterweights that have a loose fit between the retainer plate and the counterweight.

6. Install two retainer plates (8) and two retaining rings (9) on one side of counterweight (4). Measure the distance between the two retaining ring ears after installation - minimum gap is 0.212. If the gap is smaller, the retaining ring is not seated in the groove - remove the retaining ring and repeat the installation procedure.

   NOTE: Ensure retainer plates (8) have no burrs or sharp edges before installation in counterweight (4).

   NOTE: Retaining ring (9) must be installed with “flat or sharp edge” outboard. Refer to Figure 16-21.

   CAUTION: Do not mix pins in the same counterweight.

7. Install counterweight (4) on crankshaft (1) blade and insert correct pins (6 or 7).

   NOTE: Some IO-360 series engines use four (-109) pins and some use two (-110) pins in one counterweight and two (-111) pins in the other counterweight. Refer to the illustrated parts catalog for correct pins.

8. Install two retainer plates (8) and two retaining rings (9) on other side of counterweight (4) from step 6 side. Measure the distance between the two retaining ring ears after installation - minimum gap is 0.212. If the gap is smaller, the retaining ring is not seated in the groove - remove the retaining ring and repeat the installation procedure.

   NOTE: Ensure retainer plates (8) have no burrs or sharp edges before installation in counterweight (4).

   NOTE: Retaining ring (9) must be installed with “flat or sharp edge” outboard. Refer to Figure 16-21.

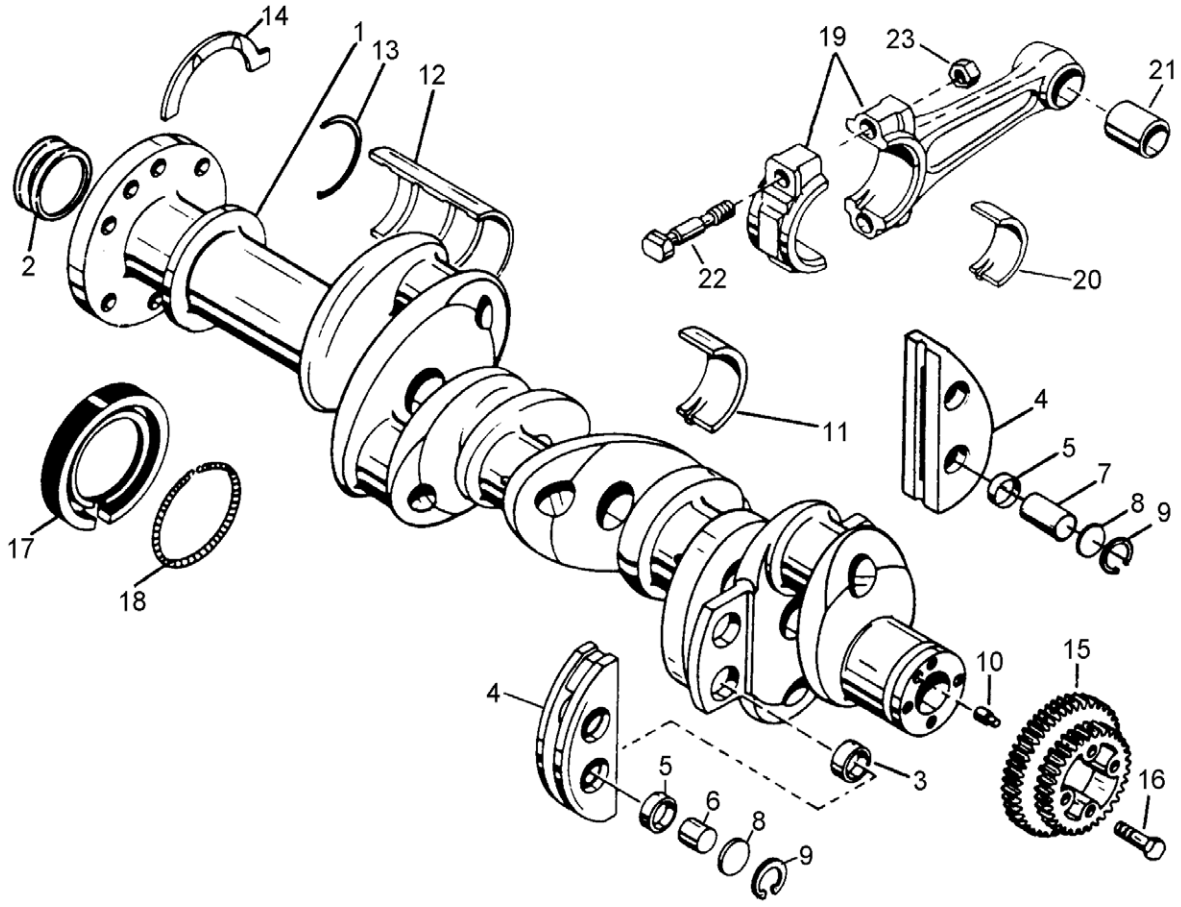


Figure 16-20. Crankshaft Assembly

1	Crankshaft Assembly	7	Pin - G, H, J and K Models	13	Packing	19	Connecting Rod Assembly
2	Plug	8	Retainer Plate	14	Thrust Washer	20	Bearing
3	Bushing	9	Retaining Ring	15	Cluster Gear	21	Bushing
4	Counterweight	10	Dowel	16	Bolt	22	Bolt
5	Bushing	11	Bearing	17	Oil Seal	23	Nut
6	Pin	12	Bearing	18	Seal Spring		

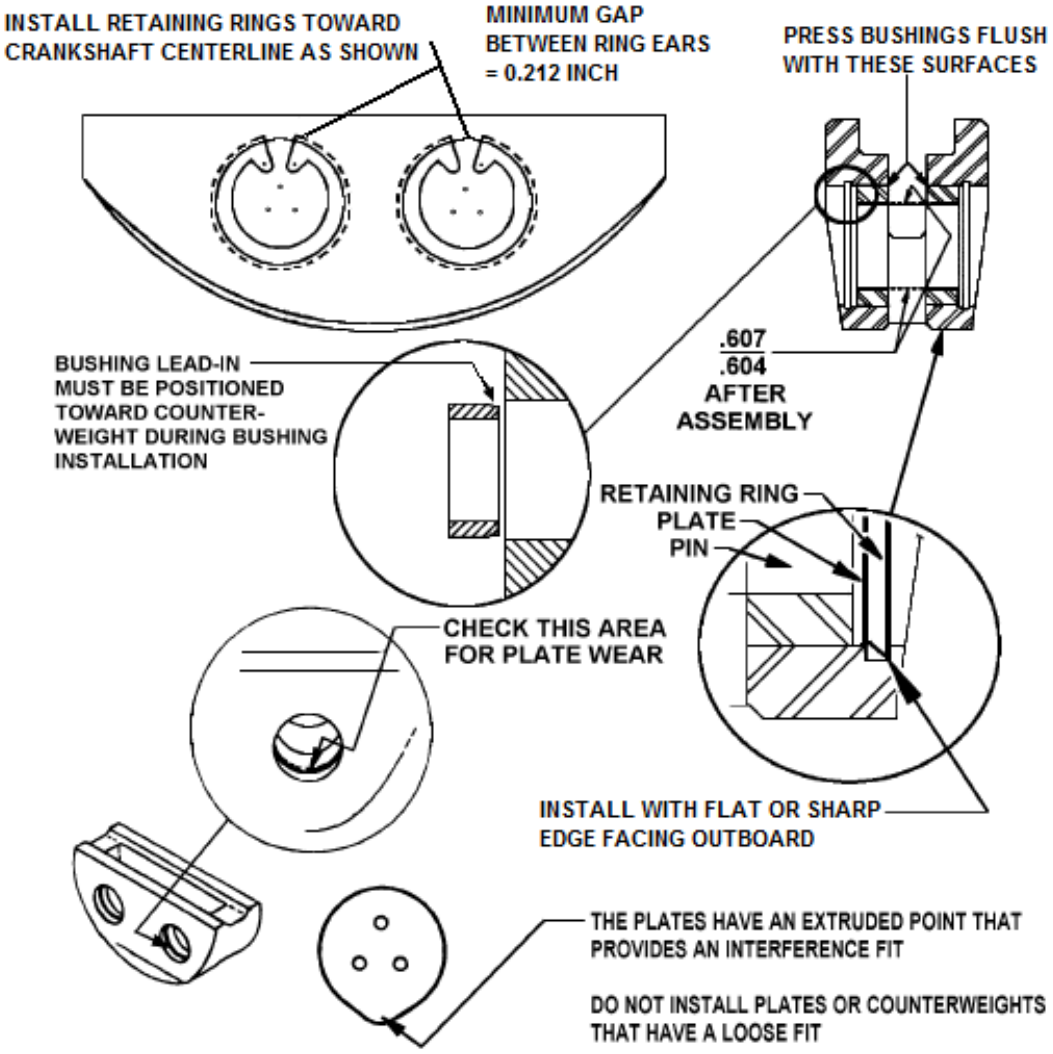


Figure 16-21. Counterweight Inspection, Repair and Installation

16-8.3. Connecting Rod and Bearing Assembly

1. Dampen a sheet of crocus cloth with solvent and place it on a flat surface plate.
2. Lightly rub the parting surface of the cap and rod across the crocus cloth to remove any burrs or nicks. Inspect the parting surfaces, bolt holes and bolt hole edges to ensure there are no nicks, burrs or sharp edges.
3. Original connecting rods are numbered 1 through 6 to identify the installed crankpin position. Vibro-etch new connecting rods and cap pairs with the position numbers of the connecting rod assembly (Figure 16-20)(19) being replaced, in the location shown in Figure 16-22.

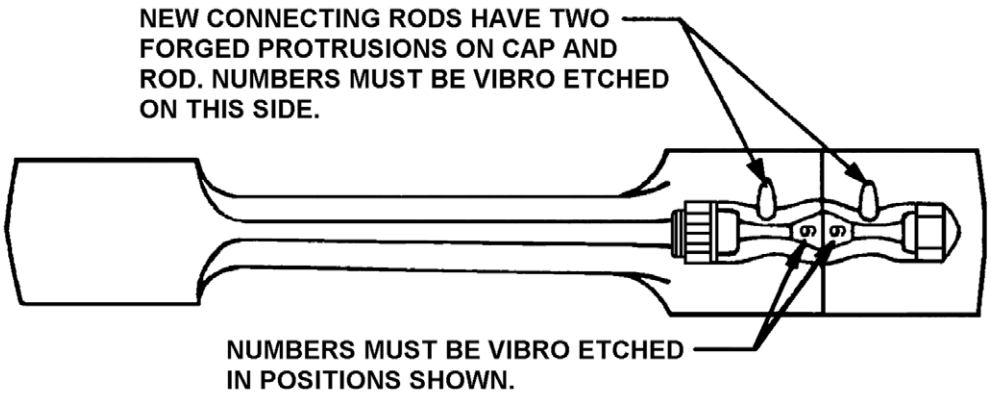


Figure 16-22. Connecting Rod Position Number

4. Install a new connecting rod bearing (20) in each connecting rod assembly (19). Ensure the bearing ends project the same distance, even with the parting surface and they are properly seated.
5. Look closely for and remove any metal that may have shaved from the bearing back onto the parting surface during assembly.
6. Lubricate the new connecting rod assemblies (19) cap and rod side of the connecting rod bearings (20), the threads of the new bolts (22) and new nuts (11) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual). Insert the new bolts (22) through the lower side of the connecting rod cap.
7. Viewing the crankshaft (1) from the rear (gear end), install the No. 1 connecting rod on the right side of the crankshaft at crankpin No. 1 with the position number facing up. Align the connecting rod cap and bolts with the connecting rod, position number facing up and secure the assembly on the crankshaft with new nuts (23). Repeat for the No. 3 and No. 5 connecting rod assemblies.
8. Viewing the crankshaft (1) from the rear (gear end), install the No. 2 connecting rod on the left side of the crankshaft at crankpin No. 2 with the position number facing up. Align the connecting rod cap and bolts with the connecting rod, position number facing up and secure the assembly on the crankshaft with new nuts (23). Repeat for the No. 4 and No. 6 connecting rod assemblies.
9. Torque the connecting rod nuts (23) to Appendix B specifications.
10. Check connecting rod on crankshaft pin side clearance according to Appendix D specifications.

16-8.4. Crankshaft Nose Oil Seal Assembly

1. Remove the seal spring (Figure 16-20)(18) from the crankshaft nose oil seal (17).
2. Unhook the seal spring (18) ends, using an unwinding motion.
3. Verify the seal spring length is 7.53” to 7.59” as illustrated in Figure 16-23. If the spring length is not within this tolerance, replace it.
4. Place the seal spring (18) around the crankshaft (1) in the helix area.
5. Turn the seal spring (18) ends in an unwinding direction and allow one end to wind into the other end.
6. Apply P/N 654561 grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the lip of the new oil seal (17).
7. Twist the split oil seal (17) and slide over the crankshaft (1). Bring the ends of the seal back together.
8. After the oil seal (17) is installed on the crankshaft (1), wipe the grease from the oil seal and crankshaft. Verify the outer diameter of the oil seal is clean and dry.
9. Press the seal spring (18) into the oil seal (17) recess cavity. Ensure the seal spring is in the deepest part of the oil seal recess cavity all the way around and the hooked ends of the seal spring are opposite of the seal split.

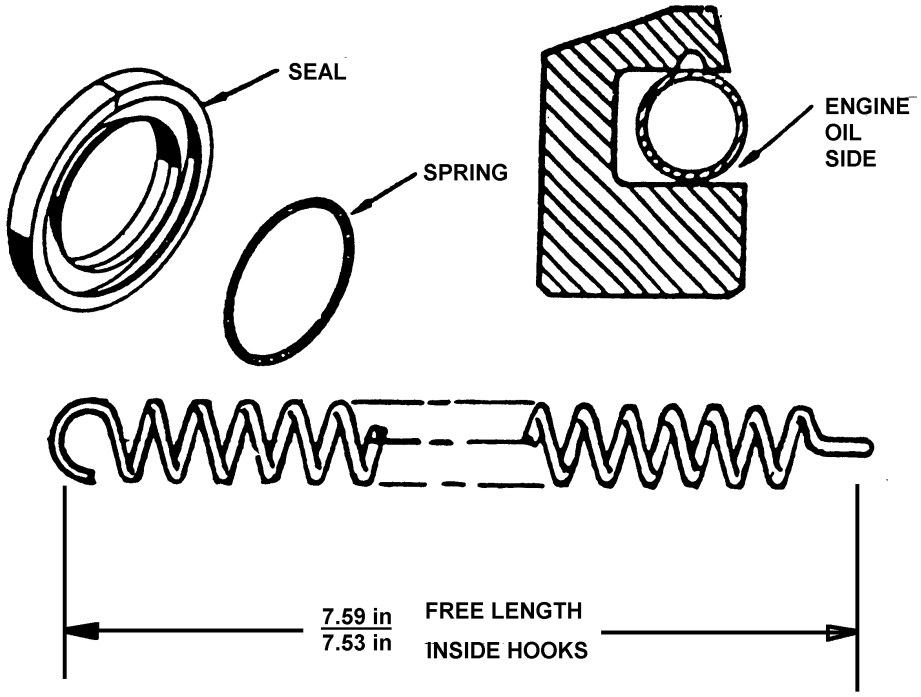


Figure 16-23. Crankshaft Nose Oil Seal Parts

Chapter 17. Engine Assembly

17-1. Engine Assembly Sequence

Assemble the engine in the sequential steps listed below, referring to corresponding sections in this chapter (and specified references) for detailed instructions:

1. Lubricate the engine components.
2. Assemble the crankcase.
3. Install the engine cylinders.
4. Torque the engine cylinders and crankcase.
5. Install the cylinder drain tubes.
6. Install the hydraulic lifters and push rods.
7. Install the rocker arms and valve train.
8. Install the intercylinder baffles.
9. Install the oil sump.
10. Install the accessory case.
11. Install the starter and starter adapter assembly.
12. Install the alternator (and optional alternator bracket assembly).
13. Install the oil cooler.
14. Install the Induction System.
15. Install the Fuel Injection System.
16. Install the Ignition System.
17. Install the Exhaust System.
18. Install the engine in the aircraft according to instructions in Section 5-2.

17-1.1. Component Lubrication

WARNING

Lubricate hardware according to instructions in Chapter 3 and Appendix B of M-0, Standard Practice Maintenance Manual. Inspect fasteners for proper plating and thread form. Verify fastener serviceability and correctly lubricate the fastener for proper fastener pre-loading and torque application.

Prior to engine assembly, apply clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual) liberally to bare steel surfaces, journals, and bushings, except where special lubricants are required. Chapter 3 of M-0, Standard Practice Maintenance Manual includes a comprehensive list of authorized lubricants, sealants and adhesives.

17-2. Crankcase Assembly

17-2.1. Drive Train Installation

CAUTION: All parts must be clean and free of debris before the crankcase can be assembled. Perform the assembly in a clean, dry, dust-free environment.

1. Install the left (2-4-6) crankcase half on the engine stand with the open side up. Place the right (1-3-5) crankcase half on a workbench with the open side up.
2. Shake or mix well the full strength, non-thinned P/N 654663 Gasket Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual).
3. Apply P/N 654663 Gasket Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the 2-4-6 case half only where silk thread is depicted in Figure 17-1. Apply an even thin coat of P/N 654663 Gasket Sealant using short light brush strokes. Sealant should be viscous enough for brush marks to disappear, if not, use new container of sealant.

   NOTE: Allow gasket sealant to air dry to a tacky condition before threading.

4. Apply a thin coat of P/N 646942 Gasket Maker (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the 1-3-5 case half, not to exceed 0.010-inch thick. Apply Gasket Maker in the areas where P/N 654663 was applied on the 2-4-6 case half. Refer to Gasket Maker application instructions in Appendix C-9.
5. Apply P/N 653692 Primer (Chapter 3 of M-0, Standard Practice Maintenance Manual) on the nose seal pocket of both crankcase halves and allow it to dry for one to two minutes.
6. Apply a thin coat of P/N 646942 Gasket Maker (Chapter 3 of M-0, Standard Practice Maintenance Manual) on the nose seal pocket of both crankcase halves. Refer to Gasket Maker application instructions in Appendix C-9.

   CAUTION: Do not apply engine oil on the crankshaft bearing saddles. Bearing saddles must be dry when installing the crankshaft main bearings.

7. Install bearings (Figure 17-2)(11 and 12) into bearing saddles on both crankcase halves.

   NOTE: Verify bearings (11 and 12) are completely seated (edges near flush and the bearing tabs are mated with the lockslots). Verify bearings are positioned and aligned centrally in housing. Verify oil holes in bearings are aligned with the supply holes in the crankcases.

8. Install packings (13) in bearing (12). Ensure packings are completely seated in the bearing, then trim packings flush with bearing.

CAUTION: Do not oil surfaces covered in gasket sealant or Gasket Maker.

9. Thoroughly coat both crankcase halves camshaft bearing surfaces, crankshaft bearing surfaces, starter bushing bearing surfaces and the propeller governor gear bearing surface with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
10. Install the governor driven gear (Figure 17-3)(1) and verify that it rotates freely.

CAUTION: Ensure that the plug is used in the AF models.

11. Install the starter bushing or plug (AF) in the 2-4-6 crankcase half with dowel hole upward. Refer to Figure D-14, item 6.
12. Temporarily install the camshaft assembly into the 2-4-6 crankcase, meshing the governor driven gear (1) with the governor drive gear (3). Rotate camshaft to verify free movement of camshaft and governor driven gear.
13. Remove camshaft assembly from the 2-4-6 crankcase and temporarily install into the 1-3-5 crankcase. Rotate camshaft to verify free movement.
14. Remove camshaft assembly from the 1-3-5 crankcase and apply a thin film of Dow Corning G-N Paste (Chapter 3 of M-0, Standard Practice Maintenance Manual) to all camshaft lobes.

NOTE: Ensure that the entire surface of lobe is coated with paste.

15. Apply P/N 641543 Silk Thread (Chapter 3 of M-0, Standard Practice Maintenance Manual) on the 2-4-6 case half only as shown in Figure 17-1. Gently press the thread onto the flanges until it is held in place by the gasket sealant.

NOTE: Do not let the thread come into contact with oil or grease. Ensure that 0.25 inch of thread is sticking out where shown on Figure 17-1.

16. With the aid of an assistant, lift the crankshaft assembly by the No. 1 connecting rod and propeller flange.
17. Have the assistant hold the number 3 and 5 connecting rods upward while carefully lowering the crankshaft assembly into position. Ensure that the journals are aligned with the bearings.
18. Position the crankshaft at top dead center (TDC) (No. 1 connecting rod is straight up.).
19. Install camshaft assembly into the 2-4-6 crankcase. Ensure that the camshaft gears (Figure 17-3)(3 and 6) mesh with the crankshaft cluster gear (Figure 17-2)(15) and the governor driven gear (Figure 17-3)(1).

NOTE: Verify that the camshaft gear (Figure 17-3)(6) timing mark lines up with the timing mark on the crankshaft cluster gear (Figure 17-2)(15). Refer to Figure 17-4.

20. Lubricate the thrust washers (14) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
21. Install the thrust washers (14) on both sides of the bearing (12) journal.

22. Clean the oil seal (17) split line with acetone and apply P/N 654663 Gasket Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) on split line. Orient the oil seal at the 1 o'clock position from the split line of the crankcase.

23. Measure the camshaft end clearance with a dial indicator (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) to ensure it conforms to Appendix D specifications.

24. Measure the crankshaft end clearance with a dial indicator (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) to ensure it conforms to Appendix D specifications.

WARNING

Failure to achieve minimum gear backlash during engine assembly will cause gear damage and subsequent engine failure.

25. Measure the governor driven gear backlash with a dial indicator (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) to ensure it meets Appendix D specifications.

26. Carefully slide the oil seal (17) into the pocket on the crankcase until seated.

NOTE: Ensure the ends of the silk thread are centered between the OD of the seal and the ID of the pocket.

27. Apply P/N 646941 High Strength Adhesive/Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to two bolts (25).

28. Apply P/N 653693 Loctite 7471 Primer (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the 2-4-6 crankcase half retainer bolt holes.

29. Install the crankshaft nose oil seal retainer plate (24) on the 2-4-6 crankcase half and secure with the two retainer bolts (25). Torque the bolts to Appendix B specifications.

WARNING

Failure to lubricate designated parts may result in damage to the crankcase, crankshaft, camshaft and subsequent engine malfunction or failure.

30. Lubricate the crankshaft cluster gear, camshaft gear, governor drive gear, governor driven gear, crankshaft journals and camshaft bearings with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual). Refer to Figure 17-5.

CAUTION: Use extreme care to prevent damage to nose seal or silk thread when installing crankcase halves together.

31. Have an assistant balance the 1-3-5 connecting rods upright and carefully lower the 1-3-5 crankcase half onto the 2-4-6 crankcase half.

NOTE: Rotate the starter bushing or plug (AF) as necessary to align the hole with the dowel in the crankcase.

32. Apply P/N 646941 High Strength Adhesive/Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to two bolts (25).

33. Apply P/N 653693 Loctite 7471 Primer (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the 1-3-5 crankcase half retainer bolt holes.

34. Install the crankshaft nose oil seal retainer plate (24) on the 1-3-5 crankcase half and secure with the two retainer bolts (25). Torque the bolts to Appendix B specifications.

    CAUTION: If the connecting rods are not secured with the old cylinder base o-rings (Figure 17-6) the connecting rods or the cylinder mounting deck could be damaged.

35. Use the old cylinder base o-rings (Figure 17-6) to immobilize the connecting rods until the cylinders are installed.

WARNING

Do not apply <u>any</u> form of sealant to the crankcase cylinder deck, chamfer, cylinder mounting flange, cylinder base o-ring, cylinder fastener threads or crankcase main bearing bosses. The use of RTV, silicone, Gasket Maker or <u>any</u> other sealant on the areas listed above during engine assembly will cause a loss of cylinder deck stud or through bolt torque. Subsequent loss of cylinder attachment load, loss of main bearing crush and/or fretting of the crankcase parting surfaces will occur. The result will be cylinder separation, main bearing movement, oil starvation and catastrophic engine failure. USE ONLY CLEAN 50 WEIGHT AVIATION ENGINE OIL ON SURFACES LISTED.

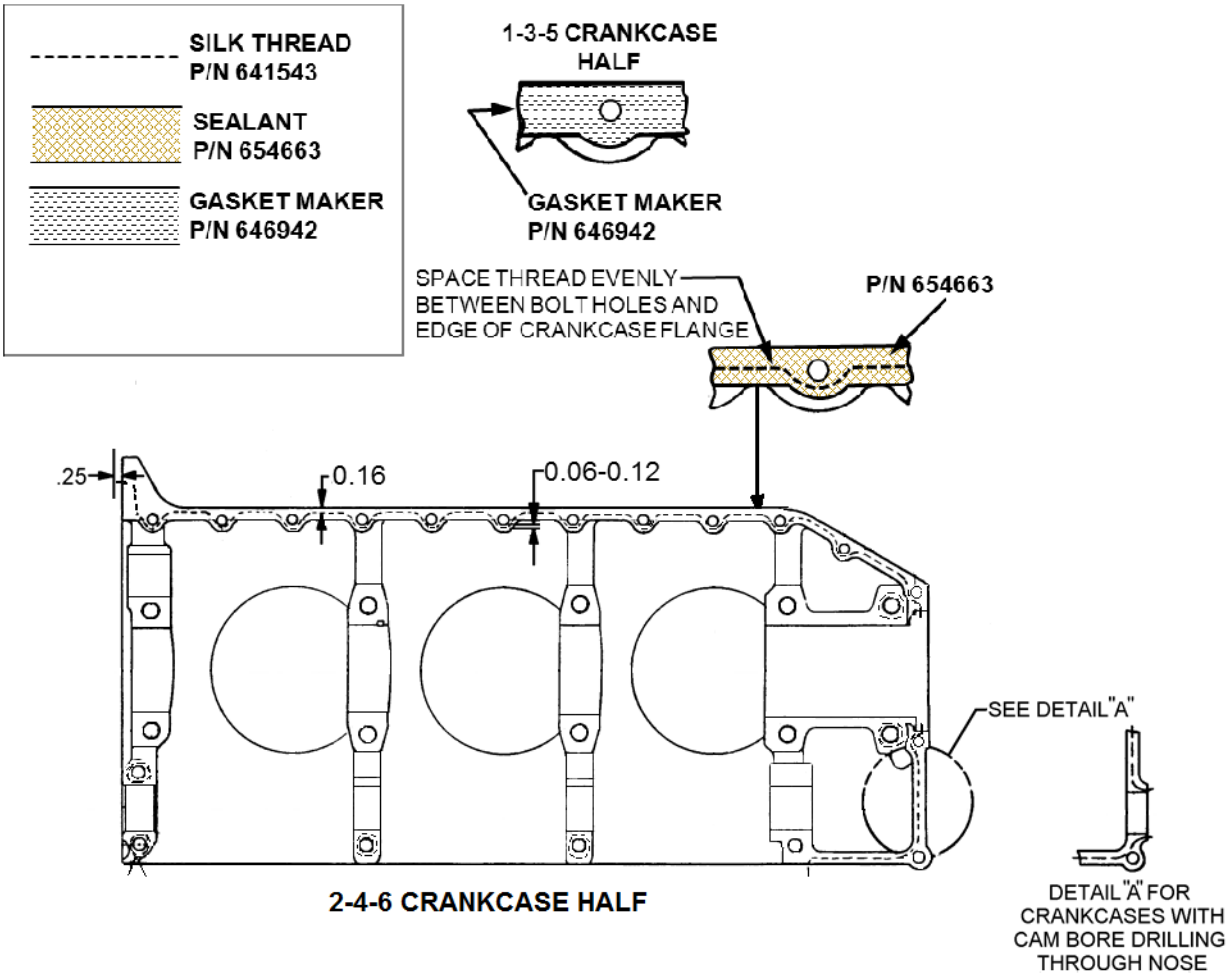


Figure 17-1. Crankcase Sealant and Threading

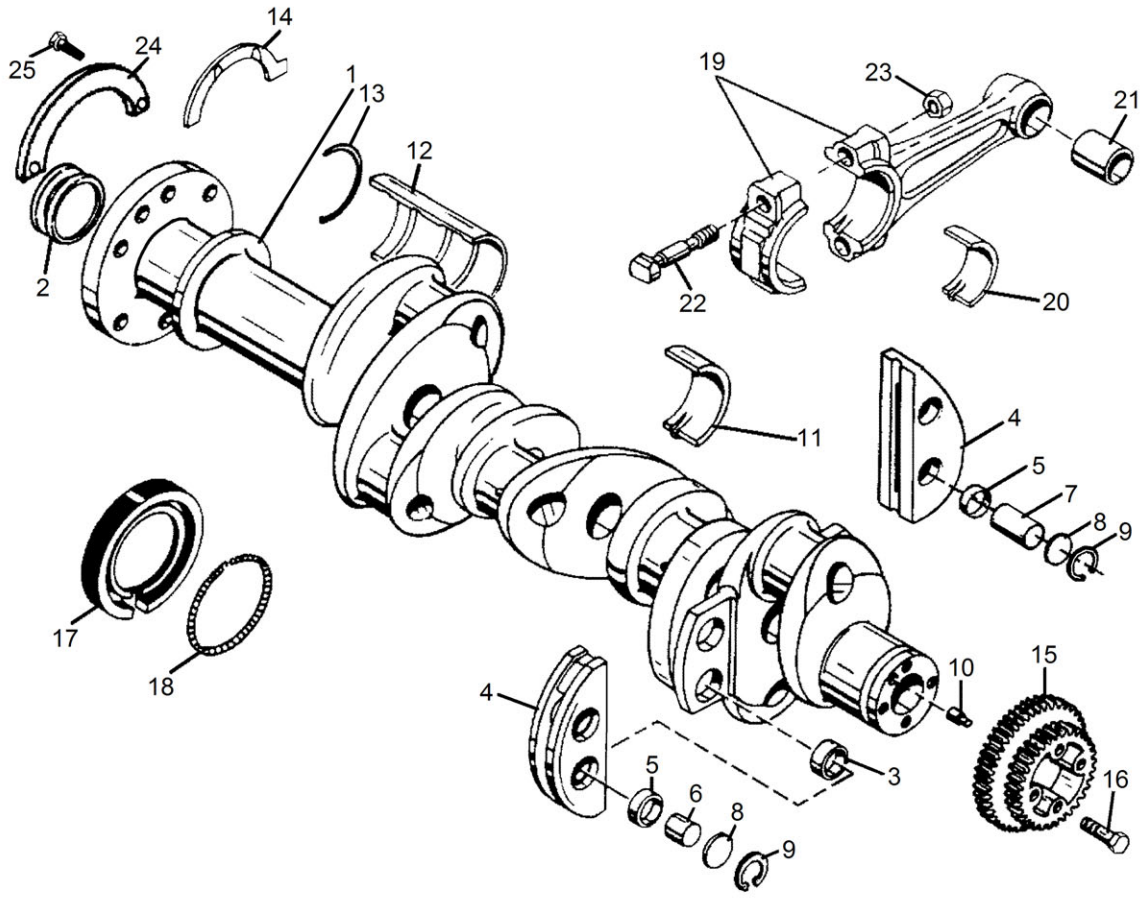


Figure 17-2. Crankshaft Assembly

1	Crankshaft Assembly	8	Retainer Plate	15	Cluster Gear	22	Bolt
2	Plug	9	Retaining Ring	16	Bolt	23	Nut
3	Bushing	10	Dowel	17	Oil Seal	24	Retainer Plate
4	Counterweight	11	Bearing	18	Seal Spring	25	Bolt
5	Bushing	12	Bearing	19	Connecting Rod Assembly		
6	Pin	13	Packing	20	Bearing		
7	Pin - G, H, J and K Models	14	Thrust Washer	21	Bushing		

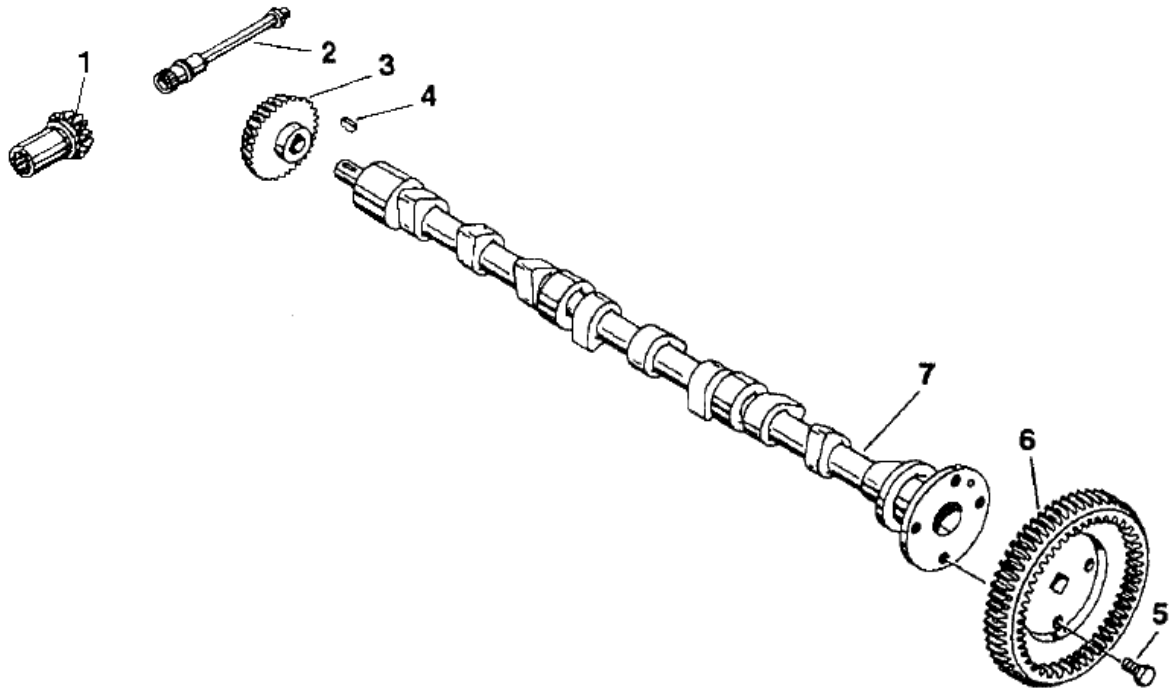


Figure 17-3. Camshaft Assembly

1	Governor Driven Gear	3	Governor Drive Gear	5	Bolt	7	Camshaft
2	Fuel Pump Drive Shaft	4	Woodruff Key	6	Camshaft Gear		

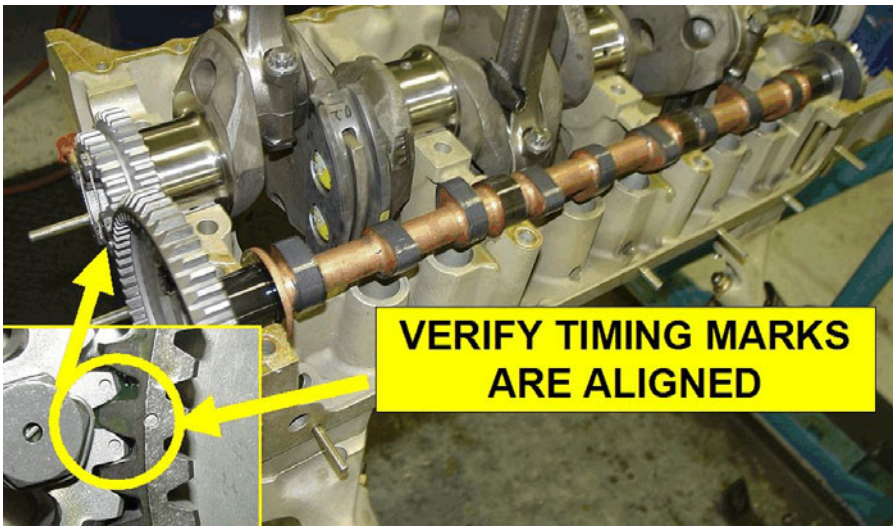


Figure 17-4. Timing Mark Alignment

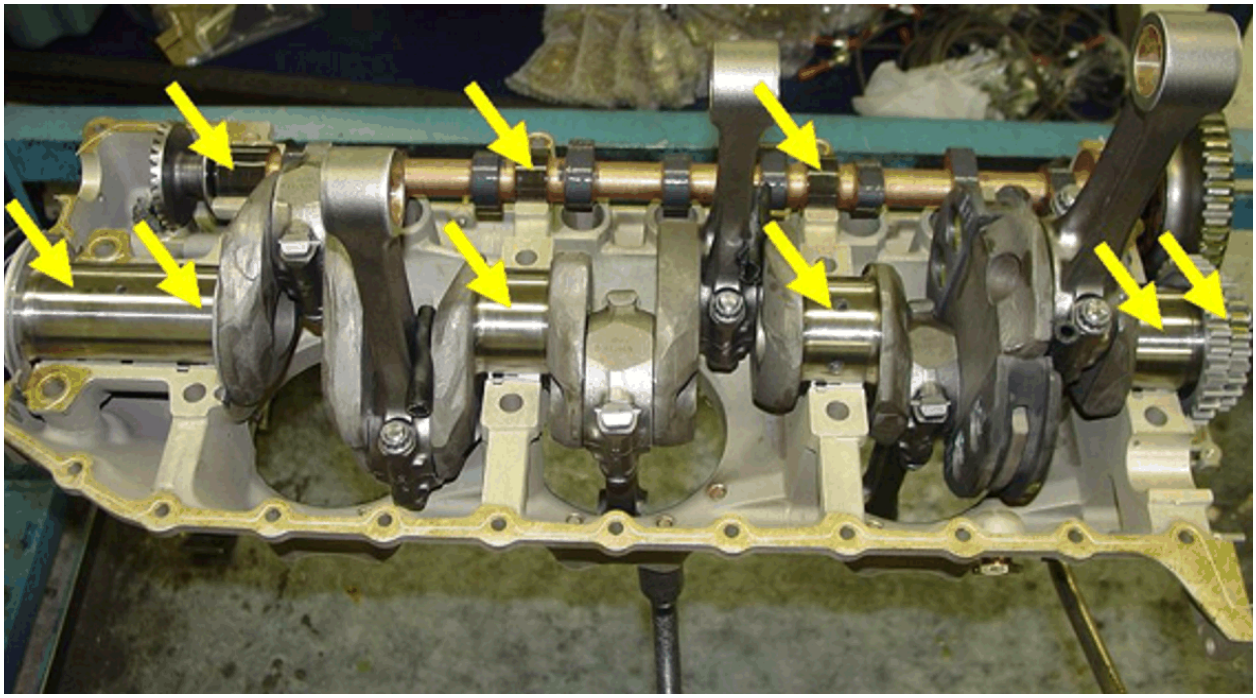


Figure 17-5. Gears and Bearings Lubrication

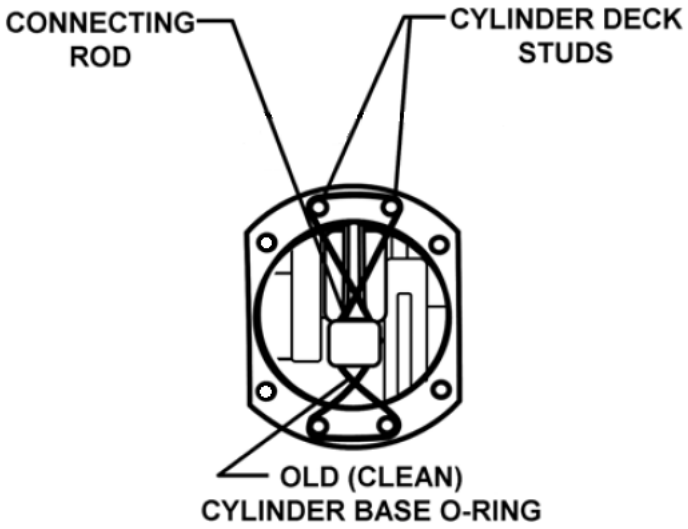


Figure 17-6. Cylinder Base O-ring Supporting the Connecting Rods

17-2.2. Crankcase Hardware Installation

The IO-360 crankcase assembly is the same for all engine models except external hardware fastener lengths vary, the placement of the manifold valve bracket, throttle body bracket and lifting eyes will vary. Refer to the instructions matching the engine model in Section 17-2.2.1 and Section 17-2.2.2. Refer to your engine model in the Illustrated Parts Catalog for placement and parts.

17-2.2.1. IO-360 Crankcase Assembly (Except AF and ES)

1. Lubricate all studs and crankcase through bolts according to instructions in Appendix B with approved lubricants (Chapter 3 of M-0, Standard Practice Maintenance Manual).

WARNING

Lubricate fasteners and apply torque to the crankcase hardware in the proper sequence. Failure to do so may result in crankcase damage or engine failure.

NOTE: Positions cited in this procedure refer to Figure 17-7.

2. Install through bolts (Figure 17-9)(22, 23, 24 and 42) with new o-rings (25) in positions 19a, 22a, 33a, 30a, 1, 4, 10, 13, 27 and 28, use o-ring installation tool (Chapter 2-1 of M-0, Standard Practice Maintenance Manual). Use a soft mallet to tap the through bolts into position, with equal threads protruding on both sides.
3. Install bolts (45), washers (30) and nuts (33) in positions 39 and 52; tighten, but do not torque bolts.

NOTE: Place bolt heads on the 1-3-5 side.

4. Install bolt (31), washers (30) and nut (33) in position 51; tighten, but do not torque bolt.

NOTE: Place bolt head on the 1-3-5 side.

5. Rotate the crankshaft to verify free movement of internal components.
6. Install through bolt (37) in position 40. Use a soft mallet to tap the through bolt into position, with equal threads protruding on both sides. Secure with washers (36) and nuts (33); tighten, but do not torque nuts.

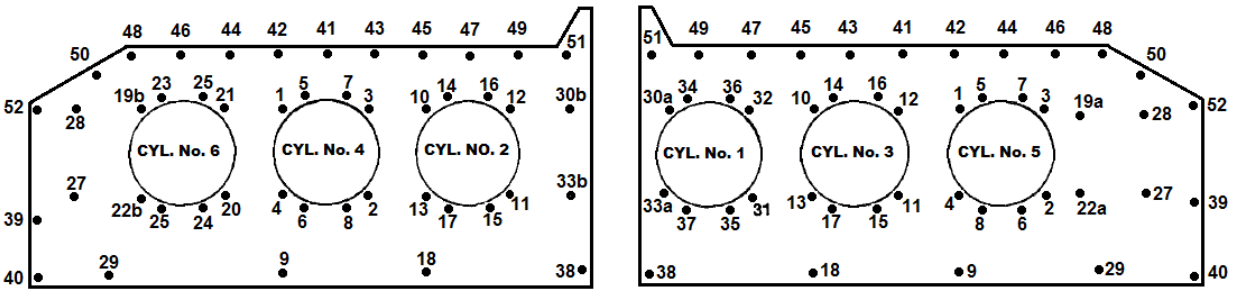


Figure 17-7. IO-360 Crankcase Fastener Locations

7. Install through bolt (26) in position 29. Use a soft mallet to tap the through bolt into position, with equal threads protruding on both sides. Secure with washers (43) and nuts (44); tighten, but do not torque nuts.
8. If applicable to your model, do the following:
   a. Apply P/N 646942 Gasket Maker (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the silk threads and lay them inward towards the camshaft hole. Refer to Figure 17-8.
   b. Install gasket and camshaft hole cover. Beaded side of gasket must be facing the cover.

   NOTE: Ensure that the silk thread is under gasket.

   c. Apply Loctite 592 Teflon PS/T Pipe Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to bolt threads.
   d. Install bolts and lock washers through camshaft hole cover; tighten, but do not torque bolts.

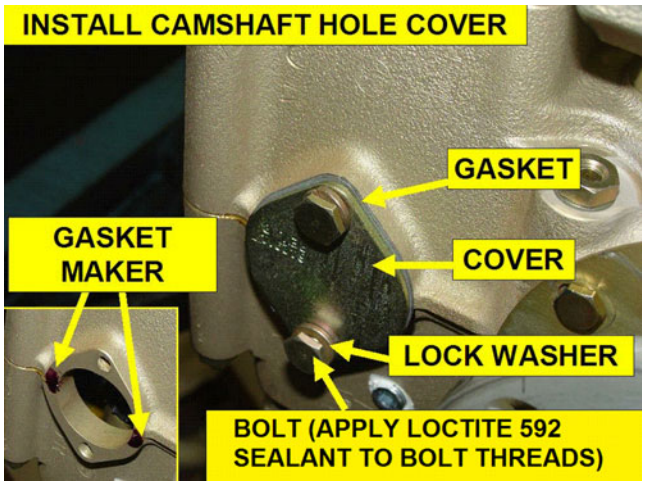


Figure 17-8. IO-360 Camshaft Cover Installation

9. Install through bolts (29) in positions 9 and 18. Use a soft mallet to tap the through bolt into position, with equal threads protruding on both sides. Secure with washers (43) and nuts (44); tighten, but do not torque nuts.
10. Install through bolt (27) in position 38. Use a soft mallet to tap the through bolt into position, with equal threads protruding on both sides. Secure with washers (43) and nuts (44); tighten, but do not torque nuts.
11. Install manifold and bracket over positions 45 and 47.
12. Install rear lifting eye (35) on the 2-4-6 side of the crankcase at positions 45 and 43.
13. Secure manifold bracket and rear lifting eye (35) with bolt (34), bolts (38), screw (32), washers (30), washer (28) and nuts (33); tighten, but do not torque nuts.

    NOTE: At position 43, ensure that washer (28) is between the rear lifting eye (35) and the crankcase. Place bolt heads and screw head on the 1-3-5 side.

14. Install throttle and metering assembly bracket and secure with screws (39), washers (30) and nuts (33) in positions 46 and 48; tighten, but do not torque nuts.

    NOTE: Place screw heads on the 1-3-5 side.

15. Install bolts (31), washers (30) and nuts (33) in positions 41, 42, 44, 49 and 50; tighten, but do not torque nuts.

    NOTE: Place bolt heads on the 1-3-5 side.

16. Secure through bolts (22 and 42) with washers (40) and nuts (41); tighten, but do not torque nuts.

17. Rotate the engine on the stand to the upright position. With connecting rods supported by old cylinder o-rings, secure 1-3-5 side engine mounts to the engine stand.

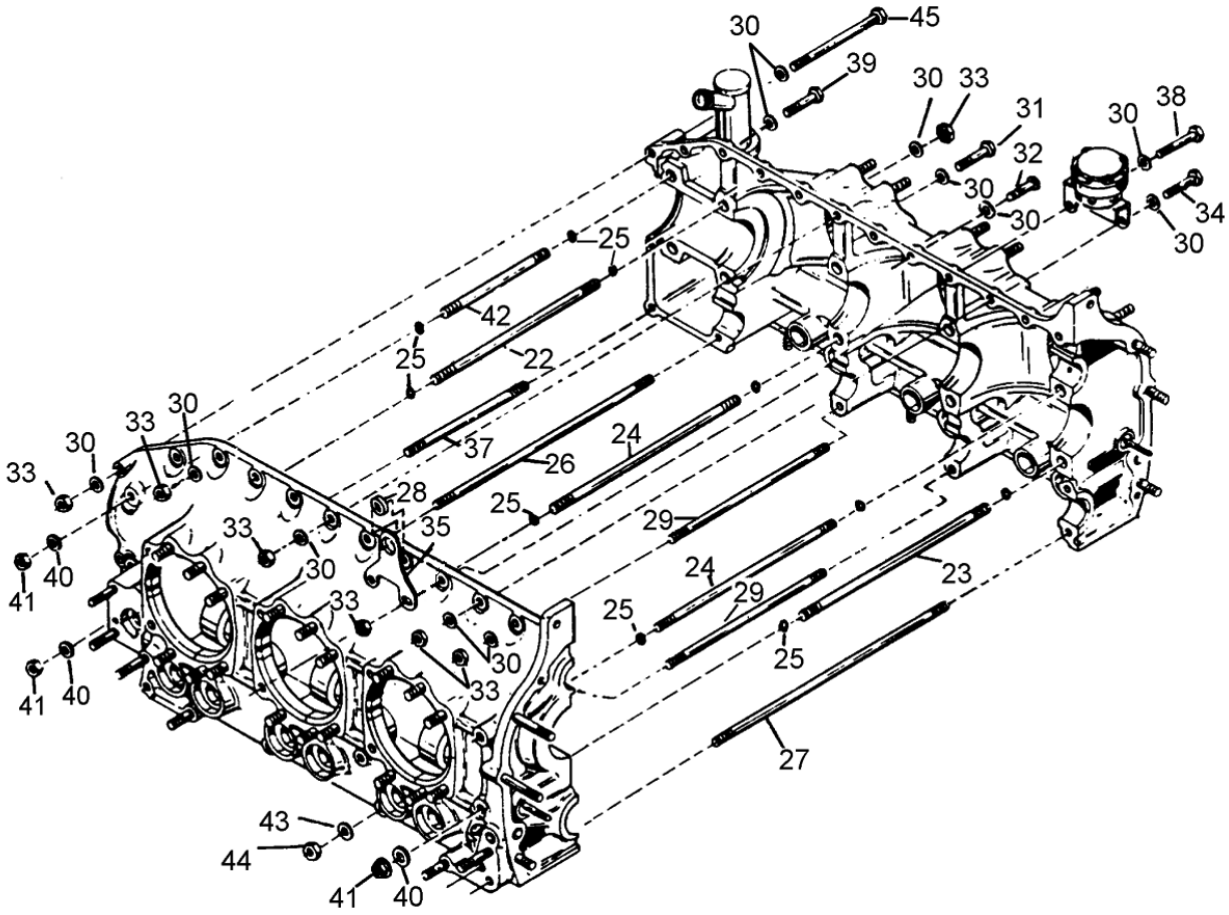


Figure 17-9. IO-360 Crankcase Fasteners

22	Through Bolt	28	Washer	34	Bolt .25-28 X 1.53	40	Washer
23	Through Bolt	29	Through Bolt	35	Lifting Eye	41	Nut
24	Through Bolt	30	Washer	36	Washer	42	Through Bolt
25	O-ring	31	Bolt .25-28 X 1.41	37	Through Bolt	43	Washer
26	Through Bolt	32	Screw .25-28 X 1.63	38	Bolt .25-28 X 1.66	44	Nut
27	Through Bolt	33	Nut	39	Screw .25-28 X 1.78	45	Bolt .25-28 X 3.88

17-2.2.2. IO-360-AF, ES Crankcase Assembly

1. Lubricate all studs and crankcase through bolts according to instructions in Appendix B with approved lubricants (Chapter 3 of M-0, Standard Practice Maintenance Manual).

WARNING

Lubricate fasteners and apply torque to the crankcase hardware in the proper sequence. Failure to do so may result in crankcase damage or engine failure.

NOTE: Positions cited in this procedure refer to Figure 17-10.

2. Install through bolts (Figure 17-13)(24, 24A, 25, 26, 31 and 43) with new o-rings (27) in positions 22a, 19a, 33a, 30a, 1, 4, 10, 13, 18, 27 and 28, use o-ring installation tool (Chapter 2-1 of M-0, Standard Practice Maintenance Manual). Use a soft mallet to tap the through bolts into position, with equal threads protruding on both sides.

NOTE: Through bolt (24A) is used on IO-360-AF1, ES6, 8, 16, 18, 21, 22, 23, 24 and 25 engines. Other ES engines use through bolt (24) in that position.

3. Install bolts (37), washers (32) and nuts (34) in positions 39 and 52; tighten, but do not torque bolts.

NOTE: Place bolt heads on the 1-3-5 side.

4. Install bolt (33), washers (32) and nut (34) in position 51; tighten, but do not torque bolt.

NOTE: Place bolt head on the 1-3-5 side.

5. Rotate the crankshaft to verify free movement of internal components.

6. Install through bolt (44) in position 40. Use a soft mallet to tap the through bolt into position, with equal threads protruding on both sides. Secure with washers (40) and nuts (41); tighten, but do not torque nuts.

7. Install through bolt (28) in position 29. Use a soft mallet to tap the through bolt into position, with equal threads protruding on both sides.

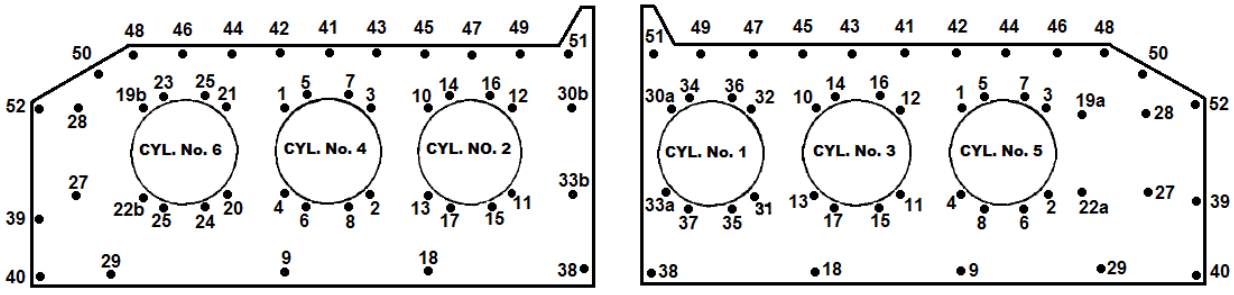


Figure 17-10. IO-360-AF, ES Crankcase Fastener Locations

8. Install bushing (42) on through bolt (28), then mount mixture control cable support (46) on bushing and 1-3-5 side of front engine mount stud. Secure with washers (40) and nuts (39); tighten, but do not torque nuts.

   NOTE: IO-360-ES2 and 11 engines do not use bushing (42) or mixture control cable support (67).

9. Install bushing (42) on through bolt (28), then mount propeller control cable support (45) on bushing and 2-4-6 side of front engine mount stud. Secure with washers (40) and nuts (39); tighten, but do not torque nuts.

   NOTE: IO-360-ES2 and 11 engines do not use bushing (42) or propeller control cable support (66).

10. If applicable to your model, do the following:

    a. Apply P/N 646942 Gasket Maker (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the silk threads and lay them inward towards the camshaft hole. Refer to Figure 17-11

    b. Install gasket and camshaft hole cover. Beaded side of gasket must be facing the cover.

    NOTE: Ensure that the silk thread is under gasket.

    c. Apply Loctite 592 Teflon PS/T Pipe Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to bolt threads.

    d. Install bolts and lock washers to camshaft hole cover; tighten, but do not torque bolts.

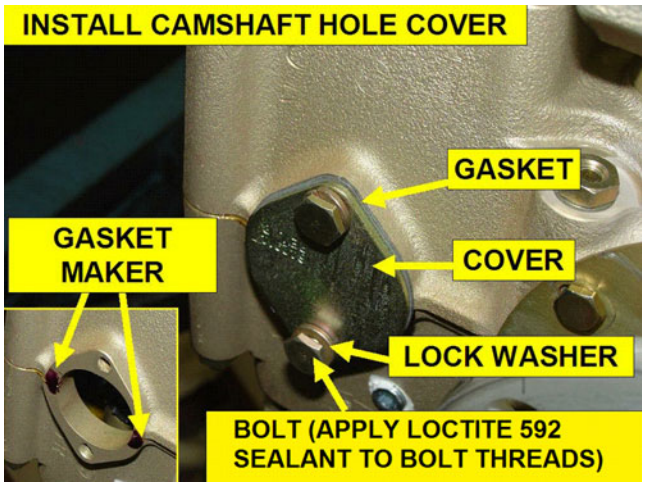


Figure 17-11. IO-360-AF, ES Camshaft Cover Installation

11. Install through bolt (30) in position 9. Use a soft mallet to tap the through bolt into position, with equal threads protruding on both sides. Secure with washers (40) and nuts (41); tighten, but do not torque nuts.

12. Install through bolt (29) in position 38. Use a soft mallet to tap the through bolt into position, with equal threads protruding on both sides. Secure with washers (40) and nuts (41); tighten, but do not torque nuts.

13. Install manifold and bracket over positions 46 and 48.

    NOTE: Ensure that the vent is pointed to the rear and is on the 2-4-6 side of crankcase.

14. Install forward lifting eye (36) as shown in Figure 17-12 on the 2-4-6 side of the crankcase at positions 48 and 50.

15. Secure manifold bracket and forward lifting eye (36) with bolts (35), washers (32) and nuts (34); tighten, but do not torque nuts.

    NOTE: At position 50, ensure that a washer is between the lifting eye (36) and the crankcase. Place bolt heads on the 1-3-5 side except in position 50 as shown in Figure 17-12.

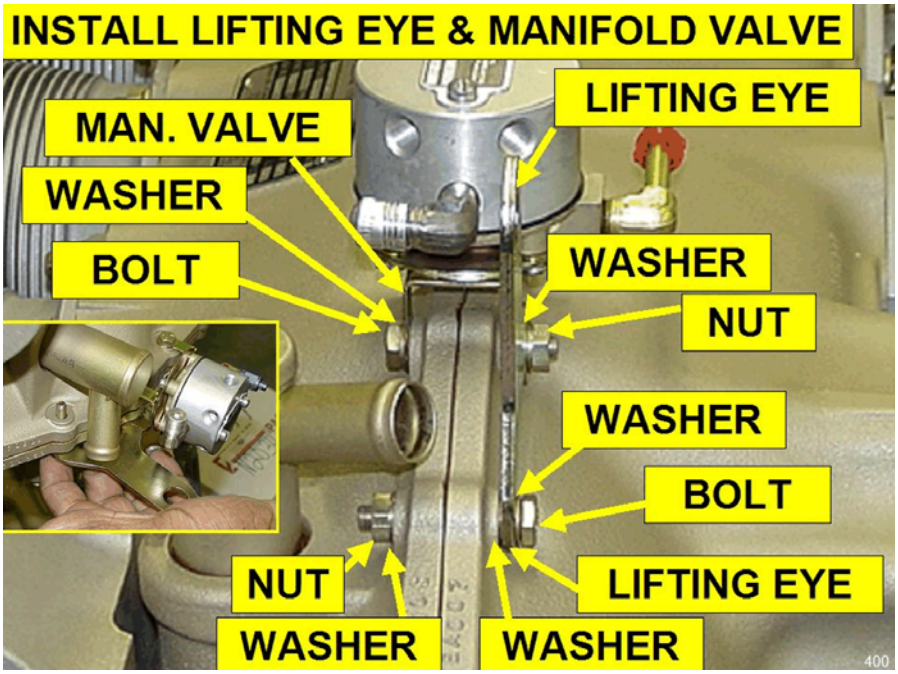


Figure 17-12. IO-360-AF, ES Manifold and Forward Lifting Eye Installation

16. Install bolts (33), washers (32) and nuts (34) in positions 41, 42, 43, 44, 45, 47 and 49; tighten, but do not torque nuts.

17. Secure through bolts (24, 24A and 43) with washers (38) and nuts (39); tighten, but do not torque nuts.

18. Secure through bolt (31) with washers (40) and nuts (41); tighten, but do not torque nuts.

19. Rotate the engine on the stand to the upright position. With connecting rods supported by old cylinder o-rings, secure 1-3-5 side engine mounts to the engine stand.

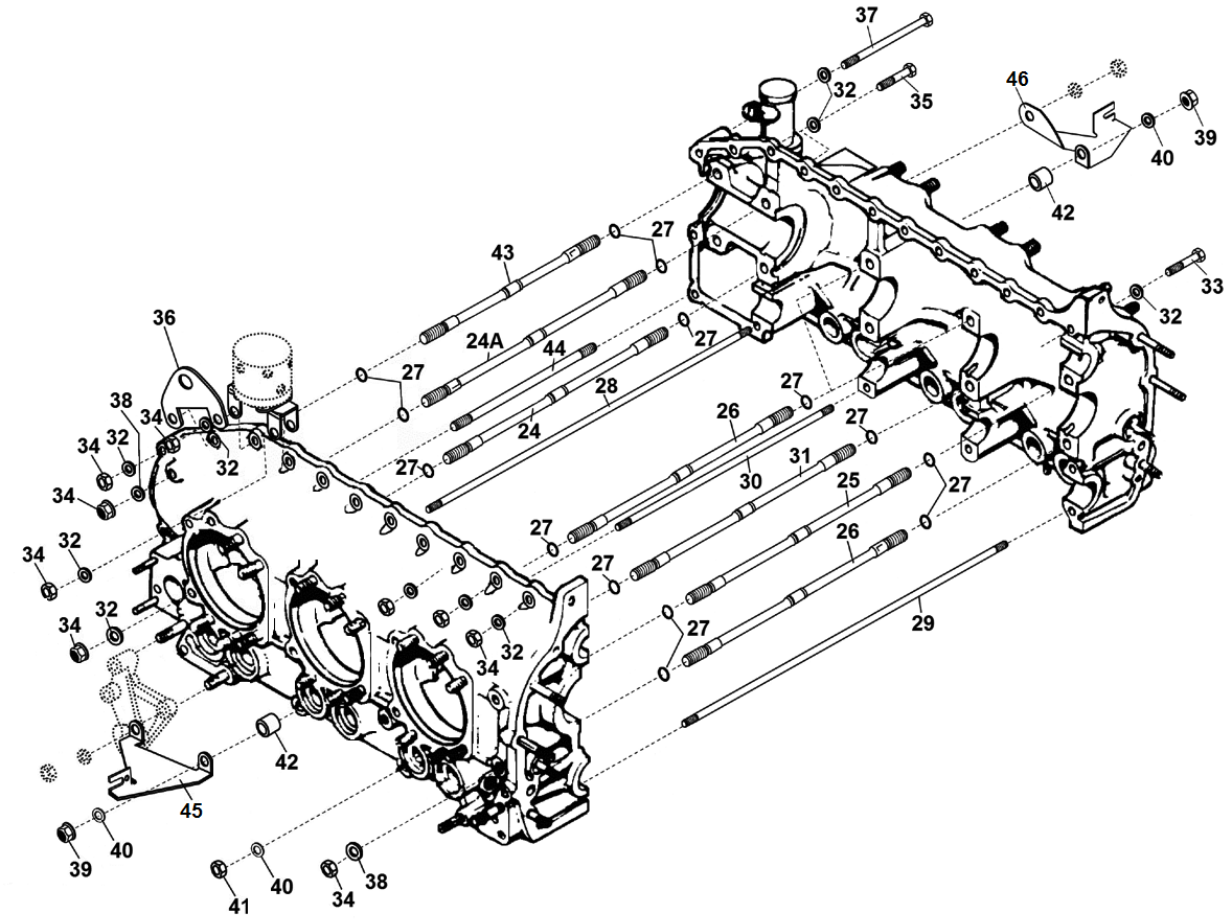


Figure 17-13. IO-360-AF, ES Crankcase Fasteners

24	Through Bolt	29	Through Bolt	35	Bolt .25-28 X 1.53	41	Nut
24A	Through Bolt	30	Through Bolt	36	Lifting Eye	42	Bushing
25	Through Bolt	31	Through Bolt	37	Bolt .25-28 X 3.88	43	Through Bolt
26	Through Bolt	32	Washer	38	Washer	44	Through Bolt
27	O-ring	33	Bolt .25-28 X 1.41	39	Nut	45	Support - Prop Control Cable
28	Through Bolt	34	Nut	40	Washer	46	Support - Mixture Control Cable

17-3. Cylinder Installation

17-3.1. IO-360 Cylinder Installation

WARNING

Do not install a cylinder that does not conform to Chapter 15, "Overhaul Inspection and Repair" and Appendix D, "Overhaul Dimensional Limits." Ensure each cylinder has the required new parts and is clean, free of cracks, nicks, scratches, pitting, and corrosion before installation.

Do not apply <u>any</u> form of sealant to the crankcase cylinder deck, chamfer, cylinder mounting flange, cylinder base O-ring, or cylinder fastener threads. The use of RTV, silicone, Gasket maker or <u>any</u> other sealant on surfaces noted in listing above during engine assembly, will cause a loss of cylinder deck stud or through bolt torque. Subsequent loss of cylinder attachment load, loss of main bearing crush and/or fretting of the crankcase parting surfaces will occur. The result will be cylinder separation, main bearing movement, oil starvation and catastrophic engine failure. USE ONLY CLEAN 50 WEIGHT AVIATION OIL ON THE SURFACES LISTED.

NOTE: This procedure requires two people.

1. Lubricate all cylinder through bolt and deck stud threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
2. Carefully rotate the crankshaft until the connecting rod of the cylinder being installed is in the outer most position.
3. Remove the old cylinder base packing from the connecting rod of the cylinder being installed.
4. Install a new cylinder base packing (Figure 17-14)(8), lubricated with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual), on the cylinder base flange; verify the packing is not twisted on the cylinder base after installation.
5. Back the new piston pin (55) out of the new piston (54) far enough to allow the piston to be installed on the connecting rod.
6. Align the piston (54) pin bore with the connecting rod and slide the piston pin (55) into the connecting rod. The pin should move freely (no binding) and be centered in the piston upon installation.
7. Compress the fourth piston ring (56) with a Piston Ring Compressor (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) and push the cylinder (2) until the fourth piston ring is positioned inside the cylinder barrel. Remove the Piston Ring Compressor and push the cylinder assembly against the crankcase cylinder deck with the studs protruding from the cylinder flange.

8. While supporting the cylinder, install and tighten in an alternating pattern, but do not torque, the cylinder flange nuts (46 and 47).

   NOTE: Ensure the through bolts have the same amount of threads on each side of the crankcase.

9. Repeat steps 2 through 8 for the remaining cylinders.
10. Proceed to Section 17-3.2, “Cylinder and Crankcase Torque.”

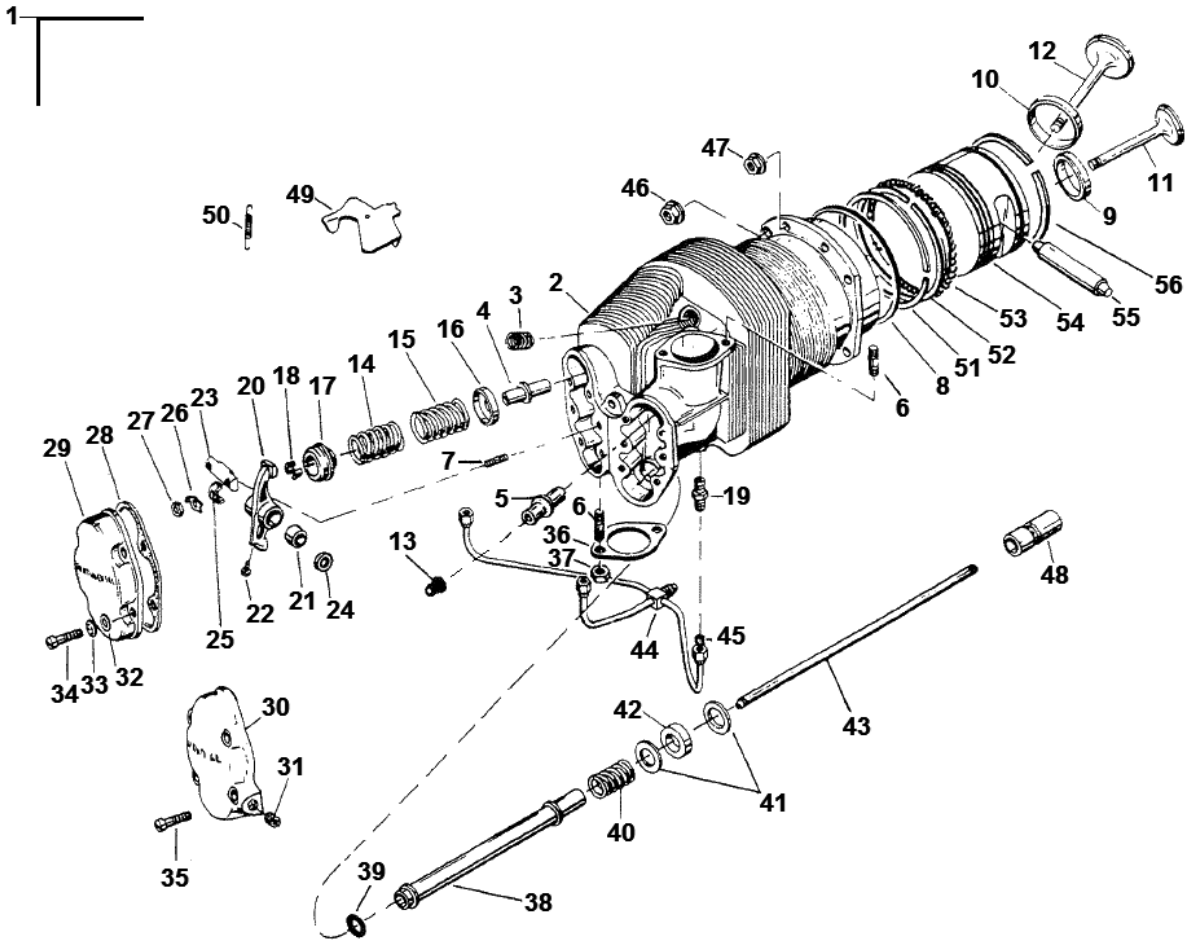


Figure 17-14. Cylinder Assembly

1	Cylinder Assembly	15	Outer Valve Spring	29	Rocker Cover	43	Push Rod
2	Cylinder	16	Valve Spring Seat	30	Rocker Cover	44	Drain Tube Assembly
3	Insert	17	Rotocoil	31	Insert	45	Compression Seal
4	Exhaust Valve Guide	18	Valve Spring Key	32	Washer	46	Flanged Nut
5	Intake Valve Guide	19	Male Connector	33	Lock Washer	47	Flanged Nut
6	Stud	20	Rocker	34	Screw	48	Hydraulic Lifter
7	Stud	21	Bushing	35	Screw	49	Baffle
8	Packing	22	Screw	36	Flange Gasket	50	Spring
9	Exhaust Valve Seat Insert	23	Rocker Shaft	37	High Nut	51	Top Piston Ring
10	Intake Valve Seat Insert	24	Thrust Washer	38	Push Rod Housing	52	Second Piston Ring
11	Exhaust Valve	25	Thrust Retainer	39	O-ring	53	Oil Control Ring
12	Intake Valve	26	Tab Washer	40	Spring	54	Piston
13	Intake Valve Guide Seal	27	Nut	41	Washer	55	Piston Pin
14	Inner Valve Spring	28	Gasket	42	Seal	56	Scraper Ring

17-3.2. Cylinder and Crankcase Torque

Before torquing the crankcase, use a straight edge to confirm that the rear crankcase half ends are flush with each other. Do not proceed with final torque unless the crankcase halves are flush.

NOTE: Crankcase and cylinder torque requires two people; the torque is applied in two stages: first in a preliminary torque sequence, followed by a final torque sequence.

WARNING

Torque values specified for engine assembly are for use with clean nuts, bolts and studs with threads that are free of damage, or distortion, which have been pre-lubricated with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual) prior to assembly. The torque wrench must be currently calibrated and traceable to the National Bureau of Standards. Incorrect through bolt and deck stud torque may result in subsequent engine malfunction and failure.

1. After cylinders and hardware is installed, have an assistant hold the fastener on the opposite side of crankcase and simultaneously torque the crankcase fasteners in the sequence shown in Figure 17-15. Torque all the fasteners to ½ the value listed in Appendix B.

   NOTE: Through bolt positions on the 1-3-5 crankcase half are 1, 4, 9, 10, 13, 18, 19a, 22a, 27, 28, 29, 30a, 33a, 38 and 40.

2. Using the torquing sequence shown in Figure 17-15, torque nuts at positions (1 through 52) to the final torque values listed in Appendix B.

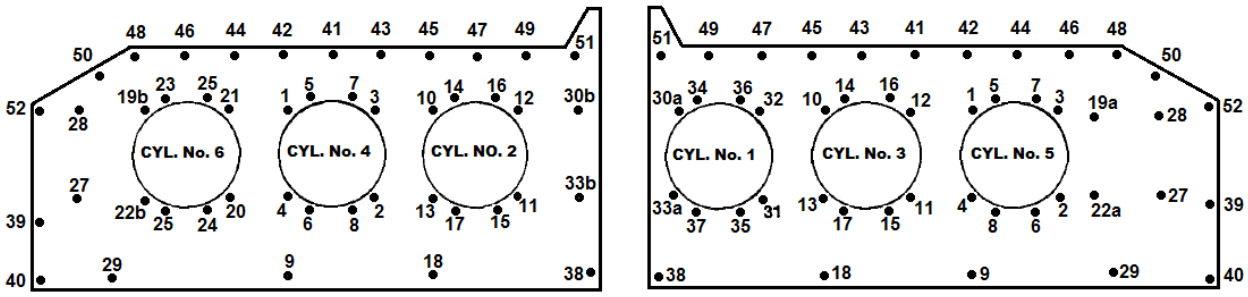


Figure 17-15. Crankcase Torque Sequence

3. Torque camshaft cover bolts (if equipped) to Appendix B specifications.

17-3.3. Cylinder Drain Tubes

1. Lightly coat the male threads of male connector (Figure 17-14)(19) with P/N 646940 F/I sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual). Refer to Figure 17-16.

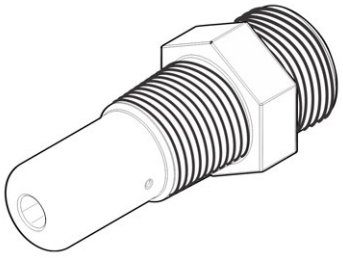


Figure 17-16. Cylinder Drain Connector

2. Install male connector (19) in the cylinder. Torque male connector to Appendix B specifications.
3. Install new drain tube compression seals (45) and cylinder drain tube assemblies (44). Torque the “B” nuts to Appendix B specifications.
4. Install check valve on drain tube assemblies (44) outlet and torque to Appendix B specifications. Connect the check valve outlet to the overboard drain according to the aircraft maintenance manual instructions after engine installation.

   NOTE: Check valve is provided by CM for the IO-360ES8, 11, 18, 23 and 24 model/specifications, all other models/specifications the check valves are provided by the aircraft manufacturer.

17-3.4. Hydraulic Lifter and Push Rod Installation

1. Rotate the engine to the upside down position on the stand.
2. Lubricate the new hydraulic lifter faces with Dow Corning G-N Paste (Chapter 3 of M-0, Standard Practice Maintenance Manual) (or equivalent).
3. Lubricate the crankcase lifter bores with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
4. Install new hydraulic lifters (Figure 17-14)(48) into the lifter bores on the 1-3-5 side of the crankcase and in the lifter bores on the 2-4-6 side of the crankcase.
5. Install the 12 push rod housings (38).
   a. Install a new spring (40) on the push rod housing (38) using a Kent-Moore P/N 68-3 Push Rod Spring Compressor Tool (Chapter 2-1 of M-0, Standard Practice Maintenance Manual) (or equivalent), compress the new spring.
   b. Place the new seal (42) between the two washers (41), and install on the *crankcase* end of the push rod housing.
   c. While the spring (40) is compressed, install new o-ring (39) on the cylinder end of the push rod housing (38).
   d. Insert the push rod housing (38), with new seal (42), washers (41) and new o-ring (39) in the respective crankcase lifter bore.
   e. While the spring (40) is still compressed and the push rod housing (38) is installed in the crankcase, guide the *cylinder* end of the push rod housing into the cylinder head bore while slowly releasing the tension on the push rod spring with the Push Rod Spring Compressor Tool. Remove the Push Rod Spring Compressor Tool from the push rod housing. Verify the packing (37) and washers (36) are properly seated in the crankcase bore and o-ring (39) is properly seated in cylinder head bore.



Figure 17-17. Push Rod Housing Installation

6. Rotate the engine to the upright position on the stand.
7. Lubricate the push rods (43) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual) and insert the push rods through the cylinder openings into the push rod housings (38).

17-3.5. Rocker Arm Installation

1. Rotate the crankshaft until the piston is at top dead center on the compression stroke and the push rods for the rocker arm being installed are at their lowest position. If necessary, bleed down the lifter by applying a constant pressure on the push rod with the cap end of the rocker arm.
2. Lubricate the rockers (Figure 17-14)(20), new thrust washers (24), new rocker shafts (23) and rocker arm studs with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
3. Slide a new rocker shaft (23) with the beveled side facing the cylinder base into the rocker (20) assembly.
4. Install new thrust washers (24) onto each side of rocker shaft (23).
5. Install thrust retainers (25) onto each side of rocker shaft (23).
6. Install the rocker and shaft assemblies on the cylinder with new tab washers (26) and nuts (27). Ensure tab washers are properly aligned, with all tabs inserted in the holes of the thrust retainers (25). Refer to Figure 17-18.

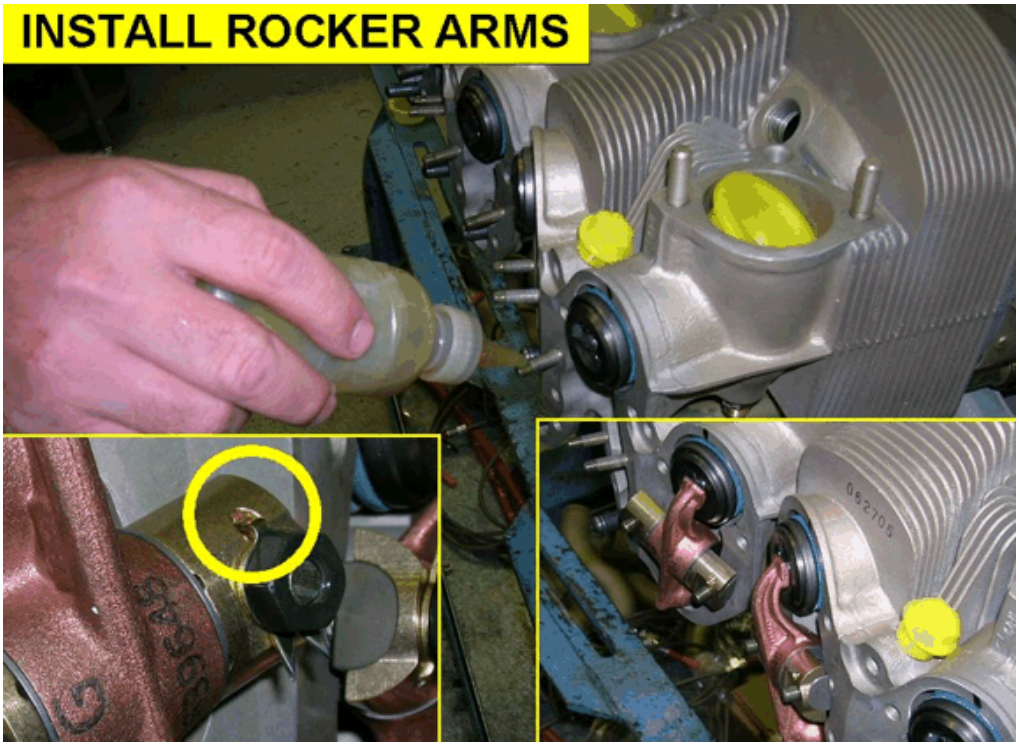


Figure 17-18. Rocker Arm Installation

7. Measure the rocker arm to retainer side clearance with a feeler gauge; side clearance must meet the specifications in Table D-9 at the location specified in Figure 17-19. If side clearance exceeds the maximum, replace the thrust washers with a thicker (oversize) thrust washer to reduce side clearance.

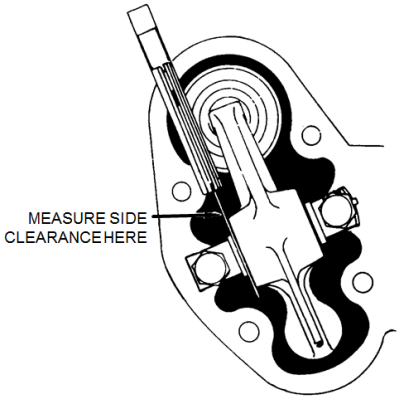


Figure 17-19. Rocker Arm Side Clearance

8. Measure the rocker arm to rotocoil clearance. Refer to Figure 17-20. If the clearance is less than 0.020-inch minimum, grind the underside of the rocker arm according to the instructions in Section 15-8.8.18.
9. Measure dry valve lash at valve tip to rocker foot by applying pressure on the rocker arm at the ball (push rod) end. Insert a feeler gauge between the rocker arm foot and valve tip; valve lash must not exceed Appendix D limits. Replace the push rods with authorized over size (AO) push rods if dry valve lash exceeds the maximum limit.

   CAUTION: Do not over- or under-torque nuts to align tab washers; replace nut and re-torque to obtain proper alignment.

10. Torque the nuts (27) to Appendix B specifications and secure the rocker assembly with the tab washers (26) according to "Tab Washer Installation" instructions in Appendix C-4. Do not re-align the nut to the tab washer.
11. Repeat steps 1 through 10 to install the rocker arms for the remaining cylinders.

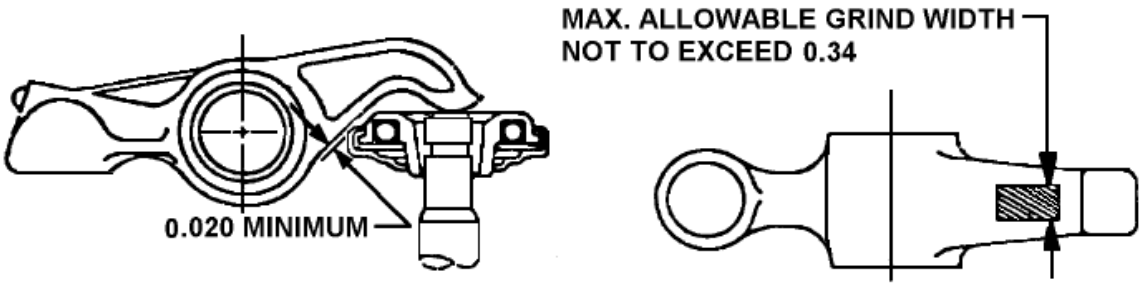


Figure 17-20. Rocker Arm to Rotocoil Clearance

12. Install the rocker covers (29 and 30)(except A and AB) with a new rocker cover gaskets (28) (beaded side of the gasket toward the rocker cover); secure the rocker covers with screws (34), screws (35)(except A and AB), new lock washers (33) and washers (32). Torque the rocker cover screws to Appendix B specifications.

17-3.6. Intercylinder Baffle Installation

NOTE: The intercylinder baffles are only installed on the IO-360-AF and ES engines. For other engine assemblies, proceed to Section 17-4.

Intercylinder baffles must be either be repaired or replaced at overhaul.

1. Install baffle assemblies (Figure 17-24)(8, 9, 12 and 13) on underside of cylinders.
2. Install baffle assemblies (14 and 15) over baffle assemblies (8, 9, 12 and 13). Baffle assemblies (14 and 15) should be inserted below the first fin on the cylinder. Refer to Figure 17-21.

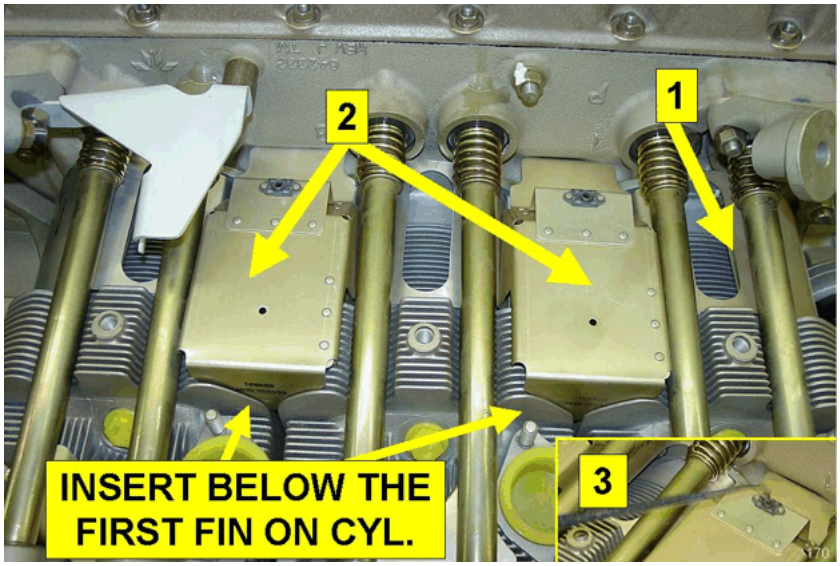


Figure 17-21. Baffle Assembly Installation

3. Lubricate the threaded holes on baffle assemblies (14 and 15) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

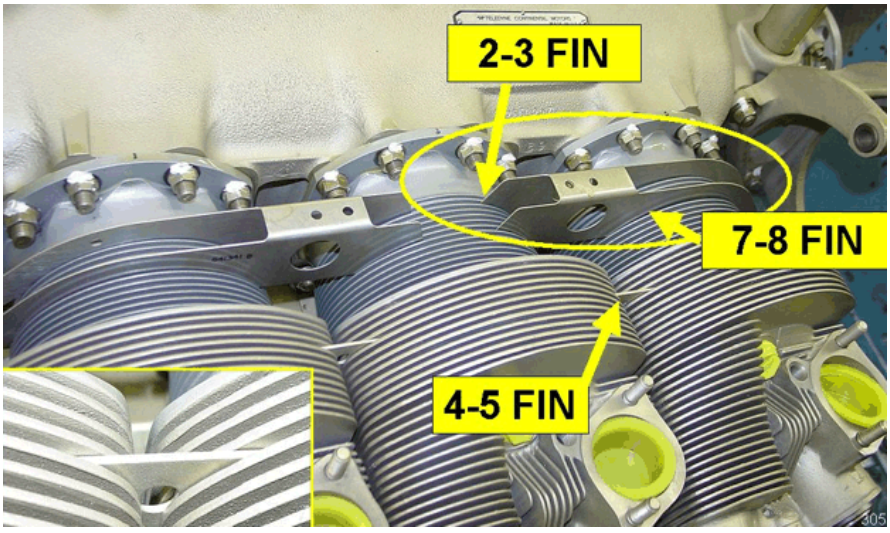


Figure 17-22. Baffle Support Installation

4. Install baffle supports (5) between barrel fins 2-3 and 7-8 on topside of cylinders as shown in Figure 17-22.
5. Install baffle supports (3) between cylinder fins 4-5 as shown in Figure 17-22.
6. Install bolts (6), washers (16), support brackets (1 and 7) and spacers (2) on baffle supports (5) securing them to baffle assemblies (14 and 15).
7. Install screws (4) and washers (18) on baffle supports (5) securing them to baffle assemblies (8, 9 and 12).
8. Torque bolts (6) and screws (4) to Appendix B specifications.
9. Install springs (11) on the baffle fasteners (10) as shown in Figure 17-23.
10. Install baffle fasteners (10) through bottom of baffle assemblies (14 and 15), up between the cylinders, and then secure the hook end in the hole in baffle supports (3) as shown in Figure 17-23.

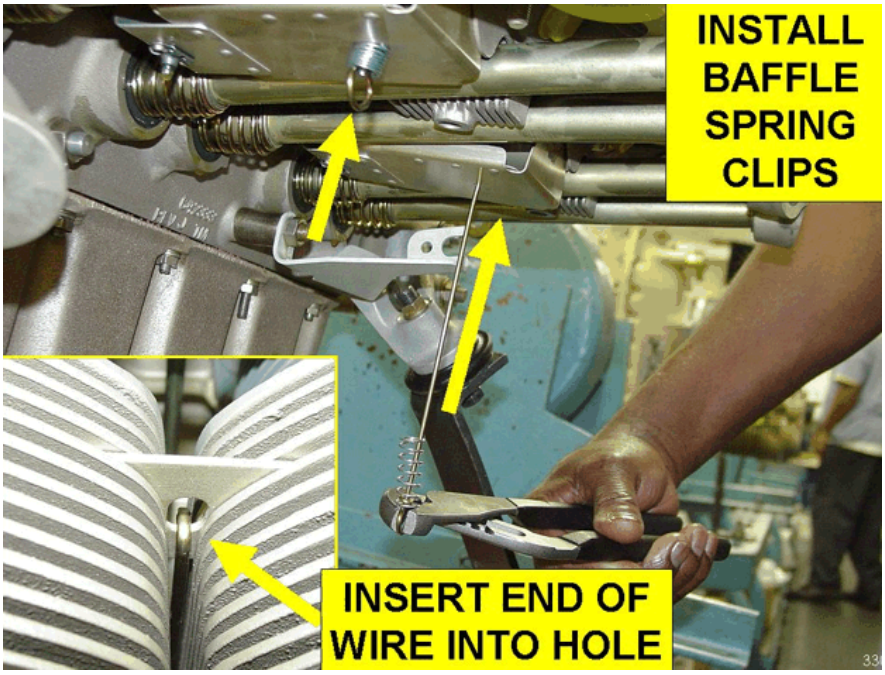


Figure 17-23. Baffle Fastener/Spring Installation

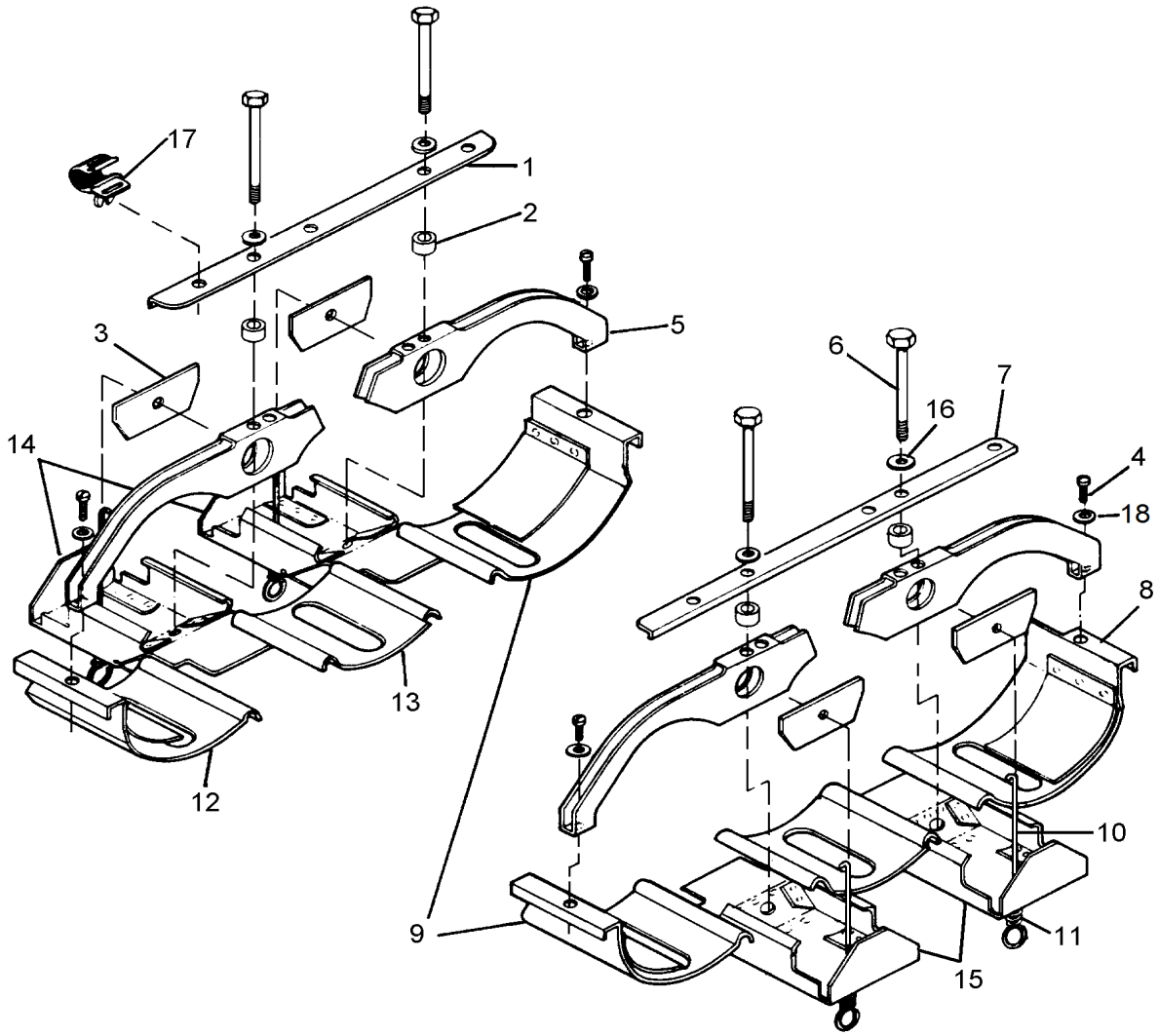


Figure 17-24. Intercylinder Baffles Installation

1	Support Bracket	6	Bolt	11	Spring	16	Washer
2	Spacer	7	Support Bracket	12	Baffle Assembly	17	Clamp
3	Baffle Support	8	Baffle Assembly	13	Baffle Assembly	18	Washer
4	Screw	9	Baffle Assembly	14	Baffle Assembly		
5	Baffle Support	10	Baffle Fastener	15	Baffle Assembly		

17-4. Oil Sump and Suction Tube Installation

Oil sump and suction tube hardware varies by IO-360 Series Engine model. Refer to the instructions matching the engine model being assembled. Torque the oil sump according to the sequence shown in Figure 17-25.

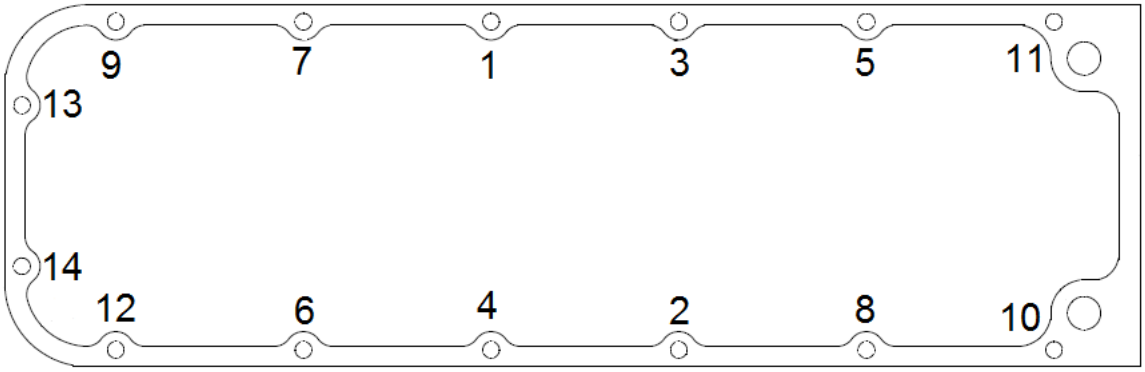


Figure 17-25. Oil Sump Torque Sequence

17-4.1. Oil Suction Tube and Sump Installation

1. Rotate engine stand to place engine in inverted position.
2. Apply a bead of P/N 646942 Gasket Maker (Chapter 3 of M-0, Standard Practice Maintenance Manual) (or equivalent) to the oil sump (Figure 17-27)(2) pan rail on crankcase; do not allow silk thread on the crankcase split line to protrude beyond the mating surface for the oil sump gasket. Refer to Appendix C-9 for Gasket Maker application instructions.
3. Install new gasket (1) on oil sump (2) pan rail on crankcase. Refer to Figure 17-26.

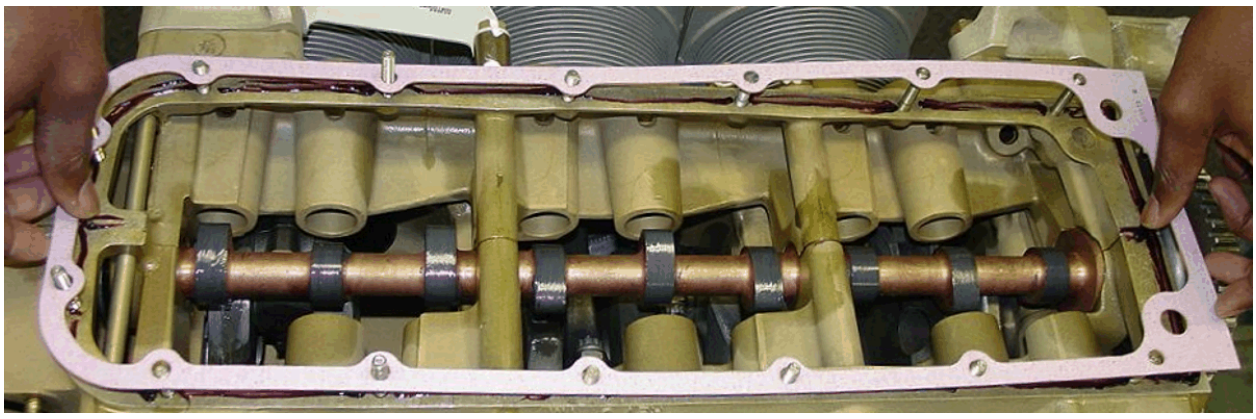


Figure 17-26. Oil Sump Gasket Installation

4. Apply Loctite 592 Teflon PS/T Pipe Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the threads of suction tube (9).
5. Install suction tube (9) into oil sump (2). Torque suction tube to Appendix B specifications.

6. Install a new copper gasket (4)(with the split line toward the oil sump (2)) on the magnetic drain plug (5).
7. Install the magnetic drain plug (5) in the bottom of the oil sump (2). Torque the magnetic drain plug to Appendix B specifications and safety wire according to the safety wiring instructions in Appendix C-3.
8. Verify there are no foreign objects in the engine or oil sump (2).
9. Install oil sump (2) straight down over studs and onto gasket (1).

   NOTE: Ensure not to damage the gasket (1) or studs when installing the oil sump (2).

10. Lubricate the stud threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
11. Install the washers (6), lock washers (7) and nuts (8). Torque nuts to Appendix B specifications and in the sequence shown in Figure 17-25.

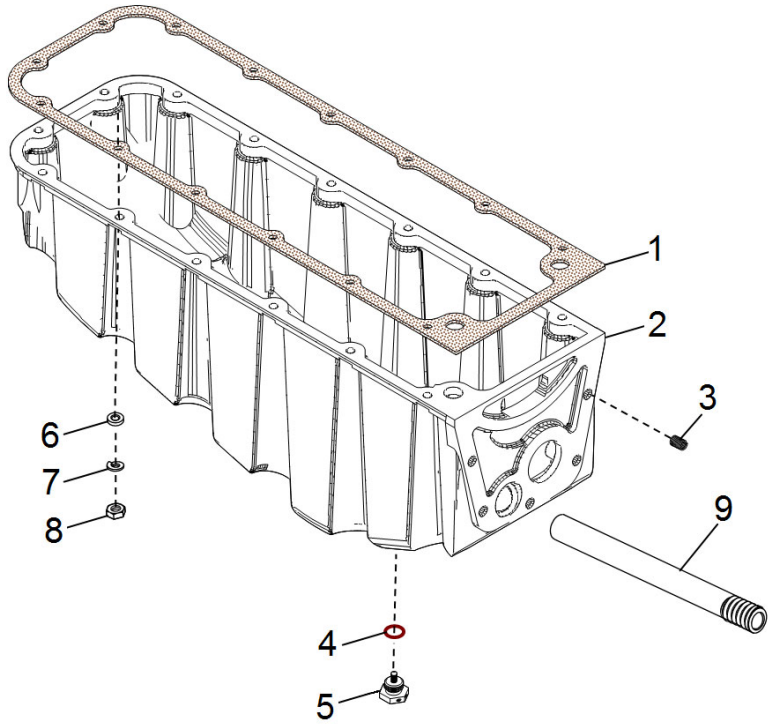


Figure 17-27. Oil Suction Tube and Sump Installation

1	Gasket	4	Copper Gasket	7	Lock Washer
2	Oil Sump	5	Magnetic Drain Plug	8	Nut
3	Insert	6	Washer	9	Suction Tube

17-4.2. Oil Suction Tube and Sump with Quick Drain Installation

1. Rotate engine stand to place engine in inverted position.
2. Apply a bead of P/N 646942 Gasket Maker (Chapter 3 of M-0, Standard Practice Maintenance Manual) (or equivalent) to the oil sump (Figure 17-28)(2) pan rail on crankcase; do not allow silk thread on the crankcase split line to protrude beyond the mating surface for the oil sump gasket. Refer to Appendix C-9 for Gasket Maker application instructions.
3. Install new gasket (1) on oil sump (2) pan rail on crankcase. Refer to Figure 17-26.
4. Apply Loctite 592 Teflon PS/T Pipe Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the threads of suction tube (9).
5. Install suction tube (9) into oil sump (2). Torque suction tube to Appendix B specifications.
6. Install a new copper gasket (4)(with the split line toward the oil sump (2)) on the quick drain coupling (5).
7. Install the quick drain coupling (5) in the bottom of the oil sump (2). Torque the quick drain coupling to Appendix B specifications and safety wire according to the safety wiring instructions in Appendix C-3.
8. Verify there are no foreign objects in the engine or oil sump (2).
9. Install oil sump (2) straight down over studs and onto gasket (1).

   NOTE: Ensure not to damage the gasket (1) or studs when installing oil sump (2).

10. Lubricate the stud threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
11. Install the washers (6), lock washers (7) and nuts (8). Torque nuts to Appendix B specifications and in the sequence shown in Figure 17-25.

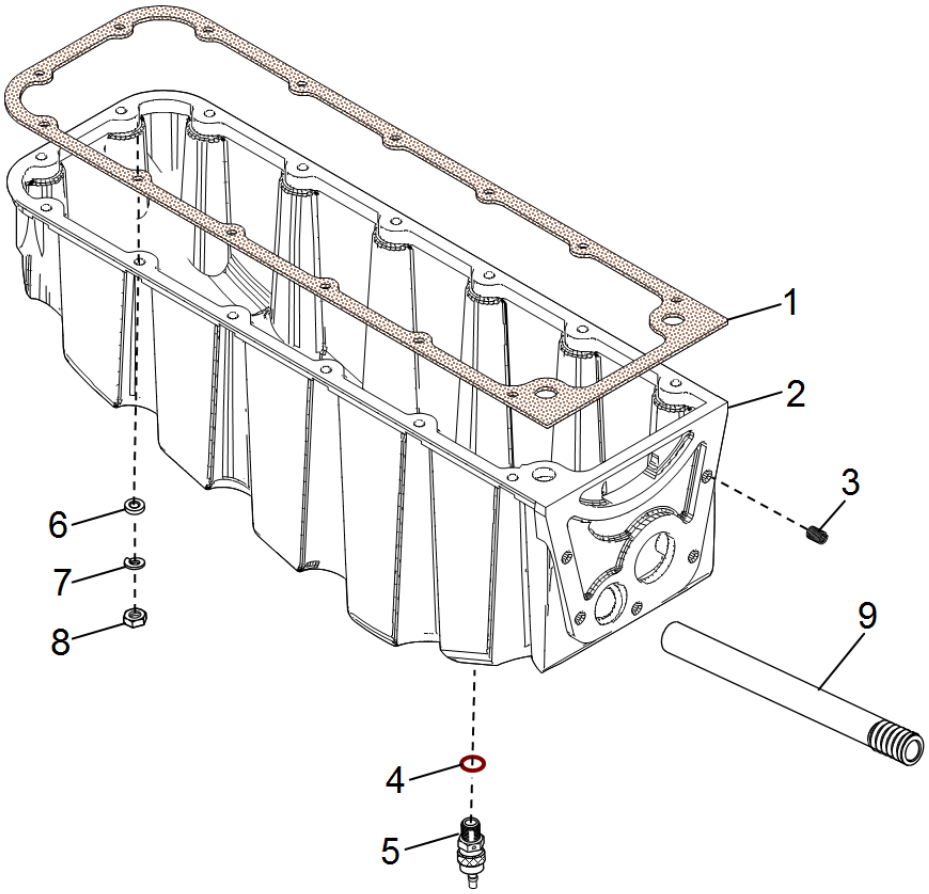


Figure 17-28. Oil Suction Tube and Sump with Quick Drain Installation

1	Gasket	4	Copper Gasket	7	Lock Washer
2	Oil Sump	5	Quick Drain Coupling	8	Nut
3	Insert	6	Washer	9	Suction Tube

17-4.3. IO-360-HB9, ES3, ES14 Oil Suction Tube and Sump Installation

1. Rotate engine stand to place engine in inverted position.
2. Apply a bead of P/N 646942 Gasket Maker (Chapter 3 of M-0, Standard Practice Maintenance Manual) (or equivalent) to the oil sump (Figure 17-29)(2) pan rail on crankcase; do not allow silk thread on the crankcase split line to protrude beyond the mating surface for the oil sump gasket. Refer to Appendix C-9 for Gasket Maker application instructions.
3. Install new gasket (1) on oil sump (2) pan rail on crankcase. Refer to Figure 17-26.
4. Apply Loctite 592 Teflon PS/T Pipe Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the threads of pickup tube (9).
5. Install pickup tube (9) into oil sump (2). Torque pickup tube to Appendix B specifications.
6. Install sump valve (11) into position and secure with bolts (12), washers (13) and lock nuts (14). Torque nuts to Appendix B specifications.
7. Apply P/N 646943 Anti-seize Lubricant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to return fitting (10) threads going into oil sump (2).
8. Install return fitting (10) into oil sump (2).

   NOTE: Fitting should end up facing rear of engine.
9. Install a new copper gasket (4)(with the split line toward the oil sump (2)) on the magnetic drain plug (5).
10. Install the magnetic drain plug (5) in the bottom of the oil sump (2). Torque the magnetic drain plug to Appendix B specifications and safety wire according to the safety wiring instructions in Appendix C-3.
11. Verify there are no foreign objects in the engine or oil sump (2).
12. Install oil sump (2) straight down over studs and onto gasket (1).

    NOTE: Ensure not to damage the gasket (1) or studs when installing oil sump (2).
13. Lubricate the stud threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
14. Install the washers (6), lock washers (7) and nuts (8). Torque nuts to Appendix B specifications and in the sequence shown in Figure 17-25.

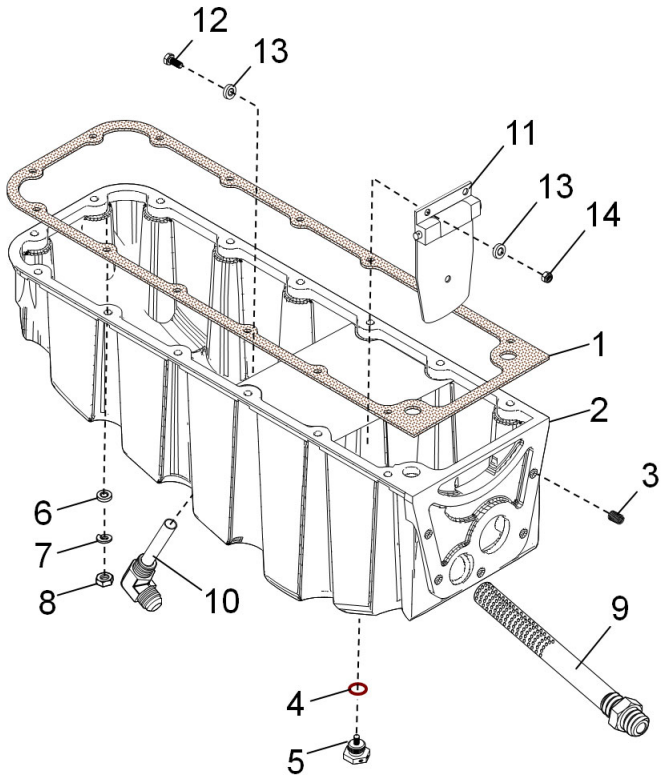


Figure 17-29. IO-360-HB9, ES3, ES14 Oil Suction Tube and Sump Installation

1	Gasket	5	Magnetic Drain Plug	9	Pickup Tube	13	Washer
2	Oil Sump	6	Washer	10	Return Fitting	14	Lock Nut
3	Insert	7	Lock Washer	11	Sump Valve		
4	Copper Gasket	8	Nut	12	Bolt		

17-5. Accessory Case Installation

The IO-360 series accessory case has many different variations of parts attached depending on the engine model and specification. Some have extended oil filler necks, some have a tach drive unit installed and some have oil filters and adapters instead of an pressure oil screen. Use the following instructions according to the appropriate instructions that match your engine configuration. Refer to the Illustrated Parts Catalog for your engine model.

17-5.1. Accessory Case with No Tach Drive Installation (Except AF and ES)

1. Rotate engine stand to place engine in upright position.
2. Apply P/N 646942 Gasket Maker (Chapter 3 of M-0, Standard Practice Maintenance Manual) (or equivalent) to the split lines of the crankcase halves and oil sump to crankcase and lay the silk thread toward the center of the crankcase. Refer to Figure 17-30.

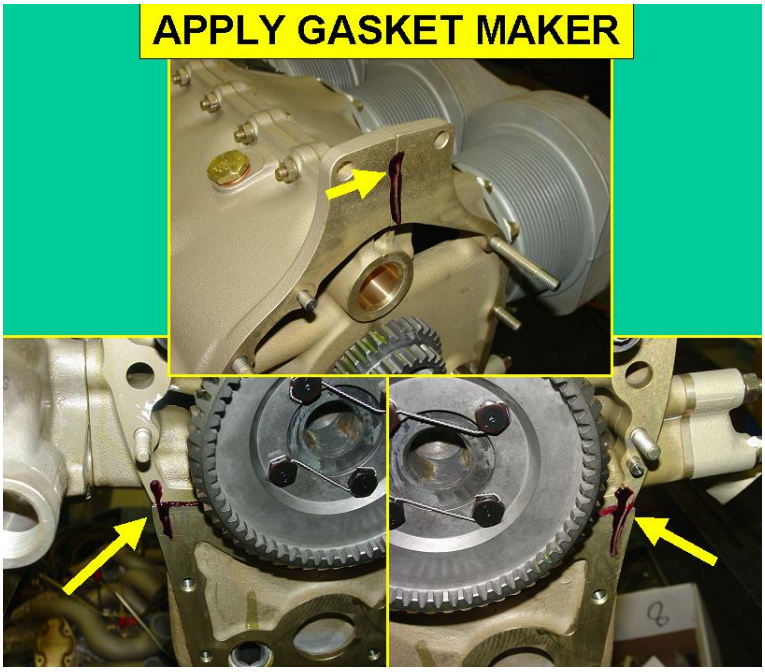


Figure 17-30. Accessory Case Gasket Maker Application

3. Apply P/N 642188 Copper Coat Gasket Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the entire surface of gasket (Figure 17-32)(2)(crankcase side only).
4. Install gasket (2) onto the crankcase studs. Fully seat the gasket by lightly pressing all areas where the gasket contacts the crankcase.

   NOTE: Ensure copper coat side of gasket (2) is towards crankcase and ensure silk thread is under gasket.

5. Apply a light coat of Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to oil pump drive gear of accessory case (1).

6. Install accessory case (1) onto crankcase. Use nut (24) to align oil pump drive gear with camshaft gear.

   NOTE: Ensure not to damage the gasket (2) or studs when installing accessory case (1).

7. Lubricate the top left screw (37) threads with clean 50 weight aviation engine oil. (Chapter 3 of M-0, Standard Practice Maintenance Manual)
8. Install the top left screw (37) in accessory case and secure with washers (12), lock washer (13) and nut (14); tighten, but do not torque nut.
9. Lubricate the crankcase studs threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual). Refer to Figure 17-31.
10. Install washers (12), lock washers (13) and nuts (14); tighten, but do not torque nuts. Refer to Figure 17-31.

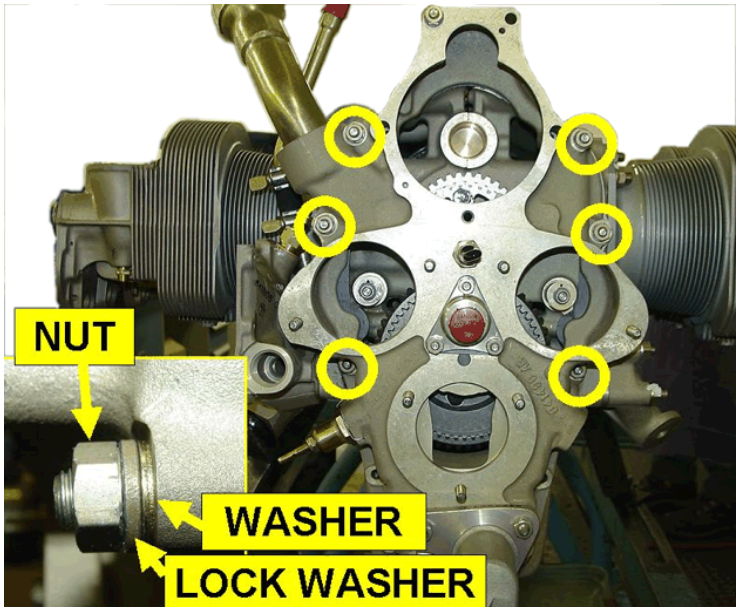


Figure 17-31. Accessory Case Fasteners

11. Torque the nuts (14) from step 8 and step 10 to Appendix B specifications in an alternating pattern.
12. Lubricate screws (15) threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
13. Install washers (12), lock washers (13) and screws (15). Torque screws to Appendix B specifications in an alternating pattern.
14. Assemble pressure relief valve assembly, using plunger (16), new springs (17 and 18), adjustment screw (19), new copper gasket (20), cap (21), new copper washer (22) and stop nut (23).
15. Apply Loctite 592 Teflon PS/T Pipe Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to cap (21) threads.

16. Install pressure relief valve assembly into accessory case (1). Torque cap (21) to Appendix B specifications; safety wire according to the safety wiring instructions in Appendix C-3.
17. Apply P/N 654663 Gasket Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to both sides of gasket (25).
18. Install gasket (25), cover (26), washers (38), lock washers (27) and nuts (28). Torque nuts to Appendix B specifications.
19. Install copper gasket (29) on scavenge oil screen (30).
20. Install scavenge oil screen (30) into accessory case (1). Torque scavenge oil screen to Appendix B specifications.
21. Install copper gasket (31) on pressure oil screen (32) assembly.
22. Install pressure oil screen (32) assembly into accessory case (1). Torque pressure oil screen to Appendix B specifications.
23. Safety wire scavenge oil screen (30) to pressure oil screen (32) according to the safety wiring instructions in Appendix C-3.
24. Install copper gaskets (9) on plugs (10) and lubricate plug threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
25. Install plugs (10) in the bottom ports of accessory case (1). Torque plugs to Appendix B specifications.
26. Safety wire the plugs (10) together according to the safety wiring instructions in Appendix C-3.
27. Install clamps (36) over the filler neck tube (6).

    NOTE: Some models without tach drive do not have filler neck (34), hose (35) or clamps (36). Skip steps 27 through 30 if they do not apply.

28. Install hose (35) on filler neck tube (6); roughly half way down hose.
29. Install filler neck (34) into hose (35); roughly half way down hose.
30. Position clamps (36) into position on hose (35). Torque clamps to Appendix B specifications.
31. Install filler cap assembly (33).

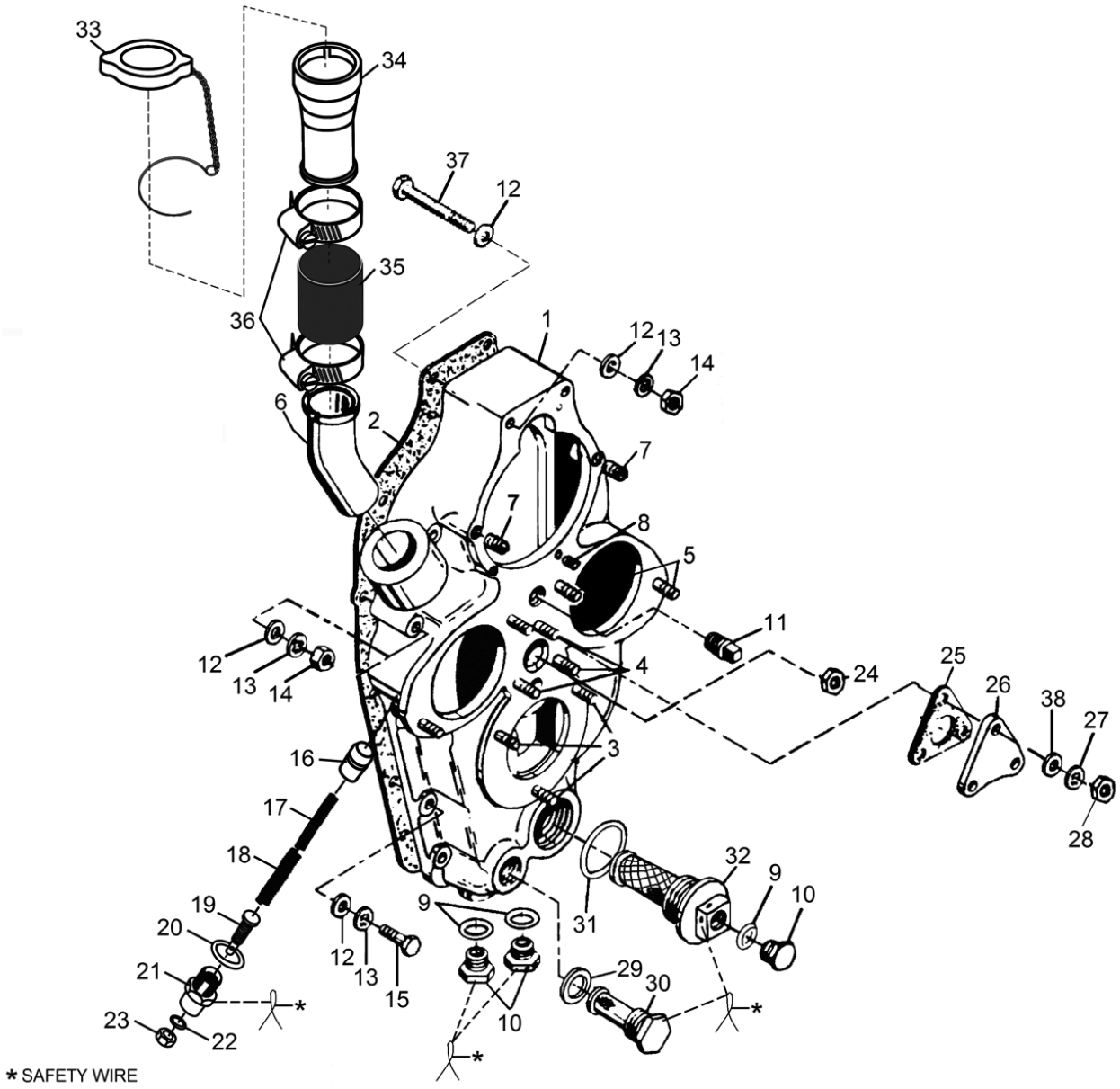


Figure 17-32. Accessory Case with No Tach Drive Installation (Except AF and ES)

1	Accessory Case	11	Plug	21	Cap	31	Copper Gasket
2	Gasket	12	Washer	22	Copper Washer	32	Pressure Oil Screen
3	Stud	13	Lock Washer	23	Stop Nut	33	Filler Cap Assembly
4	Stud	14	Nut	24	Nut	34	Filler Neck
5	Stud	15	Screw	25	Gasket	35	Hose
6	Filler Neck Tube	16	Plunger	26	Cover	36	Clamp
7	Insert	17	Spring	27	Lock Washer	37	Screw
8	Insert	18	Spring	28	Nut	38	Washer
9	Copper Gasket	19	Adjustment Screw	29	Copper Gasket		
10	Plug	20	Copper Gasket	30	Scavenge Oil Screen		

17-5.2. Accessory Case with Tach Drive Installation (Except AF and ES)

1. Rotate engine stand to place engine in upright position.
2. Apply P/N 646942 Gasket Maker (Chapter 3 of M-0, Standard Practice Maintenance Manual) (or equivalent) to the split lines of the crankcase halves and oil sump to crankcase and lay the silk thread toward the center of the crankcase. Refer to Figure 17-33.

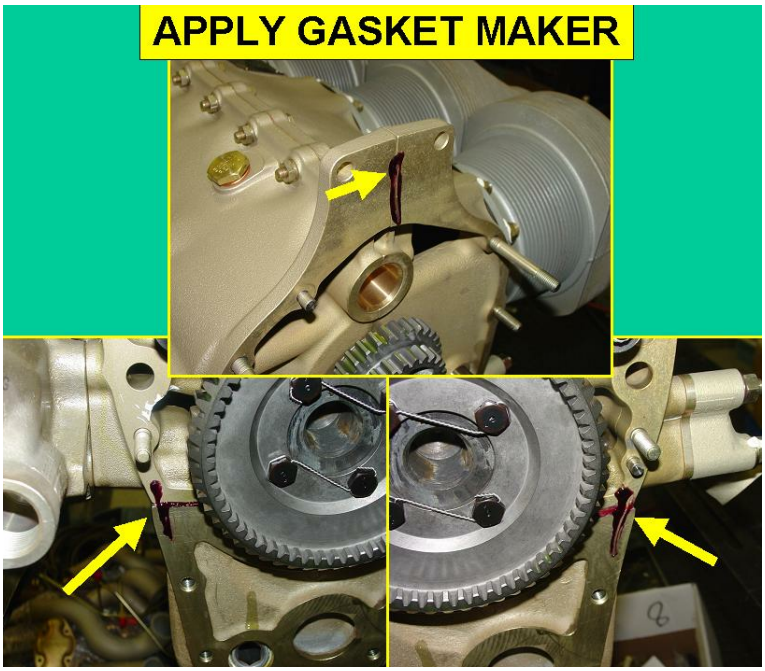


Figure 17-33. Accessory Case Gasket Maker Application

3. Apply P/N 642188 Copper Coat Gasket Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the entire surface of gasket (Figure 17-35)(2)(crankcase side only).
4. Install gasket (2) onto the crankcase studs. Fully seat the gasket by lightly pressing all areas where the gasket contacts the crankcase.

   NOTE: Ensure copper coat side of gasket (2) is towards crankcase and ensure silk thread is under gasket.

5. Apply a light coat of Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to oil pump drive gear of accessory case (1).
6. Install accessory case (1) onto crankcase. Use nut on oil pump drive gear to align oil pump drive gear with camshaft gear.

   NOTE: Ensure not to damage the gasket (2) or studs when installing accessory case (1).

7. Lubricate the top left screw (38) threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

8. Install the top left screw (38) in accessory case and secure with washers (12), lock washer (13) and nut (14); tighten, but do not torque nut.
9. Lubricate the crankcase studs threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual). Refer to Figure 17-34.
10. Install washers (12), lock washers (13) and nuts (14); tighten, but do not torque nuts. Refer to Figure 17-34.

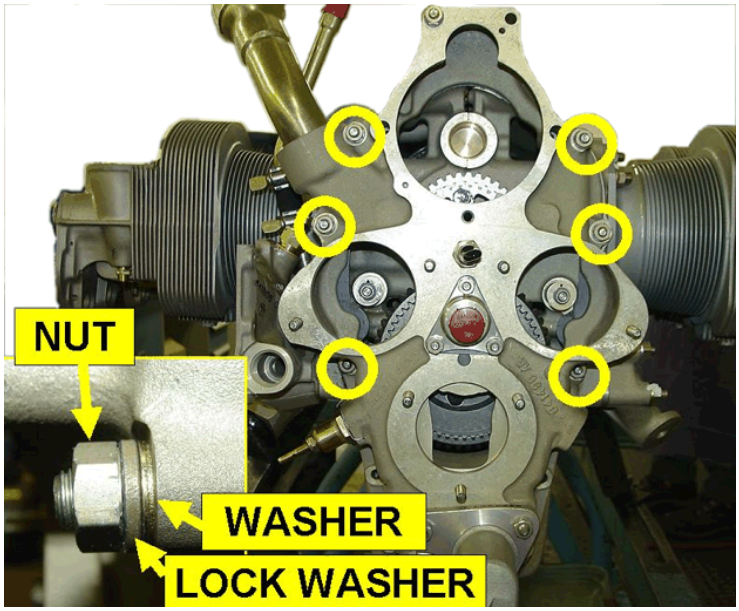


Figure 17-34. Accessory Case Fasteners

11. Torque the nuts (14) from step 8 and step 10 to Appendix B specifications in an alternating pattern.
12. Lubricate screws (15) threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
13. Install washers (12), lock washers, (13) and screws (15). Torque screws to Appendix B specifications in an alternating pattern.
14. Assemble pressure relief valve assembly, using plunger (16), new springs (17 and 18), adjustment screw (19), new copper gasket (20), cap (21), new copper washer (22) and stop nut (23).
15. Apply Loctite 592 Teflon PS/T Pipe Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to cap (21) threads.
16. Install pressure relief valve assembly into accessory case (1). Torque cap (21) to Appendix B specifications; safety wire according to the safety wiring instructions in Appendix C-3.
17. Remove nut temporarily installed to hold oil pump drive gear in accessory case (1).
18. Install tach drive connector (28) and torque to Appendix B specifications.

19. Apply P/N 654663 Gasket Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to both sides of gasket (29).
20. Install gasket (29), seal (30), tach drive adapter (31) and tach reduction adapter (35); secure with washers (32), lock washers (33) and nuts (34). Torque nuts to Appendix B specifications.
21. Install copper gasket (24) on scavenge oil screen (25).
22. Install scavenge oil screen (25) into accessory case (1). Torque scavenge oil screen to Appendix B specifications.
23. Install copper gasket (26) on pressure oil screen (27) assembly.
24. Install pressure oil screen (27) assembly into accessory case (1). Torque pressure oil screen to Appendix B specifications.
25. Safety wire scavenge oil screen (25) to pressure oil screen (27) according to the safety wiring instructions in Appendix C-3.
26. Install copper gaskets (10) on plugs (11).
27. Lubricate plugs (11) threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
28. Install plugs (11) in the bottom ports of accessory case (1). Torque plugs to Appendix B specifications.
29. Safety wire the plugs (11) together according to the safety wiring instructions in Appendix C-3.
30. Install clamps (39) over the filler neck tube (6).

    NOTE: Some models with tach drive do not have filler neck (36), hose (40) or clamps (39). Skip steps 30 through 33 if they do not apply.

31. Install hose (40) on filler neck tube (6); roughly half way down hose.
32. Install filler neck (36) into hose (40); roughly half way down hose.
33. Position clamps (39) into position on hose (40). Torque clamps to Appendix B specifications.
34. Install filler cap assembly (37).

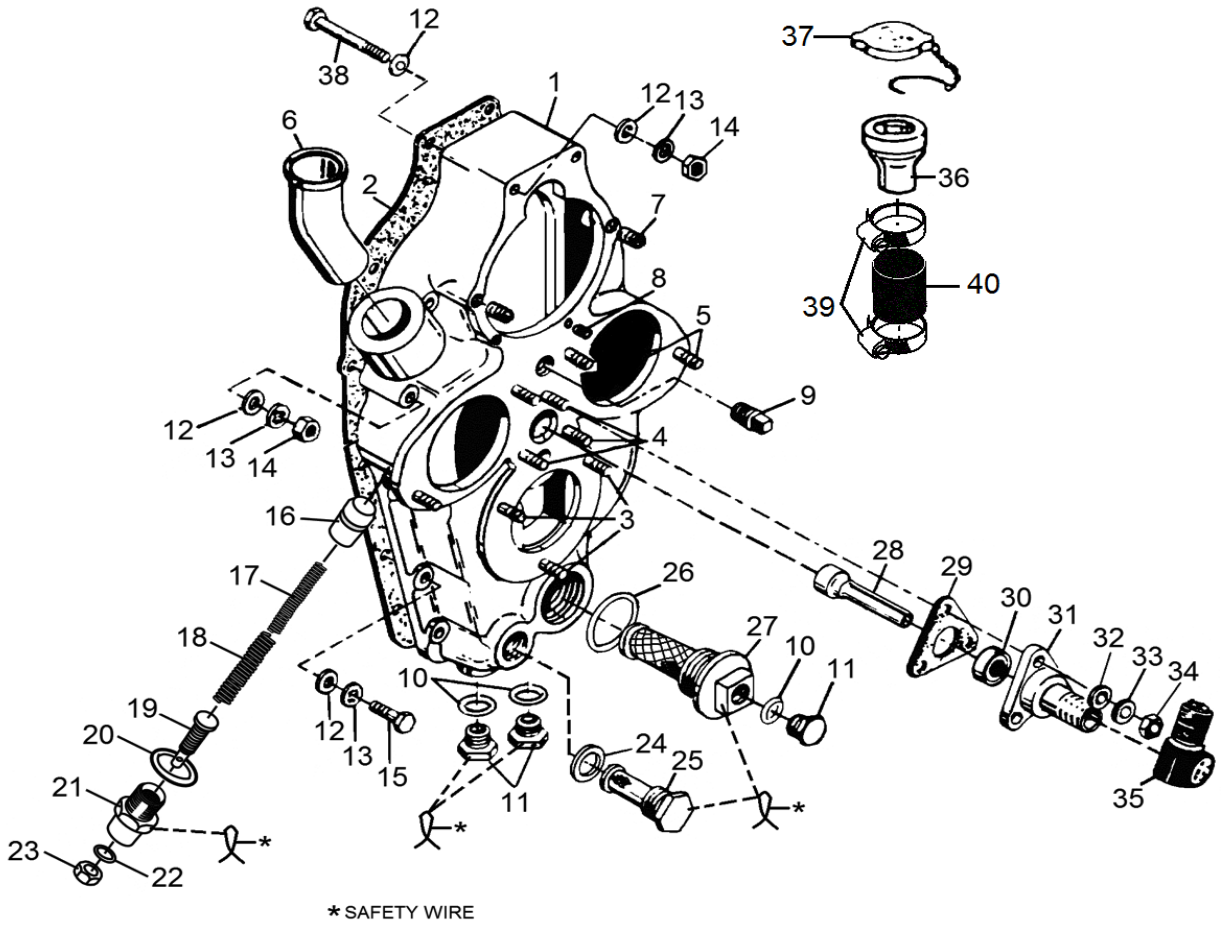


Figure 17-35. Accessory Case with Tach Drive Installation (Except AF and ES)

1	Accessory Case	11	Plug	21	Cap	31	Tach Drive Adapter
2	Gasket	12	Washer	22	Copper Washer	32	Washer
3	Stud	13	Lock Washer	23	Stop Nut	33	Lock Washer
4	Stud	14	Nut	24	Copper Gasket	34	Nut
5	Stud	15	Screw	25	Scavenge Oil Screen	35	Tach Reduction Adapter
6	Filler Neck Tube	16	Plunger	26	Copper Gasket	36	Filler Neck
7	Insert	17	Spring	27	Pressure Oil Screen	37	Filler Cap Assembly
8	Insert	18	Spring	28	Tach Drive Connector	38	Screw
9	Plug	19	Adjustment Screw	29	Gasket	39	Clamp
10	Copper Gasket	20	Copper Gasket	30	Seal	40	Hose

17-5.3. Accessory Case with Oil Filter and Adapter Installation (Includes HB9, ES3B and ES14B)

1. Install top screen (Figure 17-35)(41) into accessory case (1) and secure with bolts (42) and washers (43). Torque bolts to Appendix B specifications.

   NOTE: This applies to HB9, ES3B and ES14B models only.

2. Rotate engine stand to place engine in upright position.

3. Apply P/N 646942 Gasket Maker (Chapter 3 of M-0, Standard Practice Maintenance Manual) (or equivalent) to the split lines of the crankcase halves and oil sump to crankcase and lay the silk thread toward the center of the crankcase. Refer to Figure 17-36.

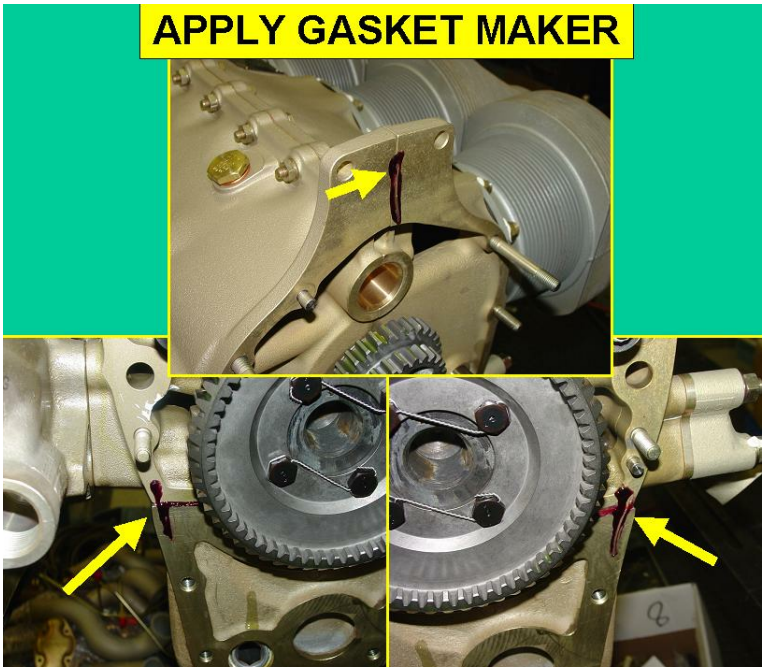


Figure 17-36. Accessory Case Gasket Maker Application

4. Apply P/N 642188 Copper Coat Gasket Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the entire surface of gasket (2)(crankcase side only).

5. Install gasket (2) onto the crankcase studs. Fully seat the gasket by lightly pressing all areas where the gasket contacts the crankcase.

   NOTE: Ensure copper coat side of gasket (2) is towards crankcase and ensure silk thread is under gasket.

6. Apply a light coat of Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to oil pump drive gear of accessory case (1).

7. Install accessory case (1) onto crankcase. Use nut on oil pump drive gear to align oil pump drive gear with camshaft gear.

   NOTE: Ensure not to damage the gasket (2) or studs when installing accessory case (1).

8. Lubricate the top left screw (44) threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
9. Install the top left screw (44) in accessory case and secure with washers (12), lock washer (13) and nut (14); tighten but do not torque nut.
10. Lubricate the crankcase studs threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual). Refer to Figure 17-37.
11. Install washers (12), lock washers (13) and nuts (14); tighten, but do not torque nuts. Refer to Figure 17-37.

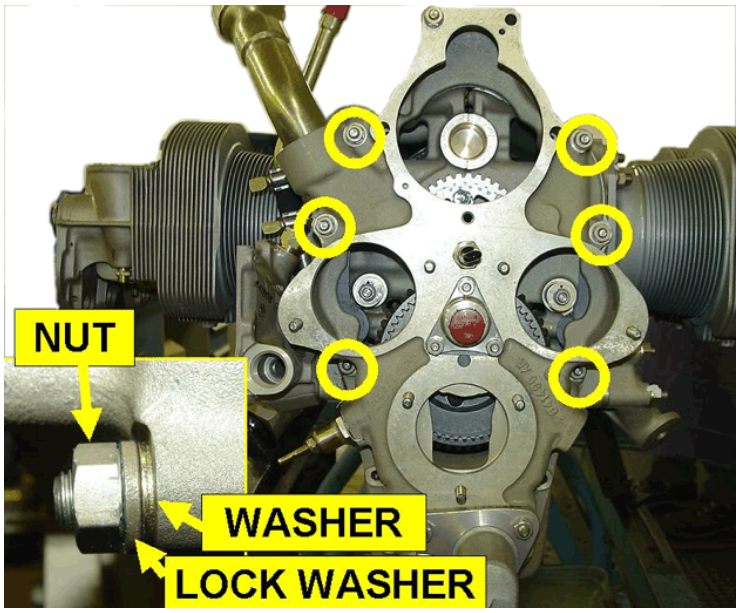


Figure 17-37. Accessory Case Fasteners

12. Torque the nuts (14) from step 9 and step 11 to Appendix B specifications in an alternating pattern.
13. Lubricate screws (15) threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
14. Install washers (12), lock washers (13) and screws (15). Torque screws to Appendix B specifications in an alternating pattern.
15. Assemble pressure relief valve assembly, using plunger (16), new springs (17 and 18), adjustment screw (20), new copper gasket (19), cap (21), new copper washer (22) and stop nut (23).
16. Apply Loctite 592 Teflon PS/T Pipe Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to cap (21) threads.
17. Install pressure relief valve assembly into accessory case (1). Torque cap (21) to Appendix B specifications; safety wire according to the safety wiring instructions in Appendix C-3.
18. Remove nut temporarily installed to hold oil pump drive gear in accessory case (1).

19. Install tach drive connector (30). Torque tach drive connector to Appendix B specifications.
20. Apply P/N 654663 Gasket Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to both sides of gasket (31).
21. Install gasket (31), seal (32), tach drive adapter (33) and tach reduction adapter (37); secure with washers (34), lock washers (35) and nuts (36). Torque nuts to Appendix B specifications.

    NOTE: Some models with oil filter and adapter will not have a tach drive unit but a cover. Refer to Section 17-5.1 for cover installation procedure.

22. Install copper gasket (24) on adapter (25).
23. Install adapter (25) in accessory case (1). Torque adapter to Appendix B specifications.

    NOTE: This applies to HB9, ES3B and ES14B models only, other models will have scavenge oil screen. Refer to Section 17-5.1 for scavenge oil screen installation procedure.

24. Apply clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual) to o-ring (28).
25. Install o-ring (28) in groove on filter adapter (29).
26. Install gasket (27) and filter adapter (29) on accessory case (1). Secure with washers (12), lock washers (13) and nuts (14). Torque nuts to Appendix B specifications.

    NOTE: Refer to the Illustrated Parts Catalog for correct oil filter adapter to engine application, adapter to engine angle orientations may vary according to engine model.

27. Apply Dow Corning No. 4 lubricant (Chapter 3 of M-0, Standard Practice Maintenance Manual) on the rubber oil seal of the oil filter (39).
28. Install new oil filter (39) on adapter stud (38) of the filter adapter (29). Torque oil filter to Appendix B specifications.
29. Safety wire adapter (25) to filter adapter (29) nut (14) according to the safety wiring instructions in Appendix C-3.

    NOTE: This applies to HB9, ES3B and ES14B models only, other models will have scavenge oil screen. Skip to step 30 if your model has a scavenge oil screen.

30. Safety wire scavenge oil screen to filter adapter (29) nut (14) according to the safety wiring instructions in Appendix C-3.
31. Install copper gaskets (9) on plugs (10) and lubricate plug threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
32. Install plugs (10) in the bottom ports of accessory case (1). Torque plugs to Appendix B specifications.
33. Safety wire the plugs (10) together according to the safety wiring instructions in Appendix C-3.

34. Install filler neck extension. Refer to Section 17-5.1 for installation procedure.

    NOTE: Some models with oil filter and adapter will not have a filler neck extension. Skip this step if it does not apply.

35. Install filler cap assembly (40).

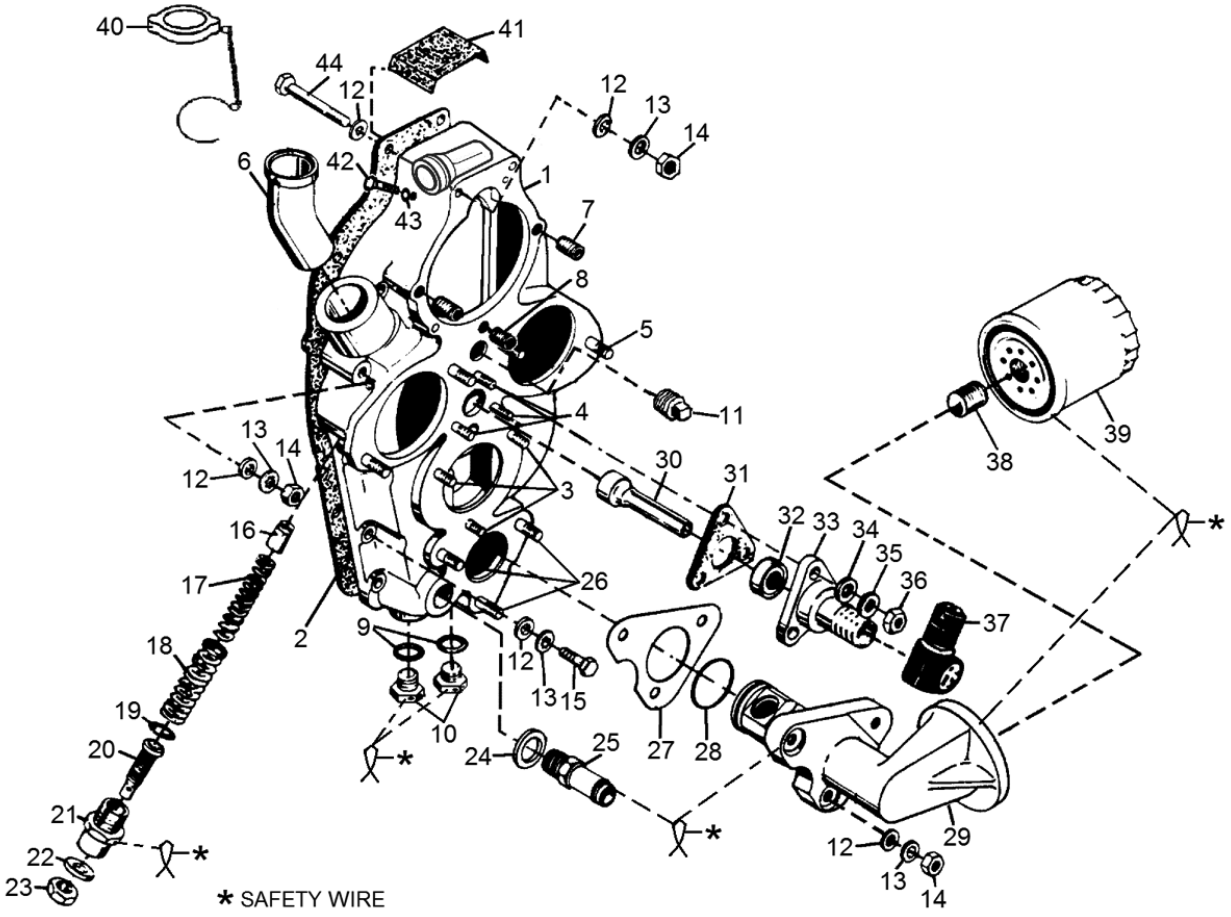


Figure 17-38. Accessory Case with Oil Filter and Adapter Installation (Includes HB9, ES3B and ES14B)

1	Accessory Case	13	Lock Washer	25	Adapter (HB9,ES3B, ES14B)	37	Tach Reduction Adapter
2	Gasket	14	Nut	26	Stud	38	Adapter Stud
3	Stud	15	Screw	27	Gasket	39	Oil Filter
4	Stud	16	Plunger	28	O-ring	40	Filler Cap Assembly
5	Stud	17	Spring	29	Filter Adapter	41	Top Screen (HB9,ES3B, ES14B)
6	Filler Neck Tube	18	Spring	30	Tach Drive Connector	42	Bolt (HB9,ES3B, ES14B)
7	Insert	19	Copper Gasket	31	Gasket	43	Washer (HB9,ES3B, ES14B)
8	Insert	20	Adjustment Screw	32	Seal	44	Screw
9	Copper Gasket	21	Cap	33	Tach Drive Adapter		
10	Plug	22	Copper Washer	34	Washer		
11	Plug	23	Stop Nut	35	Lock Washer		
12	Washer	24	Copper Gasket	36	Nut		

17-5.4. Accessory Case with Oil Filter and Adapter Installation

1. Rotate engine stand to place engine in upright position.
2. Apply P/N 646942 Gasket Maker (Chapter 3 of M-0, Standard Practice Maintenance Manual) (or equivalent) to the split lines of the crankcase halves and oil sump to crankcase and lay the silk thread toward the center of the crankcase. Refer to Figure 17-39.

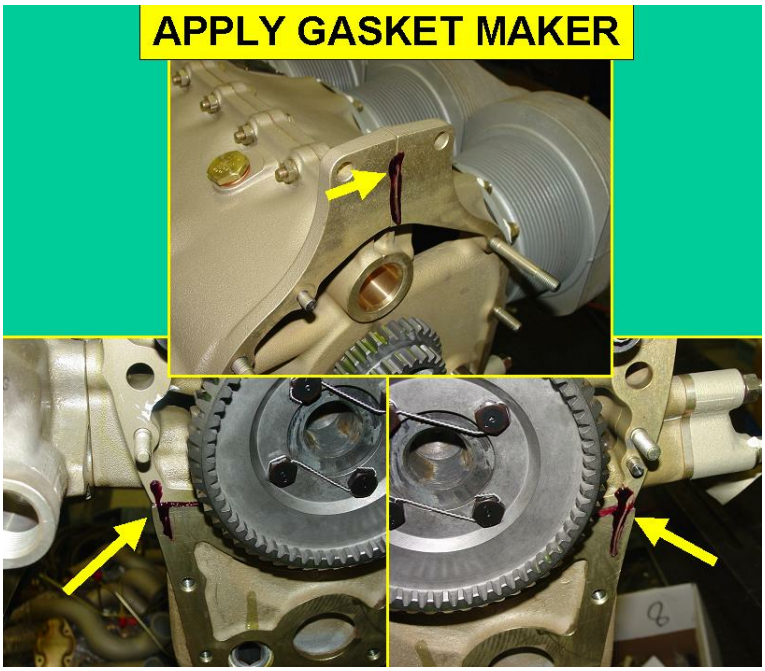


Figure 17-39. Accessory Case Gasket Maker Application

3. Apply P/N 642188 Copper Coat Gasket Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the entire surface of gasket (Figure 17-41)(2)(crankcase side only).
4. Install gasket (2) onto the crankcase studs. Fully seat the gasket by lightly pressing all areas where the gasket contacts the crankcase.

   NOTE: Ensure copper coat side of gasket (2) is towards crankcase and ensure silk thread is under gasket.

5. Apply a light coat of Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to oil pump drive gear of accessory case (1).
6. Install accessory case (1) onto crankcase. Use nut on oil pump drive gear to align oil pump drive gear with camshaft gear.

   NOTE: Ensure not to damage the gasket (2) or studs when installing accessory case (1).

7. Lubricate the top left screw (44) threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

8. Install the top left screw (44) in accessory case and secure with washers (23), lock washer (24) and nut (25); tighten but do not torque nut.
9. Lubricate the crankcase studs threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual). Refer to Figure 17-40.
10. Install washers (23), lock washers (24) and nuts (25); tighten, but do not torque nuts. Refer to Figure 17-40.

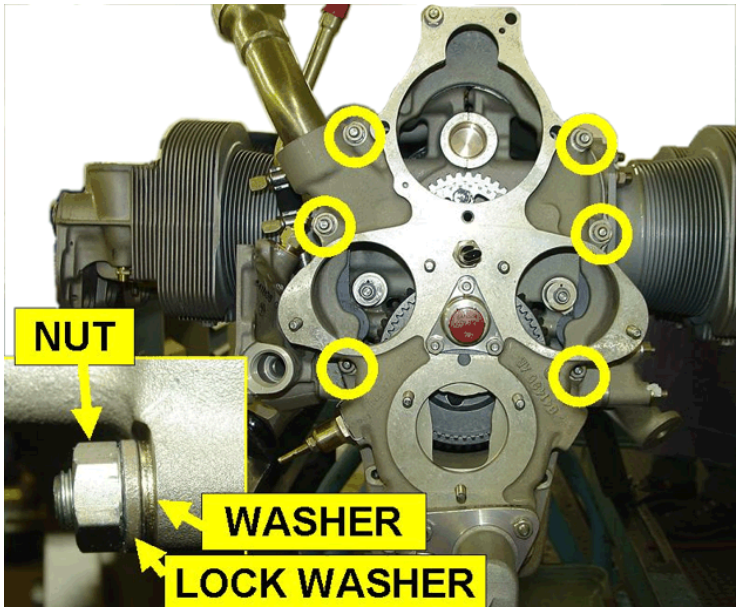


Figure 17-40. Accessory Case Fasteners

11. Torque the nuts (25) from step 8 and step 10 to Appendix B specifications in an alternating pattern.
12. Lubricate screws (26) threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
13. Install washers (23), lock washers (24) and screws (26). Torque screws to Appendix B specifications in an alternating pattern.
14. Assemble pressure relief valve assembly, using plunger (13), new springs (14 and 15), adjustment screw (17), new copper gasket (16), cap (18), new copper washer (19) and stop nut (20).
15. Apply Loctite 592 Teflon PS/T Pipe Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to cap (18) threads.
16. Install pressure relief valve assembly into accessory case (1). Torque cap (18) to Appendix B specifications; safety wire according to the safety wiring instructions in Appendix C-3.
17. Lubricate studs (3) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
18. Install gasket (32), alternator pad cover (33) and secure with washers (23) and lock nuts (34). Torque lock nuts to Appendix B specifications.

    NOTE: This applies to only those models with the optional belt driven alternator.

19. Apply Loctite 592 Teflon PS/T Pipe Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to bushing (11) threads.
20. Install bushing (11) into accessory case (1). Torque bushing to Appendix B specifications.

    NOTE: Some models will have a plug at this location instead of the adapter and bushing. Skip steps 19 and 21 if plug is installed at this location.

21. Apply Loctite 592 Teflon PS/T Pipe Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to adapter (12) threads.
22. Install adapter (12) into bushing (11). Torque adapter to Appendix B specifications.
23. Remove nut temporarily installed to hold oil pump drive gear in accessory case (1).
24. Install tach drive connector (35). Torque tach drive connector to Appendix B specifications.
25. Apply P/N 654663 Gasket Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to both sides of gasket (36).
26. Install gasket (36), seal (37), tach drive adapter (39) and tach reduction adapter (42); secure with washers (39), lock washers (40) and nuts (41). Torque nuts to Appendix B specifications.
27. Install copper gasket (24) on scavenge oil screen (22).
28. Install scavenge oil screen (22) in accessory case (1). Torque scavenge oil screen to Appendix B specifications.
29. Apply clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual) to o-ring (28).
30. Install o-ring (28) in groove on filter adapter (29).
31. Install gasket (27) and filter adapter (29) on accessory case (1). Secure with washers (23), lock washers (24) and nuts (25). Torque nuts to Appendix B specifications.

    NOTE: Refer to the Illustrated Parts Catalog for correct oil filter adapter to engine application, adapter to engine angle orientations may vary according to engine model.

32. Apply Dow Corning No. 4 lubricant (Chapter 3 of M-0, Standard Practice Maintenance Manual) on the rubber oil seal of the oil filter (31).
33. Install new oil filter (31) on adapter stud (30) of the filter adapter (29). Torque oil filter to Appendix B specifications.
34. Safety wire oil filter (31) to filter adapter (29) according to safety wiring instructions in Appendix C-3.
35. Safety wire scavenge oil screen (22) to filter adapter (29) nut (25) according to the safety wiring instructions in Appendix C-3.
36. Install copper gaskets (9) on plugs (10).
37. Lubricate plugs (10) threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
38. Install plugs (10) in the bottom ports of accessory case (1). Torque plugs to Appendix B specifications.

39. Safety wire the plugs (10) together according to the safety wiring instructions in Appendix C-3.

40. Install filler cap assembly (43).

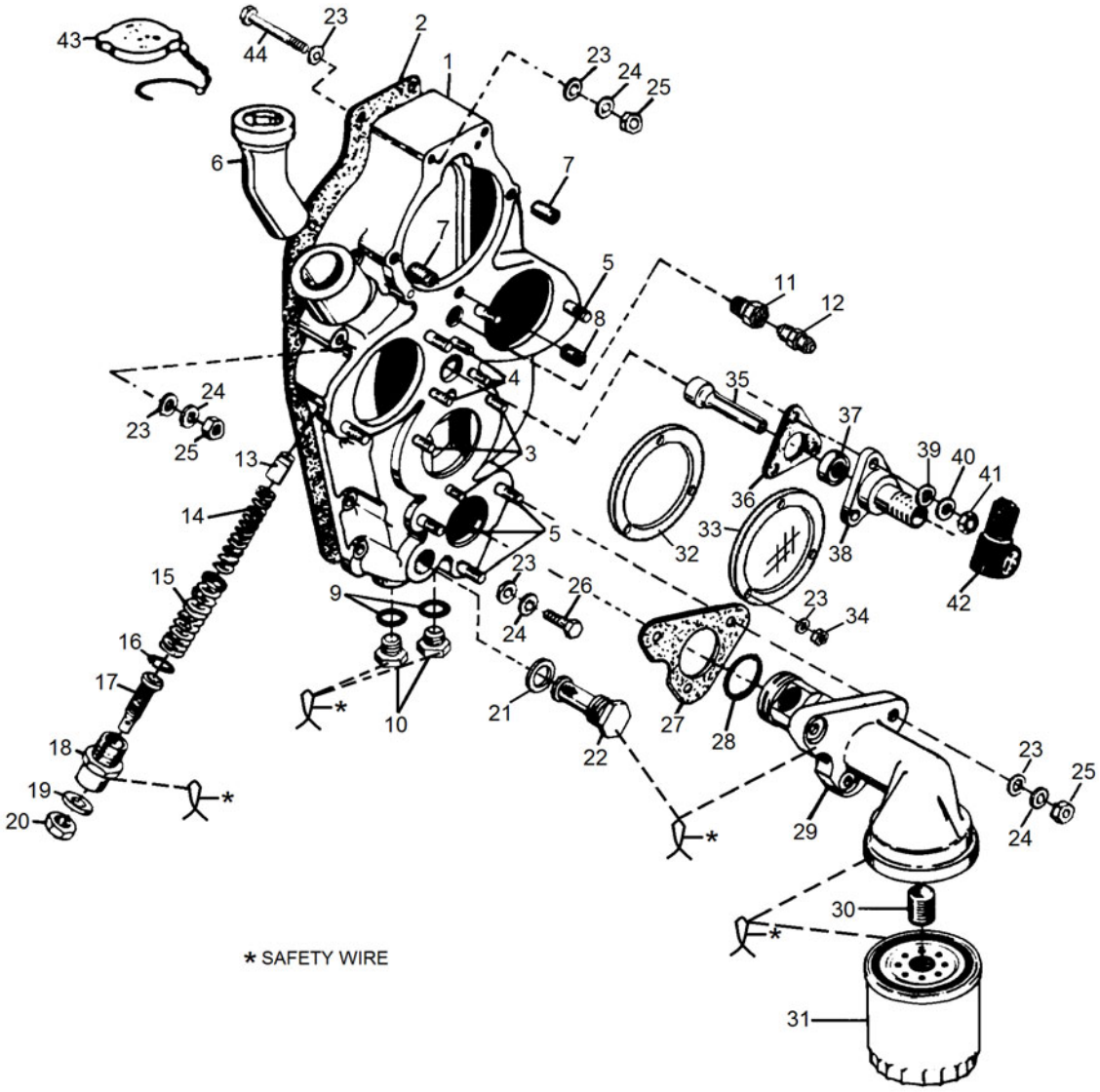


Figure 17-41. Accessory Case with Oil Filter and Adapter Installation

1	Accessory Case	12	Adapter	23	Washer	34	Lock Nut
2	Gasket	13	Plunger	24	Lock Washer	35	Tach Drive Connector
3	Stud	14	Spring	25	Nut	36	Gasket
4	Stud	15	Spring	26	Screw	37	Seal
5	Stud	16	Copper Gasket	27	Gasket	38	Tach Drive Adapter
6	Filler Neck Tube	17	Adjustment Screw	28	O-ring	39	Washer
7	Insert	18	Cap	29	Filter Adapter	40	Lock Washer
8	Insert	19	Copper Washer	30	Adapter Stud	41	Nut
9	Copper Gasket	20	Stop Nut	31	Oil Filter	42	Tach Reduction Adapter
10	Plug	21	Copper Gasket	32	Gasket	43	Filler Cap Assembly
11	Bushing	22	Scavenge Oil Screen	33	Alternator Pad Cover	44	Screw

17-5.5. Accessory Case with Oil Filter and Adapter Installation (AF and ES)

NOTE: Accessory case top bolts will be installed with starter motor installation. Refer to 17-43.

1. Rotate engine stand to place engine in upright position.
2. Apply P/N 646942 Gasket Maker (Chapter 3 of M-0, Standard Practice Maintenance Manual) (or equivalent) to the split lines of the crankcase halves and oil sump to crankcase and lay the silk thread toward the center of the crankcase. Refer to Figure 17-42.

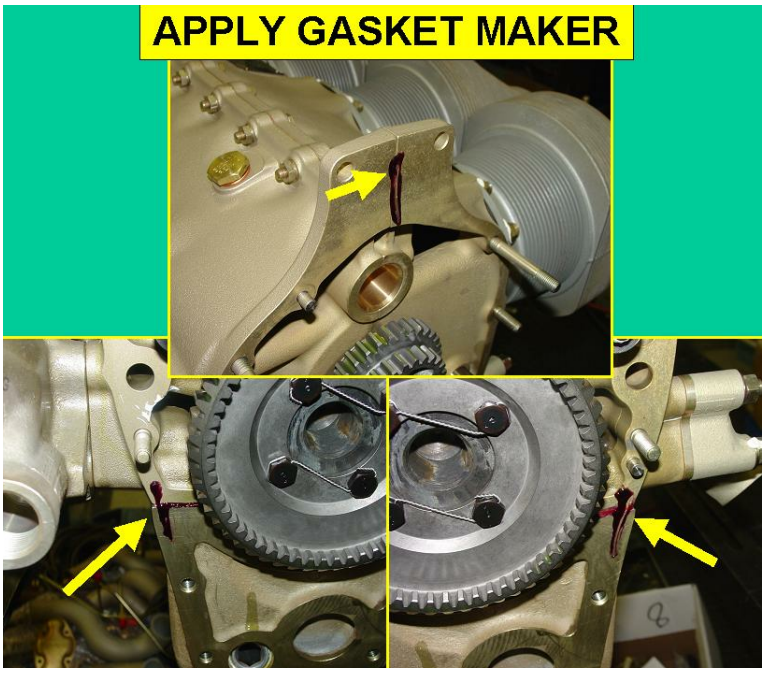


Figure 17-42. Accessory Case Gasket Maker Application

3. Apply P/N 642188 Copper Coat Gasket Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the entire surface of gasket (Figure 17-44)(37)(crankcase side only).
4. Install gasket (37) onto the crankcase studs. Fully seat the gasket by lightly pressing all areas where the gasket contacts the crankcase.

NOTE: Ensure copper coat side of gasket (37) is towards crankcase and ensure silk thread is under gasket.

5. Apply a light coat of Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to oil pump drive gear of accessory case (1).
6. Install accessory case (1) onto crankcase. Use nut (38) to align oil pump drive gear with camshaft gear.

NOTE: Ensure not to damage the gasket (37) or studs when installing accessory case (1).

7. Lubricate the crankcase case studs threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual). Refer to Figure 17-43.
8. Install washers (33), lock washers (34) and nuts (35); tighten, but do not torque nuts. Refer to Figure 17-43.

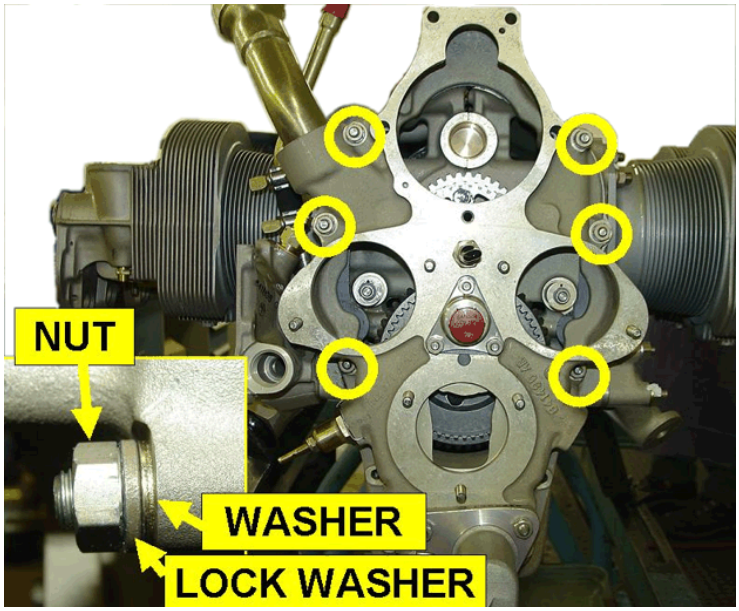


Figure 17-43. Accessory Case Fasteners (AF)

9. Torque the nuts (35) from step 8 to Appendix B specifications in an alternating pattern.
10. Lubricate screws (36) threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
11. Install washers (33), lock washers (34) and screws (36). Torque screws to Appendix B specifications in an alternating pattern.
12. Assemble pressure relief valve assembly, using plunger (13), new springs (14 and 15), adjustment screw (17), new copper gasket (16), cap (18), new copper washer (19) and stop nut (20).
13. Apply Loctite 592 Teflon PS/T Pipe Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to cap (18) threads.
14. Install pressure relief valve assembly into accessory case (1). Torque cap (18) to Appendix B specifications; safety wire according to the safety wiring instructions in Appendix C-3.
15. Apply P/N 654663 Gasket Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to both sides of gasket (21).
16. Install gasket (21), cover (22), washers (23), lock washers (24) and nuts (25). Torque nuts to Appendix B specifications.
17. Install copper gasket (28) on scavenge oil screen (29).
18. Install scavenge oil screen (29) into accessory case (1). Torque scavenge oil screen to Appendix B specifications.

19. Apply clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual) to o-ring (27).
20. Install o-ring (27) in groove on filter adapter (30).
21. Install gasket (26) and filter adapter (30) on accessory case (1). Secure with washers (33), lock washers (34) and nuts (35). Torque nuts to Appendix B specifications.

    NOTE: Refer to the Illustrated Parts Catalog for correct oil filter adapter to engine application, adapter to engine angle orientations may vary according to engine model.

22. Apply Dow Corning No. 4 lubricant (Chapter 3 of M-0, Standard Practice Maintenance Manual) on the rubber oil seal of the oil filter (32).
23. Install new oil filter (32) on adapter stud (31) of the filter adapter (30). Torque oil filter to Appendix B specifications.
24. Safety wire oil filter (32) to filter adapter (30) according to safety wiring instructions in Appendix C-3
25. Safety wire scavenge oil screen (29) to filter adapter (30) nut (35) according to the safety wiring instructions in Appendix C-3.
26. Install copper gaskets (10) on plugs (11).
27. Lubricate plugs (11) threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
28. Install plugs (11) in the bottom ports of accessory case (1). Torque plugs to Appendix B specifications.
29. Safety wire the plugs (11) together according to the safety wiring instructions in Appendix C-3.
30. Install filler cap assembly (9).

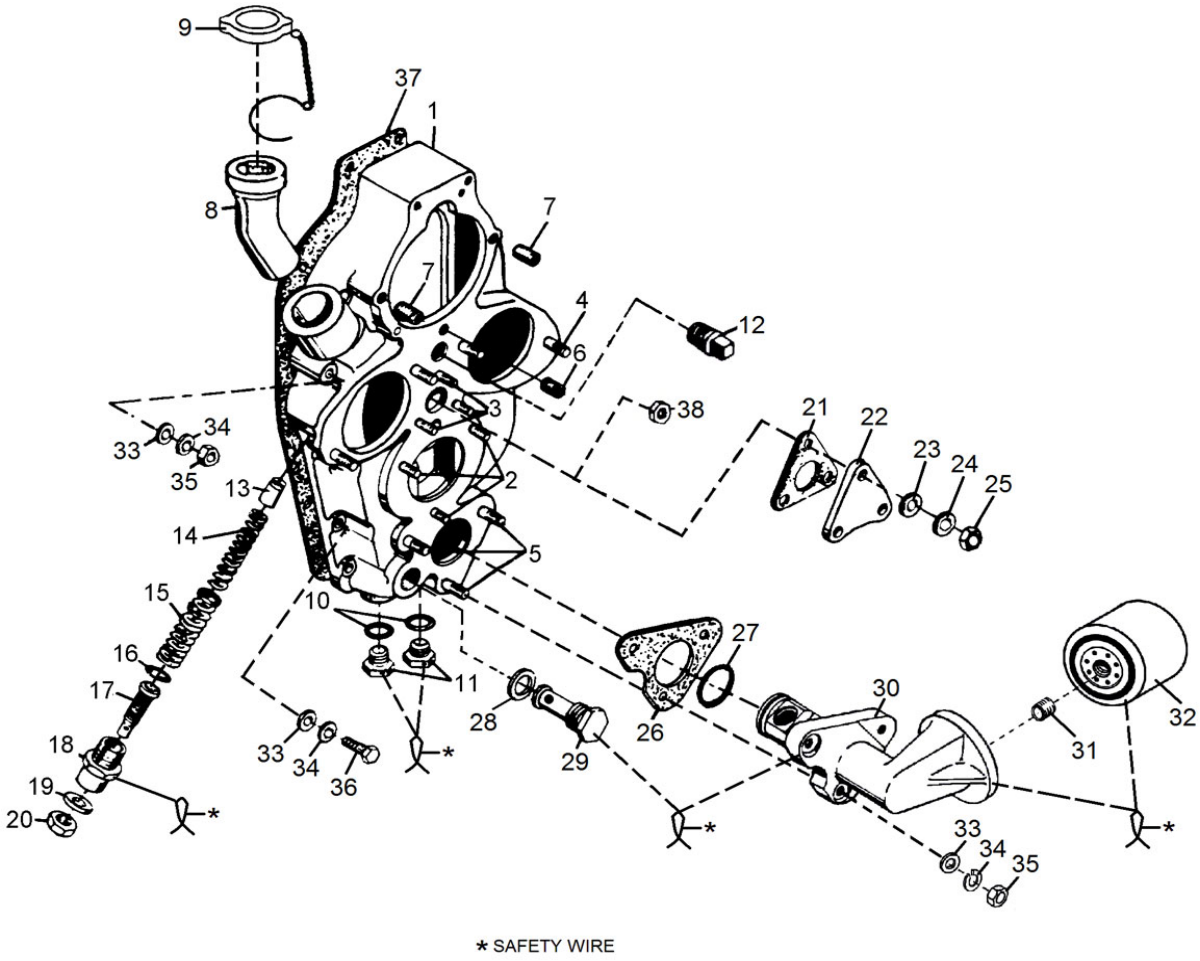


Figure 17-44. Accessory Case with Oil Filter and Adapter Installation (AF and ES)

1	Accessory Case	11	Plug	21	Gasket	31	Adapter Stud
2	Stud	12	Plug	22	Cover	32	Oil Filter
3	Stud	13	Plunger	23	Washer	33	Washer
4	Stud	14	Spring	24	Lock Washer	34	Lock Washer
5	Stud	15	Spring	25	Nut	35	Nut
6	Insert	16	Copper Gasket	26	Gasket	36	Screw
7	Insert	17	Adjustment Screw	27	O-ring	37	Gasket
8	Filler Neck Tube	18	Cap	28	Copper Gasket	38	Nut
9	Filler Cap Assembly	19	Copper Washer	29	Scavenge Oil Screen		
10	Copper Gasket	20	Stop Nut	30	Filter Adapter		

17-6. Starter and Starter Adapter Installation

17-6.1. Starter and Starter Adapter Installation (Except AF)

Different starter motors and starter adapters are used on the IO-360 series engine models; the primary physical difference is an accessory drive on the back of the housing or a flat cover. Figure 17-46 shows one possible starter adapter option. Refer to the Illustrated Parts Catalog for your engine.

1. Install the new gasket (Figure 17-46)(11) on the accessory case.
2. Lubricate the teeth on the shaftgear with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
3. Mesh the teeth with the crankshaft gear while placing the starter adapter into position.
4. Seat the starter adapter (1) against the gasket (11).
5. Lubricate bolt (8) threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
6. Install bolt (8), washers (6), lock washer (7) and nut (12).
7. Lubricate right side bolt (10) threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
8. Install right side bolt (10), lock washer (7) and washer (6).
9. Apply Loctite 592 Teflon PS/T Pipe Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to bolt (9) threads.
10. Install bolt (9), lock washer (7) and washer (6).
11. If engine model has rear lifting eye mounted to starter adapter, do the following, otherwise skip to step 12:

    NOTE: Some lifting eyes are mounted on opposite side of starter adapter if optional rear mounted alternator is installed. Refer to the Illustrated Parts Catalog.

    a. Remove nut and lock washer from starter adapter cover. Refer to Figure 17-45.
    b. Lubricate the stud and left side bolt (10) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
    c. Install washer, rear lifting eye, new lock washer and nut on stud.
    d. Install washers (6), lock washer (7) and left side bolt (10) as depicted in Figure 17-45.
12. If engine model has no lifting eye mounted on starter adapter, do the following:
    a. Lubricate left side bolt (10) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
    b. Install left side bolt (10), lock washer (7) and washer (6).

13. Torque bolts (8, 9 and 10) and nuts (12 and stud nut, if removed) to Appendix B specifications.
14. Safety wire bolts (8, 9 and 10) together according to the safety wiring instructions in Appendix C-3.
15. Lubricate the starter adapter starter mount studs and o-ring (5) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
16. Install o-ring (5) on starter motor (2).
17. Apply Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the starter motor (2) drive lug.
18. Install starter motor (2) on starter adapter (1); secure with washers (4) and nuts (3). Torque nuts to Appendix B specifications.

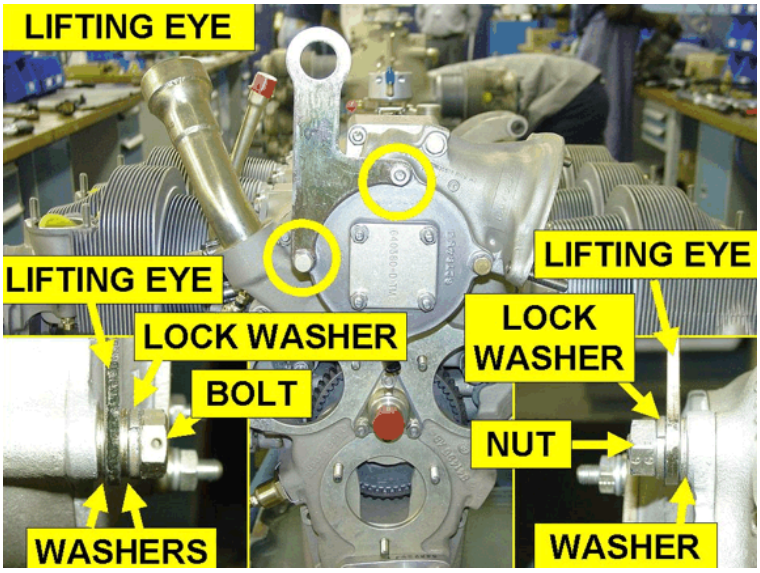


Figure 17-45. Rear Lifting Eye on Starter Adapter

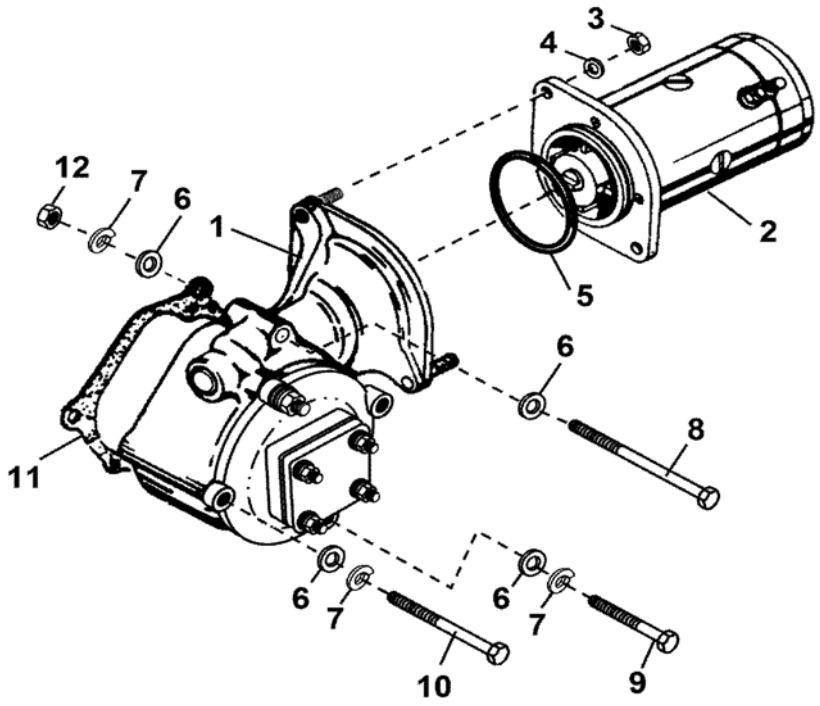


Figure 17-46. Starter and Adapter Installation (Except AF)

1	Starter Adapter	4	Washer	7	Lock Washer	10	Bolt
2	Starter Motor	5	O-ring	8	Bolt	11	Gasket
3	Nut	6	Washer	9	Bolt	12	Nut

17-6.2. Starter Motor Installation (AF)

1. Install lock washers (Figure 17-47)(5), washers (8) and spacers (6) on bolts (4).
2. Install bolts (4) through crankcase and accessory case.
3. Apply P/N 642188 CRC Copper Coat Gasket Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the accessory case mating surface of the gasket (2).
4. Install gasket (2) on the accessory case (1).
5. Apply Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the starter motor (3) drive lug.
6. Install starter motor (3) on accessory case (1).
7. Install lifting eye (7), washers (8), new lock washers (5) and nuts (9) on bolts (4).
8. Install washers (11) and new lock washers (12) on screws (10 and 13).
9. Install screws (10 and 13) through starter motor (3) and into accessory case (1).
10. Torque the screws (10 and 13) and nuts (9) to Appendix B specifications.

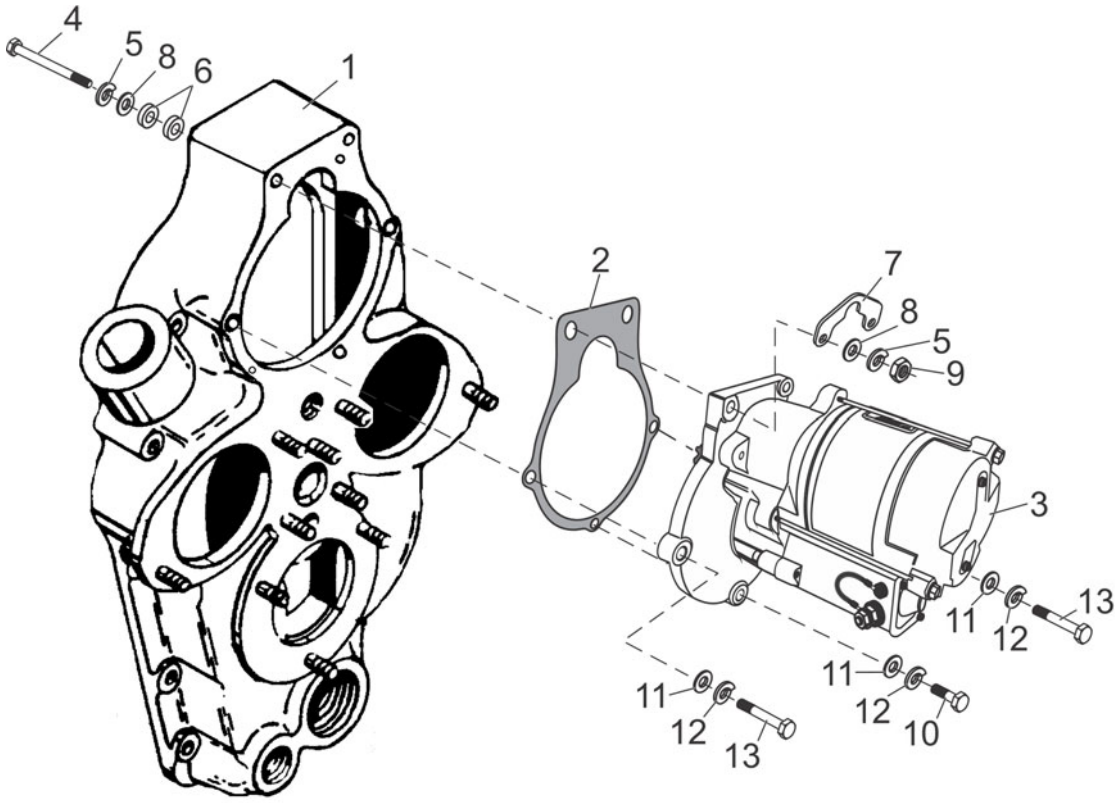


Figure 17-47. Starter Motor Installation (AF)

1	Accessory Case	5	Lock Washer	9	Nut	13	Screw
2	Gasket	6	Spacer	10	Screw		
3	Starter Motor	7	Lifting Eye	11	Washer		
4	Bolt	8	Washer	12	Lock Washer		

17-7. Alternator Installation

Most IO-360 engine models are fitted with a direct drive alternator as standard equipment. The alternator voltage and amperage output varies, depending on the engine model and specification, refer to the Illustrated Parts Catalog. Optional belt-driven alternators are also available. Install the alternator on the engine according to the appropriate instructions that match the installed engine configuration.

17-7.1. Direct Drive Alternator Installation

1. Install a new gasket (Figure 17-48)(2) on the accessory case studs.
2. Install the alternator (1) on the accessory case studs using three washers (11) and new lock nuts (12).
3. Torque the lock nuts (12) to Appendix B specifications.
4. If the alternator had a grounding strap when it was removed, install the grounding strap according to the aircraft maintenance manual.

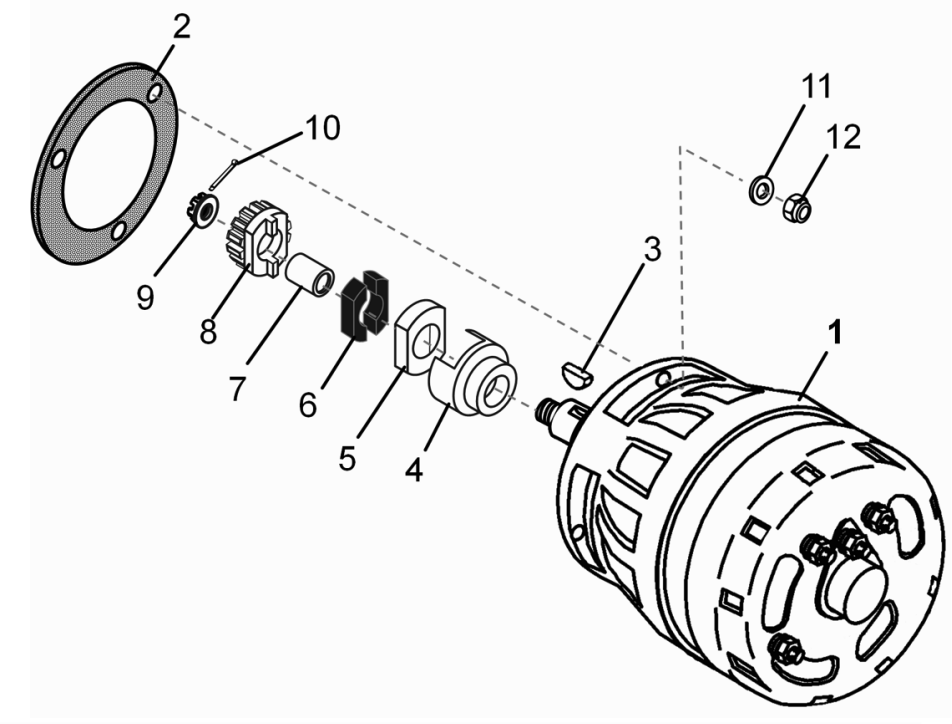


Figure 17-48. Direct Drive Alternator Installation

1	Alternator	4	Hub	7	Sleeve	10	Cotter Pin
2	Gasket	5	Retainer	8	Gear	11	Washer
3	Woodruff Key	6	Bushing	9	Castellated Nut	12	Lock Nut

17-7.2. Optional Belt Driven Alternator Brackets and Drive Sheave Installation

1. To install the brackets and sheave for the optional rear mounted alternator, do the following:

   a. Remove nut (Figure 17-51)(9) and lock washer (6) from stud on starter adapter (21).

   b. Remove bolts (7 and 8), washers (6) and washer (25) from starter adapter (21).

   NOTE: To facilitate removal of bolts (7 and 8), refer to Section 10-4.3 step 4.

   c. Install two flat washers (5), lifting eye (4), front bracket (2), lock washer (6) and nut (9) on stud. Tighten but do not torque nut. Refer to Figure 17-49.

   d. Install bolt (7), lock washer (6), lifting eye (4) and two washers (5). Tighten but do not torque bolt. Refer to Figure 17-49.

   e. Install bolt (8), lock washer (6), front bracket (2), washer (25) and two washers (5). Tighten but do not torque bolt. Refer to Figure 17-49.

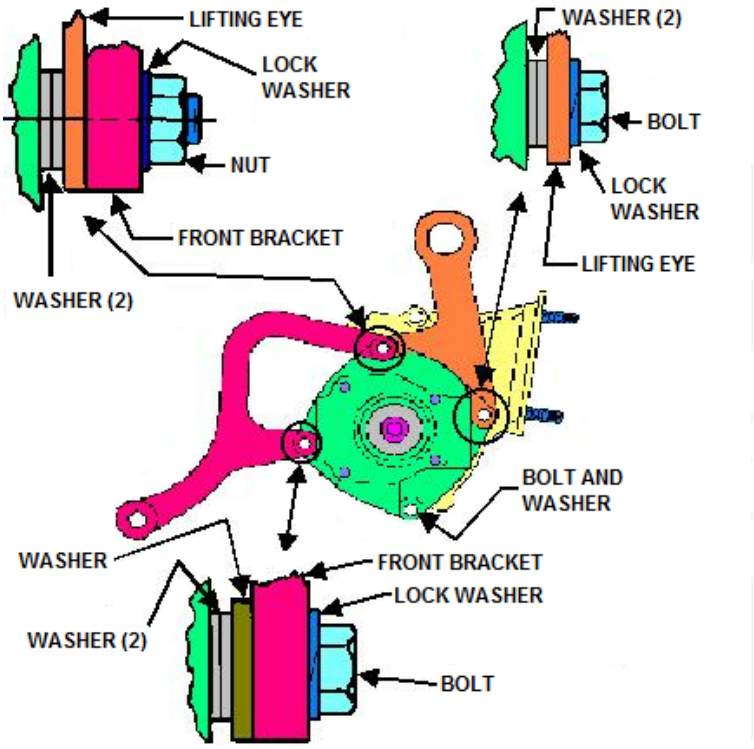


Figure 17-49. Alternator Front Bracket Installation

   f. Torque bolts (7 and 8) and nut (9) to Appendix B specifications.

   NOTE: After torquing bolts (7 and 8) reinstall accessory covers according to Section 10-4.6 step 18.

WARNING

Use eye protection when cutting safety wire because flying parts can cause injury.

g. Cut and remove the safety wire from the nuts (12).

h. Remove nuts (12) and washers (11) from gear shaft housing.

NOTE: Careful not to break seal or disturb silk thread between gear shaft housing and accessory drive adapter.

i. Install spacers (10), rear bracket (3), washers (11) and nuts (12). Torque nuts to Appendix B specifications and safety wire according to instructions in Appendix C-3.

j. Install the sheave (22) on the starter adapter (21).

k. Install bolt (24) and washer (23) on the sheave (22). Torque bolt to Appendix B specifications.

NOTE: Use a strap wrench to hold sheave (22) for torquing bolt (24).

2. To install the bracket and sheave for the optional front mounted alternator, do the following:

a. Remove the three through bolt nuts and washers on the crankcase where the bracket will be installed.

b. Install spacers (Figure 17-52)(13) on the through bolts in the two locations shown in Figure 17-50.

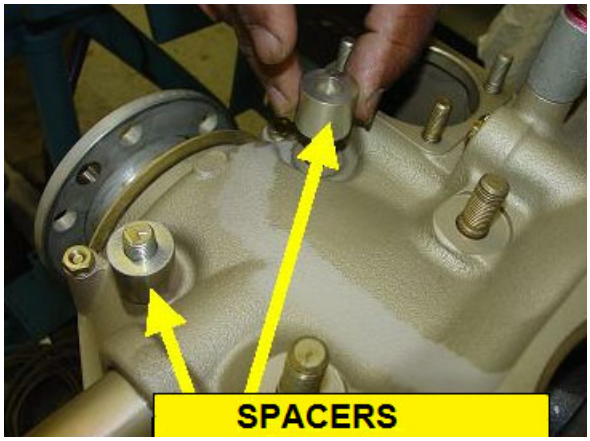


Figure 17-50. Alternator Bracket Spacers Installation

c. Install the bracket assembly (1) on the through bolts.

d. Lubricate the through bolt threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

e. Install new nuts and washers on the through bolts. Torque nuts to Appendix B specifications.

NOTE: This procedure requires two people.

f. Install sheave according to aircraft maintenance manual.

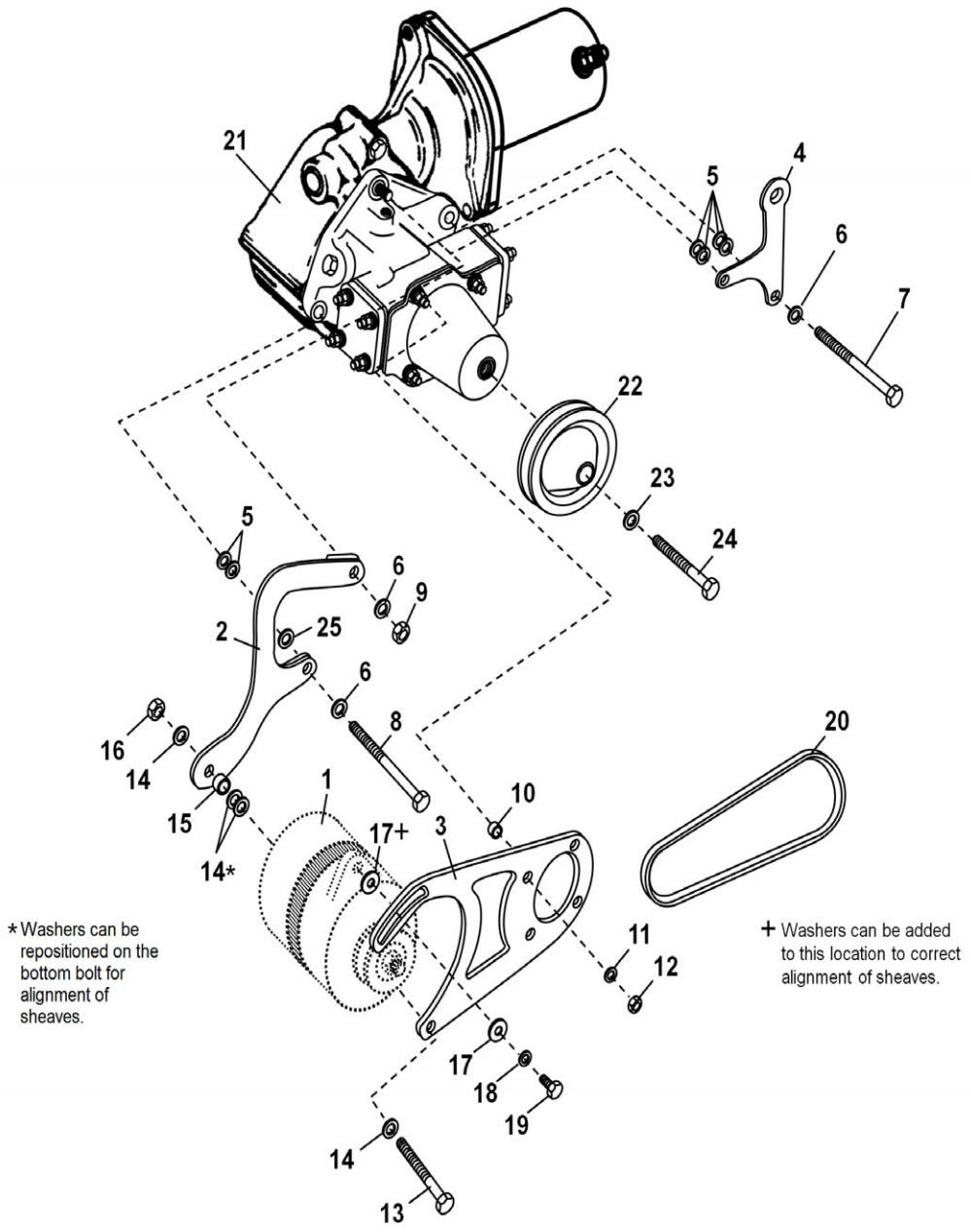


Figure 17-51. Optional Rear Mounted Alternator Assembly Installation

1	Alternator	8	Bolt	15	Spacer	22	Sheave
2	Front Bracket	9	Nut	16	Nut	23	Washer
3	Rear Bracket	10	Spacer	17	Washer (Minimum 2)	24	Bolt
4	Lifting Eye	11	Washer	18	Lock Washer	25	Washer
5	Washer	12	Nut	19	Bolt		
6	Lock Washer	13	Bolt	20	V-belt		
7	Bolt	14	Washer	21	Starter Adapter		

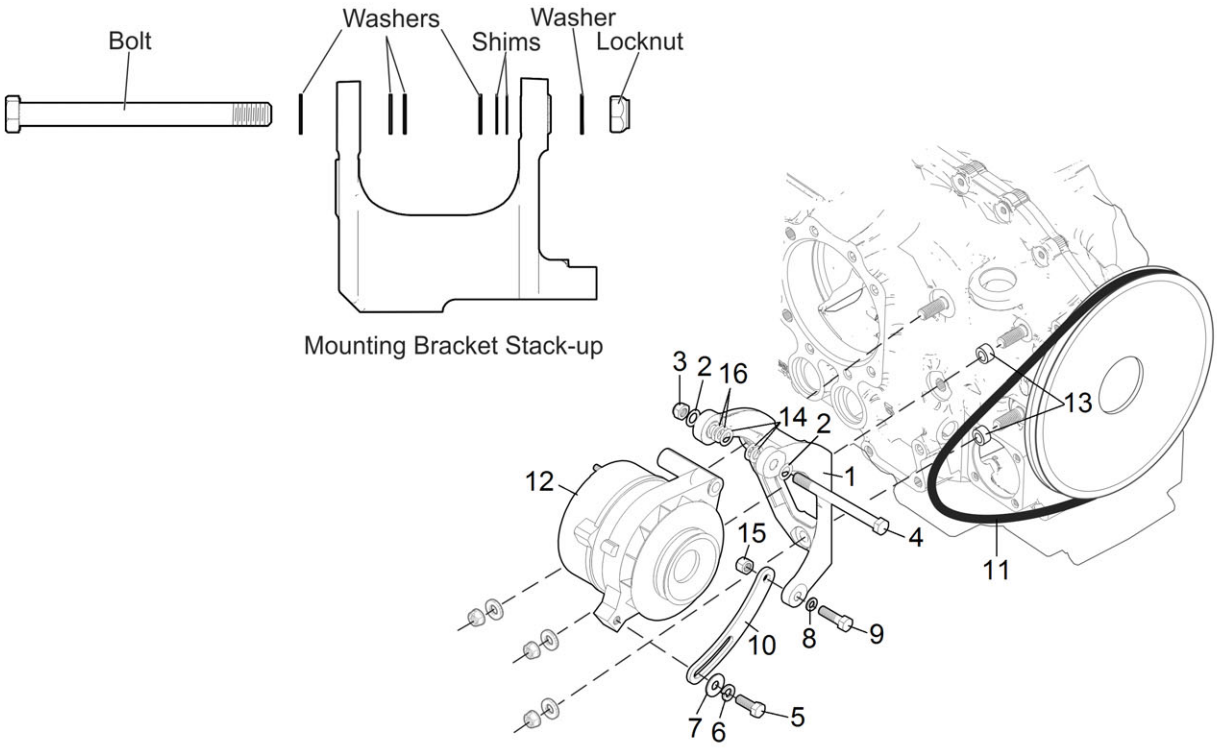


Figure 17-52. Optional Front Mounted Alternator Assembly Installation

1	Bracket Assembly	5	Bolt	9	Bolt	13	Spacer
2	Washer	6	Lock Washer	10	Adjustable Brace	14	Washer
3	Lock Nut	7	Washer	11	V-belt	15	Lock Nut
4	Bolt	8	Washer	12	Alternator	16	Shim

17-7.3. Optional Belt Driven Alternator Installation

1. To install optional rear mounted alternator, do the following:
   a. Place the alternator (Figure 17-51)(1) between the front bracket (2) and the rear bracket (3).
   b. Install bolt (13), four washers (14), spacer (15) and nut (16).
   c. Align the rear bracket (3) top bolt hole with the alternator (1) mounting hole. Loosely install the bolt (19), new lock washer (18) and two washers (17) in the rear bracket (3) and into the alternator mounting hole.
   d. Check the alignment of the alternator (1) sheave to the accessory drive sheave (22) with a P/N 8082-IA Pulley Alignment Tool (Chapter 2-1 of M-0, Standard Practice Maintenance Manual). Place the alignment tool in the center of the alternator sheave and lower the opposite end of the alignment tool into the channel of the accessory drive sheave - no more than 0.010 inch deflection is permitted. If deflection is greater than 0.010 inch, remove the bolt (13), washers (14) and nut (16) from the alternator and brackets (2 and 3) and reposition washers (14), as required, to correct front to rear alignment. If deflection is greater than 0.010 inch, remove the bolt (19), lock washer (18) and washers (17) from the alternator and add extra washers (17) between bracket (3) and alternator, as required, to correct tilt alignment. When alignment is within 0.010 inch, proceed to next step.
   e. Install V-belt (20) on sheave (22) and alternator (1) sheave.
   f. Adjust the V-belt tension according to instructions in Section 6-3.10.4.
   g. If the alternator had a grounding strap when it was removed, install the grounding strap according to the aircraft maintenance manual.
2. To install optional front mounted alternator, do the following:
   a. Install the alternator (Figure 17-52)(12) on the mounting bracket with the bolt (4), washers (2 and 14), shim(s) (16) and new lock nut (3).
   b. Align the adjustable brace (10) bolt hole with the alternator outboard mounting hole. Loosely install the bolt (5), new lock washer (6) and washer (7) through the hole in the adjustable brace (10) into the alternator outboard mounting hole.
   c. Check the alignment of the alternator (12) sheave to the propeller flange sheave with a P/N 8082-IA Pulley Alignment Tool (Chapter 2-1 of M-0, Standard Practice Maintenance Manual). Place the alignment tool in the center of the alternator sheave and lower the opposite end of the alignment tool into the channel of the propeller flange sheave - no more than 0.010 inch deflection is permitted. If deflection is greater than 0.010 inch, remove the bolt (4), washers (2 and 14), shim(s) (16) and lock nut (3) from the alternator and bracket assembly (1) and install or remove extra shims (16), as required, to fill the gap between the alternator and bracket assembly. When alignment is less than 0.010 inch, proceed to next step.
   d. Install V-belt (11) on propeller flange sheave and alternator (12) sheave.
   e. Adjust the V-belt tension according to instructions in Section 6-3.10.4.
   f. If the alternator had a grounding strap when it was removed, install the grounding strap according to the aircraft maintenance manual.

17-8. Oil Cooler Installation

NOTE: The oil cooler must be disassembled, cleaned, overhauled, and assembled by an appropriately rated FAA (or foreign country equivalent) Part 145 Repair Station, before installation. No structural repairs are allowed on the oil cooler. Replace any cooler that has structural damage, bent/broken or cracked cooling fins, with a new or serviceable oil cooler. Oil cooler weld repairs are permitted only on the mounting flange, by an appropriately rated repair station, i.e. FAA Part 145 Repair Station.

1. Install the nut (Figure 17-54)(1) and screw (2) into the No. 2 cylinder rocker cover.

   NOTE: Engine models and specifications which use the 7.88 inch oil cooler do not have these parts.

2. Lubricate screws (4) threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
3. Apply P/N 642188 Copper Coat Gasket Sealant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to gasket (8) on both sides of gasket.
4. Install screws (4), lock washers (5) and washers (6) through oil cooler (7) flange and gasket (8).
5. Install oil cooler (7) on oil cooler adapter (9); secure with screws (4). Torque screws to Appendix B specifications in an alternating pattern.
6. Install shoe (3) between the No. 2 cylinder rocker cover and the oil cooler (7). Adjust screw (2) outwards against shoe. Once contact is made with oil cooler, adjust screw another 2/3 of a complete turn towards the oil cooler.

   NOTE: Engine models and specifications which use the 7.88 inch oil cooler do not have these parts.

7. Torque nut (1) to Appendix B specifications.
8. Install gasket (10) on vernatherm valve (11).
9. Apply P/N 646943 Anti-seize Lubricant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the threads of the vernatherm valve (11).
10. Install vernatherm valve (11) in the oil cooler adapter (9) port. Torque vernatherm valve to Appendix B specifications and safety wire according to instructions in Appendix C-3 and Figure 17-53.



Figure 17-53. Vernatherm Valve Safety Wire Installation

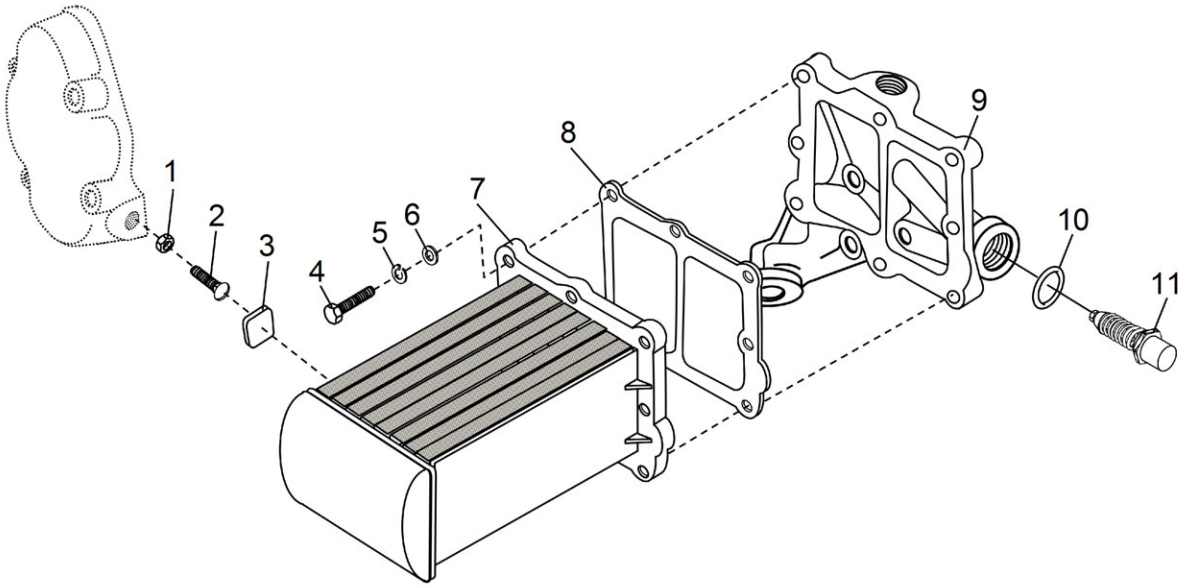


Figure 17-54. Oil Cooler Installation

1	Nut	4	Screw	7	Oil Cooler	10	Gasket
2	Bolt	5	Lock Washer	8	Gasket	11	Vernatherm Valve
3	Shoe	6	Washer	9	Oil Cooler Adapter		

17-9. Induction System Installation

Induction systems vary by engine models. Refer to the instructions which apply to the engine model being installed. Also refer to the Illustrated Parts Catalog.

17-9.1. Induction System Installation (Except AF and ES)

NOTE: Position hose clamps with tightening screw accessible for torquing. Center hoses between manifold tubes and riser tubes.

1. Lubricate the cylinder intake flange studs with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
2. Apply Chesterton #995 Release agent or WD-40 (Chapter 3 of M-0, Standard Practice Maintenance Manual) to ID of hoses (Figure 17-55)(11).
3. Install manifold gaskets (1) on 1-3-5 cylinders.
4. Install new hose (11) onto manifold tube (2) and slide two clamps (10) on new hose.
5. Install manifold tube (3) into new hose (11) installed on manifold tube (2). Slide clamps (10) into position and tighten but do not torque.
6. Install new hose (11) onto manifold tube (3) and slide two clamps (10) on new hose.
7. Install riser tube (4) into new hose (11) installed on manifold tube (3). Slide clamps (10) into position and tighten but do not torque.
8. Install new hose (11) onto riser tube (4) and slide two clamps (10) on new hose. Slide clamps (10) into position and tighten but do not torque.
9. Install assembly on 1-3-5 cylinders and secure with washers (7), new lock washers (8) and nuts (9). Torque nuts and clamps (10) to Appendix B specifications.
10. Install manifold gaskets (1) on 2-4-6 cylinders.
11. Install new hose (11) onto manifold tube (5) and slide two clamps (10) on new hose.
12. Install manifold tube (3) into new hose (11) installed on manifold tube (5). Slide clamps (10) into position and tighten but do not torque.
13. Install new hose (11) onto manifold tube (3) and slide two clamps (10) on new hose.
14. Install riser tube (6) into new hose (11) installed on manifold tube (3). Slide clamps (10) into position and tighten but do not torque.
15. Install new hose (11) onto riser tube (6) and slide two clamps (10) on new hose. Slide clamps (10) into position and tighten but do not torque.
16. Install assembly on 2-4-6 cylinders and secure with washers (7), new lock washers (8) and nuts (9). Torque nuts and clamps (10) to Appendix B specifications.

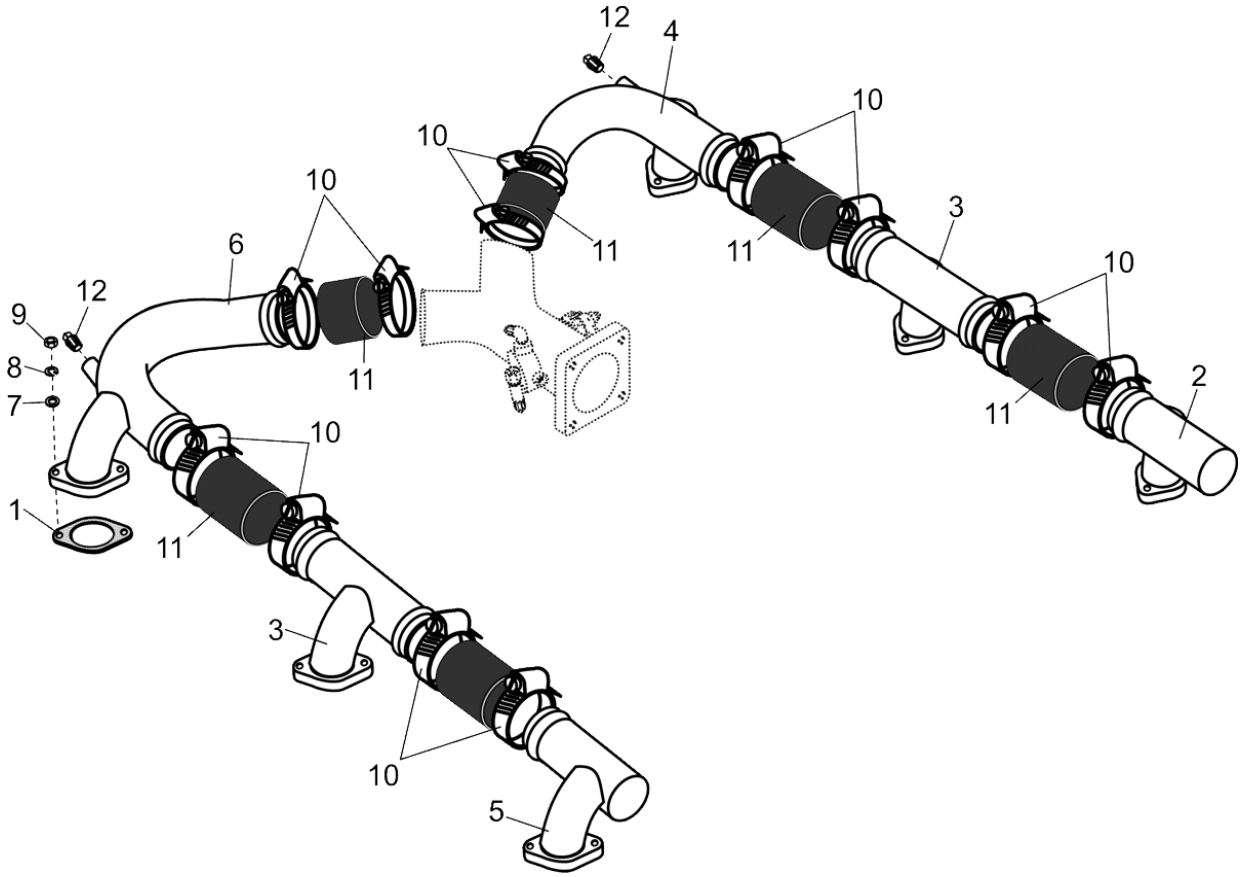


Figure 17-55. Induction Assembly Installation (Except AF and ES)

1	Manifold Gasket	4	Riser Tube	7	Washer	10	Clamp
2	Manifold Tube	5	Manifold Tube	8	Lock Washer	11	Hose
3	Manifold Tube	6	Riser Tube	9	Nut	12	Plug

17-9.2. IO-360-AF, ES Induction System Installation

NOTE: Position hose clamps with tightening screw accessible for torquing. Center hoses between tubes.

1. Lubricate the cylinder intake flange studs with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
2. Apply Chesterton #995 Release agent or WD-40 (Chapter 3 of M-0, Standard Practice Maintenance Manual) to ID of the new hoses (Figure 17-58)(19).
3. Install six new hoses (19) on manifold (2).
4. Slide two clamps (18) on each of the six new hoses (19) and tighten but do not torque. Refer to Figure 17-56.

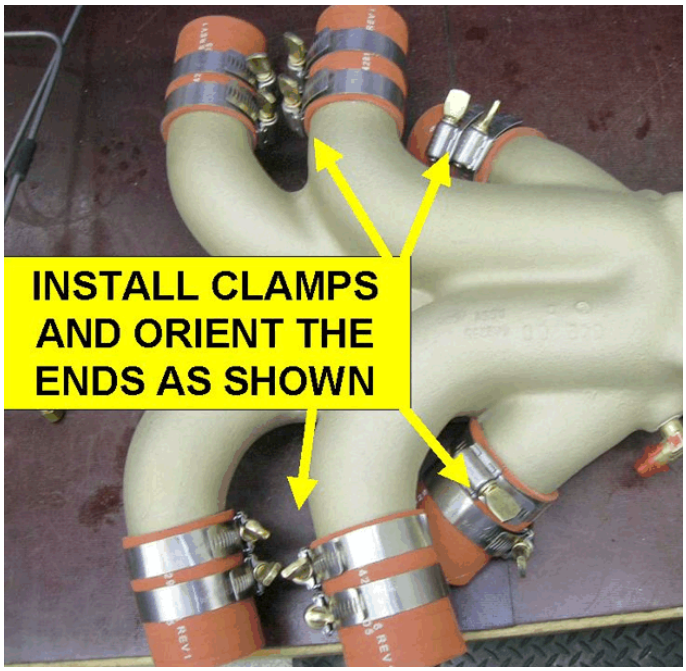


Figure 17-56. Manifold, Hoses and Clamps

5. Place manifold (2) assembly on top of engine.
6. Install gaskets (14) on 1-3-5 cylinders.
7. Install cylinder tubes (4, 7 and 10) into the new hoses (19) on the manifold (2). Slide clamps (18) into position and tighten but do not torque.
8. Install new hoses (19) onto cylinder tubes (4, 7 and 10) and slide two clamps (18) on each of the new hoses. Slide clamps into position and tighten but do not torque.
9. Install flanges (13) on cylinder tubes (3, 6 and 9).
10. Install cylinder tubes (3, 6 and 9) into the hoses (19) on cylinder tubes (4, 7 and 10). Slide clamps (18) into position and tighten but do not torque.

11. Install cylinder tubes (3, 6 and 9) and flanges (13) onto the 1-3-5 cylinder intake flange studs. Secure with washers (15), lock washers (16) and nuts (17); torque nuts to Appendix B specifications.
12. Install gaskets (14) on 2-4-6 cylinders.
13. Install cylinder tube (12) into the new hose (19) on the manifold (2). Slide clamps (18) into position and tighten but do not torque.
14. Install new hose (19) onto cylinder tube (12) and slide two clamps (18) on the new hose. Slide clamps into position and tighten but do not torque.
15. Install flanges (13) on cylinder tubes (5, 8 and 11).
16. Install cylinder tubes (5, 8 and 11) into the hoses (19) on manifold (2) and cylinder tube (12). Slide clamps (18) into position and tighten but do not torque.
17. Install cylinder tubes (5, 8 and 11) and flanges (13) onto the 2-4-6 cylinder intake flange studs. Secure with washers (15), lock washers (16) and nuts (17); torque nuts to Appendix B specifications.
18. Reposition clamps (18), as necessary, and torque clamps to Appendix B specifications. Refer to Figure 17-57.

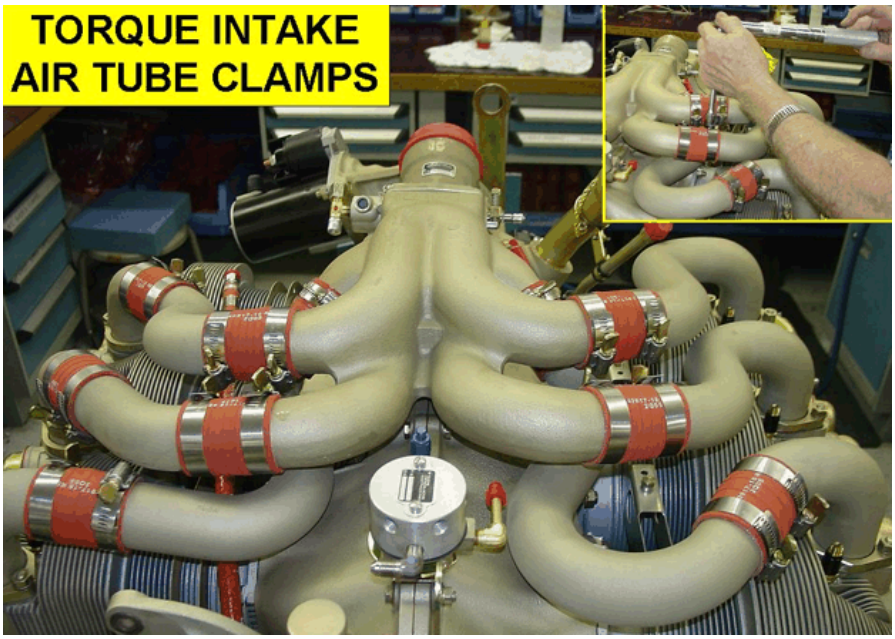


Figure 17-57. Induction Assembly Hose Clamps

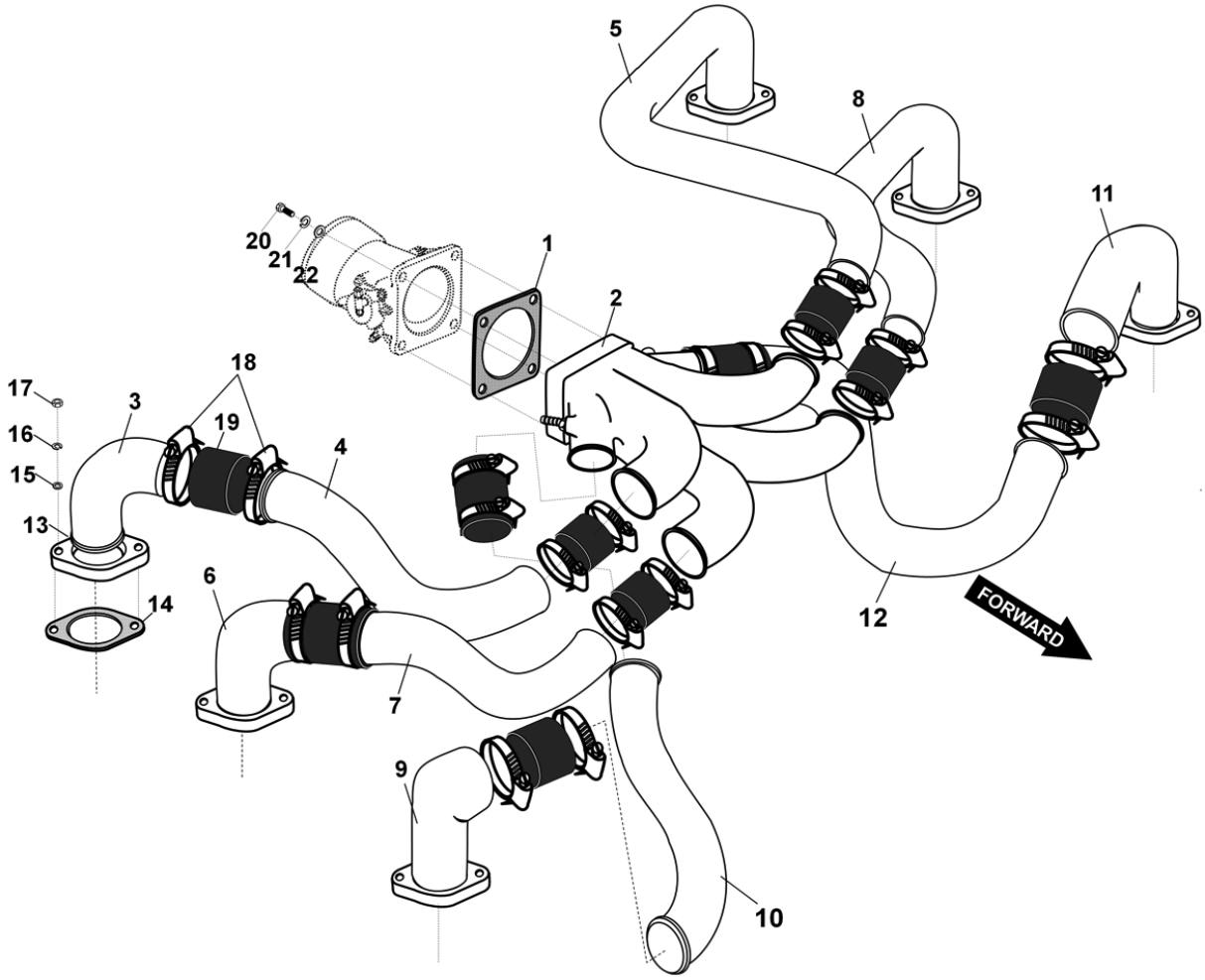


Figure 17-58. IO-360-AF, ES Induction Assembly Installation

1	Gasket	7	Tube - Cylinder #3	13	Flange	19	Hose
2	Manifold	8	Tube - Cylinder #4	14	Gasket	20	Screw
3	Tube - Cylinder #1	9	Tube - Cylinder #5	15	Washer	21	Lock Washer
4	Tube - Cylinder #1	10	Tube - Cylinder #5	16	Lock Washer	22	Washer
5	Tube - Cylinder #2	11	Tube - Cylinder #6	17	Nut		
6	Tube - Cylinder #3	12	Tube - Cylinder #6	18	Clamp		

17-10. Fuel Injection System Installation

Fuel injection systems vary significantly between engine models; refer to the instructions which apply to the engine model being overhauled. Also refer to the Illustrated Parts Catalog.

17-10.1. Fuel Injection System Installation (Except AF and ES)

WARNING

Open fuel sources are flammable. Keep ignition sources out of the work area while fuel tubes and hoses are disconnected.

CAUTION: Avoid introducing contaminants into the fuel injectors. Work with clean hands, tools, and shop towels. Place protective caps on the fuel injectors anytime the fuel tubes are not connected. Never insert an object into either end of a fuel injector.

1. Apply Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to both ends of fuel pump drive shaft (Figure 17-60)(2).
2. Install drive shaft (2) into crankcase fuel pump cavity. Drive shaft will mesh with governor drive gear.
3. Lubricate fuel pump (3) mount studs with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
4. Install new gasket (5) on fuel pump mount studs.
5. Install fuel pump (3) on crankcase. Secure with washers (6), lock washers (7) and nuts (9). Torque nuts to Appendix B specifications.

   NOTE: Rotate fuel pump drive coupling, as necessary, to mesh with drive shaft (2) to seat fuel pump (3) properly.

   CAUTION: Never use Teflon tape on fuel injection system fittings.

6. Apply P/N 646943 Anti-seize Lubricant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the fuel nozzle (16A - 16F) threads (see Figure 17-59).

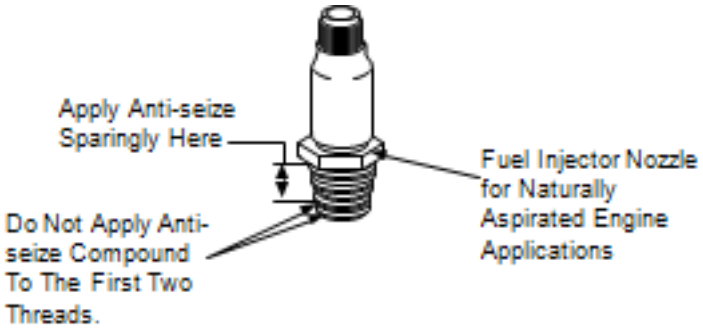


Figure 17-59. Anti-Seize Application

7. Install fuel nozzles (16A - 16F) in the cylinders matching the identification number stamped on fuel nozzle. Torque the fuel nozzles to Appendix B specifications with Ideal Aviation P/N 8168-IA Injector Nozzle Removal/Installation Tool (Chapter 2-1 of M-0, Standard Practice Maintenance Manual).

8. Lubricate “B” nut threads of fuel tubes (10 through 15) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

WARNING

Fuel injection tubes must not be bent or deformed. Do not assemble in a binding configuration.

9. Install fuel tubes (10 through 15) between the fuel nozzles (16A - 16F) and the manifold valve (4). Torque the tubes “B” nuts at the fuel nozzles and manifold valve to Appendix B specifications using the “Hose and Tubing Installation” instructions in Appendix C-11.

   NOTE: Ensure there is clearance between fuel tubes and other engine components (no chafing).

   NOTE: Fuel tubes must be supported in the aircraft installation. Customer must provide hardware to suit their installation.

10. Install throttle and metering assembly (8) in induction system hoses; secure with hose clamps but do not torque at this time.

11. Install throttle and metering assembly (8) on bracket (19); secure with screws (20) and nuts (21). Torque nuts and induction system hose clamps to Appendix B specifications.

    NOTE: Gasket (22) will be installed with aircraft induction system according to the aircraft maintenance manual.

12. Install new fuel hose (17) between throttle and metering assembly (8) fuel inlet tee fitting (Figure 17-61)(10) and fuel pump (Figure 17-60)(3) outlet fitting. Torque nuts to Appendix B specifications using the “Hose and Tubing Installation” instructions in Appendix C-11.

13. Install new fuel hose (18) between throttle and metering assembly (8) fuel outlet elbow (Figure 17-61)(12) and manifold valve (Figure 17-60)(4) inlet fitting. Torque nuts to Appendix B specifications using the “Hose and Tubing Installation” instructions in Appendix C-11.

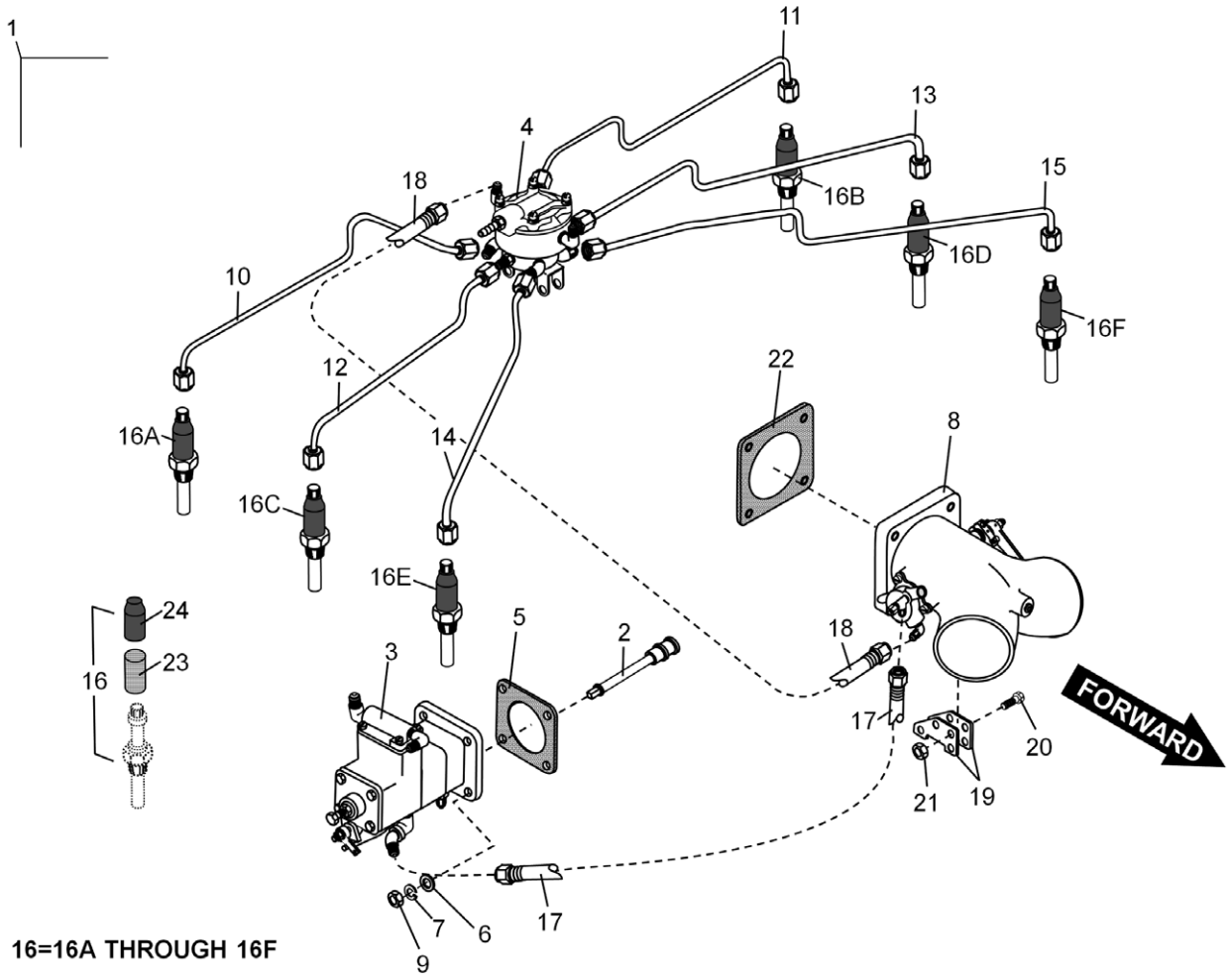


Figure 17-60. Fuel Injection Assembly Installation (Except AF and ES)

1	Fuel Injection Assembly	9	Nut	16A	Nozzle - Cylinder #1	19	Bracket
2	Drive Shaft	10	Tube	16B	Nozzle - Cylinder #2	20	Screw
3	Fuel Pump	11	Tube	16C	Nozzle - Cylinder #3	21	Nut
4	Manifold Valve	12	Tube	16D	Nozzle - Cylinder #4	22	Gasket
5	Gasket	13	Tube	16E	Nozzle - Cylinder #5	23	Nozzle Screen
6	Washer	14	Tube	16F	Nozzle - Cylinder #6	24	Dust Shield
7	Lock Washer	15	Tube	17	Hose		
8	Throttle and Metering Assembly	16	Tuned Nozzle	18	Hose		

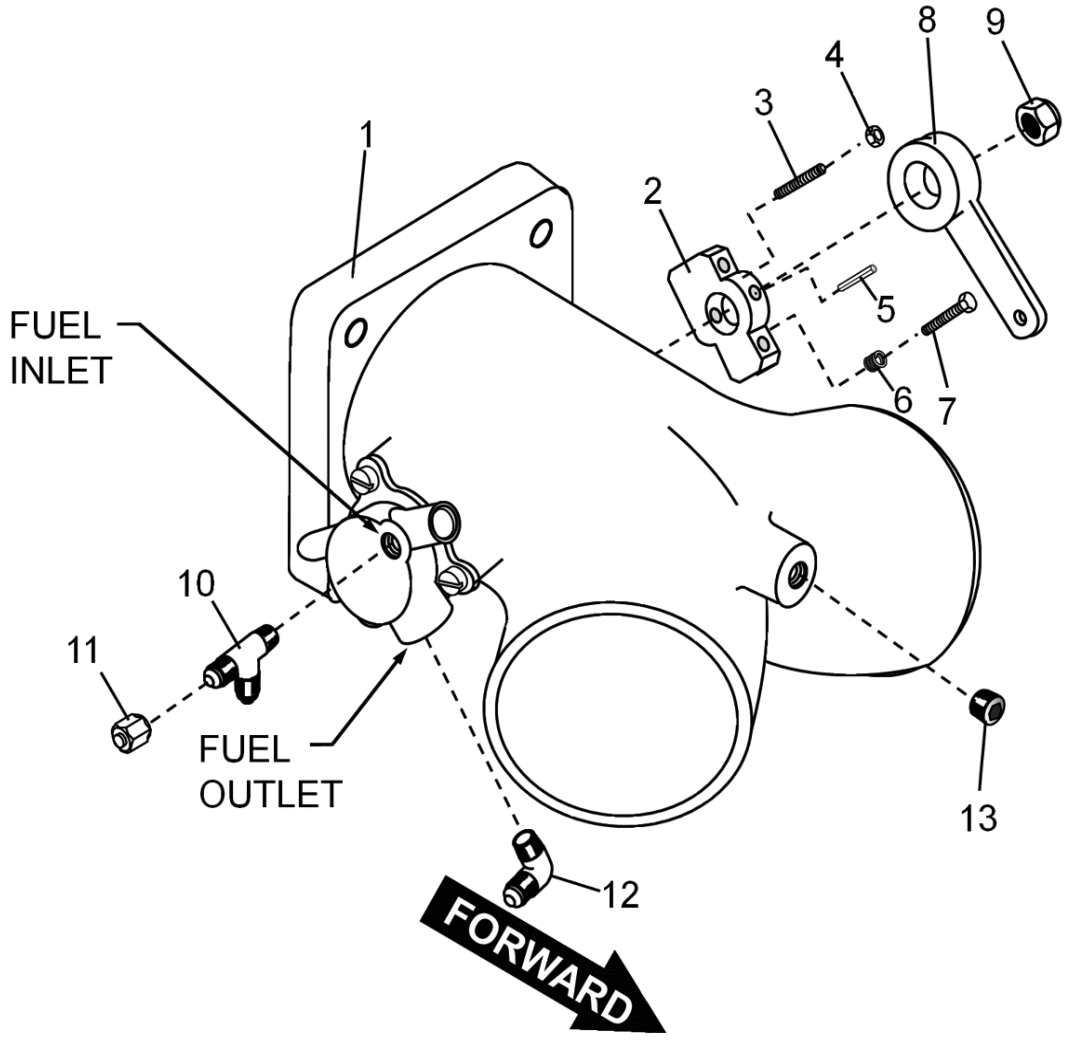


Figure 17-61. Throttle and Metering Assembly Installation (Except AF and ES)

1	Throttle	5	Pin	9	Lock Nut	13	Plug
2	Idle Control Lever	6	Spring	10	Tee Fitting		
3	Set Screw	7	Adjustment Screw	11	Cap		
4	Nut	8	Throttle Control Lever	12	Elbow		

17-10.2. IO-360-AF, ES Fuel Injection System Installation

WARNING

Open fuel sources are flammable. Keep ignition sources out of the work area while fuel tubes and hoses are disconnected.

CAUTION: Avoid introducing contaminants into the fuel injectors. Work with clean hands, tools, and shop towels. Place protective caps on the fuel injectors anytime the fuel tubes are not connected. Never insert an object into either end of a fuel injector.

1. Apply Molyshield grease (Chapter 3 of M-0, Standard Practice Maintenance Manual) to both ends of fuel pump drive shaft (Figure 17-64)(2).
2. Install drive shaft (2) into crankcase fuel pump cavity. Drive shaft will mesh with governor drive gear.
3. Lubricate fuel pump (3) mount studs with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
4. Install new gasket (5) on fuel pump mount studs.
5. Install fuel pump (3) on crankcase. Secure with washers (6), lock washers (7) and nuts (9). Torque nuts to Appendix B specifications.

   NOTE: Rotate fuel pump drive coupling, as necessary, to mesh with drive shaft (2) to seat fuel pump (3) properly.

   CAUTION: Never use Teflon tape on fuel injection system fittings.

6. Apply P/N 646943 Anti-seize Lubricant (Chapter 3 of M-0, Standard Practice Maintenance Manual) to the fuel nozzle (16A - 16F) threads see (Figure 17-62).

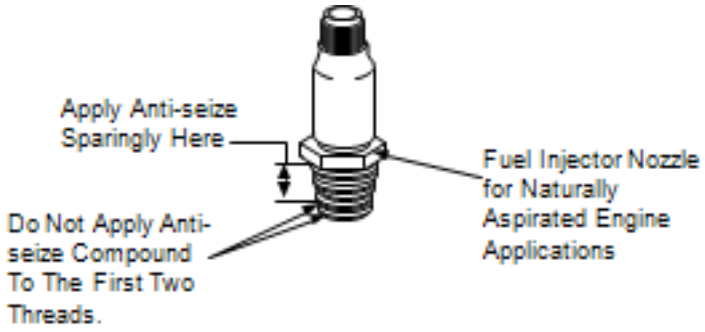


Figure 17-62. Anti-Seize Application

7. Install fuel nozzles (16A - 16F) in the cylinders matching the identification number stamped on fuel nozzle. Torque the fuel nozzles to Appendix B specifications with Ideal Aviation P/N 8168-IA Injector Nozzle Removal/Installation Tool (Chapter 2-1 of M-0, Standard Practice Maintenance Manual).
8. Lubricate “B” nut threads of fuel tubes (10 through 15) with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).

WARNING

Fuel injection tubes must not be bent or deformed. Do not assemble in a binding configuration.

9. Install fuel tubes (10 through 15) between the fuel nozzles (16A - 16F) and the manifold valve (4). Torque the tubes “B” nuts at the fuel nozzles and manifold valve to Appendix B specifications using the “Hose and Tubing Installation” instructions in Appendix C-11.
10. Install clamps (21) on induction tubes and clamps (17) on fuel tubes (10 through 15). Secure with bolts (18), washers (19) and new lock nuts (20). Torque lock nuts to Appendix B specifications. Refer to Figure 17-63.

    NOTE: Ensure there is clearance between fuel tubes and other engine components (no chafing).

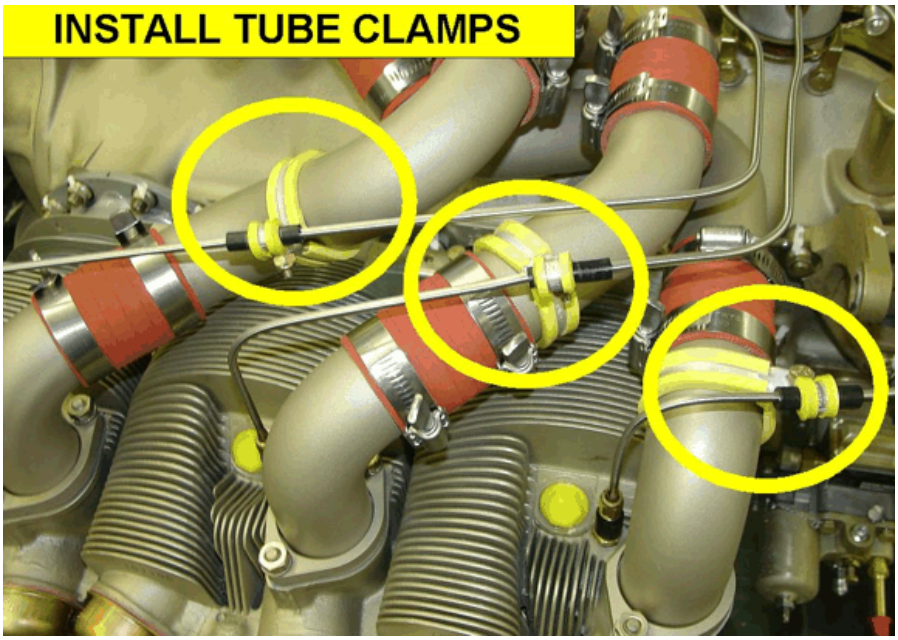


Figure 17-63. Fuel Tube/Induction Tube Clamp Installation

11. Lubricate bolt threads with clean 50 weight aviation engine oil (Chapter 3 of M-0, Standard Practice Maintenance Manual).
12. Install the throttle and metering assembly (8) and gasket (26) on the manifold; secure with screws (Figure 17-58)(20), new lock washers (21) and washers (22). Torque screws to Appendix B specifications.
13. Install new fuel hose (Figure 17-64)(22) between throttle and metering assembly (8) fuel inlet tee fitting (Figure 17-65)(15) and fuel pump (Figure 17-64)(3) outlet fitting. Torque nuts to Appendix B specifications using the “Hose and Tubing Installation” instructions in Appendix C-11.
14. Install new fuel hose (23) between throttle and metering assembly (8) fuel outlet elbow (Figure 17-65)(17) and manifold valve (Figure 17-64)(4) inlet fitting. Torque

nuts to Appendix B specifications using the “Hose and Tubing Installation” instructions in Appendix C-11.

NOTE: Some models may have two hoses and a fitting in between them instead of the hose (23) depicted in Figure 17-64. Refer to Illustrated Parts Catalog for your model and specification.

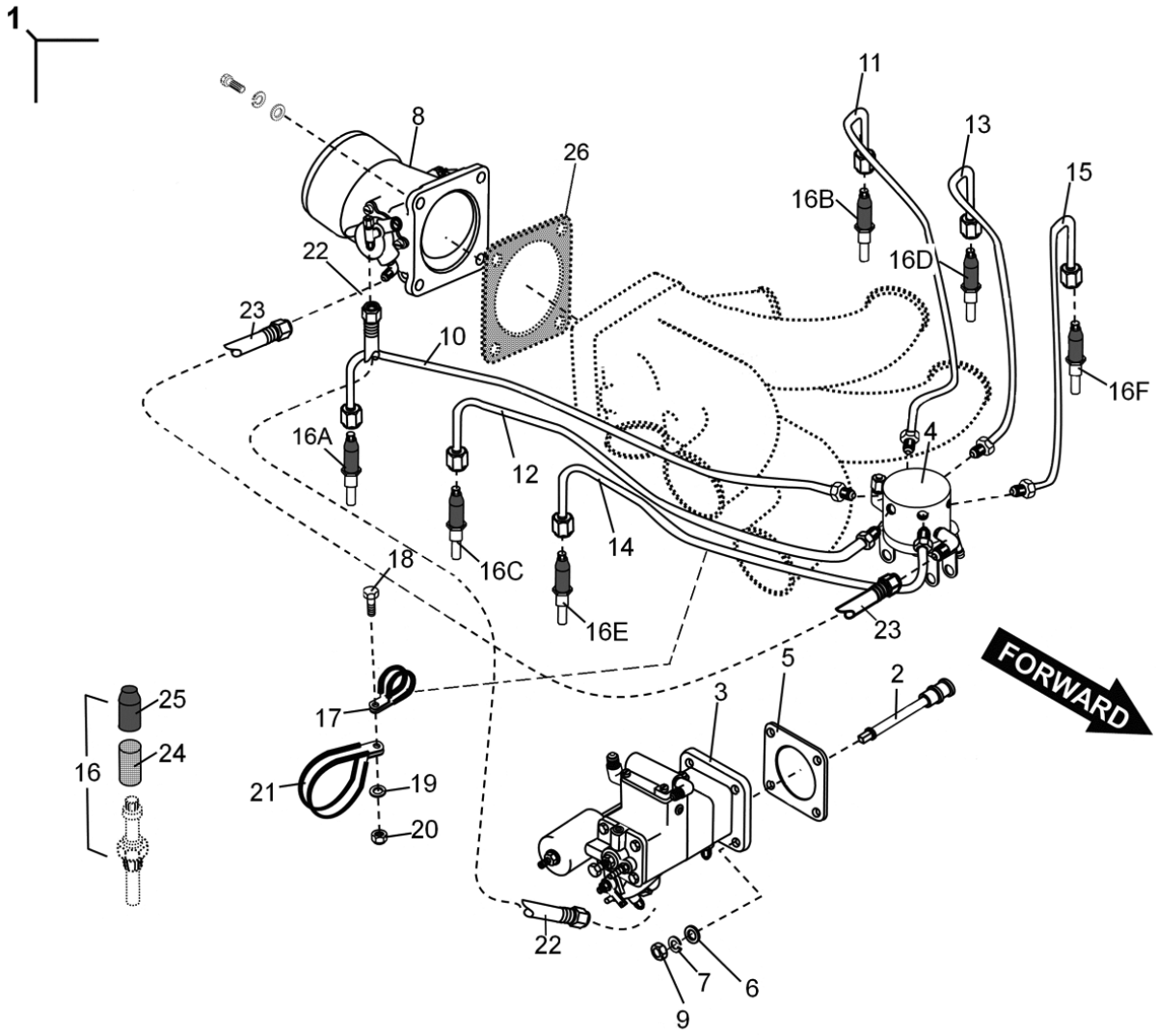


Figure 17-64. IO-360-AF, ES Fuel Injection System Installation

1	Fuel Injection Assembly	9	Nut	16A	Nozzle - Cylinder #1	19	Washer
2	Drive Shaft	10	Tube	16B	Nozzle - Cylinder #2	20	Lock Nut
3	Fuel Pump (ES Aneroid Pump Shown)	11	Tube	16C	Nozzle - Cylinder #3	21	Clamp
4	Manifold Valve	12	Tube	16D	Nozzle - Cylinder #4	22	Hose
5	Gasket	13	Tube	16E	Nozzle - Cylinder #5	23	Hose
6	Washer	14	Tube	16F	Nozzle - Cylinder #6	24	Nozzle Screen
7	Lock Washer	15	Tube	17	Clamp	25	Dust Shield
8	Throttle and Metering Assembly	16	Tuned Nozzle	18	Bolt	26	Gasket

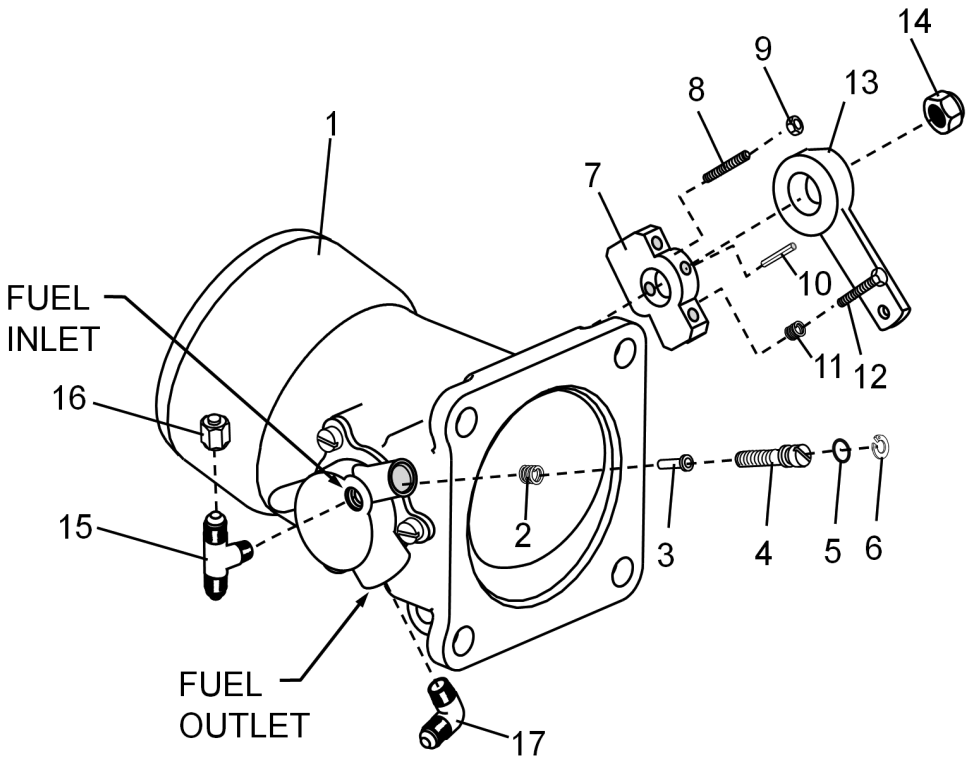


Figure 17-65. IO-360-AF, ES Throttle and Metering Assembly Installation

1	Throttle	6	Retaining Ring	11	Spring	16	Cap
2	Spring	7	Idle Control Lever	12	Adjustment Screw	17	Elbow
3	Bushing	8	Set Screw	13	Throttle Control Lever		
4	Idle Adjustment Screw	9	Nut	14	Lock Nut		
5	O-ring	10	Pin	15	Tee Fitting		

17-11. Ignition System Installation

IO-360 series engine ignition systems may be the Continental Motors magnetos or Champion (Slick) magnetos depending on model and specification. Magnetos may feature retard breakers coupled with a starting vibrator or impulse couplings. Some IO-360 magnetos are fitted with a tachometer pickup. Removal and installation procedures are similar, with only minor differences. Separate instructions are provided for Continental Motors and Champion (Slick) magnetos. Refer to the Illustrated Parts Catalog.

CAUTION: The magnetos must be replaced or overhauled according to the manufacturer's instruction prior to installation.

17-11.1. Continental Ignition System Installation

1. Install magneto drive gear assemblies in the engine. Refer to Figure 17-66.

   NOTE: Ensure magneto drive gear assemblies teeth mesh with camshaft gear.

2. Verify magneto drive gear assemblies backlash according to Appendix D-4.
3. Complete “Crankshaft Top Dead Center Alignment” procedure in Section 6-3.9.1.1.
4. Remove inspection hole plug from the magneto(s). Turn the magneto coupling backwards until the marked distributor gear tooth is approximately centered in the inspection hole.
5. Without turning the magneto coupling, hold the magneto in its approximate installed position.
   a. Align the magneto drive gear coupling slot and the magneto lugs by pulling the magneto drive gear assembly out of accessory case and turning it to the desired position.
   b. Install the magneto drive gear assembly back into the engine.

   NOTE: Ensure magneto drive gear assembly coupling bushings and retainers are properly installed.

6. Install the new gasket (Figure 17-67)(4) on the magneto (1) flange.
7. Carefully insert the magneto (1) into the accessory case, mate the magneto lugs with the magneto drive gear coupling slots.
8. Install hold washers (7), lock washers (6) and nuts (5). Snug down but do not tighten nuts as you must be able to rotate the magneto (1) to make timing adjustment.
9. Install inspection hole plug in magneto(s).
10. Complete “Magneto to Engine Timing” procedure in Section 6-3.9.1.2. Torque nuts (5) to Appendix B specifications upon completion of magneto timing.
11. Disconnect the timing light from magnetos (1).
12. Connect the two magneto tachometer leads, if installed.

13. Install the harness (2) and connect the cable outlet plates to the magnetos (1). Secure with screws (3) and torque screws to Appendix B specifications. Secure harness with clamps and cable ties.
14. Install spark plugs (10) according to Section 6-3.9.2.

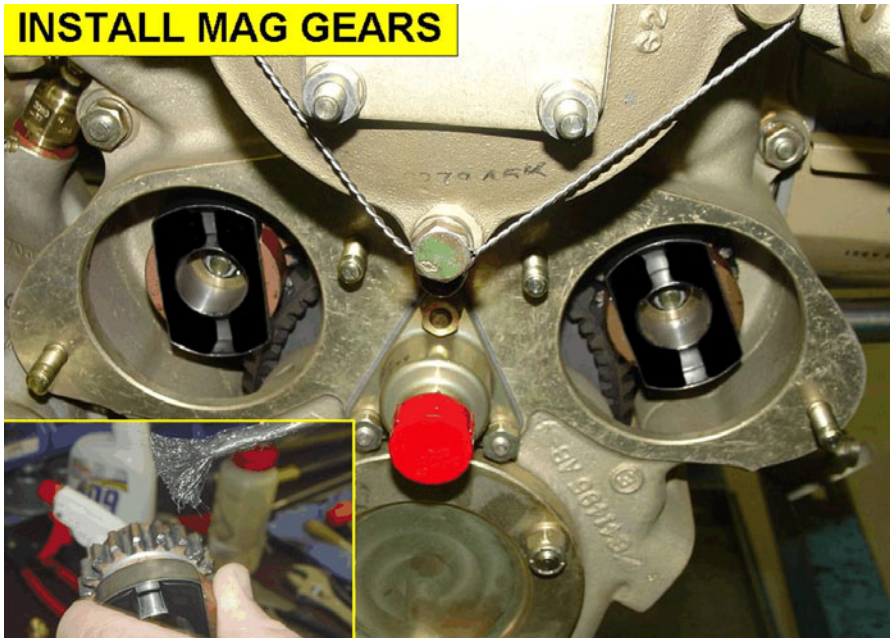


Figure 17-66. Magneto Drive Gear Assembly Installation

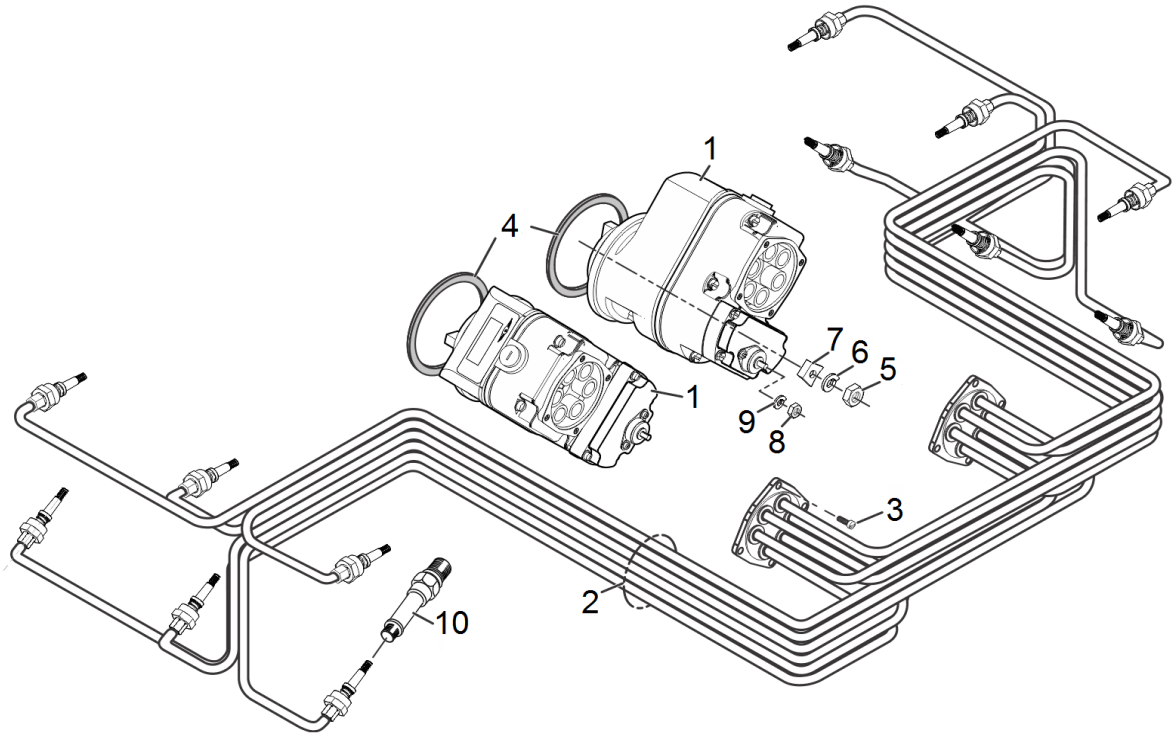


Figure 17-67. Continental Ignition Assembly

1	Magneto	4	Gasket	7	Hold Washer	10	Spark Plug
2	Harness	5	Nut	8	Nut		
3	Screw	6	Lock Washer	9	Lock Washer		

17-11.2. Champion (Slick) Ignition System Installation

1. Install magneto drive gear assemblies in the engine. Refer to Figure 17-66.

   NOTE: Ensure magneto drive gear assemblies teeth mesh with camshaft gear.

2. Verify magneto drive gear assemblies backlash according to Appendix D-4.
3. Complete “Crankshaft Top Dead Center Alignment” in Section 6-3.9.1.1.
4. Insert T118 timing pin in “L” or “R” hole (depending on magneto rotation) in the distributor block. Turn rotor in the opposite direction of rotation until pin engages the gear.
5. Without turning the magneto coupling, hold the magneto in its approximate installed position.
   a. Align the magneto drive gear coupling slot and the magneto lugs by pulling the magneto drive gear assembly out of accessory case and turning it to the desired position.
   b. Install the magneto drive gear assembly back into the engine.

   NOTE: Ensure magneto drive gear assembly coupling bushings and retainers are properly installed.

6. Install the new gasket (Figure 17-68)(3) on the magneto (1) flange.
7. Carefully insert the magneto (1) into the accessory case, mate the magneto lugs with the magneto drive gear coupling slots.
8. Install hold washers (6), lock washers (5) and nuts (4). Snug down but do not tighten nuts as you must be able to rotate the magneto (1) to make timing adjustment.
9. Remove the T118 timing pin.
10. Complete “Magneto to Engine Timing” procedure in Section 6-3.9.1.2. Torque nuts (4) to Appendix B specifications upon completion of magneto timing.
11. Disconnect the timing light from magnetos (1).
12. Install the harness (2) and connect the cable outlet plates to the magnetos (1). Secure with screws (8) and torque screws to Appendix B specifications. Secure harness with clamps and cable ties.
13. Install spark plugs (7) according to Section 6-3.9.2.

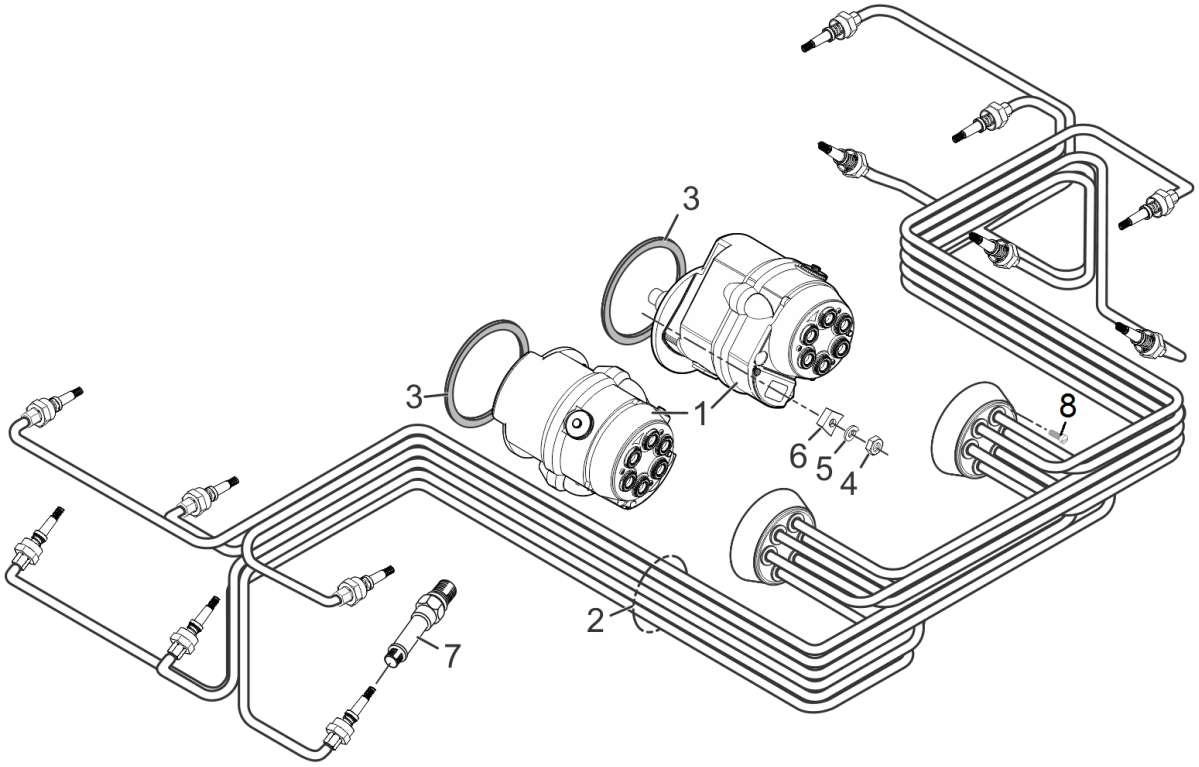


Figure 17-68. Champion (Slick) Ignition System Installation

1	Magneto	3	Gasket	5	Lock Washer	7	Spark Plug
2	Harness	4	Nut	6	Hold Washer	8	Screw

17-12. Exhaust System

Install the exhaust system according to the aircraft maintenance manual.

Chapter 18. Post-Overhaul Test and Adjustments

18-1. Introduction

Specific procedures listed in sections of this chapter must be completed after engine overhaul and before the aircraft can be released for normal flight operations.

WARNING

The tasks listed in Table 18-1 must be completed in the order listed on an engine before the aircraft is authorized for flight.

Table 18-1. Engine Operation Prerequisites

Sequence	Requirement	Section References
1	Prepare the Engine for Operation	"Maintenance Preflight Inspection" in Section 6-3.7.2
2	Maintenance Test Run	"Standard Acceptance Test" in Section 18-4
3	Complete Operational Checklist	"Engine Operational Checklist" in Table 6-5
4	Check Oil Consumption	"Oil Consumption Test" in Section 18-5
5	Perform Flight Check	"Flight Check" instructions in Section 7-2.3[1]

1. And in accordance with the Pilot's Operating Handbook (POH).

18-2. Post-Overhaul Testing Prerequisites

Install the engine in the aircraft or an engine test stand (per the applicable test stand or aircraft manufacturer's instructions). A test stand is the preferred method of testing. The following will be required to conduct post-overhaul testing:

- Fill the engine with oil according to the "Engine Oil Servicing" instructions in Section 6-3.8.

  NOTE: When a test club or fixed pitch propeller is used for testing, the governor pad cover must have an internal grooved surface to allow circulating oil. The governor pad cover is not needed if a propeller governor is installed.

- A test club mated to the propeller flange, meeting the minimum moment of inertia specified for the engine propeller in OI-7 "Installation and Operation Manual", Chapter 2, to absorb the brake horsepower (BHP) at the RPM specified in the test operating limits. Use the test club in combination with the cell, test stand, cooling apparatus, and operating limits for which it is calibrated.
- A cooling air scoop designed to fit over the tops of all cylinders, with padded seals for rear cylinders and valve rocker covers, to direct an adequate flow of air downward through the cylinder fins. CHT should not vary by more than 50°F (10°C) between the coolest and hottest cylinders.
- Vanes to direct cooling air to the center cylinder and the oil cooler.
- An air duct to the alternator vent tube.

- An air filter and housing attached to the air throttle inlet flange. The filter area must be sufficient to avoid air flow restrictions. Clean the filter before each test. Calculations of filter area should be based on approximately 290 cubic feet per minute (CFM) of air required by the engine at full throttle and on the filter capacity per unit of area. Increase the calculated area of a clean filter by at least 50% to allow for dirt accumulation.
- A flight propeller (if the engine is installed in the aircraft and cowling is in place)

The aircraft configured with a flight propeller may be considered a suitable test stand for Post-Overhaul engine testing contingent on the following:

  - The flight propeller may be used contingent upon cautious observation of engine cylinder head temperature.
  - The aircraft instruments must be calibrated prior to initiation of the Post-Overhaul engine testing.
  - Each cylinder should be fitted with a cylinder head temperature (CHT) sensing device. If the aircraft instruments monitor only one cylinder, CHT must not exceed 400°F and oil temperature must not exceed 200°F throughout all phases of engine testing.
  - Position the nose of the aircraft into prevailing winds.

- A throttle control capable of operating the throttle shaft through its complete range and a five position (OFF/R/L/BOTH/START) Ignition Switch connecting the engine with the aircraft electrical system.
- A storage battery must be connected by a No. 0 stranded copper cable from its positive terminal to the power terminal of the starter through a starter solenoid. The battery negative terminal must be connected to the engine or both battery terminal and engine may be grounded. A small insulated wire should connect the starter solenoid coil terminal to a 5 ampere push-button switch. The other switch terminal must be connected to the engine or both to common ground.
- Control panel equipped with the following calibrated engine instruments:
  - A tachometer gauge.
  - An oil pressure gauge and tube connection.
  - An oil temperature gauge and capillary assembly.
  - A water manometer with rubber hose connection to the vacuum pump oil return hole at the rear of the crankcase.
  - An ammeter connected in the alternator circuit.
  - A manifold air pressure gauge connected to a suitable manifold pressure connection on the induction manifold.
  - An exhaust gas temperature gauge connected to a temperature probe fitted to an exhaust manifold temperature probe boss.
  - A cylinder head temperature gauge connected to a temperature probe installed in bayonet fittings on the lower side of each cylinder.

- A fuel flow gauge.
- A clean, substantial hose of 3/4 inch inner diameter must be installed on the crankcase breather elbow and supported so it leads to a point above and to the rear of engine.
- Fuel system with an auxiliary (boost) pump capable of sustained fuel pressure of 2 -2.5 psi indication on fuel pressure gauge.

Make fuel line connections as follows:

1. Connect the fuel supply line to the fuel pump inlet.
2. Connect the fuel return line to the upper elbow projecting from the right side of the fuel pump.
3. Connect a fuel pressure gauge in line with the fuel distribution block fuel outlet.

18-3. Post-Overhaul Test Operating Limits

Post-overhaul test limits are the same as the “IO-360 Engine Operating Limits” found in Table 6-3.

18-4. Standard Acceptance Test

Perform a standard acceptance test according to the protocol listed in Table 18-2.

Table 18-2. Standard Acceptance Test Requirements

Engine Run Period	Time Duration (Minutes)	Engine RPM
1	5	1200 ± 25 RPM
2	5	1600 ± 25 RPM 2100 ± 25 RPM[1] (Magneto and fuel flow check)
3	5	2450 (2250 for K, KB) ± 25 RPM[1]
4	10	Rated Power RPM[2] Adjust engine - fuel flow, pressure, etc. - Reduce RPM for adjustments.
5	10	75% Power RPM Check fuel and oil pressures. Check temperatures.
6	5	Idle RPM (Cooling period - recheck idle adjustment, 300°F (149°C) Max. CHT at shut down.)[3]
7	---	Stop engine and perform leak check.[4]
8	10	75% Power RPM Stop engine and perform leak check at end of run.[4, 5]
9	5	75% Power RPM Stop engine and perform leak check at end of run.[4, 5]

1. Do not run the engine above 1700 RPM until oil temperature has reached 160°F (71°C) and cylinder head temperatures have reached 200°F (93°C).
2. Make one check on performance of each magneto channel alone at 1700 RPM. Clear the spark plugs by operating with both magnetos on for a few seconds between checks.
3. Do not shut engine down until cylinder temperatures are below 300°F (149°C).
4. Fuel and oil leaks are not acceptable.
5. The engine is not acceptable until one successive 10 and 5 minute runs are made with no leaks.

Engines failing the acceptance test for high oil consumption, major oil leaks, low power, damaged components, excessive noise, excessive roughness, low oil pressure, excessive oil filter contamination require further investigation. Correct discrepancies and repeat the Standard Acceptance Test.

18-5. Oil Consumption Test

The Oil Consumption Test must be accomplished in addition to the Standard Acceptance Test. Use Table 18-3 to complete the oil consumption test.

Table 18-3. Oil Consumption Test Requirements

Engine Run Period	Time Duration (Minutes)	Engine RPM
1	5	1200 ± 25 RPM
2	5	1600 ± 25 RPM 2100 ± 25 RPM[1] (Magneto and fuel flow check)
3	5	2450 (2250 for K, KB) ± 25 RPM[1]
4	10	Rated Power RPM[2] Adjust engine - fuel flow, pressure, etc. - Reduce RPM for adjustments.
5	10	75% Power RPM Check fuel and oil pressures. Check temperatures.
6	5	Idle RPM (Cooling period - recheck idle adjustment, 300°F (149°C) Max. at shutdown)[3]
Stop engine, drain and weigh oil for oil consumption determination; service engine		
7	5	Warm up to rated RPM
8	30	Rated RPM Take engine readings every 10 minutes.
9	5	Idle RPM (cooling period - 300°F (149°C) Max. at shutdown)[3, 4]

1. Do not run the engine above 1700 RPM until oil temperature has reached 160°F (71°C) and cylinder head temperatures have reached 200°F (93°C).
2. Make one check on performance of each magneto alone at 1700 RPM. Clear spark plugs by operating with both magnetos on for a few seconds between checks.
3. Do not shut the engine down until the cylinder temperatures are below 300°F (149°C).
4. Stop engine, drain and weigh oil. If oil consumption is in excess of 2 pounds during the 40 minutes of runs 7 through 9, it is permissible to redo runs 7 through 9. If oil consumption is still excessive, return engine to repair area for inspection and repair.

Engines failing to pass the oil consumption test require further investigation. Correct discrepancies and repeat the Oil Consumption Test. Refer to troubleshooting instructions in Chapter 8 for remedial action, if necessary.

18-6. Drive Belt Tension Check

Check new alternator drive belt tension after the first five hours of operation. Adjust belt tension, as required, according to the instructions in Section 6-3.10.4, “Belt Tension Check and Adjustment."

Check new compressor drive belt tension after minimum of twenty minutes and a maximum of two hours run-in with compressor loaded. Adjust belt tension, as required, according to the instructions in Section 6-3.10.4, “Belt Tension Check and Adjustment."

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Appendix A. Definitions

Refer to Appendix A in M-0, Standard Practice Maintenance Manual.

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Appendix B. Torque Specifications

Refer to Appendix B in M-0, Standard Practice Maintenance Manual.

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Appendix C. Standard Practices

C-1. Handling Parts

Refer to Appendix C-1 in M-0, Standard Practice Maintenance Manual.

C-2. Replacement Parts

Refer to Appendix C-2 in M-0, Standard Practice Maintenance Manual.

C-2.1. Background

Refer to Appendix C-2.1 in M-0, Standard Practice Maintenance Manual.

C-2.2. Acceptable Replacement Parts

Refer to Appendix C-2.2 in M-0, Standard Practice Maintenance Manual.

C-2.2.1. Know Your Supplier

Refer to Appendix C-2.2.1 in M-0, Standard Practice Maintenance Manual.

C-2.3. 100% Parts Replacement Requirements

Refer to Appendix C-2.3 in M-0, Standard Practice Maintenance Manual.

C-2.4. Mandatory Overhaul Replacement Parts

Refer to Appendix C-2.4 in M-0, Standard Practice Maintenance Manual.

C-2.5. Authorized Oversize/Undersize Parts

Refer to Appendix C-2.5 in M-0, Standard Practice Maintenance Manual.

C-2.6. Engine Data Plate Replacement

Refer to Appendix C-2.6 in M-0, Standard Practice Maintenance Manual.

C-3. Safety Wiring Hardware

Refer to Appendix C-3 in M-0, Standard Practice Maintenance Manual.

C-4. Tab Washer Installation

Refer to Appendix C-4 in M-0, Standard Practice Maintenance Manual.

C-5. Heli-coil Insert Replacement

Refer to Appendix C-5 in M-0, Standard Practice Maintenance Manual.

C-5.1. Heli-coil Removal

Refer to Appendix C-5.1 in M-0, Standard Practice Maintenance Manual.

C-5.2. Heli-coil Insertion

Refer to Appendix C-5.2 in M-0, Standard Practice Maintenance Manual.

C-6. Stud Replacement

Refer to Appendix C-6 in M-0, Standard Practice Maintenance Manual.

C-6.1. Stud Removal

Refer to Appendix C-6.1 in M-0, Standard Practice Maintenance Manual.

C-6.1.1. Size-on-Size Rosan Stud Removal

Refer to Appendix C-6.1.1 in M-0, Standard Practice Maintenance Manual.

C-6.1.2. Step-Type Rosan Stud Removal

Refer to Appendix C-6.1.2 in M-0, Standard Practice Maintenance Manual.

C-6.1.2.1. Step-Type Rosan Stud Removal Method 1

Refer to Appendix C-6.1.2.1 in M-0, Standard Practice Maintenance Manual.

C-6.1.2.2. Step-Type Rosan Stud Removal Method 2

Refer to Appendix C-6.1.2.2 in M-0, Standard Practice Maintenance Manual.

C-6.2. Stud Installation

Refer to Appendix C-6.2 in M-0, Standard Practice Maintenance Manual.

C-6.2.1. Rosan Stud Installation

Refer to Appendix C-6.2.1 in M-0, Standard Practice Maintenance Manual.

C-7. Cotter Pin Installation

Refer to Appendix C-7 in M-0, Standard Practice Maintenance Manual.

C-8. Fuel System Service

Refer to Appendix C-8 in M-0, Standard Practice Maintenance Manual.

C-8.1. Fuel System Purge

Refer to Appendix C-8.1 in M-0, Standard Practice Maintenance Manual.

C-9. Gasket Maker Application

Refer to Appendix C-9 in M-0, Standard Practice Maintenance Manual.

C-10. Gasket Installation

Refer to Appendix C-10 in M-0, Standard Practice Maintenance Manual.

C-11. Hose and Tubing Installation

Refer to Appendix C-11 in M-0, Standard Practice Maintenance Manual.

C-12. Harness Routing

Refer to Appendix C-12 in M-0, Standard Practice Maintenance Manual.

Appendix D. Overhaul Dimensional Limits

D-1. Overhaul Dimensional Limits = New Part Dimensions

New part dimensions are used for the Overhaul Dimensional Inspection. Overhaul tolerances are not the same as the service limits used for maintenance in Chapter 10. New parts dimensions are based on production drawings in effect at the time of publication.

WARNING

Use only new part dimensional limits during engine overhaul.

D-2. Fuel Injection System

Refer to **Figure D-1 and Table D-1** for the fuel pump overhaul dimensional limits. Index numbers in the left column of the table correspond with the numbers in the associated illustration. Discard and replace any parts that do not conform to the specified new part dimensional specifications.

Clean and dry parts thoroughly according to Chapter 12 of M-0, Standard Practice Maintenance Manual, instructions before performing the dimensional inspection.

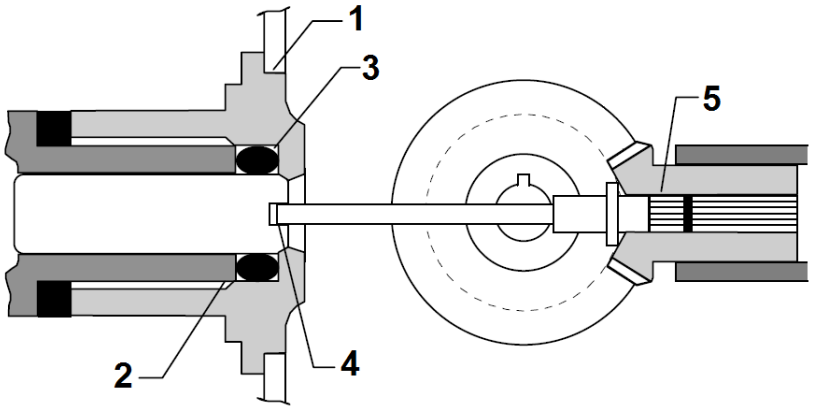


Figure D-1. Fuel Pump Overhaul Dimension Limits

Table D-1. Fuel Pump Overhaul Dimension Limits

Index	Description	Dimensions (inches)	
		Minimum	Maximum
1	Fuel pump adapter pilot in crankcase ..... diametric clearance	0.001L	0.006L
2	Fuel pump body pilot in adapter ..... diametric clearance	0.0002L	0.0045L
3	Oil seal in adapter ..... diametric clearance	0.003T	0.009T
4	Fuel pump drive shaft in impeller shaft ..... total clearance	0.002L	0.008L
5	Fuel pump drive shaft in governor gear ..... tooth clearance	0.0015	0.0039
T= Tight L= Loose			

D-2.1. Throttle Lever

If a bronze control lever is removed for any reason, regardless of condition, replace it with the current production stainless steel lever.

If the facility performing engine overhaul elects to overhaul the fuel mixture control, integrated throttle and control assembly or fuel pump in the field, the facility must discard and replace the bronze control levers, regardless of condition, with the current production stainless steel lever.

CAUTION: Current production throttle and mixture control levers are constructed of stainless steel. If the throttle or mixture control lever is constructed of any material other than stainless steel (i.e. bronze), replace the lever during overhaul with the current production stainless steel version.

If the serrated mating surfaces of the throttle or mixture control lever are deformed or will not install correctly on the throttle or mixture control shaft, replace the lever.

D-3. Starter and Starter Adapter

For the basic starter adapter overhaul limits, refer to **Figure D-2** and **Table D-2** for overhaul dimensional limits. For the starter adapter with accessory drive adapter overhaul limits, refer to **Figure D-3** and **Table D-3** for overhaul dimensional limits. For the starter adapter with accessory drive adapter with gear shaft housing overhaul limits, refer to **Figure D-6** and **Table D-4** for overhaul dimensional limits. Index numbers in the left columns of the tables correspond with the numbers in the associated illustrations. Discard and replace any parts that do not conform to the new part dimensions.

Clean and dry parts thoroughly according to Chapter 12 of M-0, Standard Practice Maintenance Manual, instructions before performing the dimensional inspection.

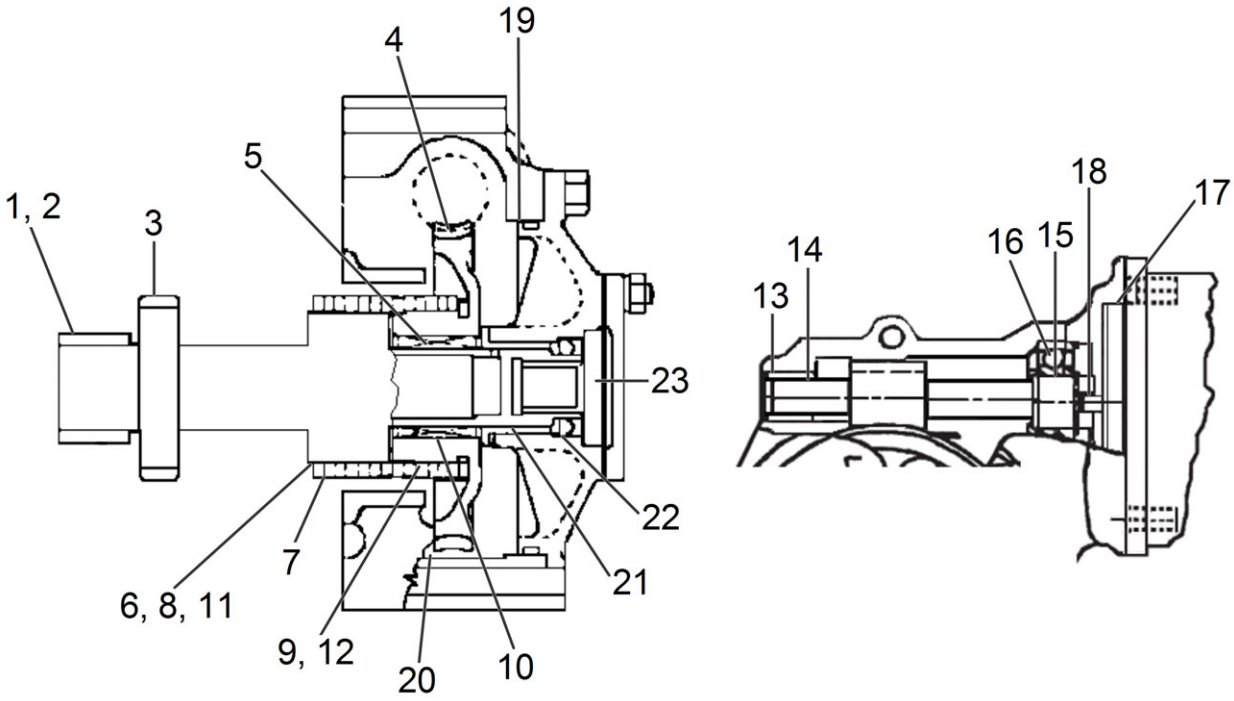


Figure D-2. Basic Starter Adapter Overhaul Dimension Limits

Table D-2. Basic Starter Adapter Overhaul Dimension Limits

Index	Description	Dimensions (inches)	
		Minimum	Maximum
1	Starter adapter shaft gear in bushing ..... diametric clearance	0.002L	0.004L
2	Starter adapter shaft gear front journal ..... diameter	1.059	1.060
3	Starter shaft gear to crankshaft gear ..... backlash	0.008	0.012
4	Starter gear and worm shaft gear ..... backlash	0.009	0.013
5	Starter shaft gear ..... diameter	0.9995	1.0000
	Ra Surface Finish	---	32 Ra
6	Starter clutch spring outside[1] ..... diameter	2.267	2.282
7	Starter clutch spring inside[1] ..... diameter	1.938	1.940
8	Starter shaft gear drum outside ..... diameter	See Figure D-4	
9	Starter gear drum outside ..... diameter	See Figure D-5	
10	Starter gear inside ..... diameter	1.3115	1.3125
11	Clutch spring on starter shaft gear drum 0.50-0.56 from drum end ..... diametric clearance	0.008T	0.012T
12	Clutch spring on gear drum 0.40 from drum end ..... diametric clearance	0.015T	0.022T
13	Needle bearing bore in adapter ..... diameter	0.7485	0.7495
14	Worm gear shaft in needle bearing ..... shaft diameter	0.5620	0.5626
15	Worm gear shaft in ball bearing ..... diametric clearance	0.0000	0.0008T
16	Ball bearing in adapter housing ..... diametric clearance	0.001L	0.0001T
17	Starter in adapter pilot ..... diametric clearance	0.001L	0.0065L
18	Starter drive tongue to worm shaft drive slot ..... total side clearance	0.012L	0.034L
19	Adapter cover in adapter housing pilot ..... diametric clearance	0.001L	0.004L
20	Starter gear ..... end clearance	0.0025L	0.0115L
21	Shaft gear in adapter cover bushing ..... diametric clearance	0.001L	0.0025L
22	Oil seal in adapter cover ..... diametric clearance	0.001T	0.007T
23	Adapter cover bore ..... diameter	1.500	1.502
T= Tight L= Loose			

1. Reduced in diameter nominally 0.015 for M015 spring.

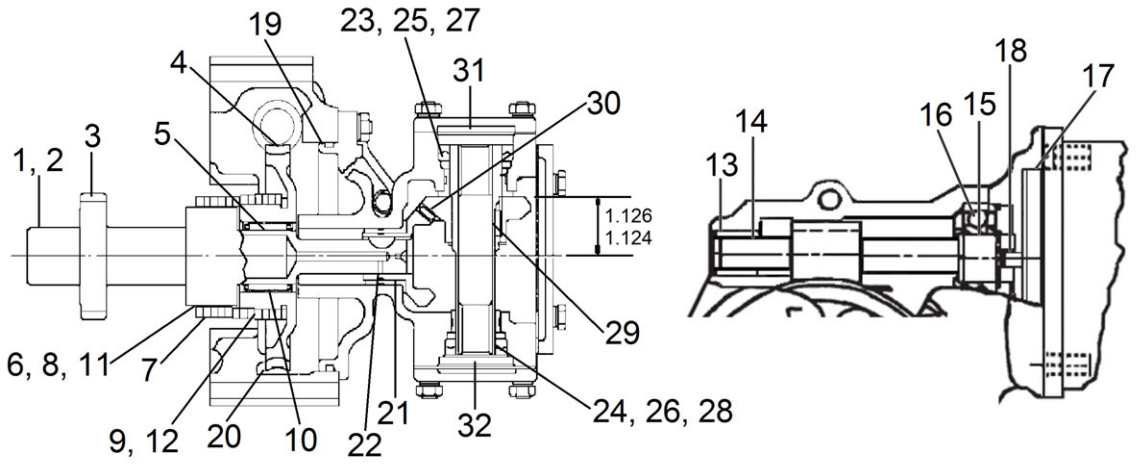


Figure D-3. Starter Adapter with Accessory Drive Adapter Overhaul Dimension Limits

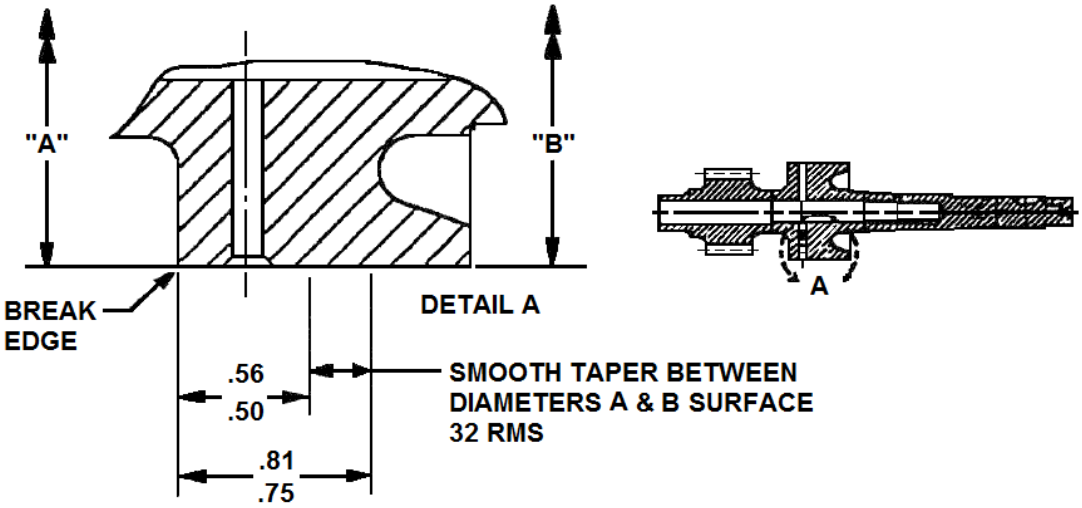


Figure D-4. Starter Shaft Gear Drum

DESCRIPTION	"A" Diameter (Inches)		"B" Diameter (Inches)	
	Minimum	Maximum	Minimum	Maximum
Starter Shaft Gear Drum	1.948	1.950	1.9365	1.9385
0.015 Undersize	1.933	1.935	1.9215	1.9235

Table D-3. Starter Adapter with Accessory Drive Adapter Overhaul Dimension Limits

Index	Description	Dimensions (inches)	
		Minimum	Maximum
1	Starter adapter shaft gear in bushing ..... diametric clearance	0.002L	0.004L
2	Starter adapter shaft gear front journal ..... diameter	1.059	1.060
3	Starter shaft gear to crankshaft gear ..... backlash	0.008	0.012
4	Starter gear and worm shaft gear ..... backlash	0.009	0.013
5	Starter shaft gear ..... diameter	0.9995	1.0000
	Ra Surface Finish	---	32 Ra
6	Starter clutch spring outside[1] ..... diameter	2.267	2.282
7	Starter clutch spring inside[1] ..... diameter	1.938	1.940
8	Starter shaft gear drum outside ..... diameter		See Figure D-4
9	Starter gear drum outside ..... diameter		See Figure D-5
10	Starter gear inside ..... diameter	1.3115	1.3125
11	Clutch spring on starter shaft gear drum 0.50-0.56 from drum end ..... diametric clearance	0.008T	0.012T
12	Clutch spring on gear drum 0.40 from drum end ..... diametric clearance	0.015T	0.022T
13	Needle bearing bore in adapter ..... diameter	0.7485	0.7495
14	Worm gear shaft in needle bearing ..... shaft diameter	0.5620	0.5626
15	Worm gear shaft in ball bearing ..... diametric clearance	0.0000	0.0008T
16	Ball bearing in adapter housing ..... diametric clearance	0.001L	0.0001T
17	Starter in adapter pilot ..... diametric clearance	0.001L	0.0065L
18	Starter drive tongue to worm shaft drive slot ..... total side clearance	0.012L	0.034L
19	Adapter cover in adapter housing pilot ..... diametric clearance	0.001L	0.004L
20	Starter gear ..... end clearance	0.0025L	0.0115L
21	Driver bevel gear in bushing ..... diametric clearance	0.001L	0.003L
22	Driver bevel gear on starter shaft gear ..... diametric clearance	0.0002L	0.002L
23	RHS accessory drive shaft end in bushing ..... diametric clearance	0.001L	0.003L
24	LHS accessory drive shaft end in bushing ..... diametric clearance	0.001L	0.003L
25	RHS seal bore ..... diameter	1.500	1.502
26	LHS seal bore ..... diameter	1.249	1.251
27	Accessory drive shaft ..... diameter	1.0600	1.0610
28	Accessory drive shaft ..... diameter	0.8100	0.8110
29	Driven bevel gear on accessory drive shaft ..... diametric clearance	0.000	0.002L
30	Driven and driver bevel gears ..... backlash	0.008	0.012
31	RHS accessory bore ..... diameter	1.500	1.502
32	LHS accessory bore ..... diameter	1.500	1.502
T= Tight L= Loose			

1. Reduced in diameter nominally 0.015 for M015 spring.

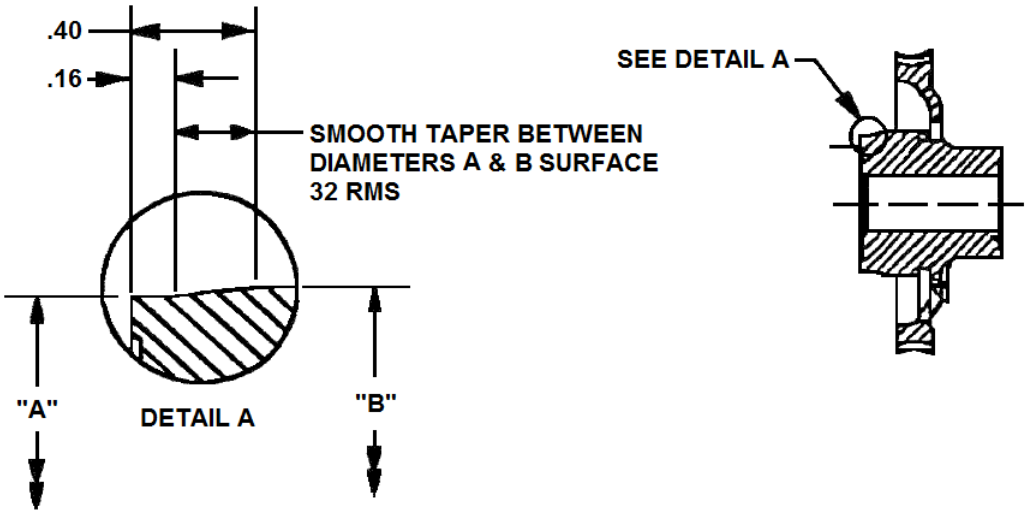


Figure D-5. Starter Gear Drum

DESCRIPTION	"A" Diameter (Inches)		"B" Diameter (Inches)	
	Minimum	Maximum	Minimum	Maximum
Starter Gear Drum	1.9365	1.9385	1.955	1.960
0.015 Undersize	1.9215	1.9235	1.940	1.945

Table D-4. Starter Adapter with Accessory Drive with Gear Shaft Housing Overhaul Dimension Limits

Index	Description	Dimensions (inches)	
		Minimum	Maximum
1	Starter adapter shaft gear in bushing.....diametric clearance	0.002L	0.004L
2	Starter adapter shaft gear front journal.....diameter	1.059	1.060
3	Starter shaft gear to crankshaft gear ..... backlash	0.008	0.012
4	Starter gear and worm shaft gear ..... backlash	0.009	0.013
5	Starter shaft gear .....diameter	0.9995	1.0000
	Ra Surface Finish	---	32 Ra
6	Starter clutch spring outside[1]..... diameter	2.267	2.282
7	Starter clutch spring inside[1].....diameter	1.938	1.940
8	Starter shaft gear drum outside .....diameter	See Figure D-4	
9	Starter gear drum outside .....diameter	See Figure D-5	
10	Starter gear inside.....diameter	1.3115	1.3125
11	Clutch spring on starter shaft gear drum 0.50-0.56 from drum end .....diametric clearance	0.008T	0.012T
12	Clutch spring on gear drum 0.40 from drum end ..... diametric clearance	0.015T	0.022T
13	Needle bearing bore in adapter ..... diameter	0.7485	0.7495
14	Worm gear shaft in needle bearing.....shaft diameter	0.5620	0.5626
15	Worm gear shaft in ball bearing.....diametric clearance	0.0000	0.0008T
16	Ball bearing in adapter housing .....diametric clearance	0.001L	0.0001T
17	Starter in adapter pilot.....diametric clearance	0.001L	0.0065L
18	Starter drive tongue to worm shaft drive slot .....total side clearance	0.012L	0.034L
19	Adapter cover in adapter housing pilot .....diametric clearance	0.001L	0.004L
20	Starter gear ..... end clearance	0.0105L	0.0215L
21	Needle bearing bore in cover.....diameter	1.2485	1.2495
22	Starter shaft gear in adapter cover bushing.....diametric clearance	0.0005L	0.002L
23	Scavenge pump driven gear on shaft .....diametric clearance	0.0005L	0.0025L
24	Scavenge pump gears in adapter cover[2].....diametric clearance	0.0055L	0.0080L
	..... end clearance	0.001L	0.0035L
25	Scavenge pump drive gear on starter shaft gear[2] .....diametric clearance	0.0002L	0.0017L
26	Scavenge pump driven gear to drive gear[2] .....backlash	0.014	0.0218
27	Driver bevel gear on starter shaft gear .....diametric clearance	0.0002L	0.0017L
	.....total side clearance	0.0002L	0.0042L
28	RHS accessory drive shaft end in bushing .....diametric clearance	0.001L	0.003L
29	LHS accessory drive shaft end in bushing.....diametric clearance	0.001L	0.003L
30	RHS seal bore.....diameter	1.498	1.500
31	LHS seal bore .....diameter	1.249	1.251
32	Accessory drive shaft.....diameter	1.0600	1.0610
33	Accessory drive shaft.....diameter	0.8100	0.8110
34	Driven bevel gear on accessory drive shaft.....diametric clearance	0.000	0.002L
35	Driven and driver bevel gears.....backlash	0.008	0.012
36	Gear shaft bearing bore in housing.....diameter	1.0610	1.0620
37	Gear shaft oil seal bore in housing .....diameter	1.574	1.576

Table D-4. Starter Adapter with Accessory Drive with Gear Shaft Housing Overhaul Dimension Limits

Index	Description	Dimensions (inches)	
		Minimum	Maximum
38	Gear shaft ..... diameter	0.8120	0.8125
39	RHS accessory bore ..... diameter	1.498	1.500
40	LHS accessory bore ..... diameter	1.500	1.502
T= Tight L= Loose			

1. Reduced in diameter nominally 0.015 for M015 spring.
2. The scavenge pump driver gear is only used in the starter adapter configuration for the I0360ES26B and 28B. Measurements for fits and limits of the driver gear only apply to I0360ES26B and 28B.

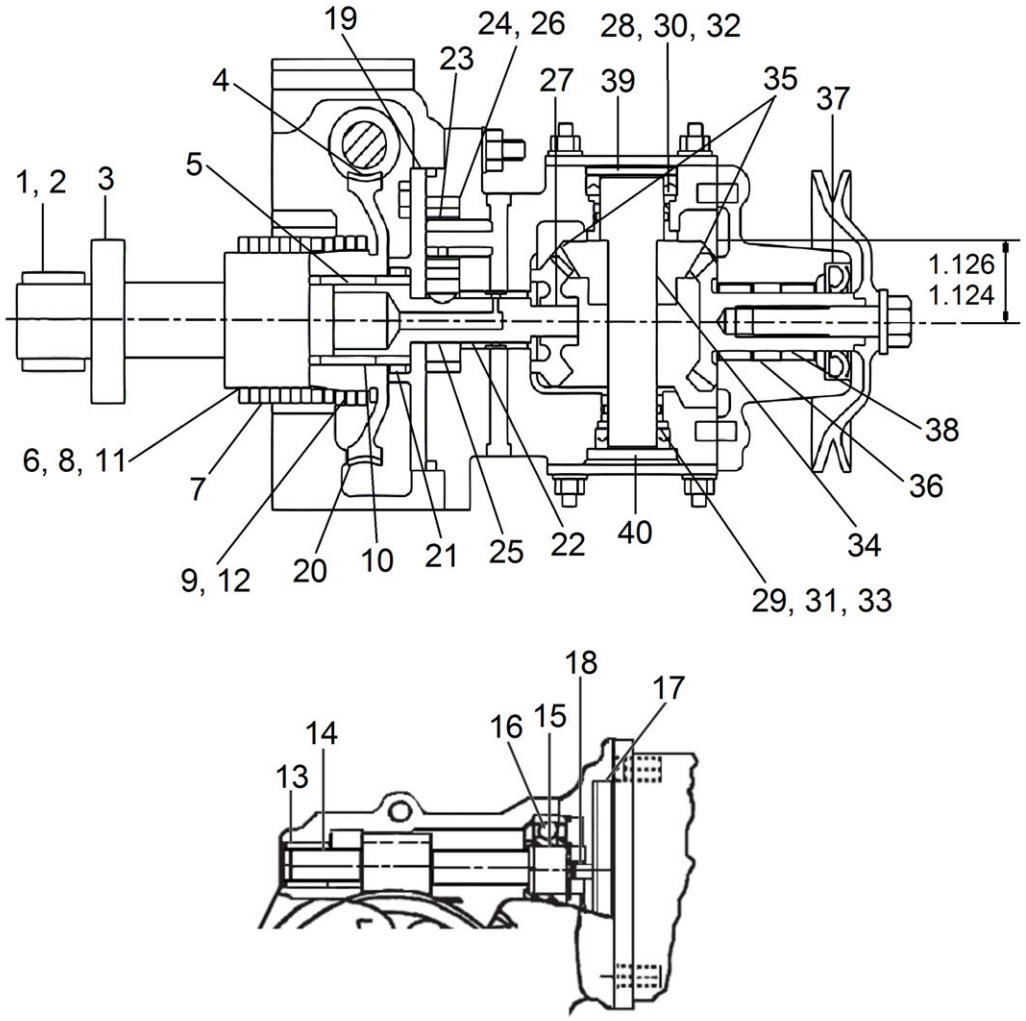


Figure D-6. Starter Adapter with Accessory Drive Adapter with Gear Shaft Housing Overhaul Dimension Limits

D-4. Ignition System

NOTE: For magneto overhaul limits, refer to the applicable Magneto Service Manual.

Refer to **Figure D-7** and **Table D-5** for the magneto drive assembly overhaul dimensional limits. Index numbers in the left column of the table correspond with the numbers in the associated illustration. Discard and replace any parts that do not conform to the new part dimensions. Additional ignition system dimensions are listed in **Table D-6**.

Clean and dry parts thoroughly according to Chapter 12 of M-0, Standard Practice Maintenance Manual, instructions before performing the dimensional inspection.

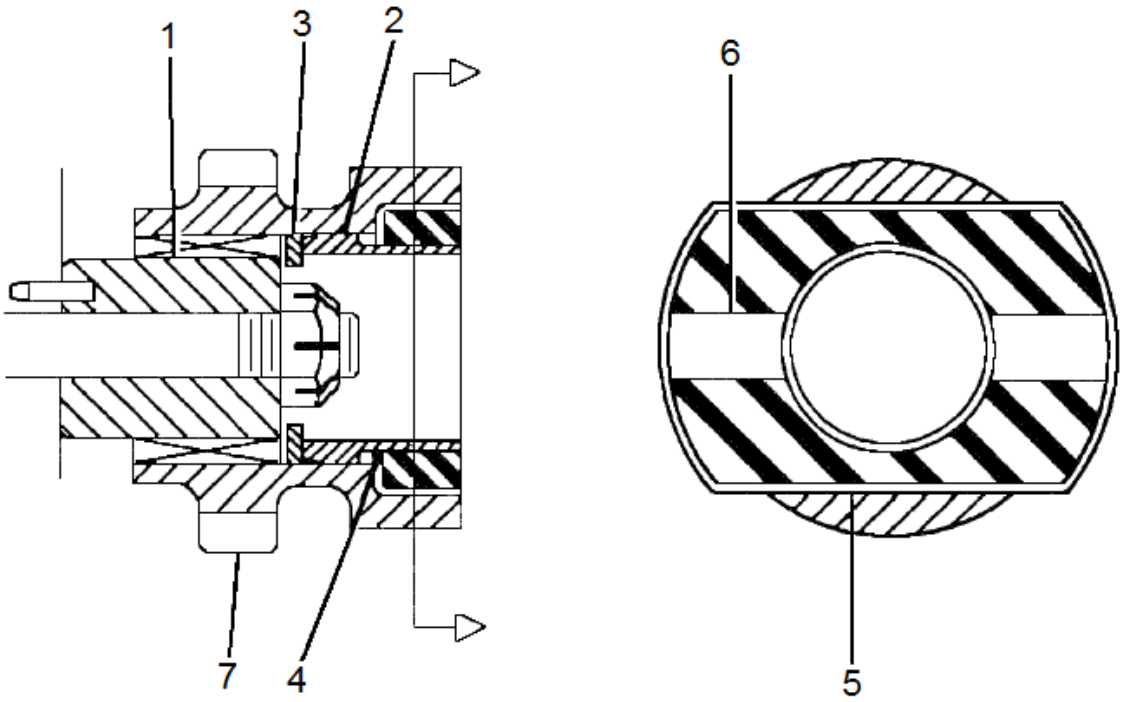


Figure D-7. Magneto Drive Assembly Overhaul Dimension Limits

Table D-5. Ignition System Overhaul Dimension Limits

Index	Description	Dimensions (inches)	
		Minimum	Maximum
1	Magneto gear support shaft to bearing.....diametric clearance	0.0003L	0.0012L
2	Sleeve in drive gear.....diametric clearance	0.0015T	0.0036T
3	Washer in drive gear .....diametric clearance	0.0000	0.0021T
4	Magneto coupling retainer on gear sleeve .....diametric clearance	0.025L	0.045L
5	Magneto coupling retainer in drive gear slot.....total side clearance	0.006T	0.036L
6	Magneto coupling rubber bushings on magneto drive lugs (replace if worn).....side clearance Magneto pilot in crankcase cover.....diametric clearance	 0.052T 0.001L	 0.010L 0.005L
7	Magneto gear to camshaft gear.....backlash	0.012	0.014
T= Tight L= Loose			

Table D-6. Ignition System Overhaul Dimension Limits
Not illustrated in Figure D-7

Part Name	Inspection Item	Dimensions (inches)	
		Minimum	Maximum
Magneto Drive Gear Shaft	Outside Diameter	0.8745	0.8750
	Length	1.020	1.030

D-5. Lubrication and Accessory Case

Refer to **Figure D-8** and **Table D-7** for lubrication and accessory case overhaul dimensional limits. Index numbers in the left column of the table correspond with the numbers in the associated illustration. Discard and replace any parts that do not conform to the new part dimensions. Additional lubrication and accessory case dimensions are listed in **Table D-8**.

Clean and dry parts thoroughly according to Chapter 12 of M-0, Standard Practice Maintenance Manual, instructions before performing the dimensional inspection.

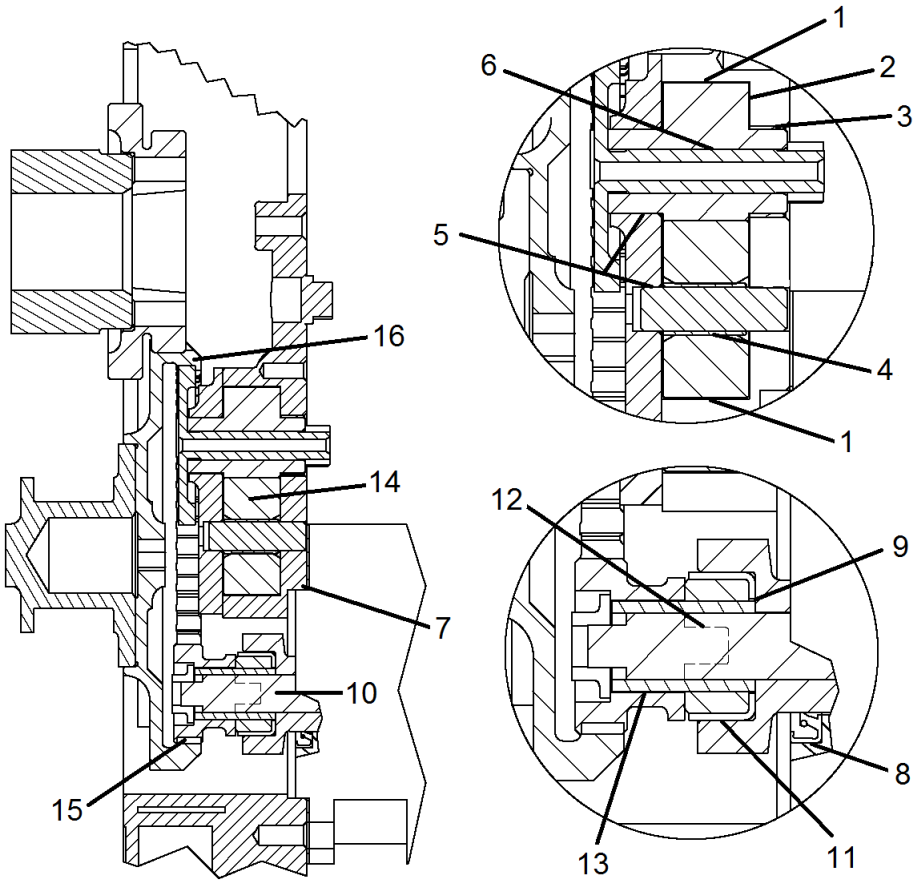


Figure D-8. Lubrication and Accessory Case Overhaul Dimension Limits

Table D-7. Lubrication and Accessory Case Overhaul Dimension Limits

Index	Description	Dimensions (inches) Minimum	Maximum
1	Oil pump gears in housing..... diametric clearance	0.0016L	0.004L
2	Oil pump gears in housing.....end clearance	0.001	0.004
3	Oil pump gear shaft in housing bushing ..... diametric clearance	0.0005L	0.002L
4	Oil pump driven gear on shaft ..... diametric clearance	0.0005L	0.002L
5	Oil pump shafts in cover ..... diametric clearance	0.0005L	0.002L
6	Driver gear shaft in oil pump drive gear..... diametric clearance	0.0005L	0.002L
7	Alternator pilot in cover..... diametric clearance	0.001L	0.005L
8	Oil seal in alternator..... diametric clearance	0.001T	0.007T
9	Alternator coupling retainer on sleeve[1] ..... diametric clearance	0.016L	0.026L
10	Alternator drive hub[2] torque before slippage	---	100 in. lbs.
11	Coupling retainer in coupling hub slot[1]..... side clearance	0.010T	0.025L
12	Coupling bushing on drive gear lugs[1]..... total side clearance	0.010L	0.043T
13	Alternator gear on sleeve[1]..... diametric clearance	0.001L	0.003L
14	Oil pump driver to driven gear ..... backlash	0.014	0.0218
15	Alternator gear to camshaft gear ..... backlash	0.010	0.014
16	Drive gear to camshaft gear ..... backlash	0.010	0.014
Oil Temperature Control Valve		Minimum Temp	Maximum Temp
0.090 inch minimum travel at.....temperature		120°F	170°F
Valve must be fully closed against seat at.....temperature		168°F	172°F
Valve must crack open at 180°F.....PSI		minimum 18 lbs.	
T= Tight L= Loose			

1. Tang drive only
2. One piece coupling only. No slippage is permitted below 100 in. lbs.

Table D-8. Lubrication and Accessory Case Overhaul Dimension Limits
Not illustrated in Figure D-8

Part Name	Inspection Item	Dimensions (inches) Minimum	Maximum
Oil Pump Drive Gear (23T)	Shaft Diameter	0.3735	0.3740
Oil Pump Driven Gear (6T)	Inside Diameter	0.3745	0.3755
Oil Pump Driven Gear Shaft	Outside Diameter	0.3735	0.3740
Oil Pump Split Bushing	Inside Diameter (installed)	0.719	0.720
Oil Pump Housing Bore	Inside Diameter	0.7805	0.7815

D-6. Engine Cylinders

Refer to **Figure D-9, Figure D-10** and **Table D-9** for cylinder overhaul dimensional limits. Index numbers in the left column of the table correspond with the numbers in the associated illustration. Discard and replace any parts that do not conform to the new part dimensions. Additional engine cylinder dimensions are listed in **Table D-10**.

Clean and dry parts thoroughly according to Chapter 12 of M-0, Standard Practice Maintenance Manual, instructions before performing the dimensional inspection.

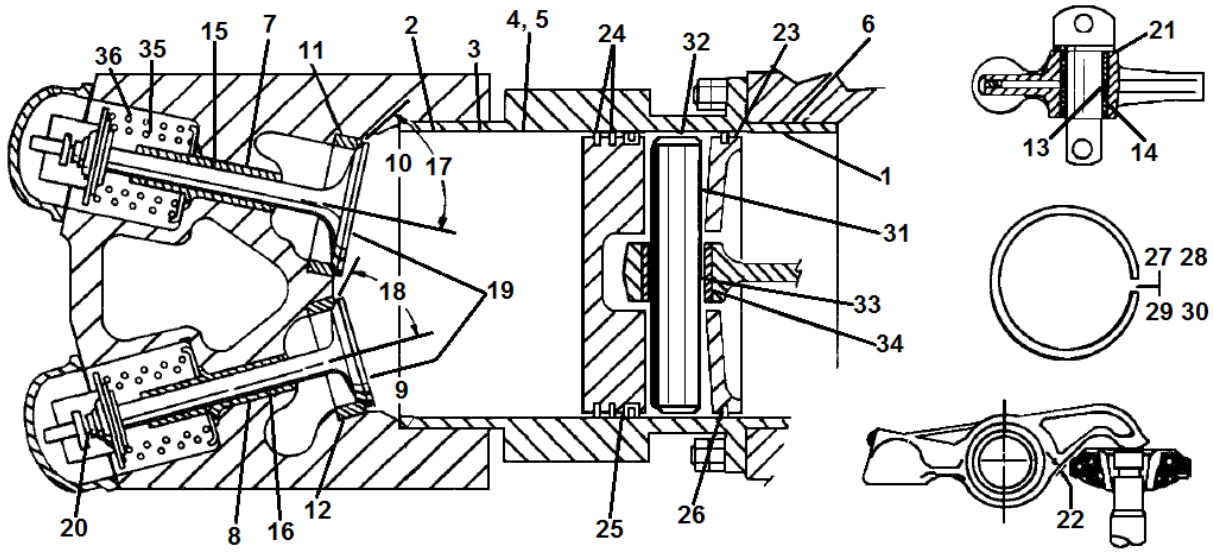


Figure D-9. Cylinder Assembly Overhaul Dimension Limits

Table D-9. Cylinder Assembly Overhaul Dimension Limits

Index	Description	Dimensions (inches)	
		Minimum	Maximum
	Cylinder Assembly		
1	Cylinder bore (lower 4-1/4 inch of barrel) .....diameter	See Figure D-10 and Table D-11	
2	Cylinder bore at "Y" location .....choke	See Figure D-10 and Table D-11	
3	Cylinder bore at "X" location .....choke	See Figure D-10 and Table D-11	
4	Cylinder bore out of round .....tolerance	0.000	0.001
5[1]	Cylinder bore surface cross hatch .....angle	22° - 32°	—
	Micro finish (measured in direction of piston travel) .....Ra	30	55
6	Cylinder barrel in crankcase ..... diametric clearance	0.003L	0.011L
7	Intake valve guide in cylinder head..... diametric clearance	0.001T	0.0025T
	Intake valve guide.....finished inside diameter	0.3745	0.3755
8	Exhaust valve guide in cylinder head ..... diametric clearance	0.001T	0.0025T
	Exhaust valve guide.....finished inside diameter	0.3745	0.3755
9	Exhaust valve seat (to valve guide axis).....angle	44°30'	45°00'
10	Intake valve seat (to valve guide axis).....angle	59°30'	60°00'
11	Intake valve seat insert in cylinder head..... diametric clearance	0.0055T	0.0085T
12	Exhaust valve seat insert in cylinder head..... diametric clearance	0.0070T	0.0100T
	Valves, Rocker Arms and Shafts		
13	Rocker shaft in rocker arm bearing..... diametric clearance	0.0005L	0.0033L
14	Rocker arm bearing in rocker arm ..... diametric clearance	0.002T	0.0065T
15	Intake valve in guide ..... diametric clearance	0.0012L	0.0030L
16	Exhaust valve in guide..... diametric clearance	0.0025L	0.0043L
17	Intake valve face (to stem axis) .....angle	60°00'	60°15'
18	Exhaust valve face (to stem axis).....angle	46°00'	46°15'
19	Intake and exhaust valve stem to face (full indicator reading)..... runout	0.000	0.002
20	Valve rocker toe to valve stem (dry lifter).....	0.060	0.200
21	Rocker arm ..... side clearance	0.005	0.035
22	Rotocoil to rocker arm.....clearance	0.020	---
	Pistons, Rings, and Pins		
23[1, 2]	Piston clearance in cylinder bore..... diametric clearance	0.009	0.012
24	Top and second piston ring in groove (semi-keystone) (with ring flush to OD of piston, measured below ring)..... side clearance	0.0015	0.0055
25	Third piston ring in groove ..... side clearance	0.0025	0.005
26	Fourth piston ring in groove ..... side clearance	0.0025	0.005
27	Top piston ring at 1.00 ± 0.50 depth in cylinder barrel.....gap	0.022	0.037
28	Second piston ring at 1.00 ± 0.50 depth in cylinder barrel .....gap	0.028	0.043

Table D-9. Cylinder Assembly Overhaul Dimension Limits

Index	Description	Dimensions (inches)	
		Minimum	Maximum
29	Third piston ring at 1.00 ± 0.50 depth in cylinder barrel ..... gap	0.008	0.025
30	Fourth piston ring at 1.00 ± 0.50 depth in cylinder barrel ..... gap	0.010	0.027
31	Piston pin in piston..... diametric clearance	0.0001L	0.0007L
32	Piston pin in cylinder.....end clearance	0.007	0.029
33	Piston pin in connecting rod bushing ..... diametric clearance	0.0014L	0.0021L
34	Bushing in connecting rod..... diametric clearance	0.002T	0.0045T
Spring Test Data			
35	Inner valve spring (Free Length Ref 2.00 in.) ..... Load Length	1.10 inch	
	Inner valve spring..... Load	62 - 68 pounds	
36	Outer valve spring (Free Length Ref 2.20 in.)..... Load Length	1.168 inch	
	Outer valve spring..... Load	77 - 83 pounds	
T= Tight L= Loose			

1. Repair of cylinders must be performed by a qualified FAA approved repair facility.
2. Measure clearance perpendicular to piston pin bore at “D” diameter. Measure at the piston pin centerline perpendicular to piston pin bore.

Table D-10. Cylinder Assembly Overhaul Dimension Limits
Not illustrated in Figure D-9

Part Name	Inspection Item	Dimensions (inches)	
		Minimum	Maximum
Rocker Arm Bushings	Inside Diameter	0.5945	0.5955
Rocker Shaft	Outside Diameter	0.593	0.594
Piston (Standard)	Diameter at Bottom	4.4295	4.4305
	Pin Bore Diameter	0.9987	0.9991
Piston Pin Assembly	Pin Diameter	0.9984	0.9986
Valve Guides	Intake and Exhaust Guide Bore (Installed)	0.3745	0.3755

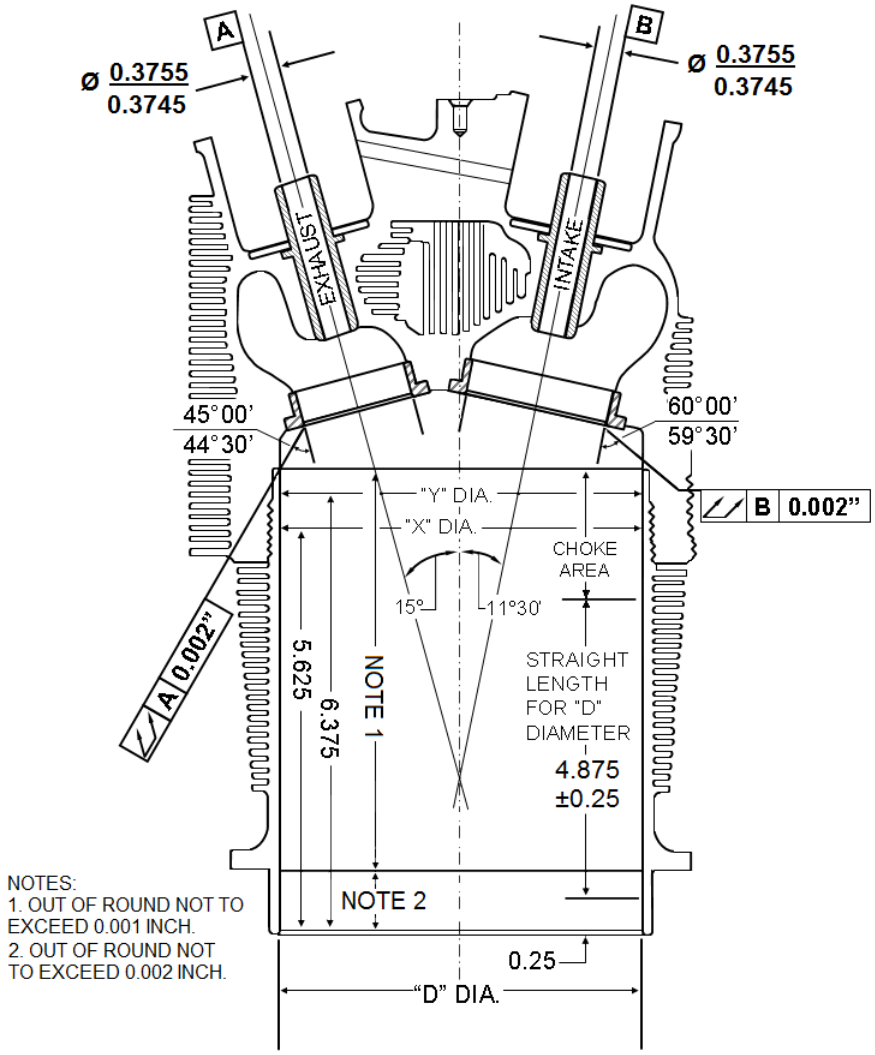
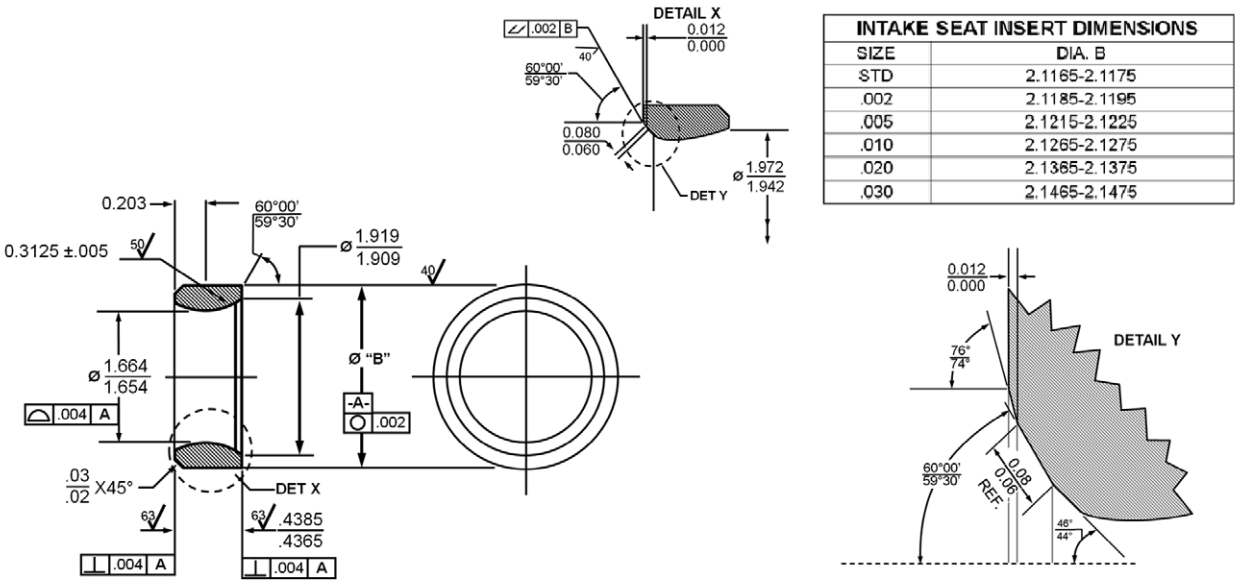


Figure D-10. Cylinder Bore Overhaul Dimension Limits

Table D-11. Cylinder Bore Overhaul Dimension Limits

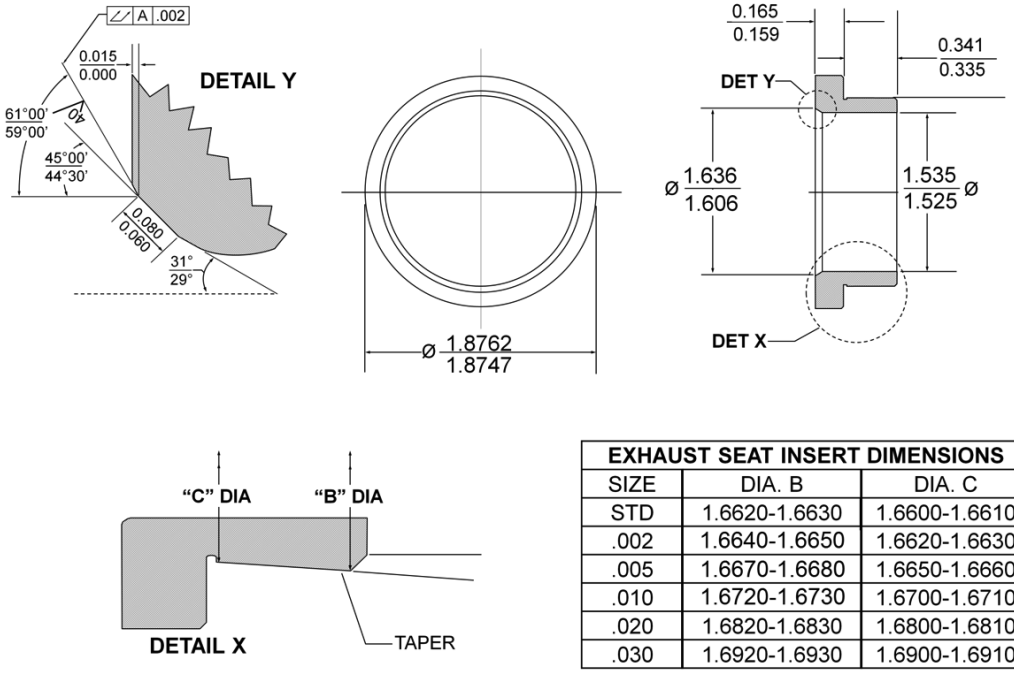
	"D" Diameter (inches)		"X" Diameter (inches)		"Y" Diameter (inches)	
Size	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
STD.	4.437	4.439	4.434	4.437	4.431	4.434
.005[1]	4.442	4.444	4.439	4.442	4.436	4.439
.010[1]	4.447	4.449	4.444	4.447	4.441	4.444
.015[1]	4.452	4.454	4.449	4.452	4.446	4.449
Note: Dimensions in the table above are shown in finish size after honing. Cylinder bore out of round limit must not exceed 0.001 inches at measured diameters.						

1. Requires use of corresponding oversize piston and rings.



INTAKE SEAT INSERT DIMENSIONS	
SIZE	DIA. B
STD	2.1165-2.1175
.002	2.1185-2.1195
.005	2.1215-2.1225
.010	2.1265-2.1275
.020	2.1365-2.1375
.030	2.1465-2.1475

Figure D-11. Intake Valve Seat Dimensions



EXHAUST SEAT INSERT DIMENSIONS		
SIZE	DIA. B	DIA. C
STD	1.6620-1.6630	1.6600-1.6610
.002	1.6640-1.6650	1.6620-1.6630
.005	1.6670-1.6680	1.6650-1.6660
.010	1.6720-1.6730	1.6700-1.6710
.020	1.6820-1.6830	1.6800-1.6810
.030	1.6920-1.6930	1.6900-1.6910

Figure D-12. Exhaust Valve Seat Dimensions

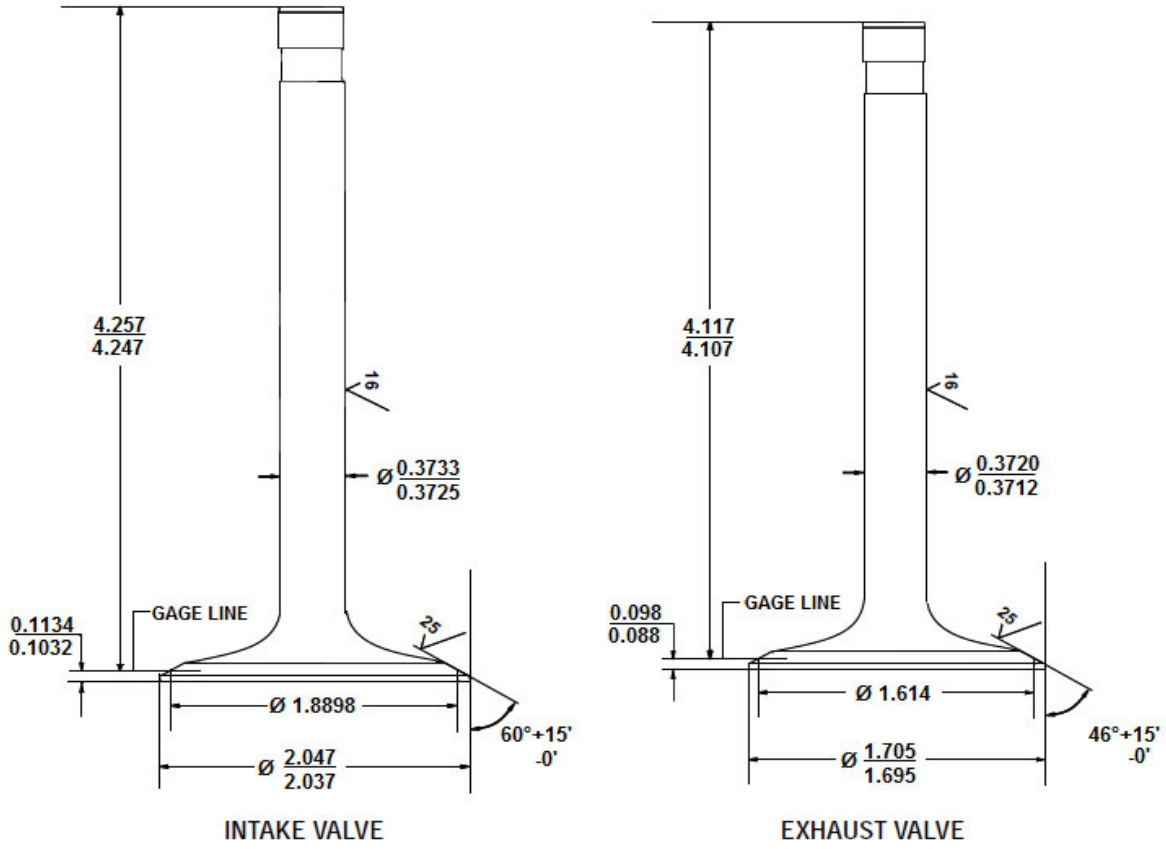


Figure D-13. Valve Dimensions

D-7. Crankcase, Crankshaft, Connecting Rods, Bearings and Camshaft

Refer to **Figure D-14** and **Table D-12** for crankcase, crankshaft, connecting rods, bearings and camshaft overhaul dimensional limits. Index numbers in the left column of the table correspond with the numbers in the associated illustration. Discard and replace any parts that do not conform to the new part dimensions. Additional crankcase, crankshaft, connecting rods, bearings and camshaft dimensions are listed in **Table D-13**.

Clean and dry parts thoroughly according to Chapter 12 of M-0, Standard Practice Maintenance Manual, instructions before performing the dimensional inspection.

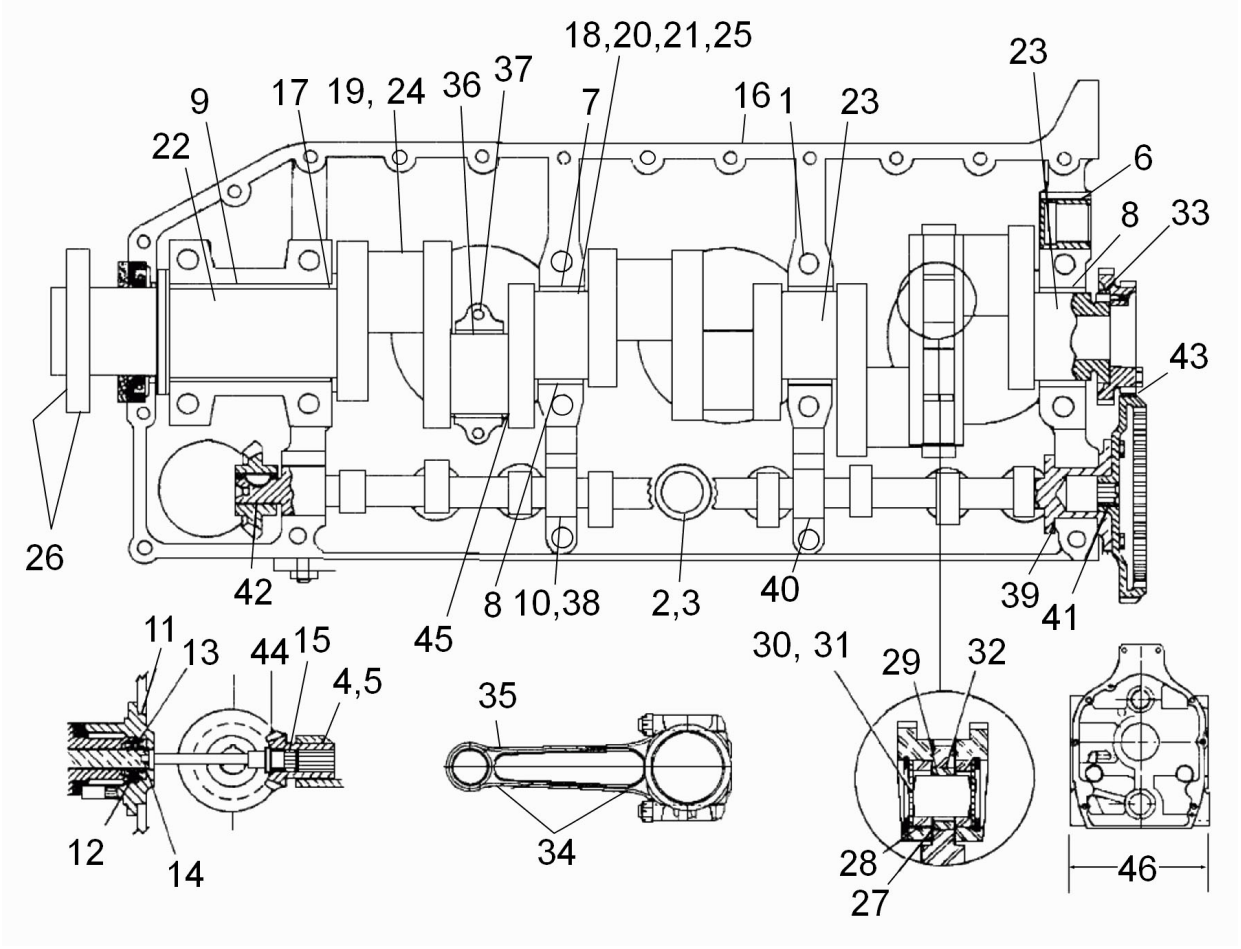


Figure D-14. Crankcase, Crankshaft, Connecting Rods, Bearings and Camshaft Overhaul Dimension Limits

Table D-12. Crankcase, Crankshaft, Connecting Rods, Bearings and Camshaft Overhaul Dimension Limits

Index	Part	Dimensions (inches)	
		Minimum	Maximum
1	Through bolts in crankcase ..... diametric clearance	0.000	0.0015L
2	Hydraulic valve lifter in crankcase ..... diametric clearance	0.001L	0.0025L
3	Hydraulic valve lifter bore in crankcase ..... diameter	1.0005	1.0015
4	Governor driven gear in crankcase ..... diametric clearance	0.0014L	0.0034L
5	Governor driven gear bore in crankcase ..... diameter	0.875	0.876
6	Starter shaft bushing in crankcase ..... diametric clearance	0.0005L	0.001T
	Rear plug in crankcase (AF only) ..... diametric clearance	0.001L	0.001T
7	Crankcase main bearing bore ..... diameter	2.437	2.438
8[1]	Crankcase rear and intermediate main bearing bore ..... diameter	2.5625	2.5635
9[1]	Crankcase front main bearing bore ..... diameter	2.437	2.438
10	Crankcase camshaft bearing bore ..... diameter	1.3745	1.3755
11	Fuel pump adapter pilot in crankcase ..... diametric clearance	0.001L	0.005L
12	Fuel pump body pilot in adapter ..... diametric clearance	0.0005L	0.0045L
13	Oil seal in adapter ..... diametric clearance	0.003T	0.009T
14	Fuel pump drive shaft in impeller shaft ..... diametric clearance	0.002L	0.008L
15	Fuel pump drive shaft in governor gear ..... tooth clearance	0.0015	0.0039
16	Crankcase (each half) ..... width	4.559	4.565
17	Crankshaft in thrust bearing ..... end clearance	0.008	0.018
18	Crankshaft in main bearing ..... diametric clearance	0.001L	0.004L
19	Crankpin ..... out of round	0.000	0.0005
20	Main journals ..... out of round	0.000	0.0005
21	Crankshaft main and thrust journals ..... diameter	2.2475	2.2485
22[1]	Crankshaft thrust journals ..... diameter	2.2475	2.2485
23[1]	Crankshaft rear and intermediate journals ..... diameter	2.373	2.374
24	Crankpin journals ..... diameter	1.936	1.937
25	Crankshaft run out at center main journals (shaft supported at thrust and rear journals) ..... full reading	0.000	0.015
	Taper over full crankshaft bearing length	0.000	0.0005
26[1]	Crankshaft run out at propeller flange (shaft supported at front and rear main journals) ..... full reading	0.000	0.005
27	Damper pin bushing in crankcheek ..... diametric clearance	0.0015T	0.003T
28	Damper pin bushing in counterweight ..... diametric clearance	0.001	0.0025
29	Damper pin		
	643626-109 ..... diameter	0.545	0.546
	643626-110 ..... diameter	0.498	0.499
	643626-111 ..... diameter	0.552	0.553

Table D-12. Crankcase, Crankshaft, Connecting Rods, Bearings and Camshaft Overhaul Dimension Limits

Index	Part	Dimensions (inches)	
		Minimum	Maximum
30	Damper pin ..... length	0.819	0.821
31	Damper pin ..... end clearance	0.011	0.037
32	Counterweight on crankcheek ..... side clearance	0.004	0.014
33	Crankshaft gear on crankshaft ..... diametric clearance	0.000	0.0025T
34	Connecting rod bearing and bushing twist or convergence per inch length	0.000	0.0005
35	Connecting rod beam section at narrowest point	0.630	0.660
36	Connecting rod bearing on crankpin ..... diametric clearance	0.0005L	0.003L
37	Connecting rod bolt in connecting rod ..... diametric clearance	0.0005L	0.0023L
38	Camshaft in crankcase ..... diametric clearance	0.001L	0.003L
39	Camshaft in crankcase ..... end clearance	0.005	0.009
40	Camshaft run out at center journals (shaft supported at end journal) ..... full reading	0.000	0.001[2]
41	Camshaft gear on camshaft ..... diametric clearance	0.0005T	0.0015L
42	Governor drive gear on camshaft ..... diametric clearance	0.0002L	0.002L
43	Crankshaft gear to camshaft gear ..... backlash	0.006	0.009
44	Governor drive gear to camshaft gear ..... backlash	0.004	0.008
45	Connecting rod on crank pin ..... side clearance	0.006	0.013
46	Crankcase width ..... deck to deck	9.118	9.130

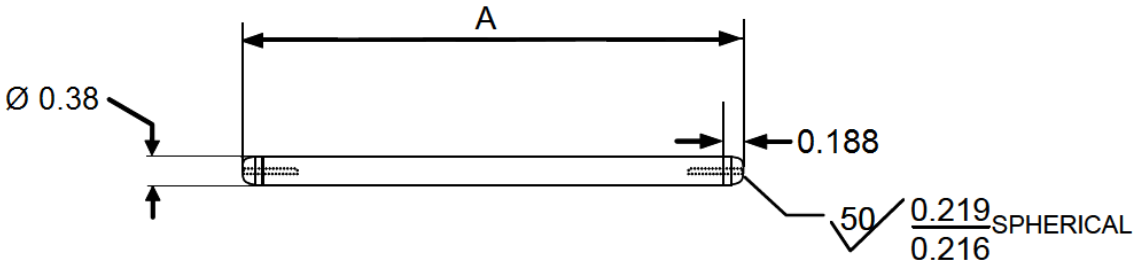
T= Tight L= Loose

1. These limits refer to the “B” (i.e IO-360-DB) configurations, IO-360-ES and IO-360-AF models.
2. Straightening of the camshaft is permissible if run out does not exceed 0.005 inch.

Table D-13. Crankcase, Crankshaft, Connecting Rods, Bearings and Camshaft Overhaul Dimension Limits
Not illustrated in Figure D-14

Part Name	Inspection Item	Dimensions (inches)	
		Minimum	Maximum
Connecting Rod	Bushing Bore Diameter	1.0620	1.0630
	Bushing Center to Crankpin Center	6.373	6.377
Bushing Bore	Diameter After Reaming	1.000	1.0005
Crankshaft Assembly	Damper Pin Bushing Inside Diameter	0.6062	0.6072
Camshaft	Journal Diameter	1.3725	1.3735
Hydraulic Lifters	Outside Diameter	0.9990	0.9995
Crankcase	Camshaft Bearings Diameter	1.3745	1.3755
	Lifter Guides Diameter	1.0005	1.0015
	Governor Driven Gear Bearing Diameter	0.875	0.876
	Starter Shaft Bearing Diameter (Except AF)	1.062	1.063
	Rear Plug Diameter (AF)	1.2505	1.2510

D-7.1. Push Rod Dimensions



"A" dimension	Min	Max
Standard	12.366	12.396
P030 Oversize	12.396	12.426

Figure D-15. Push Rod Dimensions

D-7.2. Crankshaft Counterweight Assemblies

Refer to **Figure D-16** for crankshaft counterweight dimensions.

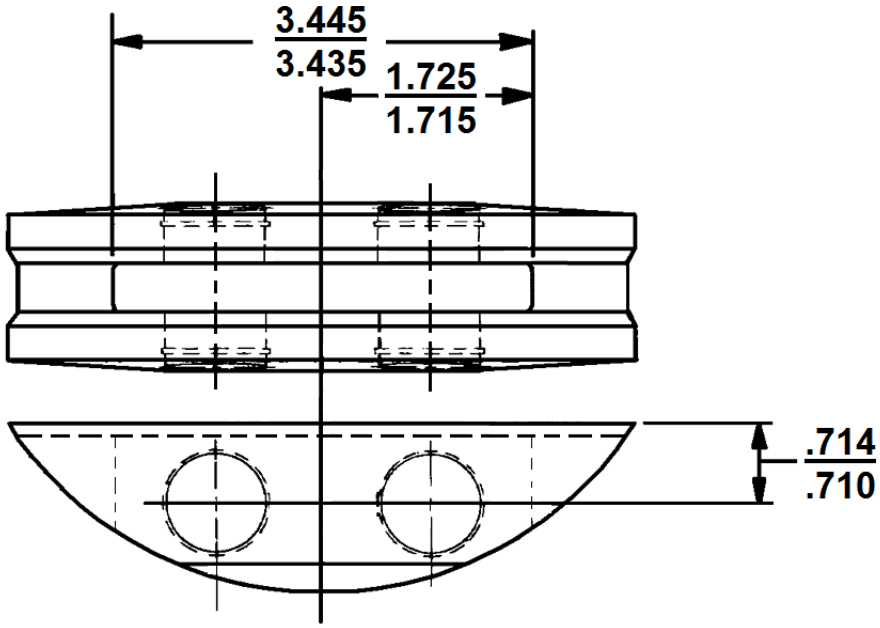


Figure D-16. Counterweight Assembly

D-7.3. Crankshaft Hanger Blade and Counterweight Bushing Dimensions

Refer to **Table D-14** and **Figure D-17** and **Figure D-18** for crankshaft counterweight bushing and hanger blade bushing dimensions.

Table D-14. Crankshaft Counterweight Blade Bushing Dimensions

Index	Description	Dimensions (inches)	
		Minimum	Maximum
A	Counterweight bushing bore (standard)..... inside diameter:	1.003	1.005
	Counterweight bushing bore (A.O.) ..... inside diameter:	1.063	1.065
B	Counterweight bushing (installed)..... diameter:	0.606	0.607
C	Crankshaft hanger blade bushing bore.....inside diameter:	0.815	0.816
D	Crankshaft hanger blade bushing .....inside diameter:	0.604	0.607

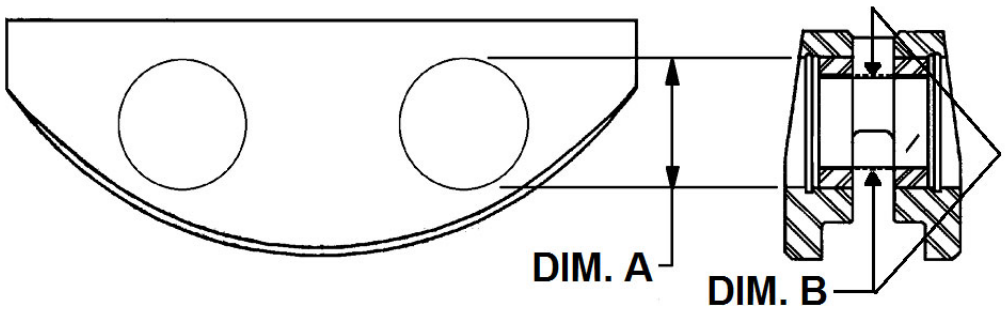


Figure D-17. Crankshaft Counterweight Bushing Bore Dimensions

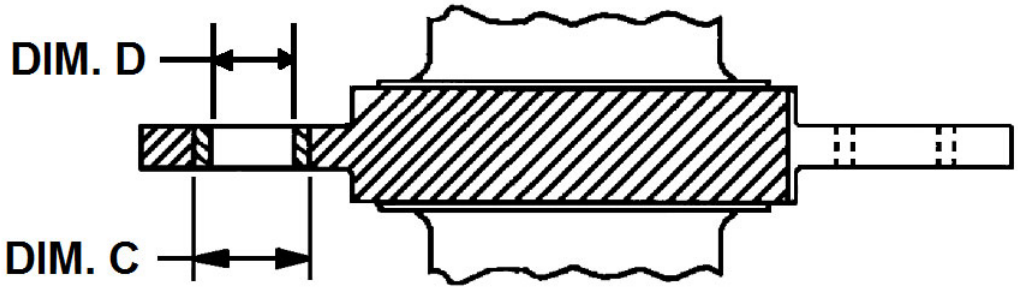


Figure D-18. Crankshaft Hanger Blade Bushing Dimensions

D-7.4. Connecting Rod Dimensions

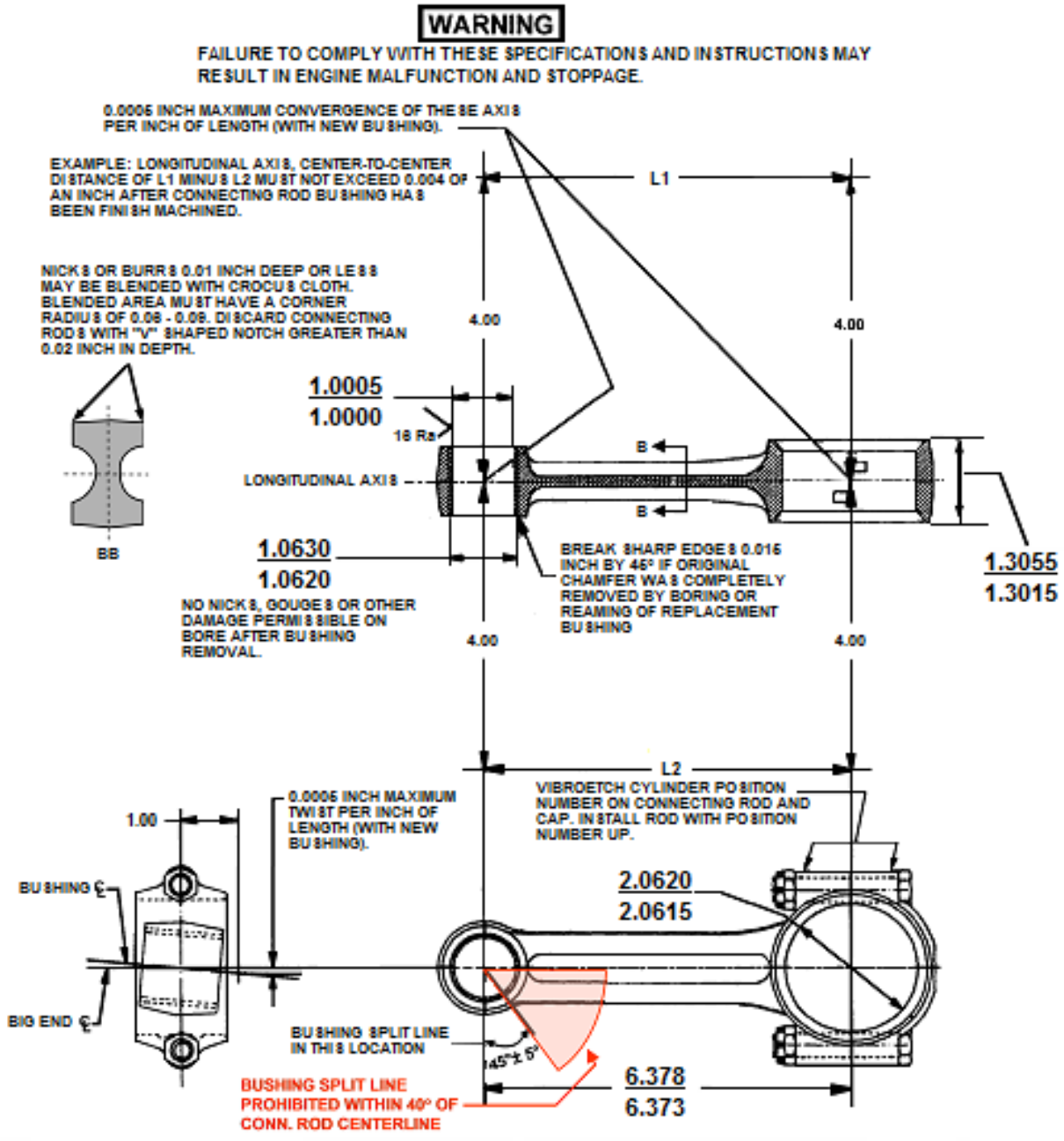


Figure D-19. Connecting Rod Dimensions

D-8. Stud Height Settings

D-8.1. Starter Adapter Stud Height Settings

Refer to **Figure D-20** and **Table D-15** depict stud height settings for the basic starter adapter and also units with basic accessory drive adapter. Stud heights for the starter adapter with accessory drive adapter IO-360-ES2, ES12, ES20, ES26 and ES28 are in **Figure D-21** and **Table D-16**. Index numbers in the tables match the numbers in the accompanying illustrations.

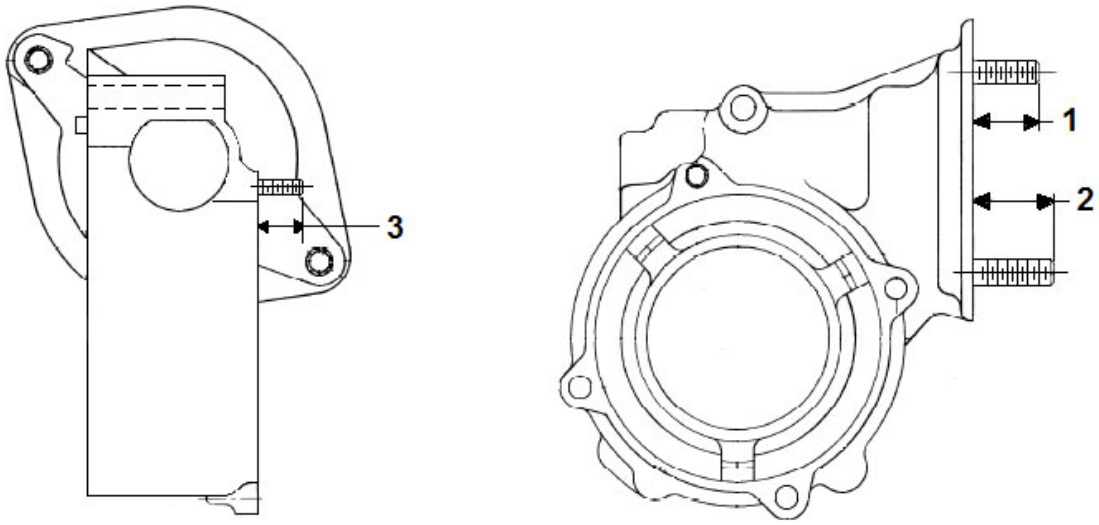


Figure D-20. Basic Starter Adapter with Basic Accessory Drive Adapter Studs

Table D-15. Basic Starter Adapter Stud Heights

Index	Location	Thread Size	Stud Height (inches)	Quantity
1	Stud, Starter Adapter to Starter	0.38-16 X 0.38-24	1.00	1
2	Stud, Starter Adapter to Starter	0.38-16 X 0.38-24	1.22	1
3	Stud, Starter Adapter to Cover/Drive	0.31-18 X 0.31-24	0.78	1

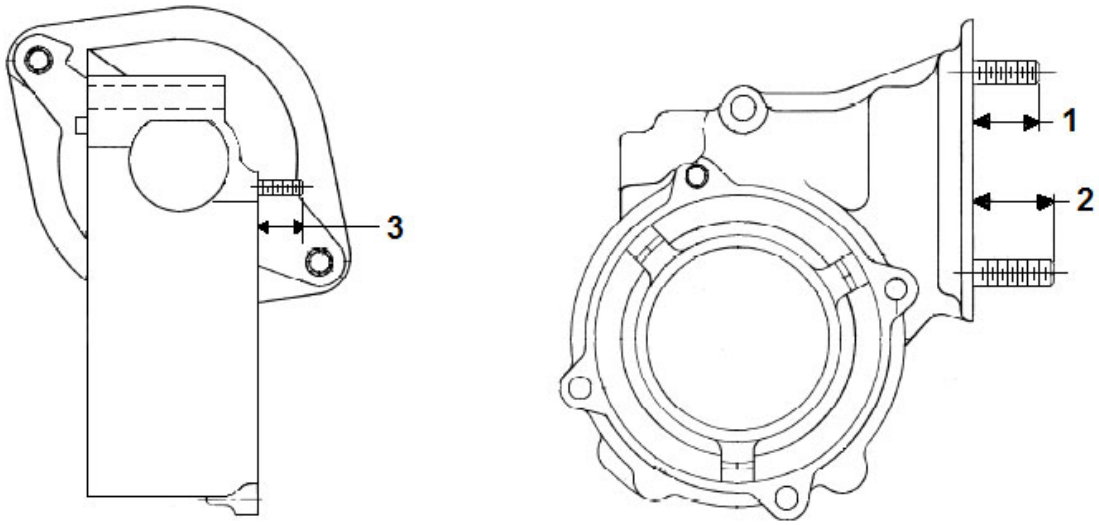


Figure D-21. Starter Adapter with Accessory Drive Studs IO-360-ES2, ES12, ES20, ES26 and ES28

Table D-16. Starter Adapter with Accessory Drive Stud Heights IO-360-ES2, ES12, ES20, ES26 and ES28

Index	Location	Thread Size	Stud Height (inches)	Quantity
1	Stud, Starter Adapter to Starter	0.38-16 X 0.38-24	1.00	1
2	Stud, Starter Adapter to Starter	0.38-16 X 0.38-24	1.22	1
3	Stud, Starter Adapter to Accessory Drive	0.31-18 X 0.31-24	1.35	1

D-8.2. Accessory Drive Adapter and Vacuum Pump Cover Stud Height Settings

Refer to **Figure D-22** and **Table D-17** depict stud height settings for the starter adapter vacuum pump cover. Stud heights for the basic accessory drive adapter are in **Figure D-23** and **Table D-18**. Stud heights for the accessory drive adapter IO-360-ES2, ES12, ES20, ES26 and ES28 are in **Figure D-24** and **Table D-19**. Index numbers in the tables match the numbers in the accompanying illustrations.

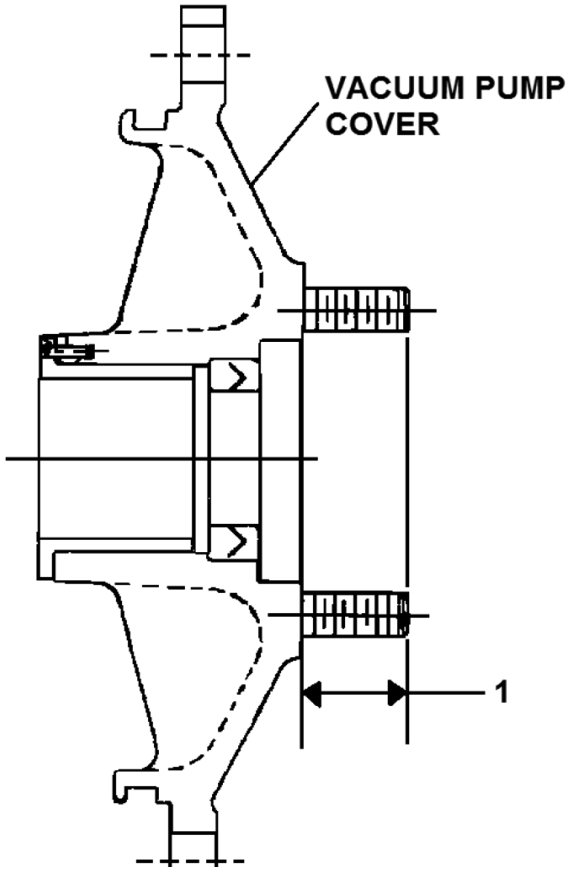


Figure D-22. Vacuum Pump Cover Studs

Table D-17. Vacuum Pump Cover Stud Heights

Index	Location	Thread Size	Stud Height (inches)	Quantity
1	Stud, Vacuum Pump Cover Pad	0.25-20 X 0.25-28	0.62	4

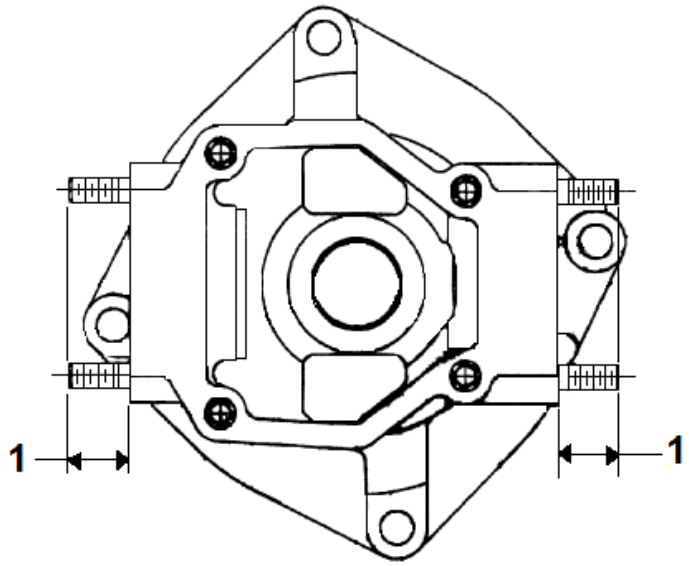


Figure D-23. Basic Accessory Drive Adapter Studs

Table D-18. Basic Accessory Drive Adapter Stud Heights

Index	Location	Thread Size	Stud Height (inches)	Quantity
1	Stud, Accessory Drive Adapter Cover Pad	0.25-20 X 0.25-28	0.62	8

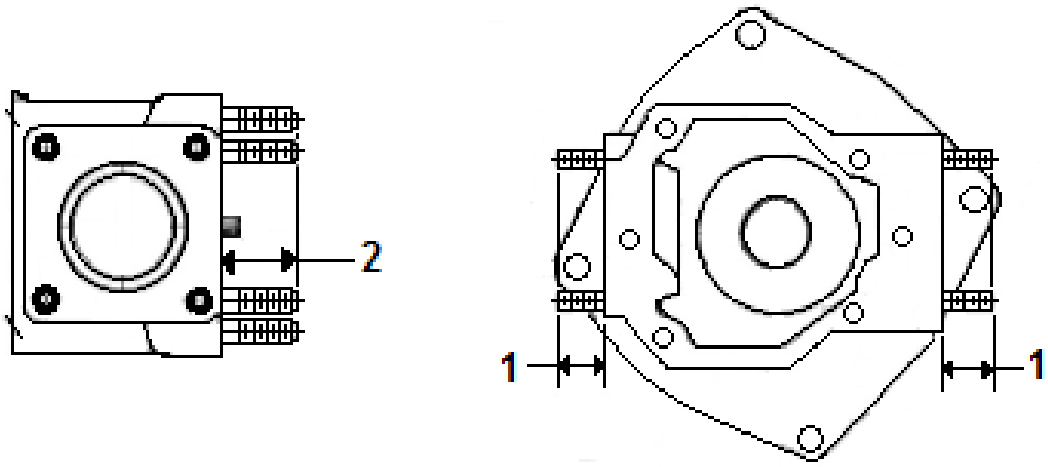


Figure D-24. Accessory Drive Adapter Studs IO-360-ES2, ES12, ES20, ES26 and ES28

Table D-19. Accessory Drive Adapter Stud Heights IO-360-ES2, ES12, ES20, ES26 and ES28

Index	Location	Thread Size	Stud Height (inches)	Quantity
1	Stud, Accessory Drive Adapter Cover Pad	0.25-20 X 0.25-28	0.62	8
2	Stud, Accessory Drive Adapter Cover Pad	0.25-20 X 0.25-28	1.25	4

D-8.3. Lubrication and Accessory Case Stud Height Settings

Refer to **Figure D-25** and **Table D-20** depict stud height settings for the oil pump cover/ tach drive adapter. Stud heights for the alternator pad are in **Figure D-26** and **Table D-21**. Stud heights for the magneto pads are in **Figure D-27** and **Table D-22**. Stud heights for the oil filter adapter are in **Figure D-28** and **Table D-23**. Index numbers in the tables match the numbers in the accompanying illustrations.

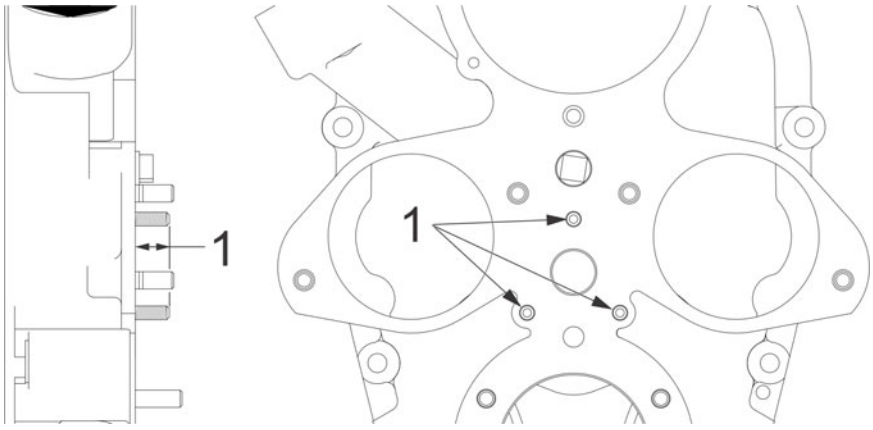


Figure D-25. Oil Pump Cover/Tach Drive Adapter Studs

Table D-20. Oil Pump Cover/Tach Drive Adapter Stud Heights

Index	Location	Thread Size	Stud Height (inches)	Quantity
1	Stud, Oil Pump Cover/Tach Drive Adapter	0.25-20 X 0.25-28	0.62	3

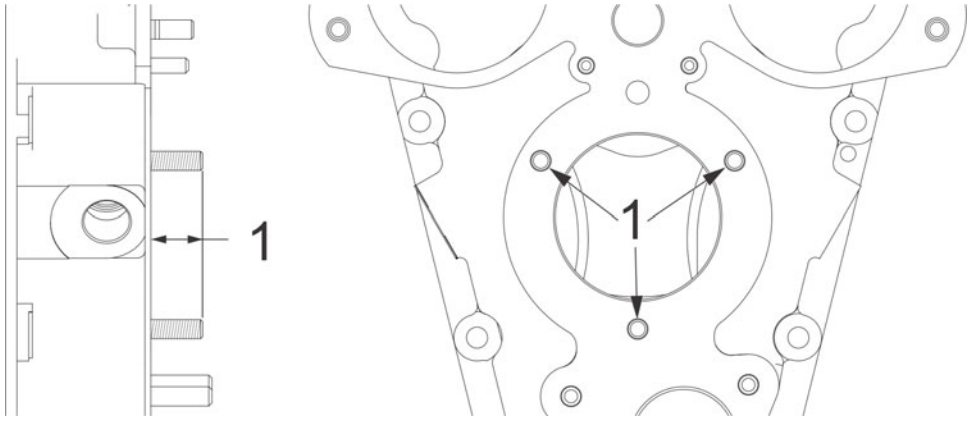


Figure D-26. Alternator Pad Studs

Table D-21. Alternator Pad Stud Heights

Index	Location	Thread Size	Stud Height (inches)	Quantity
1	Stud, Alternator Pad	0.31-18 X 0.31-24	0.85	3

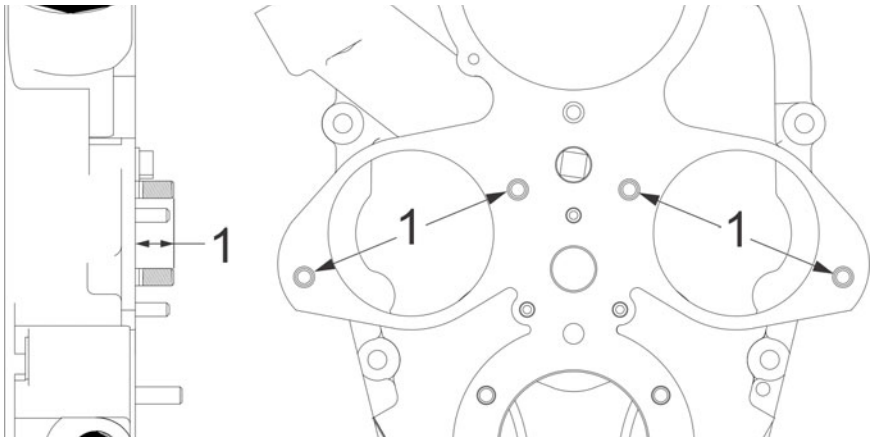


Figure D-27. Magneto Pad Studs

Table D-22. Magneto Pad Stud Heights

Index	Location	Thread Size	Stud Height (inches)	Quantity
1	Stud, Magneto Pad	0.31-18 X 0.31-24	0.70	4



Figure D-28. Oil Filter Adapter Studs

Table D-23. Oil Filter Adapter Stud Heights

Index	Location	Thread Size	Stud Height (inches)	Quantity
1	Stud, Oil Filter Adapter	0.31-18 X 0.31-24	1.00	3

D-8.4. Cylinder Stud Height Settings

Figure D-29 and **Table D-24** show cylinder head stud height settings. Check stud alignment using a tool maker's square. Index numbers in the table match the numbers in the accompanying illustration

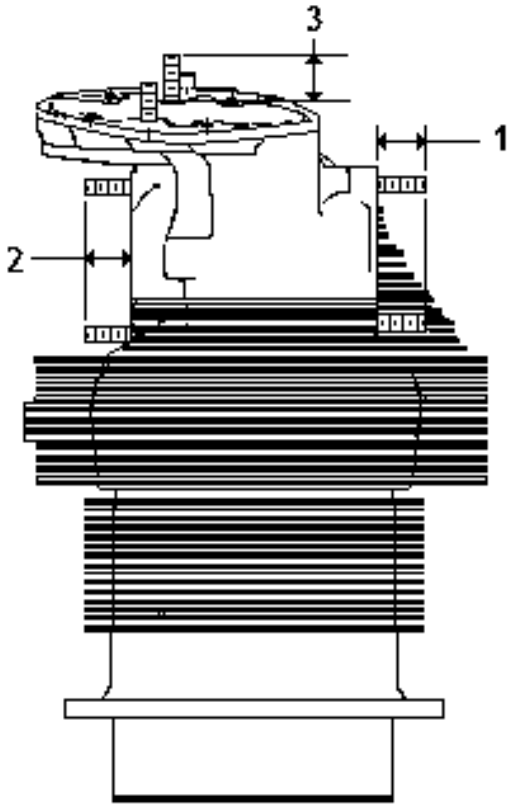


Figure D-29. Cylinder Studs

Table D-24. Cylinder Stud Heights

Index	Location	Thread Size	Stud Height (inches)	Quantity
1	Stud, Intake Flange	0.31-18 X 0.31-24	0.805-0.835	2
2	Stud, Exhaust Flange	0.31-18 X 0.31-24	0.805-0.835	2
3	Stud, Rocker Shaft	0.25-20 X 0.25-24	0.75-0.81	4

D-8.5. Crankcase Plugs and Bushing

Refer to **Figure D-30** and **Table D-25** to locate the plugs/elbows and bushing that need to be removed to allow pressure flushing of the crankcase. Tag the removed plugs/elbows and bushing for re-installation reference. Index numbers in the table match the numbers in the accompanying illustration.

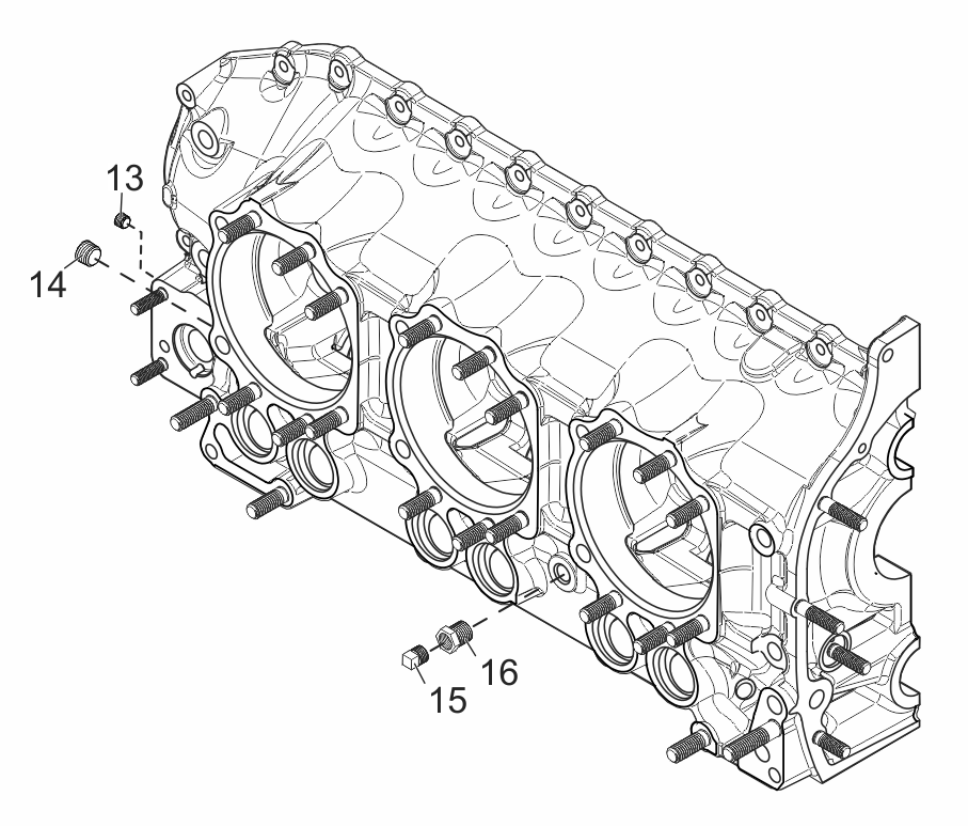


Figure D-30. Crankcase Plugs and Bushing

Table D-25. Crankcase Plugs and Bushing

Plug (13)
Plug (14)
Plug or Elbow(15)
Bushing (16)

D-8.6. Crankcase Stud Height Settings

Refer to **Figure D-31, Figure D-32** and **Table D-26** depict stud height settings for the crankcase. Index numbers in the table match the numbers in the accompanying illustrations.

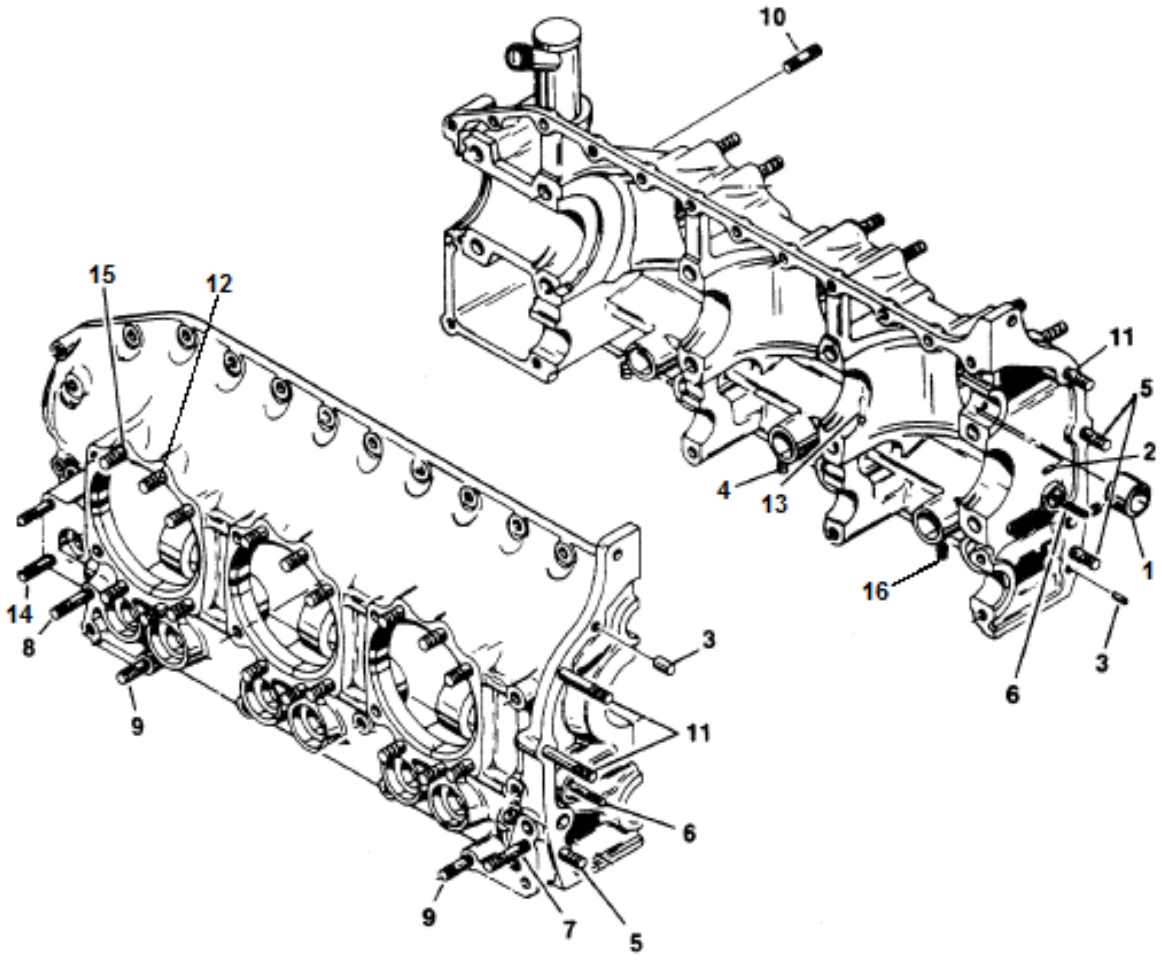


Figure D-31. Crankcase Studs (1 of 2)

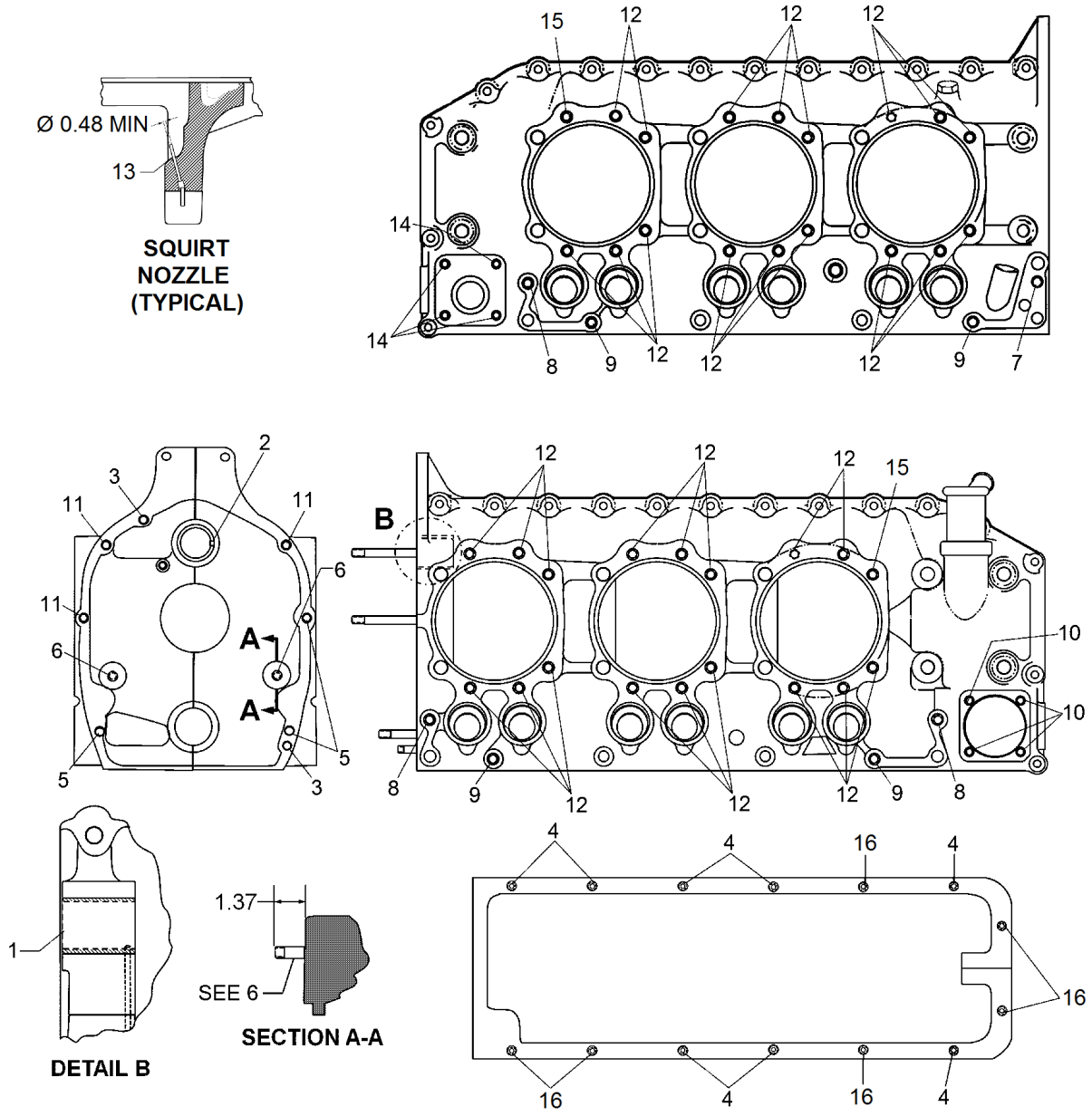


Figure D-32. Crankcase Studs (2 of 2)

Table D-26. Crankcase Stud Heights

Index	Location	Thread Size	Setting Height (inches)	Quantity
1	Bushing, Starter	----------	----------	1
2	Dowel, Starter Bushing or Plug (AF)	0.25 X 0.40	0.05-0.07	1
3	Dowel, Crankcase Cover Pad	0.25 X 0.56	0.31	2
4	Stud, Oil Sump Pad	0.25-20 X 0.25-28	0.75	8
5	Stud, Crankcase Cover Pad	0.31-18 X 0.31-24	0.84	3
6	Stud, Magneto Gear	0.31-18 X 0.31-24	1.37	2
7	Stud, Oil Cooler Adapter	0.38-16 X 0.38-24	1.50 (1.69 AF and ES)	1
8	Stud, Engine Mount Pad	0.38-16 X 0.38-24	1.50 (1.69 AF and ES)	3
9	Stud, Engine Mount Pad	0.38-16 X 0.38-24	1.19 (1.00 CB, DB, GB, HB, JB and KB)	4
10	Stud, Fuel Pump Pad	0.31-18 X 0.31-24	0.75	4
11	Stud, Crankcase Cover Pad	0.31-18 X 0.31-24	2.00	3
12	Stud, Cylinder Mount Pad	0.38-16 X 0.38-24	0.78	34
13	Squirt Nozzle	----------	*Not field replaceable*	6
14	Stud, Governor Mount Pad	0.31-18 X 0.31-24	1.38	4
15	Stud, Cylinder Mount Pad	0.38-16 X 0.38-24	0.78 (0.90 DB22B and DB36B)	2
16	Stud, Oil Sump Pad	0.25-20 X 0.25-28	0.75 (1.19 AF)	6

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