MAINTENANCE MANUAL

TSIO-360-RB

PART NO. X30645A

FAA APPROVED
OCTOBER 1996

DEFINITIONS OF NOTES, CAUTIONS and WARNINGS

NOTES, *CAUTIONS* and **WARNINGS** are defined for the use in this manual as follows:

NOTE . . . Special interest information which may facilitate performance of a procedure or operation of equipment.

CAUTION . . . Used to emphasize certain information or instructions which if disregarded may result in damage to engine or accessories.

WARNING

Used to provide warning with respect to information and/or instructions which if disregarded will endanger personnel and/or severely damage the engine resulting in subsequent engine malfunction or failure.

Notes, cautions and warnings do not impose undue restrictions. They are inserted to obtain maximum safety, efficiency and performance. Abuse, misuse or neglect of equipment can cause eventual engine malfunction or failure.

CFC WARNING STATEMENT

The United States Environmental Protection Agency (EPA) has adopted regulations under the Clean Air Act which require warning statements accompany all products "manufactured with" or which contain a Class 1 ozone depleting substance as defined in EPA regulation 58, Federal Regulation 8136, February 11, 1993. Teledyne Continental Motors is pursuing alternatives to these substances to eliminate their use as soon as possible.

WARNING: Manufactured with 1,1,1 trichloroethane and /or CFC-113, substances which harm public health and the environment by destroying ozone in the upper atmosphere.

This warning applies to all Teledyne Continental Motors fuel injection assemblies, manifold valve assemblies, regulator assemblies, magneto assemblies, starter adapters, oil pumps, oil coolers, accessory cases, crankcases, cylinder and valve assemblies, cylinder kits, bearings, turbochargers, turbocharger bearings and thrust collars, tubes, hoses, and exhaust systems and components.

WARNING: Manufactured with 1,1,1 trichloroethane, CFC-12 and /or CFC-113, substances which harm public health and the environment by destroying ozone in the upper atmosphere.

This warning applies to all Teledyne Continental Motors new and rebuilt engines.

CURRENT STATUS OF PAGES AS OF

OCTOBER 1996

See "Manual Revisions," in the introduction section for distribution procedure.

THE ORIGINAL DATE OF THIS PUBLICATION IS OCTOBER 1996. INSERT LATEST PAGES; DESTROY SUPERSEDED PAGES.

WARNING

If the user of this manual is uncertain whether all current revisions have been incorporated into the manual, contact Teledyne Continental Motors. Do not perform any operation, maintenance, installation or other operation until the manual is confirmed current.

MODEL: TSIO-360-MB & -SB **FORM X30645A**

PAGE	STATUS	PAGE	STATUS	PAGE	STATUS	PAGE	STATUS
ALL	ORIGINAL						

WARNING

BACKGROUND. Replacement parts, materials and accessories may be sold as being of aircraft quality when actually the quality and origin of these units are unknown. Users of such units are usually unaware of potential hazards involved with replacement parts not eligible for use on certificated aircraft. Units may be deceptively advertised as "unused," "like new" or "remanufactured." This implies the quality of such units is equal to an original, repaired or overhauled unit.

Federal Aviation Regulations (FAR) 43.13 and FAR 145.57 specify performance rules for replacement of parts and materials used in maintenance and alteration of United States (US) certificated aircraft. As outlined in FAR 91.403, FAR 121.363, FAR 123.45, and FAR 135.143 (a), the **owner/operator** is responsible for continued airworthiness of the aircraft which includes parts replacement.

IDENTIFICATION OF THE APPROVED PARTS. Approved serviceable replacement parts are identified by:

a. A Federal Aviation Administration (FAA) Form 8130-3 Airworthiness Approval Tag. An Airworthiness Approval Tag identifies a part or group of parts approved by authorized FAA representatives.

b. An FAA Technical Standard Order (TSO) number and identification mark that indicates the part or appliance has been manufactured under the requirements of FAR 21 Subpart O.

c. An FAA Parts Manufacturer Approval (PMA) symbol, together with the manufacturer's name, part number and make and model of the type certified product on which the part might be installed, stamped on the part. An FAA / PMA is issued under FAR 21.305. The make and model information may be on a tag attached to the part.

d. Shipping ticket, invoice or other document which verifies the part was manufactured by a facility holding an FAA Approved Production Inspection System issued under FAR 21 Subpart F or by a manufacturer holding an FAA Production Certificate issued under FAR 21 Subpart G.

e. Certificate of airworthiness for export issued by a foreign government under the provisions of FAR 21 Subpart N.

KNOW YOUR SUPPLIER. Many reproduced parts and components are available for purchase and installation on US certified aircraft. Often, an original part is used as a sample to produce duplicates. The reproduced parts appear to be as good as the original part; however, many unknown factors are not readily apparent to the purchaser such as degree of heat treating, plating, inspections, tests and calibrations. Often the faulty part is not discovered until a malfunction or an accident occurs.

SUMMARY. In accordance with FAR certification of materials, parts and appliances for return to service for use on aircraft is the responsibility of the person\agency who signs the approval. The **owner/operator** is responsible for the continued airworthiness of the aircraft. To assure continued safety in aircraft operation, great care must be used when inspecting, testing and determining the acceptability of all parts and materials. Exercise extreme discretion to identify and establish the origin of materials, parts, and accessories.

NOTICE TO ALL USERS

This manual does not contain maintenance or installation information for supplemental type certificated components or systems. This manual contains information on engines, components and systems designed, tested and certified by TCM in accordance with the pertinent type design data.

The following publication contains information applicable to each engine maintenance requirement. It is important all personnel involved with these functions thoroughly read and understand the information provided; these instructions inform of the procedures necessary to maintain continued airworthiness and they must be followed carefully.

Prior to performing maintenance, the mechanic must meet requirements of FAR 65 and must follow FAR Parts 43, 91 and 145 as applicable. Use this manual in conjunction with Teledyne Continental Motors (TCM) service documents, related publications, accessory manufacturer's instructions, FAR and FAA Advisory Circulars.

This manual contains no warranties, either expressed or implied.

Publication Format

This publication is formatted for practical use and ease of reference. Chapter and page numbering are independent so that revisions can be made without affecting the entire publication. Due to the large volume of information necessary for maintenance, maintenance chapters are independently numbered. For example, chapter 1 begins on page 1; chapter 2 begins again with page 1, etc. To locate information easily, use the Publication Table of Contents and the Chapter Contents provided at each division.

WARNING

This manual, the Service Documents, the Overhaul Manual and the Parts Catalog constitute the instructions for Continued Airworthiness prepared by TCM as approved by the FAA, pursuant to FAR Part 33. As required by FAR § 43.13, each person performing maintenance, alteration or preventive maintenance on the engine or accessories must use the methods, techniques and practices prescribed in the Instructions for Continued Airworthiness. Failure to comply with the Instructions for Continued Airworthiness may result in engine malfunction, engine failure, injury or death.

Publication Table of Contents

NOTE ... Contents of each chapter are listed in chapter "Chapter Contents" before each division.

Chapter Index

CHAPTER 1

1-1 SCOPE

This publication contains information on maintenance and installation of Teledyne Continental Motors (TCM) L/TSIO-360-RB

1-2 RELATED PUBLICATIONS

The following are related engine and accessory manuals.

1. Overhaul Manual for L/TSIO-360-RB Series Aircraft engine, Form X30596A Supplement No.
2. Illustrated Parts Catalog for L/TSIO-360-RB Series Aircraft Engine, Form XX30597A. Supplement No. 1
3. Operators and Installation Manual for L/TSIO-360-RB Series Aircraft Engine, Form X30644.
4. Teledyne Continental Motors Aircraft Engine Service Documents (including service bulletins).
5. Fuel Injection Manual, Form 30593A.
6. Starter Service Instructions, Form X30592.
7. TCM Ignition Systems Master Service Manual, Form No. X40000.
8. Alternator Maintenance and Parts Catalog, Form No. X30631A.

   The above publications can be ordered through your Teledyne Continental Motors Distributor or ordered directly, if prepaid, from:

   Teledyne Continental Motors

   P.O. Box 90

   Mobile, Alabama 36601

   ATTN: Publications Sales Department

   Telephone: (334) 438-3411

   For price information on the above publications see TCM Publications Index Form X--94, Current Publications and Form X-3-94, Optional Publications.

9. Slick Ignition Systems Master Service Manual Form No. F-1100.

   Order through:

   Slick Aircraft Products
   Unison Industries
   530 Blackhawk Park Avenue
   Rockford, Illinois 61104
   ATTN: Subscription Department
   Telephone: (815) 965-4700

1-3 MANUAL REVISIONS

Revisions to this manual will be furnished to purchasers who complete and return the registration post card in the front of this manual.

Page iii, "Current Status of Pages," is updated at each revision. Remove and discard the old page iii. Insert the new page iii as a record of which revisions have been incorporated into the manual.

WARNING

If the user of this manual is uncertain whether all current revisions have been incorporated into the manual, contact TCM. Do not perform any operation, maintenance, installation or other operations until the manual has been confirmed to be current.

1-4 SERVICE DOCUMENTS

TCM service documents include categories for: Mandatory Service Bulletins, Critical Service Bulletins, Service Bulletins, Service Information Directives, Service Information Letters and Special Service Notices.

Category Definitions:

CATEGORY 1: MANDATORY SERVICE BULLETIN (MSB) - Service documents relating to known or suspected hazards to safety that have been incorporated in whole or in part in an Airworthiness Directive (AD) issued by the FAA or have been issued, at the direction of FAA, by the manufacturer to require compliance with an already issued AD or an equivalent issued by another country's airworthiness authority.

CATEGORY 2: CRITICAL SERVICE BULLETIN (CSB) - Service documents determined by the product manufacturer to constitute a threat to continued safe operation of an aircraft or to persons or property on the ground unless some specific action (inspection, repair, replacement, etc..) is taken by the product owner or operator. Documents in this category may be candidates for incorporation in an Airworthiness Directive issued by the FAA.

CATEGORY 3: SERVICE BULLETIN (SB) - Service documents considered by the product manufacturer to constitute a substantial improvement to the inherent safety of an aircraft or component of an aircraft.

CATEGORY 4: SERVICE INFORMATION DIRECTIVE (SID) - Service documents determined by the manufacturer to enhance safety, maintenance or economy.

CATEGORY 5: SERVICE INFORMATION LETTER (SIL) - This category provides general information that may be useful to the owner/operator or aircraft maintenance technician (AMT).

SPECIAL SERVICE NOTICE (SSN) - TCM may issue a Special Service Notice when a product condition can be rectified by direct contact with each customer to whom the product was delivered. Special service notices will be upgraded to Service Bulletins if confirmation of compliance with the Special Service Notice cannot be verified by TCM.

SERVICE REPORTS AND INQUIRIES. If you have an inquiry or require technical assistance, contact a TCM distributor, field representative or customer service.

1-5 DESCRIPTION OF ENGINE MODEL CODE

Example code: L/TSIO-360-RB (1)

L	TS	I	O	360	RB	1
Left hand rotation	Turbo super charged	Fuel injection	Horizontally opposed	Displacement (360 cubic inch)	model	specification number

1-6 DEFINITION OF TERMS

Front, rear, left and right refer to the engine view facing the accessory end. The accessory end is referred to as the rear and propeller flange the front of the engine. Cylinders are numbered starting from the rear with odd numbers on the right and even numbers on the left.

1-7 ENGINE DESIGN FEATURES

The L//TSIO-360-RB series The L//TSIO-360-RB series engines are air cooled, having six horizontally opposed overhead inclined valve cylinders. The cylinder displacement of 360 cubic inches is achieved with a 4.4 inch bore and a 3.875 inch stroke. The L/TSIO-360-RB series engines are fuel injected. The crankshaft is equipped with pendulum type counterweight dampers that suppress torsional vibrations.

The L/TSIO-360-RB series engine have a doweled six bolt hole configuration propeller flange. A mounting pad is provided to utilize a hydraulic controlled governor for a constant speed propeller.

The L/TSIO-360-RB series engines are designed with a wet sump and a positive displacement oil pump. When properly adjusted under normal operating conditions, the desired oil pressure is maintained by a pressure relief valve. Engine cranking is accomplished by a geared right angle drive starter adapter and a direct current starter motor.

The L/TSIO-360-RB series incorporate provisions for a belt driven alternator installed on the from 1-3-5 side of the crankcase. The engine is equipped with two gear driven magnetos mounted on the accessory case. The exhaust and turbocharging system is supplied with the engine.

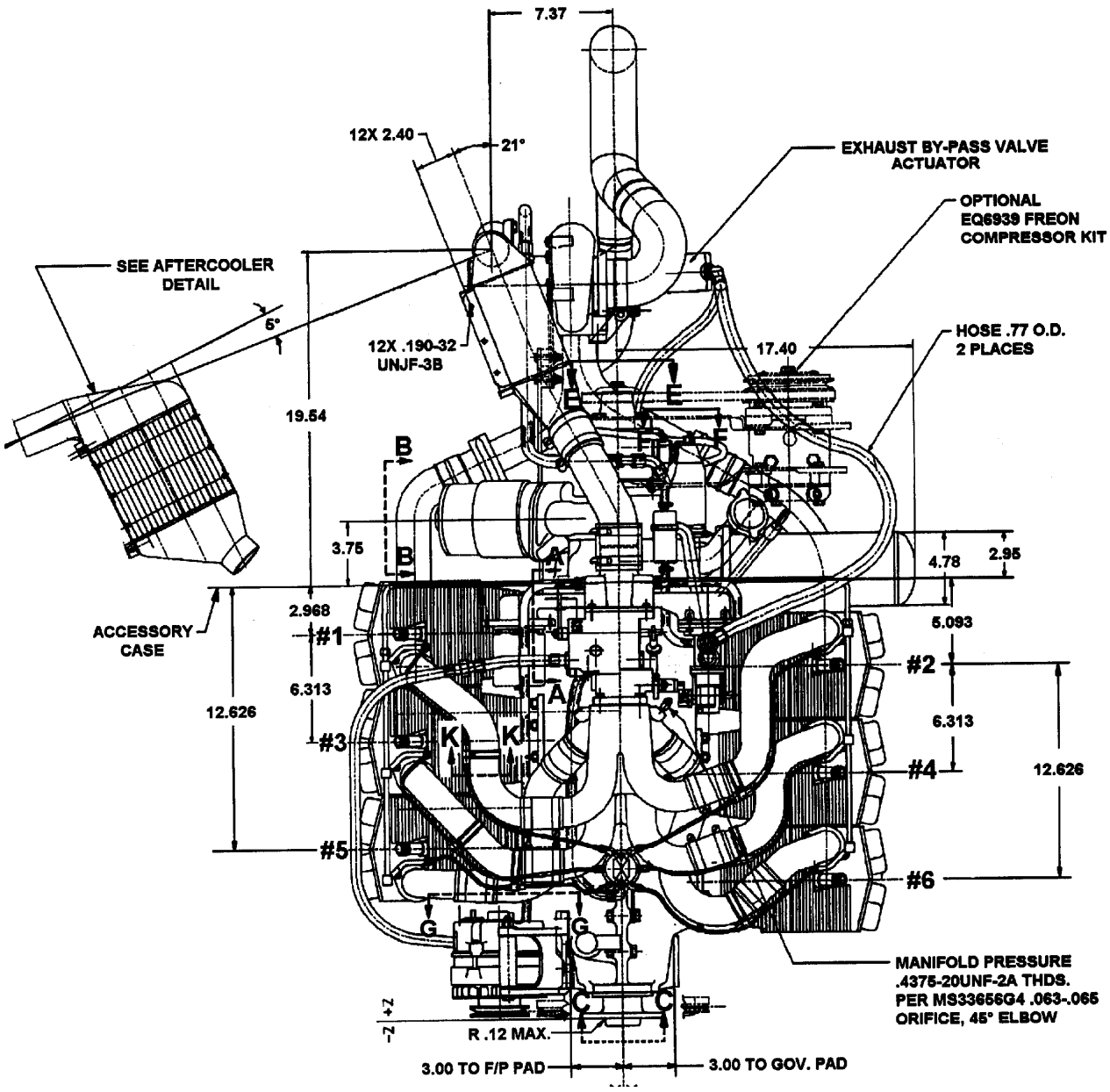

FIGURE 1-1. Engine Description L/TSIO-360-RB

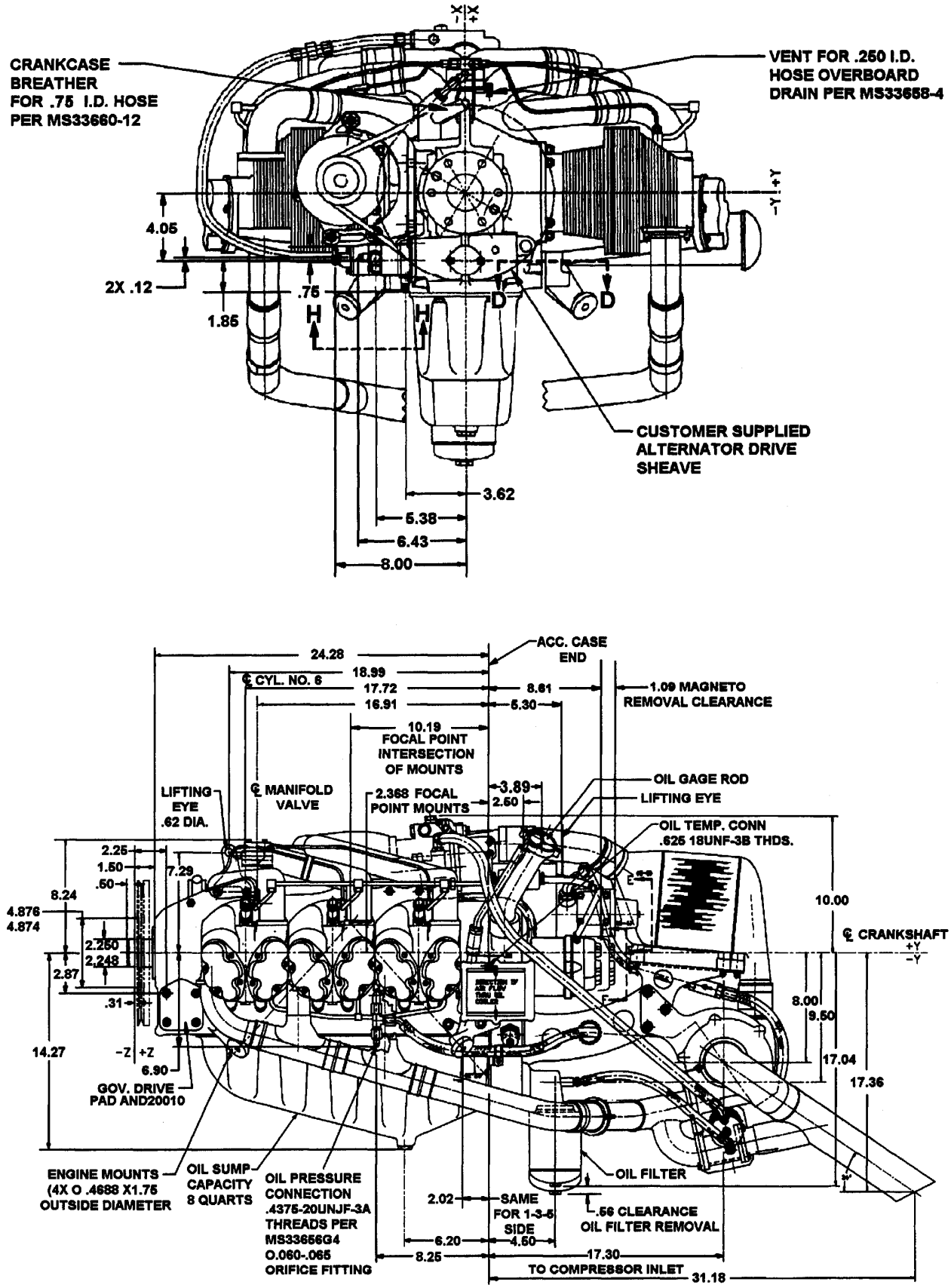

FIGURE 1-2. ENGINE DESCRIPTION L/TSIO 360-RB (Cont'd)

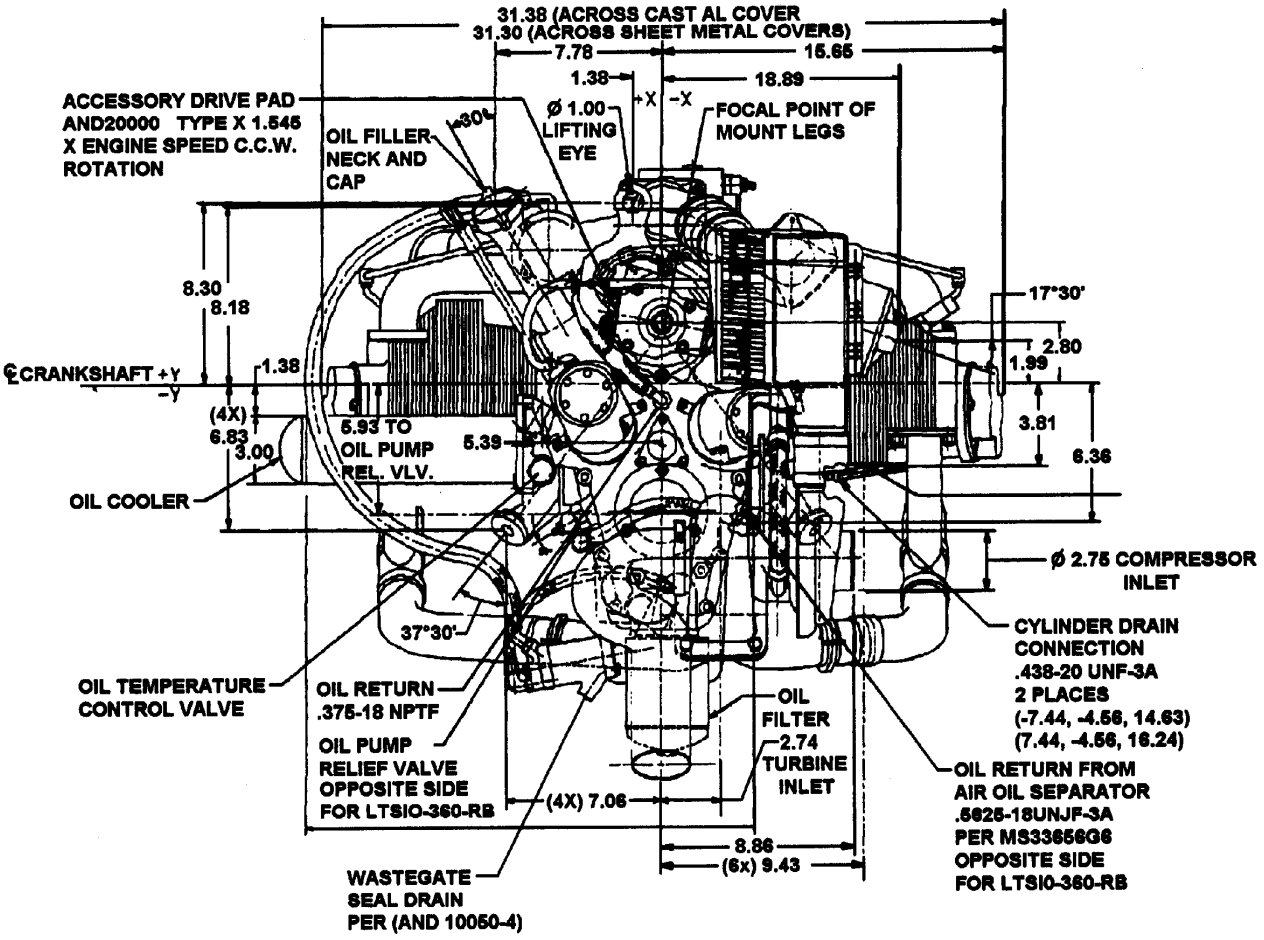

FIGURE 1-2. ENGINE DESCRIPTION L/TSIO 360-RB (Cont'd)

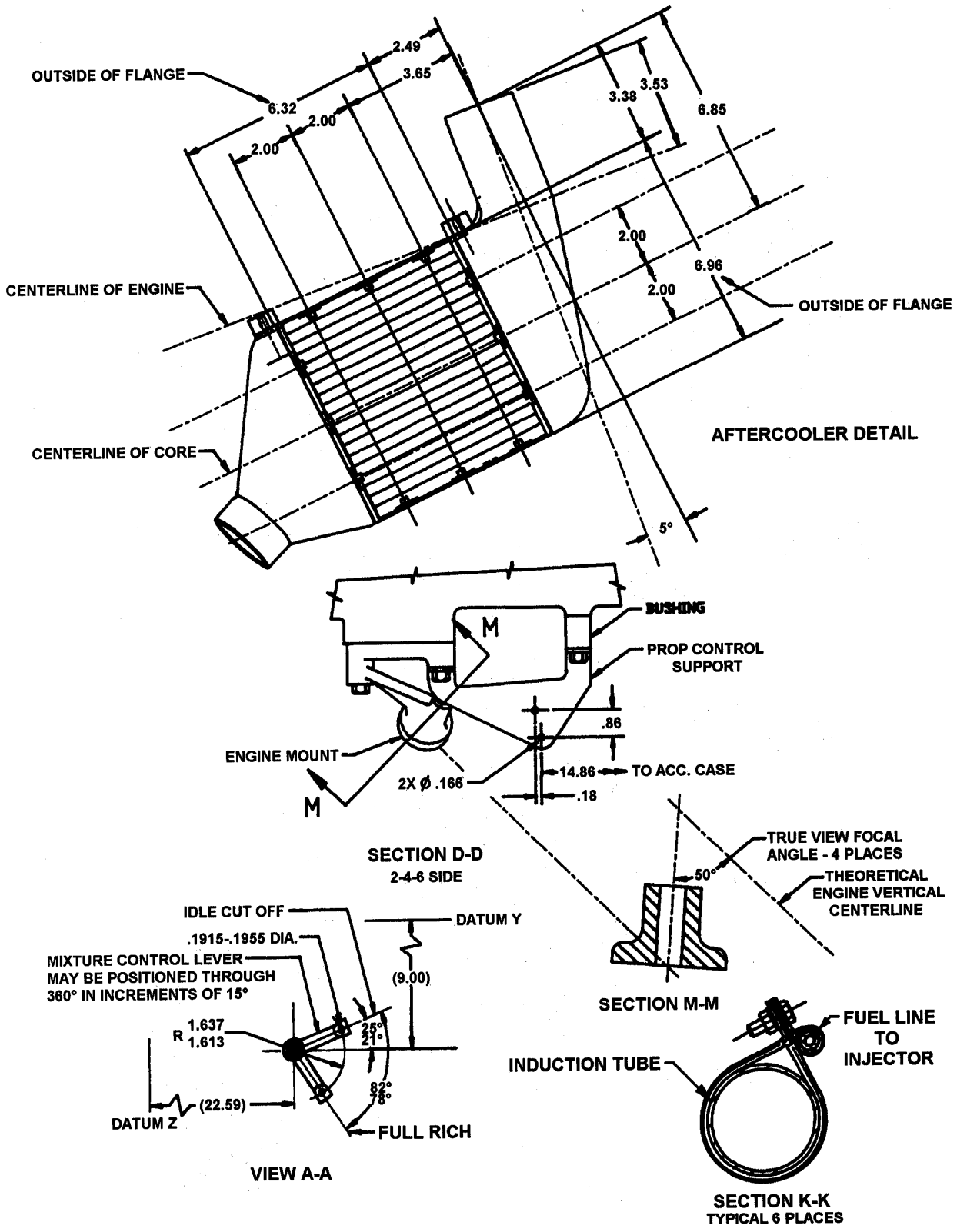

FIGURE 1-2. ENGINE DESCRIPTION L/TSIO 360-RB (Cont'd)

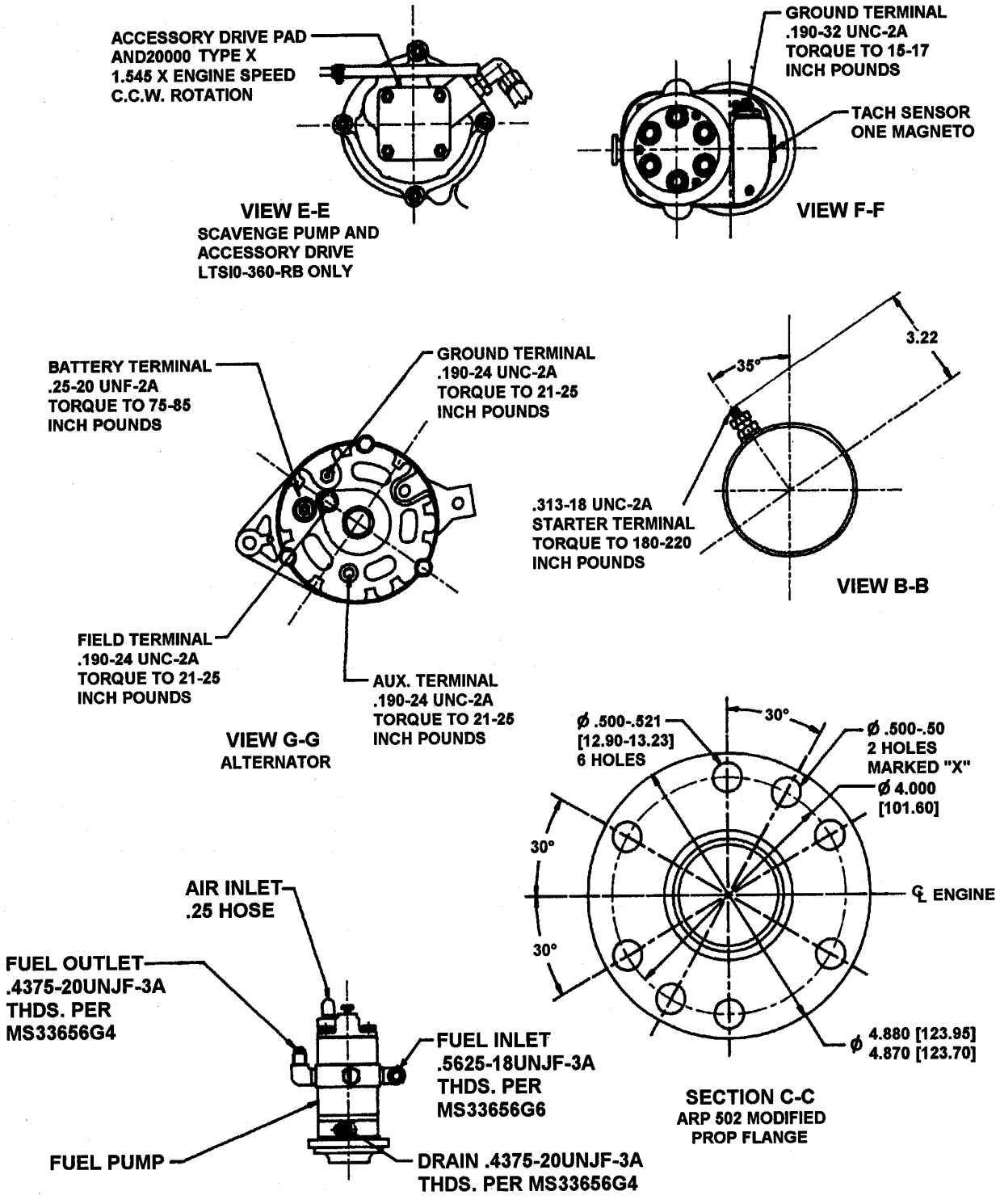

FIGURE 1-2. ENGINE DESCRIPTION L/TSIO 360-RB (Cont'd)

1-8 GENERAL

The operating limits and specifications listed in this section are applicable to the L/TSIO-360-RB series aircraft engines. Consult the L/TSIO-360-RB Operator & Installation Manual, Form X30644 for additional operating procedures.

For time between overhaul (TBO) for L/TSIO-360-RB series engines see section 5-2 and the latest TBO Service Bulletin (Overhaul Periods For All Teledyne Continental Aircraft Engines). Accessories supplied with engine by TCM have the same TBO; with criteria for service and longevity outlined in current TCM TBO Service Bulletins, unless otherwise specified.

1-9 ENGINE SPECIFICATIONS

Manufacturer Teledyne Continental Motors

Model L/TSIO-360-RB.

Cylinders

Arrangement ..... Individual cylinders in a horizontally opposed position
Compression Ratio 7.5:1
Firing Order (TSIO-360-RB) 1-6-3-2-5-4
Firing Order (LTSIO-360-RB) 1-4-5-2-3-6
Number of cylinders 6
Bore (Inches) 4.438
Stroke (Inches) 3.875
Piston Displacement (cu. in.) 360

Brake Horsepower

Rated Maximum Continuous Operation L/TSIO-360-RB, ...220 BHP

1-10 OPERATING LIMITS

NOTE . . . The following specifications apply to all L/TSIO-360-RB engines unless otherwise specified.

Crankshaft Speed - RPM

L/TSIO-360-RB
Rated Maximum Continuous Operation ..... 2600 RPM
Idle ..... 700 RPM±25
Manifold Pressure Limit (In. Hg.) Absolute ..... 38.0”

Fuel Control System ..... Precision RSA-5 Fuel Injection
Fuel .....For fuel grade , see Chapter 7, Servicing
Oil ..... For Oil grade & capacity, see Chapter 7, Servicing
Oil Pressure
Idle, Minimum, psi 10
Normal Operation, psi ..... 30 to 60
Oil Sump Capacity (U.S. Quarts) 8.0
Oil Consumption (Lb./BHP/Hr. Max.) ..... $\frac{.006 \text{ X } \% \text{ Power}}{100}$

1-10 OPERATING LIMITS (Cont'd)

Oil Temperature Specifications

All Temperatures ..... TCM Approved Multi Viscosity
Below 40°F Ambient (Sea Level) ..... TCM Approved SAE 30 or Multi Viscosity
Above 40°F Ambient (Sea Level)..... TCM Approved SAE 50 or Multi Viscosity

Oil Temperature Limits

Minimum for Take-Off..... 100°F
Maximum Allowable..... 240°F
Recommended Operational Range ..... 160 - 180°F

Cylinder Head Temperature

TSIO-360-RB
Recommended maximum at cruise.....420°F
Limit .....460°F

Turbine Inlet Temperature

Maximum Continuous .....1650°F

Maximum, 60 seconds.....1700°F

Ignition Timing (Compression stroke, breaker opens)

Right Magneto, degrees BTC.....22°±1°
Left Magneto, degrees BTC .....22°±1°

The following spark plugs are approved for use in engine models according to the following listing:

L/TSIO-360-RB.

Use:	TCM	630049
	Champion,	RHM38E

Spark Plug Gap Use spark plug manufacturer's specified gap.

ACCESSORY DRIVE RATIOS TO CRANKSHAFT

Accessory	Direction of Rotation*	Drive Ratio
Tachometer	-	
Magneto	CW	1.5:1
Starter	CW	24.73:1
* ** Propeller Governor	CW	1:1
Fuel Pump (Injection),	CCW	1:1
Freon Compressor	CW	1.545:1 * * * *
* * * Accessory Drive Pad	CCW	1.545:1

WARNING

Oil pressure is applied to the face of accessory drive pads. If gaskets, accessory or cover is not properly installed and hardware is not properly torqued oil leakage will occur.

*CAUTION . . . A removable oil transfer plug conducts oil under pressure from the propeller governor through the crankshaft to the propeller hub. When a test club or fixed pitch propeller is used for testing purposes the **governor pad cover** must have an **internal grooved surface** to allow the circulating oil to lubricate the front main bearings. The governor pad cover is not needed if a propeller governor is installed.*

* "CW" - Clockwise and CCW – Counterclockwise (facing drive pad).
* * This drive is a modified AND 20010 and is supplied with cover plate.
* * * This drive is a modified AND 20000 and is supplied with cover plate.
* * * * Ratio is for 6.0" diameter driven sheave.

CHAPTER 2
TOOLS AND EQUIPMENT

2-1 GENERAL INFORMATION

The mechanic should be equipped with a complete set of the necessary tools that include the following:

1. Wrenches - 1/4" through 1 1/4"
2. Common and Philips Head Screwdrivers
3. Pliers - Common Diagonal Cutters, Needle Nose, Duck Bill, Snap Ring
4. Ratchets 1/4",3/8", & 1/2" Drive
5. Sockets - 1/4" Drive 5/32" through 1/2" / 3/8" Drive 3/8" through 1" / 1/2" Drive 7/16" through 1-1/4"
6. Sockets (Deepwell) - 1/2" Drive 7/16" through 1"
7. Feeler Gauges
8. Leather or Soft Plastic Mallet
9. Torque Wrenches* 0-500 In. Lbs. / 0-100 Ft. Lbs.
10. Micrometers*
11. Slide Hammer
12. Pullers
13. Thickness Gauges
14. Vernier Calipers*
15. Small Hole Gauges
16. Ford Wrench

* Must be currently calibrated, and the calibration must be traceable to the National Bureau of Standards.

2-2 POSSIBLE SPECIAL TOOL PROCUREMENT SOURCES

- NOTICE -

All tools in the "Special Tool" list are for reference only, and not for the purpose of promoting or suggesting tools to be purchased from the indicated sources. The following information is given as an aid for special tool procurement purposes.

COMPANY	GENERAL PRODUCT SUMMARY
ALCOR Box 32516 10130 Jones Maltsberger Rd. San Antonio, TX 78284 (512) 349-3771	Instruments for Light Powered Aircraft Special Tools
KENT - MOORE 29784 Little Mack Roseville, MI 48066-2298 (800) 253-0138	Precision Instruments Measuring Instruments Precision Tools Special Tools
CHAMPION SPARK PLUG, CO. Box 910, 900 Upton Ave. Toledo, OH 43661 (419) 535-2461	Spark Plugs Ignitors Oil Filters Special Tools
EASTERN ELECTRONICS, INC. 180 Roberts St. East Hartford, CT 06108 (203) 528-9821	Fuel Pressure Test Equipment Measuring Instruments Precision Tools Piston Position Indicators
FEDERAL TOOL SUPPLY CO. INC. 1144 Eddy St. Providence, Rhode Island 02940 (800) 343-2050	Precision Inspection Instruments Special Tools
AIRCRAFT TOOL SUPPLY P.O. Box 4525, 2840 Breard St. Monroe, LA 71201 (507) 451-5310	Precision Tools Special Tools
McMASTER-CARR SUPPLY CO. P.O. Box 4355 Chicago, Illinois 60680 (312) 833-0300	Precision Tools Special Tools
SNAP ON TOOLS 2611 Commerce Blvd. Birmingham, Alabama 35210 (205) 956-1722	Precision Tools Special Tools
Kell-Strom Tool Company, Inc. 214 Church St. Wethersfield, CT 06109	Ignition Test Equipment
Krautkramer Branson P.O. Box 350 Lewiston PA 17044 (717) 242-0327	Ultrasonic Test Equipment
Merrit Products 201 W. Mansville Compton, California 90224 310/639-4242	Special Tools

COMPANY	GENERAL PRODUCT SUMMARY
APPROVED AIRCRAFT ACCESSORIES INC. ® 29300 Goddard Road Romulus, Michigan 48174 (313) 946-5547	Model 20 ATM-C Porta-Test Unit

2-3 SPECIAL TOOLS

Specific tools listed or equivalent tools marketed by other manufacturers are necessary for overhaul and maintenance of the aircraft engine.

ITEM NO.	TOOL	See Section
	GENERAL ENGINE RECIPROCATING	
1	646953 Master Orifice Tool for cylinder compression test available from Kent - Moore	5-4
2	7251 Differential Pressure Cylinder Checker available from Kent - Moore	5-4
	IGNITION SYSTEM	
3	Borrough's 3608A Protractor/Timing Indicator Disc or equivalent for setting engine timing	12-6
4	Model E25 Timing Indicator available from Eastern Electronics, Inc.	12-7
5	11-9110-1 Magneto Timing Light available from KELL-STROM Tool Company Inc.	12-7
	FUEL INJECTION	
6	Borrough's 8165 Injector Nozzle Remover and Installer or equivalent	13-3
	CHARGING SYSTEM	
7	Borrough's 7726 Torch Band Tension Adjuster or equivalent for Gen./Alt. Belt Tensioning	16-5
8	BTU-33-73F Belt Tension Gage available from Kent - Moore	16-5
9	Borrough's 4973 Generator Drive Holders or equivalent	16-5
10	Borrough's 61-5 Pulley Pulled or equivalent for gen./alt. sheave removal	16-5
11	Borrough's 8091 GEN./ALT. Output Tester or equivalent.	16-5
12	647 Alternator Analyzer Voltage Regulator Tester available from Eastern Electronics, Inc.	16-5
13	E100 Alternator/Regulator/Battery Tester available from Eastern Electronics, Inc.	16-5
14	Model 29 Voltage & Circuit Tester available from Eastern Electronics, Inc.	16-5
	STARTING SYSTEM	
15	Borrough's 8093C Bearing Puller or equivalent for needle bearing removal	17-5
16	Borroughs 23-1 Needle Bearing Installer or equivalent	17-5
	LUBRICATION SYSTEM	
17	8048 Oil Pressure Relief Spot Facer available from Kent - Moore	19-3
	CYLINDERS	
18	68-3 Push Rod Spring Compressor available from Kent - Moore	20-6
19	3882 Cylinder Base Nut Wrenches available from Kent - Moore	20-6
20	Borrough's 8079 Cylinder Base Nut Wrenches or equivalent	20-6
21	3882, 3882-2 Cylinder Base Nut Wrenches available from Kent - Moore	20-6
22	3601 Ring Compressor for cylinder installation available from Kent - Moore	20-6
23	8121 Piston Pin Removers available from Kent - Moore	20-6
24	3602 Valve Spring Compressor available from Kent - Moore	20-6

ITEM NO.	TOOL	See Section
25	545-116 Dial Bore Gages available from Federal Tool Supply Co. Inc.	20-6
26	CFL10 Cylinder Hone available from Snap On Tools	20-6
27	No. 1675 Valve Seat Grinder Set "Sioux Brand" available from Aircraft Tool Supply	20-6
28	AEX 375 Valve Seat Grinder Pilot .437 Dia. available from Aircraft Tool Supply	
29	K28 Intake Valve Seat Grinding Stone (Roughening 45°) available from Aircraft Tool Supply	
30	K98 Intake Valve Seat Grinding Stone (Finishing 45°) available from Aircraft Tool Supply	
31	K428 Exhaust Valve Seat Grinding Stone (Roughening 45°) available from Aircraft Tool Supply	
32	K498 Exhaust Valve Seat Grinding Stone (Finishing 45°) available from Aircraft Tool Supply	
33	Borrough's 5221A Holding Fixture Adapters or equivalent	
34	Borrough's 5221B Cylinder Holding Fixture or equivalent	
35	Borrough's 8156 Cylinder Heating Stand or equivalent	
36	Borrough's 8086 Valve Seat Insert Remover & Replacer or equivalent	
37	Borrough's 4910 Installer Valve Seat Insert or equivalent	
38	Borrough's 4956 Installer Valve Seat Insert or equivalent	
39	Borrough's 8116 Common Parts Kit or equivalent	
40	Borrough's 8116-1B through 15B Boring Bars or equivalent	
41	Borrough's 8116-1R through 15R Reamers or equivalent	
42	Borrough's 8116-1 through 16 Expanding Guide Bodies or equivalent	
43	4909 Valve Seat (Straight Side) Insert Cutters available from Kent - Moore	
	4954 Valve Seat (Straight Side) Insert Cutters available from Kent - Moore	
	4985 Valve Seat (Straight Side) Insert Cutters available from Kent - Moore	
	5224 Valve Seat (Straight Side) Insert Cutters available from Kent - Moore	
	5225 Valve Seat (Straight Side) Insert Cutters available from Kent - Moore	
44	8135 Valve Seat (Step Side) Insert Cutters available from Kent - Moore	
	8136 Valve Seat (Step Side) Insert Cutters available from Kent - Moore	
	8138 Valve Seat (Step Side) Insert Cutters available from Kent - Moore	
45	Borrough's 8122A Common Drive Handle or equivalent	
46	122 Valve Guide Cleaner available from Kent - Moore	
47	2873 Valve Guide Remover available from Kent - Moore.	
48	3619 Valve Guide Replacer available from Kent - Moore	
49	Borrough's 3170 Floating Holder or equivalent	
50	4981 Valve Guide Remover available from Kent - Moore	
51	Borrough's 8116-24 through 29 Valve Stem Hole Reamers or equivalent	
52	3606-CP Reamer (Carbide Tipped) available from Kent - Moore	
	3606-HP Reamer (High Speed Steel) available from Kent - Moore	
53	2684 Reamer to Morse Taper Adapter (Square Shank) available from Kent - Moore	
54	2848 Plug Gage for valve guide inspection available from Kent - Moore	
55	4943-1HS through 5HS Reamers, Valve Guide Boss available from Kent - Moore	
56	Borrough's 4918 Spark Plug Insert Replacer or equivalent	
57	Borrough's 4919 Spark Plug Insert Remover or equivalent	

ITEM NO.	TOOL	See Section
58	Borrough's 445, 18mm Spark Plug Tap or equivalent for straightening out damaged threads	20-6
59	2769A13 Rosan® Stud Remover available from McMASTER-CARR Supply Co.	20-6
	Rosan® is a registered trademark of Fairchild Aerospace Fastener Division	
60	8074 Rosan® Lock Ring Installer available from Kent - Moore	
61	8118 Rocker Arm Bushing Remover/Installer available from Kent - Moore	
62	3610 Reamer Rocker Arm Bushing available from Kent - Moore	20-6
	CRANKCASE	
63	Borrough's 8114 Crankcase Through Bolt Removers or equivalent	21-5
64	L423 Crankcase Splitter available from Kent - Moore	21-5
65	Borrough's 505 Stud Drivers or equivalent	21-5
	ENGINE DRIVE TRAIN	
66	Borrough's 8117A Runout Block Set or equivalent for crankshaft inspection	22-5
67	Krautkramer Branson Model USK 7D, USL42, USL 48, USN 50, USN 52, or OR7S for Crankshaft Ultrasonic Testing available from Fax Corporation	
68	Borrough's 8087A Polishing Tools for Crankshaft Bearings or equivalent	
69	3604, 8068 Crankshaft Blade and Damper Bushing Remover/Replacer available from Kent - Moore	
70	Borrough's 8077C Bushing Remover & Replacer, Counterweight or equivalent	
71	Borrough's 8111A Connecting Rod Fixture or equivalent	
72	Borrough's 8072C Adapter Kit or equivalent for connecting rod inspection	
73	8071 Reamers for connecting rod bushing available from Kent - Moore	
74	D-4000 Federal Dimension Air Gage for connecting rod bushing inspection available from Federal Tool Supply Co. Inc.	
75	1.00025 Setting Ring for checking 1.0000 to 1.0005 tolerance available from Federal Tool Supply Co. Inc.	
76	1.00025 Air Plug for checking 1.0000 to 1.0005 tolerance available from Federal Tool Supply Co. Inc.	
77	5209 Propeller Shaft Oil Seal Installer available from Kent - Moore	22-5
	OPERATIONAL INSPECTION	
78	85328 Alcor Portable Digital EGT Unit available from Alcor, Inc.	23-1
79	85329 Alcor Portable Digital CHT available from Alcor, Inc.	23-1
80	Model 20 ATM-C Porta-Test Unit available from Approved Aircraft Accessories, Inc.®	23-1

CHAPTER 3
SEALANTS AND LUBRICANTS

SEALANTS AND LUBRICANTS

Aviation Engine Oil Ashless Dispersant	
Recommended Grade	
Above 40°F ambient air, sea level	SAE 50 or Multi Viscosity
Below 40°F ambient air, sea level	SAE 30 or Multi Viscosity
Manufacturer	**Brand Name**
BP Oil Corporation	BP Aero Oil
Castrol	Castrol Aero AD Oil
Castrol Limited (Australia)	Castrol Aero AD Oil
Chevron U.S.A., Inc.	Chevron Aero Oil
Continental Oil	Conco Aero S
Delta Petroleum Company	Delta Avoil Oil
Exxon Company, U.S.A.	Exxon Aviation Oil EE
Gulf Oil Company	Gulfpride Aviation AD
Mobil Oil Company	Mobil Aero Oil
NYCO S.A.	TURBONYCOIL 3570
Pennzoil Company	Pennzoil Aircraft Engine Oil
Phillips Petroleum Company	Phillips 66 Aviation Oil, Type A
Phillips Petroleum Company	X/C Aviation Multiviscosity Oil
	SAE 20W50, SAE 20W60
Quaker State Oil & Refining Company	Quaker State AD Aviation Engine Oil
Red Ram Limited (Canada)	Red Ram X/C Aviation Oil 20W50
Shell Australia	Aeroshell (R) W
Shell Canada Limited	Aeroshell Oil W, Aeroshell Oil W 15W50
	Anti-Wear Formulation Aeroshell Oil W 15W50
Shell Oil Company	Aeroshell Oil W, Aeroshell Oil W 15W50
	Anti-Wear Formulation Aeroshell Oil W 15W15
Sinclair Oil Company	Sinclair Avoil
Texaco Inc.	Texaco Aircraft Engine Oil - Premium AD
Total France	Total Aero DM 15W50
Union Oil Company of California	Union Aircraft Engine Oil HD

Break-in Oil
MIL-C-6529 Type II Corrosion preventive mineral oil
NOTE . . . Mineral oil conforming with MIL-C-6529 Type II contains a corrosion preventive additive and must not be used for more than 25 hours or six months, whichever occurs first. If oil consumption has not stabilized in this time, drain and replenish the oil and replace the oil filter.,

Preservative Oil		
TYPE	SUGGESTED SOURCES	APPLICATION
MIL-C-6529 Type II	(Aeroshell Fluid 2F or equivalent),	For Temporary storage (up to 90 days)
MIL-P-46002	Grade 1 oil, (NOX RUST VCI-105 or equivalent) May be purchased through: Rock Island Lubricant & Chemical Co. P.O. Box 5015 1320 1st Street Rock Island, Illinois 61204 Phone: 1-800-522-1150	For Indefinite storage

Lubricants		
TYPE	**SUGGESTED SOURCES**	**APPLICATION**
Molyshield Grease	May be purchased through:	Needle bearings and ball bearings
	American Lubricants 1227 Deeds Dayton, Ohio 45401 Phone: (513) 222-2851	Valve stems
		All ACC drive splines and couplings
		Idler gear and pin
		Fuel injection controls, o-rings, springs, shafts and bushings
		Magneto rubber drive bushings
Dow Corning® G-N Paste [Dow Corning® G-N Paste is a registered trademark of Dow Corning Corporation.]	For Distributor information call 1-800-248-2481, have state & city information available	Camshaft lobes and lifter faces
Alvania (Shell #2)	For Distributor information: Shell Product Information Center, Phone: 1-800-231-6950	Front crankshaft oil seal
MIL-S-3545C Grease (Shell #5)	Shell Product Information Center, Phone: 1-800-231-6950	Fuel injection linkage pivot points, throttle shaft bushings, lever bushings
Permatex Maintain® Lubricant	For Distributor information call: Permatex Customer Service @ Phone: 1-800-641-7376	Fuel injection linkage pivot points, throttle shaft bushings, lever bushings
#646943 - Anti Seize Lubricant or Loctite Anti-Seize Lubricant 767	May be purchased through your local TCM Distributor or For Distributor information: Loctite Customer Service @ Phone: 1-800-243-4874	All fuel injector nozzles (at cylinder head)
		Exhaust studs (nut end before torquing)
		All class 4 studs
		All mechanical tach drive housing threads

Lubricants		
TYPE	**SUGGESTED SOURCES**	**APPLICATION**
Approved Ashless Dispersant Oil	See Aviation Engine Oil Ashless Dispersant Table	Cylinder studs and through bolts, crankcase studs, connecting rod bolts and nuts and engine accessory studs unless otherwise specified
CHAMPION® - Spark Plug Thread Lubricant No. 2612 [CHAMPION® is a registered trademark of Cooper Industries.]	For Champion Products Distributor information: Phone: 803-843-5400	Spark plugs
Chesterton No. 4	Chesterton Technical Product Information Phone: (508) 469-6783	Induction system hose connections
Dow Corning® No. 4	For Distributor information call 1-800-248-2481 have state & city information available	Spin-on oil filter rubber seals

Sealants		
TYPE	**SUGGESTED SOURCES**	**APPLICATION**
Permatex Aviation Grade 3D and #641543 Silk Thread and #646942 Gasket Maker or Loctite Gasket Eliminator 515 Sealant	For Distributor information call: Permatex Customer Service @ Phone: 1-800-641-7376 May be purchased through your local TCM Distributor May be purchased through your local TCM Distributor For Distributor information call: Loctite Customer Service @ Phone: 1-800-243-4874	Crankcase parting face, oil pump covers, scavenge pump covers
#653692 - Primer or Loctite LocQuic Primer 7649	May be purchased through your local TCM Distributor For Distributor information: Loctite Customer Service @ Phone: 1-800-243-4874	Crankcase crankshaft nose oil seal area
#646942- Gasket Maker or Loctite Gasket Eliminator 515 Sealant	May be purchased through your local TCM Distributor For Distributor information: Loctite Customer Service @ Phone: 1-800-243-4874	Engine nose seal, outside diameter of all uncoated oil seals, non-beaded oil sump gaskets
#642188 - Gasket Sealant (TCM) 1.5 oz. tube	May be purchased through your local TCM Distributor or	Cam bore cover gasket, idler pin gasket, oil filler neck gasket and holes, pressed in plugs

Sealants

TYPE	SUGGESTED SOURCES	APPLICATION
	K & W Copper Coat For Distributor information call: K & W Products Customer Phone: 1-800-423-9446	
Loctite Teflon PS/T Pipe Sealant	For Distributor information: Loctite Customer Service @ Phone: 1-800-243-4874	Pipe threads, pressure relief valve housing threads, tach drive threads, oil temperature control valve, studs that are exposed to oil
#646940 - F/I Sealant or Loctite Hydraulic Sealant 569	May be purchased through your local TCM Distributor For Distributor information: Loctite Customer Service, Phone: 1-800-243-4874	All pipe thread fittings in fuel injection system
Miller-Stephenson MS 122/C02 Spray	For Distributor information: Miller-Stephenson Customer Service, Phone: 1-800-992-2424	Ignition harness terminals at magneto block end

Adhesives

TYPE	SUGGESTED SOURCES	APPLICATION
646941 High Strength Adhesive Sealant or Loctite 271 653696 Primer or Loctite LocQuic Primer 7471	May be purchased through your local TCM Distributor For Distributor information: Loctite Customer Service, Phone: 1-800-243-4874	Cylinder deck studs, squirt nozzles, fuel manifold valve diaphragm and plunger assembly
649306 Sealant (optional 646940) or Loctite Adhesive Sealant 222 (optional Loctite Hydraulic Sealant 569),	May be purchased through your local TCM Distributor For Distributor information: Loctite Customer Service, Phone: 1-800-243-4874	Through stud holes on accessory end of crankcase, manifold valve to bracket screws
3M Brand EC1252 White Spot Putty	3M	Cylinder deck studs, magneto flanges, throttle body and fuel metering unit

Miscellaneous		
TYPE	**SUGGESTED SOURCES**	**APPLICATION**
TCM P/N 626531-1 Enamel - Gold (1qt) **TCM P/N 626531-2** Enamel - Gold (1 gal)	May be purchased through your local TCM Distributor	High temp. paint for cosmetic and corrosion protection
TCM P/N 535001S Lockwire -.032 in dia. Steel, Corrosion Resistant	May be purchased through your local TCM Distributor	Where applicable for lockwiring
"ACCELAGOLD" Turco® Products Tucker, GA 30084 [Accelagold is manufactured by Turco® Products, Inc.]	For sales and service: Elf Atochem N.A. Turco® Products Div. P.O. Box 195 State Route 95 West Marion, Ohio, 43302, 215-419-5376	Corrosion protection interior and exterior aluminum parts

CHAPTER 4

AIRWORTHINESS LIMITATIONS

This Airworthiness Limitations section has been FAA approved and specifies maintenance required under §§ 43.16 and 91.403 of the Federal Aviation Regulations unless an alternative program has been FAA approved. Federal Aviation Regulations §§ 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 and the engine was type certificated based upon required owner/operator compliance with the limitations.

1. Mandatory Replacement Times.

Subject to additional information contained in FAA Airworthiness Directives (AD) 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.

2. Mandatory Inspection Intervals.

Subject to additional information contained in FAA Airworthiness Directives (AD) issued after the date of certification, the engine does not require specific intervals of inspection pursuant to type certification.

3. Other Related Procedures

Subject to additional information contained in the Airworthiness Directives (AD) issued after the date of certification, there are no other related procedures required pursuant to the type certification for this engine.

4. Distribution of Changes to Airworthiness Limitations.

Changes to the Airworthiness Limitations section constitute changes to the type design of this engine and require FAA approval. Such changes will be published in FAA Airworthiness Directives (AD).

NOTE

The limitations in this section apply only to specific limitations which are part of the engine design. Under the Federal Aviation Regulations numerous other additional limitations are applicable to this engine and it's accessories. For example Federal Aviation Regulation Parts 91 and 43, among other parts, define inspection criteria, maintenance requirements and procedures that are applicable to this engine. It is the responsibility of the owner / operator to maintain the engine in an airworthy condition by complying with all applicable Federal Aviation Regulations and by performing maintenance in accordance with TCM Instructions for Continued Airworthiness, which consist of TCM publications and service documents.

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CHAPTER 5

TIME LIMITS/OPERATIONAL INSPECTION/ENGINE TROUBLESHOOTING

5-1 GENERAL

The scheduled inspection and maintenance described in this section must be complied with in addition to all aircraft manufacturer and accessory manufacturer inspection and maintenance requirements. This manual does not contain inspection or maintenance requirements for supplemental type certificated components or systems. Such information must be obtained from the supplemental type certificate holder.

Safety, efficiency and engine service life is predicated on compliance with the aircraft and engine manufacturer's required instructions, inspections and maintenance schedule. The owner/operator is primarily responsible for maintaining the engine in an airworthy condition, including compliance with applicable Airworthiness Directives as specified in Part 39 of the Federal Aviation Regulations (FAR); reference FAR 91.163.

NOTE . . . Engine operational inspection must be performed before and after any 50 or 100-hour inspections or maintenance in accordance with "Operational Inspection" requirements described in this manual (See Chapter Contents).

During engine 50 and 100-hour inspections, if engine components must be replaced, refer to the applicable system maintenance chapter. Adjustment information will be found in the individual system chapters of this section.

NOTE . . . The figures depicted in this section are for illustration purpose only. They are not intended to be accurate detailed illustrations of any specific engine model, part or equipment.

WARNING

When performing any inspection or maintenance, always treat the engine as if the ignition switch was on. Do not stand or allow anyone else to stand within the arc of the propeller. A loose or broken wire or a component malfunction could cause the engine and propeller to rotate and/or the engine to start.

Engines operated in extremely humid locations or in exceptionally cold, damp climates or coastal areas may require more frequent inspections. If the engine is operated in excess of 100 hours per year, the engine must be inspected at each 100-hour interval in addition to an annual inspection.

5-2 OVERHAUL PERIODS

Engine Model	Overhaul Period
L/TSI0-360-RB	1800 HOURS

NOTE . . . Overhaul periods for the engine include all engine accessories.

5-3 OPERATIONAL INSPECTION

An operational inspection must be performed prior to 50/100-hour inspections.

STARTING

Start engine using the starting procedure given in the airframe manufacturers Airplane Flight Manual (AFM).

OPERATIONAL CHECK LIST

Check and record the following system data :

Starter ..... _____

*Record RPM Drop for each magneto at 1700

(150 RPM MAXIMUM AND 50 RPM SPREAD MAXIMUM) ..... _____

*Propeller Operation at 1700 ..... _____

*Or as specified in aircraft manufacturer's instructions.

Increase engine to full power and record:

Manifold Pressure ..... _____

RPM ..... _____

Fuel Flow ..... _____

Oil Pressure ..... _____

Oil Temperature ..... _____

Cylinder Head Temperature ..... _____

Alternator Output ..... _____

Reduce engine to idle and record:

Manifold Pressure ..... _____

RPM ..... _____

Oil Pressure ..... _____

Oil Temperature ..... _____

Cylinder Head Temperature ..... _____

Magneto System Grounding Check ..... _____

CAUTION . . . The magneto system grounding check must be accomplished at idle RPM only. Damage to the engine may result at engine speeds above idle RPM.

WARNING

Absence of RPM drop when checking magnetos is an indication of a malfunction in the ignition system resulting in a hot magneto. This type of malfunction must be corrected prior to continued operation of the engine. The engine may inadvertently experience ignition or start-up anytime the propeller is moved. Damage, injury or death may result.

If engine continues to run when magnetos are switched Off a malfunction is occurring in the ignition system.

Slowly move mixture control to IDLE CUT OFF and record:

Mixture RPM Rise (25 to 50 RPM) ..... _____

Positive Fuel Cutoff ..... _____

When propeller stops rotating, place ignition switch, master switch and fuel selector in off position.

5-4 TEST OPERATING LIMITS

ITEM	ENGINE MODEL TSIO-360-RB	ENGINE MODEL LTSIO-360-RB
* Full Throttle Speed- RPM	2600	2600
Manifold Pressure In. hg. Absolute	38.0	38.0
Idle Speed - RPM	700±25	700±25
Fuel Grade (Octane)	100LL/100	100LL/100
Fuel Flow at Full Throttle (Lbs. /Hr.)	140 - 150	140-150
Oil Temperature Limit	240°F	240°F
Oil Pressure (Max. Oil Cold)	100	100
Minimum at Idle	10	10
Oil Pressure Operational Range	30 - 80	30 - 80
Magneto Drop (Max.) Magneto Spread	150 RPM 50 RPM	150 RPM 50 RPM
Cylinder Head Temperature with Bayonet Thermocouple (Max.)	460°F	460°F

* Maximum RPM may not be attainable at static run-up depending on setting of propeller low pitch stops

5-5 TIME INTERVAL INSPECTIONS

Inspection procedures and maintenance information are provided in the individual system chapters.

Engine mounted accessories not supplied by TCM may require servicing at specific intervals; some of these are alternators, pneumatic pumps, air / oil separators and stand-by generators. Refer to the instructions provided by the aircraft manufacturer, accessory manufacturer or STC holder for detailed information.

CAUTION . . . New, rebuilt and overhauled engines or engines that have had overhauled or new cylinders and new piston rings installed must be given a 100-hour inspection after 25 hours of operation.

Oil Change Interval: *

With small full flow filter .....50 hours

With large full flow filter .....100 hours

Oil Filter Change Interval: *

With large or small full flow filter 50 hours

***NOTE . . .** Hours stated or six months, whichever comes first.

CAUTION . . . Use only TCM approved oils. See TCM approved oils in Operation Section, "Normal Operating Procedures."

25-HOUR INSPECTION

NOTE: Research and comply with all applicable Service Publications and Airworthiness Directives.

1. After the first 25 hours of operation on new, rebuilt or overhauled engines, perform a complete 100-hour inspection. Drain the oil used for engine break-in. If engine oil consumption has stabilized, service the engine with TCM approved oil. If oil consumption has not stabilized, service engine with a mineral oil conforming to MIL-C-6529 Type II.

First 25 hours of operation - Mineral (non-detergent) oil or Corrosion Preventive oil corresponding to MIL-C-6529 Type II.

NOTE . . . Mineral oil conforming to MIL-C-6529 Type II is a straight mineral oil with a corrosion preventive additive. This oil must not be operated in excess of 25 hours or 6 months, whichever occurs first. If oil consumption has not stabilized within the first 25 hours of engine operation, drain and replenish the oil and replace the filter.

Approved Oil Grade: All Temperatures...TCM Approved Multi Viscosity

Below 40° F. Ambient Air (Sea Level)... TCM Approved SAE 30 or Multi Viscosity

Above 40° F. Ambient Air (Sea Level)... TCM Approved SAE 50 or Multi Viscosity

2. Visually inspect the engine and nacelle for fuel, oil leaks and other discrepancies.
3. Correct any discrepancies noted during this inspection prior to returning the engine to service

5-6 SCHEDULED MAINTENANCE

50-HOUR INSPECTION

NOTE: Research and comply with the Service Publications and Airworthiness Directives.

1. Thoroughly inspect the engine for any signs of leakage. Clean engine exterior by spraying or brushing with a flame resistant solvent used for general cleaning of engine parts.

NOTE . . . Any environmentally hazardous materials used in cleaning must be collected and disposed of in accordance with Environmental Protection Agency regulations.

CAUTION . . . Do not use any alkaline cleaning solutions for external engine cleaning, these solutions will remove the "alodized" finish of aluminum parts.

CAUTION . . . Do not use Kerosene or Gasoline for cleaning.

2. A pre-inspection operational run-up must be performed. See "Operational Inspection" of this chapter.
   a. Record the engine operating parameters.
   b. Verify the recorded parameters meet the published specifications for the engine as provided in the aircraft or engine manufacturer's Maintenance, Operator's and Overhaul Manuals.

WARNING

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

After the operational inspection, inspect, isolate and repair any leaks found.

3. Reference the applicable Airplane Flight Manual for operational values.
4. Remove and inspect induction air filter. Clean or replace as instructed by the filter manufacturer. Inspect induction system ducts, seals and gaskets for condition and deterioration in accordance with the aircraft manufacturer's instructions. With induction air filter installed:
   (a) Verify the induction air filter retainer is properly installed and the attaching hardware is secure in accordance with the aircraft manufacturer's instructions.
   (b) Replace any questionable components as required in accordance with the aircraft manufacturer's instructions.
   (c) Inspect all engine controls for proper travel, freedom of movement, wear, correct rigging and correct attachment in accordance with the aircraft manufacturer's instructions.

CAUTION ... Failure to properly install the induction air filter will result in unfiltered air being ingested into the engine which will accelerate engine wear and reduce engine service life.

5. Inspect induction air box for security and deterioration in accordance with the aircraft manufacturer's instructions.

WARNING

Insure the fuel selector is in the off position prior to servicing fuel filters.

6. Drain the fuel filter and service as required and reinstall in accordance with the aircraft manufacturer's instructions.
7. Visually inspect engine and nacelle for fuel, oil leaks and other discrepancies.

WARNING

Failure to identify and correct fuel or oil leaks can result in engine/nacelle fire, loss of engine power, engine failure, bodily injury or death.

8. Drain engine oil (small full flow filter). During engine oil change, oil must be drained into an appropriate container and disposed of properly. Reinstall oil drain plug with new gasket, torque to 190 - 210 in. lbs. and safety.
9. Remove oil filter. Inspect filter element. See "Oil Filter Element Inspection, Oil Analysis and Spectrographic Oil Analysis" at the end of this chapter.
10. Place a thin film of Dow Corning® DC-4 compound on new oil filter gasket. Install new oil filter. Torque filter to 192 - 216 and safety wire.
11. Inspect all induction system or cylinder drain(s) for clogging or restriction.
12. Inspect ignition leads for chafing, deterioration and proper routing.
13. Visually inspect magnetos for condition. Inspect, repair and adjust as required if magneto drop or spread was not within published limits.
14. Inspect exhaust system for cracks, excessive leakage, deterioration, loose and missing brackets, clamps and hardware. Visually inspect turbocharger and associated turbocharger system components for evidence of oil or exhaust leakage.
15. Correct all discrepancies noted.

WARNING

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

16. At the completion of any maintenance event the engine must be given a complete and thorough operational run-up. A test flight will be required if any engine adjustments have been made which affect flight characteristics or operation; This test flight is require by FAR 91.407.
    a. Record all engine parameters.
    b. Verify recorded parameters are within the specifications published for the engine and aircraft.
    c. Correct any discrepancies noted during operational run-up prior to returning engine to service.

100-HOUR INSPECTION

NOTE: Research and comply with the Service Publications and Airworthiness Directives.

In addition to the items listed in 50 Hour the following inspections and maintenance must be performed.

1. Drain engine oil. Reinstall oil drain plug with new gasket, torque to 190 - 210 in. lbs. and safety.
2. Perform a cylinder compression test.
3. Inspect the entire engine, accessory section and nacelle for indications of fuel, oil or hydraulic leaks. Inspect all wiring, flammable fluid lines and hoses and electrical connections for proper routing, support and evidence of deterioration.
4. Inspect the induction and exhaust system for leaks, cracks, deterioration, broken, missing or loose brackets, clamps and hardware.
5. **Cylinder Barrel.** Using an inspection light and mirror, thoroughly inspect the cylinder barrel including the cylinder barrel fins and the areas between and adjacent to the fins for cracks, sharp indentations, chafing damage and pitting. This visual inspection must include a detailed external inspection of the areas of the cylinder barrel which experience the highest operational stresses from the power stroke of the piston. These areas are the 12 o'clock area of the first six fins below the head on one side of the engine, and the 6 o'clock area on the other side. In addition, inspect for any signs of leakage of oil, fuel, soot or any condition that could indicate that the integrity of the cylinder or the head-to-barrel junction has been breached.
6. **Cylinder Head.** Inspect the external surfaces of the cylinder head including the cylinder head fins, intake and exhaust ports, top and bottom spark plug bosses and fuel nozzle boss. Inspect for cracks, exhaust flange leakage or any signs of leakage of oil, fuel, soot or any conditions that could indicate that structural integrity of the cylinder or the head-to-barrel junction has been breached.
7. **Inter-cylinder and peripheral baffling.** Carefully inspect all inter-cylinder and peripheral baffling for correct installation, proper positioning, deterioration, chafing and missing or broken sections. CORRECT OR REPLACE ANY DISCREPANT BAFFLING.
8. **Liquid cooled cylinders.** In addition to 5, 6 and 7 above, as applicable, inspect cylinder head cooling jacket for leaks.
9. Thoroughly wash the entire engine with an approved cleaning solution and repeat the visual inspection outlined above..

   CAUTION . . . Failure to properly install and maintain engine baffles and baffle seals will adversely affect cylinder service life.

10. Insure magneto to engine timing is within specifications.

    CAUTION . . . Magnetos using riveted type impulse coupling require repetitive 100-hour inspection.

11. Clean, inspect, gap, test and rotate all spark plugs.

WARNING

Worn spark plugs that are continued in service may cause internal arcing in the magnetos.

12. Check all engine controls, control cables, control rod ends and levers for security, wear, improper assembly, routing and freedom of movement throughout the entire range of travel.

WARNING

Insure fuel selector is in the off position prior to removing the fuel metering unit inlet screen.

13. Inspect fuel nozzles, upper deck and fuel injection nozzle reference lines, hoses, manifolds and fittings for proper routing, support and signs of fuel stains. Inspect manifold valve for security of installation, proper venting and signs of fuel stains.

14. At the first 100-hour inspection on new, rebuilt or overhauled engines, remove fuel injection nozzles. Clean nozzles by soaking in lacquer thinner, acetone or methyl ethyl ketone (MEK). Fuel nozzles must be cleaned every 300-hours or annual inspection.

NOTE . . . Any environmentally hazardous materials used in cleaning must be contained and disposed of in accordance with Environmental Protection Agency regulations.

CAUTION ... Never clean nozzles with wire or other similar object. If nozzle jet is plugged and obstruction cannot be removed by solvent action, REPLACE THE NOZZLE.

15. Inspect all accessories for condition, security of mounting and proper operation. Refer to aircraft or component manufacturer's Maintenance Manual for specifics.

16. Inspect engine mount legs for cracks. Check engine mount isolators for signs of deterioration, proper assembly and security.

17. Check all fasteners for integrity and security.

18. Visually inspect the turbocharger center housing for general condition. Inspect the compressor housing "V" band clamp for security. Inspect the exhaust housing bolts and lock tabs for security. Inspect the oil inlet and outlet fittings and surrounding area for evidence of oil leakage.

19. Remove the induction air supply duct to the turbocharger compressor and inspect the compressor blades for evidence of foreign object damage. Turn compressor wheel by hand, check for freedom of rotation. Inspect the interior of the air supply duct for general condition.

20. Remove the turbocharger exhaust stack and inspect the turbine wheel for damage, freedom of rotation and evidence of oil.

21. Visually inspect exhaust system transition unit at the turbocharger for general condition and evidence of exhaust leaks, cracks and distortion.

22. Verify operation and accuracy of EGT/TIT system. Note: The aircraft manufacturer may require the EGT/TIT system to be operational for all categories of flight. Check the limitations section of the Airplane Flight Manual for specific requirements. Calibration of the EGT/TIT system may be mandatory at 100 hour intervals. Consult the aircraft manufacturer's Maintenance Manual for specific instructions.

23. Remove the turbocharger compressor discharge duct and inspect the interior for evidence of oil. If there is evidence of oil in the duct, further inspection of the turbocharger is required to determine cause and source of oil. Refer to the turbocharger manufacturer's information for specific instructions.

24. Inspect all turbocharger control system linkage for correct rigging, looseness and lubricate link rod pins with Permatex Maintain® Lubricant.

25. Inspect waste gate actuator and butterfly valve for general condition and freedom of movement. Check link rod pins and levers for wear. Lubricate waste gate butterfly valve with "Mouse Milk".

26. Visually inspect magneto pressurization filter for contamination. If filter element is white, it may be continued in service. If filter element has turned to yellow or red, element is contaminated and must be replaced. If there is visible moisture present in the filter canister the magnetos must be removed from the engine, disassembled and inspected for possible internal contamination and corrosion.
27. Correct any discrepancies noted.
28. Perform post inspection operational run-up. Visually inspect engine and nacelle for fuel and oil leaks.
29. Correct any discrepancies noted during this inspection prior to returning engine to service.

SYSTEM DRAIN INSPECTION.

At each scheduled maintenance interval, perform the following inspection to ensure that the drain(s) function properly:

WARNING

Do not rotate the propeller or allow any personnel to stand in the area of the propeller arc while performing the following inspection.

1. Perform a normal engine start priming sequence in accordance with the Aircraft Manufacturer or STC holder's instructions.
2. Observe the drain location(s) in the engine cowling and make certain that fuel drains from each.
3. Remove, clean or replace any drain that does not function properly.

500-HOUR INSPECTION

In addition to the items listed for 100-hour inspections, perform the following inspections and maintenance every 500 hours of engine operation.

1. Magnetos require a thorough, detailed inspection. Refer to the applicable service and overhaul information published by the manufacturer of the magneto. Magnetos must be overhauled or replaced at the same intervals as the engine. TCM magnetos (formerly Bendix) must be overhauled or replaced every four years regardless of total operating hours since last overhaul or replacement.
2. Engine mounted accessories not supplied by TCM such as alternators, stand-by generators, etc., may require servicing at specific intervals. Refer to the instructions provided by the aircraft manufacturer, accessory manufacturer or STC holder for detailed information.
3. TCM gear driven alternators require inspection and testing at 500-hour intervals. Refer to the applicable alternator manufacturer's instructions. See "Related Publications" in the Introduction section of this manual.

5-7 UNSCHEDULED MAINTENANCE

Unscheduled maintenance events include but are not limited to:

PROPELLER STRIKES

A propeller strike is: (1) any incident, whether or not the engine is operating, that requires repair to the propeller other than minor dressing of the blades or (2) any incident while the engine is operating in which the propeller makes contact with any object that results in a loss of engine RPM. Propeller strikes against the ground or any object, can cause engine and component damage even though the propeller may continue to rotate. This damage can result in catastrophic engine failure.

A. PROPELLER STRIKE INSPECTIONS.

Following any propeller strike a complete engine disassembly and inspection is mandatory and must be accomplished prior to further operation. Inspect all engine accessories in accordance with the manufacturer's instructions. In addition to the engine component inspection requirements set forth in the appropriate overhaul manual, pay particular attention to the following areas while performing the specified non-destructive testing:

1. Crankshaft surfaces forward of the front main bearing journal. These surfaces must be free of sludge, paint or any other substance that could mask reliable magnetic particle inspection indications.
2. Forward crankcase bearing support and adjacent structure.

NOTE:. . . In addition to any part that is damaged, TCM recommends for counterweight equipped engines, replacement of all counterweight pins, bushings, end plates and snap rings regardless of their condition.

B. MINOR FOREIGN OBJECT DAMAGE (FOD) INSPECTION.

For instances where the propeller is damaged by a small foreign object during operation, such as a small stone, inspection and repair must be accomplished in accordance with the propeller manufacturer's published instructions. Any time foreign object damage requires propeller removal for repairs other than minor dressing of the blades, the incident is considered a propeller strike and must be inspected as outlined in paragraph A above.

HYDRAULIC LOCK

GENERAL INFORMATION

Hydraulic lock is defined as a condition in which a volume of liquid, equal to or greater than the clearance volume of the combustion chamber, is drawn into the cylinder during starting. This liquid, being incompressible, restricts piston travel during the compression stroke. Damage only occurs after the preceding cylinder or cylinders in the firing order have fired, thereby providing the required force to drive the piston of the fluid filled cylinder through the compression stroke.

Most hydraulic lock events in horizontally opposed aircraft engines are due to fuel accumulation in the induction system and/or cylinder assembly. Over priming prior to or during engine starting will allow fuel to accumulate in the induction system or cylinder faster than the system drains can evacuate it. Other causes of hydraulic lock can be attributed to:

1. Restricted or clogged induction system or cylinder drain(s).
2. Extended operation of the electric boost pump:
    a. During failed engine start.

b. Following loss of power during ground operation.

c. Following momentary engine shutdown.

d. During single engine operation for training purposes on twin engine aircraft.

3. Over priming and attempting engine start with the aircraft parked on an incline that negates the effective operation of the drain system.

4. A failure to drain oil from cylinders that have been preserved.

Damage from a hydraulic lock can be extensive. Engine components such as connecting rods, cylinder assemblies, pistons, piston pins, crankcase and crankshaft can be damaged due to the extreme stress.

WARNING

Over priming can cause a flooded intake resulting in a "hydraulic lock" event and subsequent engine malfunction or failure. If you over prime, or flood your engine, make certain that all fuel has drained from the intake manifold and/or cylinder prior to attempting engine starting.

INSPECTION PROCEDURES FOR SUSPECTED HYDRAULIC LOCK.

In the event of a suspected hydraulic lock, perform the following inspection:

1. Remove all cylinders and connecting rods in accordance with the applicable TCM Overhaul Manual. Inspect the connecting rods in accordance with applicable TCM Overhaul Manual.

2. If all rods meet the criteria specified by TCM, reassemble the engine in accordance with the overhaul manual.

3. If any connecting rod does not meet TCM acceptance criteria, remove and disassemble the engine to allow inspection of the crankcase and crankshaft in accordance with the applicable TCM Overhaul Manual. Replace any part that does not meet Overhaul Manual inspection criteria. Replace each non-conforming connecting rod and its associated piston, piston pin and cylinder assembly.

NOTE: . . Any parts that require replacement must be destroyed to prevent future installation.

4. Reassemble the engine in accordance with the applicable TCM Overhaul Manual and return the aircraft to service.

ENGINE OVERSPEED INSPECTION

Engine operation at speeds in excess of rated RPM limitations can cause damage to the engine and can result in subsequent engine failure.

If an engine overspeed occurs determine the cause for overspeed and correct it. The airframe manufacturer's instructions on engine and propeller overspeed must also be referenced and followed.

If an engine overspeed occurs comply with the following procedures:

RPM TO 3000

1. Less than one minute - No action required

2. More than one minute - Proceed as follows:

a) Drain oil through a fine mesh screen and inspect for debris.

b) Remove oil filter and inspect filter element for debris.

c) Remove and inspect inside of rocker covers for debris. Inspect valve stem (keeper grooves) and valve keepers for condition, security and proper installation. Inspect valve springs, rocker arms, spring retainers, rotocoils, pushrods, etc.

d) Perform a borescope inspection on all cylinders.

e) If no discrepancies are noted, re-service engine, perform operational inspection and correct any discrepancies noted prior to returning the engine to service.

f) If discrepancies are found a decision must be made, based on the evidence, as to the extent of the corrective action required.

RPM TO 3300

1. In addition to action required for "B" above proceed as follows:

   a) Remove all cylinder assemblies including rods and pistons.

   b) Clean, inspect, repair or replace all components removed from the engine in accordance with the manufacturer's current overhaul manual. Using new connecting rod bolts and nuts, reassemble, service and test the engine in accordance with the manufacturer's current overhaul manual.

   c) After five and ten hours of engine operation remove oil filter and inspect filter element for debris.

RPM EXCEEDING 3300

1. Remove engine and clearly identify "Removal For Overspeed".
2. Engine and accessories must be completely overhauled in accordance with the respective manufacturer's current overhaul instructions or replaced with certified airworthy components.

LIGHTNING STRIKE

It is impossible to assess internal damage that may result from a lightning strike. A complete disassembly and inspection of the engine must be accomplished in accordance with the manufacturer's current overhaul manual.

CONTAMINATED FUEL INCORRECT FUEL GRADE

If the aircraft is inadvertently serviced with the wrong grade of fuel or jet fuel the fuel must be completely drained and the tank properly serviced.

Any engine operated on fuel of lower grade than approved for the engine or jet fuel must be completely disassembled, cleaned, inspected, repaired, reassembled and tested in accordance with the manufacturer's current overhaul manual.

5-8 GENERAL INFORMATION

The troubleshooting chart which follows discusses symptoms which can be diagnosed and interprets the probable causes and the appropriate corrective actions to be taken.

Troubleshooting for individual systems will be found in that particular section of Chapters 11 through 22.

Any attempt by unqualified personnel to adjust, repair or replace any parts, may result in engine malfunction or failure.

WARNING

Operation of a malfunctioning engine can cause further damage to a disabled component and possible injury to personnel. By careful inspection and troubleshooting such damage and injury can be avoided.

5-9 ENGINE TROUBLESHOOTING CHART

This troubleshooting chart is provided as a guide. Review all probable causes given, check other listings of troubles with similar symptoms. Items are presented in sequence of the approximate ease of checking, not necessarily in order of probability.

TROUBLE	PROBABLE CAUSE	CORRECTION
Engine Will Not Start	Fuel Tank Empty	Service aircraft fuel system in accordance with the airframe manufacturer's instructions See Chapter 7, "Servicing Fluids," for correct fuel grade.
	Improper starting procedure	Refer to the airframe manufacturer's Airplane Flight Manual (AFM) for engine starting procedures. Check for performance of each item.
	Cylinder overprimed. Engine flooded.	Allow fuel to drain from intake system. **WARNING . . . Starting an engine with a flooded intake system will result in hydraulic lock and subsequent engine malfunction.**
	Induction system leak	Torque or replace loose or damaged hose connection. See Section 14-5, "Induction System maintenance."
	Excessive Starter slippage	Replace starter adapter. See Section 17-5.
	Fuel system malfunction	Isolate cause and correct. See Section 13-4, "Fuel Injection System Troubleshooting."
	Ignition system malfunction	See Section 12-5, "Ignition Troubleshooting."
	Manifold valve vent obstruction	Repair or replace manifold valve. See Section 13-5, "Fuel System Maintenance 'Manifold Valve.' "

TROUBLE	PROBABLE CAUSE	CORRECTION
Engine Will Not Run At Idling Speed	Fuel injection system improperly adjusted	See Section 13-4, "Fuel Injection System Troubleshooting."
	Air leak in intake manifold	Torque loose connection or replace damaged part. See Section 14-5, "Induction System Maintenance."
Rough Idling	Fuel injection system improperly adjusted	See Section 13-4, "Fuel Injection System Troubleshooting."
	Mixture levers set for improper mixture	Adjust the manual mixture control in accordance with the airframe manufacturer's Airplane Flight Manual (AFM).
	Fouled Spark Plugs	Remove, clean and adjust gaps. See Section 12-6, "Ignition System Maintenance 'Spark Plugs."
	Hydraulic lifters fouled	Remove and clean lifters. Inspect and clean oil filter at more frequent intervals. See Section 20-6, "Cylinder Assembly Maintenance 'Hydraulic Valve Tappets."
	Burned or warped exhaust valves, worn seat, scored valve guides	Repair cylinder. See Section 20-6, "Cylinder Assembly Maintenance."
Engine Runs Too Lean At Cruising Power	Improper manual leaning procedure	Refer to the airframe manufacturer's Airplane Flight Manual (AFM) for engine operating instructions.
	Fuel injection system maladjusted	See Section 13-4, "Fuel Injection System Troubleshooting."
Engine Runs Too Rich At Cruising Power	Restrictions in air intake passages	Check passages and remove restrictions.
	Improper manual leaning of fuel/Air mixture	See the airframe manufacturer's Airplane Flight Manual (AFM) for correct leaning procedure.
Engine Runs Too Lean Or Too Rich At Throttle Setting Other Than Cruise	Fuel injection system maladjusted	See Section 13-4, "Fuel Injection System Troubleshooting."
Continuous Fouling Of Spark Plugs	Piston rings excessively worn or broken	Replace rings. Replace cylinder if damaged. See Section 20-6, "Cylinder Assembly Maintenance."
	Piston rings are not seated	Hone cylinder walls, replace rings. See Section 20-6, "Cylinder Assembly Maintenance."

TROUBLE	PROBABLE CAUSE	CORRECTION
Engine Runs Rough At High Speed	Loose mounting bolts or damaged mount pads	Torque mounting bolts. Replace mount pads. See Section 21-5, "Crankcase Maintenance 'Engine Mounts.' "
	Plugged fuel nozzle jet	Clean. See Section 13-5, "Fuel System Maintenance 'Fuel Nozzles.' "
	Propeller out of balance	Remove and repair in accordance with airframe manufacturer's instructions.
	Ignition system malfunction	See Section 12-5, "Ignition Troubleshooting."
Continuous Missing At High Speed	Broken valve spring	Replace, See Section 20-6, "Cylinder Assembly Maintenance."
Continuous Missing At High Speed (Cont'd)	Plugged fuel nozzle jet	Clean. See Section 13-5, "Fuel System Maintenance 'Fuel Nozzles.' "
	Burned or warped valve	Repair cylinder. See Section 20-6, "Cylinder Assembly Maintenance."
	Hydraulic lifter dirty or worn	Remove and clean or replace. See Section 20-6, "Cylinder Assembly Maintenance 'Hydraulic Valve Tappets.' "
Sluggish Operation And Low Power	Throttle not full open	Check and adjust linkage. See Rigging of Mixture and Throttle Controls in the applicable airframe manufacturer's instructions.
	Restrictions in air intake passages	Inspect air intake and remove restrictions.
	Ignition system malfunction	See Section 12-5, "Ignition Troubleshooting."
	Fuel injection system maladjusted	See Section 13-4, "Fuel Injection System Troubleshooting."
	Exhaust system gas leakage	See the airframe manufacturer's instructions.
High Cylinder Head Temperature	Lean fuel/air mixture due to improper manual leaning procedure	See the airframe manufacturer's Airplane Flight Manual (AFM) for correct leaning procedure.
	Dirt between cylinder fins	Clean thoroughly.
	Magnetos out of time. No appreciable drop detected during pre-flight check.	Re-time, Check internal magneto timing and magnetos timing to engine. See Section 12-6, Ignition System Maintenance.

TROUBLE	PROBABLE CAUSE	CORRECTION
High Cylinder Head Temperature (Cont'd)	Exhaust system gas leakage	Locate and correct in accordance with the airframe manufacturer's instructions.
	Engine compartment cooling baffles in poor condition.	Repair or replace in accordance with the airframe manufacturer's instructions.
	Exhaust valve leaking	Repair cylinder. See Section 20-6, "Cylinder Assembly Maintenance."
Oil Leaks	At front of engine; damaged crankshaft oil seal	Replace. See Section 22-5, "Engine Drive Train Maintenance 'Crankshaft Nose Oil Seal.' "
	Around plugs fittings and gaskets due to looseness or damage	Torque or replace. See the applicable disassembly, reassembly portions of the L/TSIO-360 Series Overhaul Manual, Form X30596A, for correct torque values.
Low Compression	Piston rings excessively worn	Repair cylinder. See Section 20-6, "Cylinder Assembly Maintenance."
	Valve faces and seats worn	Repair cylinder. See Section 20-6, "Cylinder Assembly Maintenance."
	Excessively worn cylinder walls	Replace cylinder & piston rings. See Section 20-6, "Cylinder Assembly Maintenance."
Slow Engine Acceleration On A Hot Day	Mixture too rich	Momentarily pull mixture control back until engine acceleration picks up.
Engine Will Not Stop At Idle Cut-Off	Fuel manifold valve not seating properly	Repair or replace fuel manifold valve. See Section 13-5, "Fuel System Maintenance 'Fuel Manifold Valve.' "
Climbing to Altitude Fuel Flow Fluctuates	Fuel Vaporization, Fuel mixture too rich	Operate fuel boost pump in accordance with the airframe manufacturer's Airplane Flight Manual (AFM).
Low Fuel Pressure	Incorrect fuel pump adjustment and operation	Check and adjust in accordance with Chapter 23. Replace malfunctioning pumps. See Section 13-5, "Fuel System Maintenance 'Fuel Pump.' "
	Malfunctioning fuel pump relief valve	Replace fuel pump. See Section 13-5, "Fuel System Maintenance' Fuel Pump.' "
High Fuel Pressure	Malfunctioning relief valve operation in fuel pump	Replace fuel pump. See Section 13-5, "Fuel System Maintenance' Fuel Pump.' "
	Restricted re-circulation passage in fuel pump	Replace fuel pump. See Section 13-5, "Fuel System Maintenance' Fuel Pump.' "

TROUBLE	PROBABLE CAUSE	CORRECTION
	Incorrect fuel pump adjustment and operation	Check and adjust in accordance with Chapter 23. Replace malfunctioning pumps. See Section 13-5, "Fuel System Maintenance 'Fuel Pump.' "
Fluctuating Fuel Pressure	Fuel gage line leak or air in gage line	Drain gage line and torque connections in accordance with the airframe manufacturer's instructions.
	Vapor in fuel system, excessive fuel temperature	Normally, operating the auxiliary pump will clear system. Operate boost pump in accordance with the airframe manufacturer's Airplane Flight Manual (AFM).
Engine Has Poor Acceleration	Idle mixture too lean	(Check RPM Rise, Idle Cutoff)., Readjust idle mixture in accordance with Chapter 23, "Fuel System Adjustment."
	Incorrect fuel-air mixture, worn control linkage, or restricted air cleaner	Torque loose connections, replace worn elements of linkage. Service air cleaner in accordance with airframe manufacturer's instructions.
	Malfunctioning ignition system	Check ignition cables and connections. Replace malfunctioning spark plugs. See Section 12-4, "Ignition System Inspection."
Engine Runs Rough At Speeds Above Idle	Improper fuel-air mixture	Check fuel manifold connections for leaks. Torque loose connections. Check fuel control and linkage for setting and adjustment. Check fuel filters and screens for dirt. Check for proper fuel pump pressure, and replace pump if malfunctioning. See Section 13-5, "Fuel System Maintenance."
	Restricted fuel nozzle jet	Remove and clean all nozzle jets. See Section 13-5, "Fuel System Maintenance 'Fuel Nozzles.' "
	Ignition system and spark plugs malfunctioning	Clean and re-gap spark plugs. Check ignition cables for wear. Replace malfunctioning components. See Section 12-6, "Ignition System Maintenance."
Engine Lacks Power Reduction in Maximum Manifold Pressure	Incorrectly adjusted throttle control, "sticky" linkage or dirty air cleaner	Check movement of linkage by moving control from idle to full throttle. Make proper adjustments and replace worn components. Service air cleaner in accordance with the airframe manufacturer's instructions.

TROUBLE	PROBABLE CAUSE	CORRECTION
	Malfunctioning ignition system component	Inspect spark plugs for fouled electrodes, heavy carbon deposits, erosion of electrodes, improperly adjusted electrode gaps, and cracked porcelains. Test plugs for regular firing under pressure. Replace damaged or misfiring plugs. Gap spark plugs to spark plug manufacturer's specifications. See Section 12-6, "Ignition System Maintenance 'Spark Plugs.'
	Loose or damaged intake manifold	Inspect entire manifold system for possible leakage at connections. Replace damaged components, torque all connections and clamps. See Section 14-5, "Induction System Maintenance."
	Fuel nozzles malfunctioning	Check for restricted nozzle jets, lines and clean or replace as necessary. See Section 13-5, "Fuel System Maintenance 'Fuel Nozzles.'
	Malfunctioning Turbocharger wastegate or exhaust system	See Section 11-8, "Exhaust System Troubleshooting ."
Low Oil Pressure Indication On Engine Gage	Insufficient oil in oil sump, oil dilution or using improper grade oil for prevailing ambient temperature	Add oil, or change oil to proper viscosity. See Chapter 7, "Servicing Fluids.' "
	High oil temperature	Malfunctioning oil temperature control valve in oil cooler; oil cooler restriction. Replace valve or clean oil cooler. See Section 18-5, "Oil Cooler."
	Leaking, damaged or loose oil line connections - Restricted screen or filter	Check for restricted lines, loose connections, and for partially plugged oil filter or screens. Clean parts, torque connections, and replace malfunctioning parts. See Section 18-5, "Oil Pump," for filter replacement.
	Oil pressure gage malfunction	Check oil pressure gage calibration in accordance with the airframe manufacturer's instructions.
Low Oil Pressure Indication On Engine Gage(cont'd)	Engine oil pressure maladjusted	Adjust oil pressure in accordance with Chapter 23, "Oil Pressure Adjustment."
	Low oil supply. Oil viscosity too low	Replenish. Drain and refill with correct seasonal weight. See Chapter 7, "Servicing Fluids."

TROUBLE	PROBABLE CAUSE	CORRECTION
	Malfunctioning oil pump	Replace oil pump. See Section 18-5, "Oil Pump."
	Weak or broken oil pressure relief valve spring	Replace spring. Adjust pressure to 30-60 pounds per square inch in accordance with Chapter 23, "Oil Pressure Adjustment."
High Oil Temperature Indication	Prolonged ground operation	Limit ground operation to a minimum.
	Malfunctioning gage or bulb unit	Check wiring. Check bulb unit. Check gage. Replace malfunctioning parts in accordance with the airframe manufacturer's instructions.

CHAPTER 6
Unpacking, Deinhibiting, Installation and Testing

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6-1 GENERAL

Technicians involved with engine preparation and installation into the airframe must possess a detailed knowledge of safe procedures used in engine servicing and the operation of ground support equipment.

The engine must have a detailed visual inspection prior to installation in the airframe.

6-2 UNPACKING

Packaging Category "A" (Cardboard Container)

1. Cut steel banding straps securing the container. (Use caution as straps may spring loose when cut).
2. Remove the staples from the base of the cardboard cover.
3. Lift cardboard cover vertically and remove.
4. Attach a hoist to the engine lifting eye, located at the top of the crankcase backbone. Take up slack on the hoist, then cut the steel banding straps holding the engine to the base. (Use caution as straps may spring loose when cut.) Lift the engine vertically and install on a transportation stand or dolly.

CAUTION . . . Do not allow chains to become entangled on engine or its hardware.

Packaging Category "B" (Wooden Container)

1. Remove the (4) four lag screws attaching the wooden cover to the base.
2. Lift the wooden cover vertically and remove.
3. Open the moisture proof plastic bag.
4. Attach a hoist to the engine lifting eye located at the top of the crankcase backbone. Take up slack on the hoist, prior to loosening the engine mount bolts; then remove the bolts from the shipping shock mounts. Lift the engine vertically and install on a transportation stand or dolly.

CAUTION . . . Do not allow chains to become entangled on engine or its hardware.

6-3 GROUND HANDLING

After engine is removed from container (attached to hoist) proceed with care. Do not let engine front, rear, sides or bottom come in contact with any obstructions as the extreme weight may cause damage to the engine or components. If contact has occurred, inspect for obvious or consequential damage.

6-4 CRATING AND SHIPPING

Category"A" (cardboard container). Lower engine onto container base and attach with metal banding straps. Install and attach container cover.

Category "B" (wooden container). Lower engine onto container base. Attach engine using shock mounts and bolts. Cover engine with plastic bag. Install and attach container cover to base.

6-5 PREPARATION FOR SERVICE

If the engine is not to be installed within five (5) days after removing shipping plugs, it must be represerved in accordance with procedures listed in Chapter 8.

If the engine is to be installed within five (5) days after unpacking, remove the shipping plugs installed in the lower spark plug holes and turn the crankshaft through at least two complete revolutions in order to remove the cylinder preservation oil from the cylinder. Remove the shipping plugs installed in the upper spark plug holes and inspect the cylinder bore with a borescope for rust or contamination. Contact your Teledyne Continental Motors Distributor if any abnormal condition is noted.

Apply Champion® thread lubricant to spark plugs in accordance with the manufacturer's instructions (see Chapter 3). Install the spark plugs and torque to 300-360 in. lbs.Install the upper spark plugs finger tight.

CAUTION . . . During installation of propeller governor in accordance with the airframe manufacturer's instructions ,insure that the governor gear splines align properly with the camshaft governor drive gear and that the governor is fully seated to the crankcase prior to installing the attaching hardware. This will eliminate the possibility of misalignment forcing the governor bevel gear over the camshaft governor drive gear. Also insure that the proper gasket is used and lubrication holes are properly aligned.

WARNING

Oil pressure is applied to the face of the accessory drive pads. If gasket, accessory or cover is not properly installed and hardware is not properly torqued oil leakage will occur.

*CAUTION . . . When a test club or fixed pitch propeller is used for testing purposes the **governor pad cover** must have an **internal grooved surface** to allow the circulating oil to lubricate the front main bearing. The governor pad cover is not needed if a propeller governor is installed.*

WARNING

Do not connect the ignition harness to the spark plugs until the propeller installation is completed. Failure to comply could result in bodily injury when the propeller is rotated during installation.

NOTE . . . Remove all protective plugs from the following locations: exhaust outlets, crankshaft flange and fuel pump fittings.

NOTE . . . Drain preservative oil from sump. Engines that have a complete set of overhauled or new cylinders and new piston rings installed must be serviced with clean Engine Break-In and Preservation oil conforming with MIL-C-6529 TYPE II until it has been determined that the engine oil consumption has stabilized (approximately 25 hours of operation.) Thereafter, the engine must be serviced with clean ashless dispersant oil. See Section 7-2, "Approved Ashless Dispersant Oils."

6-6 ENGINE INSTALLATION INSTRUCTIONS (See Figures 6-1)

CAUTION . . . The engine must be hoisted using the lifting eye brackets only.

WARNING

The aircraft fuel tanks and lines must be purged to remove all contamination prior to installation of the main fuel inlet line to the fuel pump. Failure to comply can cause erratic fuel injection system operation and damage to its components.

Install the engine and make airframe to engine connections in accordance with the airframe manufacturer's instructions.

Install all airframe manufacturer required components including cooling baffles, hoses, fittings, brackets and ground straps in accordance with the airframe manufacturer's installation instructions.

WARNING

Do not connect the ignition harness to the spark plugs until the propeller installation is completed. Failure to comply could result in bodily injury when the propeller is rotated during installation.

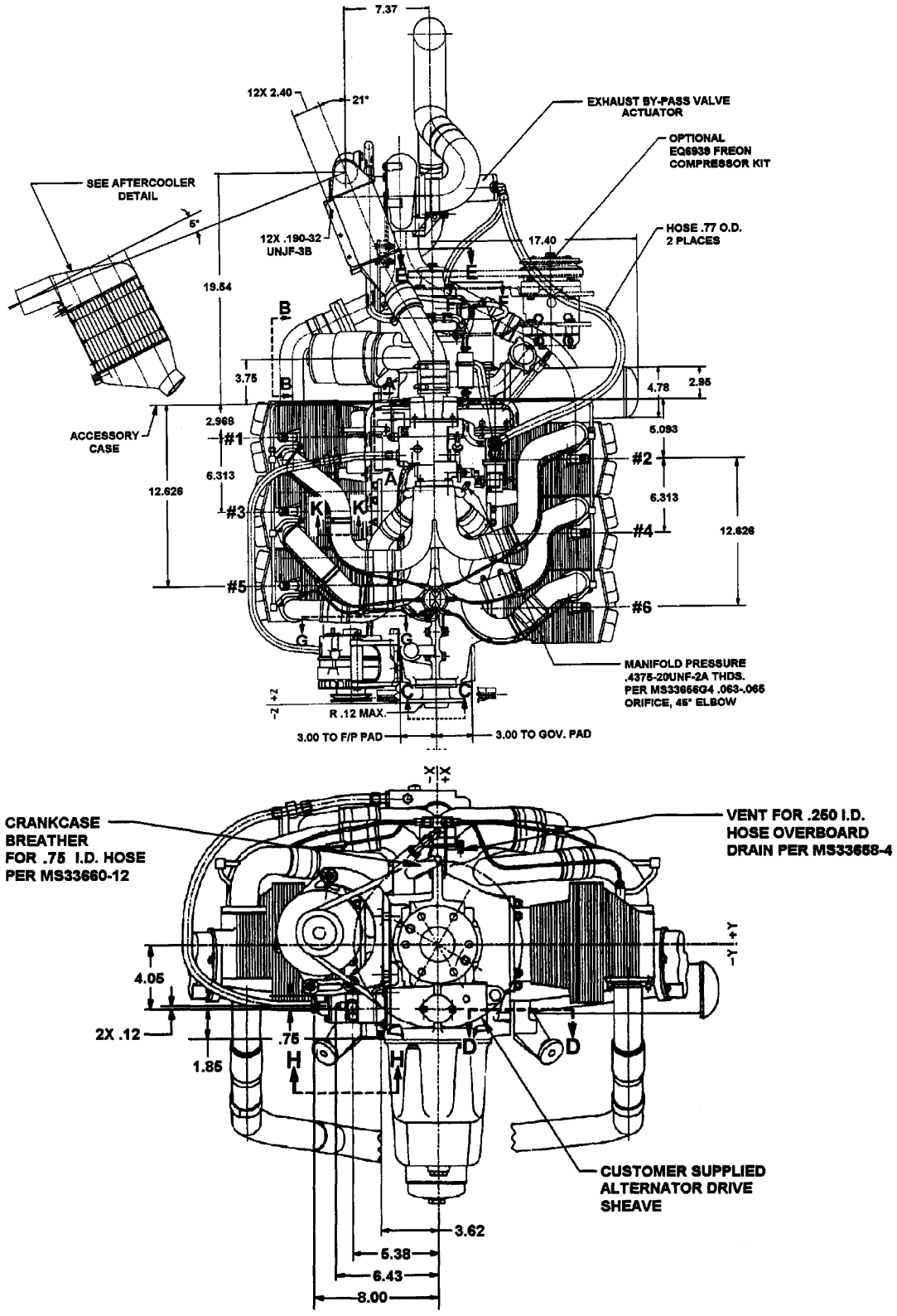

FIGURE 6-1. INSTALLATION DRAWING

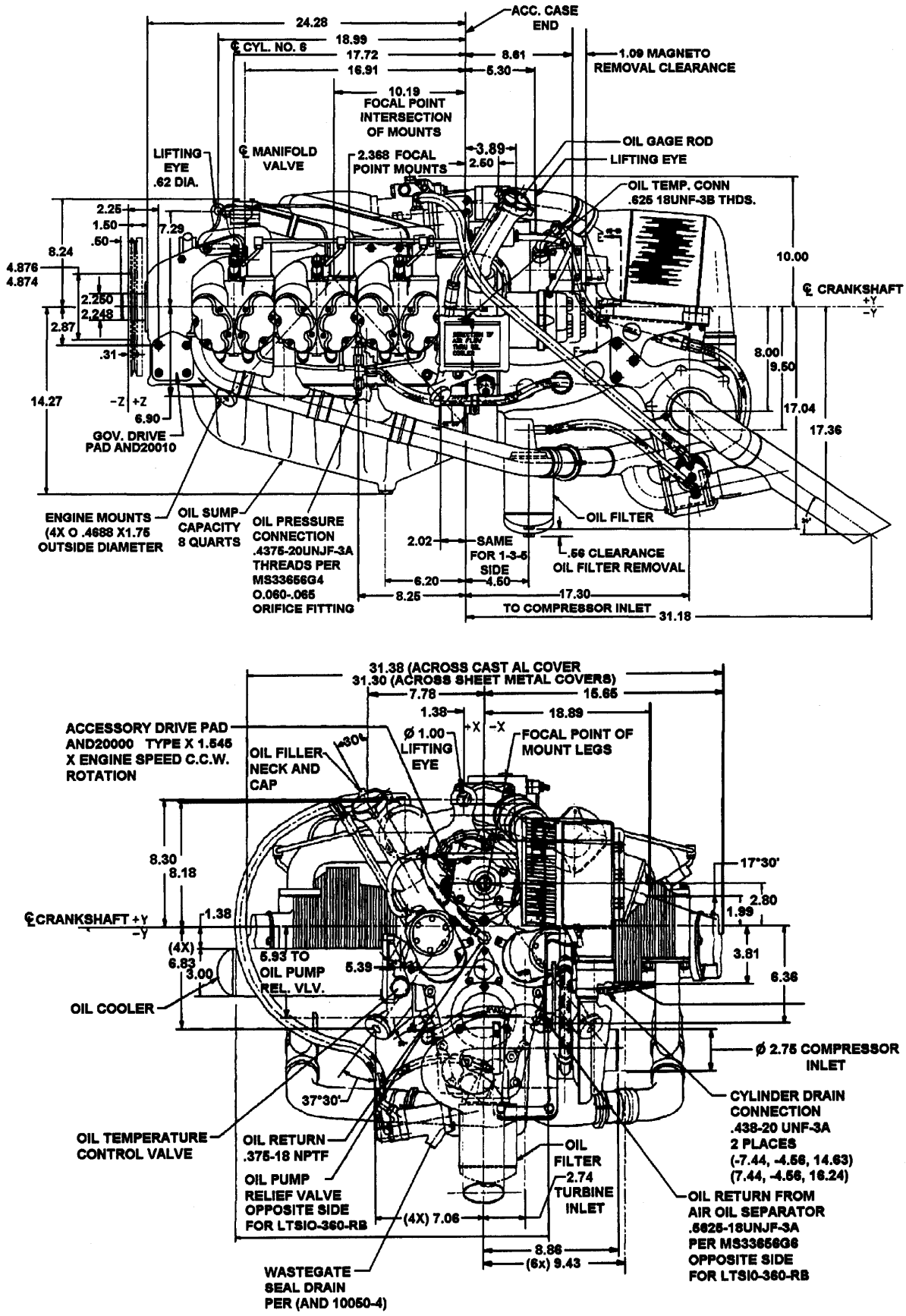

FIGURE 6-1. INSTALLATION DRAWING (cont'd)

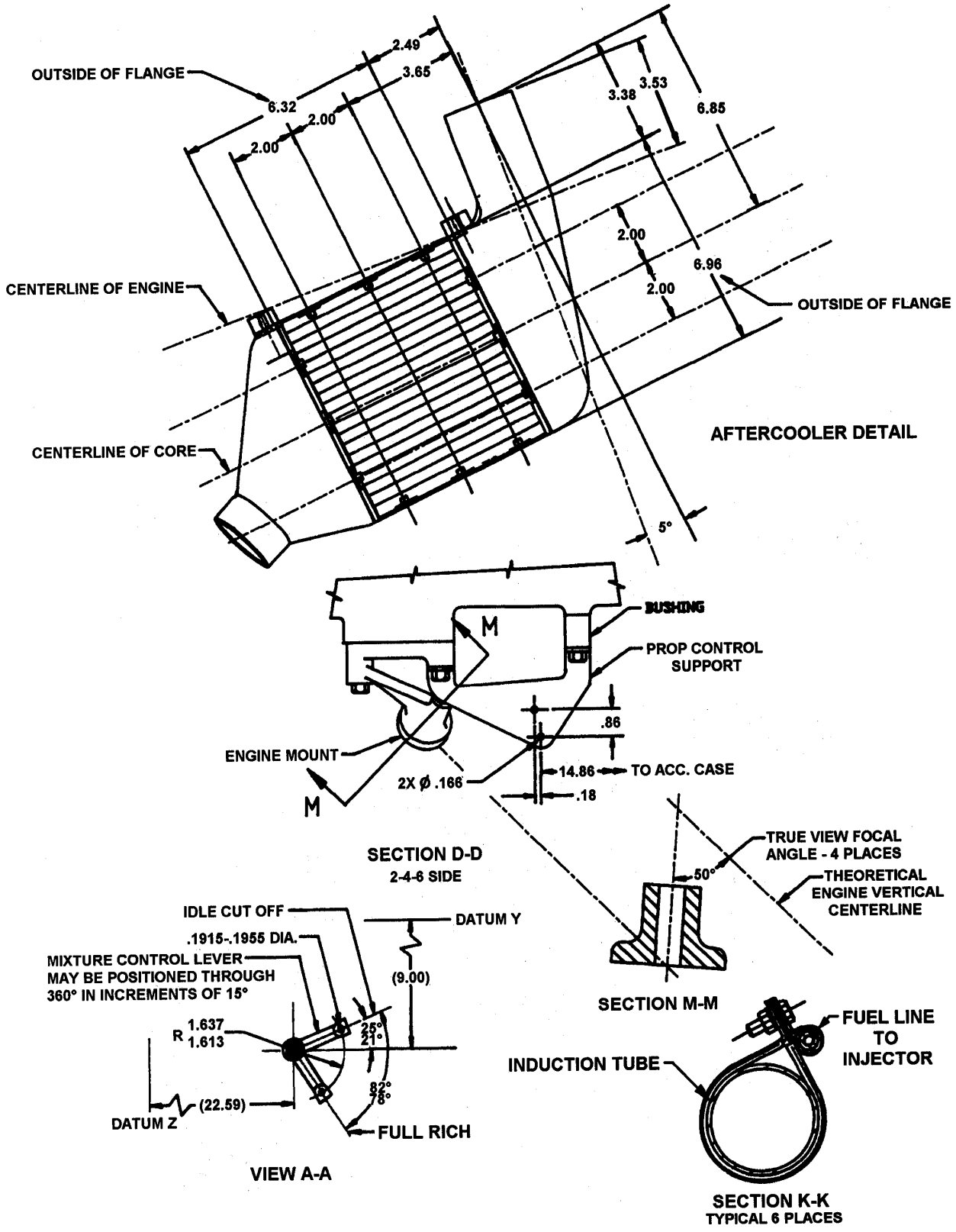

FIGURE 6-1. INSTALLATION DRAWING (cont'd)

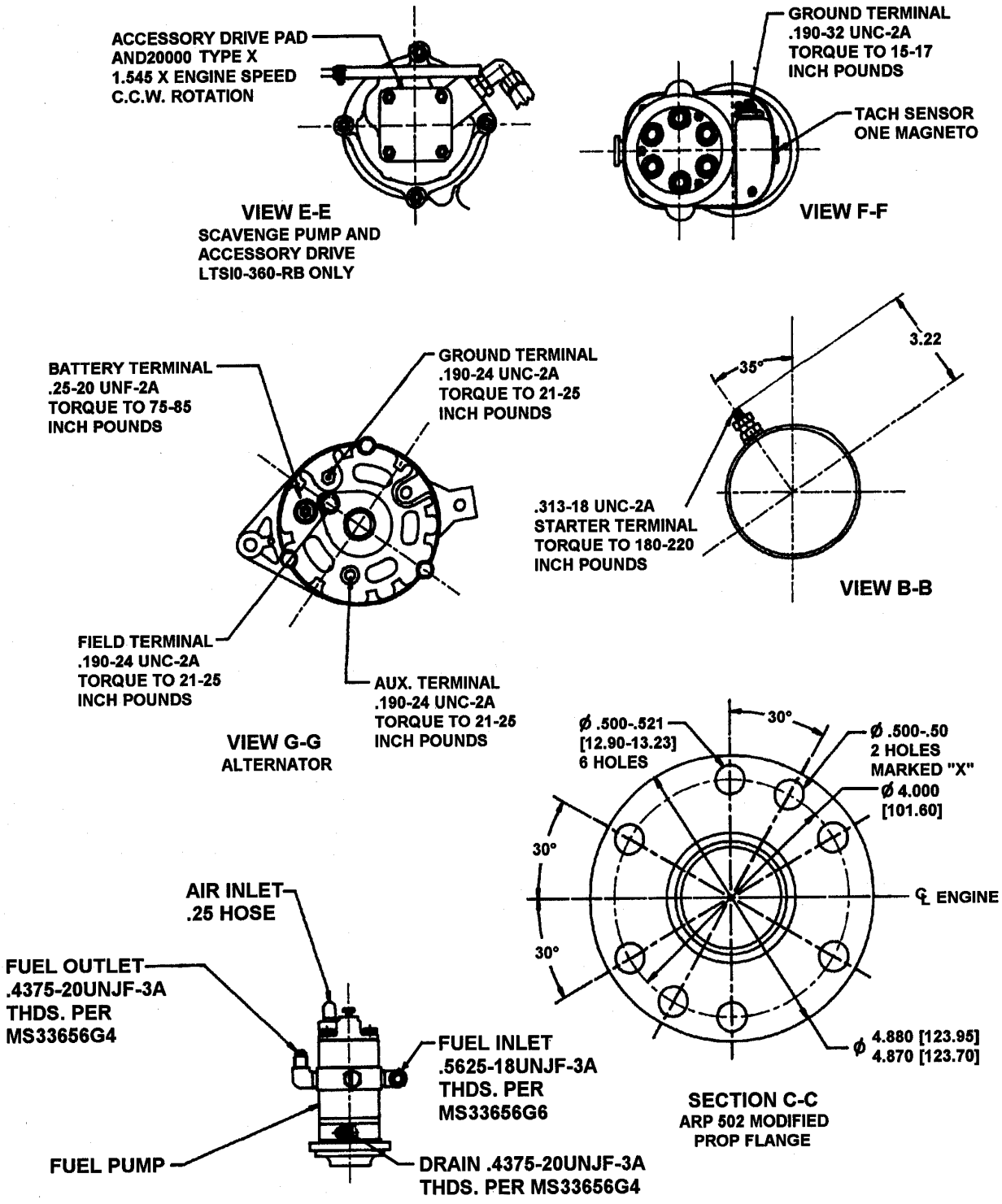

FIGURE 6-1. INSTALLATION DRAWING (cont'd)

6-7 ENGINE PRE-OILING

It is important that all engine internal moving parts be properly lubricated before initial running of engine. Pre-oil engine prior to initial engine operation according to the following procedure:

1. Pre-oiling may be accomplished using a bladder type pressure pot capable of holding at least (1) gallon of clean aviation engine oil with an output pressure of 50 not to exceed 60 psi. See Section 7-2, "Approved Ashless Dispersant Oils," for proper type of oil to use. See Section 1-10, "Operating Limits," for proper seasonal oil grade.
2. Remove rocker box covers from cylinders. Connect pre-oiler supply hose to engine oil pressure gage line connection (fitting). Open pre-oiler valve and watch cylinder rocker areas for indication of oil flow. Some engines may take as long as twenty (20) minutes for oil indication depending on oil temperature.
3. After oil flow has been confirmed, re-install rocker covers using new gaskets, torque rocker cover screws to limit specified in the L/TSIO-360 Overhaul Manual, Form OH-08. Close valve on pre-oiler. Disconnect pre-oiler supply hose and cap or re-install engine oil pressure gage line on pressure gage line connection (fitting) as applicable.
4. Check engine oil gage rod (dipstick) and service to correct capacity. Engine is now ready for initial run-up and test.

CAUTION . . . Recheck the oil level in the sump. Do not operate the engine with more or less than the oil sump capacity. See Sections 1-10, "Operating Limits" and 7-1, "Servicing Oil," for correct grade oil, sump capacity and servicing points.

If the magneto attaching nuts were loosened or the magnetos rotated during engine installation, magneto to engine timing must be adjusted to specification prior to starting. See Section 12-5 Ignition System Maintenance of this manual.

Apply Champion® thread lubricant to spark plugs in accordance with the manufacturer's instructions (see Chapter 3). Install the upper spark plugs and torque to 300-360 inch pounds.

Install the ignition harness "B" nuts on the spark plugs. The nuts are stamped with a position identifier, i.e. "1t" which means the top spark plug of the number one cylinder.

6-8 PREFLIGHT AND RUN-UP

NOTE . . . Engines that have a complete set of overhauled or new cylinders and new piston rings installed must be serviced with Engine Break-In and Preservation oil conforming with MIL-C-6529 TYPE II until it has been determined that the engine oil consumption has stabilized (approximately 25 hours of operation.)

Thereafter, the engine must be serviced with the appropriate grade (depending on ambient temperature) of ashless dispersant oil. See Section 7-2, "Approved Ashless Dispersant Oils."

Start the engine in accordance with the procedures in the airframe manufacturer's Airplane Flight Manual (AFM).

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

The fuel system must be adjusted prior to flight in accordance with this manual. See Chapter 23, "Fuel System Adjustment."

An operational inspection in accordance with section 5-3 of this manual must be performed prior to releasing the aircraft for test flight. The operational inspection must be performed to insure that no induction system, exhaust system, oil system, fuel system leaks or any other

discrepancies exist. After the operational inspection a test flight is required to insure that the engine and aircraft meet all of the manufacturer's performance and operational specifications prior to releasing the aircraft for normal service.

WARNING

Although the engine fuel system was adjusted at engine test, the fuel system must be checked and adjusted in accordance with Chapter 23 "Fuel System Adjustment," of this manual and current TCM service documents when the engine is first installed into the airframe and at 100 hour intervals to insure proper operation. All discrepancies must be corrected prior to test flight.

6-9 FLIGHT TESTING

CAUTION . . . Adhere to engine operating limits published in this Manual and the Pilot's Operating Handbook/Airplane Flight Manual during test flight.

Ambient air and engine operating temperatures are of major concern during this test flight. Accomplish a normal pre-flight run-up in accordance with the airframe manufacturer's Pilot's Operating Handbook/Airplane Flight Manual. Conduct a normal take-off with full power and monitor the fuel flow, RPM, oil pressure, cylinder head temperatures and oil temperatures. Reduce to climb power in accordance with the flight manual and maintain a shallow climb attitude to gain optimum airspeed and cooling. Rich mixture should be used for all operations except leaning for cruise economy. Leaning operations must be performed in accordance with the airframe manufacturer's Pilot's Operating Handbook/Airplane Flight Manual.

Level flight cruise should be at 75% power with best power or richer mixture for the first hour of operation. During the second hour, alternate power settings between 65% and 75% power with the appropriate best power mixture settings. The best power mixture setting is 100°F to 150°F rich of peak exhaust gas temperature.

The descent should be made at low cruise power settings with careful monitoring of engine pressures and temperatures.

Any abnormal conditions detected during test flight must be corrected and any final adjustments must be accomplished prior to releasing the aircraft for normal service.

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CHAPTER 7
SERVICING FLUIDS

7-1 SERVICING OIL

CAUTION . . . Some funnel-type quart oil containers incorporate a styrofoam or aluminum seal. Remove this seal from the container and discard it before adding oil to the engine. If the seal falls into the engine, engine damage and possible failure can result.

The oil system must be serviced to capacity with the oil grades specified.

A certain amount of oil consumption is normal. If excessive consumption or any abrupt change in rate of consumption is detected, this condition must be corrected before further flight.

Maintain the engine compartment, nacelle and the fuselage adjacent to the nacelle in a clean condition in order that an oil leak can be detected and corrected before further flight.

WARNING

Engine operation with no oil or severely reduced oil levels will cause engine malfunction or failure.

CAUTION . . . Petroleum base aviation engine oil is flammable and must be stored in a well ventilated area away from any heat source.

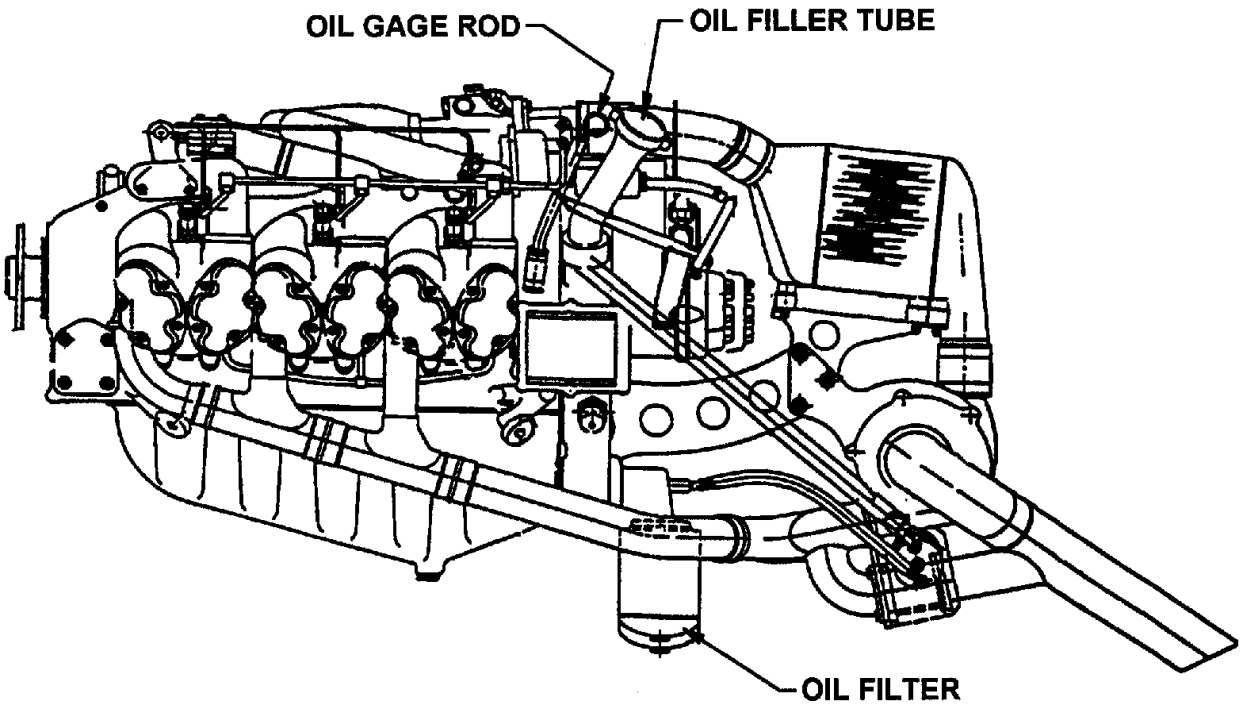

FIGURE 7-1. OIL SERVICING POINTS

7-2 APPROVED ASHLESS DISPERSANT OILS :

BP Oil Corporation	BP Aero Oil
Castrol	Castrol Aero AD Oil
Castrol Limited (Australia)	Castrol Aero AD Oil
Chevron U.S.A., Inc.	Chevron Aero Oil
Continental Oil	Conco Aero S
Delta Petroleum Company	Delta Avoil Oil
Exxon Company, U.S.A.	Exxon Aviation Oil EE
Gulf Oil Company	Gulfpride Aviation AD
Mobil Oil Company	Mobil Aero Oil
NYCO S.A.	TURBONYCOIL 3570
Pennzoil Company	Pennzoil Aircraft Engine Oil
Phillips Petroleum Company	Phillips 66 Aviation Oil, Type A
Phillips Petroleum Company	X/C Aviation Multiviscosity Oil SAE 20W50, SAE 20W60
Quaker State Oil & Refining Company	Quaker State AD Aviation Engine Oil
Red Ram Limited (Canada)	Red Ram X/C Aviation Oil 20W50
Shell Australia	Aeroshell (R) W
Shell Canada Limited	Aeroshell Oil W, Aeroshell Oil W 15W50 Anti-Wear Formulation Aeroshell Oil W 15W50
Shell Oil Company	Aeroshell Oil W, Aeroshell Oil W 15W50 Anti-Wear Formulation Aeroshell Oil W 15W15
Sinclair Oil Company	Sinclair Avoil
Texaco Inc.	Texaco Aircraft Engine Oil - Premium AD
Total France	Total Aero DM 15W50
Union Oil Company of California	Union Aircraft Engine Oil HD

APPROVED MINERAL OIL:

MIL-C-6529 TYPE II

7-3 FUEL

Aviation Minimum Grade	100LL (Blue) or 100 (Green)

WARNING

The use of lower octane rated fuel or jet fuel will result in damage or destruction of an engine the first time high power is applied. This would most likely occur on takeoff. If the aircraft is inadvertently serviced with the wrong grade of fuel or jet fuel the fuel must be completely drained and the tank properly serviced.

For aircraft fueling procedure, see the airframe manufacturer's instructions.

7-4 OIL FILTER ELEMENT INSPECTION

Inspect oil filter element at each oil and filter change even if oil analysis is being used. Filter element inspection may identify internal engine wear that will not be identified through oil analysis.

New, rebuilt, overhauled engines or engines that have had cylinders replaced will generally exhibit noticeable amounts of normal wear material at the first and second oil and filter change. The amount of material present should significantly decrease between the first and second oil and filter change if the engine and or cylinders have been properly operated during the break-in period.

As with oil analysis, oil filter element inspection provides maintenance personnel with additional information on the wear characteristics of a specific engine. Sudden, unexplained increases in concentration of wear material in a filter element should alert maintenance personnel to investigate the source and cause of the material.

Material Identification:

Ferrous - attracts to magnet.

Aluminum - will "sizz" or bubble when placed in a 50 % solution of muriatic acid.

Bronze or Copper - will turn bright green when placed in nitric acid.

Carbon - will disintegrate when rubbed between index finger and thumb.

Sand - will not disintegrate when rubbed between two hard surfaces and will scratch glass when pressure is applied.

Nickel - will not be magnetically attracted but looks similar to ferrous material.

Tin - will not be attracted magnetically. It looks similar to nickel but is soft and malleable.

7-5 SPECTROGRAPHIC OIL ANALYSIS

Spectrographic oil analysis has become popular with the owners and operators of general aviation piston powered aircraft. This process was developed more than 35 years ago by the railroads as a method of identifying wear characteristics in large diesel engines. Eventually oil analysis was adopted by the military and then by commercial and general aviation.

Engines are designed and manufactured using various materials and alloys. The engine lubrication system is designed to provide either pressure or splash oil to areas of the engine subjected to frictional loading. During normal operation these areas undergo minute, continuous wear; sub-micronscopic material is released from these contact surfaces and are suspended in the lubricating oil. Spectrographic oil analysis identifies these materials and their level of concentration in parts per million (PPM).

There are two accepted methods of performing oil analysis: atomic absorption and atomic emissions.

Atomic absorption will identify suspended wear material that is five micron in size or smaller, while atomic emissions will identify suspended wear material that is ten micron in size or smaller. Since engine oil analysis is used as a tool to establish engine wear trends and deviations from the established norm, either method is acceptable; however, it is important to realize the oil analysis program must utilize the same laboratory for all sample analysis. Comparing an oil analysis report from a separate laboratory will have little meaning if each laboratory uses a different analysis method.

7-5 SPECTROGRAPHIC OIL ANALYSIS (continued)

A proper spectrographic oil analysis program should begin with the first engine oil change. Establishing a wear trend data base for an engine will require analysis of at least three oil samples. As the engine accumulates operating time and additional oil samples are analyzed, a definitive wear trend can be identified. Unexplained deviations from normal wear trend patterns should be investigated using accepted, conventional inspection methods.

Spectrographic oil analysis must be accomplished according to a set protocol to provide any useful information. Even if done properly, spectrographic oil analysis will rarely provide any prior indication of a fatigue type failure. A single spectrographic oil sample will usually not provide a high level of useful information since there is no established wear trend data on that specific engine for comparison.

Spectrographic oil analysis will assist in the identification of an internal engine problem. If samples are properly taken at regular intervals, it should provide the owner / operator and oil analysis technician with information relative to normal or abnormal wear that occurs during the course of engine operation. Deviations from an established wear trend pattern should alert the owner / operator and oil analysis technician to further investigate.

Limitations

Variations in operation, use and maintenance may be reflected in the parts per million content reported. Deviations from standard or previously used sampling procedures may result in variations to the parts per million content in the sample report.

General Procedures

To establish a data base for comparison and analysis, oil samples must be taken on a regular schedule using the same sampling techniques and laboratory. The engine must have been operated long enough to obtain normal operational temperatures and the oil sample taken within 30 minutes after engine shut down. The tube or funnels used to drain the oil from the sump must be clean and free of any foreign material or residue. If the oil sample is taken from the oil as it drains from the sump, allow approximately 1/3 of the oil drain prior to taking the sample. If the sample is taken via the oil filler or other location using a sampling tube, it is critical the sample be taken from two or three inches above the bottom of the oil sump, not from the bottom. Do not take an oil sample from the oil filter canister.

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CHAPTER 8
ENGINE PRESERVATION AND STORAGE

8-1 GENERAL

There is no practical procedure that will insure corrosion prevention on installed aircraft engines. Susceptibility to corrosion is influenced by geographical location, season and usage. The owner/operator is responsible to recognize the conditions that are conducive to corrosion and take appropriate precautions.

8-2 ENGINE PRESERVATION

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

NOTE. . . Corrosive attack may reduce engine service life. Of primary concern are cylinders, piston rings, valves, valve guides camshaft and lifters.

NOTE. . . See Precision Airmotive Corporation instructions for preservation of the fuel servo unit.

The following procedure, if properly utilized, will aid in reducing the severity of corrosive attack.

8-3 TEMPORARY STORAGE

Preparation for storage.

1. Remove oil sump drain plug and drain oil. Replace drain plug, torque and safety. Remove oil filter. Install new oil filter torque and safety. Service engine to proper sump capacity with oil conforming to MIL-C6529 Type II.
2. Perform a ground run-up. Perform a pre-flight inspection and correct any discrepancies. Fly the aircraft for one hour at normal operation temperatures.

WARNING

To prevent possibility of serious bodily injury or death, before moving the propeller accomplish the following:

a. Disconnect all spark plug leads.
b. Verify magneto switches are connected to magnetos, that they are in the "OFF" Position and "P" leads are grounded.
c. Throttle position "CLOSED."
d. Mixture control "IDLE-CUT-OFF."
e. Set brakes and block aircraft wheels.
f. Insure that aircraft tie-downs are installed and verify that the cabin door latch is open.
g. Do not stand within the arc of the propeller blades while turning the propeller.

3. After flight remove all spark plug leads and remove the top spark plugs. Protect the ignition lead ends with AN-4060 Protectors. Using a common garden sprayer or equivalent, spray atomized preservative oil that - meets MIL-P-46002, Grade 1, at room temperature through upper spark plug hole of each cylinder with the piston at bottom dead center position. Rotate crankshaft as opposite cylinders are sprayed. Stop crankshaft with none of the pistons at top dead center.
4. Re-spray each cylinder. To thoroughly cover all surfaces of the cylinder interior move the nozzle or spray gun from the top to the bottom of the cylinder.
5. Install top spark plugs but do not install spark plug leads.

6. Seal all engine openings exposed to the atmosphere using suitable plugs and covers.
7. Tag each propeller in a conspicuous place with the following notation on the tag: DO NOT TURN PROPELLER - ENGINE PRESERVED - PRESERVATION DATE_____.

NOTE. . . If the engine is not returned to flyable status on or before the 90-day expiration, it must be preserved in accordance with "Indefinite Storage" procedures in this chapter.

8-4 INDEFINITE STORAGE

PREPARATION FOR STORAGE

1. Remove oil sump drain plug and drain oil. Replace drain plug, torque and safety. Remove oil filter. Install new oil filter torque and safety. Service engine to proper sump capacity with oil conforming to MIL-C6529 Type II.
2. Perform a ground run-up. Perform a pre-flight inspection and correct any discrepancies. Fly the aircraft for one hour at normal operation temperatures.

WARNING

To prevent possibility of serious bodily injury or death, before moving the propeller accomplish the following:

a. Disconnect all spark plug leads.
b. Verify magneto switches are connected to magnetos, that they are in the "OFF" Position and "P" leads are grounded.
c. Throttle position "CLOSED."
d. Mixture control "IDLE-CUT-OFF."
e. Set brakes and block aircraft wheels.
f. Insure that aircraft tie-downs are installed and verify that the cabin door latch is open.
g. Do not stand within the arc of the propeller blades while turning the propeller.

3. After flight remove all spark plug leads and remove the spark plugs. Protect the ignition lead ends with AN-4060 Protectors. Install protective plugs P/N 22671 in bottom spark plug holes. Using a common garden sprayer or equivalent, spray atomized preservative oil that meets MIL-P-46002, Grade 1, at room temperature through upper spark plug hole of each cylinder with the piston at bottom dead center position. Rotate crankshaft as opposite cylinders are sprayed. Stop crankshaft with none of the pistons at top dead center.
4. Re-spray each cylinder. To thoroughly cover all surfaces of the cylinder interior move the nozzle or spray gun from the top to the bottom of the cylinder.
5. Install dehydrator plugs MS 27215-1 or -2 in each of the upper spark plug holes. Make sure each plug is blue in color when installed.
6. Attach a red "REMOVE BEFORE FLIGHT" streamer to each bag of desiccant. Place a bag of desiccant in the exhaust pipes and seal the openings.
7. Seal all engine openings exposed to the atmosphere using suitable plugs and covers.
8. Tag propeller in a conspicuous place with the following notation on the tag: DO NOT TURN PROPELLER - ENGINE PRESERVED - PRESERVATION DATE_____.

8-5 INDEFINITE STORAGE INSPECTION PROCEDURES

1. Aircraft prepared for indefinite storage must have the cylinder dehydrator plugs visually inspected every 15 days. The plugs must be changed as soon as they indicate other than a dark blue color. If the dehydrator plugs have changed color in one-half or more of the cylinders, all desiccant material on the engine must be replaced.
2. The cylinder bores of all engines prepared for indefinite storage must be re-sprayed with corrosion preventive mixture every 90 days.

8-6 RETURNING AN ENGINE TO SERVICE AFTER STORAGE

1. Remove seals and all desiccant bags.
2. Remove cylinder dehydrators and plugs or spark plugs from upper and lower spark plug holes.
3. Remove oil sump drain plug and drain the corrosion preventive mixture. Replace drain plug, torque and safety. Remove oil filter. Install new oil filter torque and safety. Service the engine with oil in accordance with the manufacturer's instructions.

WARNING

To prevent possibility of serious bodily injury or death, before moving the propeller accomplish the following:

a. Disconnect all spark plug leads.
b. Verify magneto switches are connected to magnetos, that they are in the "OFF" Position and "P" leads are grounded.
c. Throttle position "CLOSED."
d. Mixture control "IDLE-CUT-OFF."
e. Set brakes and block aircraft wheels.
f. Insure that aircraft tie-downs are installed and verify that the cabin door latch is open.
g. Do not stand within the arc of the propeller blades while turning the propeller.

4. Rotate propeller by hand several revolutions to remove preservative oil.
5. Service and install spark plugs and ignition leads in accordance with the manufacturer's instructions.
6. Service engine and aircraft in accordance with the manufacturer's instructions.
7. Thoroughly clean the aircraft and engine. Perform visual inspection.
8. Correct any discrepancies.
9. Conduct a normal engine start.
10. Perform operational test in accordance with "Operational Inspection," Chapter 1, Maintenance. .
11. Correct any discrepancies.
12. Perform a test flight in accordance with airframe manufacturer's instructions.
13. Correct any discrepancies prior to returning aircraft to service.
14. Change oil and filter after 25 hours of operation.

CHAPTER 9
STANDARD PRACTICES

9-1 GENERAL

To facilitate and insure proper reinstallation, tag or mark all parts and hardware as they are removed or disassembled.

Tag any unserviceable parts or units for investigation and possible repair. Take extreme care to prevent foreign matter, lockwire, nuts, washers, dirt, etc., from entering the engine on or off the aircraft. Make use of protective caps, plugs and covers to insure openings are unexposed.

WARNING

Dust caps used to protect open lines must be installed OVER the tube ends and NOT IN the tube ends. Flow through the lines will be blocked if lines are inadvertently installed with the dust caps in the tube ends.

If anything is dropped into the engine work must be stopped immediately and the item removed.

Insure all parts are thoroughly cleaned, properly protected from dust and corrosion and properly stored until assembly .

Make sure replacement nonmetallic and metallic parts show no sign of storage deterioration. Parts exceeding specified shelf life limitations must not be used.

9-2 LOCKWIRE PROCEDURE

Lockwiring is the securing together of two or more parts with lockwire which shall be installed in such a manner that any tendency for a part to loosen will be counteracted by additional tightening of the wire.

Wire shall be pulled taut while being twisted and caution must be exercised during the twisting operation to keep the wire tight without over stressing. See Figure 9-1, "General Lockwire Procedure" for steps in applying lockwire.

All lockwire utilized on TCM engines must conform to MS 20995 Condition A. Most bolts utilized in TCM engines that require lockwiring will use .032 lock wire and require twisting at a rate of 7 to 10 twists per inch. Lockwire shall be new at each application.

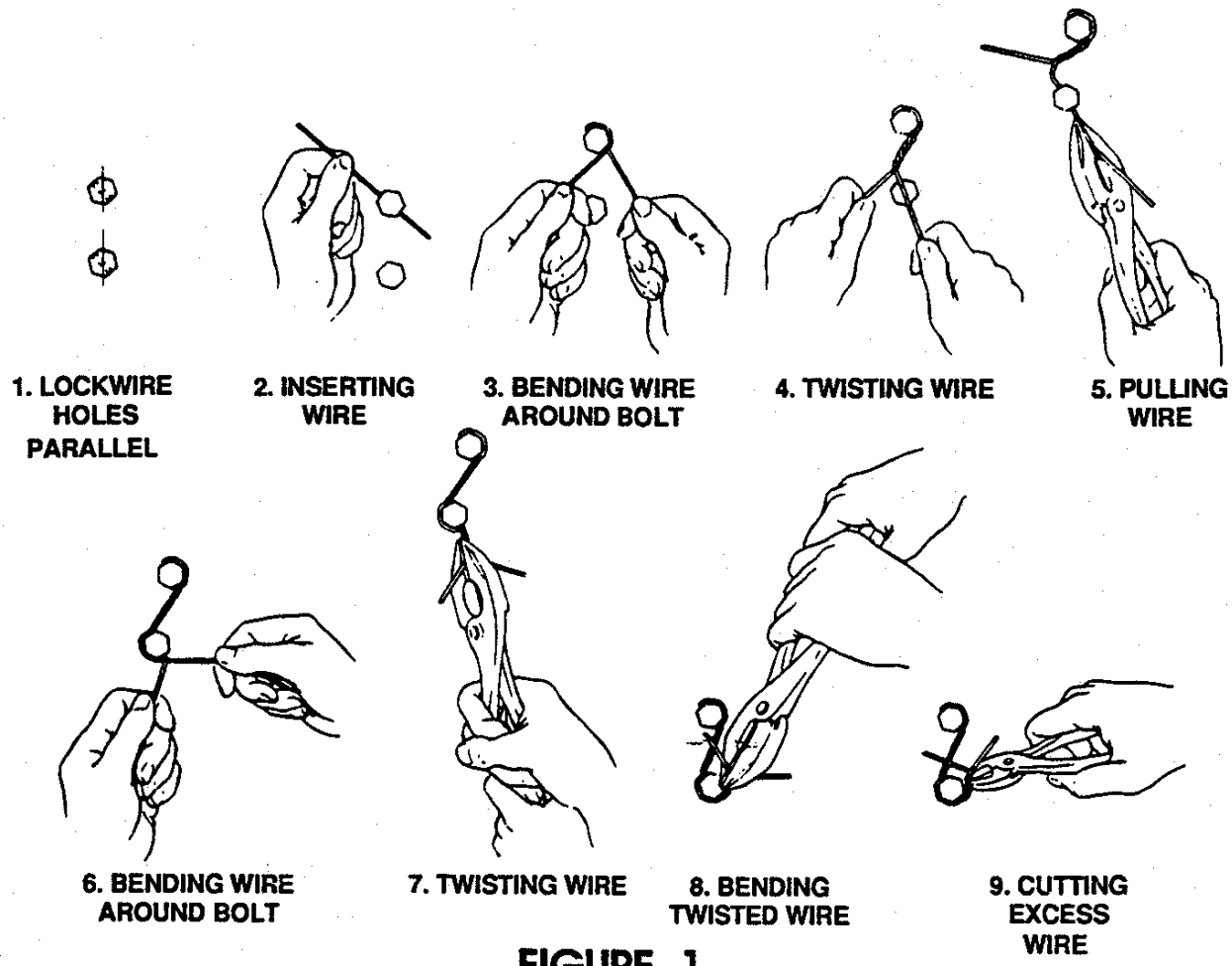

FIGURE 9-1. GENERAL LOCKWIRE PROCEDURE

9-3 LOCKWIRE PROCEDURE (cont'd)

Various examples of lockwiring are shown in Figure 9-2, "General Lockwire Patterns."

1. All items to be lockwired must be properly torqued. Applying torque that is above or below specified limits to obtain alignment of the holes is not permitted.
2. Lockwire shall be installed in such a manner that the strand through the hole will have a tendency to pull the in the tightening direction.
3. Insert half of the required length of lockwire through the first unit and bend around the head of the unit. The direction of wraps and twist of strands shall be such that the loop around the unit comes under the strand protruding from the hole so that the loop will stay down and will not tend to slip up and leave a slack loop.
4. Twist the strands while taut until the twisted part is just short of a hole in the next unit. The twisted portion should be within one-eighth (1/8) inch from the hole in either unit.
5. Insert the uppermost strand through the hole in the second unit and follow the rules in paragraph three.
6. After lockwiring the last unit, continue twisting the wire to form a pigtail providing a minimum of four twists to insure that the pigtail will not unravel. Cut off the excess lockwire and bend the pigtail toward the part and against the bolt head flats. DO NOT ALLOW THE PIGTAIL TO EXTEND ABOVE THE BOLT HEAD.

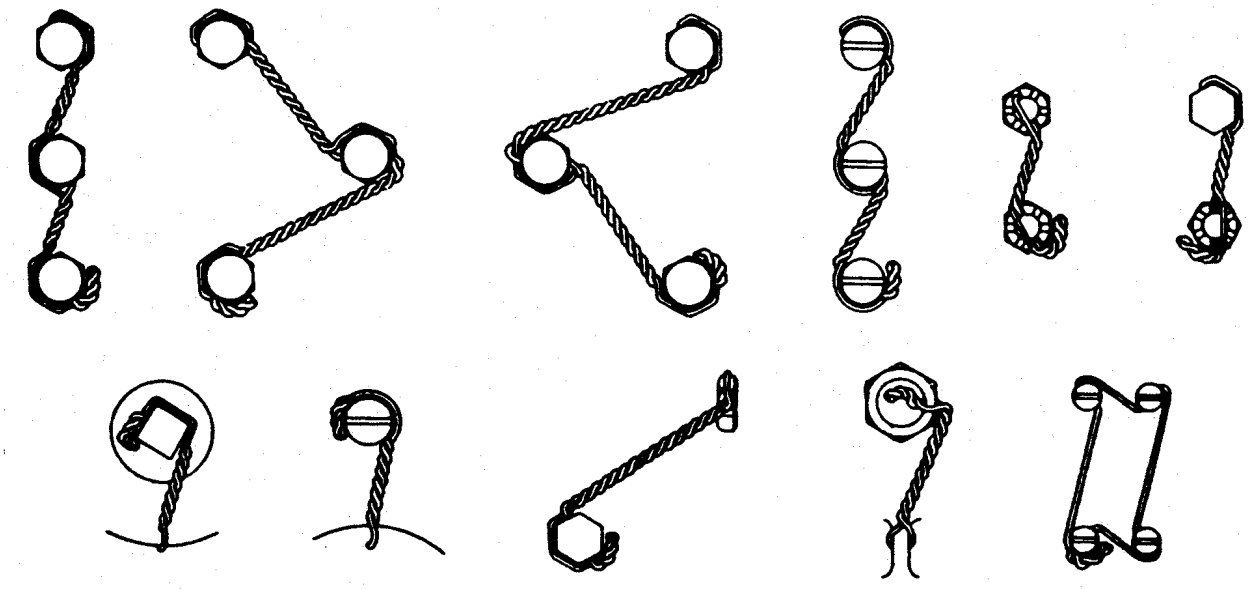

FIGURE 9-2. GENERAL LOCKWIRE PATTERNS

9-4 TAB WASHER PROCEDURE

Tab washers are installed by fitting a tab in a tab slot and bending the remaining tabs firmly against the bolt or nut flat. Tab washers are used in various locations in TCM engines and must not be reused after removal.

The tabs that are provided to be bent up against the head flats must be seated firmly, with no scarring of the tabs. This provides proper locking of the unit and prevents tabs from breaking off.

1. Make certain that the holding tab is located in the tab hole or slot.

2. Check the units to be secured and verify that they have been correctly torqued in accordance with the applicable overhaul manual.

3. Bend tabs against the head flats firmly by tapping them into place with a soft drift. See Figure 9-3, "Tab Washer Installation Procedure."

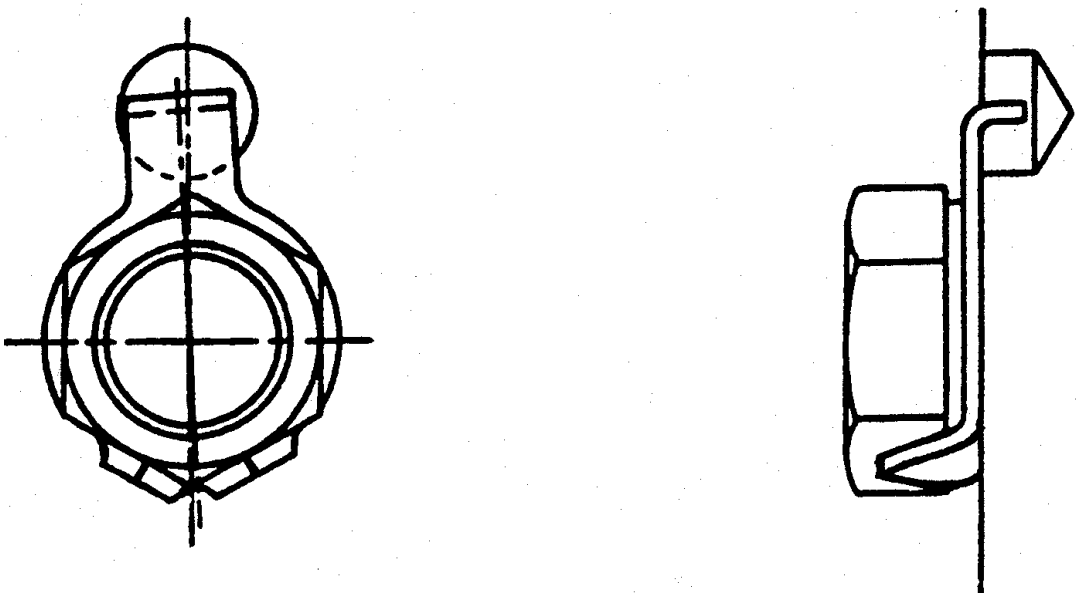

FIGURE 9-3. TAB WASHER INSTALLATION PROCEDURE

9-5 COTTER PIN PROCEDURE

Cotter pins are installed by inserting the cotter pin through a hole in one part and slots in the other part and spreading the exposed ends.

Cotter pins are not reusable and must be replaced with a new cotter pin after removal.

1. Torque the nut to the lower limit of the torque specification. If the slots in the nut do not line up with one of the holes in the bolt, continue torquing until one does but do not exceed the upper limit of the torque specification. Change the nut if necessary.
2. Insert the cotter pin with the head seated firmly in the slot of the nut. Bend the ends over the flat on the nut and the end of the bolt, trimming the prong lengths as necessary.
3. Seat the prongs firmly against the bolt and nut. See Figure 9-4, "General Cotter Pin Installation."

CAUTION. . . Do not use side-cutting type pliers to bend the ends over, since the resulting nick could weaken the pin and allow a portion to become detached.

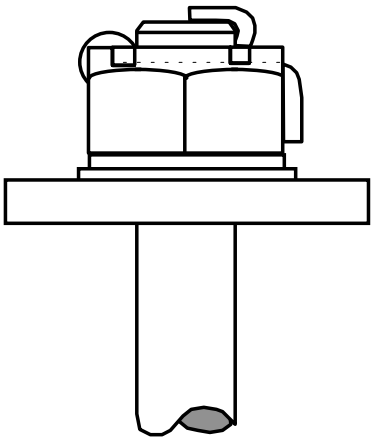

FIGURE 9-4. GENERAL COTTER PIN INSTALLATION

9-6 APPLICATION OF ADHESIVES

Adhesives and sealants will be used as specified in this manual.

WARNING

The improper use of sealants and adhesives will cause engine malfunction or failure.

Gasket Maker P/N 646942 must be applied in a thin even coat. Gasket Maker surfaces must be clean and free of oil and grit.

NOTE. . . TCM general purpose primer 653160 must be used for surface preparation before applying gasket maker at the engine nose seal area.

9-7 INSTALLATION OF GASKETS

All gaskets must be new and visually inspected prior to installation.

If the gasket shows any indication of gouges, nicks, cuts or bends discard it and obtain an undamaged gasket.

Gasket surfaces must be clean and free of oils and grit. Apply a thin coat of TCM Gasket Sealant #642188 to both sides of gasket where specified. Once gasket sealant has been applied install gasket. Install assembly and evenly torque hardware.

WARNING

Gaskets and components must be properly positioned, hardware torqued and safetied as required during assembly to prevent oil loss.

CHAPTER 10

ENGINE MAINTENANCE

10-1 GENERAL

During engine 50 and 100 hour inspections, if engine components must be remove and replaced, refer to the applicable disassembly/reassembly instructions found in the TSIO-360 Series Overhaul Manual, Form OH-08 as outlined in Maintenance Section of each system.

NOTE . . . Engine operational inspection must be performed prior to any 50 or 100 hour static inspections. See Section 5-3, “Operational Inspection.”

Compare recorded findings of operational inspection to Operating Limits Section 1-10 and information listed under applicable system 50 and 100 hour inspection of the following chapters.

Corrections and adjustments will be found in the individual system chapters of this manual under “Maintenance” and Chapter 23, “Post Maintenance Adjustment and Test.”

At the completion of all 50/100 hour inspection procedures, see Chapter 23 and perform the post maintenance operational test.

WARNING

The figures depicted in this publication are for illustration purposes only. They are not intended to be accurate detailed illustrations of any specific engine model, part or equipment.

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CHAPTER 11
EXHAUST SYSTEM

11-1 EXHAUST SYSTEM DESCRIPTION

The L/TSIO-360-RB exhaust system contains the following engine components: rear mounted turbocharger, hydraulic wastegate, lubrication plumbing, exhaust collector assembly, and turbocharger tailpipe assembly.

During normal engine operation, exhaust gases exiting the cylinder combustion chambers, flow through the exhaust collector to the turbocharger turbine housing inlets. The exhaust gas flow provides turbine wheel rotation and exits through the turbine housing discharge port and tailpipe assembly. The turbine wheel drives the compressor wheel which is connected by a common shaft.

Engine manifold pressure is maintained within the specified limits by controlling the turbocharger compressor discharge pressure.

Compressor discharge pressure (deck pressure) is regulated by controlling the flow of exhaust gas through the turbocharger turbine. This is accomplished by installing a hydraulically controlled butterfly type exhaust by-pass valve (wastegate) in the exhaust system prior to the inlet of the turbine housing. The wastegate butterfly valve is spring loaded to the open position and closed by pressurized oil from the engine.

Oil flow through the wastegate actuator is controlled by a variable absolute pressure controller (VAPC) that is mounted to the induction system after the turbocharger compressor, but before the throttle butterfly valve, sensing compressor discharge pressure. The controller is mechanically linked to the throttle and using a system of cams, followers and poppet valves controls oil flow from the wastegate actuator to the engine.

On engine start, the controller senses insufficient compressor discharge pressure (deck pressure) and restricts the flow of oil from the wastegate actuator to the engine. This causes the wastegate butterfly valve to close. As the throttle is advanced, exhaust gas flow across the turbine increases, increasing turbine/compressor shaft speed and compressor discharge pressure. The (VAPC) senses compressor discharge pressure and as pressure increases to the selected setting, the controller poppet valve begins to open, relieving oil pressure to the wastegate actuator. This allows the butterfly valve to move toward the open position. Exhaust gases by-pass the turbine and the turbine/compressor shaft speed stabilizes, and compressor discharge pressure stabilizes, maintaining selected manifold pressure.

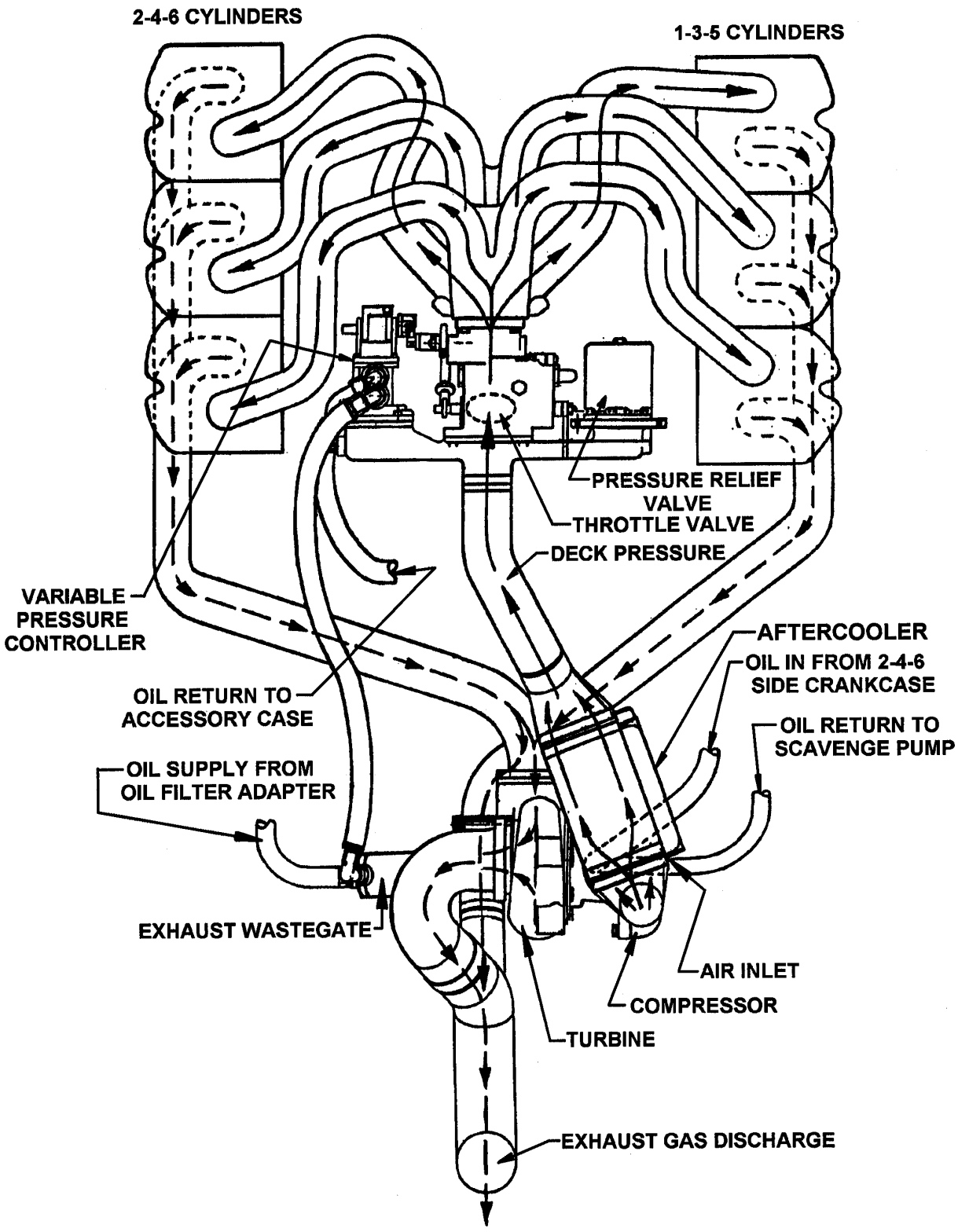

FIGURE 11-1. INDUCTION AND EXHAUST SYSTEM

11-2 TURBOCHARGER DETAILED DESCRIPTION.

The turbocharger consists of a radial inward flow turbine and turbine housing, a centrifugal flow impeller (compressor) and compressor housing, each bolted to a center housing.

The center housing incorporates bearings that support the turbine/compressor shaft. The shaft and bearings are lubricated with pressurized engine oil that enters the center housing through an oil inlet check valve and fitting. Drilled passages direct the pressurized oil to the bearings. After passing through the bearings the oil is evacuated from the center housing oil outlet and check valve by an engine driven scavenge pump. Oil seals installed outboard of the turbine/compressor shaft bearings retain the oil in the center housing. The inlet and outlet check valves prevent oil from flooding the center housing when the engine is not operating.

During engine operation, exhaust gases from the engine pass through the turbine housing and cause the turbine wheel to rotate. Since the turbine wheel and compressor are attached to a common shaft, the compressor rotates with in the compressor housing. The compressor impeller draws in ambient air, through the aircraft induction system, compresses the air and delivers it to the engine intake manifold.

As engine power is increased the flow of exhaust gases increase which increases the speed of the turbine/compressor assembly and the output of the turbocharger. The flow of exhaust gases through the turbocharger is controlled by the Exhaust By-pass Valve or wastegate**.**

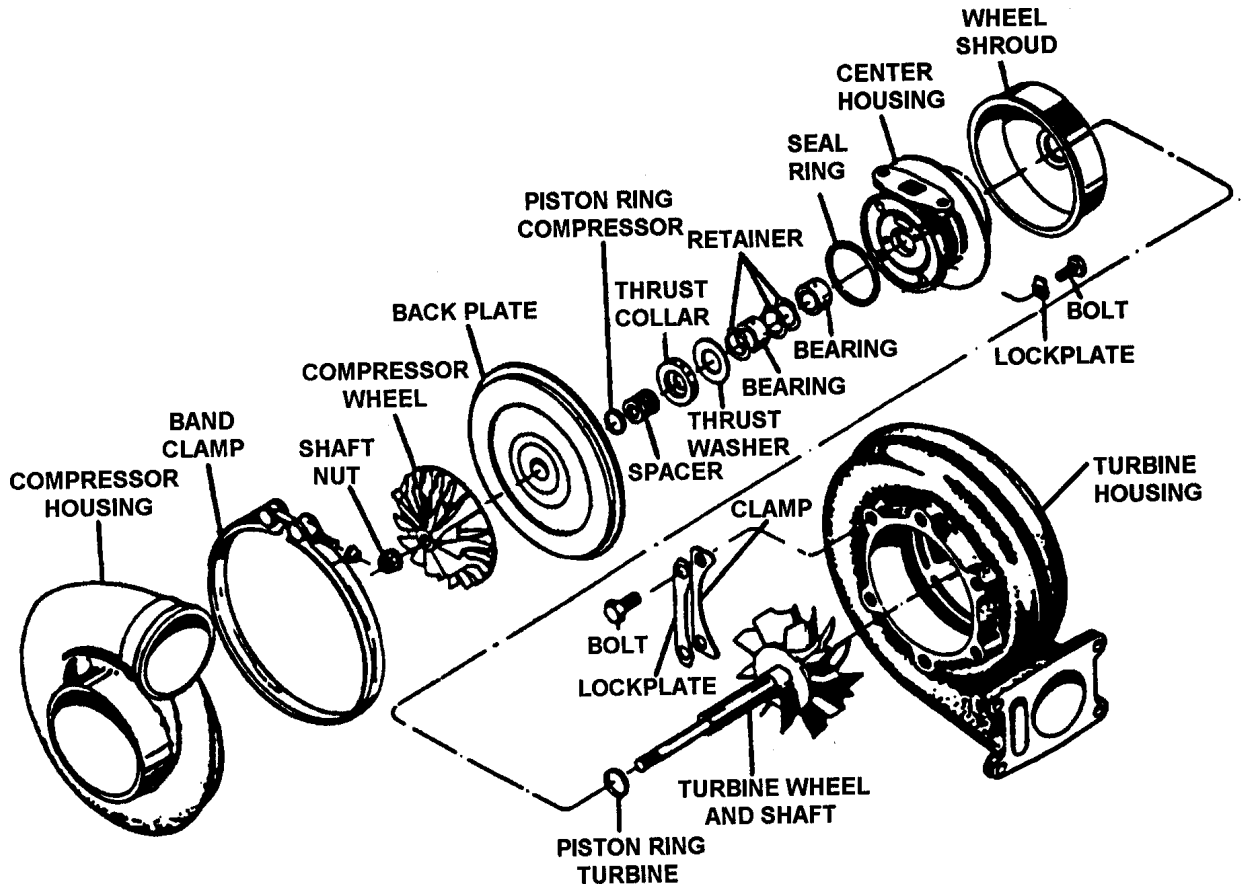

FIGURE 11-2. BASIC TURBOCHARGER

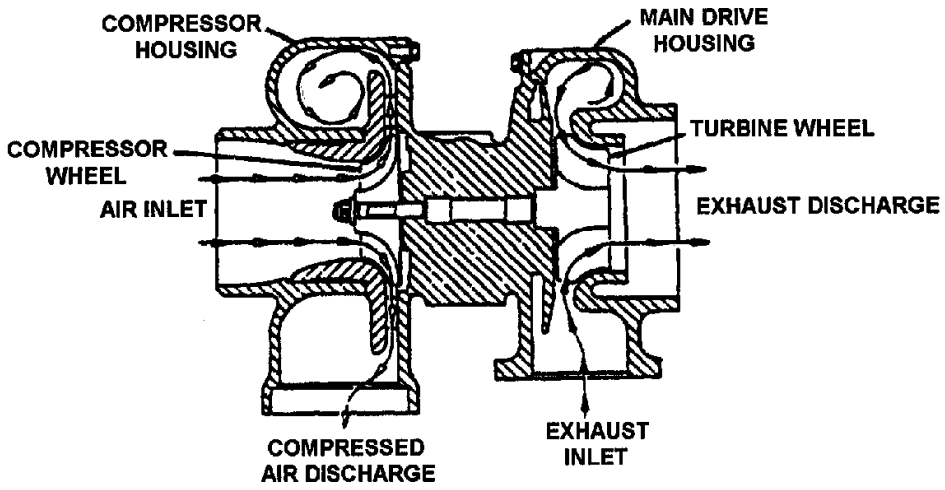

FIGURE 11-3. TURBOCHARGER SECTIONAL VIEW

11-3 EXHAUST BY-PASS VALVE (WASTEGATE) DETAILED DESCRIPTION.

The Exhaust By-pass Valve or wastegate used on the L/TSIO-360-RB engine is an oil actuated, butterfly type valve. The exhaust by-pass valve butterfly valve is connected to the actuator by mechanical linkage. The exhaust by-pass valve is installed in the engines exhaust system, near the turbocharger, in an exhaust by-pass pipe that allows some of the exhaust gases to by-pass the turbocharger turbine.

The exhaust by-pass valve butterfly valve is spring loaded to the open position. Pressurized oil from the engine is directed to the inlet of the by-pass valve actuator. The pressurized oil acting on the actuator plunger and against spring pressure, drives the by-pass valve butterfly to the closed position.

A Variable Absolute Pressure Controller (VAPC) is connected in the oil return line from the exhaust by-pass valve actuator to the engine. The VAPC controls the oil pressure acting on the exhaust by-pass valve actuator by increasing or decreasing the restriction to return oil flow from the by-pass valve actuator to the engine.

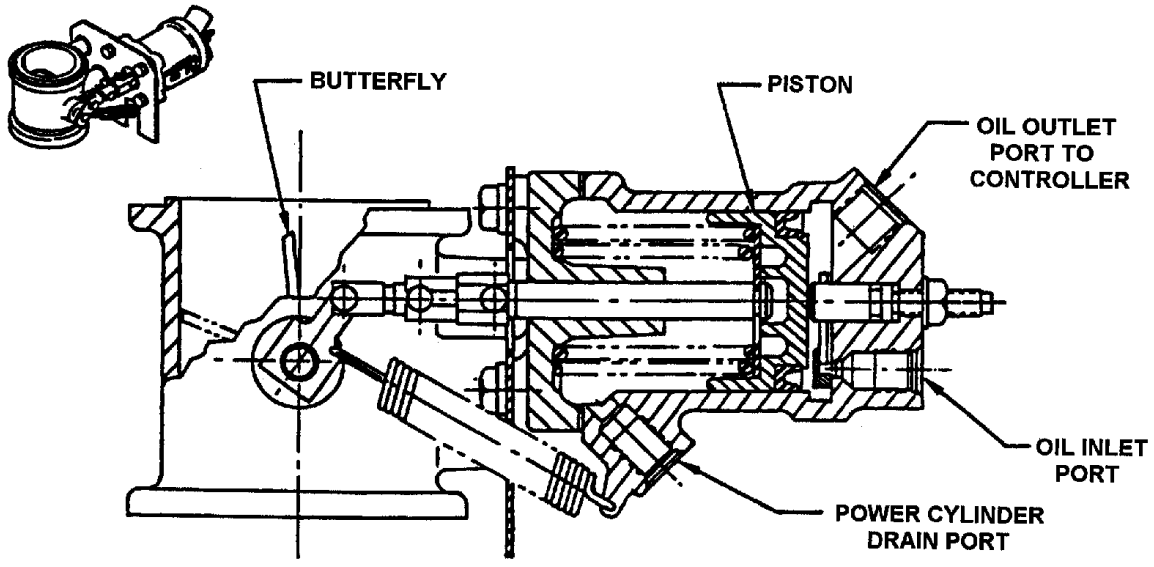

FIGURE 11-4. WASTEGATE

Figure 11-4 WASTEGATE

(continued on next page)

11-4 VARIABLE ABSOLUTE PRESSURE CONTROLLER (VAPC) DETAILED DESCRIPTION.

The variable absolute pressure controller is designed to maintain deck pressures to provide sea level horsepower at varying altitudes. By means of a sensing port in the pneumatic section of the controller, the outside of the aneroid bellows is subjected to deck pressure. The aneroid bellows is linked to a poppet valve, spring loaded normally closed. As pressure differences occur, the poppet valve readjusts, changing the amount of restriction to oil flow from the wastegate. As the restriction of oil flow occurs, pressure in the hydraulic portion of the wastegate increases, causing the wastegate butterfly valve to close, increasing exhaust gas flow to the turbocharger turbine.

The Variable Absolute Pressure Controller consists of a poppet valve (controlling oil flow), referenced to a pressure sensitive bellows on one side and a mechanically actuated, spring loaded plunger on the other. The mechanical actuated plunger is connected through a series of cams, levers and link rods to the throttle plate.

The VAPC is installed on the engine intake manifold, prior to the throttle plate, and in such a way that the pressure sensitive bellows is in the intake manifold and senses turbocharger compressor discharge pressure (deck pressure).

During engine operation compressor discharge pressure is referenced by the VAPC's bellows while the mechanically linked plunger is positioned according to throttle plate position. When ever the compressor discharger pressure sensed by the bellows is less than the mechanical and spring pressure acting on the plunger the poppet valve is positioned to restrict oil flow from the wastegate actuator to the engine and the wastegate butterfly valve goes closed. If the compressor discharge pressure sensed by the bellows is greater than the mechanical and spring pressure acting on the plunger the poppet valve moves to a position that increase oil flow from the wastegate actuator to the engine and the wastegate butterfly valve opens.

During cruise operation, the forces acting on the poppet valve are stabilized. Thus, the oil flowing from the wastegate actuator through the VAPC is constant and the wastegate butterfly valve is positioned in a intermediate position maintaining the selected compressor discharge pressure and manifold pressure.

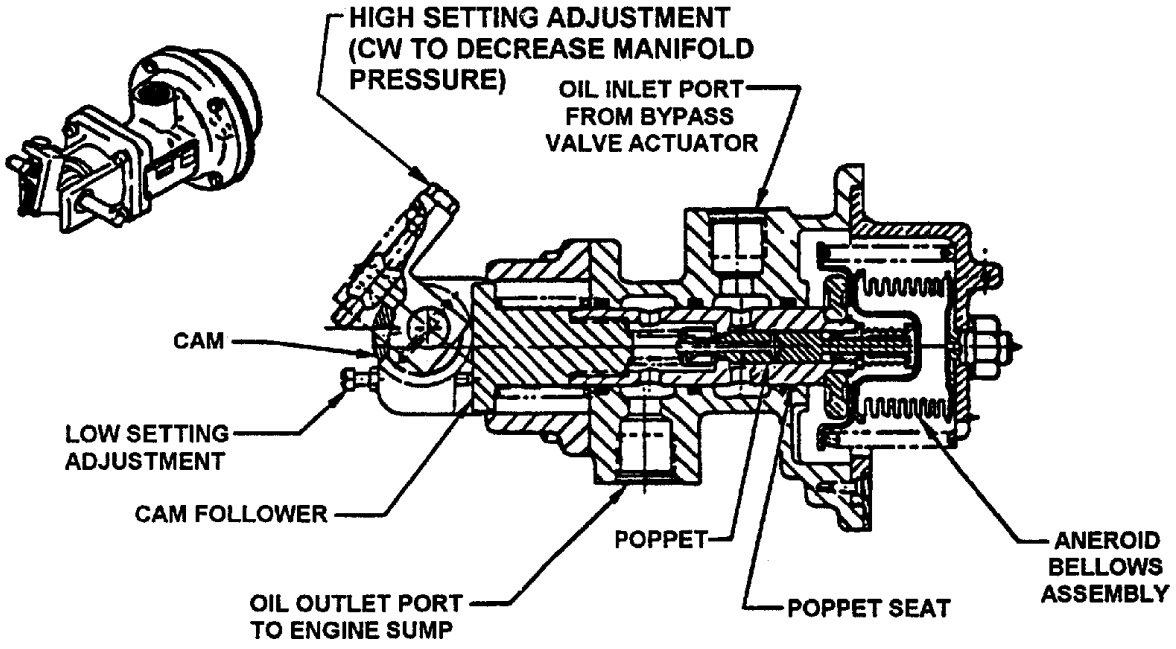

FIGURE 11-5. VARIABLE ABSOULUTE PRESSURE CONTROLLER

11-5 TURBOCHARGER LUBRICATION SYSTEM

Pressurized oil is supplied to the turbocharger from the engine. A fitting located in left crankcase half (2-4-6 cylinder side), below number 2 and 4 cylinder, oil gallery supplies pressurized engine oil to the turbocharger center housing oil inlet.

Oil is return to the engine from the turbocharger center housing is accomplished by a scavenge pump contained in the starter adapter assembly.

Flexible, high pressure hoses connect the engines oil system to the turbocharger. Since the turbocharger is mounted below the center line of the engine, check valves are installed in the oil supply hose and oil return hose to prevent oil from flooding the turbocharger center housing when the engine is not operating.

11-6 EXHAUST SYSTEM INSPECTION

50 HOUR INSPECTION - Visually inspect entire exhaust system for security, welded joints for cracking, evidence of exhaust gas leakage and turbocharger compressor, turbine for freedom of rotation. Inspect turbocharger oil seals and lubrication system plumbing for evidence of oil leakage.

100 HOUR INSPECTION

Before proceeding with cleaning and inspection, insure that the exhaust system is cool. The entire exhaust should be cleaned and visually inspected for condition and leaks using the following procedure.

Cleaning - In order to thoroughly inspect the exhaust system, components must be clean and free of oil, grease, etc. Use a suitable solvent (such as Stoddard solvent), and wipe away any debris. Wipe any excess solvent dry with a clean cloth.

CAUTION . . . Never use flammable solvents, wire brushes or abrasives to clean exhaust system components. Never use a lead pencil to mark any exhaust system component.

The turbocharger, wastegate and controller assemblies must be cleaned and inspected in accordance with the component manufacturer's instructions, Airesearch, 3201 Lomita Blvd. Torrance California, 90505.

Visual inspection - Perform all requirements of 50 hour inspection with the addition of the following: During 100 hour inspection, items which might hinder inspection may be removed except multi-segment "V" band clamps. In the event that exhaust system components have to be removed, see the L/TSI0-360 Overhaul Manual, Form X30596A.

Stacks, Risers, Elbows - Inspect these components for burned areas, cracks and looseness. During this inspection give special attention to the condition of welded area and seams for cracks.

Visually inspect exhaust elbow to manifold clamps for corrosion, cracks and security. Discard any clamps that exhibit corrosion or cracks and torque any loose connections.

Visually inspect slipjoints for bulging and cracks. See figure 11-6

(Continued on next page)

Multi-segment "V" Band Clamps, Figure 11-7. Clamps located between turbocharger and tailpipe should first be cleaned using crocus cloth on the outer band of clamp assembly. Inspect spot weld areas for cracks and looseness, inspect the corner radii of clamp inner segments for cracks using a flashlight and mirror. If clamp has been removed and reinstalled, inspect inner segment spacing. If inner segments contact after clamp assembly has been torqued, the clamp assembly must be replaced. Inspect clamp outer band flatness using a straightedge, especially within two inches of spot weld tabs that retain the "T" bolt fastener, clearance should be less than .062 of an inch. Clearances in excess of .062 of an inch are cause for rejection. Inner segment and outer band contact must be 100%.

NOTE . . . When replacement of clamp is required, install new clamp insuring "V" segments go over exhaust flanges, using a rawhide or plastic mallet, tap clamp circumferentially as clamp is torqued to 40 inch pounds.

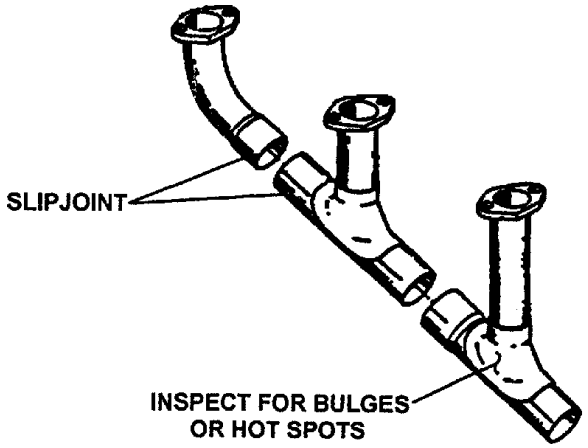

FIGURE 11-6. SLIP JOINT ASSEMBLY

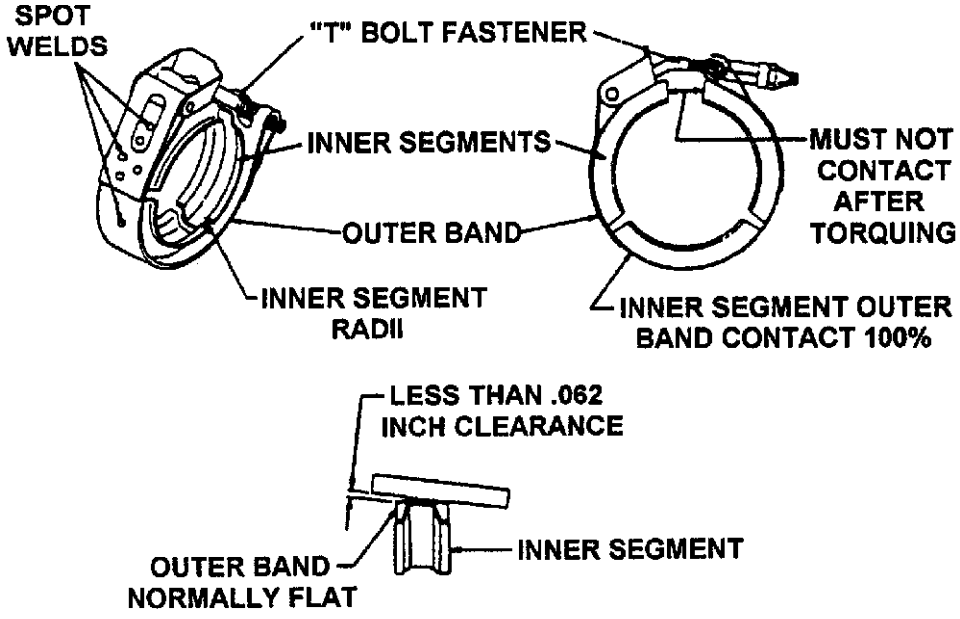

FIGURE 11-7. MULTI-SEGMENT "V" BAND CLAMP

11-7 EXHAUST SYSTEM TROUBLESHOOTING

This troubleshooting chart is provided as a guide. Review all probable causes given, check other listings of troubles with similar symptoms. Items are presented in sequence of the approximate ease of checking, not necessarily in order of probability.

TROUBLE	PROBABLE CAUSE	CORRECTION
Engine Lacks Power, Reduction In Maximum Manifold Pressure or Critical Altitude	Improperly adjusted controller	To adjust the controller, see Chapter 23.
	Loose or damaged exhaust system	Inspect entire exhaust system to turbocharger for cracks and leaking connections. Torque connections and replace damaged parts.
	Malfunctioning turbocharger	Check for unusual noise in turbocharger. If malfunction is suspected, remove exhaust and/or air inlet connections and check rotor assembly for possible rubbing in housing, damaged rotor or damaged bearings. Per component manufacturer's instructions,, replace if turbocharger damage is noted.
	Exhaust system gas leakage	Inspect exhaust system for gas leakage, gaskets at cylinder exhaust ports, gaskets at turbine inlet flanges etc., and correct.
White Smoke Exhaust	Turbo coking, oil forced through turbine housing seal	Clean or change turbocharger.
Low Manifold Pressure	Improperly adjusted controller	Adjust according to Chapter 23 or replace if adjustment cannot be made.
	Binding wastegate	Replace
	Induction or exhaust manifold leaks	Repair or replace as required
Manifold Pressure Higher Than Normal	Binding wastegate	Replace wastegate
Manifold Pressure Higher Than Normal (con't)	Improperly adjusted controller	Adjust, see Chapter 23
Loss of Aircraft's Critical Altitude	Improperly adjusted controller	Adjust,, see Chapter 23.
	Induction or exhaust manifold leaks	Repair or replace as required

TROUBLE	PROBABLE CAUSE	CORRECTION
Loss of Aircraft's Critical Altitude (cont'd)	Aftercooler plugged or damaged	Repair or replace as required.
Turbocharger Oil Seals Leaking	Worn or damaged seals	Refer to Turbocharger Manufacturer's Instructions
Engine Oil Level Frequently Low After Servicing Prior to Operation	Leaking Turbocharger check valves and seals	Replace check valves. Refer to Turbocharger Manufacturer's Instructions for turbocharger maintenance.
Lack of Oil to Turbocharger	Damaged check valve	Replace check valve

11-8 EXHAUST SYSTEM MAINTENANCE

Exhaust System Collector - Component maintenance is limited to torquing loose connections and replacement of components. Under no circumstance shall any exhaust system component be welded. For replacement of exhaust system collector component, see the applicable portion of Exhaust System Disassembly/Reassembly in the L/TSIO-360-RB Overhaul Manual, Form X30596A.

Turbochargers, Wastegate, Controller - For replacement of these components, see the applicable portion of exhaust system disassembly/reassembly in the L/TSI0-360 Series Overhaul Manual X30596A. For maintenance of these components refer to the component manufacturer's instructions, Airesearch, 3201 Lomita Blvd. Torrance California, 90505.

Lubrication Plumbing - Turbocharger lubrication plumbing must be replaced if deteriorated or leaking in accordance with the applicable Disassembly/Reassembly portions in the L/TSIO-360-RB Overhaul Manual, Form X30596A.

INTENTIONALLY

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CHAPTER 12
IGNITION SYSTEM

12-1 SLICK IGNITION SYSTEM DESCRIPTION

The L/TSIO-360 engines utilize two Slick (Unison) 6224 Series pressurized magnetos. The left magneto fires the 1-3-5-lower and the 2-4-6 upper spark plugs, while the right magneto fires the 1-3-5 upper and 2-4-6-lower spark plugs.

The Slick 6224 Series pressurized magnetos, manufactured by Slick Electro Incorporated, 530 Blackhawk Park Avenue, Rockford, Illinois 61101, are designed to provide ignition for six cylinder light aircraft engines. The magnetos generate and distribute high tension current through high tension leads to the spark plugs.

To obtain the retard spark necessary for starting, the magnetos employ an impulse coupling. The impulse coupling rotates the magneto between impulse trips faster than engine cranking speed, thus generating a better spark for starting the engine. The impulse coupling automatically retards the spark during engine cranking, and drives the magneto.

The Slick 6224 magnetos are pressurized by engine deck pressure piped from the 2-4-6 side of the controller and overboost valve adapter.

12-2 IGNITION SYSTEM COMPONENT DETAILED DESCRIPTION

For a detailed description of magnetos and harnesses see Slick Ignition Systems Master Service Manual Order Form F-1100 as applicable. See Related Publications Section 1-4 for ordering information.

Magneto Drive Assembly - Each magneto is driven by a magneto drive gear, retainer and bushings housed inside the accessory case. Two rubber bushings (per magneto) are installed within a retainer on the drive gear. The rubber bushings provide a shock absorbing engagement between magneto and engine drive train. The magnetos are attached to the upper rear portion of the accessory case and secured by retainers, lockwashers and nuts. The magneto drive gear assemblies are driven by the camshaft gear

12-3 IGNITION SYSTEM INSPECTION

WARNING

Absence of any RPM drop when checking magnetos may indicate improper grounding in the ignition circuit. Should the propeller be moved by hand (as during pre-flight) the engine may fire and cause injury to personnel. This type of malfunction must be corrected prior to continued operation of the engine. Continued operation of the engine at idle RPM with the ignition switch in the "OFF" position will verify this malfunction.

50 HOUR INSPECTION - Compare recorded findings of operational inspection with the following: The magneto drop for left or right magneto must be no greater than 150 RPM and magneto spread no greater than 50 RPM with ignition timing at 20° BTC ±1°. If magneto drop is out of tolerance proceed to Ignition System Maintenance, Section 12-6 ignition timing for the applicable ignition system. During magneto off check, if the engine continues to run then see Slick service instructions.

Visually inspect high tension ignition leads for chafing, deterioration and other requirements in accordance with Ignition System Manufacturer's instructions. Inspect magneto accessory drive adapters for secureness and oil leaks.

100 HOUR INSPECTION - Perform all requirements of 50 hour inspection and the following:

WARNING

Magneto-to-engine timing maintenance does not insure magneto, harness and spark plug performance. Failure to properly maintain the magneto, harness and spark plugs will lead to internal engine damage and failure. Magneto, ignition harness and spark plugs must be maintained in accordance with the manufacturer's instructions.

NOTE . . . A single severe "kick back" while cranking the engine can cause failure of components in the cranking system. Kick back can be caused by intermittent operation of the impulse couplings. Perform the following operational tests at the specified intervals to insure that these systems are functioning properly.

Magneto Inspection:

See the magneto manufacturer's instructions for magneto 100 hour inspection procedures.

12-3 IGNITION SYSTEM INSPECTION (continued)

NOTE . . . Minor changes in magneto timing can be expected during normal engine service. The time and effort required to check and adjust the magnetos to specifications is slight and the operator will be rewarded with longer contact point life, smoother engine operation and less corrective maintenance between routine inspections. See Section 12-5 for ignition system maintenance of the harness, magneto, spark plugs and timing procedure.

WARNING

Spark plug and spark plug lead maintenance is necessary to insure proper magneto operation. Failure to maintain the spark plugs and ignition harness leads will result in ignition system malfunction and subsequent engine malfunction.

Spark Plug Inspection:

Disconnect ignition leads and remove spark plugs. Spark plug inspection must be performed in accordance with Section 12-5 "Spark Plugs."

500 HOUR INSPECTION - At each 500 hour interval the magnetos must be disassembled and inspected in accordance with the applicable magneto service manual. Magnetos require overhaul at engine TBO, every 4 years, or as specified by the manufacturer. See Chapter 1 "Related Publications" for manual ordering information.

12-4 IGNITION TROUBLESHOOTING

The following troubleshooting chart is provided as a guide. Review all probable causes given, check other listings of troubles with similar symptoms. Items are presented in sequence of the approximate ease of checking not necessarily in order of probability.

TROUBLE	PROBABLE CAUSE	CORRECTION
Engine Fails To Start Due To Ignition Troubles	Ignition switch OFF or grounded switch wires	Turn switch ON. Check for grounded wires
	Spark plugs fouled improperly gapped or loose	Remove and clean. Adjust to proper gap in accordance with Spark Plug Manufacturer's Specifications. Re-install and torque to 300-360 inch pounds.
	Magnetos improperly timed to engine	See Section 12-5 Ignition System Maintenance, "Placing Crankshaft In Timing Position" and "Magneto Timing And Installation On Engine."
	Shorted condenser	Replace condenser in accordance with magneto manufacturer's instructions.
	Magneto internal timing incorrect or timed for opposite rotation.	Inspect internal timing of magnetos in accordance with the magneto manufacturer's instructions. See Section 12-5 Ignition System Maintenance,, "Placing Crankshaft In Timing Position" and "Magneto Timing And Installation On Engine."

TROUBLE	PROBABLE CAUSE	CORRECTION
Rough Idling	Spark plugs fouled or improperly gaped	Clean spark plugs. Adjust spark plug gap in accordance with spark plug manufacturer's specifications.
	Weak condenser	Replace condenser in accordance with magneto manufacturer's instructions.
Rough At Speeds Above Idle	Loose or improperly gaped spark plugs	Torque to 300-360 inch pounds torque. Adjust to proper gap in accordance with spark plug manufacturer's specifications.
	High tension leak in ignition harness	Inspect ignition harness in accordance with ignition harness manufacturer's instructions.
	Weak or burned out condenser as evidenced by burned or pitted breaker points	Replace points and condenser in accordance with magneto manufacturer's instructions.
Sluggish Operation and/or Excessive RPM Drop	Fouled or dead spark plugs	Clean spark plugs. Replace dead spark plugs. See Section 12-6, "Spark Plugs".
	Improperly gaped spark plugs	Adjust to proper gap in accordance with spark plug manufacturer's specifications.
	Magnetos out of time	Inspect internal timing of magnetos in accordance with magneto manufacturer's instructions. See Section 12-5 "Placing The Crankshaft In Timing Position" and 'Magneto Timing And Installation On Engine."
	Damaged magneto breaker points or condenser	Replace points and condenser in accordance with magneto manufacturer's instructions.

12-5 IGNITION SYSTEM MAINTENANCE

Harness Assemblies - Remove the harness assemblies for repair or replacement in accordance with the applicable portion of Ignition System Disassembly/Reassembly instructions in the L/TSIO-360 Overhaul Manual Form X30596A. See Chapters 8 and 18. Any harness assembly maintenance such as single lead replacement must be performed in accordance with the Harness Manufacturer's Instructions, See Slick Order Form F-1100. See Section 1-4," Related Publications" for ordering information.

Magnetos - Remove the magnetos for repair or replacement in accordance with the applicable portion of Ignition System Disassembly/Reassembly instructions in the L/TSIO-360 Overhaul Manual Form X30596A. Any magneto maintenance such as point replacement, condenser replacement, impulse coupling replacement or internal magneto

timing must be performed in accordance with the magneto manufacturer's instructions. See Slick Order Form F-1100. See Section 1-4", Related Publications" for ordering information.

Magneto Drive Assemblies - Remove the magneto drive assemblies for repair or replacement in accordance with the applicable portion of the Magneto and Accessory Drive disassembly instructions in the L/TSIO-360 Overhaul Manual Form X30596A.

CAUTION . . . When performing dimensional inspection the following "Service Limits" may be used. However, they are only intended as a guide for re-use when performing maintenance of the engine prior to major overhaul. Parts with dimensions or fits that exceed service limits must not be re-used. Parts with values up to and including service limits may be re-used, however, judgment should be exercised considering the PROXIMITY of the engine to its recommended overhaul time. Service limits must NOT be used when overhauling an engine. See the current L/TSIO-360 Overhaul Manual for minimum fits and limits.

12-5 IGNITION SYSTEM MAINTENANCE (cont'd)

FITS & LIMITS		
REF.	**LEFT AND RIGHT MAGNETO ACCESSORY**	**SERVICE**
1	Magneto gear Support Shaft-to-Bearing.....Diameter	0.0002L
2	Sleeve in magneto and accessory drive gear.....Diameter	0.0036T
3	Washer in Drive Gear.....Diameter	0.0021T
4	Magneto coupling retainer on magneto and accessory drive gear sleeve .....Diameter	0.0550L
5	Magneto coupling retainer in magneto drive gear slot ..... Side Clearance	0.040L
6	Magneto coupling rubber bushings on magneto drive lugs..... Side Clearance	0.010L

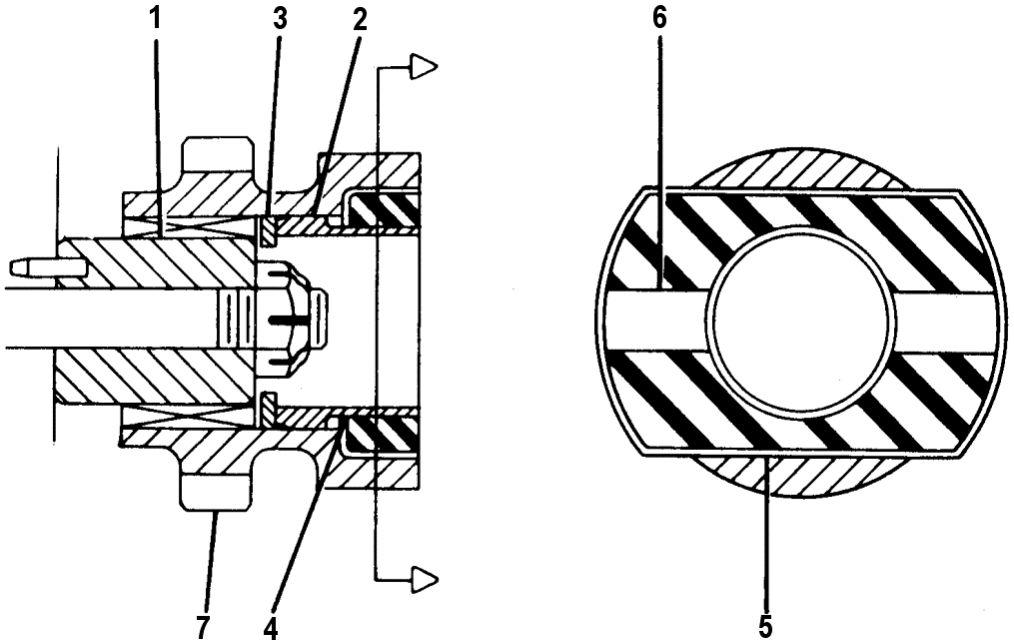
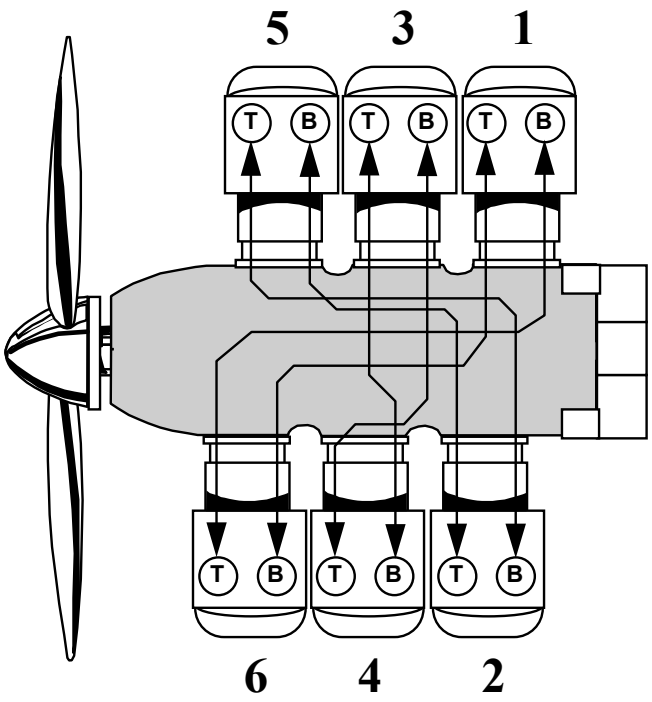


FIGURE 12-1. MAGNETO ACCESSORY DRIVE ADAPTER

Spark Plugs - Remove the spark plugs for cleaning or replacement in accordance with applicable portions of Ignition System Disassembly/Reassembly instructions in the TSIO-360-MB &-SB Overhaul Manual, Form. After spark plugs are removed, clean and gap the spark plugs in accordance with the spark plug manufacturer's instructions and test. Replace any spark plug that does not meet the manufacturer's specifications. Insure that each spark plug is free of any residue from cleaning process. If all requirements of cylinder compression test in Section 20-4 have been accomplished, apply Champion® thread lubricant to spark plugs in accordance with the manufacturer's instructions (see Chapter 3.) Re-install spark plugs using the reverse spark plug installation order. Torque spark plugs to 300 - 360 inch pounds.

CAUTION . . . Never install a spark plug that has been dropped. Discard them.

For determination of spark plug re-use see" Spark Plug Wear", Figure 12-3.



CYLINDER ROTATION	
CYLINDER NUMBER	CYLINDER NUMBER
FROM	TO
1 TOP	6 BOTTOM
1 BOTTOM	6 TOP
2 TOP	5 BOTTOM
2 BOTTOM	5 TOP
3 TOP	4 BOTTOM
3 BOTTOM	4 TOP
4 TOP	3 BOTTOM
4 BOTTOM	3 TOP
5 TOP	2 BOTTOM
5 BOTTOM	2 TOP
6 TOP	1 BOTTOM
6 BOTTOM	1 TOP

FIGURE 12-2. SPARK PLUG ROTATION PROCEDURE

NORMAL ELECTRODE CONDITION
Insulator tip gray, tan or light brown. Few combustion deposits. Electrodes not burned or eroded. Proper type heat range plug for engine and service. Spark plug should be cleaned regapped and tested before reinstallation.

NORMAL WORN-OUT CONDITION
Electrodes eroded by high-voltage sparking and by corrosive gases formed during combustion to less than 1/2 original thickness. More voltage needed to fire spark plugs - often more than ignition system can produce. Discard and replace with new spark plugs.

SEVERE WORN-OUT CONDITION
Excessively eroded center and ground electrodes plus extensive necking of fine wire ground electrodes indicate abnormal engine power or plugs long over-due for replacement. Check fuel metering and magneto timing. Discard spark plugs and check heat range before installing new ones.

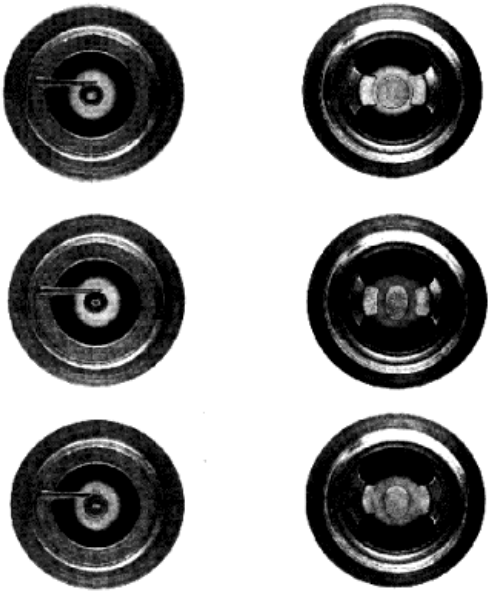


FIGURE 12-3. SPARK PLUG WEAR

NOTE . . . If the engine is equipped with a right angle drive starter adapter and does not freely turn in the opposite direction of normal rotation the starter motor must be removed from the starter adapter. Some right angle starter drive adapters incorporate an over-riding spring clutch design that restricts engine rotation in the opposite direction of normal rotation.

CAUTION . . . The importance of establishing and maintaining correct magneto to engine timing cannot be overemphasized. Incorrect timing, in addition to producing a rough running engine, can lead to detonation, pre-ignition and possible internal engine damage or failure.

MAGNETO TO ENGINE TIMING

WARNING

To prevent injury or death, before beginning maintenance on the ignition system, insure that the magneto switches and master switches are in the off position the aircraft battery is disconnected and all ignition leads are disconnected and removed from the spark plugs. Attach a sign stating "Hot Magneto - Do Not Turn," on each propeller blade.

In conducting magneto timing check, use a top dead center locator, protractor and pointer such as the Eastern Electronics Model E25 Timing Indicator or equivalent.

Use the following basic timing procedure to insure that timing is accomplished in accordance with the required specifications.

1. Remove all top spark plugs. Rotate the crankshaft to the start of the compression stroke on the number one cylinder. Install the top dead center locator in the number one cylinder spark plug hole.
2. Install timing disk of indicator on the crankshaft flange, propeller spinner or propeller hub.
3. Turn propeller slowly in direction of normal rotation until the piston lightly touches the top dead center locator.
4. Rotate the disc of the timing indicator until the 0° mark aligns with the pointer.

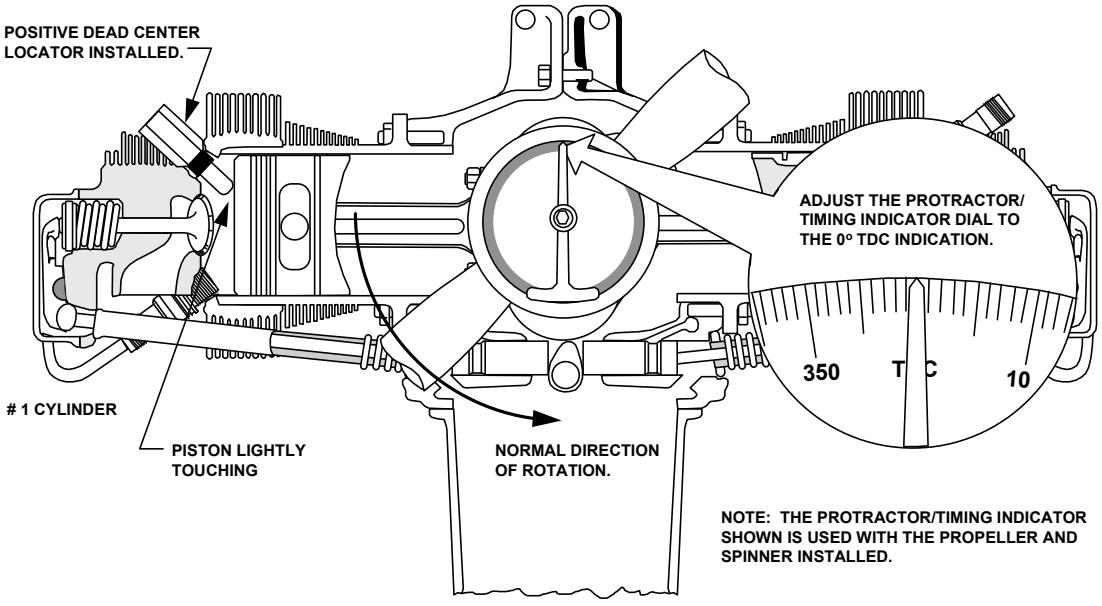


FIGURE 12-4 TIMING POSITION STEP 1

5. Slowly rotate the crankshaft in the opposite direction of normal rotation until the piston lightly touches the dead center locator. Observe reading on the disk under the pointer.

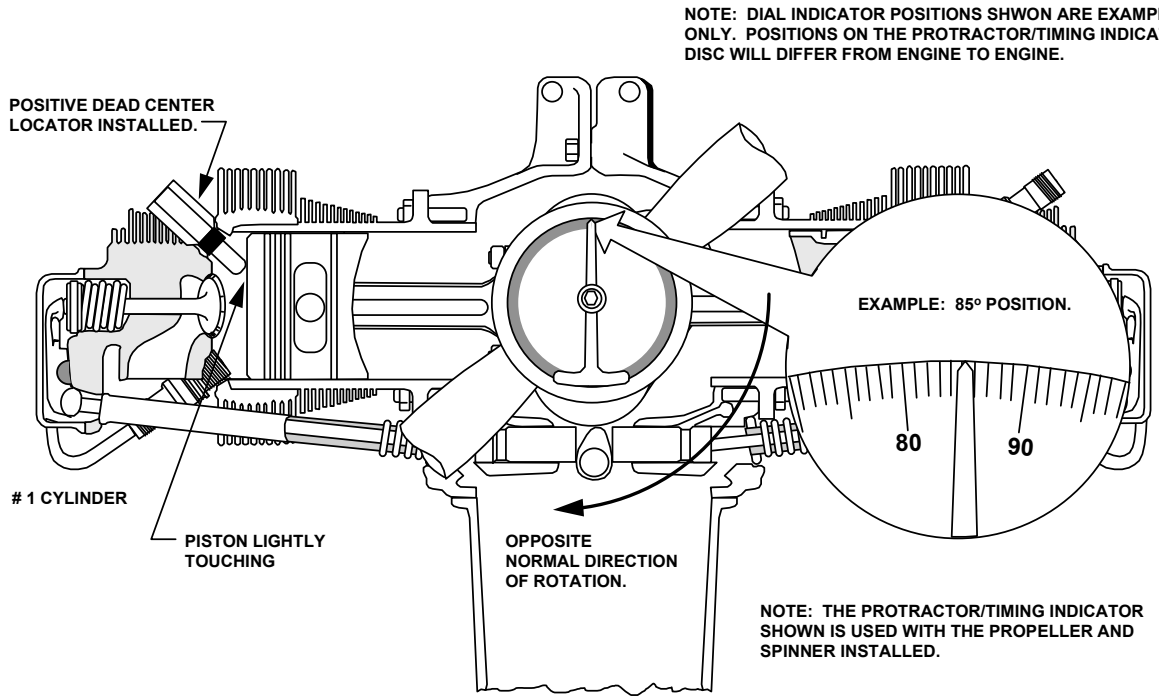


FIGURE 12-5. TIMING POSITION STEP 2

6. Move the disk to exactly one half of the number of degrees observed toward the top center mark.

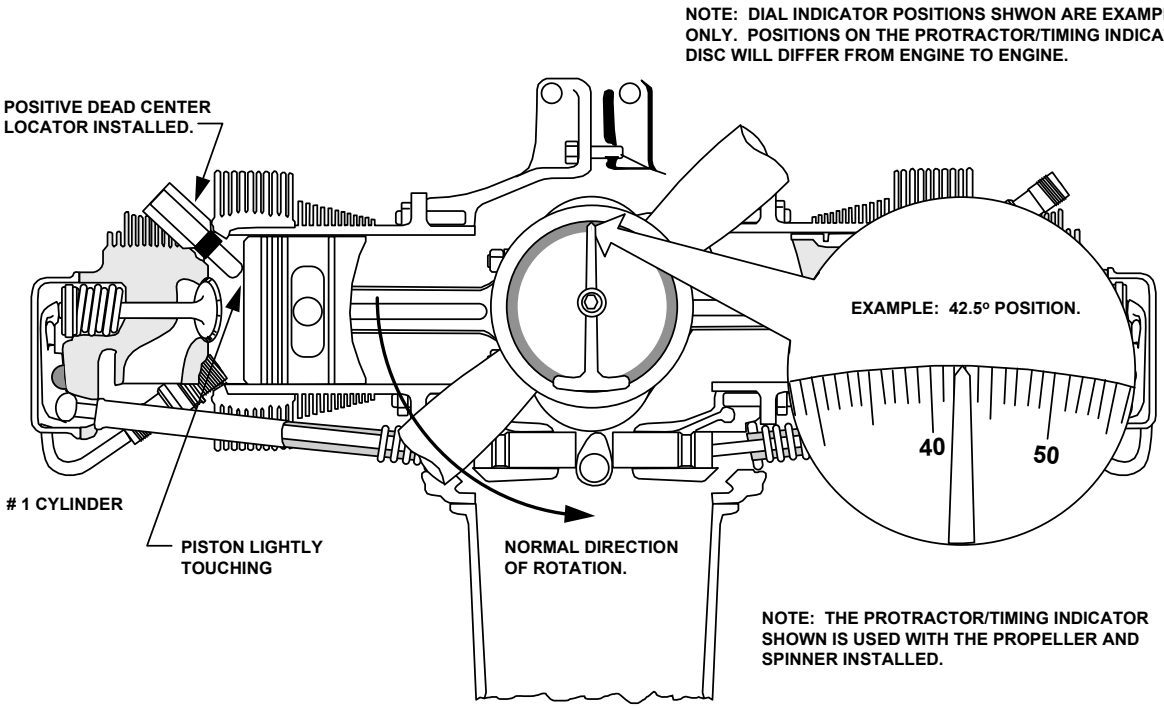


FIGURE 12-5. TIMING POSITION STEP 3

7. This will be approximately one half the number of degrees remaining of 360 degrees of crankshaft rotation. You have now located top dead center.

8. Remove the top dead center locator from the number 1 cylinder and find the compression stroke on the number 1 cylinder by placing a finger over the spark plug hole as the crankshaft is rotated. Continue rotating crankshaft on the compression stroke until the 0° mark is under the pointer. On engines equipped with impulse couplings, continue turning the crankshaft in the normal direction of rotation until each impulse coupling trips. Couplings may trip a few degrees on either side of top dead center. If one or both impulse couplings trip after top dead center, turn the propeller back to a few degrees before top dead center and approach the top dead center position from the normal direction of rotation.

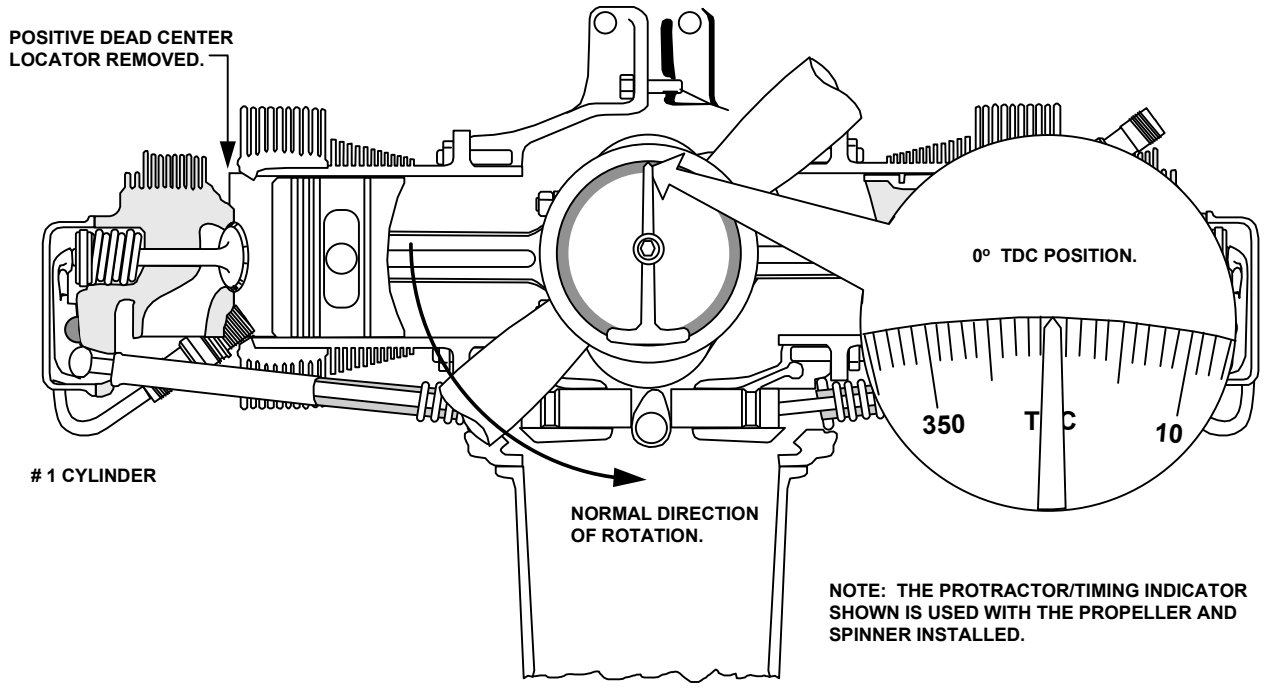


FIGURE 12-5. TIMING POSITION STEP 4

9. To check either the magneto timing or to time the magneto to the engine, move the propeller in the opposite direction of normal rotation past the specified magneto timing setting and then back in the direction of normal rotation until the desired setting before top dead center is under the pointer to remove the gear backlash. Disconnect the ground switch leads from the magnetos. Place a Bendix 11-851 timing light or equivalent on the engine and connect the right lead to the right magneto ground terminal and connect the left lead to the left magneto ground terminal. Connect the timing light ground lead to a suitable ground such as a bolt or stud.

   With the crankshaft in the correct timing position, turn the crankshaft a few degrees counterclockwise, then clockwise until the timing pointer is approaching the correct degree position. As the pointer aligns with the specified timing position, both timing lights must indicate that both magneto points are breaking within the specified timing tolerance.

   If the magnetos are not timed to the engine within the required specification, the magneto(s) must be removed from the engine and inspected and repaired in accordance with the magneto manufacturer's instructions and specifications

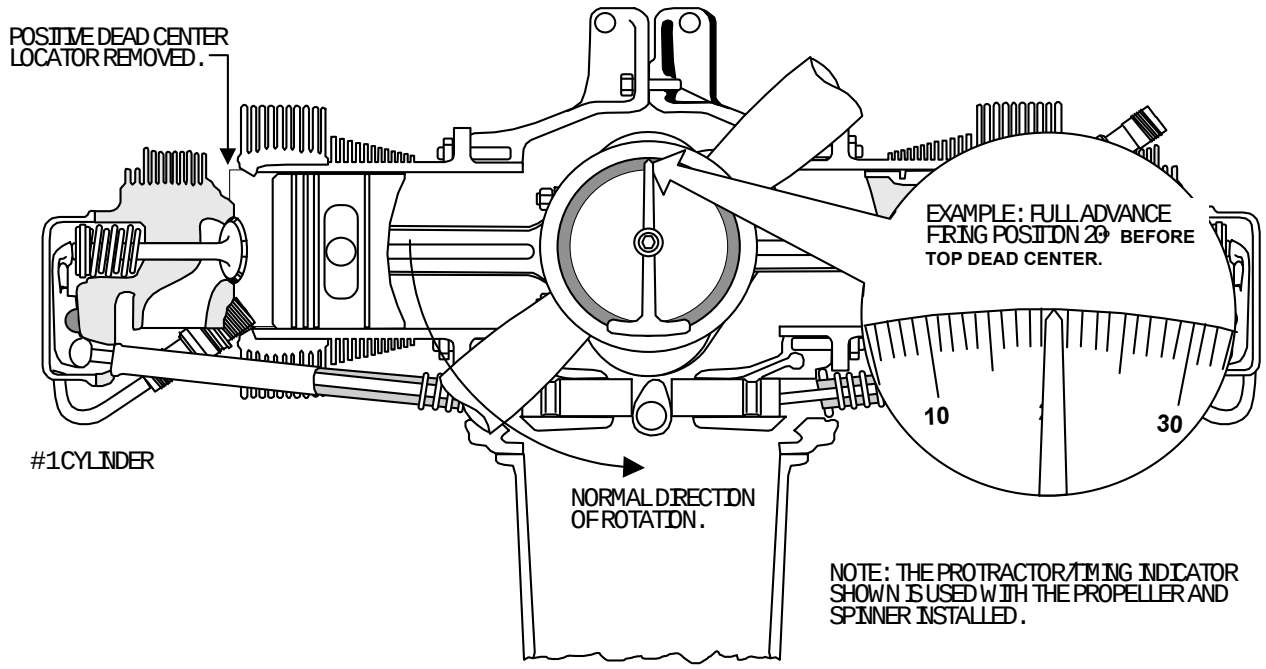


FIGURE 12-5. TIMING POSITION STEP 5

MAGNETO TIMING AND INSTALLATION ON ENGINE

A. Insert the T118 timing pin, going in "L" or "R" hole (depending on magneto rotation) in the distributor block. Turn rotor in the opposite rotation of magneto until pin engages the gear.

B. Without turning the magneto coupling, hold the magneto in the position it will occupy when installed. Check the alignment of the gear coupling slot and impulse coupling lugs. If not aligned, pull the magneto drive gear out of mesh and turn to position needed. Push gear back into mesh.

WARNING

Prior to any engine or magneto timing procedure disconnect all ignition harness spark plug leads from the spark plugs. Do not attach any ignition harness spark plug leads to the spark plugs until all magneto, engine timing procedures and magneto to switch connections have been entirely completed. The magneto is in a SWITCH ON condition when the switch wire is disconnected. To prevent possibility of serious bodily injury or death, before moving the propeller accomplish the following:

a. Disconnect all spark plug leads.
b. Verify magneto switches are connected to magnetos, that they are in the "OFF" Position and "P" leads are grounded.
c. Throttle position "CLOSED."
d. Mixture control "IDLE-CUT-OFF."
e. Set brakes and block aircraft wheels.
f. Insure that aircraft tie-downs are installed and verify that the cabin door latch is open.
g. Do not stand within the arc of the propeller blades while turning the propeller.

C. Insure that the crankshaft is positioned in accordance with Section 12-6 "Placing Crankshaft In Timing Position."

D. Insure that the magneto drive coupling bushings and retainers are properly installed. Place a new gasket on the magneto flange and install magneto carefully so that the drive coupling lugs mate with the slots of the drive bushings. Install holding washers, lock washers and nuts. Snug nuts but do not torque. This will allow turning of the magnetos for final timing. Remove the T118 timing pins from Slick magnetos.

WARNING

Any debris that falls into the engine interior must be removed prior to engine operation.

E. Using the above procedure, paragraphs A through D, install the remaining magneto.

F. The magneto timing light breaker point leads are connected to the ground terminals of the magnetos. The timing light breaker point leads are connected so that the light on the right side of the timing light box represents the right magneto and the light on the left side of the timing light box represents the left magneto. The timing lights should indicate that the points in both magnetos are closed. Tap the right magneto up with a non-marring hammer until the light indicates points just opening. Tap the left magneto down until the light indicates points just opening. Secure magnetos.

G. Watch the lights on the magneto timing light. Turn the crankshaft a few degrees counterclockwise then clockwise until the timing indicator's pointer is pointing to the correct degree. As the pointer aligns with the correct degree both lights on the magneto timing light must indicate that the points just open within one-half-degree of crankshaft rotation. If timing light does not indicate the above re-adjust the magnetos.

NOTE . . . Point opening is indicated by light illumination on some timing lights while other timing lights operate in the reverse manner, i.e., the light goes out when the points open.

CAUTION . . . When installing the magneto on the engine using the specified nuts and clamps, take the following precautions. Tighten both nuts by hand to finger tightness. Torque each nut alternately to 8.3 to 10.0 ft.-lbs. Exceeding 10.0 ft.-lbs. torque may cause the mounting flange to crack.

H. Torque the magneto attaching hardware to 8.3 - 10.0 foot pounds.

Disconnect timing light from magnetos. Insure that connections between magneto and ignition switch are secure.

I. If the ignition harness was removed during ignition system maintenance it must be reinstalled in accordance with the following instructions.

IGNITION HARNESS PRE- INSTALLATION INSTRUCTIONS

A. Clean the mating surfaces before installing harness on magneto. Install and tighten nuts around plate alternately to seat cover squarely on magneto. Torque screws according to the Magneto Manufacturer's Instructions.

B. The harness assemblies are constructed of a lightweight, flexible, silicone coated cable. Because the harness assemblies are lightweight and flexible the following must be observed when installing the harness on an engine:

1. Support leads with the necessary clamps and cable ties to prevent any whipping or chafing action.

2. Route leads as far away as possible from exhaust manifold to insure they are not exposed to temperatures in excess of 400°F.

3. To prevent sticking of sleeves and to minimize twisting of ferrule coat insulating sleeves, use MS122N/C02 Spray, Miller-Stephenson Chemical Co., Inc., 16 Sugar Hollow Road, Danbury, Connecticut 06810. See Figure 12-9, "Coating Insulating Sleeve."

NOTE . . . Hold ferrules while torquing or loosening spark plug coupling nuts to protect against twisting conduit or cable.

4. Clamp harness leads as required.

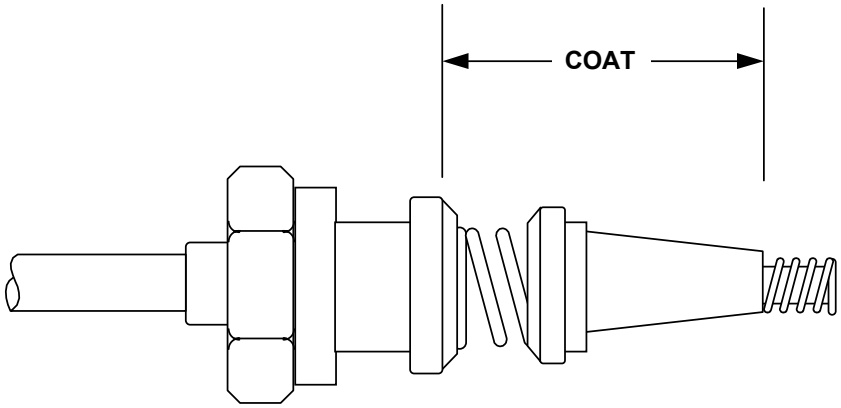


FIGURE 12-9. COATING INSULATING SLEEVE

IGNITION HARNESS INSTALLATION

A. The high tension cable outlet plates can be attached to either magneto in only one position.

B. Attach cable outlet plate to magneto.

C. Apply Champion® thread lubricant to spark plugs in accordance with the manufacturer's instructions see Chapter 3. Install all spark plugs and torque to 300-360 inch pounds.

D. Secure the ignition leads to the cylinder rocker covers using the ignition lead clamps and rocker cover screws. Use caution routing and attaching leads. Keep leads away from high heat sources such as the exhaust manifold. Keep the leads away from any engine component that may cause chafing.

CHAFING: A condition caused by a rubbing action between adjacent or contacting parts under light pressure which results in wear.

NOTE . . . An ignition system wiring diagram is located on next page, see figure 12-10.

NOTE . . . The cylinder firing order is 1-6-3-2-5-4.

Install the ignition leads on the proper plugs and screw on. Torque ignition lead coupling nuts to 110 - 120 inch pounds.

E. Consult service bulletins issued by the ignition harness manufacturer regarding tips for increased service life.

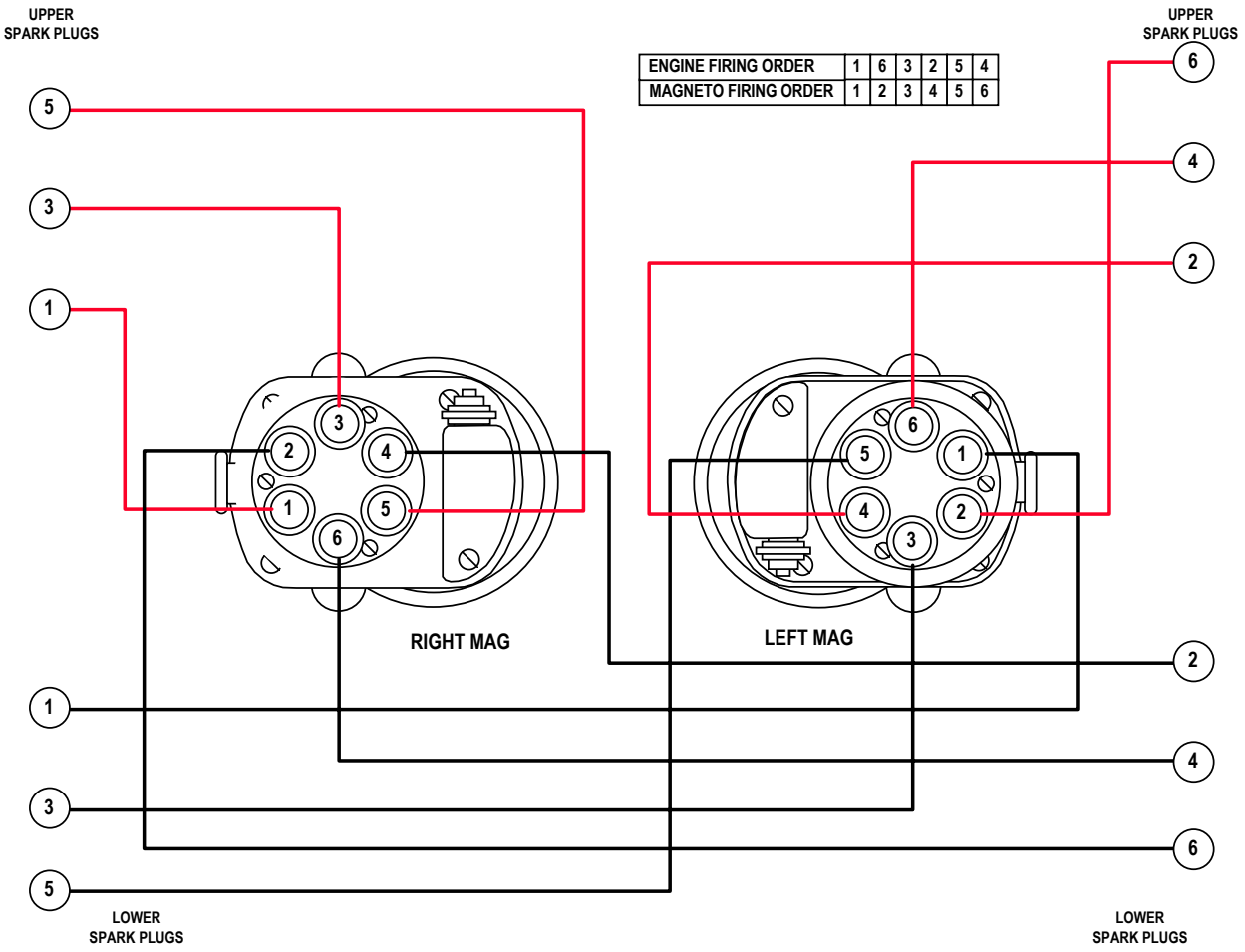


FIGURE 12-10. IGNITION WIRING DIAGRAM

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CHAPTER 13
FUEL SYSTEM

13-1 ENGINE FUEL SYSTEM DESCRIPTION

Fuel System L/TSIO-360-RB

The fuel injection system, composed of a TCM fuel pump, manifold valve, nozzles and a ®Precision Airmotive fuel servo. Fuel flows from the fuel pump to the fuel servo unit. The fuel then flows from the fuel servo unit to the fuel manifold valve where it is distributed to the six fuel injector nozzles. Fuel flows through the fuel nozzles to the intake valve ports. A detailed description of the fuel pump, fuel manifold and nozzles are given in the following sections. See the Precision Airmotive Corporation RSA-5 Operating and Service Manual for a schematic of the fuel sustem and a detailed description of the fuel servo unit. See Related Publications Section 1-4 for ordering information.

13-2 FUEL INJECTION SYSTEM COMPONENT DETAILED DESCRIPTION (cont'd)

Fuel Pump L/TSIO-360-RB (See Figure 13-1)

Fuel enters the fuel pump inlet where it is directed to the fuel pump blades. The fuel pump blades create fuel flow and the fuel is directed to the fuel pump outlet. Fuel leaving the fuel outlet is directed through various fittings and fuel line to fuel servo assembly.

The use of a positive displacement, engine-driven pump means that changes in engine speed affect pump flow and pressure proportionally. The fuel pump provides greater capacity than is required by the engine.

An adjustable relief valve maintains pump flow and pressure proportional to engine speed. This provision insures proper pump pressure and delivery for all engine operating speeds.

A check valve is provided so that the aircraft boost pump pressure to the system can by – pass the engine driven fuel pump during engine priming and starting. This feature also aids in the suppression of vapor formation during high ambient temperature conditions. The check valve also permits the use of the aircraft auxiliary fuel boost pump in the unlikely event of an engine driven fuel pump malfunctions.

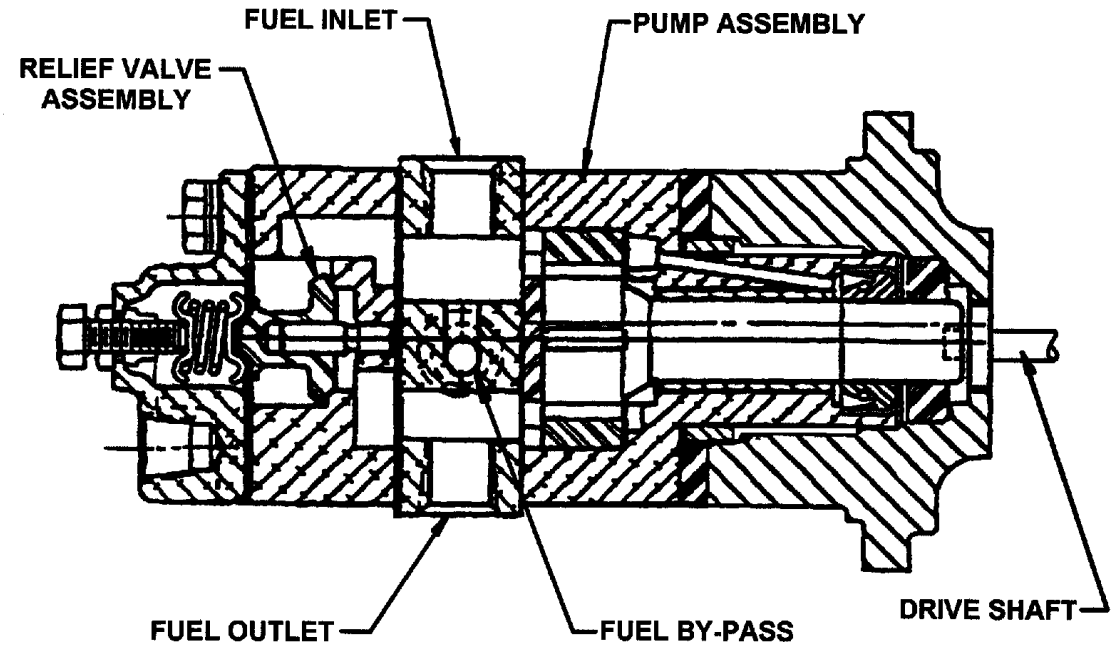

FIGURE 13-1. FUEL PUMP DESCRIPTION L/TSIO-360-RB

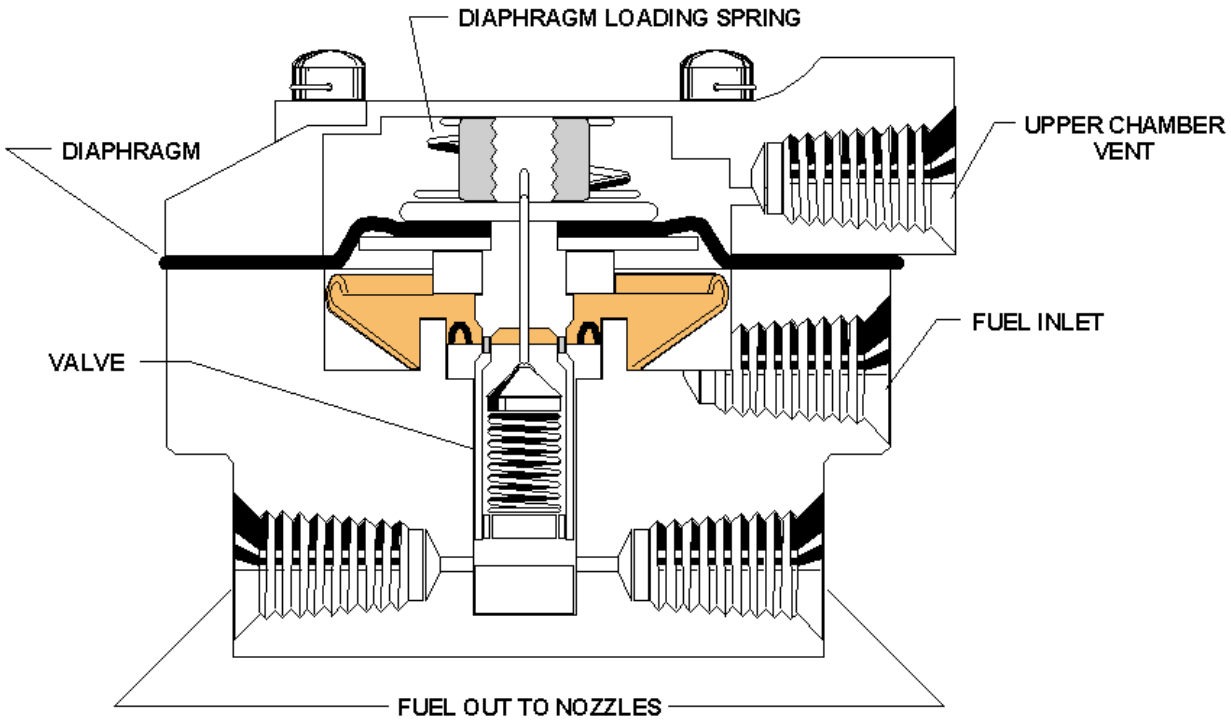

FIGURE 13-2. GENERAL FUEL MANIFOLD VALVE DESCRIPTION

Fuel manifold Valve (See Figure 13-2)

The fuel manifold valve body contains a fuel inlet, diaphragm chamber and outlet ports for fuel lines to the individual nozzles. The diaphragm is enclosed by a vented cover which retains the diaphragm loading spring. When the plunger is down in the body bore, fuel passages to the nozzles are closed off. The plunger is drilled for passage of fuel from the fuel inlet chamber to its base. As fuel flow increases, pressure overcomes diaphragm spring tension causing the plunger to move to the open position and fuel flows from manifold valve outlets through fuel lines to the fuel lines to the fuel nozzles assemblies.

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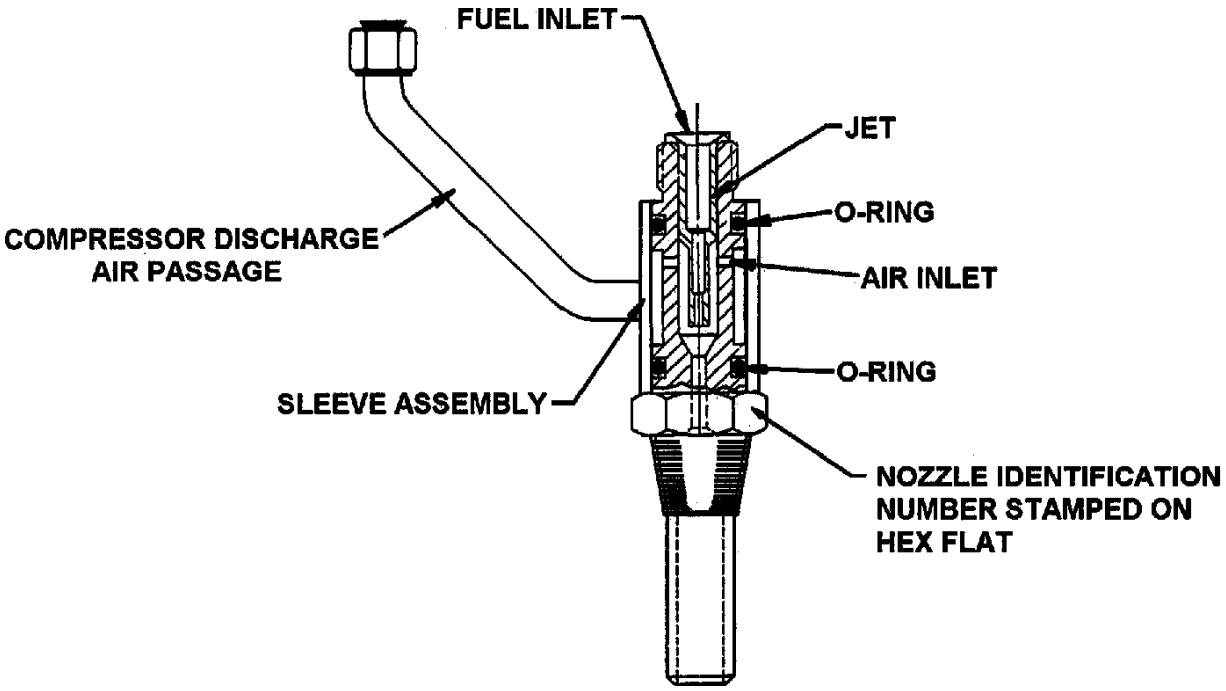

FIGURE 13-3. FUEL NOZZLE DESCRIPTION

Fuel nozzle (See Figure 13-3)

The fuel discharge nozzle is located in the cylinder head. The nozzle outlet is screwed into the tapped fuel nozzle hole in the cylinder head. The nozzle body has a drilled central passage with a counterbore at each end. The lower end is the fuel outlet. The upper bore contains a removable jet for calibrating the nozzles. Near the top, radial holes connect the upper counterbore with the outside of the nozzle body for air admission. A shroud is mounted on the nozzle body and extends over the nozzle body. The nozzle shroud is sealed to the nozzle body using o-rings. The nozzle shrouds are referenced to upper deck pressure. This provides a positive air pressure differential to insure proper fuel atomization at all operating parameters. Nozzles are calibrated in several ranges and all nozzles furnished for one engine are of the same range identified by a letter stamped on the hex of the nozzle body.

13-3 FUEL INJECTION SYSTEM INSPECTION

50 Hour- Inspect the fuel servo unit in accordance with the manufacturer's instructions. See Related Publication Section 1-4 for ordering information. Visually inspect all fuel injection system components, plumbing and connections for security, deterioration, leaks and chafing.

WARNING

Fuel injection lines must not be bent or deformed. The fuel injection lines must be securely clamped to the fuel line support brackets. Do not assemble in a binding configuration.

WARNING

Never clean nozzles with wire or other similar object. If nozzle jet is plugged and obstruction cannot be removed by solvent action REPLACE THE NOZZLE.

100 Hour- Perform all requirements under 50 hour inspection. The fuel nozzles must be removed, cleaned and visually inspected every three hundred hours of operation. The nozzles must be cleaned by soaking in lacquer thinner, methyl ethyl keytone or acetone for several hours. Blow dry with compressed air. Apply 646943 anti seize lubricant to fuel nozzle threads (cylinder end) in accordance with Figure 13-4, " General F/I Sealant Application." Install fuel nozzles in cylinders 1 through 6. Torque fuel nozzles to 55-65 inch pounds. Re- install fuel lines on fuel nozzles. Torque fuel line "B" nuts to 40-45 inch pounds.

CAUTION… Never use Teflon tape on fuel injection system fittings.

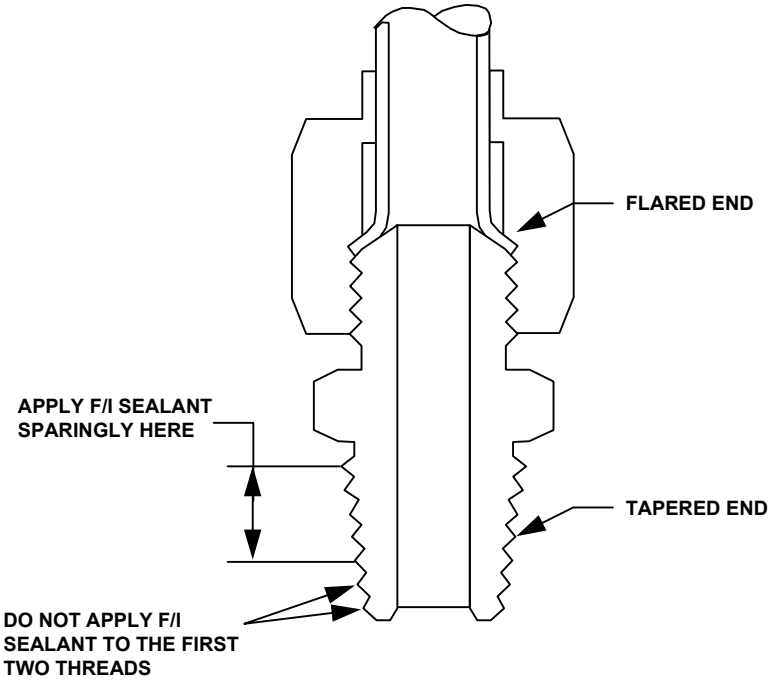

FIGURE 13-4. GENERAL F/I SEALANT APPLICATION

(continued on next page)

WARNING

Failure to comply with the following instructions can result in fuel system linkage and/or related component damage and subsequent loss of engine power.

Inspect the operation of each engine related control, including the throttle, mixture, propeller and alternate air controls. Make certain that each control has full limit of travel and that no binding or excessive play caused by worn parts or improper installation is evident. Inspect the fuel servo levers in accordance with the manufacturer's instructions. See Related Publications Section 1-4 for ordering information.

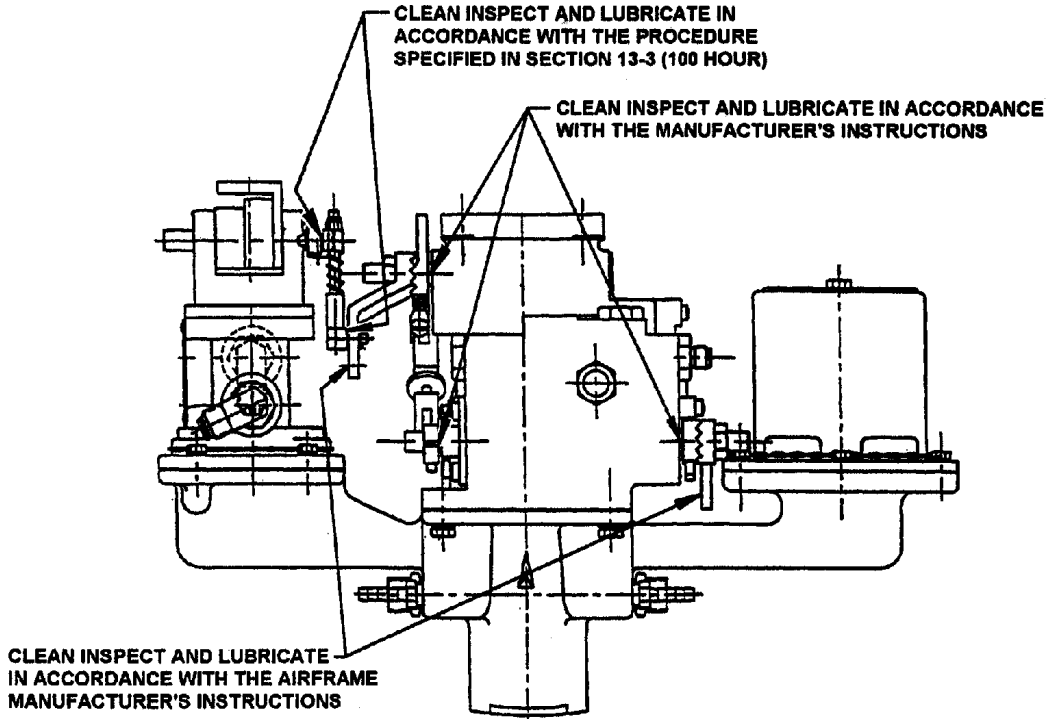

FIGURE 13-5. GENERAL CONTROL LINKAGE LUBRICATION POINTS

WARNING

Connections requiring torqued fasteners must not exhibit any movement or motion between components. Such movement may cause abnormal wear resulting in component malfunction or failure and subsequent loss of power.

Inspect all engine control cables for proper routing and security in accordance with the airframe manufacturer's instructions. Inspect all engine control cables for signs of damage or wear caused by chafing and heat distress in accordance with the airframe manufacturer's instructions.

See Figure 13-5. To insure proper operation and to pr3event accelerated water, the fuel servo to controller linkage must be inspected for excessive play which can cause lost motion and breakage of parts. Inspect the pivot points of levers and linkages for debris, old grease and oil. Inspect the fuel servo levers for worn bushings which cause excessive play in accordance with the servo manufacturer's instructions. Clean pivot point areas thoroughly using clean Stoddard solvent. After cleaning, dry each area using compressed air.

Unless otherwise specified by the servo or airframe manufacturer, apply LPS 2, PERMATEX “Maintain” Lubricant or equivalent to the two pivot points shown in Figure 13-5. If lever or link rods are replaced initial lubrication must be accomplished using SHELL #5 or LUBRICATE #630AA or equivalent. The other pivot points and control connections shown in Figure 13-5 must be maintained in accordance with the servo or airframe manufacturer’s instructions.

WARNING

Anytime fuel control to throttle linkage, attaching hardware, levers or lever bushings haven replaced or reassembled, the fuel system must be checked, adjusted and tested in accordance with Precision Airmotive Corporation RSA-5 Operation and Service Manual. See Related Publication Section 1-4 ordering information.

Worn or corroded linkage or attaching hardware must be replaced in accordance with Chapters 9 and 10 of the L/TSIO-360 overhaul manual, Form X30596A. Fuel servo levers or lever bushings must be replaced in accordance with Precision Airmotive Corporation RSA-5 Operation and Service Manual. See Related Publications Section 1-4 for ordering information.

Consult the airframe manufacturer and /or their most current published instructions concerning aircraft engine control cable attach point inspection, cleaning, repair, installation and lubrication.

After the preceding procedures have been accomplished verify that each control has full limit of travel, the required safeties are in place, that no binding of levers or linkages is occurring and that control movement is unrestricted by contact with other parts or components that are located in close proximity.

Compare recorded findings of operational inspection with the following data:

ENGINE	① RPM Propeller	① Unmetered or Pump Pressure (PSID)	Fuel Flow Lbs./Hr.	Fuel Flow Gal./Hr. (APPROX.)
L/TSIO-360-RB	700 RPM IDLE 2600 RPM F/T	35-45	140-150	24.0 - 25.0
NOTE . . . The fuel system must be adjusted using a calibrated Porta-Test Unit® connected in accordance with the manufacturer’s instructions.				
①See Aircraft Specifications for other values where applicable.				

NOTE… Fuel pressures must be checked using external, calibrated instrumentation connected to the fuel system as shown in Chapter 23, “Fuel System Adjustment.” **Do not use airframe cockpit gages when checking fuel pressures.**

If the fuel system is not functioning properly, proceed to fuel system troubleshooting to determine the cause and procedure for correction.

(continued on next page)

13-4 FUEL INJECTION SYSTEM TROUBLESHOOTING

This troubleshooting chart is provided as a guide. Review all probable causes given, check other listings of troubles with similar symptoms. Items are presented in sequence of the approximate ease of checking, not necessarily in order of probability.

TROUBLE	PROBABLE CAUSE	CORRECTION
Engine Will Not Start And No Fuel Flow Gage Indication	No fuel to engine	Check tank fuel level. See the airframe manufacturer's instructions.
	Mixture control improperly rigged	Check mixture control for proper rigging. See the airframe manufacturer's instructions.
	Engine not primed	Prime in accordance with the airframe manufacturer's instructions.
	Selector valve in wrong position	Position selector valve to MAIN TANK position.
Engine Will Not Start With Fuel Flow Gauge Indication	Engine flooded	Allow all fuel to drain from intake system. **WARNING...Starting an engine with a flooded intake system will result in hydrostatic lock and subsequent engine malfunction or failure.**
	No fuel to engine	Loosen one line at nozzle. If no fuel shows, with fuel flow on gage, replace fuel manifold valve. See Section 13-5, "Manifold Valve."
Rough Idle	Nozzle jet restricted	Remove nozzles and clean. See Section 13-5 Fuel Nozzles."
	Improper idle mixture	Adjust fuel mixture in accordance with Precision Airmotive Corporation RSA-5 Operation and Service Manual. See Related Publications Section 1-4 for ordering information.
Poor Acceleration	Idle mixture incorrect	Adjust fuel mixture in accordance with Precision Airmotive Corporation RSA-5 Operation and Service Manual. See Related Publications Section 1-4 for ordering information.
Poor Acceleration (cont'd)	Unmetered fuel pressure too high	Lower unmetered fuel pressure. Adjust in accordance with Section 23-2, "Fuel System Adjustment."
	Worn linkage	Replace worn elements of linkage in accordance with airframe manufacturer's instructions.
Engine Runs Rough	Restricted nozzle jet	Remove and clean all nozzles. See Section 13-5, "Fuel Nozzles."
	Improper mixture	Adjust engine-driven fuel pump in accordance with Section 23-2, "Fuel System Adjustments"
Low Fuel Flow Gauge Indication	Restricted flow to metering unit	Check for restriction between fuel pump and metering unit.
	Inadequate flow from fuel pump	Adjust engine-driven fuel pump in accordance with section 23-2, "Fuel System Adjustments."
High Fuel Flow Gauge Indication	Restricted flow beyond metering valve	Check for restricted nozzles or fuel manifold valve. Clean or replace as required. See Section 13-5, "Fuel Nozzles & Fuel Manifold Valve."
	Restricted recirculation passage in fuel pump	Replace engine-driven fuel pump. See Section 13-5, "Fuel Pump."

TROUBLE	PROBABLE CAUSE	CORRECTION
Fluctuating or Erroneous Fuel Flow Indications	Fuel vapor as a result of high ambient temperatures	If not cleared with auxiliary pump, check for clogged vapor vent in fuel pump vapor separator cover. Clean only with solvent, no wires. See Section 13-5, "Fuel Pump."
	Air in fuel flow gauge line. Leak at gage connection.	Repair leak and purge line. Refer to airframe manufacturer's instruction.
Poor Idle Cut-Off	Engine getting fuel	Check mixture controls in full idle cut-off. Check auxiliary pump is OFF. If neither, replace manifold valve. See Section 13-5, "Manifold Valve."

13-5. FUEL SYSTEM MAINTENCE

WARNING

Anytime the fuel pump, fuel servo unit, fuel manifold valve or fuel injection nozzles are removed and replaced, the fuel system must be checked, adjusted and tested in accordance with Precision Airmotive Corporation RSA-5 Operation and Service Manual. See Related Publications Section 1-4 for ordering information.

Fuel Manifold Valve - For replacement of fuel manifold valve, see the applicable portion of disassembly and reassembly procedure in the L/TSIO-360-RB Overhaul Manual, Form X30596A. The manifold valve may be replaced with new or it must be repaired and calibrated in accordance with the applicable instructions in the Fuel Injection Systems Parts and Overhaul Manual, Form X30593A.

NOTE… The appropriate test calibration equipment must be available for the overhaul of any TCM fuel injection system component.

Fuel Nozzles- For replacement of fuel nozzles, see the applicable portion of disassembly and reassembly procedure in the L/TSIO-360-RB Overhaul Manual, Form X30596A. If nozzles are obstructed and ccanot be cleaned by soaking in lacquer thinner, methyl ethyl keytone or acetone for several hours and blown dry with compressed air, they must be replaced with new.

FUEL Pump- For replacement of fuel pump see the applicable portion of disassembly and reassembly procedure in the L/TSIO-360 RB Overhaul Manual, Form X30596A. The fuel pump may be replaced with new or it must be repaired and calibrated in accordance with the applicable instructions in the Fuel Injection System Parts And Overhaul Manual, Form X30593A.

NOTE… The appropriate test calibration equipment must be available for overhaul of any TCM fuel injection component.

(continued on next page)

Whenever the fuel pump is removed from the engine the following Fits and Limits must be checked.

CAUTION…When performing dimensional inspection the following "Service Limits" may be used. However, they are only intended as a guide for re-use when performing maintenance of the engine prior to values up to and including service limits may be re- used, however, judgment should be exercised considering the PROXIMITY of the engine to its recommended overhaul time. Service limits must NOT be used when overhauling an engine. See current L/TSIO-360RB Overhaul manual for minimum fits and limits.

REF. NO	FITS & LIMITS	SERVICABLE LIMIT (MAX)
	FUEL PUMP DRIVE	
1	Fuel pump adapter pilot in crankcase .....diameter:	0.005L
2	Fuel pump body pilot in adapter.....diameter:	0.0045L
3	Oil seal in adapter .....diameter:	0.002T
4	Fuel pump drive shaft in impeller shaft .....diameter:	0.011L
5	Fuel pump drive shaft in governor gear .....diameter:	0.055L
6	Governor driven gear in crankcase .....diameter:	0.005
7	Governor driven gear bore in crankcase.....diameter:	0.876
8	Governor drive gear to camshaft gear .....diameter:	0.012

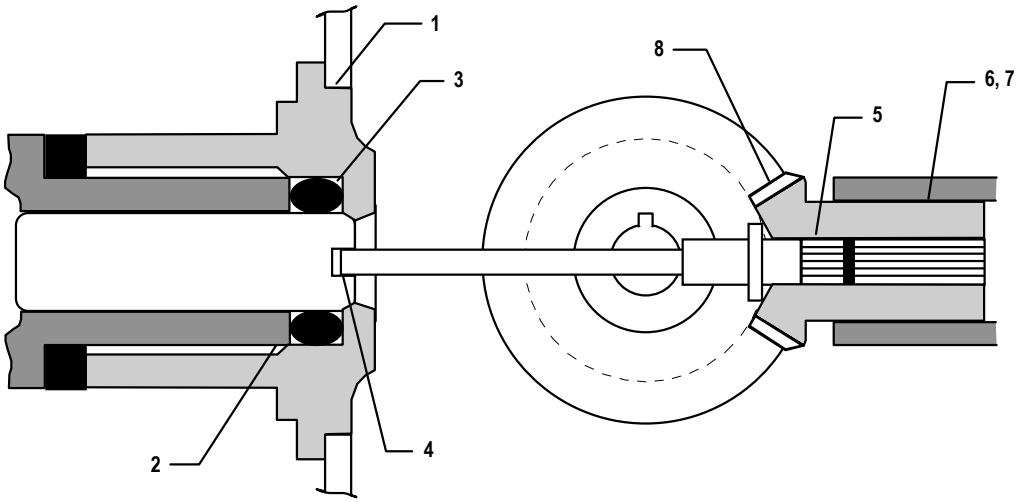

FIGURE 13-6. FUEL PUMP DRIVE FITS AND LIMITS

FUEL SYSTEM MAINTENANCE (cont'd)

Fuel Servo Unit- For removal and replacement of the fuel servo unit, see the applicable portion of disassembly and reassembly procedure in the L/TSIO-360 RB Overhaul Manual, Form X30596A. The fuel servo unit may be replaced with new or it must be repaired and calibrated in accordance with the applicable instructions in the Precision Airmotive Corporation RSA-5 Operation and Service Manual. See Related Publications Section 1-4 for ordering information.

Fuel Injection System Plumbing- Any fuel injection system plumbing or attaching hardware found to be loose, deteriorated, leaking, chafed, broken, bent or dirty must torqued, replaced or cleaned in accordance with the applicable portion of the L/TSIO-360 Overhaul manual, Form X30596A.

CHAPTER 14
INDUCTION SYSTEM

14-1 INDUCTION SYSTEM DESCRIPTION

See Figure 11-1, “Induction and Exhaust System Schematic,” for induction system components and induction air flow.

The induction system is mounted above the engine. It serves to carry induction air to the individual cylinder intake ports.

Engine components through which air flows following the aircraft air inlet filter/alternate air door are: turbocharger compressor, aftercooler, overboost/controller adapter, fuel servo unit throttle area, balanced manifold, induction tubes and cylinder intake ports. Air flows through these components in the order they are listed.

As the compressor wheel rotates high volume compressed intake air is discharged from the compressor housing outlet.

The compressed air flows through induction tubing to the aftercooler. The cooled compressed air flows from the aftercooler through induction tubes to the throttle assembly.

Installed on the controller, overboost valve adapter assembly is an overboost valve that will relieve excessive deck pressure in the event of wastegate/controller malfunction. Air exiting the fuel metering/throttle assembly flows into the balanced induction manifold and is distributed to the individual cylinder intake ports through induction tubes. Induction air flows into the intake ports and is mixed with fuel from the injector nozzles where it enters the cylinder as a combustible mixture when the intake valve opens.

Refer to the airplane manufacturer's Airplane Flight Manual (AFM) for alternate air door operations.

14-2 OVERBOOST VALVE DETAILED DESCRIPTION.

The overboost valve consists of a housing, spring, valve head and aneroid bellows assembly. The valve head is held in the closed position by the spring and aneroid bellows. The overboost valve is set to open slightly above maximum deck pressure to prevent damage in the event of a system malfunction.

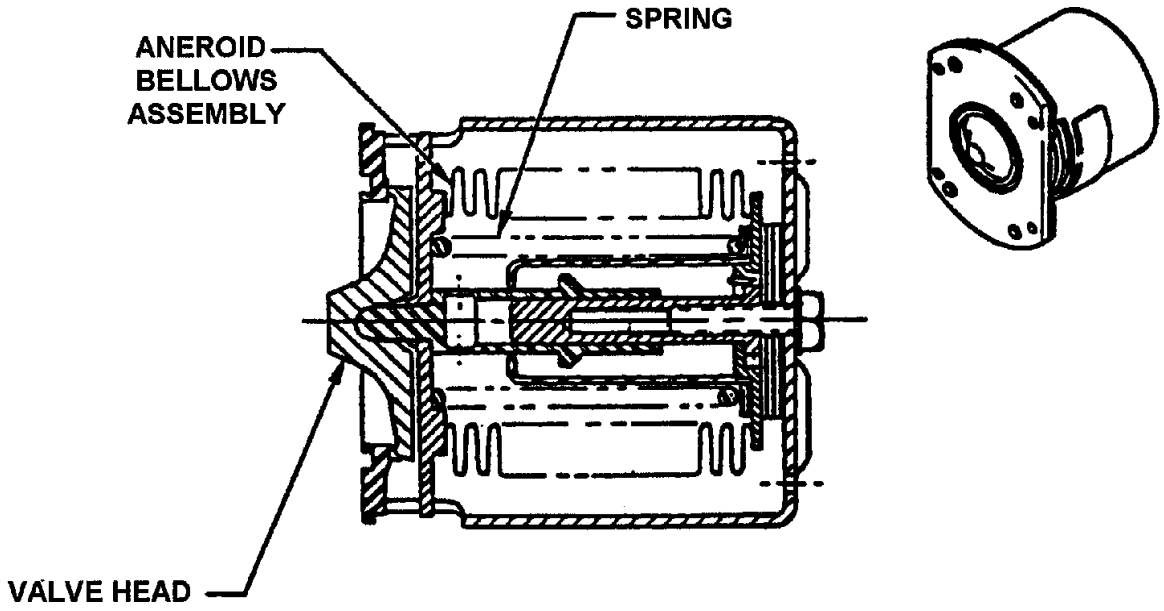

FIGURE 14-2. OVERBOOST VALVE

14-3 INDUCTION SYSTEM INSPECTION

50 HOUR - Visually inspect the induction manifold, aftercooler and overboost valve for security, safetying, leaks, cracks, and chafing. Inspect all induction tube connections for security and wear. Inspect all induction tube hoses for deterioration. Any attaching brackets exhibiting cracks must be replaced. Torque loose hardware using the values specified in the L/TSIO-360 Series Overhaul Manual, Form X30596A.

100 HOUR - Perform all inspection procedures listed under 50 hour inspection and inspect alternate air door operation, air filter and control connections for freedom of movement and/or lost motion due to wear in accordance with the airframe manufacturer's instructions. Fuel control unit to controller linkage, levers, and bushings must be cleaned, inspected and lubricated in accordance with the instructions in Section 13-3, "Fuel Injection System Inspection, 100 Hour."

Inspect manifold drain lines and check valves for leaks, chafing and function. At each scheduled maintenance interval, perform the following inspection to ensure that the drain(s) function properly:

14-4 INDUCTION SYSTEM TROUBLESHOOTING

This troubleshooting chart is provided as a guide. Review all probable causes given. Check other listings of troubles with similar symptoms. Items are presented in sequence of approximate ease of checking, not necessarily in order of probability.

TROUBLE	PROBABLE CAUSE	CORRECTION
Engine Will Not Start	Induction system intake obstructed	Locate and remove obstruction
Engine Will Not Run At Idling Speed	Induction system leakage	See Section 14-5.
Engine Runs Too Rich At Cruise Power	Restrictions in air intake passages	Check air passages remove restriction
Sluggish Operation And Low Power	Throttle not opening wide	Check and adjust control connections in accordance with the airframe manufacturer's instructions.

14-5 INDUCTION SYSTEM MAINTENANCE

Induction System - Induction system maintenance is limited to removal and replacement of malfunctioning components and torquing loose connections in accordance with the applicable portions of the L/TSIO-360 Series Overhaul Manual, Form X30596A. Induction System disassembly and reassembly procedures.

Lubrication - Fuel and controller linkage, levers, and bushings must be cleaned, inspected and lubricated in accordance with the instructions in Section 13-3, "Fuel Injection System Inspection, 100 Hour."

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CHAPTER 15
AIR CONDITIONING

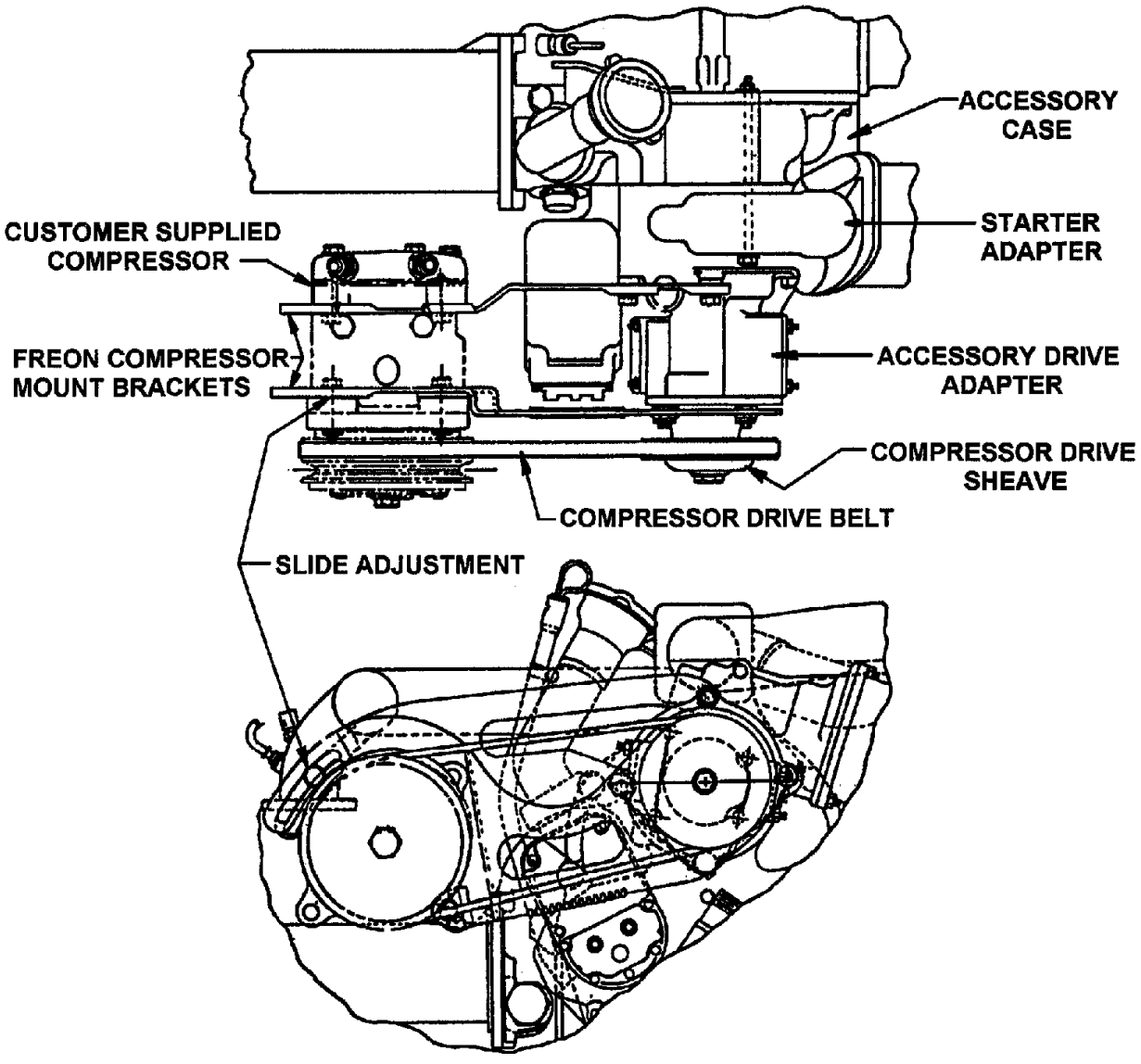
15-1 AIR CONDITIONING SYSTEM DESCRIPTION

Air Conditioning – The TSIO-360-RB engine utilizes a compressor mounting kit for the addition of a customer supplied belt driven compressor and air conditioning system. For a description of the complete air conditioning system refer to the airframe manufacturer's information.

15-2 AIR CONDITIONING SYSTEM COMPONENT DETAIL DESCRIPTION

Compressor Mounting Kit – The accessory drive adapter and compressor mounting brackets are attached to the rear of the starter adapter assembly. The accessory drive adapter houses the scavenge pump gears and gearing for two right angle drive adapter pads and a shaftgear for the compressor drive sheave. Two compressor mounting brackets are attached to the adapter by the adapter cover attaching hardware.

ENGINE TOP VIEW



ENGINE REAR VIEW

FIGURE 15-1. COMPRESSOR DRIVE (TSIO-360-RB)

15-3 COMPRESSOR BRACKET INSPECTION

50-Hour – Visually inspect the compressor bracket assembly for security and cracks. The drive belt, customer supplied, air conditioning components, plumbing and connections must be inspected in accordance with the airframe manufacturer's instructions.

15-4 AIR CONDITIONING SYSTEM TROUBLESHOOTING

See the Airframe Manufacturer's Instructions

15-5 COMPRESSOR MOUNTING KIT MAINTENANCE

Remove and replace worn or malfunctioning compressor mounting kit components in accordance with applicable portions of disassembly, reassembly in the L/TSIO-360 Overhaul Manual, Form X30596A Supplement 1. Freon compressor drive belt inspection, removal/installation, alignment and tensioning must be performed in accordance with airframe manufacturer's instructions. Customer supplied, air conditioning components, plumbing and connections must be repaired in accordance with airframe manufacturer's instructions.

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CHAPTER 16
ELECTRICAL SYSTEM

16-1 ELECTRICAL CHARGING SYSTEM DESCRIPTION

The L/TSIO-360-RB engines incorporate provisions on the right front crankcase half for mounting a belt driven alternator. The alternator generates electrical current for powering the aircraft electrical system. For description of the aircraft electrical and charging system see the applicable Airframe manufacturer's Instructions.

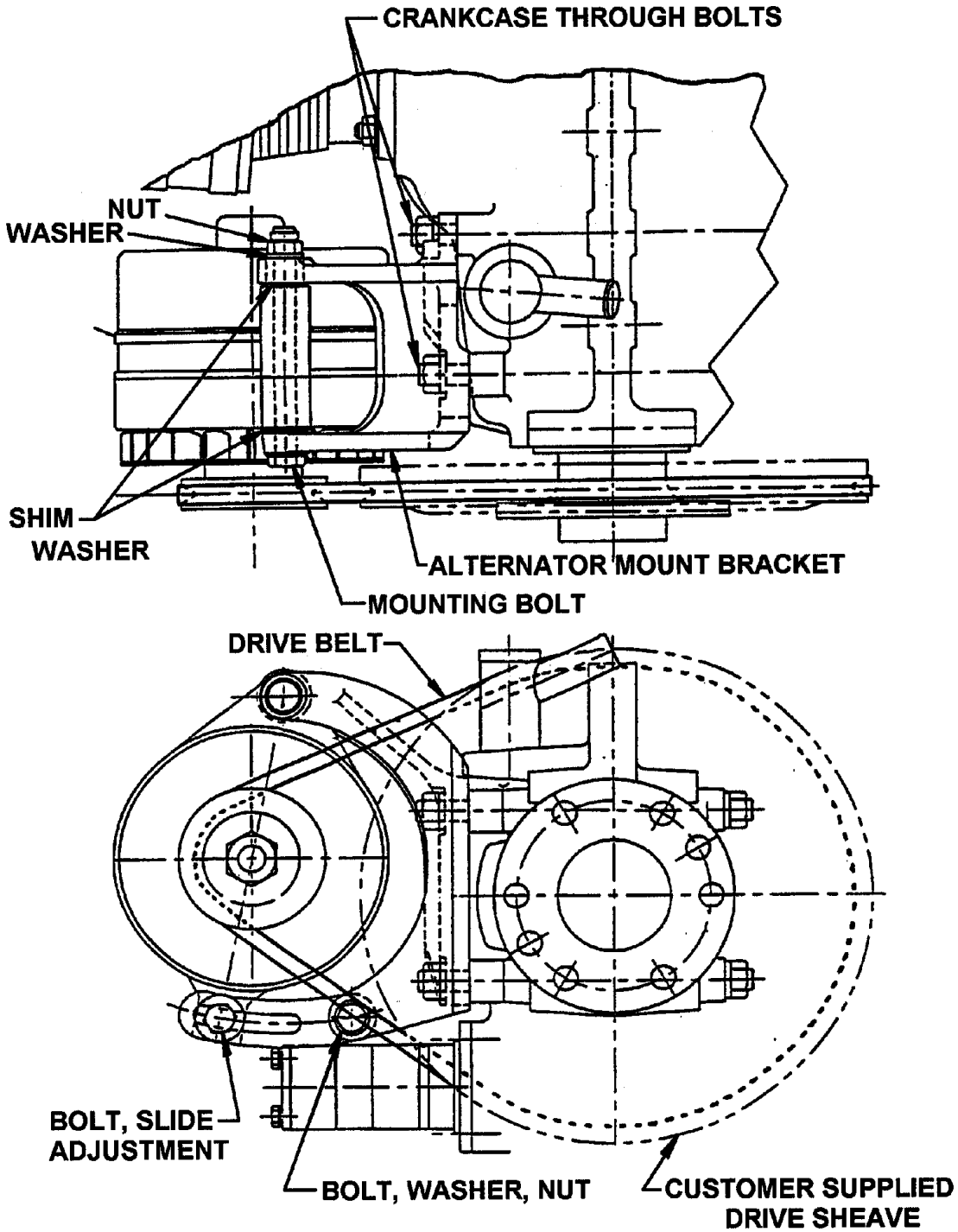

FIGURE 16-1. BELT DRIVEN ALTERNATOR

16-2 ELECTRICAL CHARGING SYSTEM COMPONENT DETAILED DESCRIPTION

Alternator - For a detailed description of TCM alternators see TCM Form No. X30531-3," Alternator Service Instructions." See Section 1-4," Related Publications" for ordering information.

16-3 CHARGING SYSTEM INSPECTION

50 Hour - Visually inspect the alternator mounting hardware for security and corrosion. Inspect the alternator and mounts for cracks. The drive belt belt and electrical connections must be inspected in accordance with the airframe manufacturer's instructions.

100 Hour - Perform all requirements of 50 hour inspection. Compare findings of engine operational inspection with Airframe Manufacturer's Alternator Output And Load Specifications. During inspection of charging system, any indication of an alternator malfunction will require alternator removal. The alternator may be removed for repair or replacement in accordance with the applicable portions of the L/TSIO-360 Overhaul Manual, Form X30596A, alternator disassembly/reassembly.

16-4 CHARGING SYSTEM TROUBLESHOOTING

Refer to the airframe manufacturer's applicable charging system troubleshooting information.

16-5 CHARGING SYSTEM MAINTENANCE

Alternator - For maintenance or repair of TCM alternators See TCM Form No. X30531-3," Alternator Service Instructions." The alternator and mounting bracket may be removed for repair or replacement in accordance with the applicable portions of the L/TSIO-360 Overhaul Manual, Form X30596A, alternator disassembly/reassembly.

Alternator drive belt inspection, removal/installation, alignment and tensioning must be performed in accordance with the airframe manufacturer's instructions.

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CHAPTER 17
STARTING SYSTEM

17-1 STARTER AND STARTER ADAPTER DESCRIPTION

The L/TSIO-360-RB engines utilize a starting system that employs an electric starter motor mounted on a right angle drive adapter. As the starter motor is electrically energized, the adapter worm shaft and gear engage the starter shaftgear by means of a spring and clutch assembly. As the shaftgear rotates, it in turn rotates the crankshaft gear and crankshaft. After engine start, the clutch spring disengages from the shaftgear.

The TSIO-360-RB engines utilize an accessory drive adapter and freon compressor mounting brackets. The accessory drive adapter has provisions for installing a sheave on an extended shaft.

Accessories may be mounted on either of the drive pads provided. See Chapter 15.

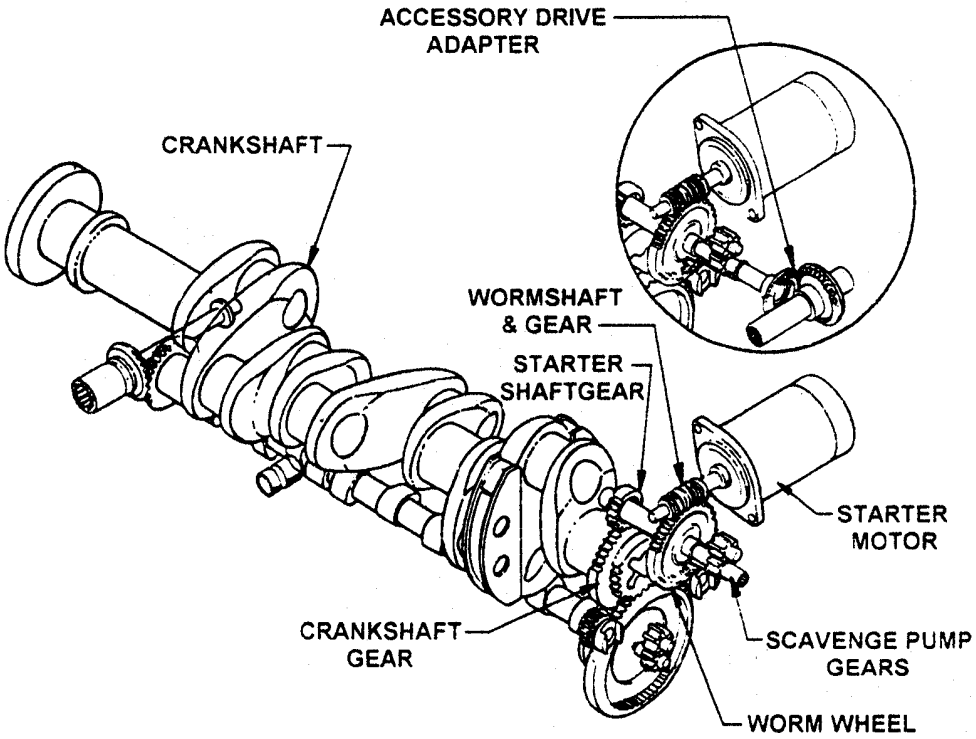
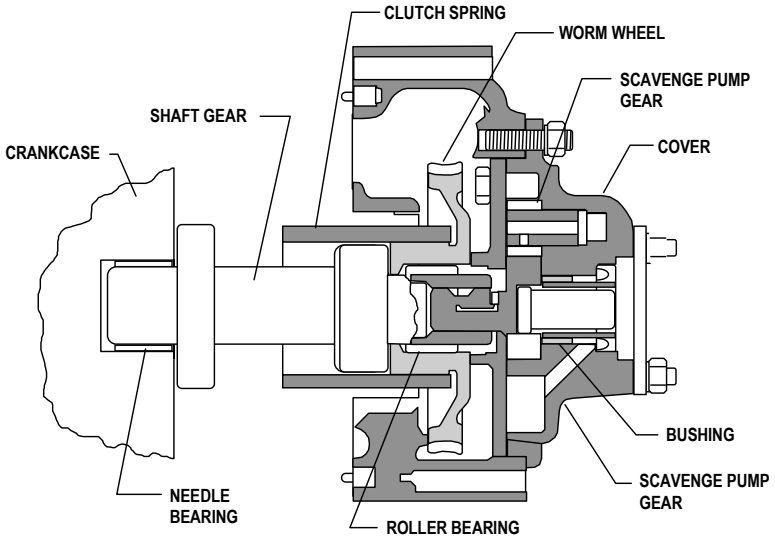


FIGURE 17-1. STARTER AND STARTER ADAPTER DESCRIPTION

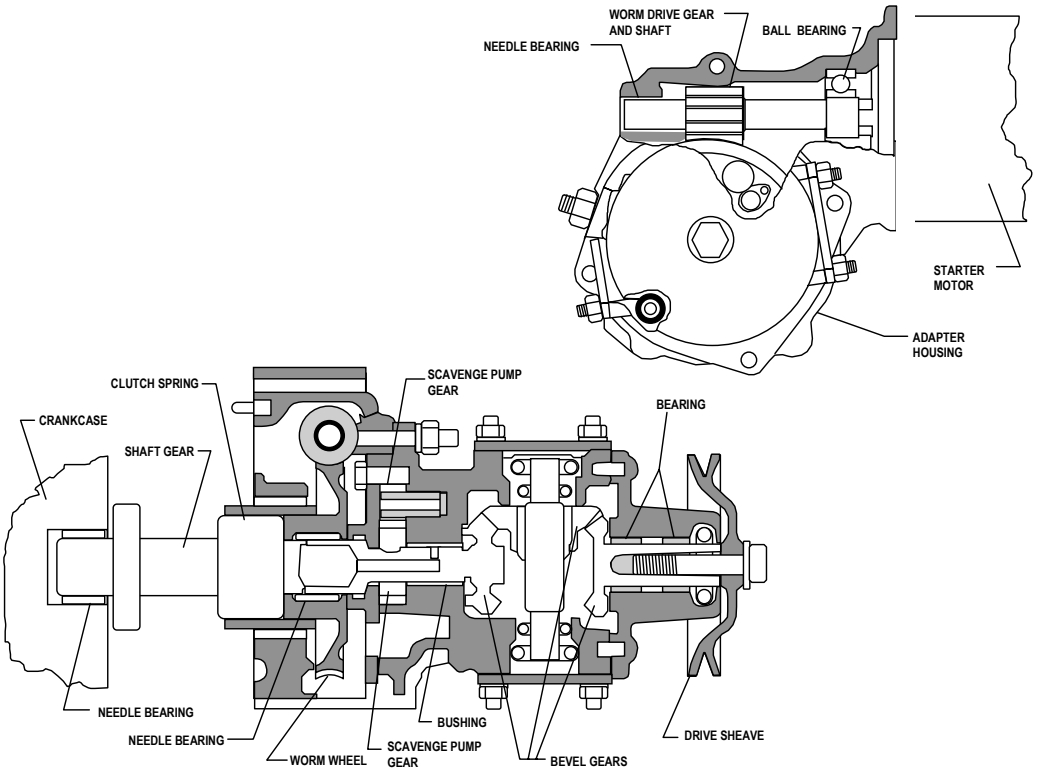
17-2 STARTING SYSTEM COMPONENT DETAIL DESCRIPTION

Starter - For a detailed description of TCM electric starter motors see TCM Form X30592, Starter Service Instructions. See Section 1-4," Related Publications" for ordering information.

Starter Adapter - The starter adapter assembly uses a worm drive gear shaft and worm gear to transfer torque from the starter motor to the clutch assembly. The shaft is supported in the housing at the starter end by a ball bearing and retaining ring, the opposite end is supported by a needle bearing pressed into the adapter housing. As the worm gear rotates the worm wheel and clutch spring, the clutch spring is tightened around the drum of the starter shaftgear. As the shaftgear turns, its torque is transmitted directly to the crankshaft gear. The starter shaftgear is supported at the adapter cover by a pressed in ball bearing, and is supported at the opposite end by a needle bearing in the crankcase. The L/TSIO-360-RB starter adapter rotates the crankshaft in a clockwise direction.



STANDARD STARTER ADAPTER L/TSIO-360-RB



STANDARD ADAPTER TSIO-360-RB

FIGURE 17-2. STARTER ADAPTER DESCRIPTION

17-3 STARTER AND STARTER ADAPTER INSPECTION

50 Hour - Visually inspect starter drive adapter to engine, starter adapter cover to adapter housing and starter to adapter attaching hardware for security. Visually inspect for oil leakage at cover oil seal area, cover to adapter and starter adapter to engine area.

100 Hour - Perform all visual inspection requirements of 50 hour inspection. Starter motor electrical connections must be inspected for security and corrosion.

17-4 STARTING SYSTEM TROUBLESHOOTING

This troubleshooting chart is provided as a guide. Review all probable causes given. Check other listings of troubles with similar symptoms. Items are presented in sequence of the approximate ease of checking, not in order of probability.

TROUBLE	PROBABLE CAUSE	CORRECTION
Starter Will Not Operate	Master switch circuit continuity	Refer to the airframe manufacturer's instructions
	Master circuit continuity	Refer to the airframe manufacturer's instructions
	Starter motor malfunctioning	See Section 17-5, "Starter".
Starter Motor Runs But Does Not Turn Crankshaft	Starter adapter drive train or clutch malfunctioning	See Section 17-5, "Starter Adapter".
Starter Motor Dragging	Improperly charged battery	Refer to airframe manufacturer's instructions
	Starter switch contacts burned or dirty	Refer to airframe manufacturer's instructions
	Malfunctioning Starter	See Section 17-5, "Starter".

17-5 STARTING SYSTEM MAINTENANCE

Starter - The starter motor may be removed for repair or maintenance in accordance with applicable portions of starter and starter adapter disassembly/ reassembly instructions in the L/TSIO-360 Overhaul Manual, Form X30596A Supplement 1. Disassembly, maintenance and reassembly of the starter motor must be performed in accordance with the starter manufacturer's instructions.

Starter Adapter - The starter adapter may be removed from the engine and disassembled in accordance with the applicable portions of starter and starter adapter disassembly/reassembly instructions in the L/TSIO-360 Overhaul Manual, Form X30596A Supplement 1. Whenever the starter adapter is removed from the engine because of malfunction it must be disassembled, cleaned, inspected and repaired in accordance with the L/TSIO-360 Overhaul Manual, FormX30596A Supplement 1. During maintenance the service limits on the next page can be used.

CAUTION. . . When performing dimensional inspection the following "Service Limits" may be used. However, they are only intended as a guide for re-use when performing maintenance of the engine prior to major overhaul. Parts with dimensions or fits that exceed service limits must not be re-used. Parts with values up to and including service limits may be re-used, however, judgment should be exercised considering the PROXIMITY of the engine to its recommended overhaul time. Service limits must NOT be used when overhauling an engine. See the current L/TSIO-360 Overhaul Manual, for minimum and limits.

If starter adapter is disassembled, the following components must be dimensionally inspected.

Ref. No.	Description	Serviceable Limit
1	Starter shaftgear in bearing ..... Diameter	0.0045
2	Starter shaftgear front (bearing) journal ..... Diameter	1.058
3	Starter shaftgear in needle bearing ..... Diameter	0.0031L
4	Scavenge pump gear shaft in cover bushing ..... Diameter	0.0035L
5	Bushing in adapter cover ..... Diameter	0.003T
6	Adapter cover oil seal bore ..... Diameter	1.249 -1.251
7	Starter adapter Cover Pilot In Adapter Housing ..... Diameter	0.003L
8	Worm wheel gear ..... End Clearance	0.015
9	Clutch spring on Starter Shaftgear drum .50-.56 from drum end ..... Diameter	0.004T
10	Clutch spring on clutch drum ..... Diameter	0.008L
11	From center line of worm gearshaft to starter adapter thrust pads	0.252
12	Needle bearing bore ..... Diameter	7485 - .7495
13	Ball bearing in starter adapter ..... Diameter	0.001L
14	Worm gearshaft in needle bearing area ..... Diameter	0.5600
15	Worm gearshaft in ball bearing ..... Diameter	0.0004L
16	Starter pilot to starter drive adapter ..... Diameter	0.0065L
17	Starter drive tongue to worm shaft drive slot ..... Side Clearance	0.030L
18	Needle bearing to worm gear shaft ..... Diameter	0.0031L
19	Starter gear to crankshaft gear ..... Backlash	0.016
20	Starter worm wheel gear and worm gear ..... Backlash	0.020
21	Scavenge pump driven gear on shaft ..... Diameter	0.004L
22	Scavenge pump drive gear in adapter ..... Diameter	0.004L
23	Scavenge pump gears in adapter ..... Diameter	0.008L
24	Scavenge pump drive gears in adapter ..... End Clearance	0.005
25	Scavenge pump drive gear in starter shaftgear ..... Diameter	0.004
26	Starter shaftgear in scavenge pump cover ..... Diameter	0.004L
27	Scavenge pump driven gear to drive gear ..... Backlash	0.027

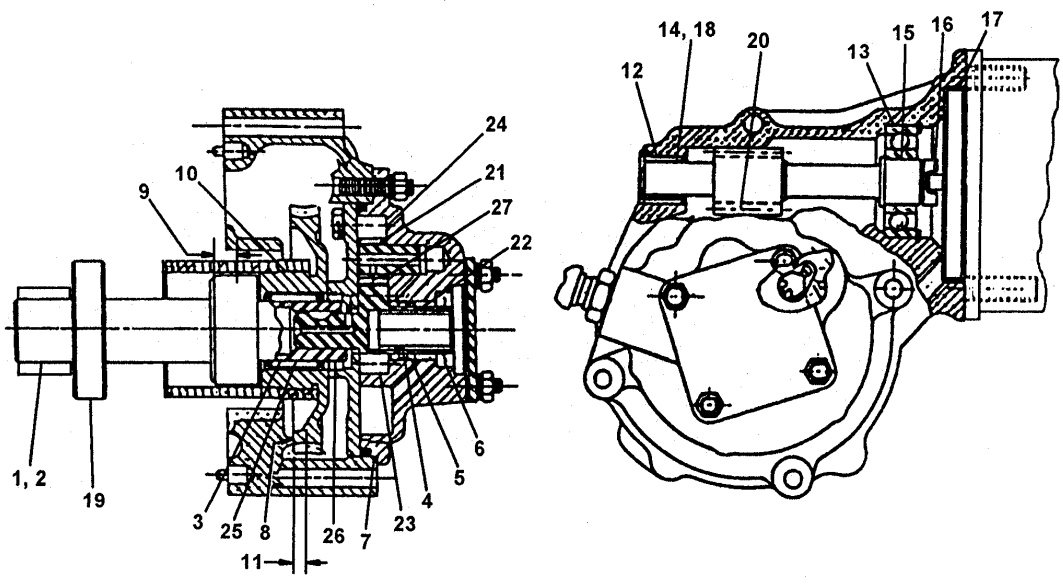


FIGURE 17-3. STARTER ADAPTER FITS AND LIMITS (LTSIO-360-RB and OPTIONAL TSIO-360-RB)

17-5 STARTING SYSTEM MAINTENANCE (cont'd)

Ref. No.	Description	Serviceable Limit
1	Starter shaftgear in bearing ..... Diameter	0.0045
2	Starter shaftgear front (bearing) journal ..... Diameter	1.059
3	Starter shaftgear in needle bearing	0.0031L
4	Starter shaftgear in accessory drive adapter bushing	0.002L
5	Bushing in adapter cover	0.003T
6	Gearshaft housing oil seal bore	1.574-1.576
7	Starter adapter cover pilot in adapter housing ..... Diameter	0.003L
8	Worm wheel gear ..... End Clearance	0.015
9	Clutch spring on Starter Shaftgear drum .50-.56 from drum end ..... Diameter	0.004T
10	Clutch spring on clutch drum ..... Diameter	0.008T
11	From center line of worm gearshaft to starter adapter thrust pads	0.252
12	Needle bearing bore ..... Diameter	.7485- .7495
13	Worm gearshaft in ball bearing ..... Diameter	0.0004L
14	Ball bearing in starter adapter housing ..... Diameter	0.001L
15	Starter pilot to starter drive adapter ..... Diameter	0.0065L
16	Starter drive tongue to worm shaft drive slot ..... Side Clearance	0.030L
17	Needle bearing to worm gear shaft ..... Diameter	0.0031L
18	Worm gearshaft in needle bearing area ..... Diameter	0.5600
19	Starter gear to crankshaft gear ..... Backlash	0.016
20	Starter worm wheel gear and worm shaft gear ..... Backlash	0.020
21	Scavenge pump driven gear on shaft ..... Diameter	0.004L
22	Scavenge pump gears in adapter ..... Diameter	0.0080L
23	Scavenge pump drive gear on starter shaftgear ..... Diameter	0.0017L
24	Scavenge pump driven gear to drive gear ..... Backlash	0.027
25	R/H side accessory drive bushing in adapter ..... Diameter	0.004T
26	R/H accessory drive shaft end in bushing ..... Diameter	0.003L
27	L/H side accessory drive bushing in adapter ..... Diameter	0.004T
28	L/H accessory drive shaft end in bushing ..... Diameter	0.003L
29	Driver bevel gear on shaftgear ..... Diameter	0.002L
30	Accessory drive shaft ..... Diameter	1.0600-1.0610
31	Accessory drive shaft ..... Diameter	.9360-.9370
32	Accessory drive shaft ..... Diameter	.8100-.8110
33	Driven bevel gear inside ..... Diameter	.9370-.9380
34	R/H oil seal bore ..... Diameter	1.249-1.251
35	L/H oil seal bore ..... Diameter	1.500-1.502
36	Driven and driver bevel gears ..... Backlash	0.016
37	Gearshaft housing bearing bore ..... Diameter	1.0610-1.0620
38	Sheave gearshaft ..... Diameter	0.8120-0.8125

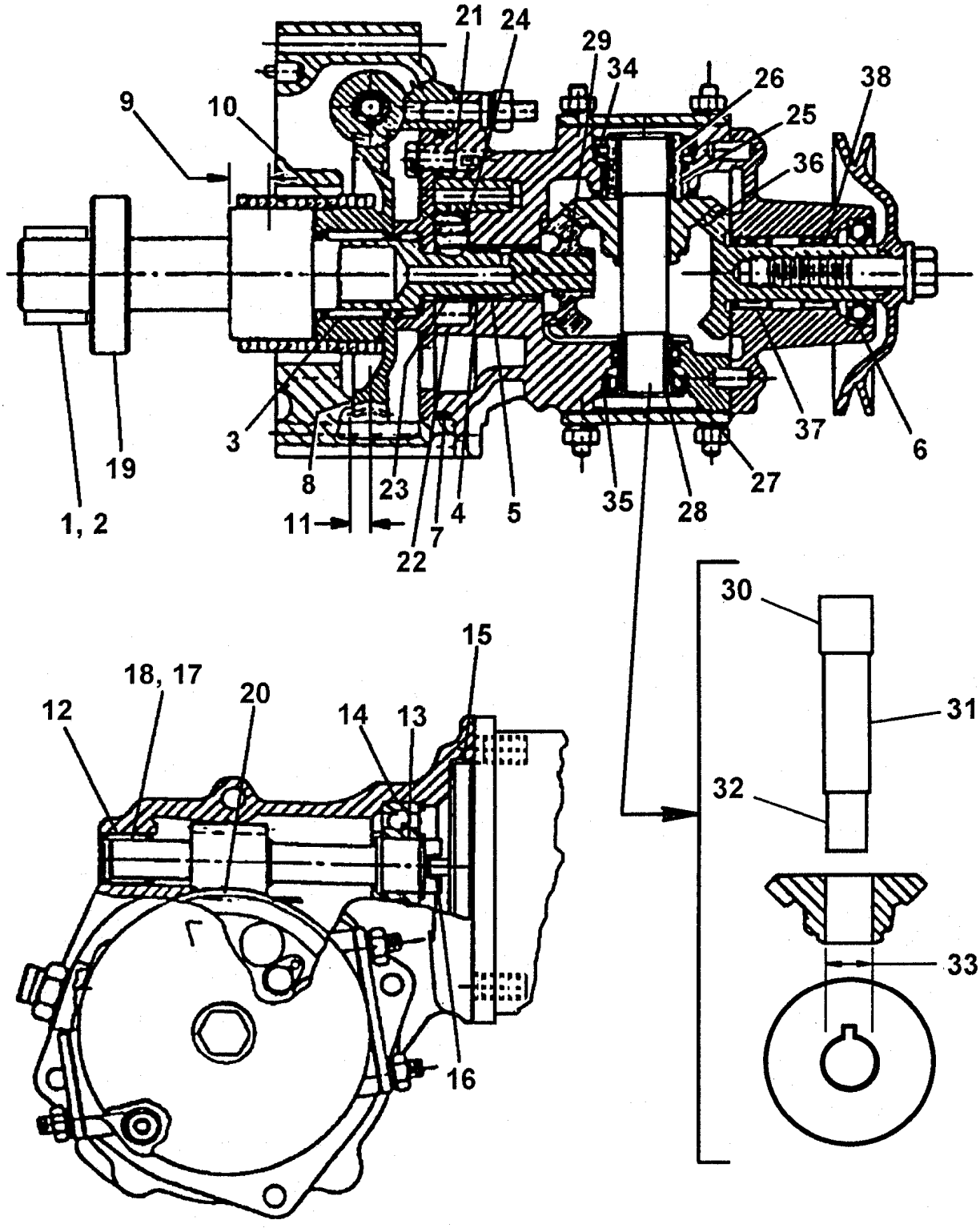


FIGURE 17-4. STARTER ADAPTER FITS & LIMITS

INTENTIONALLY

LEFT

BLANK

CHAPTER 18
ACCESSORY CASE

18-1 ACCESSORY CASE

The aluminum alloy casting is attached to the rear of the engine crankcase. Crankcase dowels align the accessory case with the crankcase. The accessory case is secured to the crankcase by crankcase studs and various attaching hardware. Accessory mount pads on the rear surface are machined in one plane parallel to the machined parting flange which surrounds the front side of the casting. Mounting pads for the magnetos, alternator cover, starter, tachometer drive, oil filter adapter, oil pressure relief valve and an oil suction screen boss are provided. The oil pump housing is machined into the internal portion of the accessory case.

18-2 ACCESSORY CASE DETAILED DESCRIPTION

See Figure 18-1 for accessory locations. A machined, threaded boss is located on the lower right hand side of the L/TSIO-360-RB and lower left hand side of the TSIO-360-RB accessory case for installation of an oil pressure relief valve. The front face of the accessory case is machined flat to mate with the crankcase. Oil pump gear chambers are machined in the interior of the accessory case. The oil pump is driven by the cam gear. Passages are cast into the accessory case to allow oil to flow from the oil sump through the suction tube to the oil pump gears, pressure relief valve and main oil gallery. The accessory case is sealed to the crankcase and oil sump by a gasket.

Oil Suction Screen Boss - A threaded oil screen boss is located on the bottom left hand side of the accessory case.

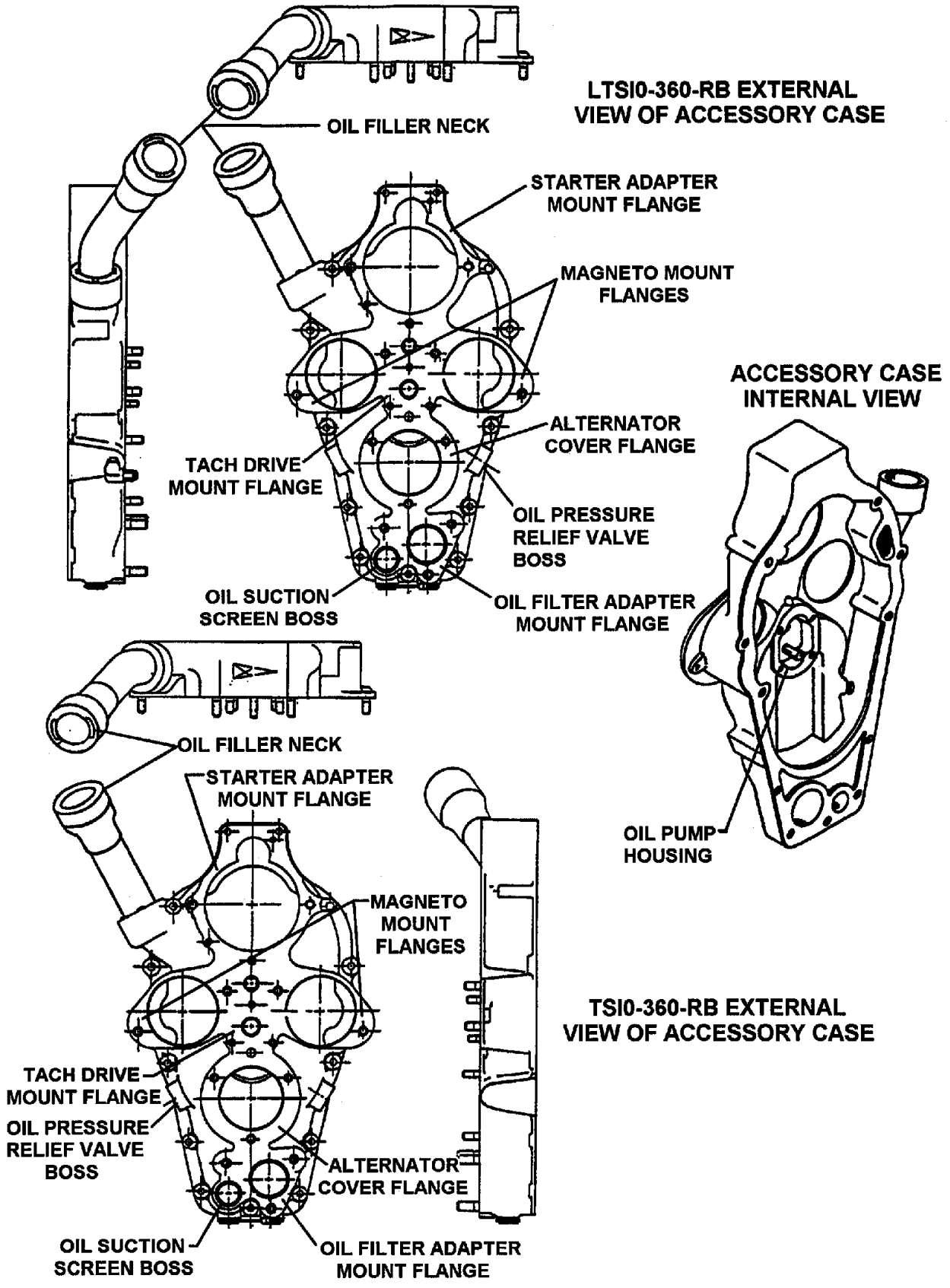


FIGURE 18-1. ACCESSORY CASE DESCRIPTION

18-3 ACCESSORY CASE INSPECTION

50 Hour - Visually inspect accessories for security and all gasket areas for oil leaks. All accessory studs must be visually inspected and checked for security. Safety mechanisms such as lockwire and locking tab washers must be inspected for proper installation and security. Inspect all areas of the accessory case for cracks.

100 Hour - Perform all inspection requirements of 50 hour inspection.

18-4 ACCESSORY CASE TROUBLESHOOTING

This troubleshooting chart is provided as a guide. Review all probable causes given. Check other listings of troubles with similar symptoms. Items are presented in sequence of the approximate ease of checking, not in order of probability.

TROUBLE	PROBABLE CAUSE	CORRECTION
Oil Loss	Loose accessories or deteriorated gaskets. Loose or stripped studs. Insufficient torque	See Section 18-5, Accessory Case
	Cracked accessory case	See the L/TSIO-360 Series Overhaul Manual Form X30596A for accessory case replacement.
Loose Accessories	Loose or stripped studs. Insufficient torque	See the L/TSIO-360 Series Overhaul Manual, Form X30596A for stud replacement and torque values.

18-5 ACCESSORY CASE MAINTENANCE

Accessories - If oil leaks are found remove applicable component, replace gasket and re-install component in accordance with the applicable system or component Disassembly/Reassembly portions of the L/TSIO-360 Series Overhaul Manual, Form X30596A. Insure re-installed component is properly torqued and safetied.

Studs - The replacement of studs may require component removal and replacement in accordance with the applicable component/system, Disassembly/Reassembly portions of the L/TSIO-360 Series Overhaul Manual, Form X30596A. When re-installing components, insure they are properly torqued and safetied.

CHAPTER 19
LUBRICATION SYSTEM

19-1 LUBRICATION SYSTEM DESCRIPTION

The engine oil supply is contained in the oil sump. Oil is drawn from the sump through the oil suction tube to the intake side of the engine driven, gear type, oil pump. From the outlet side of the pump, oil passes to an oil pressure relief valve installed in the oil gallery in the accessory case. The valve opens when the pump pressures exceed the adjusted limit and oil is directed back to the oil sump. From the pressure relief valve the oil flows to a full flow oil filter.

From the oil filter oil is directed through a gallery to the oil cooler. The oil cooler incorporates an oil temperature control valve. Oil passing through the oil temperature control valve cavity is directed either through the oil cooler core or by-passes the oil cooler core depending on the oil temperature to the left crankcase gallery. In this manner engine oil temperature is maintained within the normal operating range.

Oil passages off the left main gallery direct oil flow to the camshaft journals, the right main gallery and hydraulic valve tappet bosses. Oil flow is also directed upward to each of the crankshaft main bearings and forward to the propeller governor pad. Oil from the rear crankshaft main bearing is directed upward to the starter shaft gear bushing. Oil flow is tapped off the left main oil gallery and directed to the turbocharger through various hoses, fittings and a check valve to the turbocharger bearings. The oil from the turbocharger is collected through various hoses, fittings and a check valve by the oil scavenge pump where it is returned to the engine oil sump.

From the propeller governor lubricating oil is directed through a crankcase gallery to the front main bearing where it is directed to the interior of the crankshaft. Oil then travels through a transfer plug installed in the crankshaft to the variable pitch propeller. Hydraulic valve tappets transfer oil from the main oil galleries to the cylinder overhead through the hollow pushrods to a drilled oil passage in the rocker arms. Oil exiting the rocker arms lubricates the valve stems, springs and rotocoils. The oil then falls to the lower rocker cavity and returns to the crankcase and sump through the pushrod housings.

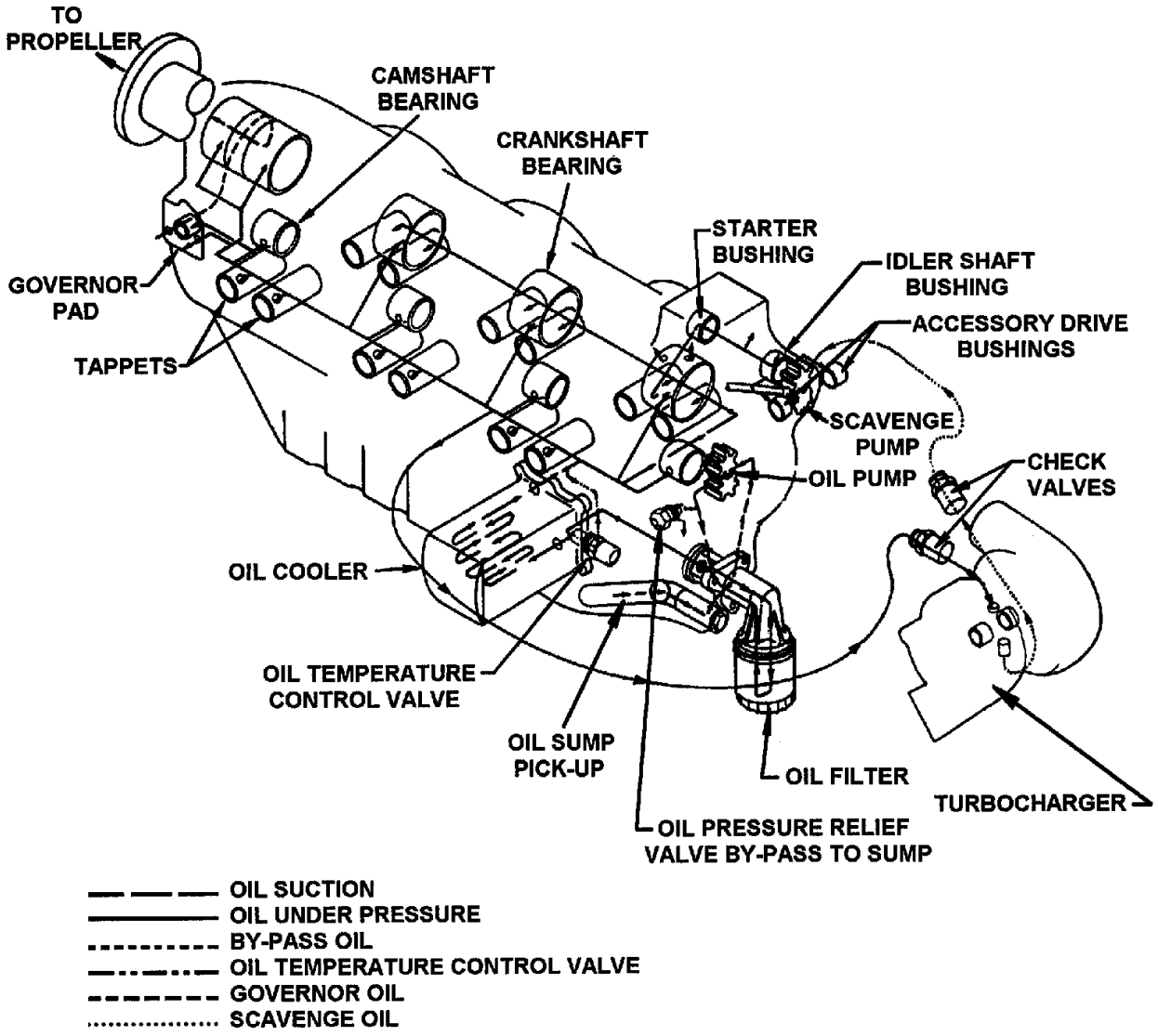


FIGURE 19-1 LUBRICATION SYSTEM SCHEMATIC

19-2 LUBRICATION SYSTEM COMPONENT DETAILED DESCRIPTION

Oil Pump - The oil pump is a positive displacement pump that consists of two meshed steel gears that revolve inside the oil pump cavity machined in the accessory case.

The camshaft drives the oil pump drive gear, which drives the oil pump driven gear. The oil pump driven gear is supported by a shaft pressed into the accessory case and supported by the oil pump cover plate.

The oil pump drive gear shaft is supported by bushings pressed into the accessory case.

As the engine starts rotating the oil pump drive gear turns (looking from the rear of the engine forward) counterclockwise, this drives the driven gear in a clockwise direction. The two gears turning create a suction that draws oil from the sump, through the oil suction tube to the oil pump gears. The oil is then forced around the outside of the gears and directed through a gallery to the pressure relief valve and oil filter.

An adjustable oil pressure relief valve regulates oil pressure within the specified limits. This insures adequate lubrication to the engine and its accessories at all speeds.

ACCESSORY CASE INTERNAL VIEW
TSIO-360

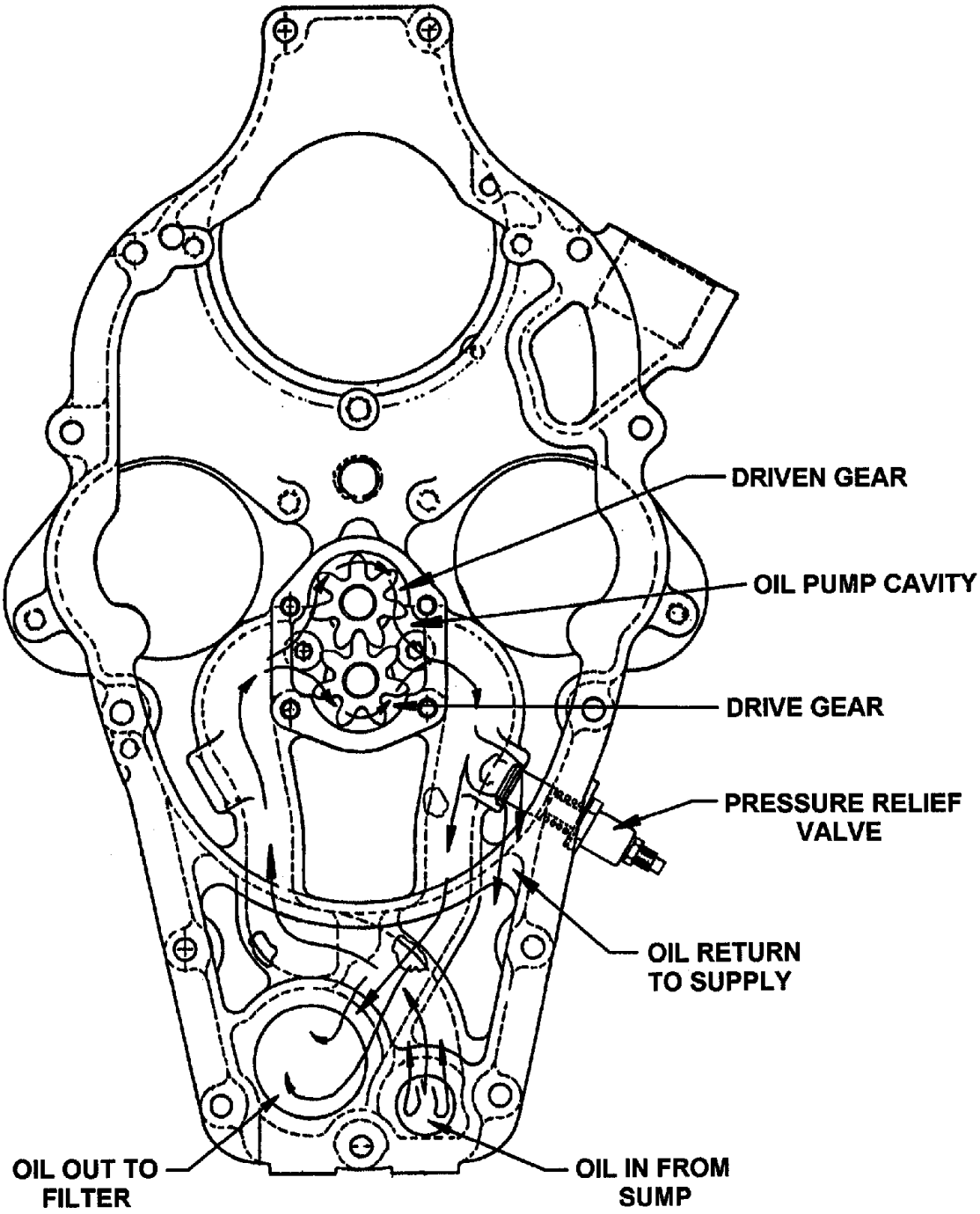


FIGURE 19-2. OIL PUMP DESCRIPTION TSIO-360

ACCESSORY CASE INTERNAL VIEW

LTSIO-360

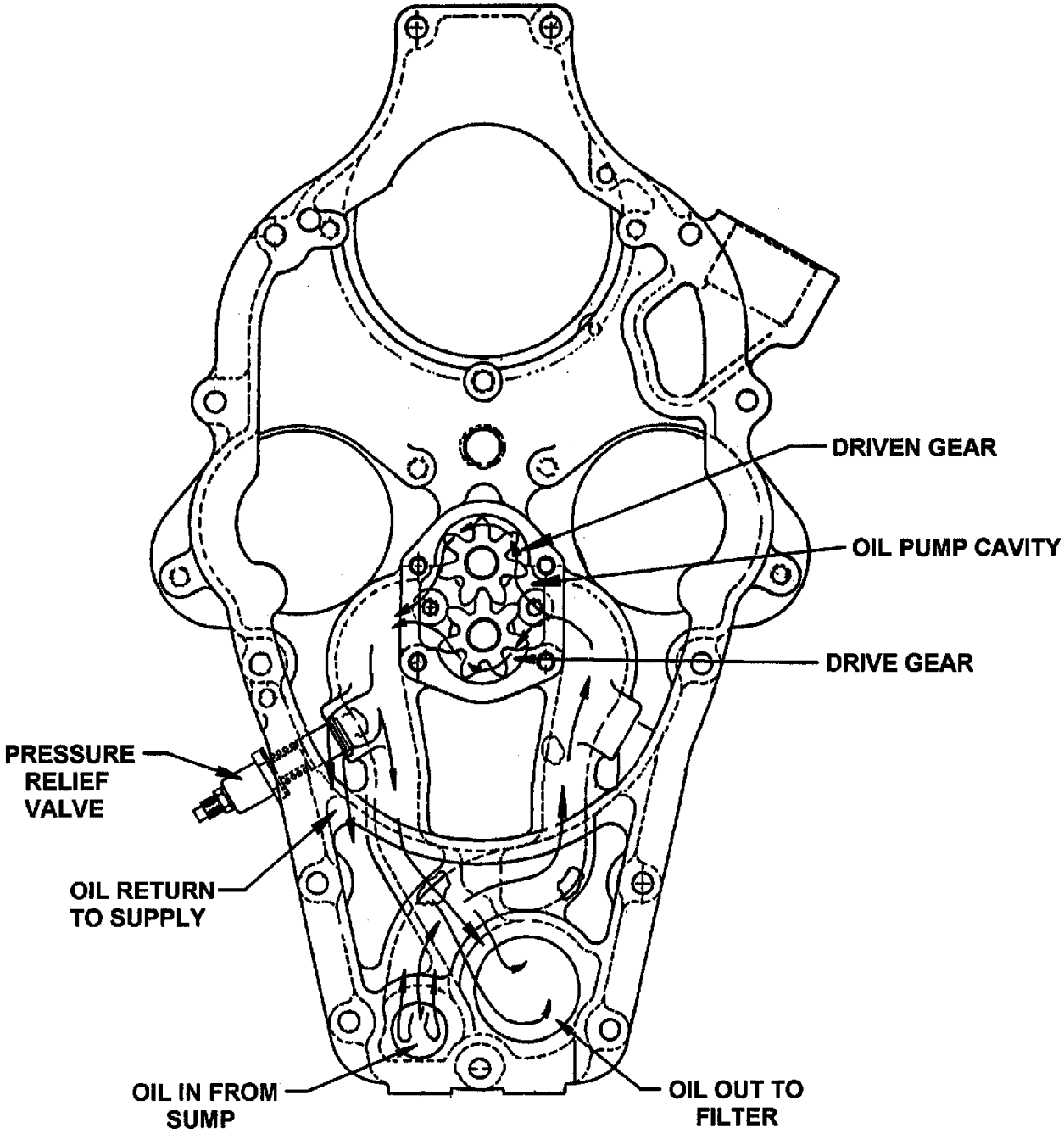
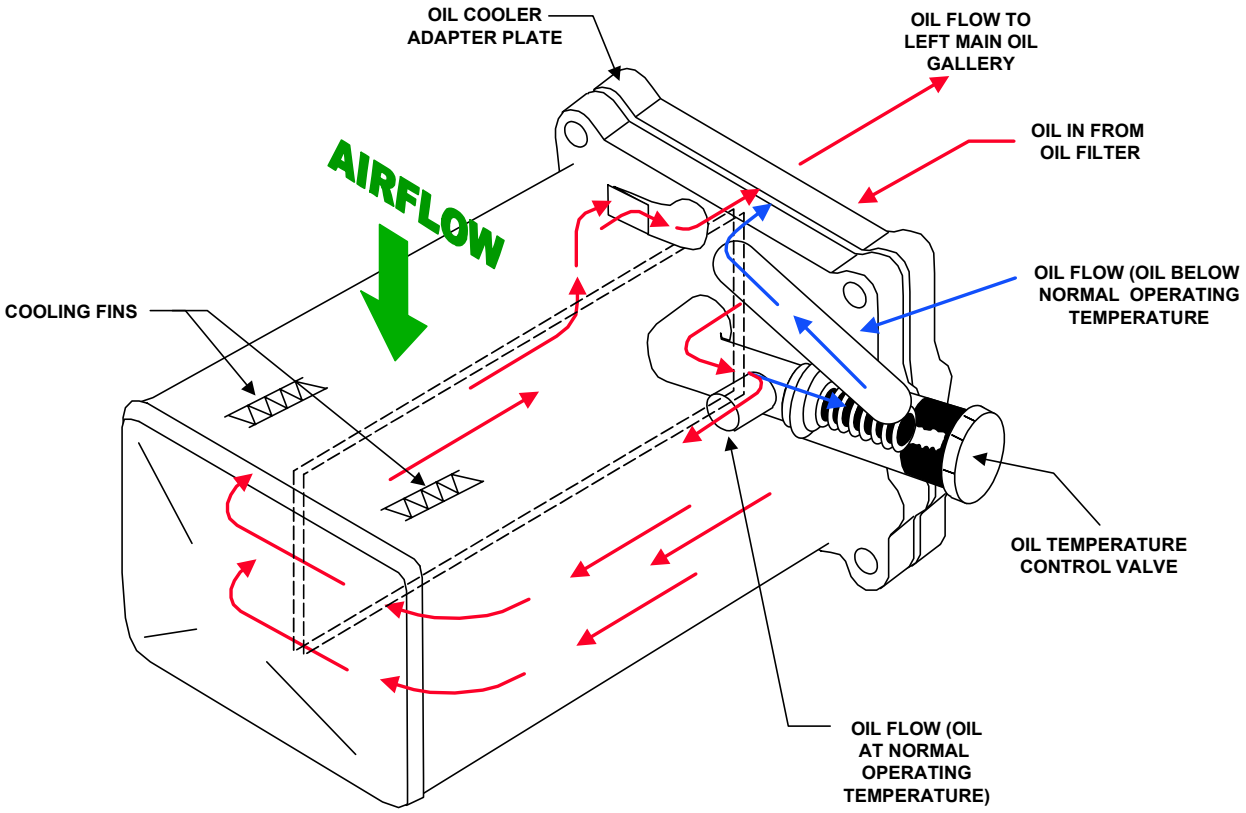


FIGURE 19-3. OIL PUMP DESCRIPTION LTSIO-360

19-2 LUBRICATION SYSTEM COMPONENT DETAILED DESCRIPTION (continued)

Oil Cooler And Oil Temperature Control Valve - Oil flowing from the oil filter enters the oil cooler inlet, oil temperature control valve cavity. When the oil is below normal operating temperature, the oil temperature control valve (vernatherm) is open allowing oil to flow through the by-pass portion of the oil cooler adapter. Oil flowing through the by-pass flows past the oil temperature control valve and out to the crankcase left main oil gallery.

When oil temperature reaches 168°F-172°F the oil temperature control valve closes and the oil flows through the cooler core. As the oil flows through the cooler core cooling air fins between the core oil passages dissipate heat from the oil maintaining normal operational oil temperatures.



19-4. OIL COOLER AND OIL TEMPERATURE CONTROL VALVE DESCRIPTION

(continued on next page)

19-2LUBRICATION SYSTEM COMPONENT DETAILED DESCRIPTION (continued)

Oil Sump - The oil sump is cast aluminum. The sump is attached to the crankcase flange with 14 nuts, washers and lock washers. The oil sump assembly incorporates a tapped drain plug boss. The drain plug boss has provisions for safety wiring of the oil drain plug.

Oil Suction Tube - The oil suction tube is threaded into the oil sump and sealed to the accessory case by the accessory case gasket. Oil flows from the sump through the oil suction tube to the accessory case oil suction screen cavity.

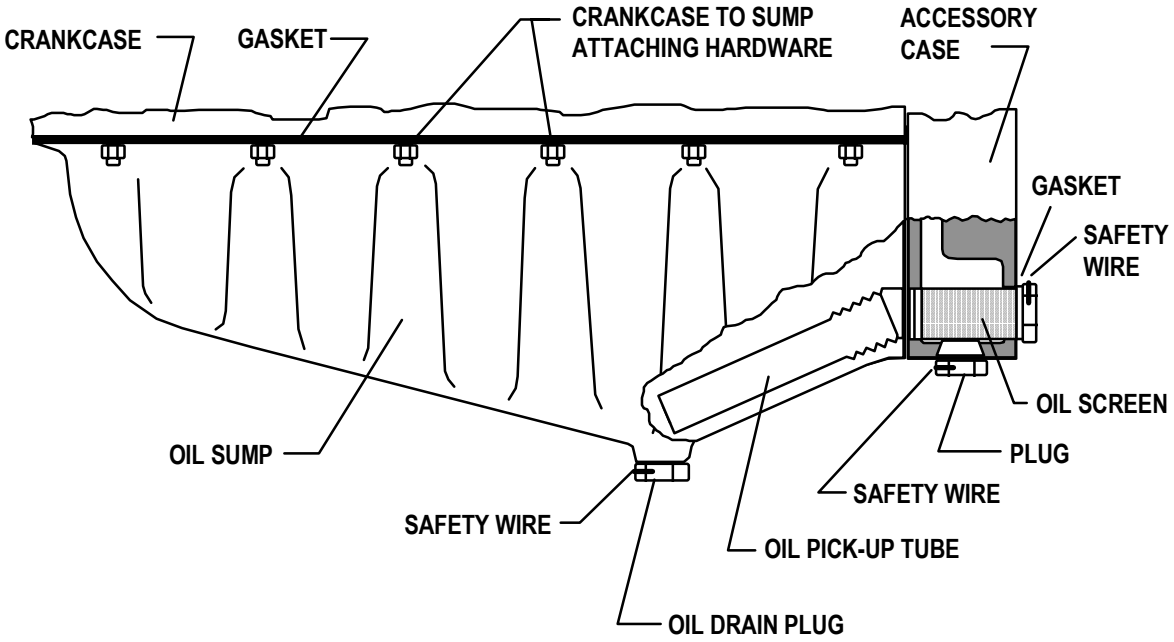


FIGURE 19-5. OIL SUMP AND SUCTION TUBE DESCRIPTION

19-3 LUBRICATION SYSTEM INSPECTION

50 HOUR - Remove oil drain plug, drain oil into approved container (oil warm) and replace plug. Torque oil sump plug to 190-210 inch pounds and safety as required. Oil must be properly disposed of. Cut safety wire and remove oil filter.

Oil Filter Adapter Inspection - A new stud P/N 653489 must be installed if the old stud is a plain steel color with a length of 1.440" inch, if it is found to be loose or it is installed beyond the stud setting height specified in Figure 19-7, "Oil Filter Adapter Stud Inspection." Install new stud in accordance with the following procedure:

A. Remove old stud P/N 632373 and inspect the threads in the adapter housing for damage. Replace the adapter housing if any thread damage is evident.

Note. . . Oil filter adapters that incorporate this modification from the factory can be determined by the letter "S" stamped into the adapter housing, See Figure 19-6 "Stud Identification."

B. Clean the adapter housing threads thoroughly to remove any remaining thread adhesive and oil.

C. Install the applicable new stud (P/N 653489) and confirm that the incomplete thread on the stud stops at the first thread in the adapter housing and does not continue into the housing below the minimum .500" extension. See Figure 19-7, "Oil Filter Adapter Stud Inspection." Replace the adapter housing if the extension is less than the specified .500" minimum.

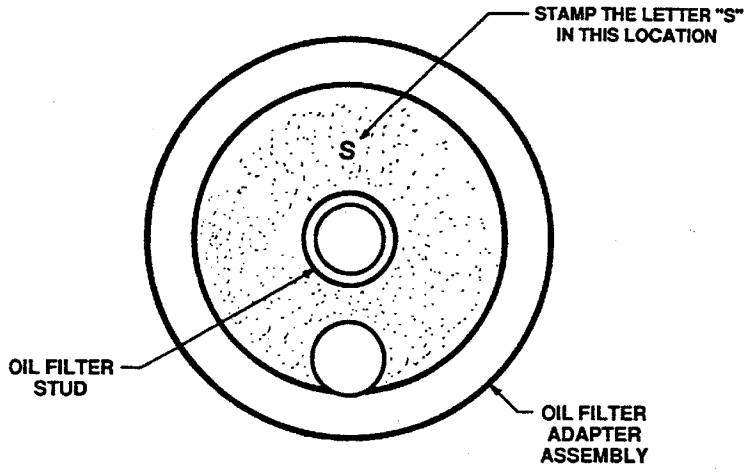


FIGURE 19-6. STUD IDENTIFICATION

D. After extension height inspection, remove the stud from the adapter. Clean the threads of the adapter housing and stud with Loctite "Primer T" (TCM P/N 646944) and allow to dry.

E. Apply a line of Loctite 271 (TCM P/N 646941) along the large threads (.8125-16 end) of the stud and install into the adapter finger tight to 30 inch pounds torque. Check for proper stud extension height in accordance with Figure 19-7," Oil Filter Adapter Stud Inspection."

F. Allow the parts to cure for a minimum of thirty minutes prior to installation of the oil filter.

CAUTION. . . Curing times may vary depending on ambient temperature. Consult Loctite instructions.

After installation of a new oil filter adapter stud, stamp a .125" high letter "s" in the location shown in Figure 19-6 Stud Identification

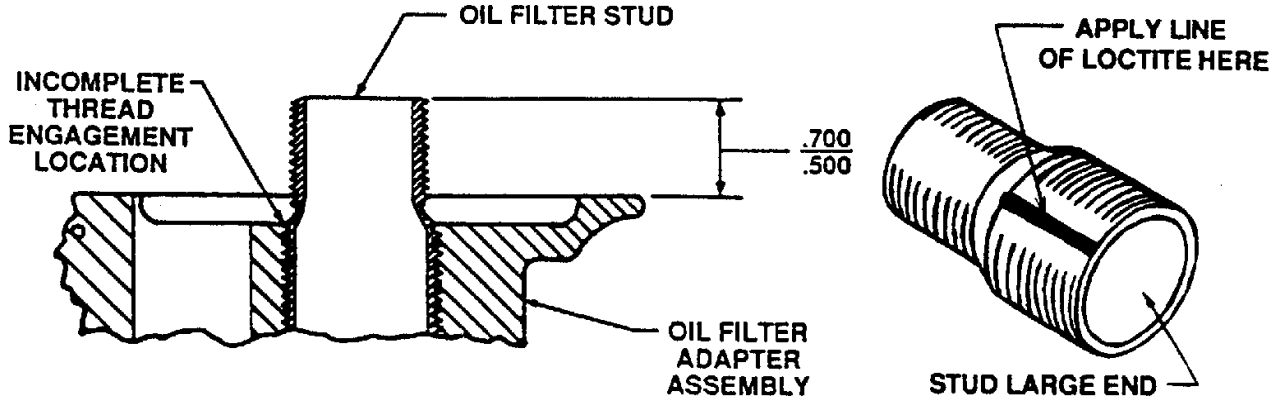


FIGURE 19-7. OIL FILTER ADAPTER STUD INSPECTION

(continued on next page)

Using an oil filter can cutter (See Chapter 2 Tools), open filter can and inspect filter element for debris. If no foreign particles are present, insure oil filter adapter is clean, lubricate oil filter seal using Dow Corning® DC-4 compound and install new oil filter. Torque oil filter to 192-216 inch pounds. Safety as required in accordance with Section 9-2," Lockwire Procedure." If debris is detected on filter element, see Section 19-5," Oil Filter.**"**

NOTE. . . Oil and filter change intervals may vary depending on the type of oil filter used. See Section 5-2," Oil And Filter Change Interval."

NOTE. . . If the aircraft is exposed to severe conditions, such as training, extreme weather or infrequent operation, oil change hourly intervals should be decreased.

Install oil sump plug, torque to 190-210 inch pounds. Safety wire in accordance with Section 9-2," Lockwire Procedure." Refill engine with clean aviation engine oil of the proper grade and weight, to the correct engine oil quantity in accordance with Chapter 7, "Servicing Oil."

CAUTION. . . Use only TCM approved oils after break in period. See chapter 7 for TCM approved oils.

Visually inspect oil sump to crankcase attaching hardware and oil sump drain plug for security and safetying. Visually inspect all lubrication system component gasket areas for oil leaks. Visually inspect all lubrication system components for cracks, dents, stripped threads, punctures and abnormal wear. Visually inspect oil pressure gauge plumbing for oil leaks, security and deterioration. Any components exhibiting cracks, dents, punctures or that are worn beyond serviceable limits must be discarded and replaced with new.

100 HOUR - Perform all inspection requirements of 50 hour inspection and the following. If oil pressure does not conform with 10 psi minimum 30 to 60 psi normal operation and 100 psi maximum (oil cold) pressure determine the cause and adjust or repair as required.

19-4 LUBRICATION SYSTEM TROUBLESHOOTING

This troubleshooting chart is provided as a guide. Review all probable causes given. Check other listings of troubles with similar symptoms. Items are presented in sequence of the approximate ease of checking, not necessarily in order of probability.

TROUBLE	PROBABLE CAUSE	CORRECTION
Excessive Oil Consumption (See Excessive Crankcase Pressures, See Section 19-5),	Oil leakage	Replace leaking oil lines, torque loose connections, see Section 19-5.
	Gasket or seal leakage	Replace gasket or oil seals, see Section 19-5.
	Improper seasonal weight or grade oil	Service engine with proper oil, see Chapter 7, "Servicing Oil".
	Worn piston rings or valve guides	See Section 19-6, "Pistons".
High Oil Temperature Indication	Low oil supply, Replenish	See Chapter 7, "Servicing Oil".
	Cooler air passages clogged	Clean thoroughly, see Section 19-5. "Oil Cooler".
	Cooler core plugged	Remove cooler and flush thoroughly, see Section 19-5, "Oil Cooler".
	Thermostat damaged or held open by solid matter	Remove clean valve and seat. If still inoperative, replace. See Section 19-5, "Oil Temperature Control Valve".

TROUBLE	PROBABLE CAUSE	CORRECTION
High Oil Temperature Indication (cont'd)	Oil viscosity too high	Drain and refill with correct seasonal weight. See Chapter 7, "Servicing Oil".
	Prolonged ground operation	Limit ground operation to a minimum, refer to airframe manufacturer's operating instructions.
	Malfunctioning gauge or bulb unit	Check wiring. Check bulb unit. Check gage. Refer to airframe manufacturer's instructions.
Low Oil Pressure Indication	Low oil supply, Oil viscosity too low	Replenish. Drain and refill with correct seasonal weight. See Chapter 7, "Servicing Oil".
	Malfunctioning pressure pump	Replace pump. See Section 19-5, "Oil Pump".
	Malfunctioning pressure gauge	Check gauge. Clean plumbing. Replace if required in accordance with airframe manufacturer's instructions.
	Weak or broken oil pressure relief valve spring	Replace spring. Adjust oil pressure in accordance with Section 23-2, "Oil Pressure Adjustment".
	Clogged Oil Filter	See Section 19-5," Oil Filter".
	Oil Pressure Maladjusted	Adjust oil pressure in accordance with Section 23-2, "Oil Pressure Adjustment".

19-5 LUBRICATION SYSTEM MAINTENANCE

Oil Pump - The accessory case may be removed in accordance with applicable portions of accessory case disassembly/reassembly instructions in L/TSIO-360 Series Overhaul Manual, Form X30596A. See Section 23-4 for oil pressure adjustment.

NOTE. . . Repairs other than stoning nicks on parting flanges, replacement of studs, worn parts and refacing the oil pressure relief valve seat on the oil pump housing are not possible. The oil pump driven gear shaft is pressed into the accessory case pump housing and cannot be replaced. The pump gear chamber must not be enlarged. If it is scored, the accessory case must be discarded. Heavy scoring on the gear contact area of the oil pump cover renders it unserviceable. See Section 19-3, "100 Hour Inspection" for oil pressure relief valve seat refacing. Discard accessory cases with oil pump housing that exhibit cracks or that are worn beyond specified limits.

Oil Filter Adapter - Repairs other than stud replacement, worn parts replacement, and stoning nicks on parting flanges, are not possible. Discard oil filter adapters that exhibit cracks. The oil filter adapter stud must be inspected and replaced if necessary in accordance with Section 19-3," Oil Filter Adapter Inspection."

Oil Filter - Cut safety wire and remove the filter. Using an oil filter can cutter, open can and inspect the oil filter element.

Oil Sump - If repair or replacement is required, the oil sump assembly may be removed from the engine in the aircraft provided clearance is available. After clearance has been gained, the oil sump may be removed and reinstalled in accordance with the L/TSIO-360 Series Overhaul Manual, Form X30596A. Whenever oil sump is removed for

maintenance the oil suction tube screen must be cleaned and all lower internal hardware inspected for security and safetying. Oil sumps that are warped or cracked must be discarded.

19-5 LUBRICATION SYSTEM MAINTENANCE (continued)

Oil Suction Tube - The oil sump and accessory case must be removed to gain access to the oil suction tube. If oil suction tube access is required, see the applicable portions of oil sump/accessory case in accordance with the applicable disassembly/reassembly in the L/TSIO-360 Series Overhaul Manual, Form X30596A

Oil Cooler - The oil cooler or its components may be removed for replacement and repair in accordance with the applicable portions of oil cooler disassembly/reassembly instructions in the L/TSIO-360 Series Overhaul Manual, Form OH-08..

Oil Pressure Relief Valve - Cut safety wire, remove the oil pressure relief valve and inspect the plunger for scoring, nicks, and the conical face for roughening. Inspect oil pressure relief valve limits in accordance with Section 19-5. Oil pressure relief valves with scoring, nicks, roughening of the conical face or that exceed the specified limits must be discarded and replaced with new.

Inspect the oil pressure relief valve seat for scoring, nicks or roughening. Seats with these indications must be refaced. Using an Oil Pressure Relief Spot Facer as shown in Chapter 2," Tools," reface the pressure relief valve seat in the oil pump housing.

CAUTION. . . Reface pressure relief valve seat using light finger pressure when turning refacing tool.

After the refacing procedure, the depth from the top of the oil pump housing to the seat face must not exceed the specified limit item (2) in Figure 19-8," Lubrication System Service Limits." Accessory cases with oil pressure relief valve housings that exceed specified limits must be discarded.

CAUTION. . . Thoroughly clean oil pressure relief valve cavity after refacing procedure. All debris from the refacing procedure must be removed.

Reassemble serviceable or new relief valve housing and adjusting screw. Turn adjusting screw into housing about halfway. Install new copper washer and nut. Assemble plunger, spring, washer and slide into housing. Coat housing threads with TCM anti-seize lubricant. insure relief valve components are aligned and install in oil pump housing. Torque housing to 240-260 inch pounds. Safety wire oil pressure relief valve housing in accordance with Section 9-2," Lockwire Procedure." The engine oil pressure must be adjusted prior to release for return to service in accordance with Section 23-2, "Oil Pressure Adjustment."

Oil Temperature Control Valve - Remove the oil temperature control valve and inspect the valve seat for scoring, nicks, roughness or deterioration. Inspect oil temperature control valve limits in accordance with Section 19-5. Oil temperature control valves exhibiting any of the above indications or that exceed specified limits must be discarded and replaced with new. Reinstall serviceable or new oil temperature control valve using new gasket and torque to 440-460 inch pounds. Safety wire oil temperature control valve housing in accordance with Section 9-2," Lockwire Procedure."

CAUTION. . . When performing dimensional inspection the following "Service Limits" may be used. However, they are only intended as a guide for re-use when performing maintenance of the engine prior to major overhaul. Parts with dimensions or fits that exceed service limits must not be re-used. Parts with values up to and including service limits may be re-used, however, judgment should be exercised considering the PROXIMITY of the engine to its recommended overhaul time. Service limits must NOT be

used when overhauling an engine. See the current L/TSIO-360 Series Overhaul Manual Form X30596A for minimum fits and limits.

19-5 LUBRICATION SYSTEM MAINTENANCE (continued)

If the accessory case is removed from the engine the following components must be dimensionally inspected.

REF. NO.	DESCRIPTION	SERVICEABLE LIMIT
1	Oil pump gears in housing ..... End Clearance:	0.006
2	Oil pump gears in housing ..... Diameter:	0.006L
3	Oil pump gear shafts in housing ..... Diameter:	0.004L
4	Oil pump gear shafts in cover ..... Diameter:	0.004L
5	Oil pump driven gear on shaft ..... Diameter:	0.004L
6	Oil pump driver gear to driven gear ..... Backlash:	0.027
7	Driver gear shaft in oil pump drive gear ..... Diameter:	0.003L
8	Oil pump driver gear to camshaft gear ..... Backlash:	0.019
9	Oil pressure relief valve spring (compressed to 1.58 inches) ..... Load:	14.5-15.5 Lbs
10	Oil pressure relief valve seat ..... Depth:	1.19-1.29
11	Oil temperature control valve 0.090 inch minimum travel at ... Oil Temperature:	120°F-170°F
	Oil temperature control valve must be fully closed ..... Oil Temperature:	168°F-172°F
	Oil temperature control valve must crack open at 180°F ..... PSI:	18 Pounds

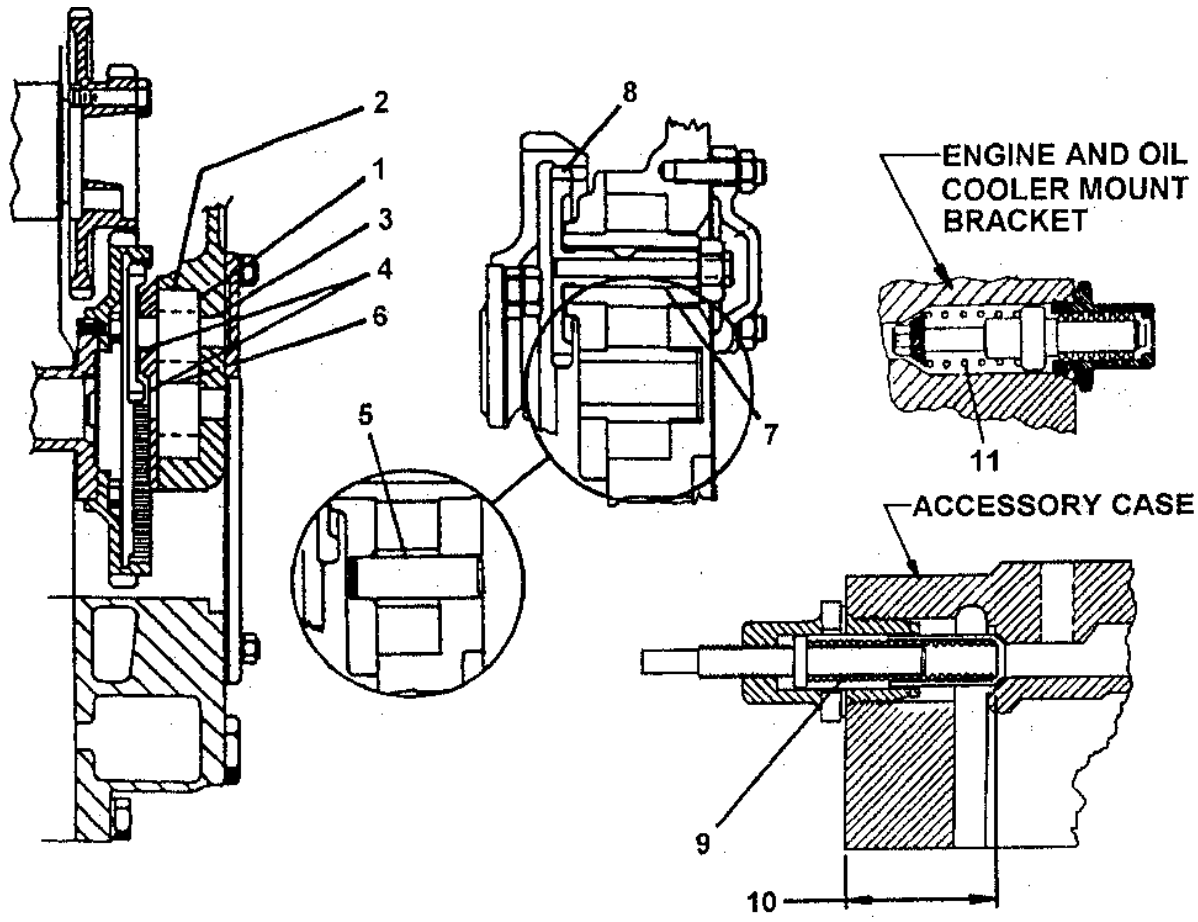


FIGURE 19-7. LUBRICATION SYSTEM SERVICE LIMITS

INTENTIONALLY

LEFT

BLANK

CHAPTER 20
CYLINDER ASSEMBLY

20-1 CYLINDER COOLING

Cylinder cooling is accomplished by transferring heat from the cylinder barrel and cylinder head cooling fins to the surrounding airflow. The engine cowling, inner cylinder baffles, peripheral baffles and baffle seals direct cooling airflow evenly around the cylinders providing uniform cylinder temperatures. Ram air induced by the aircrafts forward speed provides the source of cooling air. Airflow is regulated by the size of the cooling air inlets and outlets. Increasing or decreasing outlet size with the use of airframe cowl flaps changes airflow and is used as an aid in controlling engine operating temperatures. Below is a general illustration showing engine cooling airflow.

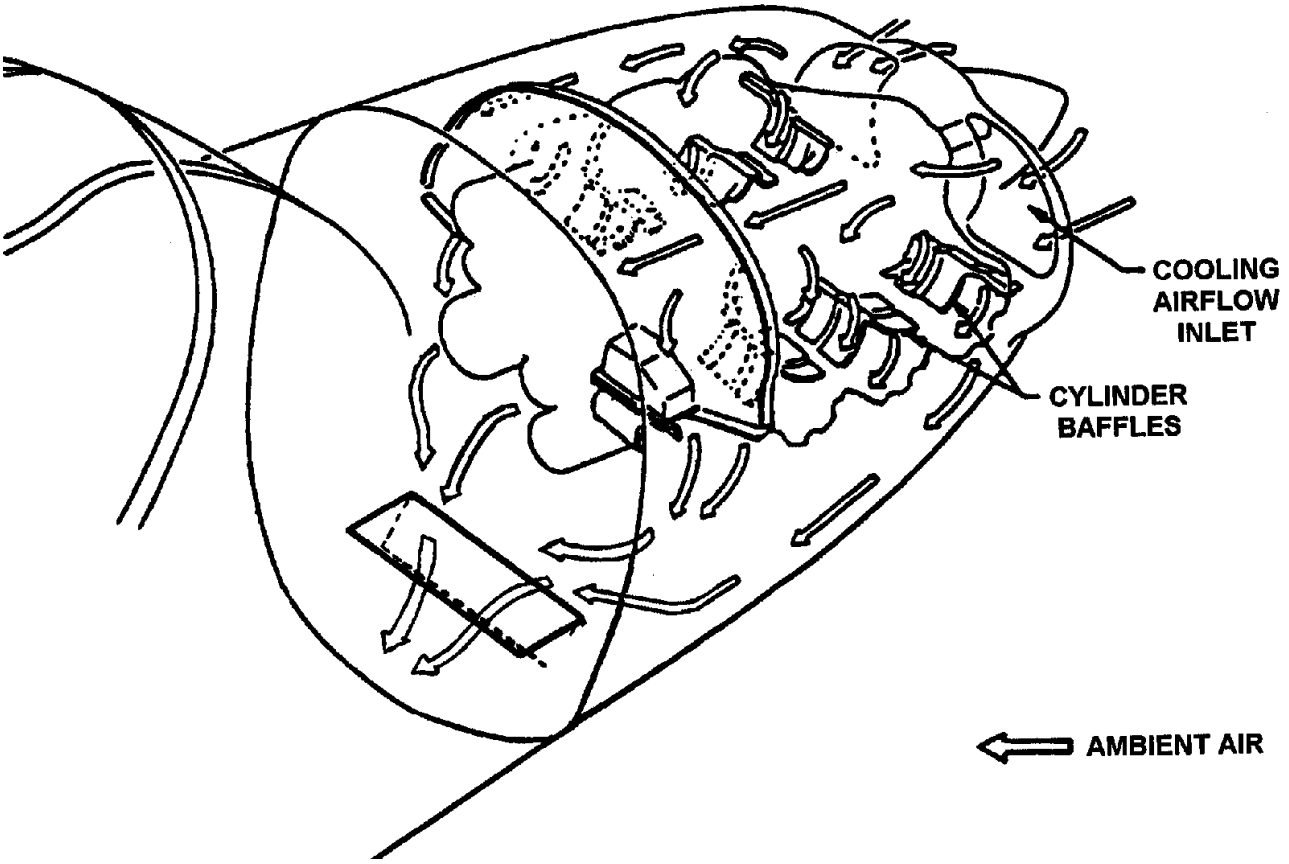


FIGURE 20-1. GENERAL ENGINE COOLING AIRFLOW DIAGRAM

(continued on next page)

20-2 CYLINDERS, PISTONS AND VALVE DRIVE TRAIN

The cylinders, pistons and valve train are the portion of the engine that develop power. The cylinder combustion chamber provides a controlled area for burning fuel/air mixture and converting that heat energy into mechanical energy. Aviation fuel and air is drawn into a cylinder during the intake stroke, compressed by the piston during the compression stroke and then ignited by a high intensity spark from the spark plug. As the mixture is ignited, the expanding gases force the piston to move inward toward the crankshaft.

This inward motion acting on the connecting rod and crankshaft throw is converted into rotary motion by the crankshaft. As the crankshaft throw rotates past half of one revolution, the connecting rod and piston start moving outward on the exhaust stroke toward the cylinder head. During this movement, the exhaust valve begins to open allowing the burned mixture (exhaust) to escape. Momentum from the crankshaft forces the piston toward the cylinder head in preparation of the next intake stroke event.

Proper mechanical timing between the crankshaft and camshaft allows the intake and exhaust valves to open and close in synchronization with piston position in all six cylinders.

Proper magneto internal timing and magneto to engine mechanical timing allow precise spark plug ignition at 20° ±1° before top dead center during the piston's compression stroke.

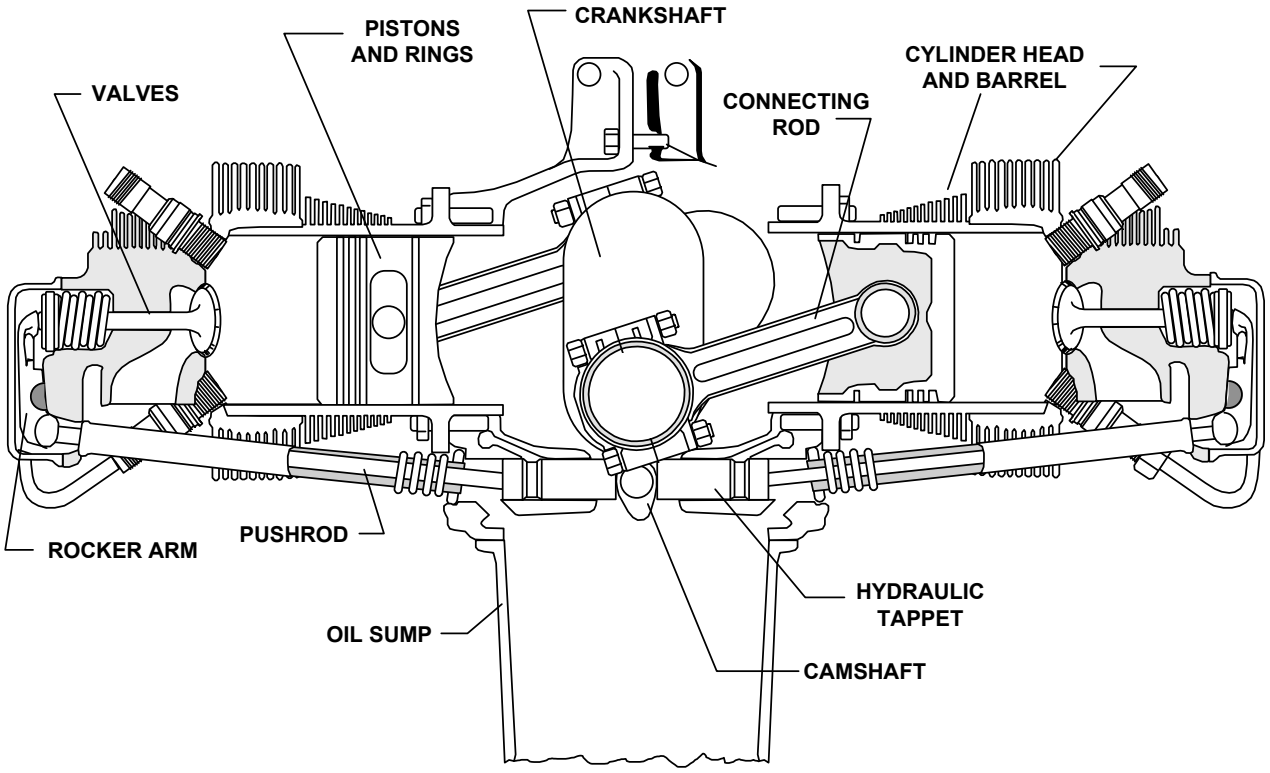


FIGURE 20-2. CYLINDER PISTON AND VALVE TRAIN

20-3 CYLINDER ASSEMBLY DETAILED DESCRIPTION

Cylinder, Valve Guides, Valves, Rotocoils - The externally finned aluminum alloy head castings are heated and valve seat inserts installed before the head is screwed and shrunk onto an externally finned steel alloy barrel to make the permanent head and barrel assembly. The cylinder barrel is nitrided for wear resistance. Intake and exhaust valve guides are pressed into the cylinder head. Special helical coil thread inserts are installed in upper and lower spark plugs holes. The cylinder intake port is located on top of the cylinder and the exhaust port is located on the bottom. Rotocoil assemblies retain two concentric springs surrounding each valve and are locked to the stems by tapered, semi-circular keys which engage grooves around the valve stems. Valve rocker covers are stamped sheet steel and zinc plated.

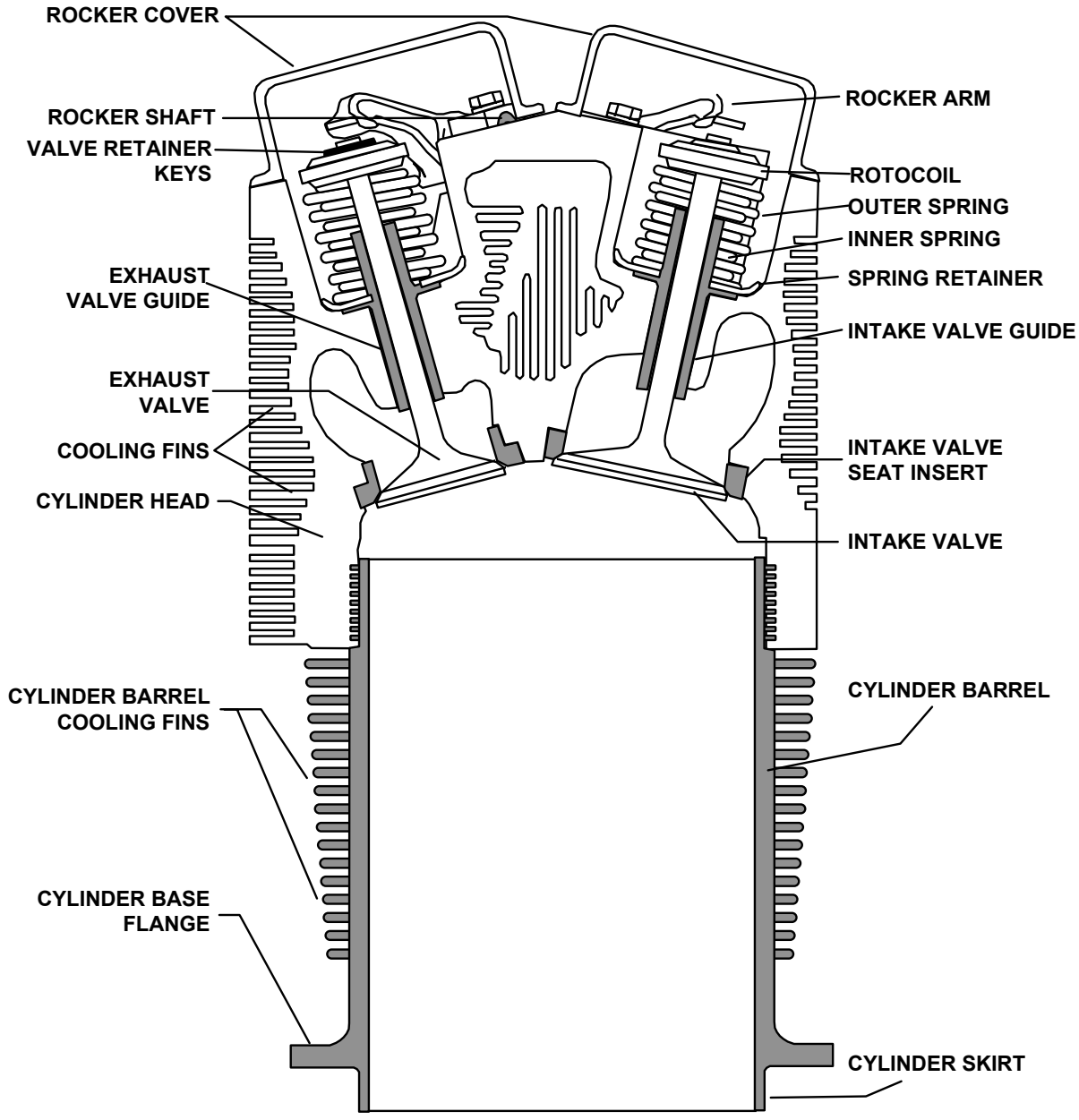


FIGURE 20-3. CYLINDER ASSEMBLY DESCRIPTION

20-3 CYLINDER ASSEMBLY DETAILED DESCRIPTION (continued).

Piston - Pistons are aluminum alloy castings with a steel insert cast into the top ring groove. Pistons have three ring grooves above the 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 slotted oil control ring and expander is installed in the third groove which has six oil drain holes to the interior. Weight differences are limited to 1/2 ounce or 14.175 grams in opposing bays. Piston pins are full floating with permanently pressed-in aluminum end plugs.

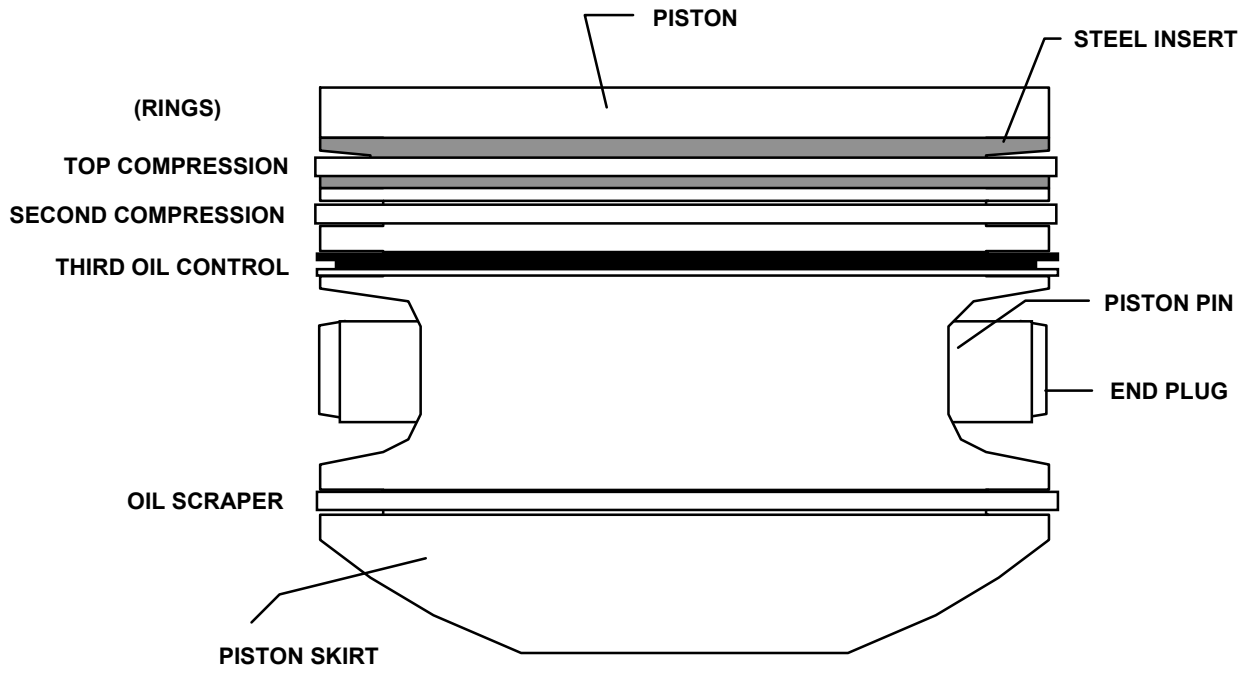


FIGURE 20-4. PISTON ASSEMBLY DISCRIPTION

20-3 CYLINDER ASSEMBLY DETAILED DESCRIPTION (continued).

Valve Rocker arms, Shafts, Pushrods And Housings (Valve Train) - Valve rocker arms are steel forgings with hardened pushrod sockets and rocker faces. The rocker arm has a precision bronze bushing that accommodates the rocker shaft. The rocker arm shaft is secured to the rocker boss studs using retainers, lock tabs and nuts. They have a drilled oil passage for lubrication. Pushrods are steel tubes with forged steel ball ends, which are center drilled for oil passages. The pushrod 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, packing ring and second washer.

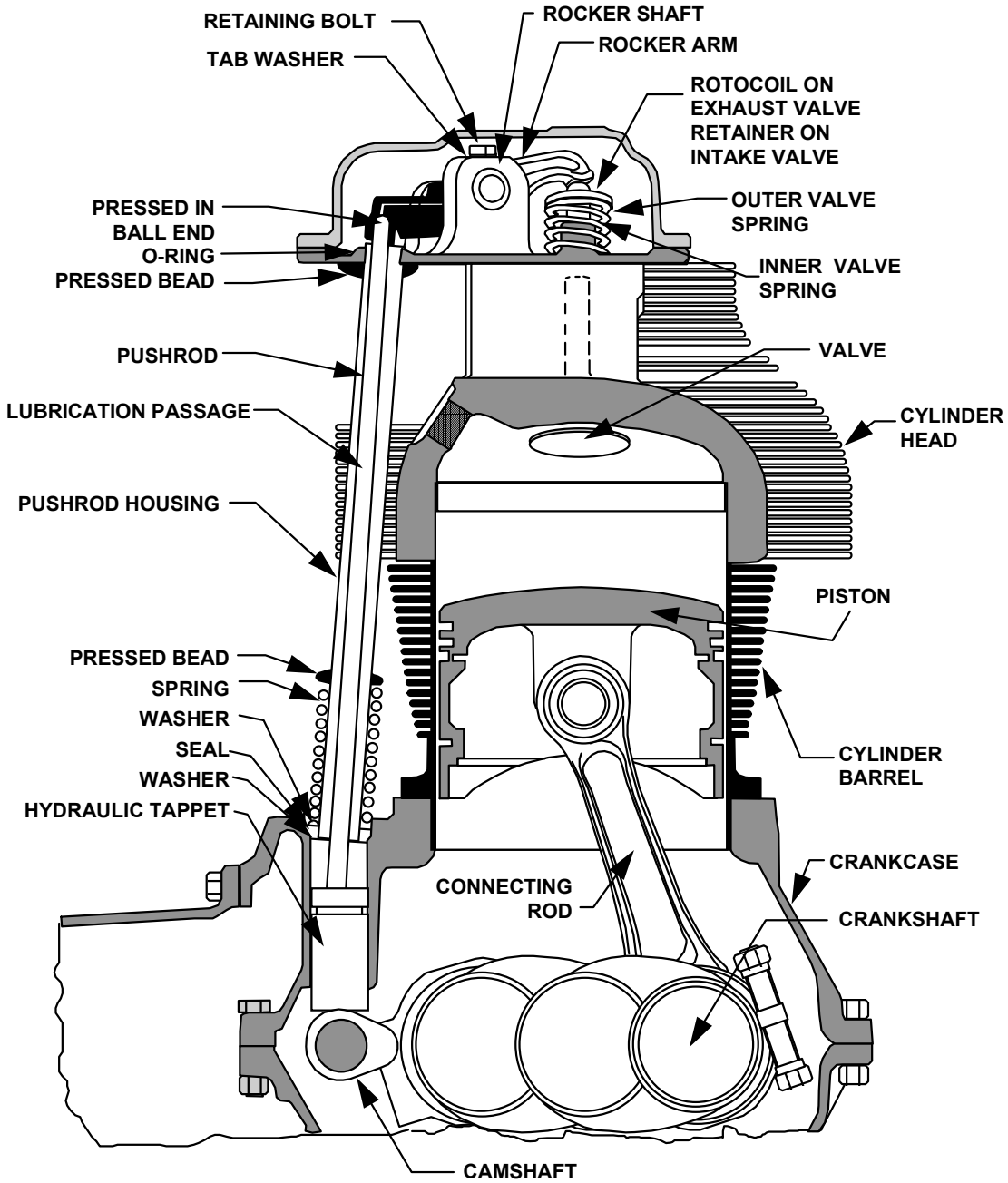
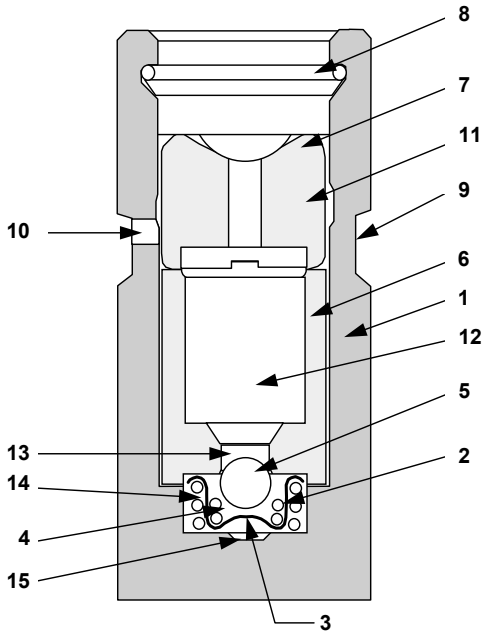


FIGURE 20-5. VALVE TRAIN DESCRIPTION

20-3 CYLINDER ASSEMBLY DETAILED DESCRIPTION (continued).

Hydraulic Tappet - See Figure 20-6. The barrel type hydraulic valve tappet consists of a steel body (1), an expanding spring (2), a check valve assembly (3, 4 and 5), a plunger (6), a socket (7) and a retaining ring (8). A groove (9), around outside of the body picks up oil from the crankcase oil gallery. From the exterior groove oil is directed to the interior body groove (11) through hole (10) and from the interior groove through the hole to the reservoir (12). Oil is withheld from reservoir (14) by check valve ball (5) which is supported by a spring (4) in the housing (3). The check valve is opened by outward motion of the plunger under pressure of the expanding spring whenever a clearance occurs in the valve train. The reservoir is kept full of oil which transmits lifting force from the body of the plunger. The plunger and socket are selectively fitted to the body to permit a calibrated leakage so the lifter will readjust its effective length after each cycle while the cylinder valve is closed to return "lash" in valve train to zero. The barrel type hydraulic tappets may be removed and replaced without complete disassembly of the engine.



1. Body
2. Spring Plunger
3. Check Ball Retainer
4. Spring, Check Ball
5. Check Ball
6. Plunger
7.Socket
8. Ring, retaining
9. Oil groove, exterior
10. Oil inlet, body
11. Oil groove, interior
12. Oil reservoir, plunger
13. Hole, oil discharge
14. Oil reservoir, body
15. Hole, Oil Outlet

FIGURE 20-6. HYDRAULIC TAPPET DESCRIPTION

20-4 CYLINDER ASSEMBLY INSPECTION

50 HOUR - Visually inspect cylinder to engine attaching hardware for security. Inspect exhaust and intake flange areas for leaks. Inspect induction and exhaust tube attaching hardware for security. Inspect rocker box cover hardware for security and safetying. Inspect rocker cover to cylinder gasket area for evidence of oil leakage. Inspect pushrod housings at both ends for evidence of oil leakage. Visually inspect fuel injection and cylinder drain plumbing connections for security and evidence of leakage. Check spark plug and ignition connections for security. Check cylinder baffling for security, cracks, dents and wear from chafing.

Inspect the steel barrel fins for rust, pitting or any other damage. Inspect the cylinder barrel flange and flange radius for rust and pitting. Inspect the cylinder barrel for cracks. Discard cylinders exhibiting any of the above indications. Discard any cylinders that have been involved in an overheating or high temperature operation event such as detonation, severe piston scoring, or piston pin damage to the cylinder bore.

Inspect for corrosion and pitting on the cylinder head, the head fins and fin roots. Inspect the cylinder head for cracks. A radial fin crack extending to the root of a fin may have penetrated the dome wall. Discard cylinders exhibiting any of the above indications.

CAUTION. . . Corrosion pits reduce wall thickness and will cause stress concentrations and subsequent fracture. Discard cylinders that have been allowed to become pitted in the areas mentioned in cylinder barrel and head inspections above.

Inspect for evidence of cylinder head to barrel leakage. Inspect for possible turning of the cylinder head in relation to the barrel flange. Cylinders with this indication must be discarded and replaced with a serviceable cylinder assembly.

Visually inspect pushrod housings for cracks and dents. Discard cracked or dented pushrod housings.

WARNING

Welding of the cylinder head structure can destroy the assembly preloads and casting strength resulting in cylinder assembly failure.

100 HOUR - Perform all visual inspection requirements of 50 hour inspection. Perform the following cylinder compression test which is to be done soon after the operational engine test in Section 5-4.

Cylinder Compression Test - The differential pressure test is an accepted method of determining cylinder condition by measuring air pressure loss past the pistons, rings and valves. The operation of the equipment is based on the principle that, for any given airflow through a fixed orifice, a constant pressure drop across that orifice will result.

The compression testing equipment must be calibrated and used in the proper manner to insure accurate results.

To accurately accomplish a leakage check, use the following information on leakage and use the Master Orifice tool to calibrate the leakage checking equipment used on Teledyne Continental engines.

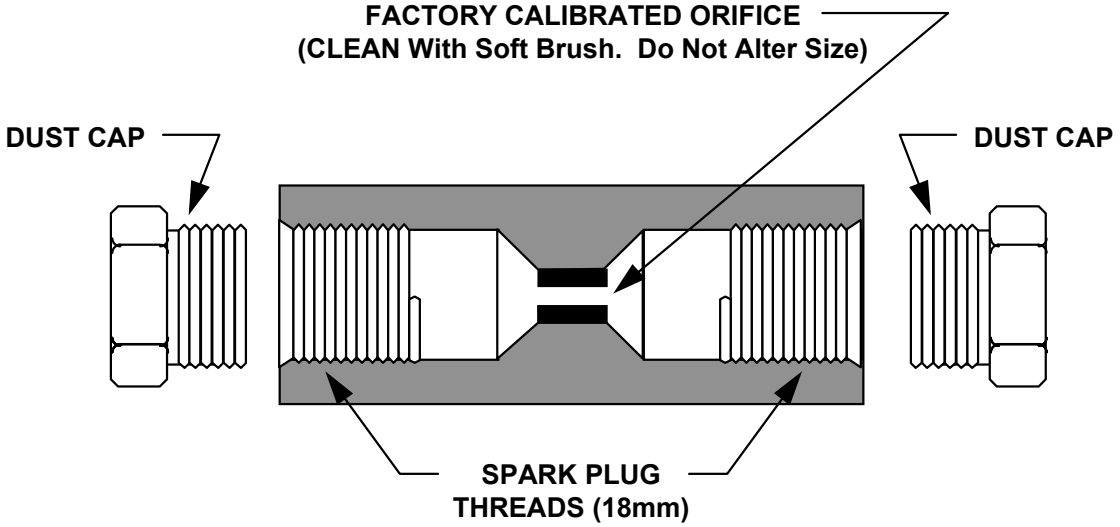


FIGURE 20-7. MASTER ORIFICE TOOL (For procurement, see chapter 2)

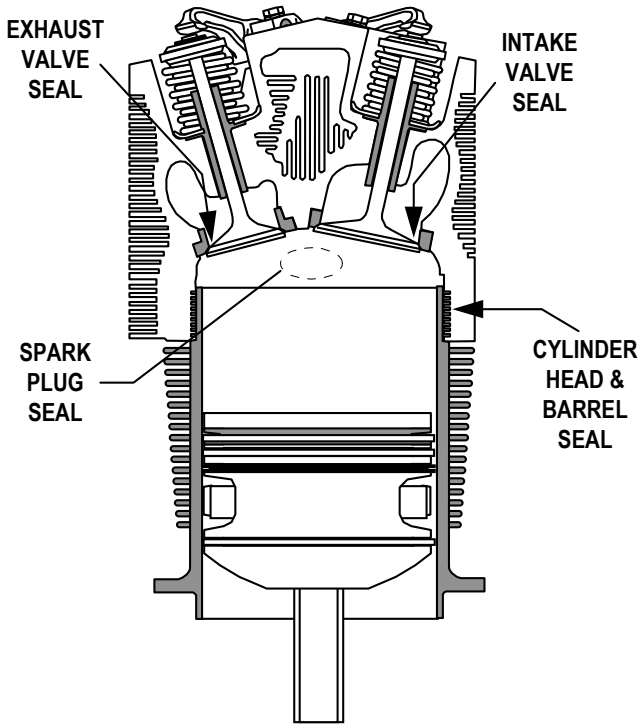


FIGURE 20-8. STATIC SEAL

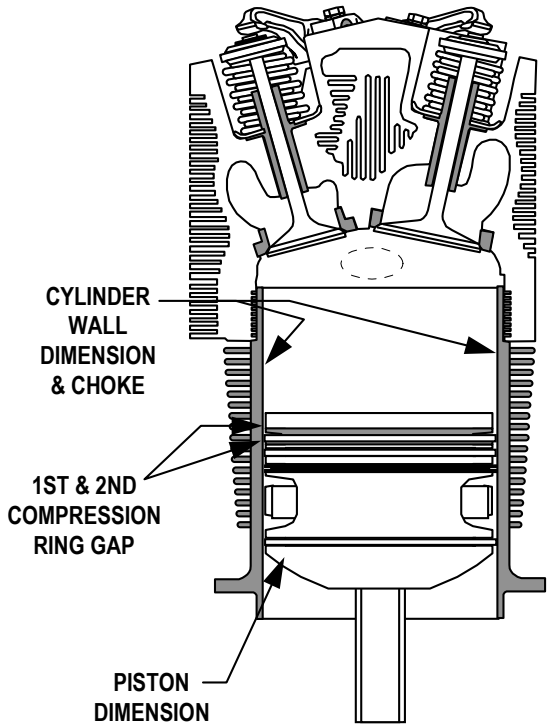


FIGURE 20-9. DYNAMIC SEAL

LEAKAGE CHECKS.

Cylinder leakage is broken down into two areas of concern the "Static Seal" and the "Dynamic Seal."

Static Seal

The static seal consists of the valve to valve seat seals, spark plug to spark plug port seals and cylinder head to barrel seal. No leakage of the static seal is permissible.

Dynamic Seal

The dynamic seal consists of the piston rings to the cylinder wall seal. This seal leakage can vary from cylinder to cylinder, ring gap position, wear or the amount of engine oil on the cylinder wall.

EQUIPMENT

Testing equipment must be kept clean and checked periodically for accuracy as follows: using a line pressure of 100 to 120 pounds per square inch, close the cylinder pressure valve, then set the regulator pressure valve to 80 pounds per square inch. The pressure in both gages should stabilize with no leakage.

The restrictor orifice dimension in the Master Orifice Tool for Teledyne Continental aircraft engines must be 0.040 inch orifice diameter, 0.250 inch long with 60° approach angle, and must flow 120 ±5 cubic feet per hour at 30 pounds per square inch differential pressure.

Master Orifice Tool

For conformity in testing equipment a Master Orifice Tool, Part Number 646953, has been developed to calibrate equipment and determine the low indicated leakage limit prior to the engine leakage check. Connect compressed air at 100 - 120 pounds per square inch to the tester with cylinder pressure valve closed. Turn the regulator pressure valve on, adjusting pressure to indicate 80 pounds per square inch. Remove the dust caps from both ends of the Master Orifice Tool and install onto a cylinder spark plug adapter. Turn the cylinder pressure valve on and readjust regulator pressure gauge to read 80 pounds per square inch. At this time the cylinder pressure gauge indication will be the low allowable limit for cylinder leak checks. The low allowable limit is referred to as the master orifice calibrated pressure reading. After the master orifice calibrated pressure reading has been recorded, close regulator pressure valve and remove Master Orifice Tool from the cylinder adapter. See the schematic diagram of a typical differential pressure tester shown below.

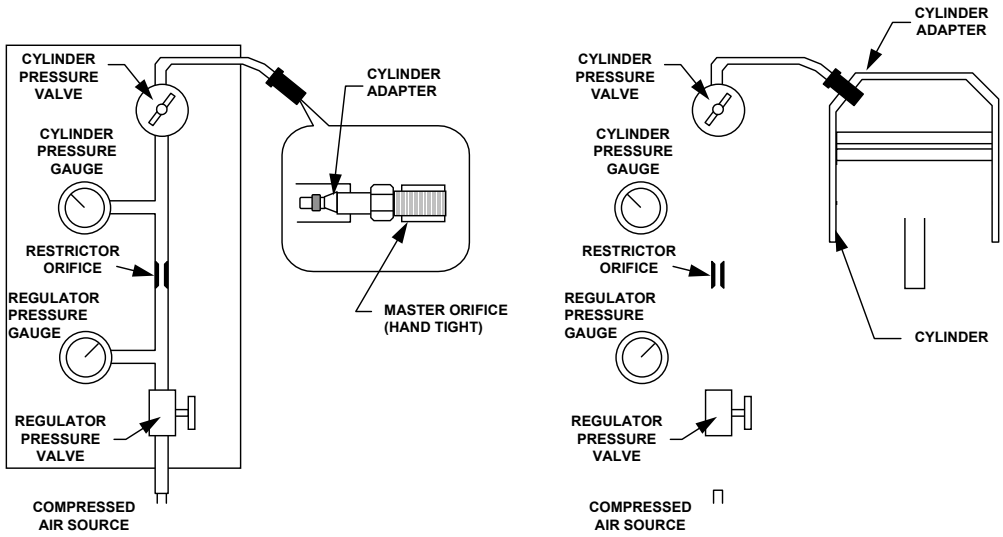


FIGURE 20-10. DIFFERENTIAL PRESSURE TESTER CALIBRATION

PERFORMING THE CHECK.

The following procedures are listed to outline the principles involved, and are intended to supplement the manufacturer's instructions for the particular tester being utilized.

WARNING

To prevent possibility of serious bodily injury or death, before moving the propeller accomplish the following:

a. Disconnect all spark plug leads.
b. Verify magneto switches are connected to magnetos, that they are in the "OFF" Position and "P" leads are grounded.
c. Throttle position "CLOSED."
d. Mixture control "IDLE-CUT-OFF."
e. Set brakes and block aircraft wheels.
f. Insure that aircraft tie-downs are installed and verify that the cabin door latch is open.
g. Do not stand within the arc of the propeller blades while turning the propeller.

1. Perform the test as soon as possible after the engine is shut down to insure that the piston rings, cylinder walls, and other engine parts are well lubricated and at operating conditions.
2. Turn the crankshaft by hand in the direction of rotation until the piston, in the cylinder being checked, is coming up on its compression stroke.
3. Install an adapter in the spark plug hole and connect the calibrated differential pressure tester to the adapter. (NOTE: Cylinder pressure valve is in the Closed position). Slowly open the cylinder pressure valve and pressurize the cylinder, not to exceed 20 pounds per square inch. Continue rotating the engine against this pressure until the piston reaches top dead center. Reaching top dead center is indicated by a flat spot or sudden decrease in force required to turn the crankshaft. If the crankshaft is rotated too far, back up at least one-half revolution and start over again to eliminate the effect of backlash in the valve operating mechanism and to keep the piston rings seated on the lower ring lands. This is critical because the slightest movement breaks this piston ring sealing and allows the pressure to drop.

WARNING

Care must be exercised in opening the cylinder pressure valve, since sufficient air pressure will be built up in the cylinder causing it to rotate the crankshaft if the piston is not at top dead center. The propeller must be secured during check to prevent rotation.

4. Open the cylinder pressure valve completely. Check the regulator pressure gauge and adjust, if necessary to 80 pounds per square inch.
5. Observe the pressure indication on the cylinder pressure gage. The difference between this pressure and the pressure shown by the regulator pressure gauge is the amount of leakage through the cylinder. If the cylinder pressure gauge reading is higher than the previously determined master orifice calibrated pressure reading, proceed to the next cylinder and perform leak check. If the cylinder pressure gauge reading is lower, proceed with the following:

NOTE. . . Document cylinder compression pressure.

Static Seal Check(See Figure 20-8, "Static Seal.")

6. First check the static seal for leakage. Positive identification of static seal leakage is possible by listening for air flow sound at the exhaust or induction system port. When checking for cylinder head to barrel leakage, use a soapy solution between the fins and watch for bubbles. Use a soapy solution around both spark plug seals for leakage. NO LEAKAGE IS ALLOWED IN STATIC SEALS.
7. If leakage is occurring in the intake or exhaust valve areas, See Section 20-6, "Cylinder Maintenance" for staking valves. Leakage by the valves must be eliminated before a dynamic seal check can be performed.
8. If leakage is noted between the cylinder head and barrel, REPLACE THE CYLINDER, See Section 20-6, "Cylinder Maintenance."

Dynamic Seal Check (See Figure 20-9, "Dynamic Seal.")

9. To check the dynamic seal of a cylinder, proceed with the leakage test and observe the pressure indication of the cylinder pressure gauge. The difference between this pressure and the pressure shown by the regulator gauge is the amount of leakage at the dynamic seal.

10. If the leakage is below the previously determined low cylinder gauge reading, loss past the dynamic seal may be due to piston ring end gap alignment or by the piston and piston rings angular direction in the cylinder bore see Figure 20-11,"Ring Positioning." First insure that the piston and piston rings are centered. This can be accomplished by reducing regulator pressure to 20 pounds per square inch and working piston through top dead center several times bringing the piston to top dead center in the normal direction of engine rotation. Adjust regulated pressure to 80 pounds per square inch and determine amount of loss. If the gauge reading is higher than the previously determined master orifice calibrated reading, proceed to next cylinder to be tested.

    NOTE. . . Piston ring rotation within the ring land is a normal design characteristic. As illustrated in Figure 20-11, "Ring Positioning," the compression ring location may have a direct bearing on the dynamic seal pressure check. Therefore, complete the test in the opposite direction if readings are below prescribed limits.

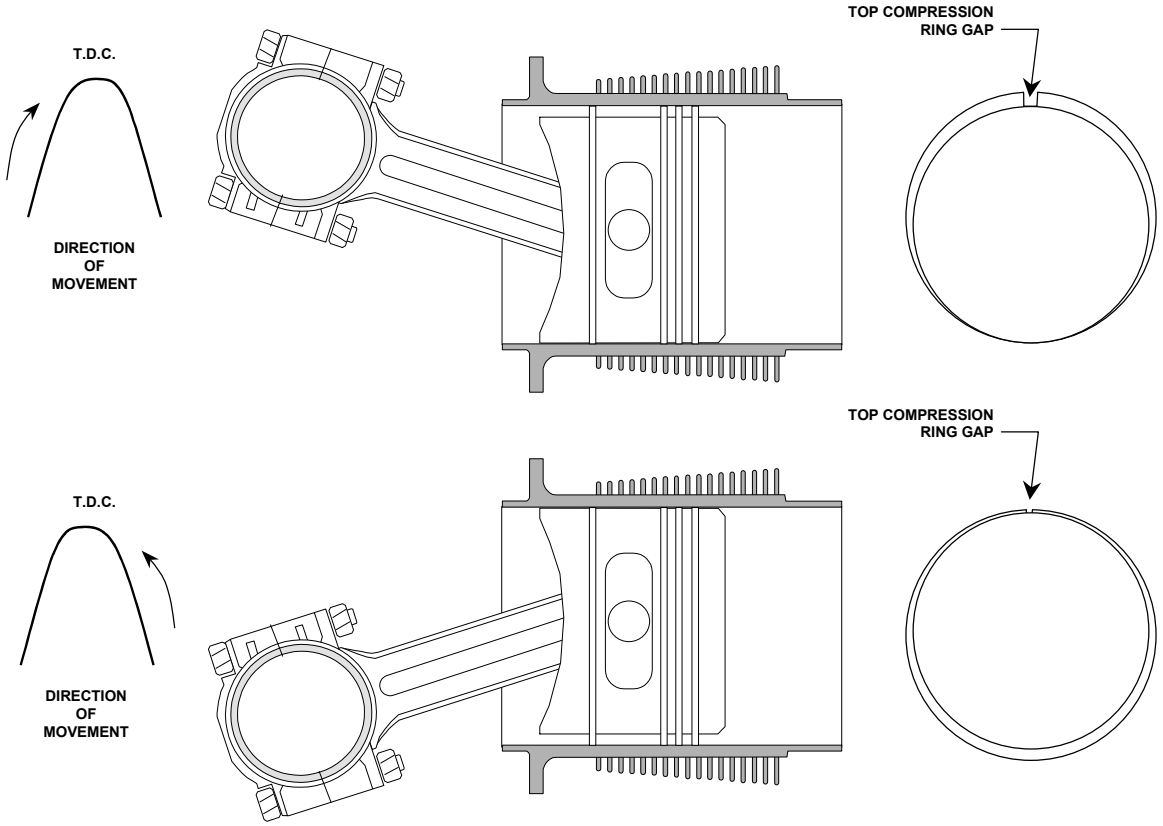


FIGURE 20-11. RING POSITIONING

11. If recheck of cylinder pressure gauge reading indication remains below allowable loss, engine may be run up to operating temperature and rechecked prior to cylinder being removed and repaired. Rework of cylinders must be accomplished in accordance with "Cylinder Assembly Repair And Replacement" in the L/TSIO-360 Series Overhaul Manual, Form X30596A.

COMPRESSION TEST TROUBLESHOOTING				
FIRST CHECK	**CHECK FOR**	**METHOD**	**CONDITIONS**	**① CORRECTIVE ACTION**
STATIC SEAL (NO LEAKAGE PERMISSABLE	Intake Valve to seat seal	Listen for air flow in intake port	Carbon	Stake Valve
			Cracked Cylinder	Replace cylinder
			Seat worn or burned	Reface or replace
			Valve worn or burned	Reface or replace
	Exhaust valve to seat seal	Listen for air flow in exhaust port	Carbon	Stake Valve
			Cracked Cylinder	Replace cylinder
			Seat worn or burned	Reface or replace
			Valve worn or burned	Reface or replace
	Spark plug (2) to port seal	Apply soapy solution around spark plug	Loose helical coil	Replace helical coil
			Cracked cylinder	Replace cylinder
	Cylinder head to barrel seal	Apply soapy solution between head and barrel	Bubbles	Replace cylinder
	Cylinder head cracks	Apply soapy solution around cylinder head area	Bubbles	Replace cylinder
DYNAMIC SEAL	Leakage by piston rings remove oil filler cap, listen	Test gauge below tolerance	Piston cracked or out of limits	Replace Piston
			Worn rings	Replace rings
			Cylinder wall dimensions out of limits	Replace Cylinder
		Test gauge above tolerance	None	None

NOTE: ① Perform all corrective actions in accordance with Section 20-6 "Cylinder Assembly Maintenance."

20-5 CYLINDER ASSEMBLY TROUBLESHOOTING

This troubleshooting chart is provided as a guide. Review all probable causes given. Check other listings of troubles with similar symptoms. Items are presented in sequence of the approximate ease of checking, not necessarily in order of probability.

TROUBLE	PROBABLE CAUSE	CORRECTION
Rough Idling	Hydraulic tappets fouled	See Section 20-6 Cylinder Assembly Maintenance "Hydraulic Tappets."
	Burned or warped exhaust valves, worn valve seats Scored valve guides	See Section 20-6 Cylinder Assembly Maintenance "Cylinders."
	Valve seats worn and leaking, piston rings worn or stuck in ring lands	See Section 20-6 Cylinder Assembly Maintenance "Cylinders."
High Cylinder Head Temperature	Exhaust valve leaking, cylinder baffles loose or bent. Cooling area between cylinder fins obstructed.	See Section 20-6 Cylinder Assembly Maintenance "Cylinders."
	Exhaust gasket leaking	Replace gasket.

TROUBLE	PROBABLE CAUSE	CORRECTION
	Valve seats worn and leaking,, piston rings worn or stuck in ring lands	See Section 20-6 Cylinder Assembly Maintenance "Cylinders."
Low Compression	Piston rings excessively worn	See Section 20-6 Cylinder Assembly Maintenance "Cylinders."
	Valve faces and seats worn	See Section 20-6 Cylinder Assembly Maintenance "Cylinders."
	Excessively worn cylinder walls	See Section 20-6 Cylinder Assembly Maintenance "Cylinders."
	Valve seats worn and leaking, piston rings worn or stuck in ring lands	See Section 20-6 Cylinder Assembly Maintenance "Cylinders."
Continuous Fouling Of Spark Plugs	Piston rings excessively worn or broken	See Section 20-6 Cylinder Assembly Maintenance "Cylinders."
	Piston rings not seated	See Section 20-6 Cylinder Assembly Maintenance "Cylinders."
	Cylinder has been overheated	See Section 20 -6 Cylinder Assembly Maintenance "Cylinders."
	Cylinder bore out of round	See Section 20-6 Cylinder Assembly Maintenance "Cylinders."
	Valve seats worn and leaking piston rings worn or stuck in ring lands	See Section 20-6 Cylinder Assembly Maintenance "Cylinder."
Sluggish Operation and Low Power Output	Valve seats worn and leaking, piston rings worn or stuck in ring lands	See Section 20-6 Cylinder Assembly Maintenance "Cylinder."

Excessive Crankcase Pressures

The following troubleshooting test is recommended when excessive crankcase pressures are suspected. An airspeed indicator may be used as a substitute for a water manometer. The indicator can be plumbed into a field modified oil cap, dipstick housing or timing plug, depending on engine model, to determine excessive crankcase pressure.

Engines with timing plugs can be modified or use P/N 630415 plug which is already drilled for attachment of the fitting for the airspeed indicator. On engines that incorporate a separate dip stick tube, the rubber hose to the airspeed indicator can be connected directly to this tube and secured with a clamp.

By the use of the following table it will be possible to obtain actual water pressure (in H_2O) when checking a suspect engine. Run engine on the ground at full power to check for excessive pressure. If the pressures are excessive, check the system with crankcase breather system disconnected from the engine vent standpipe. If the pressure then drops appreciably the breather system should be checked for possible blockage caused by, but not limited to, the air oil separator, collapsed lines, sludge build up, wet vacuum pump, etc.

After disconnecting the breather system if the pressure is still high the cylinders must be checked for blow-by.

If the aircraft has an air oil separator installed in the breather system it will cause a higher airspeed reading when connected because of the back pressure. When the ground run has been finished the breather system must be reinstalled.

NOTE. . . Excessive crankcase pressure in flight can be caused by ram air entering the engine interior through an improper fitting oil cap seal and/or damaged crankshaft nose seal.

AIRSPEED VERSUS WATER PRESSURE (Inches H_2O)

50MPH=	1.23	H_20	Limits for TSIO-360
60 MPH=	1.77	H_20	
70 MPH=	2.42	H_20	
80 MPH=	3.16	H_20	
90 MPH=	4.00	H_20	
100 MPH=	4.94	Reference: 1 PSI = 2" Hg	
120 MPH=	7.131		1" Hg. = 13.6" H_20
140 MPH=	9.729		
150 MPH=	11.18		

20-6 CYLINDER ASSEMBLY MAINTENANCE

WARNING

Fuel injection lines must not be bent or deformed. The fuel injection lines must be securely clamped to the fuel line support brackets. Do not assemble in a binding configuration.

Single Cylinder Removal - Disconnect battery in accordance with the airframe manufacturer's instructions. Tag the propeller with the warning "DO NOT TURN PROPELLER." Remove cowling and any airframe supplied accessories in accordance with the airframe manufacturer's instructions. Remove cylinder using cylinder and piston removal instructions in the L/TSIO-360 Series Overhaul Manual, Form X30596A.

NOTE. . . When the cylinder is removed with the spark plugs installed, inspection can be accomplished by filling the inverted cylinder bore with nonflammable solvent and then inspected for leaks at the static seal areas.

When cylinder is removed use the following information to clean pistons prior to dimensional inspection.

Pistons - Do not use wire brushes or scrapers of any kind. Soft or hard carbon deposits may yield to solvent action. If deposits remain, install tight fitting skirt protector sand blast the piston heads with soft grit or by the vapor grit method. Do not use sand, shot, metal grit or glass beads. Ring grooves must be cleaned by pulling lengths of binder twine or very narrow strips of crocus cloth through them. Do not use automotive ring grooves scrapers, since the corner radii at the bottoms of the grooves and side clearances must not be altered. Abrasive cloth must not be used on the piston skirts because the diameters and cam-ground contour must not be altered. Scored or burned pistons must be discarded. After cleaning, thoroughly rinse pistons using a stoddard solvent to remove all debris.

Rings - Piston rings must be replaced 100%.

Cylinder Baffling - Refer to the airframe manufacturer's instructions.

Before any repair procedures are performed after cleaning, the cylinder and it's related components must be visually, fluorescent penetrant and magnetic particle Inspected as applicable in accordance with the L/TSIO-360 Series Overhaul Manual, Form X30596A.

CAUTION. . . When performing dimensional inspection the following "Service Limits" may be used. However, they are intended as a guide for performing maintenance of the engine prior to major overhaul. Parts with dimensions or fits that exceed service limits must not be re-used. Parts with values up to and including service limits may be re-used. Judgement should be exercised considering the PROXIMITY of the engine to its recommended overhaul time. Service limits must NOT be used when overhauling an engine. See the current L/TSIO-360 Series Overhaul Manual for minimum fits and limits.

If the cylinder and it's components meet the required visual, fluorescent penetrant and magnetic particle inspections, the cylinder and its components must be dimensionally inspected.

CYLINDER ASSEMBLY SERVICE LIMITS

Ref. No.		Description	Servicable Limit Max.
		CYLINDER AND HEAD ASSEMBLY	
1	②	Cylinder bore (lower 4 1/4" of barrel) ..... Diameter:	See Note ②
2	②	Cylinder bore choke at (5.75 from open end of barrel) .....Taper:	See Note ②
3		Cylinder bore out-of-round ..... :	0.0020
4	① ②	Cylinder bore ..... Allowable Oversize:	See Note ②
5		Cylinder bore surface roughness (Nitride Barrels) using 180 grit stone,, cross hatch .....Angle: Microfinish (measured in direction of piston travel)..... RMS:	 22° - 32° 25
5		Cylinder bore surface roughness (Channeled Chrome) using 180 grit stone, cross hatch .....Angle: Finish all area within ring travel. Must show evidence of contact with honing stone. Partially honed areas shall not exceed 10% of bore surface and no area shall exceed one inch in any direction. Finish - pitting is undesirable if present,, it is subject to the following limits: Pits (No more than two pits in any 1/4 inch Diameter circle) Not more than 25 pits of any one size in entire cylinder bore is acceptable. Pit Size..... Diameter:	 22° - 32° .031
5		Cylinder bore surface roughness (Cermicrome®) Finish - pitting is undesirable if present,, it is subject to the following limits: Pits (No more than two pits in any 1/4 inch Diameter circle) Not more than 25 pits of any one size in entire cylinder bore is acceptable. Pit Size..... Diameter:	 .031
6		Cylinder barrel in crankcase..... Diameter:	0.0110L
7	⑥	Intake valve seat insert in cylinder head ..... Diameter:	0.0055T
8	⑥	Intake valve guide in cylinder head ..... Diameter:	0.0010T
9		Exhaust valve guide in cylinder head..... Diameter:	0.0010T
10		Exhaust valve seat insert in cylinder head ..... Diameter:	0.0070T
11		Intake valve seat.....Width:	See Note ④
12		Exhaust valve seat .....Width:	See Note ④
		Exhaust valve seat-to-valve guide axis .....Angle:	45° - 30'
		Intake valve seat-to-valve guide axis .....Angle:	60° - 30'
		ROCKER ARMS AND SHAFTS	
13		Rocker shaft in rocker arm bearing..... Diameter:	0.0060L
14		Rocker arm bushing (inside) .....Finish Bore Diameter:	0.5955
15		Rocker Arm..... Side Clearance:	0.0150
16		Rocker arm to roto-coil .....Clearance:	0.020

Ref. No.		Description	Servicable Limit Max.
		CYLINDER AND HEAD ASSEMBLY	
17		Rocker arm grind ..... Width:	0.34
18		Intake valve in guide ..... Diameter:	0.0050L
19		Exhaust valve in guide ..... Diameter	0.0057L
20		Intake valve face (to stem axis) ..... Angle:	60° - 15°
21		Exhaust valve face (to stem axis) ..... Angle:	45° - 15'
22	③	Intake valve ..... Length:	See Note ③
23	③	Exhaust Valve ..... Length:	See Note ④
24		Intake valve seat-to-stem (full indicator reading) ..... Run Out:	0.0040
25	④	Exhaust valve seat-to-stem (full indicator reading) ..... Run Out:	Replace 100%
26		Rocker arm foot-to-valve stem (dry valve gear lash) ..... :	0.2000
		PISTONS, RINGS AND PINS	
27		Piston (bottom of skirt) in cylinder ..... Diameter:	0.0120L
28		Top piston ring in groove ..... Side Clearance:	0.0040L
29		Second piston ring in groove ..... Side Clearance:	0.0040L
30		Third piston ring in groove ..... Side Clearance:	0.0065L
31		Fourth piston ring in groove ..... Side Clearance:	0.0065L
32		Top ring gap at 6.22 depth (in cylinder barrel) ..... Gap:	0.030
33		Second ring gap at 6.22 depth (in cylinder barrel) ..... Gap:	0.030
34		Third ring gap at 1.00 depth (in cylinder barrel) ..... Gap:	0.030
35		Fourth ring gap at 1.00 depth (in cylinder barrel) ..... Gap:	0.030
36		Piston pin in piston (standard or 0.005' oversize) ..... Diameter:	0.0010L
37		Piston pin ..... Diameter: Piston pin (0.005' oversize) ..... Diameter:	0.9984 1.0034
38		Piston pin in cylinder ..... End Clearance:	0.050L
39		Piston pin in connecting rod bushing ..... Diameter:	0.0040L
40		Hydraulic tappet in crankcase ..... Diameter:,	0.0035L
		SPRING TEST DATA	
41		Inner valve spring 625957 compressed to 1.100 in. length ..... Load: Inner valve spring 625957 compressed to 1.500 in. length ..... Load:	62 LBS 33 LBS
42		Outer valve spring 625958 compressed to 1.168 in. length ..... Load: Outer valve spring 625958 compressed to 1.159 in. length ..... Load:	77 LBS 43 LBS
43		Installed outer valve spring ..... Height:	1.559

NOTES:

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① Use .005" oversize rings.

② See Figure 20-13, "Maintenance Cylinder Dimensions."

③ Intake valves may be reworked in accordance with the L/TSIO-360 Series Overhaul Manual, Form X30596A.

④ Exhaust valves MUST NOT be reworked, worn exhaust valves must be replaced 100%. See TCM Service Bulletin M90-13 or current revision as applicable.

⑤ Intake and exhaust valve seats may be reworked in accordance with the TSIO-360 Series Overhaul Manual, Form X30596A.

⑥ Valve guides may be replaced in accordance with the L/TSIO-360 Series Overhaul Manual, Form X30596A.

⑦ If the required rocker arm to roto-coil clearance cannot be obtained without exceeding 0.34 - $^{11}/_{32}$ grind width, the rocker must be replaced.

(See illustration on next page)

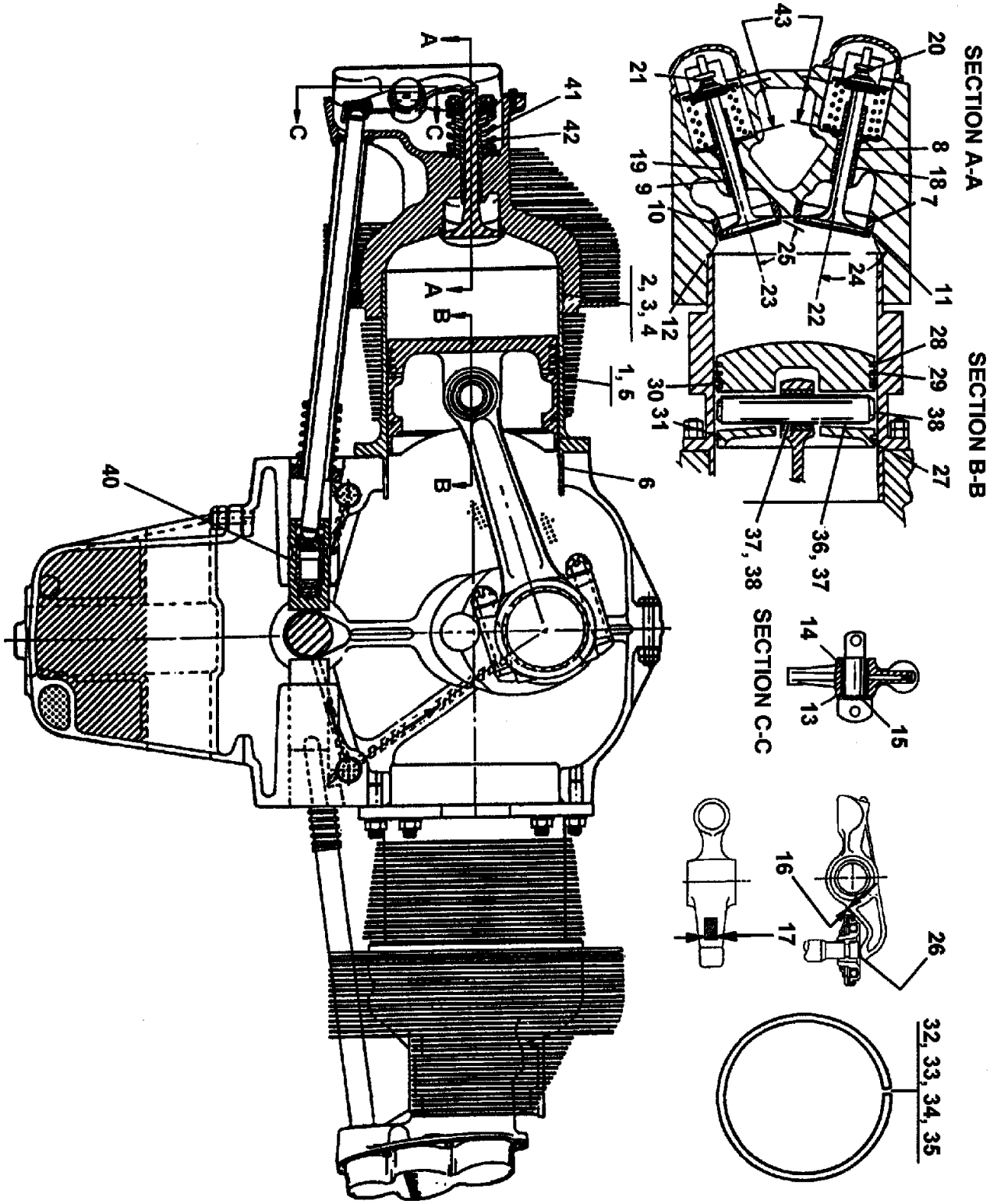
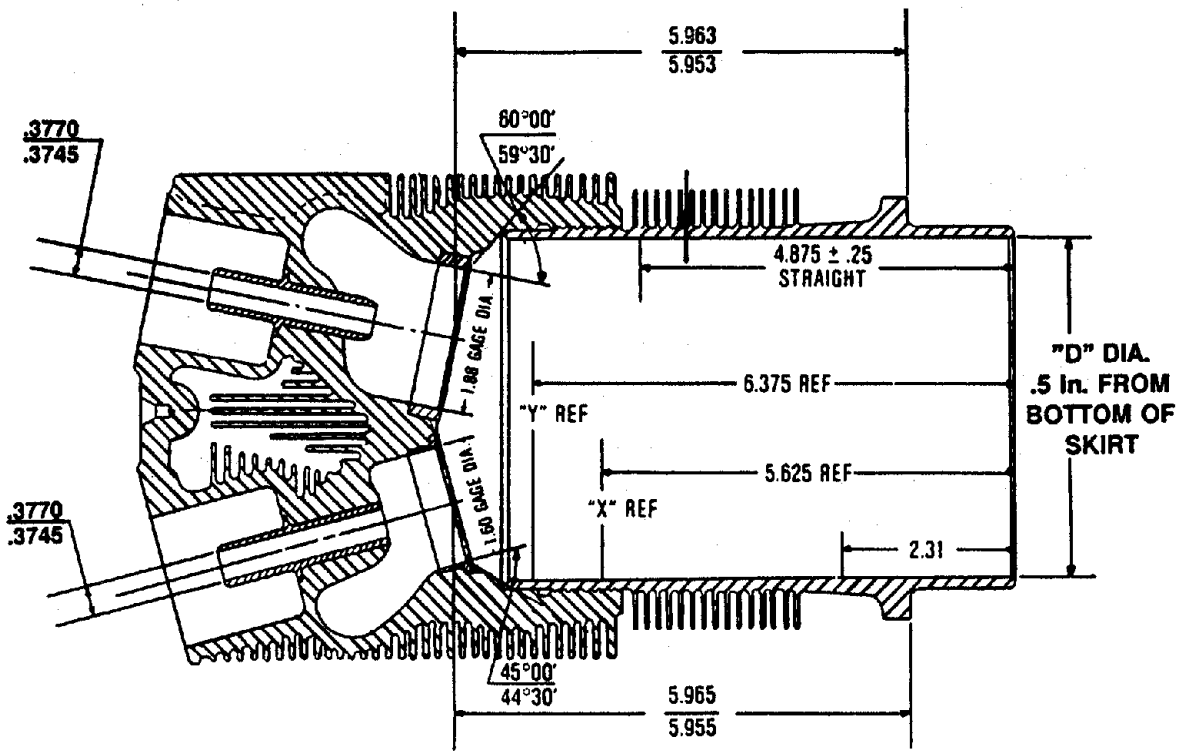


FIGURE 20-12. CYLINDER ASSEMBLY SERVICE LIMITS

(For "Maintenance Cylinder Dimensions," (see next page)



SIZE	"D" DIAMETER (Inches) NEW PART		SERVICE LIMITS
	MINIMUM	MAXIMUM	MAX.
STANDARD	4.437	4.439	4.442
.005	4.442	4.444	4.447
.015	4.452	4.454	4.457

SIZE	"X" DIAMETER (Inches) NEW PART		SERVICE LIMITS FOR "X" DIA. IS ACTUAL MEASURED "D" DIA. PLUS .001 In.
	MINIMUM	MAXIMUM	
STANDARD	4.434	4.436	
.005	4.439	4.441	
.015	4.449	4.451	

SIZE	"Y" DIAMETER (Inches) NEW PART		
	MINIMUM	MAXIMUM	
STANDARD	4.431	4.433	
.005	4.436	4.438	
.015	4.446	4.448	

TSIO-360 SERIES

CAUTION. . . Cylinder assemblies exceeding new parts dimension shown are acceptable when performing maintenance before engine overhaul. However, piston ring gaps given in the table of limits must be maintained. When engine is being overhauled TCM requires that all Parts be brought back to new parts limits by rework or replacement. See New Parts and Service Limits in L/TSIO-360 Series Overhaul Manual,Form X30596A.

NOTE. . . DIMENSIONS SHOWN ARE FINISHED AFTER HONING.

FIGURE 20-13. MAINTENANCE CYLINDER DIMENSIONS

Single Cylinder Reassembly - After all cylinder components have been cleaned, inspected and repaired in accordance with TCM specifications, reassemble cylinder in accordance with Cylinder and Piston Sub-Assembly of the L/TSIO-360 Series Overhaul Manual, Form X30596A.

Single Cylinder Reinstallation - Reinstall repaired or new cylinder in accordance with the L/TSIO-360 Series Overhaul Manual, Form X30596A. Loosely install spark plugs and gaskets in cylinder. Have an assistant hold nuts on opposite end of cylinder through bolts when torquing cylinder attaching hardware.

Hydraulic Valve Tappets - Malfunctioning hydraulic valve tappets must be removed, discarded and replaced with new. Remove and replace tappets in accordance with the applicable instructions in the L/TSIO-360 Series Overhaul Manual, Form X30596A.

Reinstall all valve train components that were removed using new o-rings, seals and gaskets in accordance with in the L/TSIO-360 Overhaul Manual, Form X30596A. Rocker cover screws must be torqued to 45-55 inch pounds and safetied as required.

CHAPTER 21
CRANKCASE ASSEMBLY

21-1 CRANKCASE DESCRIPTION

The crankcase provides a tight enclosure and oil galleries for lubrication. The crankcase is sufficiently rigid to provide support for the crankshaft, camshaft and bearings.

21-2 CRANKCASE DETAILED DESCRIPTION

Two aluminum alloy castings are joined along the vertical center plane to form the complete crankcase. The individual castings (with studs and inserts) will be referred to as the "left crankcase" and "right crankcase" throughout this section.

Bosses molded in the crankcase castings are line bored in the assembled castings to form bearings for the camshaft and saddles for precision crankshaft main bearing inserts. A needle bearing is installed between the left and right rear upper crankcase halves to support the front end of the starter adapter shaft gear. Guides are bored through lateral bosses for hydraulic tappets.

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 left hand lower front corner of the of the left case half. A fuel pump mounting pad is located on the front lower right crankcase.

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

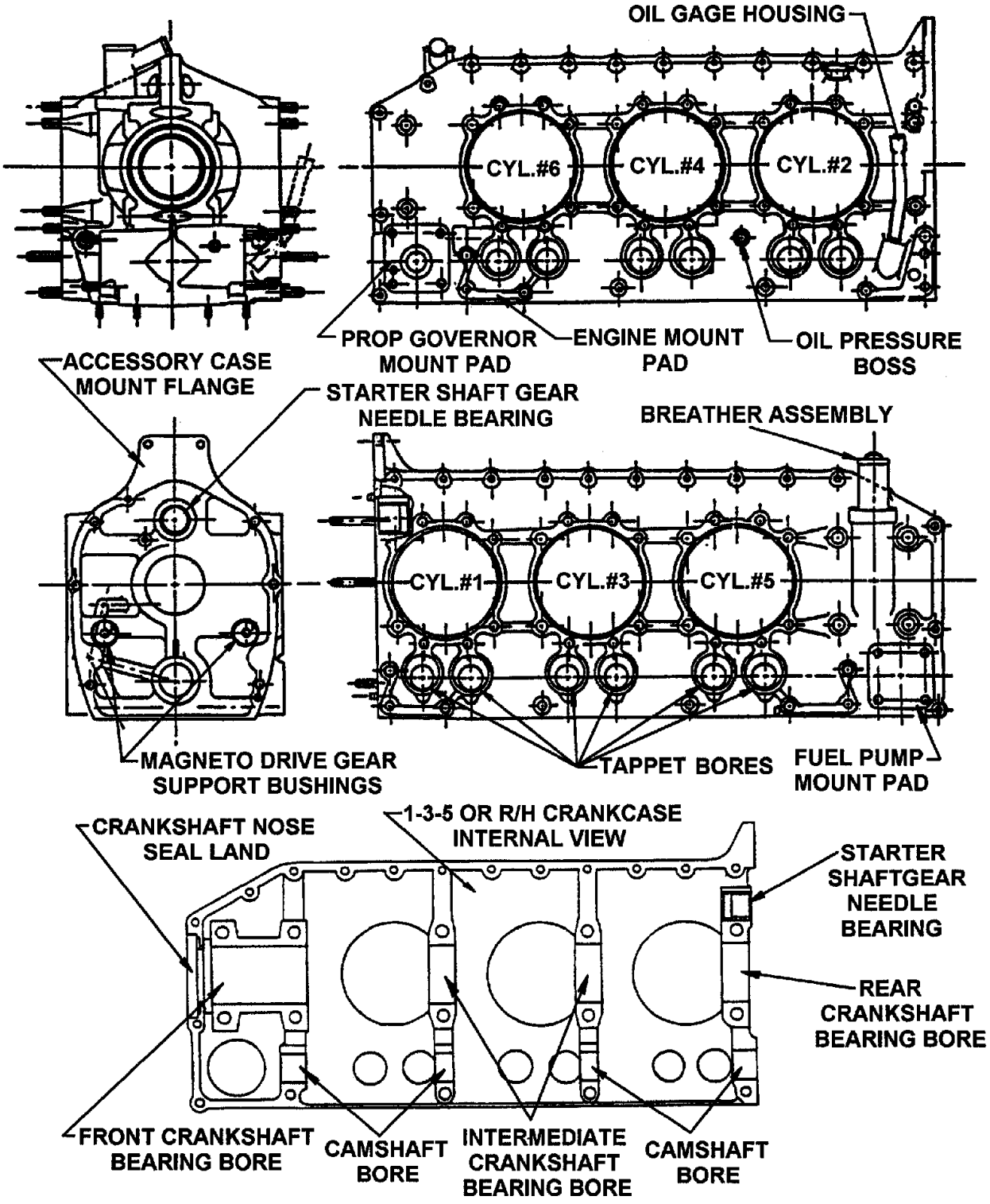


FIGURE 21-1. CRANKCASE DESCRIPTION

21-3 CRANKCASE INSPECTION

50 HOUR - Visually inspect accessories for security and all gasket areas for oil leaks. All accessory and cylinder mounting studs must be visually inspected and checked for security. Safety mechanisms such as lockwire and locking tab washers must be inspected for proper installation and security. Inspect engine mount brackets for cracks and security. Inspect all areas of crankcase for cracks.

100 HOUR - Perform all visual inspection requirements of 50 hour inspection. Inspect crankcase for cracks in accordance with the following instructions.

Critical (gray) and non-critical areas are illustrated in Figure 21-3. If a crack is observed in any of the non-critical (dark gray) areas that is less than two (2) inches in length, the crack should be scribe marked at its extremities and re-inspected for crack progression at the next 50 hours of operation. If no progression is observed and no additional cracks are found, continue to inspect at regular intervals not to exceed 100 hours duration.

If a crack is observed in any non-critical (dark gray) areas that is more than two (2) inches in length, or if a previously observed crack has progressed to two (2) or more inches in length, repair or replace the crankcase prior to further flight. If any crack is observed in a critical (gray) area, repair or replace the crankcase or engine prior to further flight.

Reasons for crankcase replacement:

A. Any crack in the critical (gray) areas.

B. Any crack two (2) inches or more in length in the non-critical (dark gray) area.

C. Any crack that is leaking oil (not seeping).

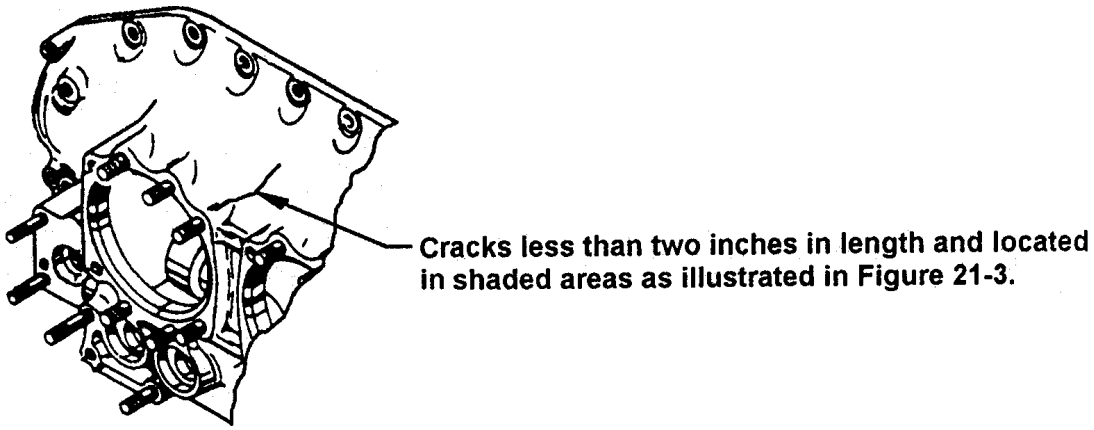


FIGURE 21-2. INSPECTION OF CRANKCASE NON CRITICAL AREA

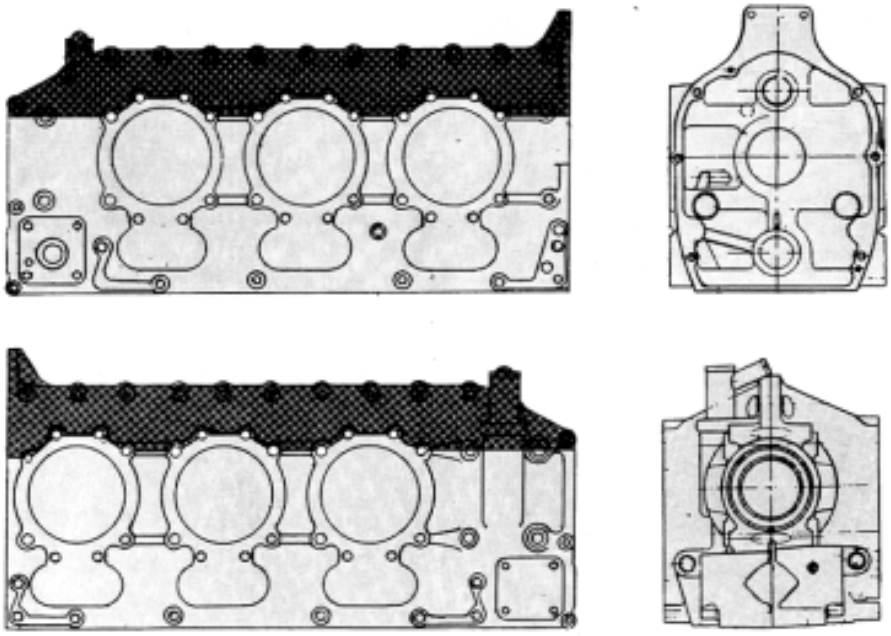


FIGURE 21-3. INSPECTION OF CRANKCASE CRITICAL (GRAY) AND NON CRITICAL (DARK GRAY) AREAS

21-3 CRANKCASE INSPECTION (continued)

CAUTION. . . Repair of the crankcase must be performed by FAA approved repair facilities only.

TCM has established that welding of the crankcase is an acceptable repair process. The weld procedure must conform with approved FAA repair standards and the dimensional integrity of the crankcase must be maintained. Refer to TCM Service Bulletin M90-17 or current revision as applicable.

(continued on next page)

21-4 CRANKCASE TROUBLESHOOTING

This troubleshooting chart is provided as a guide. Review all probable causes given. Check other listing of troubles with similar symptoms. Items are presented in sequence of the approximate ease of checking, not necessarily in order of probability.

TROUBLE	PROBABLE CAUSE	CORRECTION
Oil Loss	Loose accessories or deteriorated gaskets	See Section 21-5 "Crankcase Maintenance."
	Cracked crankcase	See Section 21-3 "Crankcase Inspection."
	Insufficient torque	Torque hardware to proper value in accordance with the TSI0-360 Series Overhaul Manual, Form X30596A.
Loose Accessories	Loose or stripped studs	See Section 21-5 "Studs."
	Insufficient torque	Torque hardware to proper value in accordance with Most current version of the L/TSIO-360 Series Overhaul Manual X30596A.
Engine Runs Rough	Cracked engine mount	See Section 21-5 "Engine Mounts."
Excessive Crankcase Pressure	Cylinder blow-by	See Section 20-4, "Cylinder Compression Test."

21-5 CRANKCASE MAINTENANCE

Crankcase - Leaking gaskets must be replaced. Remove component, replace gasket and re-install component in accordance with applicable system or component section in the most current version of the L/TSIO-360 Series Overhaul Manual, Form X30596A. Exercise judgment as to the extent of disassembly required. During reassembly, insure that all reinstalled components are properly torqued and safetied.

Studs – The replacement of crankcase studs or helical coils will require component removal and replacement in accordance with the applicable component system section in the L/TSIO-360 Series Overhaul Manual, Form X30596A. Replace studs or helical coils in accordance with the L/TSIO-360 Series Overhaul Manual, Form X30596A. During reassembly, insure that all reinstalled components are properly torqued and saftied.

Engine Mounts - Replace engine shock mounts in accordance with the airframe manufacturer's instructions.

CAUTION. . . When relieving engine weight from the airframe, the engine hoist must be attached to the engine lifting eyes only.

NOTE. . . Place a support at the load bearing area of aircraft tail to prevent damage to the airframe.

Crankcase Separation - If the crankcase halves must be separated, remove the engine from airframe in accordance with the most current version of the L/TSIO-360 Series Overhaul Manual, Form X30596A and the airframe manufacturer's instructions. Engine disassembly, cleaning, inspection, repair, replacement and assembly must be accomplished in accordance with the most current version of the L/TSIO-360 Series Overhaul Manual, Form X30596A.

NOTE. . . Exercise judgment in determining how far systems and components should be disassembled.

Any maintenance of engine systems and components removed from engine must be performed in accordance with that particular system or component section of this manual.

CAUTION. . . Dimensional inspection of the crankcase and crankcase internal components must be performed in accordance with the L/TSIO-360 Series Overhaul Manual, Form X30596A. Prior to dimensional inspection, insure that the part conforms with all visual, fluorescent penetrant, magnetic particle or ultrasonic inspection requirements.

All crankcase repairs must be performed in accordance with the most current version of the L/TSIO-360 Series Overhaul Manual, Form X30596A. Any non TCM supplied accessory that was disassembled for maintenance must be re-assembled in accordance with the applicable accessory manufacturer's instructions. Any maintenance involving crankcase separation will require an acceptance test, oil consumption determination, reinstallation in airframe and test flight in accordance with the most current version of the L/TSIO-360 Series Overhaul Manual, Form X30596A.

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CHAPTER 22
ENGINE DRIVE TRAIN

22-1 ENGINE DRIVE TRAIN DESCRIPTION

When starting engine, torque is transmitted from the starter (12) through adapter components (13, 14, 15 & 16) to crankshaft gear (1). As worm-wheel (15) is turned, the spring mounted on its hub, is tightened to grip drum of shaftgear (16). After engine is started the spring returns to its normal position releasing the shaftgear and disengaging the starter.

Torque from the crankshaft (2) is transmitted by the crankshaft gear (1) directly to the camshaft gear (3).

The camshaft gear, rotating in a counterclockwise direction drives the magneto drive gears (10, 11).

The fuel pump is driven by a shaft (19) connected to the prop governor driven bevel gear (7). The governor drive bevel gear (6) is keyed to the camshaft (4) and meshes with and drives the governor drive bevel gear (7). The oil pump drive gear (8) mates with the internal teeth of the camshaft gear (3).

The scavenge pump is part of the starter adapter assembly and is driven by the starter shaft gear (16) which drives gear (17) and (18).

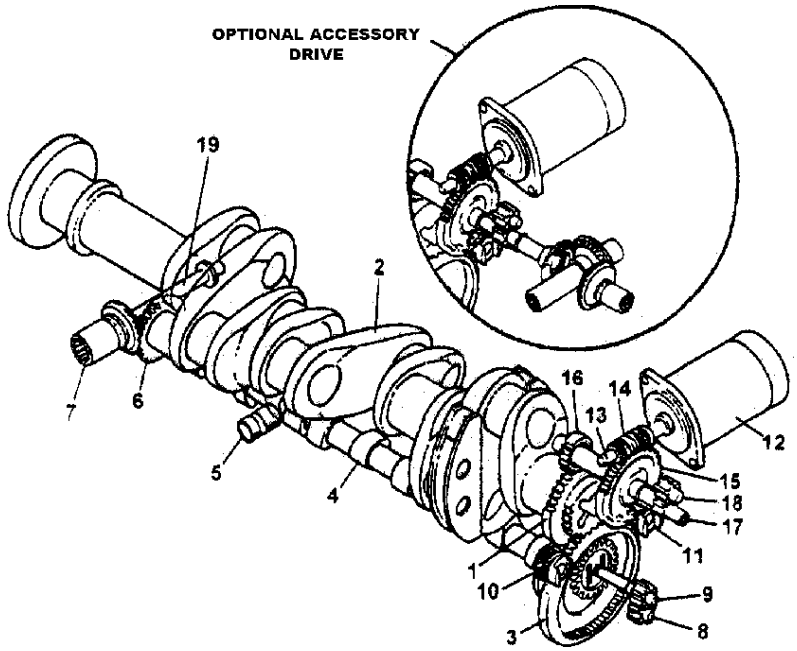


FIGURE 22-1. ENGINE DRIVE TRAIN DESCRIPTION

1. Crankshafts Gears
2. Crankshaft
3. Camshaft Gear
4. Camshaft
5. Hydraulic Tappet
6. Governor Drive Bevel Gear
7. Governor Driven Bevel Gear
8. Oil Pump Drive Shaftgear
9. Oil Pump Driven Gear
10. Left Magneto Drive Gear
11. Right Magneto Drive Gear
12. Starter
13. Starter Coupling
14. Worm Drive Shaft
15. Starter Worm Wheel
16. Starter Shaftgear
17. Scavenge Pump Drive Gear
18. Scavenge Pump Driven Gear
19. Fuel Pump Drive Shaft

(continued on next page)

22-2 ENGINE DRIVE TRAIN COMPONENT DETAILED DESCRIPTION

Crankshaft - The crankshaft has four, machined, main journals which are supported by precision bearing inserts in each of the four bearing saddles machined in the crankcase. Six machined rod journals provide attachment of the connecting rod assemblies.

Figure 22-2 shows the method of numbering the crankshaft main journals, connecting rod journals and crankshaft cheeks which are identified by letters and location numbers.

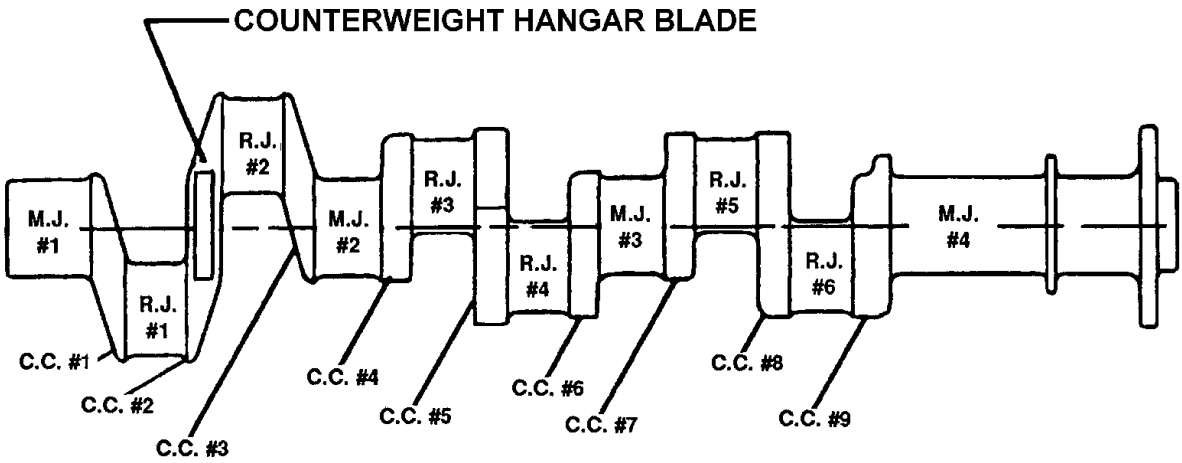
Counterweights assemblies are supplied in matched pairs with the bushings installed. Maximum weight difference not to exceed 2 grams.

The counterweight order number designates the vibration frequency the counterweight is absorbing. If a vibration frequency occurs six times per revolution, the counterweight is designated a 6th order counterweight. Similarly, if a vibration occurs five times per revolution, the counteracting counterweight is designated a 5th order counterweight.

One sixth order counterweight is installed on one #2 cheek hanger. A four and one-half order counterweight is installed on the opposite hanger. It does not matter on which side of a cheek a particular counterweight is installed.

The crankshaft gear is heated to facilitate installation. The gear is indexed on the crankshaft by a dowel and secured by machined bolts.

A neoprene oil seal is seated in a machined bore in the crankcase assembly in the shaft exit area, and is sealed to the crankshaft by a helical spring inside the seal's cavity.



CC = Crankshaft Cheek
RJ = Rod Journal
MJ = Main Journal

FIGURE 22-2. CRANKSHAFT DESCRIPTION

Connecting Rod - The connecting rods are made of aircraft quality steel. The connecting rod large diameter end, which attaches to the crankshaft crankpin or rod journal, is fitted with a cap and two (2) piece bearing. The bearing cap is held to the main rod by special bolts and nuts.

A split steel backed bronze bushing is pressed into the piston pin end and machined for a precision fit. Weight variation of connecting rods in opposing bays, Example: #1 and #2 connecting rods, is limited to 1/2 ounce/14 grams.

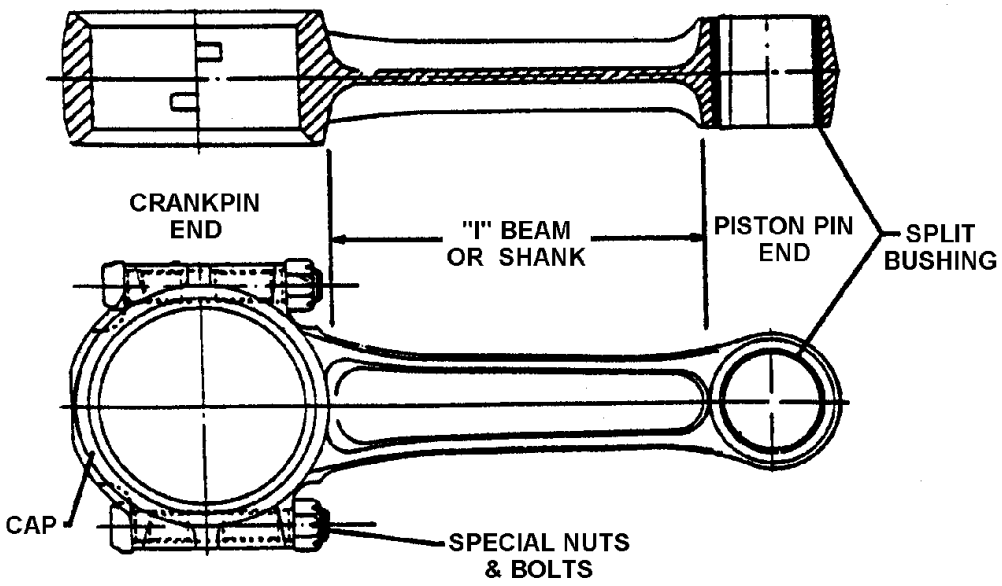


FIGURE 22-3. CONNECTING ROD DESCRIPTION

Camshaft - The forging is machined on four main journals, nine cam lobes and the gear mount flange at the rear of the camshaft. The main journals are supported in the crankcase by machined bearing saddles. The hydraulic tappets move inward and outward in their bores by the eccentric shape of the cam lobes. The lobes and journals are ground and hardened. Movement of the tappets open and close the intake and exhaust valves within the cylinder by mechanical linkage of the pushrods and rocker arms. Valve opening and closing is synchronized with piston position by timing the camshaft and crankshaft gears. Four unequally spaced bolts secure the gear to the camshaft and insure proper positioning, locating the gears timing mark in relation to the cam lobes. The camshaft gear has internal teeth for driving the oil pump gear and if installed a gear driven alternator or generator. A front mounted, keyed bevel gear drives the governor driven bevel gear which drives the fuel pump through a common shaft.

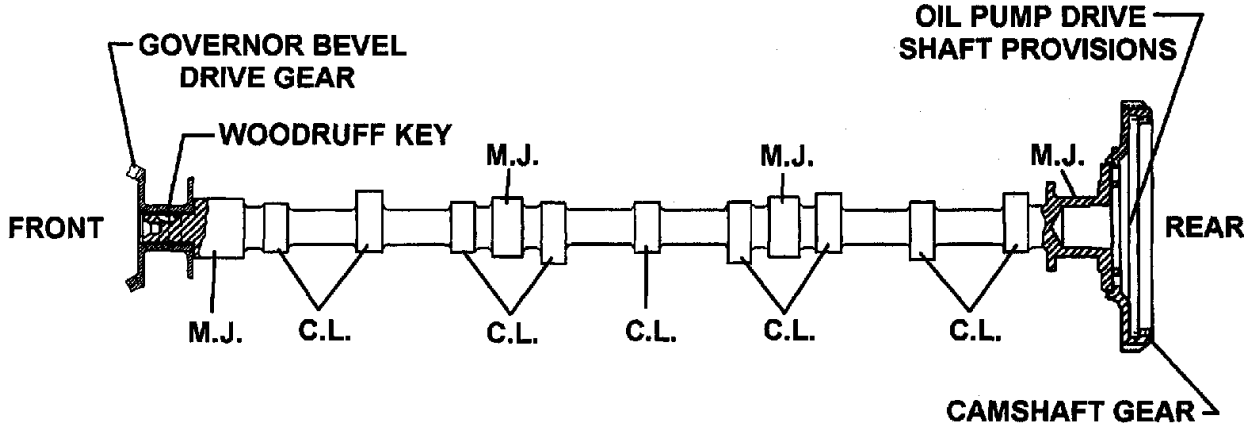


FIGURE 22-4. CAMSHAFT DESCRIPTION

22-3 ENGINE DRIVE TRAIN INSPECTION

50 Hour - Visually inspect the front crankshaft exit area for evidence of oil leakage, corrosion or pitting and any obvious over stressing of the crankshaft and flange. Visually inspect propeller installation in accordance with the airframe manufacturer's Instructions.

100 Hour - Perform visual inspection requirements of 50 hour inspection.

Crankshaft Sudden Stoppage - In case of prop strike (sudden stoppage) see Section 5-7 of this manual.

Engine Overspeed - In case of engine overspeed, see Section 5-7 of this manual.

22-4 ENGINE DRIVE TRAIN TROUBLESHOOTING

This troubleshooting chart is provided as a guide. Review all probable causes given. Check other listings of troubles with similar symptoms.

TROUBLE	PROBABLE CAUSE	CORRECTION
Oil Loss	Worn crankshaft nose seal	Replace nose seal, See Section 22-6.

22-5 ENGINE DRIVE TRAIN MAINTENANCE

Crankshaft Nose Oil Seal - The crankshaft nose oil seal may be replaced according to the following instructions:

WARNING

To prevent starting of engine before moving the crankshaft accomplish the following:

a. Disconnect all spark plug leads.
b. Verify magneto switches are connected to magnetos, that they are in the "OFF" Position and "P" leads are grounded.
c. Throttle position "CLOSED."
d. Mixture control "IDLE-CUT-OFF."
e. Set brakes and block aircraft wheels.
f. Insure that aircraft tie-downs are installed and verify that the cabin door latch is open.
g. Do not stand within the arc of the propeller blades while turning the propeller.

A. SPLIT TYPE OIL SEAL

1. Remove oil seal.
2. Clean surfaces thoroughly making certain that no debris remains on the shaft or in the seal counterbore. Wash seal area with solvent.
3. Remove any plating in the one inch area shown in Figure 22-5, "Helix Pattern Application." Remove plating by working a piece of very fine emery cloth back and forth around the shaft. This should blend the finish uniformly without leaving any lines (scratches).

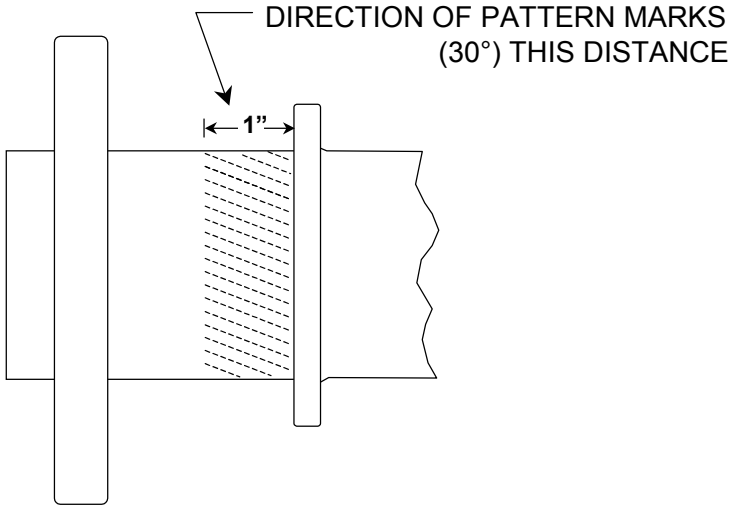


FIGURE 22-5. HELIX PATTERN APPLICATION TSIO-360

4. See Figure 22-5, "Helix Pattern Application." Apply helix using a strip of 180 grit emery cloth approximately one half inch wide. Do approximately one quarter of the surface indicated at a time, stroking the cloth outward toward the propeller flange in the direction of rotation (CCW) towards you using maximum hand pressure. Reverse direction for left hand rotating engines. This should result in a 30° pattern similar to that illustrated in Figure 22-5, "Helix Pattern Application." After doing the first portion rotate crankshaft by hand to make next portion available. Apply the same pattern again and continue completely around the crankshaft in this manner.

1. Repeat cleaning operation.

B. INSTALLATION

1. Use only oil seal assembly P/N 530917 which consists of an oil seal and spring P/N 530974 Check the spring length. It should be 7 - 9/16" ±1/32" in length. See Figure 22-6 "Crankshaft Oil Seal."

2. Remove spring from new oil seal. Unhook the spring ends using an unwinding motion. Wrap spring around shaft in seal area. Turn spring ends in unwinding direction, then join and allow one end to wind into the other end.

3. Lubricate the oil seal lips using Alvania (Shell #2). Twist the seal and slide over crankshaft with the recessed side toward the engine. Bring the ends of the seal back together. With the spring ends opposite the seal split carefully work the spring into it's recess in the seal.

4. Apply a thin coat of Permatex to outside diameter of seal.

5. Using thumb pressure, work seal into counterbore with the oil seal split at the 10 o'clock or 2 o'clock position.

6. After seal is in place, wipe oil from seal and shaft.

7. Spray exposed portion, from which plating has been removed, with aluminum primer.

8. After installation, re-install oil seal retainer plates. Torque retainer plate hardware 4 each 10 - 24 screws to 21.0 - 25.0 inch pounds.

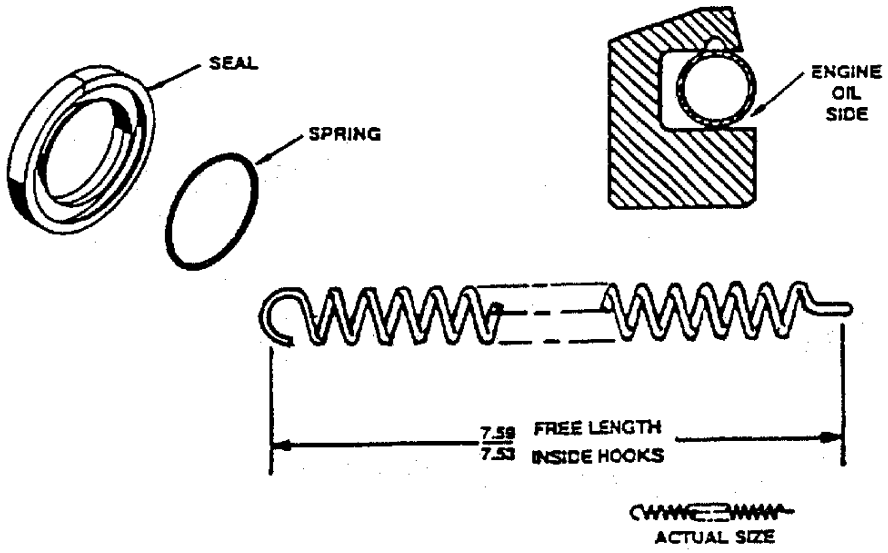


FIGURE 22-6. CRANKSHAFT OIL SEAL

Engine Drive Train Component Removal - If all other probabilities have been evaluated and it is determined a malfunction is occurring with internal engine components, the engine must be removed from the airframe in accordance with the L/TSIO-360 Series Overhaul Manual, Form X30596A and the airframe manufacturer's instructions.

CAUTION. . . When relieving engine weight from the airframe, the engine hoist must be attached to the engine lifting eyes only.

NOTE. . .Place a support at the load bearing area of airframe tail to prevent damage to the airframe.

NOTE. . .Exercise judgment in determining the extent of disassembly.

Maintenance of removed engine systems and components must be performed in accordance with that particular system or component section of this manual.

CAUTION. . . Dimensional inspection of the crankcase and crankcase internal components must be performed in accordance with the L/TSIO-360 Series Overhaul Manual, Form X30596A. Prior to dimensional inspection, insure that the part conforms with all visual, fluorescent penetrant, magnetic particle or ultrasonic inspection requirements.

NOTE. . .When the engine has been disassembled a complete visual, dimensional and non destructive test inspection must be performed on all components prior to re-assembly.

Engine disassembly, cleaning, inspection, repair, replacement, assembly and test must be accomplished in accordance with the L/TSIO-360 Series Overhaul Manual, Form X30596A.

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CHAPTER 23
POST MAINTENANCE ADJUSTMENT AND TEST

23-1 POST MAINTENANCE OPERATIONAL TEST
STARTING

WARNING

Over priming can cause hydrostatic lock and subsequent engine malfunction.

CAUTION. . . Insure propeller area is clear before initiating starting sequence.

NOTE. . . If engine has had a new cylinder or cylinders and piston rings installed, start the engine in accordance with the airframe manufacturer's Airplane Flight Manual (AFM.) Operate the engine at 750 RPM for one minute, gradually increasing RPM to 1000 RPM in three minutes. Check the magneto circuit for proper grounding prior to a normal shut-down. Allow the engine to cool adequately and make a visual inspection for any discrepancies. If engine exhibits any discrepancies, return to the applicable chapter to correct the discrepancy. All discrepancies must be corrected prior to operational test and engine adjustment.

NOTE. . . Before starting engine, insure that fuel tanks contain proper type of fuel (100LL-blue or 100 green). The aircraft fuel system must be serviced in accordance with the airframe manufacturer's instructions. Check engine oil sump for proper servicing. See Chapter 7 for oil type, specification and servicing point.

Start engine using the starting procedure given in the airframe manufacturers Airplane Flight Manual (AFM).

Oil Pressure - Check, If no oil pressure is noted within 30 seconds, shut engine down and investigate.

CAUTION. . . Operation of engine without oil pressure may result in engine malfunction or stoppage.

OPERATIONAL INSPECTION
An operational inspection must be performed prior to 50/100-hour inspections.

OPERATIONAL CHECK LIST

Check and record the following system data :

Starter ..... _____
*Record RPM Drop for each magneto at 1700
(150 RPM MAXIMUM AND 50 RPM SPREAD MAXIMUM) ..... _____
*Propeller Operation at 1700 ..... _____

*Or as specified in aircraft manufacturer's instructions.

Increase engine to full power and record:

Manifold Pressure ..... _____
RPM ..... _____
Fuel Flow..... _____
Oil Pressure ..... _____
Oil Temperature ..... _____
Cylinder Head Temperature ..... _____
Alternator Output..... _____

Reduce engine to idle and record:

Manifold Pressure....._____
RPM....._____
Oil Pressure....._____
Oil Temperature....._____
Cylinder Head Temperature....._____
Magneto System Grounding Check....._____

CAUTION. . . The magneto system grounding check must be accomplished at idle RPM only. Damage to the engine may result at engine speeds above idle RPM.

WARNING

Absence of RPM drop when checking magnetos is an indication of a malfunction in the ignition system resulting in a hot magneto. This type of malfunction must be corrected prior to continued operation of the engine. The engine may inadvertently experience ignition or start-up anytime the propeller is moved. Damage, injury or death may result.

If engine continues to run when magnetos are switched Off a malfunction is occurring in the ignition system.

Slowly move mixture control to IDLE CUT OFF and record:

Mixture RPM Rise (25 to 50 RPM) ..... _____
Positive Fuel Cutoff ..... _____

When propeller stops rotating, place ignition switch, master switch and fuel selector in off position.

TABLE 23-1. OPERATING LIMITS

ITEM	ENGINE MODEL L/TSIO-360-RB
Full Throttle Speed - RPM	2600
Idle Speed - RPM	700
Fuel Grade (Octane)	100LL/100
Fuel Flow at Full Throttle (Lbs. /Hr.)	140 - 150
Oil Temperature Limit	240° F
Oil Pressure (Max. Oil Cold)	100 PSI
Minimum at Idle	10 PSI
Magneto Drop (Max.) Magneto Spread	150 RPM 50 RPM
Cylinder Head Temperature with Bayonet Thermocouple (Max.)	460°F

23-2 ENGINE ADJUSTMENT AND SETUP

Oil Pressure Adjustment

The adjusting screw is turned clockwise to increase oil pressure and counterclockwise to decrease oil pressure. With normal operating oil temperature (180° - 200°F), adjust oil pressure to maintain, 30-80 pounds per square inch at full power RPM. Torque locknut and safety as required.

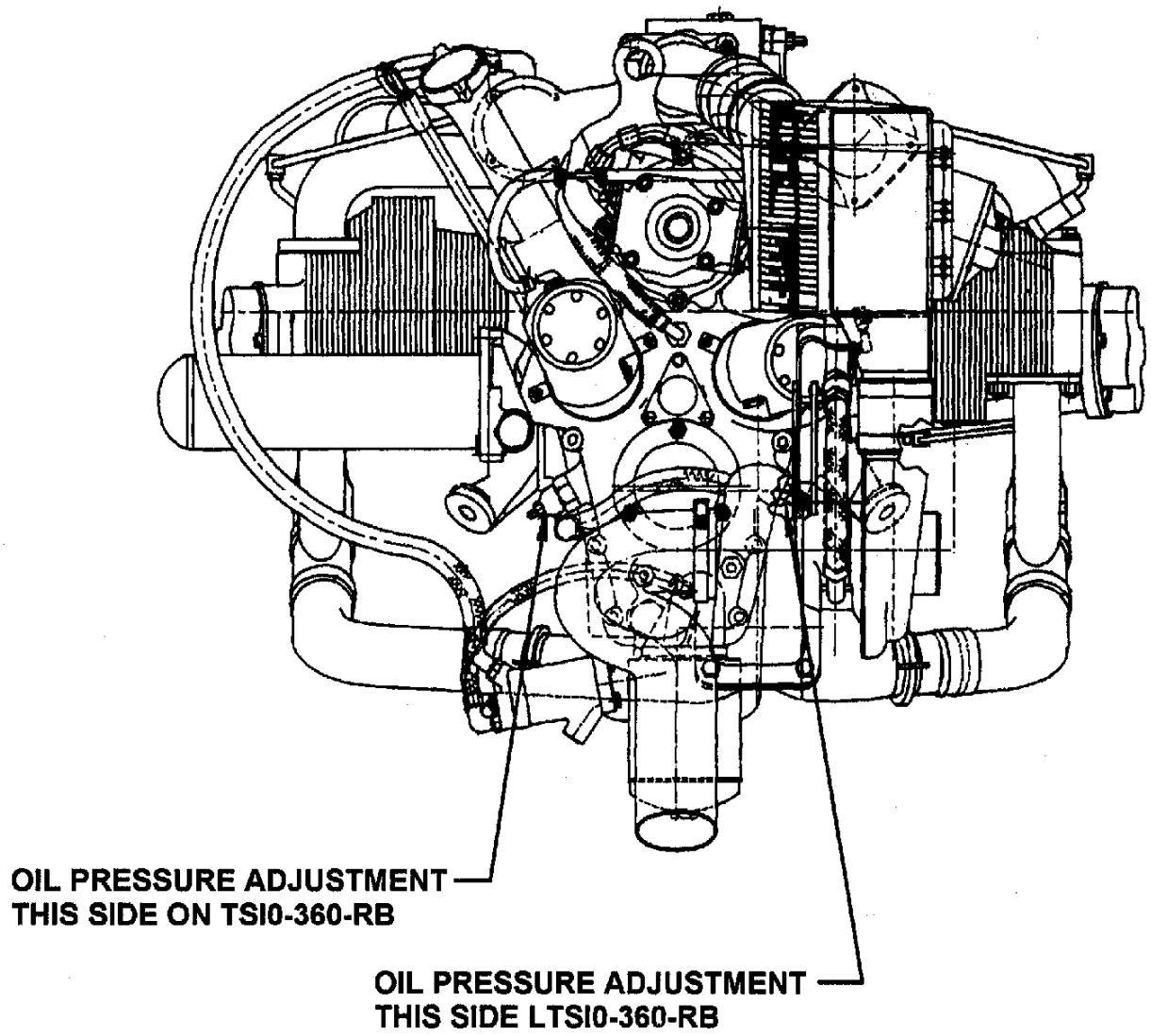

FIGURE 23-1. OIL PRESSURE ADJUSTMENT

23-2 ENGINE ADJUSTMENT AND SETUP (continued)

Fuel System Adjustment

Verify that the aircraft fuel system is operating properly in accordance with the airframe manufacturer's instructions before performing any engine fuel system setup procedures.

Adjust the engine fuel system as follows:

NOTE : . . A currently calibrated Porta-Test Unit® Model number 20 ATM-C manufactured by Approved Aircraft Accessories, Inc. or equivalent must be used to adjust the fuel system. The Porta-Test Unit must be connected and operated in accordance with the manufacturer's instructions.

Engine-driven fuel pump:

With the engines operating at 2600 rpm and 38.0 inches Hg. Manifold pressure mixtures to 24.0 to 25.0 gallons per hour, and the emergency fuel pumps in the off position, verify the the engine-driven fuel pump discharge pressure is set to 35 - 45 psig. If the engine driven fuel pump pressure does not fall within this range, the fuel pressure may be adjusted by the following method:

a. Loosen jam nut on the fuel pressure adjustment.

b. Adjust screw clockwise to increase fuel pressure, or counter-clockwise to decrease fuel pressure.

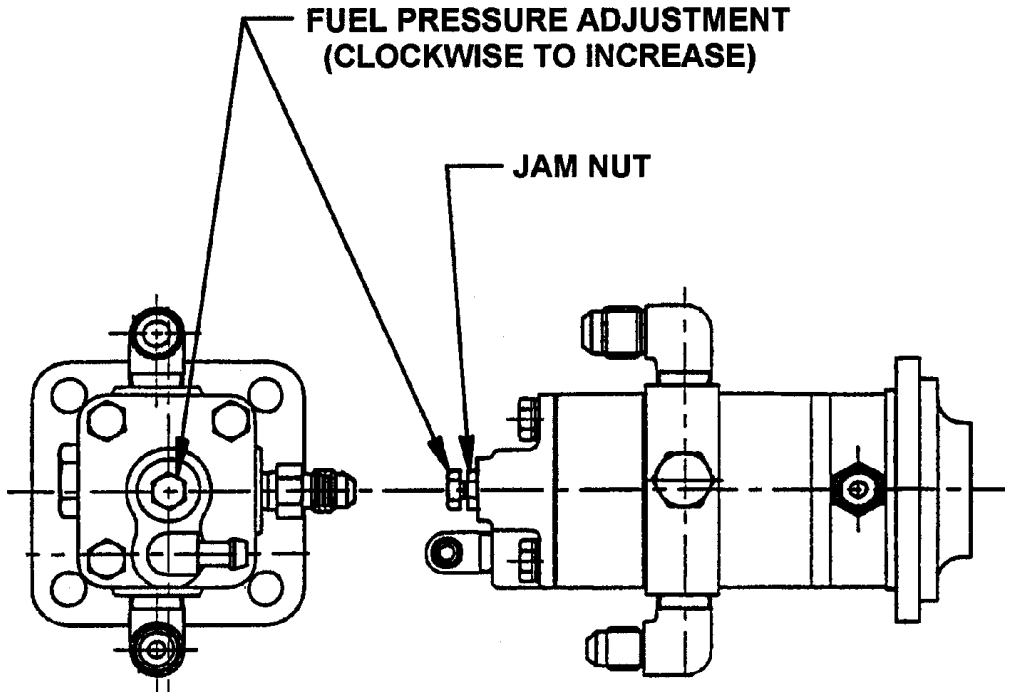

FIGURE 23-2. FUEL PUMP ADJUSTMENT

(continued on next page)

c. Repeat static runup and readjust pressure as required to obtain fuel pump pressure of 35 to 45 psig.

Idle Mixture: Check and adjust idle mixture as follows:

Idle Performance

a. Operate the engine at 1500 to 1800 rpm until cylinder head temperatures are 250° F to 350° F and the oil temperature is 160° F to 180° F.

b. Reduce the engine speed and stabilize it at 700 ± 25 RPM.

c. Slowly but positively, move the mixture control from FULL RICH toward IDLE CUTOFF. The engine speed should increase 25 to 50 rpm before beginning to drop toward zero.

d. If the engine speed increase is less that 25 rpm, the mixture is too lean and you will need to adjust the idle mixture set screw to enrich the mixture. If the engine speed increase is more that 50 rpm, the mixture is too rich and you will need to adjust the idle mixture set screw to lean the mixture.

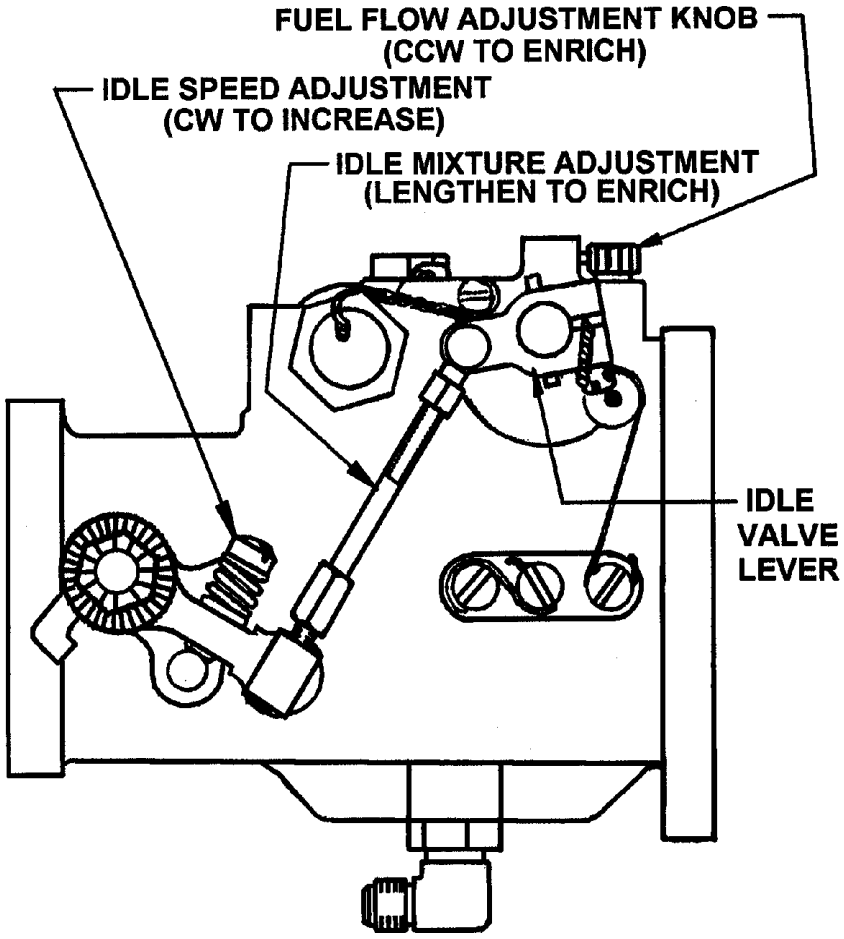

FIGURE 23-3. FUEL MIXTURE ADJUSTMENT

Idle Speed: Check and adjust idle speed as follows:

a. Operate the engine at 1500 to 1800 rpm until cylinder head temperatures are 250° F to 350° F and the oil temperature is 160° F to 180° F.

b. Reduce engine speed and stabilize it at 700 ± 25 rpm.

c. Adjust the idle speed screw that is located on the aft side of the throttle lever until contact is made with the throttle arm stop.

Full Power Performance: Check and adjust full power performance as follows:

a. Orient the aircraft so that it is pointed into the prevailing wind and run engine at 1500 to 1800 rpm until the oil temperature is 160°F to 180°F.

b. Using a handheld digital tachometer, adjust the propeller controls to 2600. With the throttle in the full forward position, set the intake manifold pressure to the value shown in Figure 23-5 (±0.5 In. Hg.) by adjusting the screw on the top of the controller.

Turning the screw clockwise decreases manifold pressure, and turning the screw counterclockwise increases manifold pressure. One complete (360°) turn of the screw changes the manifold pressure approximately 1.0 inch.

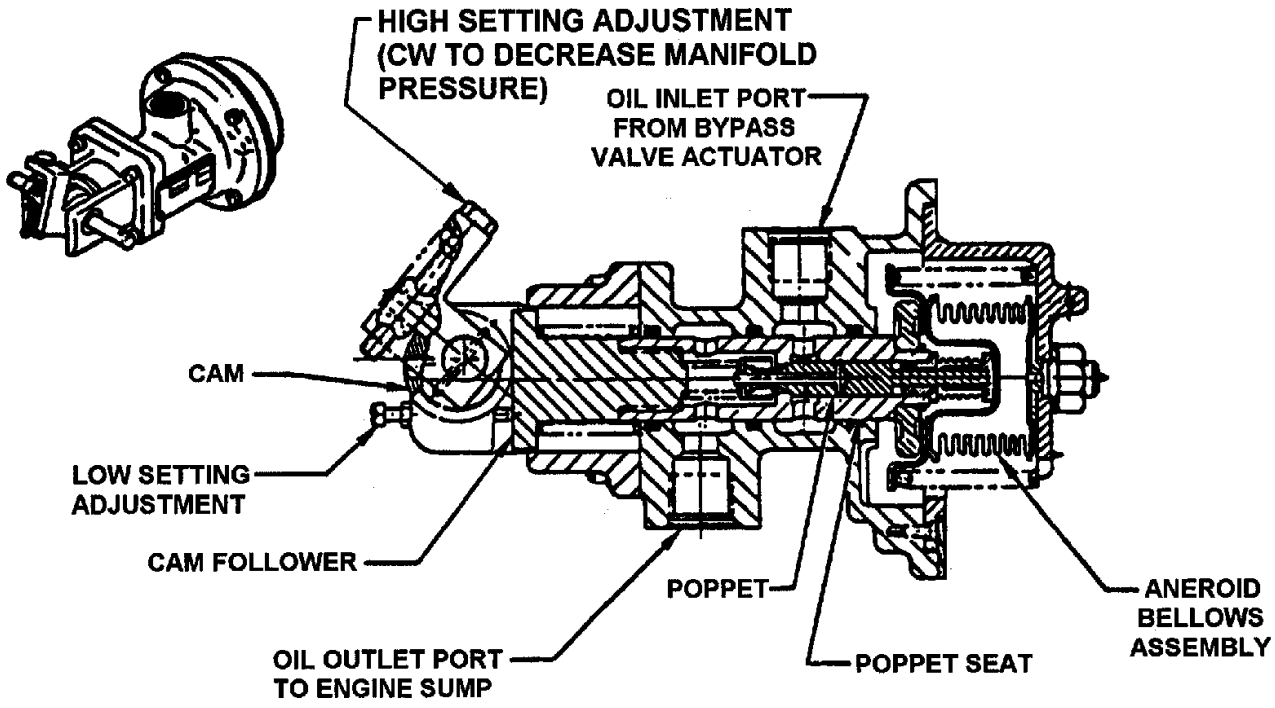

FIGURE 23-4. CONTROLLER ADJUSTMENT

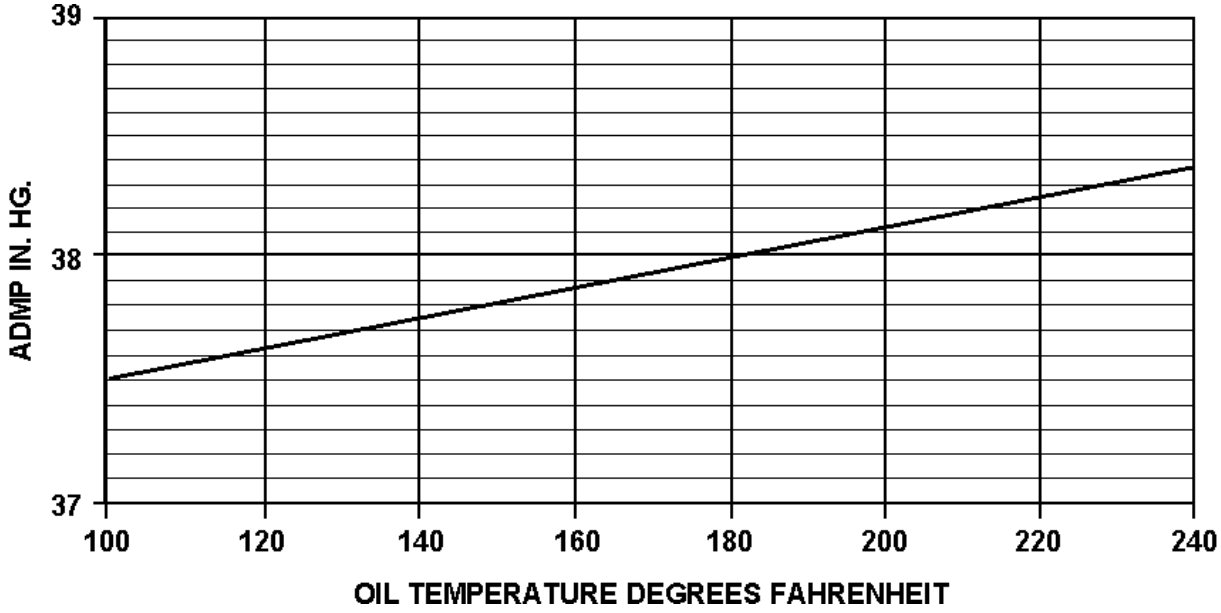

FIGURE 23-5. ADMP VS. OIL TEMPERATURE

c. Adjust fuel flow rates: Set the engines to 2600 rpm, the manifold pressure to 38.0 Hg. And the mixture controls to full rich. Adjust fuel flow rates to the range of 24.0 to 25/0 gallons per hour with the fuel flow adjustment knob that is located on the top, left side of the FSA-5 fuel servo. Turn the knob clockwise to decrease the fuel flow or counter-clockwise to reduce it. Turning the knob seven clicks in either direction reduces or increases fuel flow approximately 1 gallon per hour. The final fuel flow setting shall not exceed 15 clicks in the counter-clockwise (LEAN) direction.

Recheck

a. Recheck idle settings 700 $\pm$ 25 RPM and adjust as required.

b. Recheck full power settings as specified above and adjust as required.

c. Remove test equipment in accordance with the manufacturer's instructions.

d. After all ground checks and adjustments are completed, check to insure that all lines that were disconnected during setup have been reconnected and torqued to specified values. Safety wire mixture adjustment knob. Torque "jam nut" on the controller adjustment screw to the limit specified in the L/TSIO-360 Series Overhaul Manual, Form X30596A to prevent the screw setting from changing. Torque the jam nut on the engine-driven fuel pump to the limit specified in the L/TSIO-360 Series Overhaul Manual, Form X30596A.

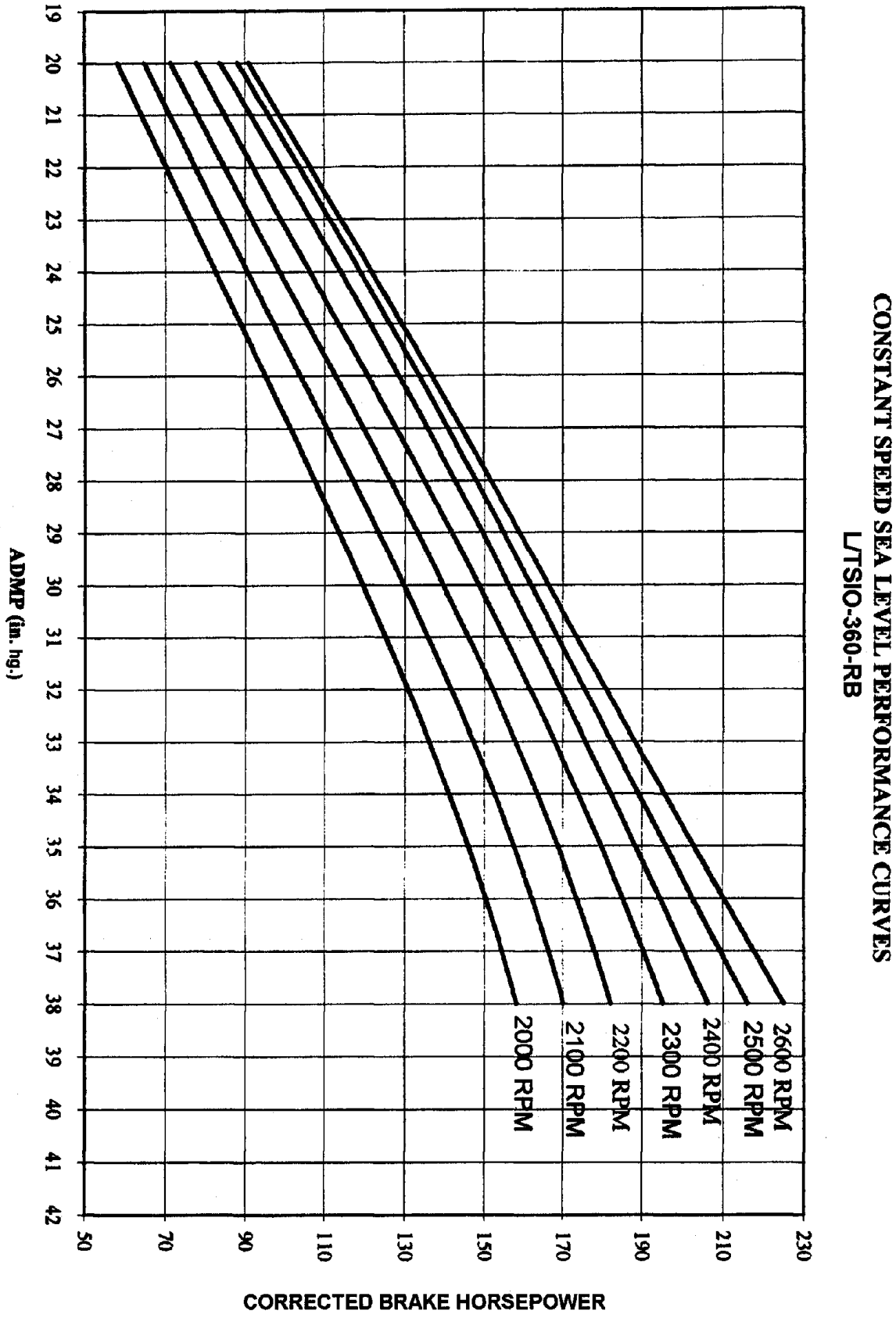

FIGURE 23-6. CONSTANT SPEED SEA LEVEL PERFORMANCE CURVE

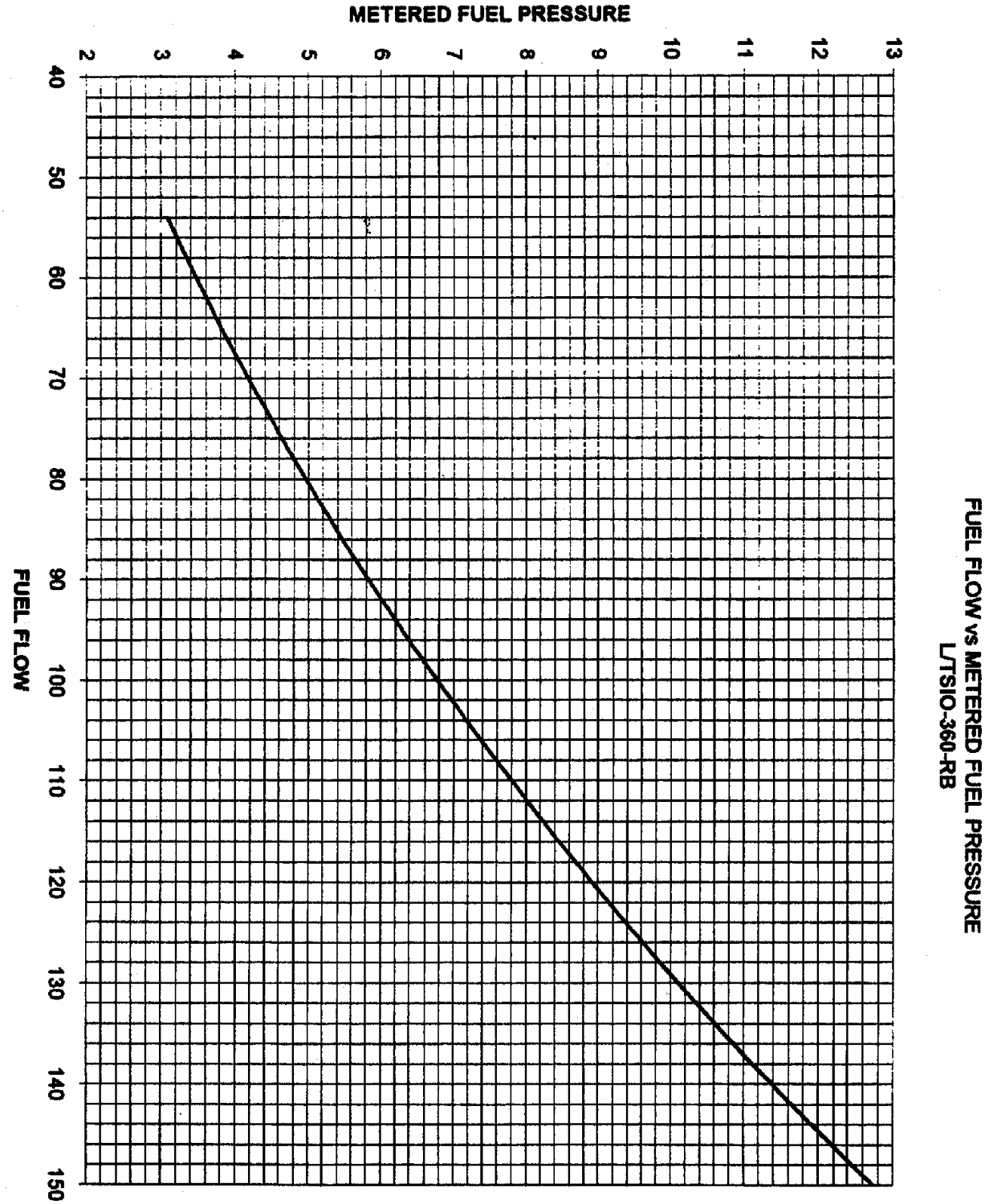

FIGURE 23-7. FUEL FLOW VS. METERED FUEL PRESSURE

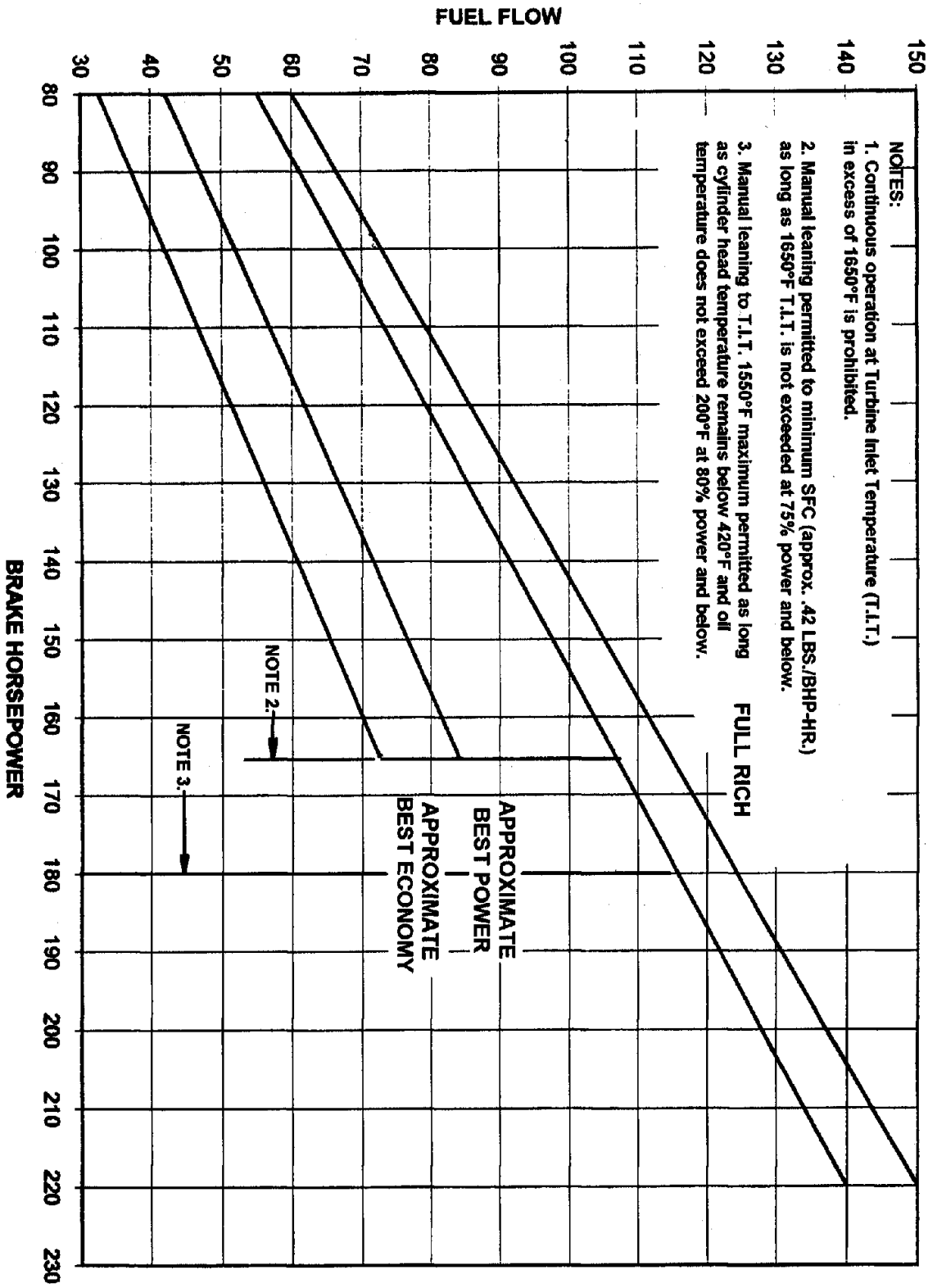

FIGURE 23-8. FUEL FLOW VS. BRAKE HORSEPOWER

23-3 TEST FLIGHT

Ambient air and engine operating temperatures are of major concern during this test flight. Do a normal pre-flight run-up in accordance with the Airplane Flight Manual. Conduct a normal take-off with full power and monitor the fuel flow, RPM, oil pressure, cylinder head temperatures and oil temperatures. Reduce to climb power in accordance with the Airplane Flight Manual. The manual mixture control should be set in the full rich position for all operations except leaning for field elevation and leaning to maintain smoothness during climb and leaning for cruise economy. Leaning operations must be performed in accordance with the Airplane Flight Manual.

NOTE. . . New, rebuilt and overhauled engines or engines that have had new or repaired cylinders installed must be flown in accordance with the following procedure for the first two hours of operation.

Level flight cruise should be at 75% power with best power or richer mixture for the first hour of operation. The second hour power settings should alternate between 65% and 75% power with the appropriate best power mixture settings. The best power mixture setting is 100° to 125° rich of peak turbine inlet temperature. Engine controls or aircraft attitude should be adjusted as required to maintain engine temperatures and pressures within specifications.

Descent from high altitude should be accomplished at low cruise power settings. During descent engine pressures and temperatures must be carefully monitored. Avoid long descents with cruise RPM and manifold pressure below 18" Hg.

CAUTION. . . Rapid descents at high RPM and low manifold pressure are to be avoided.

During descent monitor cylinder head and oil temperatures maintaining above the minimum recommended operating range.

NOTE. . . Avoid long descents at low manifold pressure, which can result in excessive engine cooling. Satisfactory engine acceleration may not occur when power is applied.

Any discrepancies detected during test flight must be corrected and the aircraft again test flown prior to approval of engine for return to service. The appropriate logbook entries must be made in accordance with Part 43 of the Federal Aviation Regulations (FAR) before the engine can be returned to service.