TSIO-520-BE

PERMOLD SERIES
CONTINENTAL® AIRCRAFT ENGINE

MAINTENANCE AND OPERATOR'S MANUAL

TECHNICAL CONTENT ACCEPTED BY THE FAA

Publication X30570

AUG 2011

Supersedure Notice

This manual revision replaces the front cover and list of effective pages for Publication Part No. X30570, dated February 1990. Previous editions are obsolete upon release of this manual.

Effective Changes for this Manual

0 ....February 1990			
1 .... 31 August 2011			

List of Effective Pages

Document Title: TSIO-520-BE Permold Series Engine Maintenance and Operator's Manual
Publication Number: X30570 Initial Publication Date: February 1990

Page Change	Page Change	Page Change	Page Change
Cover............................1			
A...................................1			
i thru iv..........................0			
1-1 thru 1-10.................0			
2-1 thru 2-42.................0			
3-1 thru 3-8...................0			
4-1 thru 4-4...................0			
5-1 thru 5-8...................0			
6-1 thru 6-8...................0			
7-1 thru 7-6...................0			
8-1 thru 8-6...................0			
9-1 thru 9-12.................0			
10-1 thru 10-12.............0			
11-1 thru 11-4 0			
12-1 thru 12-2...............0			
13-1 thru 13-15.............0			

Published and printed in the U.S.A. by Continental Motors, Inc.

Available exclusively from the publisher: P.O. Box 90, Mobile, AL 36601

MAINTENANCE AND OPERATOR'S MANUAL
FOR
TSIO-520-BE AIRCRAFT ENGINE

- NOTICE-

The operator must comply with all the instructions contained in this manual in order to assure safe and reliable engine performance. Failure to comply will be deemed misuse, thereby relieving the engine manufacturer of responsibility under its warranty.

This manual contains no warranties, either expressed or implied. The information and procedures contained herein provide the operator with technical information and instructions applicable to safe operation.

FORM NO. X30570-1

CHAPTER INDEX

FIGURE INDEX

Figure No. Page

INTENTIONALLY

LEFT

BLANK

CHAPTER 1

INTRODUCTION

Section Index

Section | Page

INTRODUCTION

1-1 SCOPE

Recommendations, cautions and warnings regarding operation of this engine are not intended to impose undue restrictions, but are inserted to enable the pilot to obtain maximum performance from the engine commensurate with safety and efficiency. Abuse, misuse, or neglect of any piece of equipment can cause eventual failure. In the case of an aircraft engine it should be obvious that a failure may have disastrous consequences. Failure to observe the instructions contained in this manual constitutes unauthorized operation in areas unexplored during development of the engine, or in areas which experience has proved to be undesirable or detrimental.

Notes, Cautions and Warnings are included throughout this manual, Application is as follows:

NOTE . . . Special interest information which may facilitate the operation of equipment.

CAUTION . . . Information issued to emphasize certain instructions or to prevent possible damage to engine or accessories.

WARNING . . . Information which, if disregarded, may result in severe damage to or destruction of the engine or endangerment to personnel.

1-2 RELATED PUBLICATIONS

I. Engine Manuals:

A. Overhaul Manual for TSIO-520-BE Series Aircraft Engine. Form No. X30574A.

B. Illustrated Parts Catalog for TSIO-520-BE Series Aircraft Engine. Form No. X30576A.

C. Teledyne Continental Motors Aircraft Engine Service Bulletins.

D. Fuel Injection Manual. Form X30593A.

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

Teledyne Continental Motors
Aircraft Products
P. O. Box 90
Mobile, AL 36601

Attn: Accounts Receivable

For price information see TCM Optional and Current Publications Service Bulletins.

II. Accessory Manuals:

A.	Magnetos	Service Manual Teledyne Continental Motors Aircraft Products P. O. Box 90 Mobile, AL 36601 Attn: Accounts Receivable
B.	Starter Motor	Teledyne Continental Motors Aircraft Products P. O. Box 90 Mobile, AL 36601 Attn: Accounts Receivable
C.	Alternator	Alternator Service Instructions Form X30531-3 Teledyne Continental Motors Aircraft Products P. O. Box 90 Mobile, AL 36601 Attn: Accounts Receivable

1-3 DEFINITIONS AND ABBREVIATIONS

ABBREVIATIONS/SYMBOLS

TERM	EXPLANATION
A,B,C	After Bottom Center
ADMP	Absolute Dry Manifold Pressure
Approx.	Approximately
A.T.C.	After Top Center
Bar.	Barometric
B.B.C.	Before Bottom Center
B.H.P.	Brake Horsepower
BSFC	Brake Specific Fuel Consumption
B.T.C.	Before Top Center
F.A.A.	Federal Aviation Administration
C.A.R.	Civil Air Regulations
c.f.m.	Cubic Feet Per Minute
C.G.	Center of Gravity
C.H.T.	Cylinder Head Temperature
CCW	Counterclockwise Rotation
CW	Clockwise Rotation
°	Degrees of Angle
°F.	Degrees Fahrenheit
EGT	Exhaust Gas Temperature
Fig.	Figure (Illustration)
Front	Propeller End
ft.	Foot or Feet
F.T.	Full Throttle
FT-LBS	Foot Pounds Torque
G.P.M.	Gallons Per Minute
gms	Grams
H2O	Water
Hg.	Mercury
I.D.	Inside Diameter
in.(")	Inches
Hex.	Hexagon
hr.	Hour
IN-LBS	Inch Pounds Torque
Left Side	Side on which Nos. 2, 4 and 6 cylinders are located (Rear to Front)
Lbs.	Pounds
Lockwire	Stainless Steel Wire Used To Safety Connections, Etc.
100LL	100 Octane Low Lead Fuel
Man.	Manifold Manometer
Max.	Maximum
Min.	Minimum
30'	Thirty Minutes of Angle (60' equals one degree)
N.P.T.	National Pipe Thread (tapered)
N.C.	National Course (thread)
N.F.	National FIne (thread)
NRP	Normal Rated Power
OAT	Outside Air Temperature
O.D.	Outside Diameter
oz	Ounce
Press.	Pressure
p.s.i.	Pounds Per Square Inch

PSIA	Pounds Per Square Inch Absolute
PSIG	Pounds Per Square Inch Gage
PPH	Pounds Per Hour
Rear	Accessory End of Engine
Rec.	Recommended
Right Side	Side on Which Nos. 1, 3 and 5 Cylinder are Located (rear to front)
R.P.M.	Revolution Per Minute
Std.	Standard
TBO	Time Between Overhaul
T.D.C.	Top Dead Center
T.I.T.	Turbine Inlet Temperature
Torque	Force x Lever Arm (125 ft. - lbs. torque = 125 lbs. force applied one ft. from bolt center or 62 1/2 lbs. applied 2 ft. from center, etc.)

DEFINITIONS

ADMP — Absolute dry manifold pressure, is used in establishing a baseline standard of engine performance. Manifold pressure is the absolute pressure in the intake manifold; measured in inches of mercury.

Ambient — A term used to denote a condition of surrounding atmosphere at a particular time. For example: Ambient Temperature or Ambient Pressure.

BHP — Brake Horsepower. The power actually delivered to the engine propeller shaft. It is called Brake Horsepower because it was formerly measured by applying a brake to the power shaft of an engine. The required effort to brake the engine could be converted to horsepower - hence: "brake horsepower".

BSFC — Brake Specific Fuel Consumption. Fuel Consumption stated in pounds per hour per brake horsepower. For example, an engine developing 300 horsepower while burning 150 pounds of fuel per hour, has a BSFC of .5.

$$\frac{\text{Fuel Consumption in PPH}}{\text{Brake Horsepower}}$$

Cavitation — Formation of partial vacuums in a flowing liquid as a result of the separation of its parts.

Cold Soaking — Prolonged exposure of an object to cold temperatures so that its temperature throughout approaches that of ambient.

Corrosion — Deterioration of a metal surface usually caused by oxidation of the metal.

Critical Attitude — The maximum altitude at which a component can operate at 100% capacity. For example, an engine with a critical altitude of 16,000 feet cannot produce 100% of its rated manifold pressure above 16,000 feet.

Density Altitude — The effective altitude, based on prevailing temperature and pressure, equivalent to some standard pressure altitude.

Dynamic Condition — A term referring to properties of a body in motion.

EGT — Exhaust gas temperature. Measurement of this gas temperature is sometimes used as an aid to fuel management.

Exhaust Back Pressure	Opposition to the flow of exhaust gas, primarily caused by the Pressure size and shape of the exhaust system. Atmospheric pressure also affects back pressure.
Four Cycle	Short for "Four Stroke Cycle". It refers to the four strokes of the piston in completing a cycle of engine operation (Intake, Compression, Power and Exhaust).
Fuel Injection	A process of metering fuel into an engine by means other than a carburetor.
Gallery	A passageway in the engine or subcomponent. Generally one through which oil is directed.
Galling or Scuffing	Excessive friction between two metal surfaces resulting in particles of the softer metal being torn away and welded to the harder metal.
Humidity	Moisture in the atmosphere. Relative humidity, expressed in percent, is the amount of moisture (water vapor) in the air compared with the maximum amount of moisture the air could contain at a given temperature.
Hydrostatic Lock	Inability or restriction of piston rotation at TDC due to fluid accumulation in excess of combustion chamber displacement.
Impulse Coupling	A mechanical device used in some magnetos to retard the ignition timing and provide higher voltage at cranking speeds for starting.
Lean Limit Mixture	The leanest mixture approved for any given power condition. It is not necessarily the leanest mixture at which the engine will continue to operate.
Major Overhaul	Per FAA AC43-11 consists of the complete disassembly of an engine, inspected, repaired as necessary, reassembled, tested, and approved for return to service within the fits and limits specified by the manufacturer's overhaul data. This should be to new fits or limits. The determination as to what fits and limits are used during an engine overhaul should be clearly understood by the engine owner at the time the engine is presented for overhaul. The owner should also be aware of any parts that are replaced, regardless of condition, as a result of manufacturer's overhaul data, service bulletin, or an airworthiness directive.
Manifold Pressure	Pressure measured in the intake manifold down-stream of the air throttle. Usually measured in inches of mercury.
Mixture	Mixture ratio. The proportion of fuel to air used for combustion.
Naturally Aspirated (Engine)	A term used to describe an engine which obtains induction air by drawing it directly from the atmosphere into the cylinder. A non-supercharged engine.
Octane Number	A rating which describes relative anti-knock (detonation) characteristics of fuel. Fuels with greater detonation resistance than 100 octane are given performance ratings.
Oil Temperature Control Valve	A thermostatic unit used to divert oil through or around the oil cooler, as necessary, to maintain oil temperature within desired limits.
Overboost Valve	A safety device used on some turbocharged engines to relieve excessive manifold pressure in the event of malfunction.
Overhead Valves	An engine configuration in which the valves are located in the cylinder head itself.

Performance Rating	A rating system used to describe the ability of fuel to with-stand heat and pressure of combustion as compared with 100 octane fuel. For example, an engine with high compression and high temperature needs a higher Performance Rated fuel than a low compression engine. A rating of 100/130 denotes performance characteristics of lean (100) and rich (130) mixtures respectively.
Permold	A term used to describe a process by which a crankcase is made. An engine with a permold crankcase has a front, right-hand mounted, gear driven alternator.
Pressure Altitude	Altitude, usually expressed in feet, (using absolute static pressure as a reference) equivalent to altitude above the standard sea level reference plane (29.92" Hg. Standard).
Propeller Load Curve	A plot of horsepower, versus RPM, depicting the power absorption characteristics of a fixed pitch propeller.
Propeller Pitch	The angle between the mean chord of the propeller and the plane of rotation.
PSIA	The absolute thermodynamic pressure measured by the number of pounds - force exerted on an area of one square inch.
RAM	Increased air pressure due to forward speed.
Rated Power	The maximum horsepower at which an engine is approved for operation.
Retard Breaker	A device used in magnetos to delay ignition during cranking. It is used to facilitate starting.
Rich Limit	The richest fuel/air ratio permitted for a given power condition. It is not necessarily the richest condition at which the engine will run.
Rocker Arm	A mechanical device used to transfer motion from the pushrod to the valve.
Run Out	Eccentricity or wobble of a rotating part.
Sandcast	A term used to describe a process by which a crankcase is made. An engine with a sandcast crankcase has a belt driven alternator mounted on the left rear accessory case and a front, right-hand mounted oil cooler.
Scavenge Pump	A pump (especially an oil pump) to prevent accumulation of liquid in some particular area.
Sonic Venturi	A restriction, especially in cabin pressurization systems, to limit the flow of air through a duct.
Standard Day	By general acceptance, a condition of the atmosphere wherein specific amounts of temperature, pressure, humidity, etc. exist.
Static Condition	A term referring to properties of a body at rest.
Sump	The lowest part of a system. The main oil sump on a wet sump engine contains the oil supply.

T.D.C.	Top Dead Center. The position in which the piston has reached the top of its travel. A line drawn between the crankshaft rotational axis, through the connecting rod end axis and the piston pin center would be a straight line. Ignition and valve timing are stated in terms of degrees before or after TDC.
Thermal Efficiency	Regarding engines, the percent of total heat generated which is converted into useful power.
T.I.T.	Turbine Inlet Temperature. The measurement of E.G.T. at the turbocharger turbine inlet.
Torque	Twisting moment, or leverage, stated in pounds - foot (or pounds - inch).
Turbocharger	A device used to supply increased amounts of air to an engine induction system. In operation, a turbine is driven by engine exhaust gas. In turn, the turbine directly drives a compressor which pumps air into the engine intake.
Turbo Supercharged (Engine)	A term used to describe an engine which obtains induction air by drawing it directly from the atmosphere into the Turbocharger Compression Inlet, compressing the air and routing it to the pressurized induction system.
Vapor Lock	A condition in which the proper flow of a liquid through a system is disturbed by the formation of vapor. Any liquid will turn to vapor if heated sufficiently. The amount of heat required for vaporization will depend on the pressure exerted on the liquid.
Variable Pressure Controller	A device used to control the speed, and thus the output of the turbocharger. It does so by operating the wastegate which diverts, more or less, exhaust gas over the turbine.
Vernatherm Valve	A thermostatic valve used to divert oil through or around the oil cooler, as necessary, to maintain oil temperature within desired limits.
Viscosity	The characteristic of a liquid to resist flowing. Regarding oil, high viscosity refers to thicker or "heavier" oil while low viscosity oil is thinner. Relative viscosity is indicated by the specified "weight" of the oil such as 30 "weight" or 50 "weight". Some oils are specified as multiple-viscosity such as 10W30. In such cases, this oil is more stable and resists the tendency to thin when heated or thicken when it becomes cold.
Volatility	The tendency of a liquid to vaporize.
Volumetric Efficiency	The ability of an engine to fill its cylinders with air compared to their capacity for air under static conditions. A "naturally aspirated" engine will always have a volumetric efficiency of slightly less than 100%, whereas superchargers permit volumetric efficiencies in excess of 100%.
Wastegate Valve	A unit, used on the turbocharged engines, to divert exhaust gas through or around the turbine, as necessary, to maintain turbine speed. As more air is demanded by the engine, due to throttle operation, the compressor must work harder. In order to maintain compressor and turbine speed, more exhaust must flow through the turbine. The wastegate valve closes and causes gas, which would go directly overboard, to pass through the turbine. The wastegate is usually operated by an actuator which gets necessary signals from the turbocharger controller.

1-4 MANUAL REVISIONS

This manual and Teledyne Continental Motors related manuals are current and correct to the best of Teledyne continental Motors' knowledge at the time of publication. Any errors, recommended changes, or questions should be submitted in writing to:

Department Manager
Technical Publications Department
Teledyne Continental Motors
P. O. Box 90
Mobile, Alabama 36601

Manuals will be revised and updated as necessary.

Consult Teledyne Continental Motors' Service Bulletin publications for latest technical information available.

INTENTIONALLY

LEFT

BLANK

CHAPTER 2

TOOLS AND EQUIPMENT

Section Index

2-1 GENERAL INFORMATION

The mechanic should be equipped with a complete set of common tools to include a minimum of:

1. Wrenches 1/4" thru 1"
2. Common and Philister Head Screwdrivers
3. Pliers - Common Dykes, Needle Nose, Duck Bill, Vise Grip.
4. Ratches 1/4", 3/8", 1/2" Drive
5. Sockets - 1/4" Drive 5/32" thru 1/2" - 3/8" Drive 3/8" thru 1" - 1/2" Drive 7/16" thru 1-1/4"
6. Sockets (Deepwell) - 1/2" Drive 7/16" thru 1"
7. Feeler Gages
8. Leather Mallet
9. Torque Wrenches* (Calibrated) - 0-500 In. Lbs. - 0-100 Ft. Lbs.
10. Micrometers* (Calibrated)

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

2-2 SPECIAL TOOLS

The specific tools illustrated or similar tools marketing by other manufacturers will be necessary for service and maintenance of the TSIO-520-BE aircraft engine. The tool illustrations shown on the following pages are used with the permission of the respective manufacturers.

Most special tools illustrated in this section are marketed by Burroughs Tool and Equipment Corporation, 2429 North Burdick Street, Kalamazoo, Michigan 49007. A complete catalog of special tools for Teledyne Continental Motors Aircraft engines can be obtained by writing the Borroughs Tool Company.

The illustrations in this section show only the general appearance of the tools and do not necessarily correspond to the actual size or shape. Individual illustrations may cover a number of tools with the same overall design, but with different part numbers.

SPECIAL TOOLS
PROCUREMENT SOURCES

COMPANY	GENERAL PRODUCT SUMMARY
ALCOR Box 32516 10130 Jones Maltsberger Rd. San Antonio, TX 78284 512/349-3771	Instruments for Aircraft Special Tools
BORROUGHS TOOL AND EQUIP. CORP. 2429 N. Burdick St. Kalamazoo, MI 49007-1897 616/345-5163 or 345-2700 Special Tools	Precision Instruments Measuring Instruments Precision 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 Printed and Standard Circuits
FEDERAL TOOL SUPPLY CO., INC. 10631 Capital Oak Park, Michigan 48237 800/521-1508 TOLL FREE or 313/543-9300	Precision Inspection Instruments Special Tools
OTC TOOLS & EQUIPMENT Division of Owatonna Tool Company Owatonna, Minnesota 55060 507/451-5310	Precision Tools Special Tools Hydraulic Accessories
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

-- NOTICE --

All tools referenced under Sub-section 2-2 Special Tools, are for reference only, not for the purpose of promoting or suggesting tools to be purchased from the indicated sources.

IDENTIFICATION CODE FOR TOOLS

CODE		SUPPLIER
(ALR)	=	ALCOR, INC.
(BTC)	=	BORROUGHS TOOL AND EQUIPMENT CORP.
(CSPC)	=	CHAMPION SPARK PLUG, CO.
(EEI)	=	EASTERN ELECTRONICS, INC.
(FTSC)	=	FEDERAL TOOL SUPPLY CO., INC.
(OTC)	=	OTC TOOLS & EQUIPMENT CO.
(MCSC)	=	McMASTER-CARR SUPPLY CO.
(SOT)	=	SNAP ON TOOLS
(KTC)	=	KELL-STROM TOOL COMPANY INC.

CODE		
	44	Numbers referenced in the left-hand bottom corner of each picture correspond to the numbers located in the Special Tool Index.

WARNING . . . Whenever using test equipment, keep equipment and personnel clear of prop area.

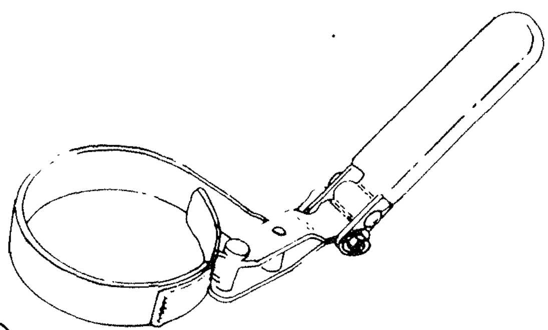
SPECIAL TOOLS

Item & Part Number		Nomenclature	Application	Vendor
1.	GA333	Strap Wrench	Oil Filter Removal 3" to 3 3/8"	SOT
	GA340	Strap Wrench	Oil Filter Removal 3 1/2" to 3 7/8"	SOT
	YA341	Strap Wrench	Oil Filter Removal 4 1/8" to 4 7/16"	SOT
2.	CT-470	Oil Filter Can Cutter	Oil Filter Sludge Inspection	CSPC
3.	3882	Cylinder Base Nut Wrenches	Cylinder Removal	BTC
4.	8079	Cylinder Base Nut Wrenches	Cylinder Removal	BTC
5.	8121	Piston Pin Removers	Piston Removal	BTC
6.	CFL10	Cylinder Hone	Cylinder Reconditioning	SOT
7.	5221A	Holding Fixture Adapters	Cylinder Hold Down	BTC
8.	4965A	Crankshaft Blade and Damper Bushing Remover/ Replacer	Crankshaft Reconditioning	SOT
	3604	Crankshaft Blade and Damper Bushing Remover/ Replacer	Crankshaft Reconditioning	BTC
	3607	Crankshaft Blade and Damper Bushing Remover/ Replacer	Crankshaft Reconditioning	BTC
	3607-1	Crankshaft Blade and Damper Bushing Remover/ Replacer	Crankshaft Reconditioning	BTC
	8068	Crankshaft Blade and Damper Bushing Remover/ Replacer	Crankshaft Reconditioning	BTC
9.	5221A	Holding Fixture Adapters	Cylinder Hold Down	BTC
10.	5221B	Holding Fixture	Cylinder Hold Down	BTC
11.	122	Valve Guide Cleaner	Cylinder Reconditioning	BTC
12.	8066	Seal Seat Cutter	Cylinder Reconditioning	BTC
13.	7521A	Spring Checker	Spring Inspection	BTC
14.	3611	Valve Guide Remover	Cylinder Reconditioning	BTC
	2874	Valve Guide Remover	Cylinder Reconditioning	BTC
15.	4912	Valve Guide Replacer	Cylinder Reconditioning	BTC
	3619	Valve Guide Replacer	Cylinder Reconditioning	BTC
	2842	Valve Guide Replacer	Cylinder Reconditioning	BTC
16.	8118	Rocker Arm Bushing Remover/Installer	Rocker Arm Reconditioning	BTC
17.	4901	Ring Compressor	Engine Assembly	BTC
	2839	Ring Compressor	Engine Assembly	BTC
	3618	Ring Compressor	Engine Assembly	BTC
18.	4901B	Ring Compressor	Engine Assembly	BTC
	4901A	Ring Compressor	Engine Assembly	BTC
	3601	Ring Compressor	Engine Assembly	BTC
	2839A	Ring Compressor	Engine Assembly	BTC
	5201	Ring Compressor	Engine Assembly	BTC
19.	3170	Floating Holder	Cylinder Reconditioning	BTC
20.	3602	Valve Spring Compressor	Cylinder Assembly/Disassembly	BTC
21.	68-3	Push Rod Spring Compressor	Push Rod Housing Installation/Removal	BTC
22.	4915A	Flaring Tool Push Rod Hsg.	Push Rod Housing Reconditioning	BTC
23.	4981	Valve Guide Remover	Cylinder Reconditioning	BTC
24.	8086	Valve Seat Insert R&R	Cylinder Reconditioning	BTC

Item & Part Number		Nomenclature	Application	Vendor
25.	4910	Installer Valve Seat Insert	Cylinder Reconditioning	BTC
	4956	Installer Valve Seat Insert	Cylinder Reconditioning	BTC
26.	8116	Common Parts Kit	Cylinder Reconditioning	BTC
27.	8116-24 thru 29	Valve Stem Hole Reamers	Cylinder Reconditioning	BTC
28.	8116-1R thru 15R	Reamers	Cylinder Reconditioning	BTC
29.	8116-1B thru 15B	Boring Bars	Cylinder Reconditioning	BTC
30.	8116-1 thru 16	Expanding Guide Bodies	Cylinder Reconditioning	BTC
31.	4909	Valve Seat (Straight Side) Insert Cutters	Cylinder Reconditioning	BTC
	4954	Valve Seat (Straight Side) Insert Cutters	Cylinder Reconditioning	BTC
	4985	Valve Seat (Straight Side) Insert Cutters	Cylinder Reconditioning	BTC
	5224	Valve Seat (Straight Side) Insert Cutters	Cylinder Reconditioning	BTC
	5225	Valve Seat (Straight Side) Insert Cutters	Cylinder Reconditioning	BTC
32.	8135	Valve Seat (Step Side) Insert Cutters	Cylinder Reconditioning	BTC
	8136	Valve Seat (Step Side) Insert Cutters	Cylinder Reconditioning	BTC
	8138	Valve Seat (Step Side) Insert Cutters	Cylinder Reconditioning	BTC
33.	2769A13	Rosan[R] Stud Remover	Stud Remover	MCSC
34.	8111A	Connecting Rod Fixture	Connecting Rod Inspection	BTC
35.	8042C	Adapter Kit	Connecting Rod Inspection	BTC
36.	874-40,41	Reamers Conrod Bushing	Connecting Rod Reconditioning	BTC
	5008,8071	Reamers Conrod Bushing	Connecting Rod Reconditioning	BTC
37.	8098	Remover/Installer Set Connecting Rod Bushing	Connecting Rod Reconditioning	BTC
38.	8122A	Common Drive Handle	Cylinder Reconditioning	BTC
	8139,40,41	Pilots	Cylinder Reconditioning	BTC
39.	23-1	Needle Bearing Installer	Needle Bearing Replacement	BTC
	8053	Needle Bearing Installer	Needle Bearing Replacement	BTC
40.	8077A&B	Bushing R/R Set	Crankshaft Reconditioning	BTC
41.	8077C	Bushing R/R Counterweight	Crankshaft Reconditioning	BTC
42.	8104	Engine Stand	Engine Assembly/Disassembly	BTC
43.	7726	Tork Band Tension Adjuster	Generator/Alternator Belt Tensioning	BTC
44.	4973	Generator Drive Holders	Generator/Alternator Disassembly	BTC
45.	8156	Cylinder Heating Stand	Cylinder Reconditioning	BTC
46.	8093C	Bearing Puller	Bearing Removal Starter Clutch Shaft	BTC
47.	8093D	Bearing Puller	Bearing Removal Starter Clutch Shaft	BTC
48.	5210	Differential Pressure Gauge	Setting Differential Fuel Pressure	BTC
49.	7251	Differential Pressure Cylinder Checker	Checking Cylinder Compression	BTC
50.	BT-33-73F	Belt Tension Gauge	Alternator/Generator Belt Adjustment	BTC

Item & Part Number		Nomenclature	Application	Vendor
51.	BT-60C	Hydraulic Valve Lifter Tester	Hydraulic Lifter Testing	BTC
52.	8091	GEN/ALT Tester	Checking GEN/ALT Output	BTC
53.	3608A	Timing Disc	Setting Engine Timing	BTC
54.	4974	Pulley Holder	Sheave Removal	BTC
55.	8082	Alignment Gage Bar	Checking Comp & Driver Sheave Alignment	BTC
56.	8094A	Crankcase Drill Fixture	Crankcase Modification	BTC
57.	8334	Vacuum Pump	Vacuum Testing	BTC
58.	61-5	Pulley Puller	GEN/ALT Sheave Removal	BTC
59.	8094B	Drill Fixture	Journal Bearing Modification	BTC
60.	4918	Spark Plug Insert Replacer	Cylinder Reconditioning	BTC
61.	8064	Step Cutter Thru-Bolt	Crankcase Modification	BTC
	8065	Step Cutter Thru-Bolt	Crankcase Modification	BTC
62.	504-1	Spark Plug Insert Tap	Cylinder Reconditioning	BTC
63.	4919	Spark Plug Insert Remover	Cylinder Reconditioning	BTC
64.	8054	Slide Hammer	Multi Use	BTC
65.	445	Spark Plug Tap	Cylinder Reconditioning	BTC
66.	8074	Rosan[R] Lock Ring Installer	Stud Installation	BTC
67.	505	Stud Drivers	Stud Installation	BTC
68.	4987	Scavenge Pump Drill Fixture	Crankcase Modification	BTC
69.	8025	Drill Fixture	Crankcase Squirt Nozzle Replacement	BTC
70.	L423	Crankcase Splitter	Crankcase Separation	BTC
71.	5209	Propeller Shaft Oil Seal Installer	Installation of seal over Propflange	BTC
72.	8048	Oil Pressure Relief Spot Facer	Removal of surface Material around holes	BTC
	8155	Oil Pressure Relief Spot Facer	Removal of surface Material around holes	BTC
73.	8117A	Runout Block Set	Crankshaft Inspection	BTC
74.	8087A&B	Polishing Tools for Crank-shaft Bearings	Crankshaft Reconditioning	BTC
75.	8165	Injector Nozzle Remover and Installer	Injector Removal & Replacement	BTC
76.	8114	Crankcase thru Bolt Removers	Engine Disassembly	BTC
77.	7912A	Hex Drive	Loosening Tubing "B" Nuts	BTC
78.	7710	Rotabroach Cutters	Hole Cutting	BTC
79.	1153	Puller	Removal of Press Fit Parts	OTC
	679	Puller	Removal of Press Fit Parts	OTC
80.	1035	Puller	Removal of Press Fit Parts	OTC
	927	Puller	Removal of Press Fit Parts	OTC
81.	1037	Puller	Removal of Press Fit Parts	OTC
82.	1079	Puller	Removal of Press Fit Parts	OTC
	1063	Puller	Removal of Press Fit Parts	OTC
83.	115-153	Outside Micrometers	Dimensional Inspection	FTSC
84.	545-116	Dial Bore Gages	Dimensional Inspection	FTSC
85.	122-125	Blade Micrometers	Dimensional Inspection	FTSC
86.	126-137	Screw Thread Micrometers	Dimensional Inspection	FTSC
	226-137	Screw Thread Micrometers	Dimensional Inspection	FTSC
87.	159-211	Depth Micrometers	Dimensional Inspection	FTSC

Item & Part Number		Nomenclature	Application	Vendor
88.	4903-1 thru -5	Reamers Rocker Shaft Support Boss	Cylinder Reconditioning	BTC
	4905	Reamers Rocker Arm & Shaft Bushing	Rocker Arm Reconditioning	BTC
	5129-1 thru -5	Reamers (Straight Valve Cylinder)	Cylinder Reconditioning	BTC
	5130	Reamer Rocker Shaft Bushing	Cylinder Reconditioning	BTC
	7232	Reamer Rocker Arm Bushing	Rocker Arm Reconditioning	BTC
89.	4914-1HS thru 5HS	Reamers Valve Guide Boss	Cylinder Reconditioning	BTC
	4943-1HS thru 5HS	Reamers Valve Guide Boss	Cylinder Reconditioning	BTC
90.	2847-2Cp	Reamer (Carbide Tipped)	Cylinder Reconditioning	BTC
	4913-1CP	Reamer (Carbide Tipped)	Cylinder Reconditioning	BTC
	3606-CP	Reamer (Carbide Tipped)	Cylinder Reconditioning	BTC
	2847-1Cp	Reamer (Carbide Tipped)	Cylinder Reconditioning	BTC
	2847-2HP	Reamer (High Speed Steel)	Cylinder Reconditioning	BTC
	4913-1HP	Reamer (High Speed Steel)	Cylinder Reconditioning	BTC
	3606-HP	Reamer (High Speed Steel)	Cylinder Reconditioning	BTC
	28471HP	Reamer (High Speed Steel)	Cylinder Reconditioning	BTC
91.	2684	Reamer (Square Shank)	Cylinder Reconditioning	BTC
	2686	Reamer (Square Shank)	Cylinder Reconditioning	BTC
	2689	Reamer (Square Shank)	Cylinder Reconditioning	BTC
	2693	Reamer (Square Shank)	Cylinder Reconditioning	BTC
	4104	Reamer (Square Shank)	Cylinder Reconditioning	BTC
92.	2848-1	Plug Gage	Valve Guide Inspection	BTC
	2848-2	Plug Gage	Valve Guide Inspection	BTC
	3615	Plug Gage	Valve Guide Inspection	BTC
93.	7308	Dial Thickness Gage	Dimensional Inspection	FTSC
94.	52.030-006	Precision Vernier Calipers	Dimensional Inspection	FTSC
95.	600R-30	Inside Measuring Instrument	Dimensional Inspection	FTSC
96.	647	Alternator Analyzer Voltage Regulator Tester	Charging System Test	EEI
97.	E100	Alternator/Regulator/ Battery Tester	Charging System Test	EEI
98.	Model 29	Voltage & Circuit Tester	Electrical System Test	EEI
99.	11-9110-1	Magneto Timing Light	Set Engine Timing	KTC
100.	Model E25	Timing Indicator	Set Engine Timing	EEI
101.	Model E10	Cold Cylinder Tester	Cylinder Firing Improperly	EEI
102.	Model E5	Hi-Voltage Tester	Test Ignition Cable Continuity	KTC
103.	646953	Master Orifice Tool	Cylinder Compression Test	BTC
104.	85328	Alcor Portable Digital EGT Unit	Engine Test	ALR
105.	85329	Alcor Portable Digital CHT Unit	Engine Test	ALR



1

Strap Wrench

For removal of oil filter, spring steel band surrounds and tightens as the handle is pulled. Vinyl gripped handle swivels to clear obstructions.

GA333 for 3" to 3-3/8" Dia. Filters
GA340 for 3-1/2" to 3-7/8" Dia. Filters
YA 341 for 4-1/8" to 4-7/16" Dia. Filters

Oil Filter Sludge Inspection

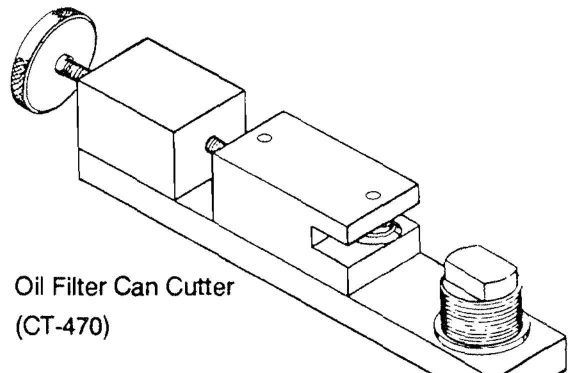
Inspection of engine sludge trapped in spin-on oil filters has been a recommended practice for many years. Licensed aircraft mechanics recognize the value of visual inspection to aid in determining if internal engine wear or malfunction has occurred, and to inspect for metal or other contaminates within the engine oil system.

Use of the Champion CT-470 Oil Filter Can Cutter eases the opening of spin-on filters without introducing foreign material into the filter.

Following is the recommended procedure for inspection of full flow oil filters:

1) Remove filter from the engine and place on a drain tray. Allow oil to drain through a clean cloth to determine if foreign material drains from the filter.

2) Using the Champion CT-470 Can Cutter, open the filter as follows; (See photos):

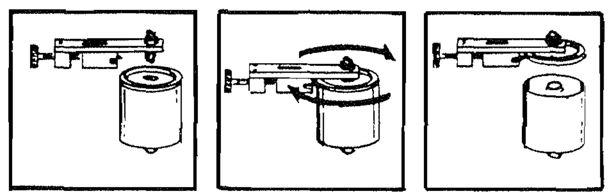


2

a. Insert threaded adapter in female threads of filter, or screw rotating bushing on male threads of filter.

b. Slightly tighten cutter blade against filter and rotate 360°. Repeat operation until mounting plate section separates.

c. Lift mounting plate to expose complete filter media for inspection.



3) Using a clean plastic bucket containing approximately 1 pt. clean varsol, swish filter element around in the varsol to loosen entrapped metal or other contaminant.

4) Using a clean magnet, work it around in the varsol solution. Ferrous metal particles in the solution should adhere to the magnet for inspection.

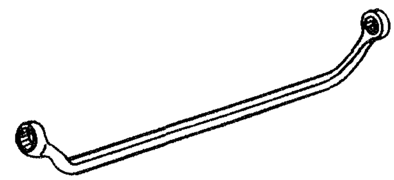
5) After all ferrous metal particles have been retrieved by the magnet, pour remaining varsol through another clean shop rag, and in a bright light, any non-ferrous metals should be detectable.

Cylinder Base Nut Wrenches 3882 Series

The 3882 Series Wrenches feature 1/2" square drive and 12-point hex sockets. The wall thickness between the hex and wrench O.D. is closely controlled for maximum strength. Approx. 16" long overall.

3882	9/16" hex	**3882-3**	5/8" hex
3882-1	7/16" hex	**3882-4**	3/4" hex
3882-2	1/2 " hex		

3882A 9/16"hex
3882-3A 5/8" hex

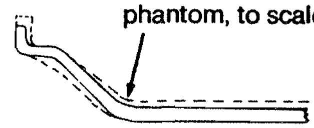


3

Cylinder Base Nut Wrench

Special modified 3882-type wrench, this special wrench is perfect for those occasional situations when the 3882 wrench won't fit. It's a slightly different configuration, as shown.

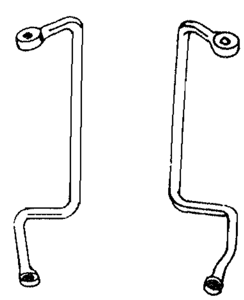
8079 9/16" hex



4

Cylinder Base Nut Wrench
For 470 and 520 Series

The special configuration of these wrenches permits access to the cylinder base nut areas as shown. Approx. 17" long.



5

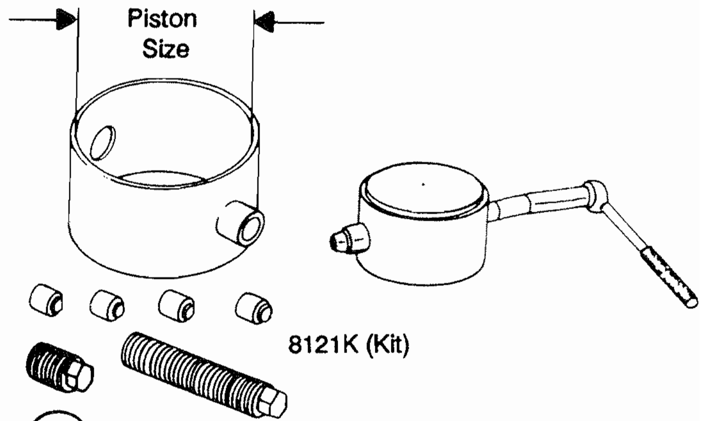
Piston Pin Removers

8121 Series

Design allows piston pin removal without removing adjoining cylinder. Sizes to fit Continental engines.

Body Assy. Piston Size

8121A	4-7/16"
8121B	5"
8121C	5-1/8"
8121D	5-1/4"

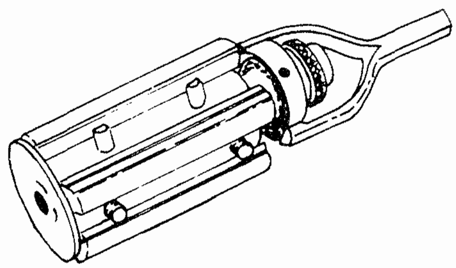


6

Cylinder Hone

Expandable racks adjust to cylinder size with universal joint action. Optional set for use on TCM cylinders.

CFL10	Standard/3" to 4-1/4"
CFL10-7	Optional/4" to 6-1/2"

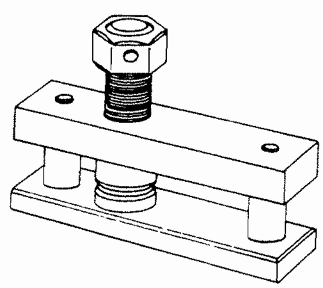


7

Crankshaft Blade and Dampener Bushing Removers/Replacers

Back-up plates and forcing screws are rugged, heat-treated alloy steel. Be sure to keep forcing screws greased.

4965A	-	for 5/8" I.D. Bushing
3604	-	for 3/4" I.D. Bushing
3607	-	for 15/32" I.D. Bushing
3607-1	-	for GTSIO-520
8068	-	for .604 I.D. Bushings



8

Holding Fixture Adapters

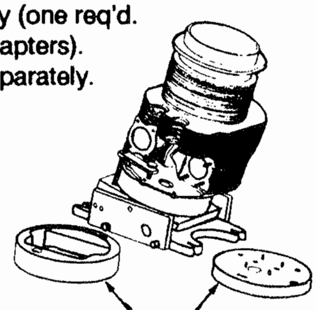
With these adapters, you may bolt the cylinder onto the 5221B Fixture in order to do:

Cylinder Honing
Valve Seat Insert Work (insert removal, seat cutting, insert installation).

5221-13A Adapter for Continetal O and IO-470 and 520 Series

Note: The original #5221 Fixtures require 4 additional tapped holes in rocker plate to accept the above adapters- a blueprint showing hole sizes and locations is included with adapters.

5221-17A Cylinder Holdown Clamp Assembly (one req'd. fits all adapters). Order separately.



(9)

Universal Cylinder Holding Fixture 5221B

This is a heavy-duty, precision fixture manufactured to extremely close tolerances. Suitable for use on vertical mills or drill presses, it allows quick indexing of required angles for valve work.

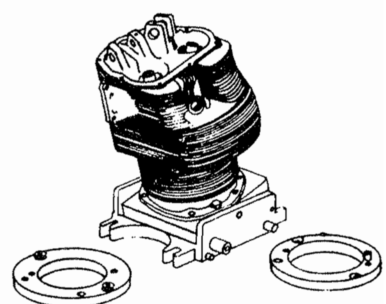
FEATURES:

* For all Continental Engines
* Fixture indexes in all present positions required to machine valve guides.
* Locks in at these angles:

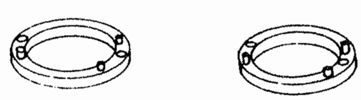
0°	11° 45'	12° 40'	16°
11° 30'	12°	15°	

* Adapter rings are included to cover all Continental engines.

5221-10LA For wide deck
5221-11LA For narrow deck



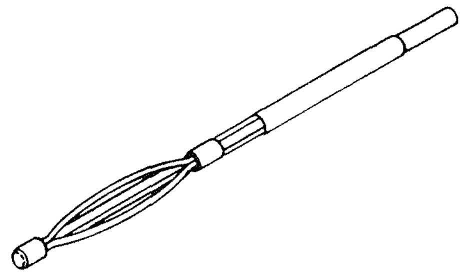
5221B



(10) 5221-10LA 5221-11LA

Valve Guide Cleaner 122

Expandable type fits all Continental engines.

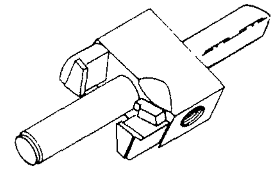


11

Seal Seat Cutter 8066

Per Continental Bulletin M76-24R.1

Modifies valve guide to comply with M76-24R.1 carbide-tipped cutter blades compensate for wear.



12

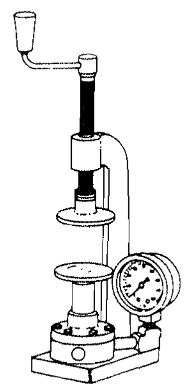
Spring Checker 7521A

Per Continental Bulletin M74-16

Check valve spring quickly and easily. Hydraulically actuated extremely accurate readout (0-160 pounds). Includes step gauges for all required dimensions. 7521 Checker is less step gauges.

Max. spring dimensions: Ht.-2-1/2", O.D.-2".

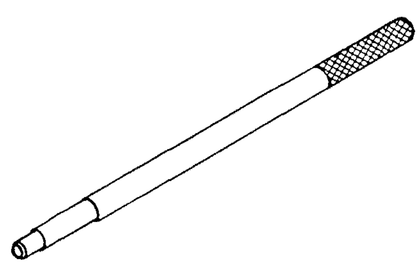
(Heat-Shrink Type)



13

Valve Guide Removers
(Cold Force Removal Type)

Tough heat-treated steel.
3611 - .375" I.D. Guide
2874 - .436/.438" I.D. Guide

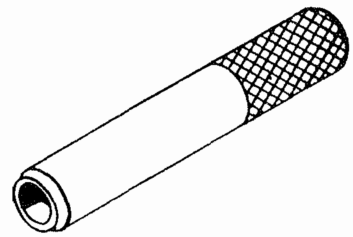


14

Valve Guide Replacers

Alloy steel, heat-treated for maximum toughness.

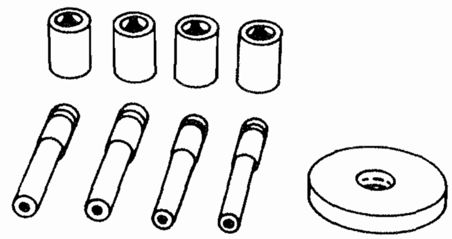
4912 - .344" I.D. Guide
3619 - .375" I.D. Guide
2842 - .436/.438 I.D. Guide



15

Rocker Arm Bushing Remover/Installer Set 8118

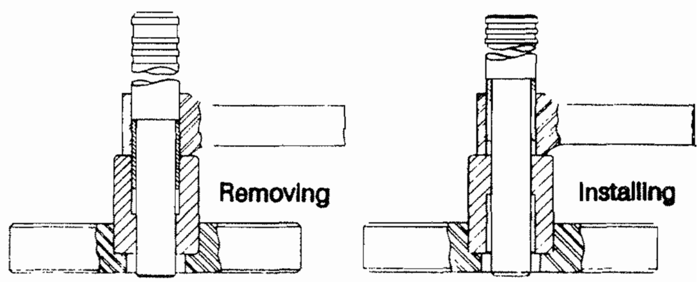
Driver and Adapter Assy.	Pilot Dia.	Ram Dia.	Replaces Tool
8118G	.731	.871	7233
8118H	.706	.808	5007/2881-1
8118J	.593	.699	4904
8118K	.573	.714	------



8118 Set includes one each 8118G, 8118H, 8118J, 8118K and 8098-10 Base.

Driver and Adapter Assemblies also available individually. The 8098-10 Base must be used with 8118G, 811H, 8118J and 8118K Driver and Adapter Assemblies.

Makes rocker arm bushing removal/installation fast and easy. All components of 8118 set are also available individually.

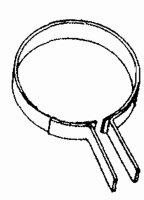


16

Piston Ring Compressors

Flexible Band Type

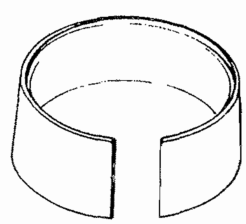
4901 - for 3-7/8" and 4-1/6" bore engines
2839 - for 5" and 5-1/4" bore engines
3618 - for 4-7/16" bore engines



17

Tapered Type

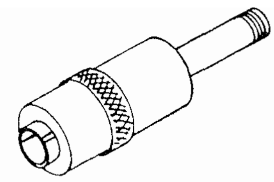
4901B - for 3-7/8" bore engines
4901A - for 4-1/6" bore engines
3601 - for 4-7/16" bore engines
2839A - for 5" bore engines
5201 - for 5-1/4" bore engines



18

3170 - Floating holder

No. 3 Morse male, compensates for misalignment between reamer and work. Provides unrestricted float.

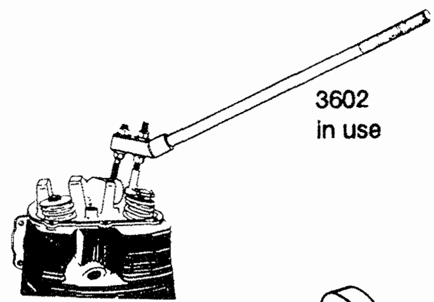


19

Valve Spring Compressor 3602

Adjustable type works on all Continental engines.

Hook installs on rocker shaft (or on special rocker nut furnished) and c-shaped collar compresses spring to allow keeper removal. All stressed parts are heated-treated steel. Handle is approx. 18" long for good leverage.

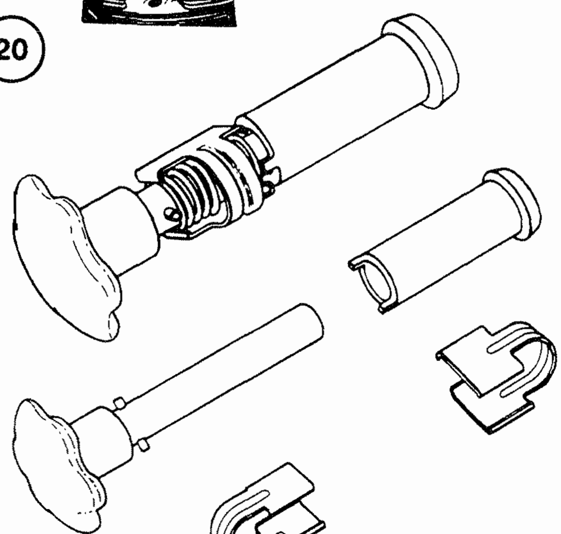


20

Push Rod Spring Compressor 68-3

For compressing and holding push rod springs on all engines with spring loaded tubes. The 68-3 compresses the spring, which can then be removed with furnished clips.

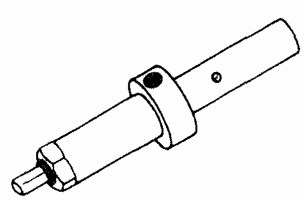
Eliminates wiring springs together- to install, simply insert spring then pull off clip! Includes instructions.



21

Flaring Tool for Push Rod Housing 4951A

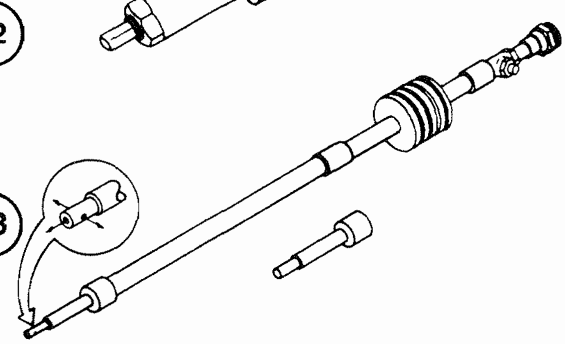
For A & C Series - expanding ball type tool. Balls rotate inside housing, expanding it into aluminum boss.



22

Valve Guide Remover 4981

Removes guides by heat-shrink method. Cylinder is heated to 475°F, then tool injects water to guide bore. A light tap with the slide hammer removes guide. A water reservoir (not included) supplies the low water pressure required to cool the guides for easy removal. Replacement guide is usually same size as the one removed.



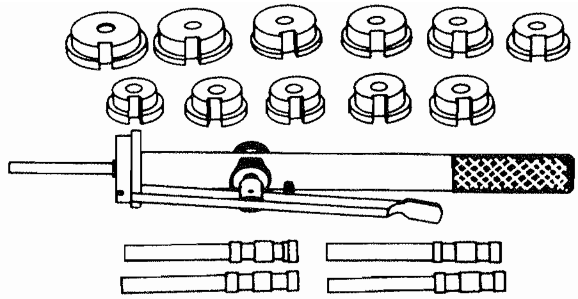
23

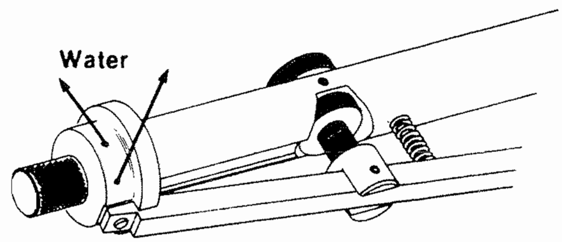
Valve Seat Insert Remover and Replacer 8086

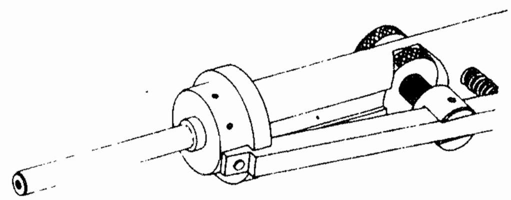
A complete tool set to remove and install valve seats by the heat-shrink method. Cylinders are heated to 500°-550°F. Same handle and head is used to remove and drive down seats during installation. Mallet may be used on the handle as the seating force. Low water pressure on the order of 1 to 2 p.s.i. is all that is needed for pulling seats. This one tool set will do all Continental engines from 65 to 520 and IO-550.

Set includes:

* (1) Handle/lever assembly
* (12) Puller heads (size to fit all Continental engines
* (10) Installer pilots
* (1) Remover plug
* 6 feet of super flexible hose to attach to water supply
* Instructions
* Storage case.



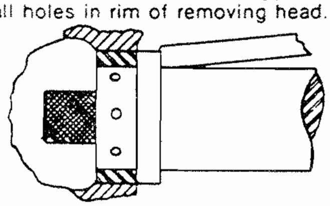




24

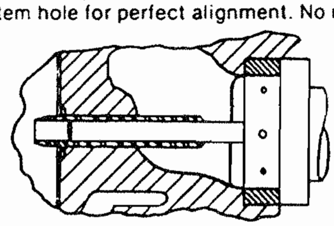
Tool is rigged for removal. Center is plugged to route water out thru small holes in rim of removing head.

Fig 1



Tool is rigged for replacement. Guide on end of tool slips into valve stem hole for perfect alignment. No more cocked seats.

Fig. 2.



Installer Valve Seat Inserts

4910-For 1-45/64" O.D. Exhaust and 1-53/64" O.D. Intake Inserts. (Includes head and handle)

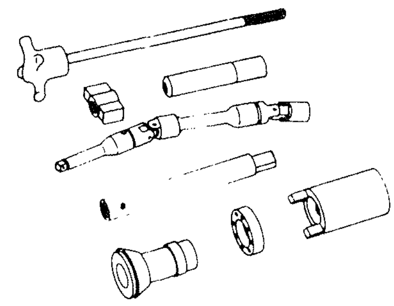
4956-For 1-3/4" O.D. Exhaust and 1-57/64" O.D. Intake Inserts. (Includes head and handle)

25

8116 Common Parts Kit

Does not include Expanding Guide Bodies or cutting tools. See below.

Select Size Parts are not part of 8116 kit. You buy only what you need (reamers, expanding guide bodies, boring bars, etc.).



Valve Guide To Valve Seat

Alignment System

MIS-ALIGNED VALVE SEATS AND GUIDES CAN BE RE-ALIGNED QUICKLY:

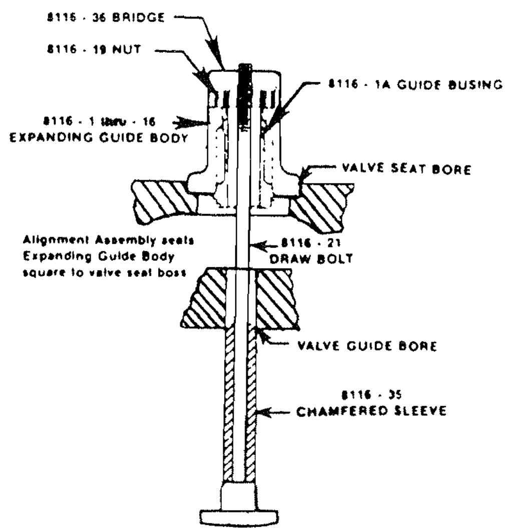
Here's how it's done:

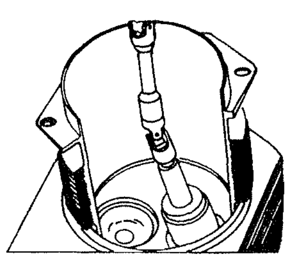
Step 1. Removed old guides and seats

Step 2. Install Expanding Guide Body into valve seat boss.

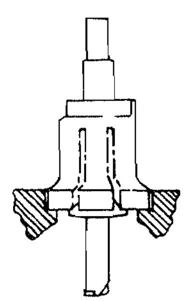
Step 3. Place Boring Bar into Guide. Bore valve guide boss concentric and perpendicular to valve seat. Follow up with Reamer.

Step 4. Use your drill press for bore or ream operations as shown in this picture. The same guide set-up works for both.





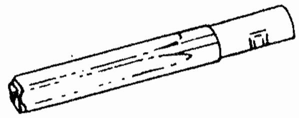
26



Valve Stem Hole Reamers

(Takes the place of 2847, 3606 & 4913 Series reamers).

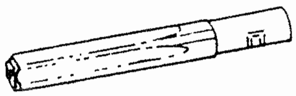
Tool No.	Hole Dia.
8116.24	.344
8116.25	.375
8116.27	.436
8116.29	.438



27

Boring Bars

Made of high speed M2 tool steel, precision ground.



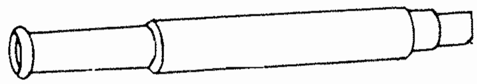
28

Reamers

Tool No.	Hole Dia.
8116-1R	.531
8116-2R	.536
8116-3R	.541
8116-4R	.546
8116-5R	.551
8116-6R	.561
8116-10R	.625
8116-11R	.630
8116-12R	.635
8116-13R	.640
8116-14R	.645
8116-15R	.655

Reamers

Valve Guide Boss. (Takes place of 4914 and 4943 Series reamers).



29

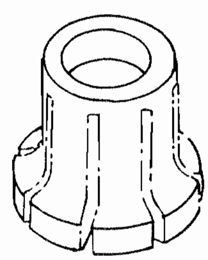
Boring Bars

Tool No.	Hole Dia.
8116-1B	.525
8116-2B	.530
8116-3B	.535
8116-4B	.540
8116-5B	.545
8115-6B	.555
8116-10B	.620
8116-11B	.625
8116-12B	.630
8116-13B	.635
8116-14B	.640
8116-15B	.650

(*Example: Use **8116-6B Boring Bar** to bore hole to .555, then finish with **8116-6R Reamer** to .561 dia.)

Expanding Guide Bodies

Expanding Body No.	Minimum Retracted Dia.	Maximum Expanded Dia.
8116-1	1.656	1.681
8116-2	1.685	1.710
8116-3	1.748	1.773
8116-4	1.785	1.810
8116-5	1.810	1.835
8116-6	1.839	1.864
8116-7	1.873	1.898
8116-8	2.068	2.093
8116-9	2.108	2.133
8116-10	2.113	2.138
8116-11	2.228	2.253
8116-12	2.388	2.413
8116-13	2.474	2.499
8116-14	2.515	2.540
8116-15	2.594	2.619
8116-16	2.629	2.654

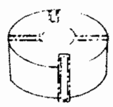


30

Valve Seat Insert Cutters

Straight Side - Non Step

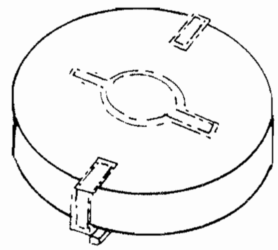
WARNING! Measure New Insert O.D. and then select proper cutter.



Straight Side Cutters

(31)

Part No.	Use	Finish Dim.	O.S.	Part No.	Use	Finish Dim.	O.S.
4909-8	Int	1.822	.010"	4985-5	Int	2.140	.030"
4909-9	Int	1.814	.002"	4985-6	Exh	1.669	.005"
4909-12	Exh	1.689	.002"	4985-7	Exh	1.664	.010"
4909-13	Exh	1.697	.010"	4985-8	Exh	1.669	.015"
4954-5	Int	1.880	.005"	4985-9	Exh	1.674	.020"
4954-8	Int	1.885	.010"	4985-10	Exh	1.684	.030"
4954-9	Int	1.885	.002"	5224-5	Int	2.522	.005"
4954-10	Int	1.895	.020"	5224-10	Int	2.527	.010"
4954-11	Int	1.905	.030"	5224-15	Int	2.523	.015"
4954-12	Exh	1.752	.002"	5224-20	Int	2.537	.020"
4954-13	Exh	1.760	.010"	5224-30	Int	2.547	.030"
4954-14	Exh	1.770	.020"	5225-5	Exh	1.793	.005"
4954-15	Exh	1.780	.030"	5225-10	Exh	1.798	.010"
4985-1	Int	2.115	.005"	5225-15	Exh	1.808	.015"
4985-2	Int	2.120	.010"	5225-20	Exh	1.808	.020"
4985-3	Int	2.125	.015"	5225-30	Exh	1.818	.030"
4985-4	Int	2.130	.020"				



Step Side Cutters

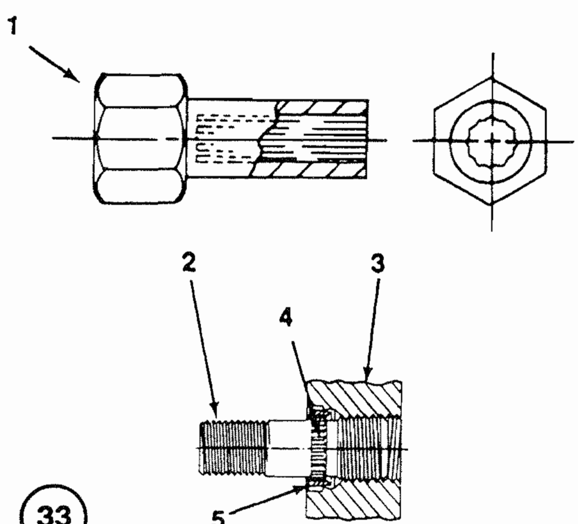
(32)

Part No.	Small Diameter	Large Diameter	O.S.	Part No.	Small Diameter	Large Diameter	O.S.
8135	1.654	1.884	STD	8138-3	1.803	2.070	.015"
8135-1	1.659	1.884	.005"	8136-4	1.808	2.070	.020"
8135-2	1.664	1.884	.010"	8138-5	1.818	2.070	.030"
8135-3	1.669	1.884	.015"	8138	2.271	2.632	STD
8135-4	1.674	1.884	.020"	8138-1	2.276	2.632	.005"
8135-5	1.684	1.884	.030"	8138-2	2.281	2.632	.010"
8136	1.788	2.070	STD	8138-3	2.286	2.632	.015"
8136-1	1.793	2.070	.005"	8038-4	2.291	2.632	.020"
8136-2	1.798	2.070	.010"	8138-5	2.301	2.632	.030"

Rosan® Stud Remover

This stud remover is for use in extracting studs from cylinder assemblies using **Rosan® type Studs.**

Using the hammer, drive the stud driver (1) over stud (2) as far as possible without making contact with the cylinder head (3). Using the ratchet or pull handle, apply a firm, constant pressure in the clockwise (tightening) direction, the serration (4) on the stud will strip. When the stud gives, reverse the ratchet and back the stud out until there are three threads still engaged in the lock ring (5). Move the stud with the driver still attached, up, down and sideways. The lock ring will pop out of the cylinder without damaging it. The stud driver is Part No. 2769A13.



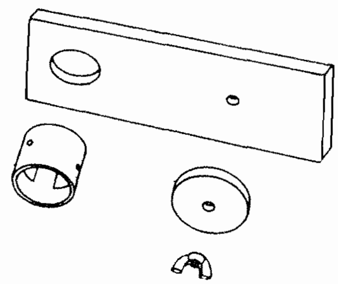
(33)

Connecting Rod Reaming and Alignment Checking Fixture

With these precision tools, it's easy to check connecting rods (without bushings) for alignment and warpage.

The 8111A Base/Retainer Kit is required as well as one (or more) of the Adapter Kits described below. The 8111A Kit includes the high-carbon steel base (hardened and ground for long life); retaining collar, cap (for connecting rod) and wing nut.

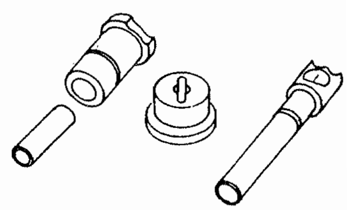
The 8111A Base/Retainer Kit fits the following Adapter Kits as described below.



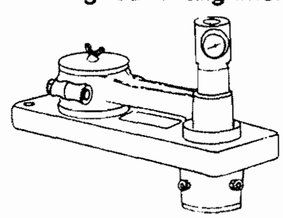
(34) Base/Retainer Kit 8111A

Adapter Kits

These kits contain the indicator gauge assembly, which as a dial indicator reading in ten-thousandths of an inch (.0001"). The gauge body is lapped into the mating bushing for accurate readings. Instructions are included.



Complete tool combining 8111A Base with one of the 3 listed adapter kits shown checking rod for alignment.



(35)

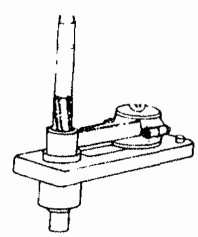
Adapter Kits

8042C	for 520-470-E Series	1.125"
8072C	for O-200, O-300,360	1.00" & .922"

Reamers, Connecting Rod Bushing

High-speed steel reamers with 3/4" diameter pilot. Use with 8111A Base/Retainer Kit and proper Adapter Kit as shown above.

874-40	.920" Roughing	use together
874-41	.923" Finishing	
5008	1.126" Finishing	
8071	1.000" Finishing	



(36) Complete tool using same adapters shown above with piston pin reamer. See at left for proper reamer to use

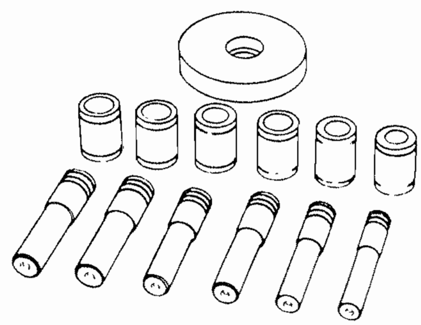
Universal Connecting Rod Bushing Remover and Installer Set 8098

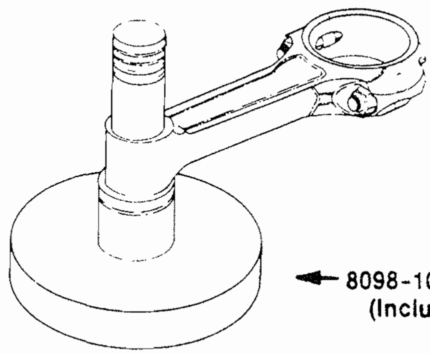
Complete set for removing and installing connecting rod bushings for Continental Support bushing reverses for either installing or removing.

8098 Complete Set Includes:
8098-10 Base

Driver and Adapter Assy.	Pilot Dia.	Ram Dia.	Replaces Tool
8098A	.844	.966	4902
8098B	.907	1.058	4949
8098C	.967	1.058	-
8098D	.984	1.082	3613
8098E	1.109	1.182	L-149
8098F	1.109	1.230	2879

(Above Driver and Adapter Assemblies also available individually).





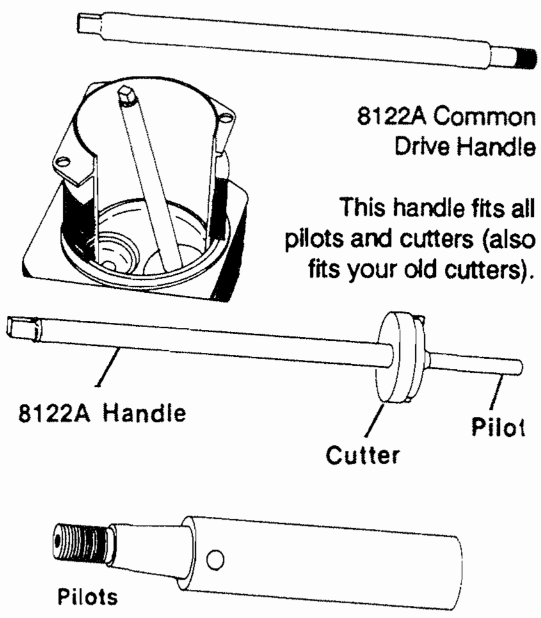
8098-10 Base (Included)

37

Common Drive Handle 8122A

This Drive Handle fits all pilots and cutters, and it features positive pin drive as shown. (Combination of Morse taper and pin drive eliminates any slippage between handle and cutter.)

By using the 8122A with the proper pilot from below, you may choose to pilot into valve stem hole or valve guide boss.



38

Pilots

All pilots are hardened and precision ground for accuracy. Two choices- pilot into valve stem hole or valve guide boss.

Pilot Choice No. 1- Pilot Into Valve Stem Hole
(On new installations only)

Part No.	Pilot Dia.
8139	.343
8410	.374
8141	.435

CAUTION: DO NOT USE ON WORN GUIDES!

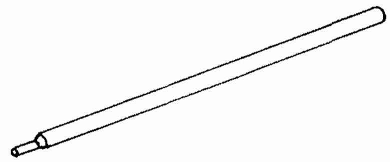
Pilot Choice No. 2 — Pilot Into Valve Guide Boss

Part No.	Pilot Dia.	Application	Part No.	Pilot Dia.	Application
8123	.530	Standard	8129	.624	Standard
8124	.535	Oversize .005	8130	.629	Oversize .005
8125	.540	Oversize .010	8131	.634	Oversize .010
8126	.545	Oversize .015	8132	.639	Oversize .015
8127	.550	Oversize .020	8133	.644	Oversize .020
8128	.560	Oversize .030	8134	.654	Oversize .030

Needle Bearing Installers

Precisely machined to make bearing installation fast.

23-1 .562" pilot
8053 .750" pilot



39

Hydraulic Crankshaft Dampener Bushing Remover/Replacer Sets 8077A and 8077B

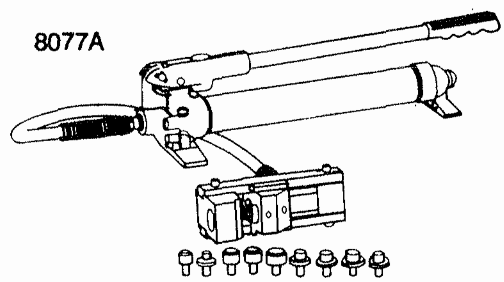
Remove and replace crankshaft bushings in a fraction of the time hydraulically! A few strokes of the pump handle removes or installs bushing with very little effort. Small actuating head fits in and around the crankshaft. Once the bushing is removed (or installed), a turn of the valve returns actuator for another cycle.

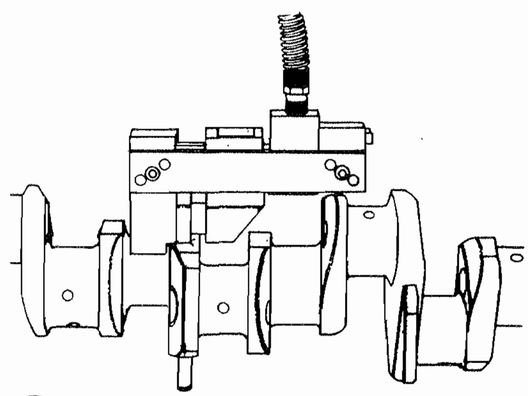
8077A includes:

10,000 p.s.i. pump and cylinder; 5-ton output cylinder; 3-ft. long flex hydraulic hose; all adapters to fit 0-300 and 360, 470 and 520 Series.

8077B (less hydraulics) includes:

Items shown above in 8077A except no hydraulics are furnished. The actuator head has 1/4" NPT female port for connecting to your hydraulic hose.

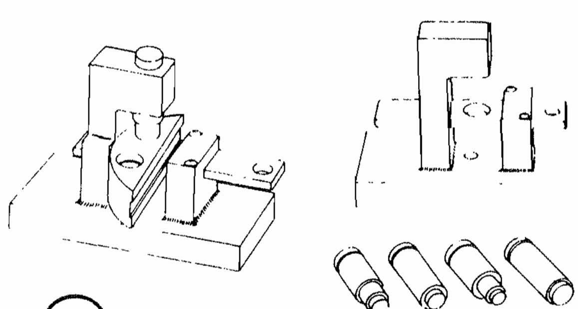




40

Counterweight Bushing Remover/Installer 8077C

Positive guide of all components assures perfect alignment. Includes adapters for O-300, 360, 470 and 520 Series engines.



41

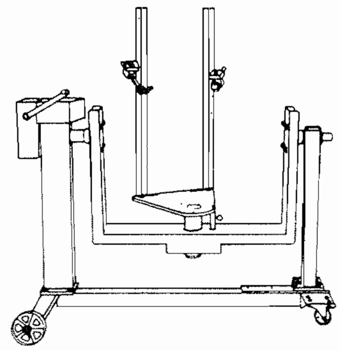
All Position Engine Stand

Assembly-Disassembly Transportation 8104

Designed to save time on the overhaul floor. Minimum attaching hardware allows complete engine accessibility.

Positive frame rotation (360°) locks in infinite number of positions simply by releasing handle. Engine mounting plate also rotates 360° and locks in place with heat-treated lock pin.

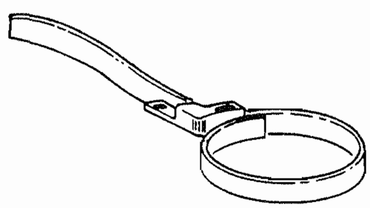
Flange holder is pre-drilled to accept all Continental engines. Threaded adapters included to mount non-flanged crankshafts. Shipping weight 400 lbs.



42

Tork Band Tension Adjuster
7726

Adjust belt tension without damage to components. Use on alternators, compressors, etc. Allows grabbing difficult round components.

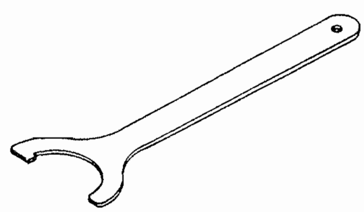


43

Generator Drive Holder

Hold drive gear for torquing or removing retaining nut.

4973 2.600" dia.
4973A 2.510" dia.



44

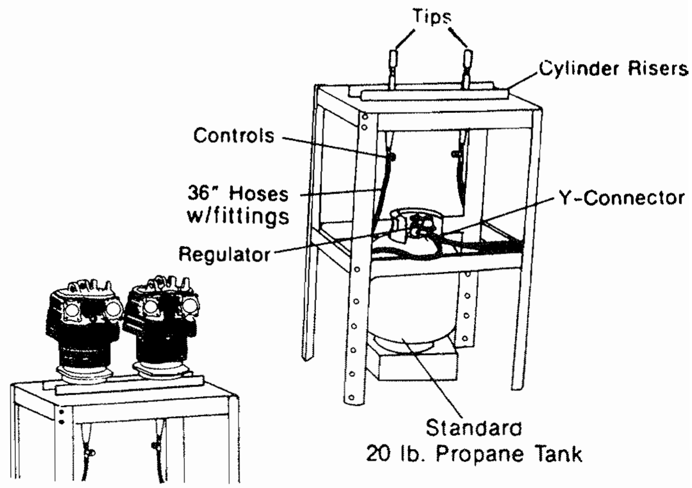
Cylinder Heating Stand 8156

In just 8-10 minutes, you can heat 2 cylinders simultaneously to 600^{O}F. Or, you can heat one at a time (each tip is separately controlled).

Included with the 8156 Cylinder Heat Stand:

(2) Tips
(2) 36" Propane Hoses w/fittings
(1) Propane Regulator
(2) Controls
(1) Y-Connector
(1) Stand
(2) Cylinder Risers

All screws, nuts and washers needed; and instructions.

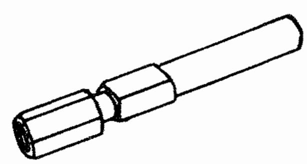


45

Blind Needle Bearing 8093C

Puller

Use to remove 5/8" I.D. needle bearings in 470 and 520 Series engines. Use with 8054 Slide Hammer.

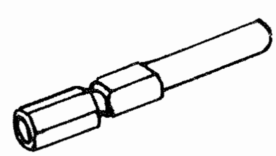


46

Starter Clutch Shaft

Bearing Pullers

47

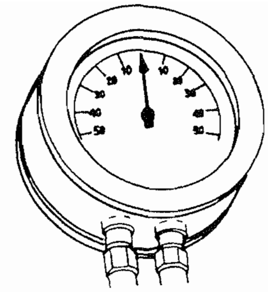


Use with 8054 Slide Hammer

8093D for removing 3/4" I.D. bearings.

Differential Pressure Gauge 5210

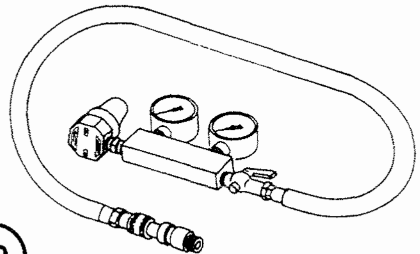
For turbo superchargers. A rugged, high precision gauge needed to set differential fuel measures. 50-0-50 psi, 4-1/2" dia. face, 1/4" pipe connection.



48

Differential Pressure 7251
Cylinder Checker

Use standard shop air pressure to check condition of rings, cylinder walls and valves.

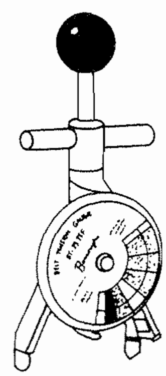


49

Belt Tension Gauge BT-33-73F
(TSIO-520-BE uses BT-33-89P)

Set belt tension quickly and accurately to ensure maximum belt and bearing life. The proper belt-tension eliminates slippage and increases efficiency of belt-driven opponents.
Compact- only 3 1/4" wide to fit in crowded areas. Easy to use- just apply gauge to belt, release ball handle and read tension on rotating dial.

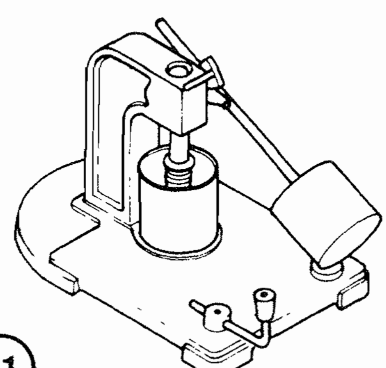
Calibrated for A-section V-belts (3/8" to 1/2" top width) and K-section (4,5, and 6 rib) poly-V belts. Range 30 to 180 lbs. and 130 to 800 newtons (dual scale).



50

Hydraulic Valve BT-60C
Lifter Tester

For checking bleed down rate on hydraulic lifters. Hand input turns lifter as in actual use. Includes one gallon of BT-59 Test Oil (also available separately).



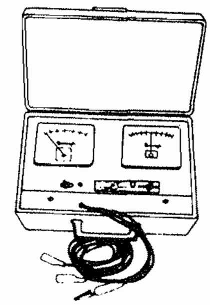
51

In-Aircraft Alternator/ Generator Tester 8091

Replace test bench. Uses aircraft's own engine to check systems and tests without component removal. Long leads permit tester to remain in cockput during testing.

* Voltage output
* Rotor
* Brushes
* Stator
* Field Input
* Diodes
* Windings

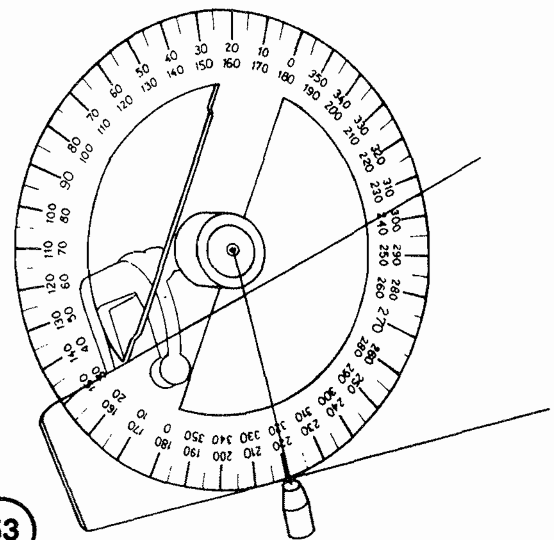
Features 0-30v DC voltmeter; 10-0-10 amp DC ammeter; circuit breaker protected. Two point hook-up- field term, and cigarette lighter.



52

Engine Timing Disc 3608A

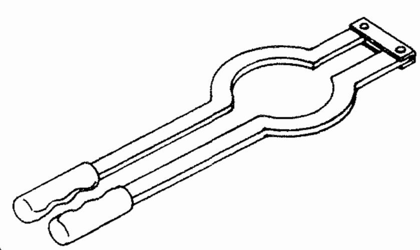
For all engines- universal application from J3 to DC3. Fastens to prop tip and accurate to $\pm$ 1/4 degree. Includes piston stop 3608A-15.



53

Pulley Holder 4974

For holding 2-1/2" to 3-1/2" dia. pulleys grip in pulley groove.

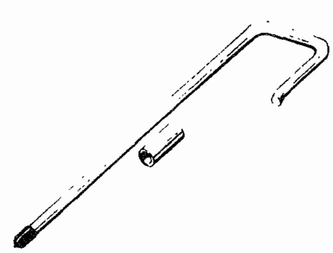


54

Pulley Alignment Gage Bar 8082

The 8082 gage bar allows a quick and easy alignment check between driver sheave and compressor sheave.

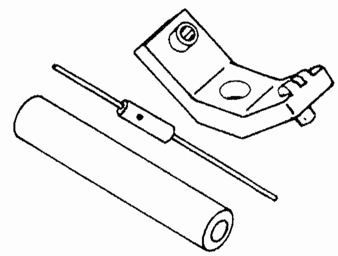
Used when installing air conditioning on models IO-520 and TSIO-520. Includes adapter sleeve for 1/2" v-belts.



55

Crankcase Drill Fixture 8094A
For Starter Clutch Adapter
Per Continental Bulletin 79-10

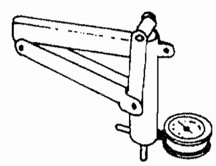
Modifies crankcase by drilling extra oil passage from rear main to starter bushing area.



56

Vacuum Pump 8334

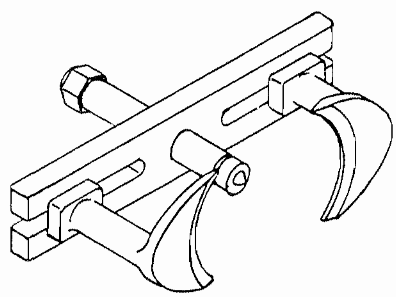
This new heavy-duty vacuum pump is designed for one-hand operation. Heavy steel wall; O-30 in Hg; nozzle fits several sizes of tubing.



57

Generator Pulley Puller 61-5

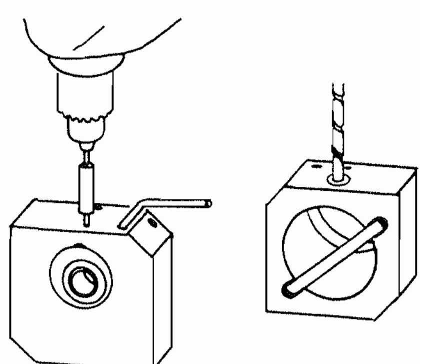
Quick removes pulleys from 2-1/2" to 5" diameter. Applies even pressure on outside of pulley in pulley groove. All components are tough, heat-treated alloy steel.



58

Bearing and Bushing 8094B
Drill Fixture
Per Continental Bulletin 79-10

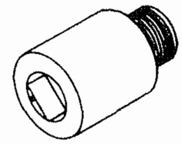
Use to rework your present stock of main journal bearings and starter shaft bushings. Use Bearing Puller 8093B (see at right).



59

Spark Plug Insert Replacer 4918

Features 1/2" square drive. Use on all engines.

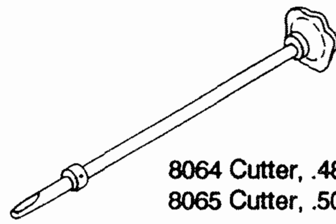


60

Thru-Bolt Bore Step Cutters

Per Continental Bulletin M77-9

Use to chamfer step in thru-bolt dowel boss prior to inserting improved thru-bolt with O-ring seal.

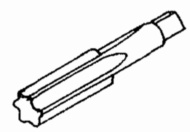


8064 Cutter, .480" dia.
8065 Cutter, .500" dia.

61

Spark Plug Insert Tap 504-1

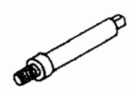
Use on all engines.



62

Spark Plug Insert Remover 4919

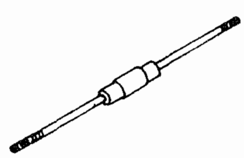
Use on all engines.



63

Slide Hammer 8054

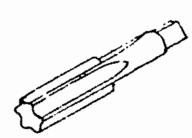
Heavy duty slide hammer features 2-1/2-lb. slide and 5/8"-18 thread. 24" long overall. Use with 8114 Series removers.



64

Spark Plug Tap 445

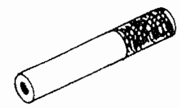
18 millimeter threads. High-speed steel.



65

Rosan® Lock Ring Installer
8074

Heat-treated, tough alloy steel. Knurled for sure grip. Approximately 4" long.

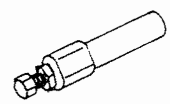


66

Stud Drivers

Six (6) different thread sizes:

505-1	1/4"-28	**505-5**	1/4"-20
505-2	5-16"-24	**505-6**	5/16"-18
505-3	3/8"-24	**505-4**	7/16"-20

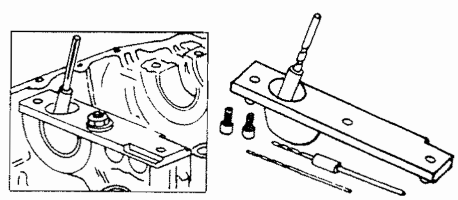


67

Drill Fixture
4978

For Scavenge Pump. Includes fixture and drills with pre-set stops

To modify 470 Scavenge Pump per Continental Bulletin M72-8.

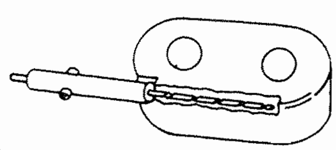


68

Drill Fixture
8025

For drilling and installing piston oil squirt nozzles in O-470V engines, converting to O-470VO per Continental Bulletin M75-13, IO-470 to IO-470OS.

Includes all drills, drill bushings and stops required to a fast and efficient job.

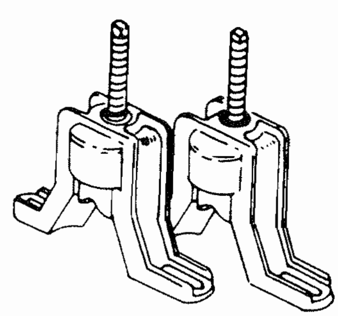


69

Crankcase Splitter Set L423

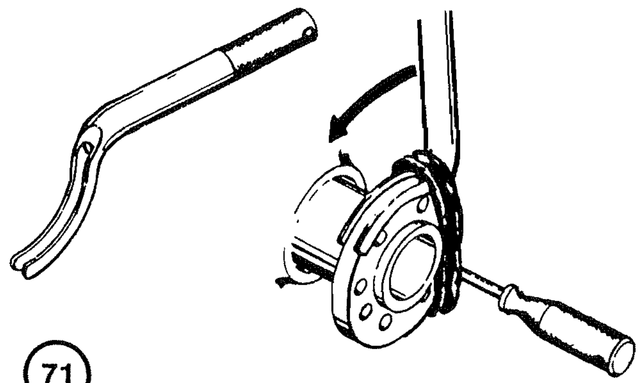
Makes splitting Continental crankcases easier and faster. Prevents crankcase damage. Puller assemblies bolt onto crankcase studs.

70



Propeller Shaft Oil Seal Installer 5209

For all flanged shafts. For installing one piece stretch seals without damaging sealing surfaces. Be sure to oil the seal before installing.

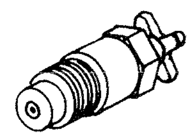


71

Oil Pressure Relief Spot Facers

Positive stop to prevent excess material removal. Cutter blades are heat-treated highspeed steel.

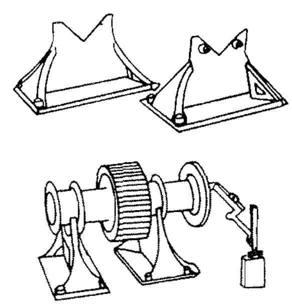
8048 Spot Facer for 470 and 520.



72

Runout Block Set 8177A

Use this set to check runout on crankshafts, etc. up to 4" diameter. Blocks are aluminum alloy with Teflon bearing surfaces. Approx. size: 4" w x 8" 1 x 5" h each.



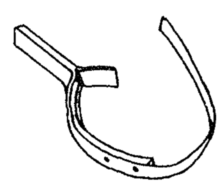
73

(Dial indicator not included)

Polishing Tools for Crankshafts Bearings

Special aluminum frame and felt polishing surfaces.

8087A 1-7/8" to 2-1/4" dia.
8087B 2-1/4" to 2-5/8" dia.



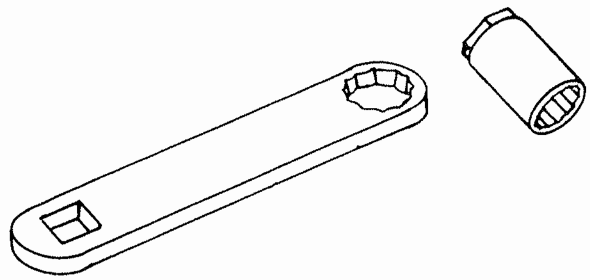
74

Injector Nozzle Remover and Installer 8165

This tool allows you to remove, install and tighten injector nozzles located close to intake parts on Piper Aircraft. Torque Wrench extension allows use of 3/8" square drive torque wrench to tighten nozzles to proper specifications.

Torque wrench extension is made of heat-treated steel for durability. Torque input and output is marked on extension.

Installer is special, thin-walled 6-pt. 1/2" hex socket.

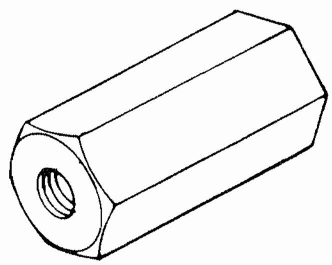


75

Crankcase Thru-Bolt Removers

Use with 8054 Slide Hammer to remove stubborn bolts.

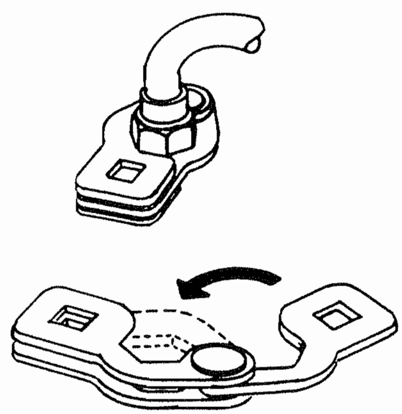
8114-8 Remover, 1/2"-20 threads
8114-7 Remover, 7/16"-20 threads
8114-6 Remover, 3/8"-24 threads



76

Hex Drive for Hex Tube Nut 7912A

Tubing nut wrench set for fuel systems, hydraulic systems and brakes.

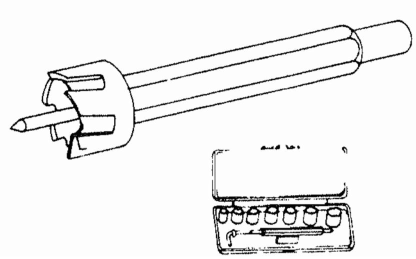


77

Rotabroach Cutters 7710

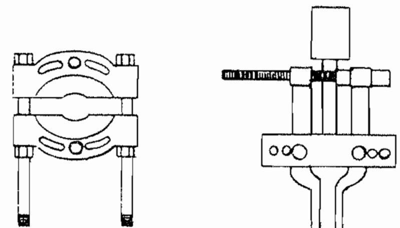
These cutters cut faster and cleaner than twist drills with only a fraction of the power and effort.

78



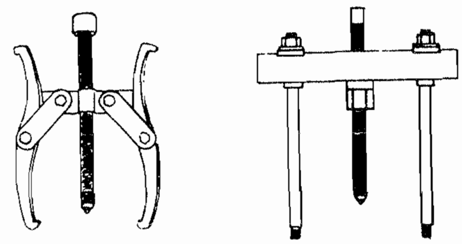
Pullers

These pullers provide a more controlled method to remove press-fit parts.



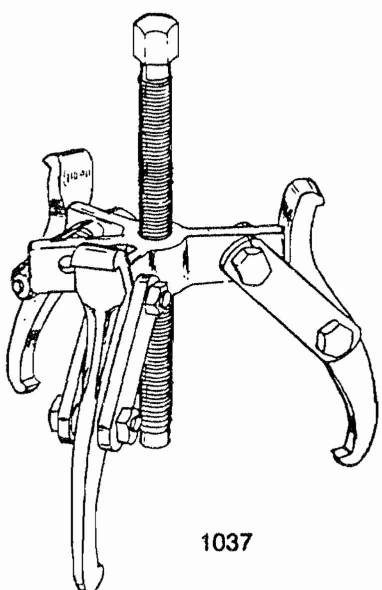
1153 679

79



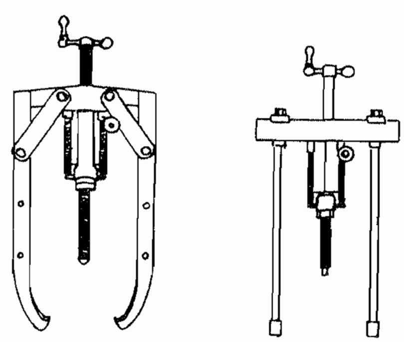
1035 927

80



1037

81



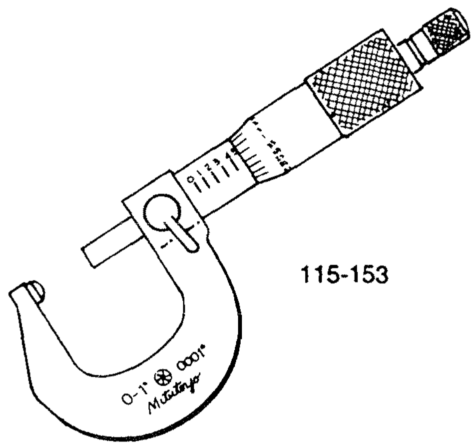
1079 1063

82

INSPECTION INSTRUMENTS

*Outside Micrometers

Spherical Anvil Micrometers are specially useful in measuring the wall thicknesses of small parts such as sleeves, collars, tubings and various cylindrical workpieces. They are also used to measure dimensions from inside of holes to outside edges.



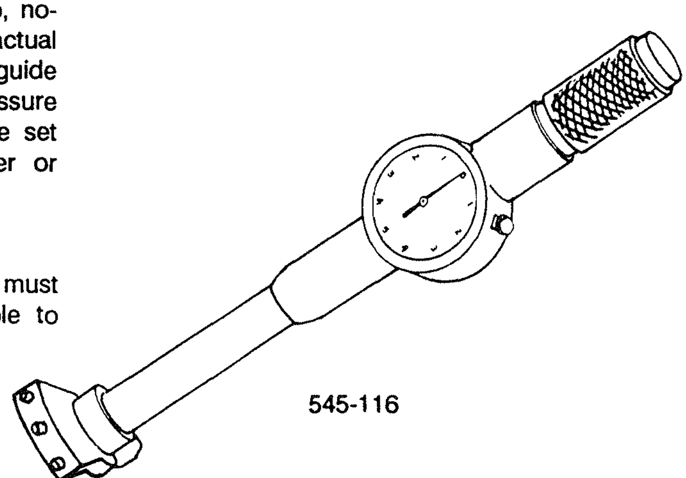
115-153

83

*Dial Bore Gages

Dial Bore Gages used for large volume "go, no-go" inspections or for determination of actual dimensions. Three-point contact (two guide pins and one interchangeable rod) assure alignment within bore. Zero point may be set with ring gage, micrometer, height master or gage blocks.

*NOTE: All precision measuring devices must have a current calibration that is traceable to the National Bureau of Standards.



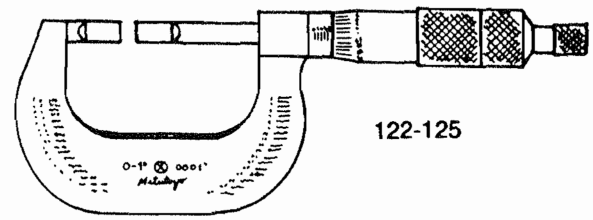
545-116

84

* Blade Micrometers

Non-Rotating Spindle TYPE 122, 222

For measurements of narrow grooves, keyways and other hard to reach dimensions.



85

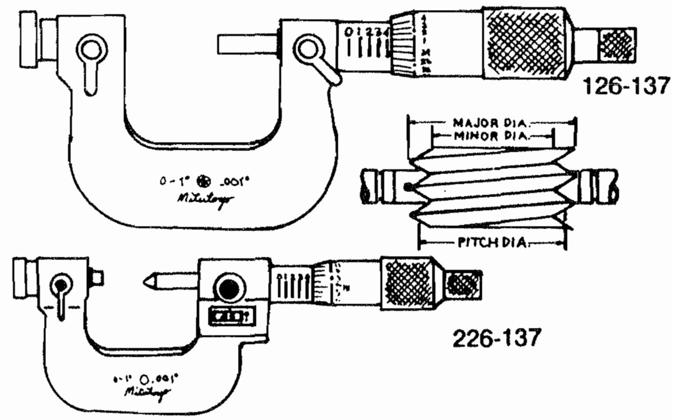
*Screw Thread Micrometers

FOR MEASURING PITCH DIAMETERS

TYPE 126, TYPE 226

Interchangeable V-Anvil Type

60 degree V-Anvil and Conical Spindle are made of high-grade special steel, hardened and precision ground.



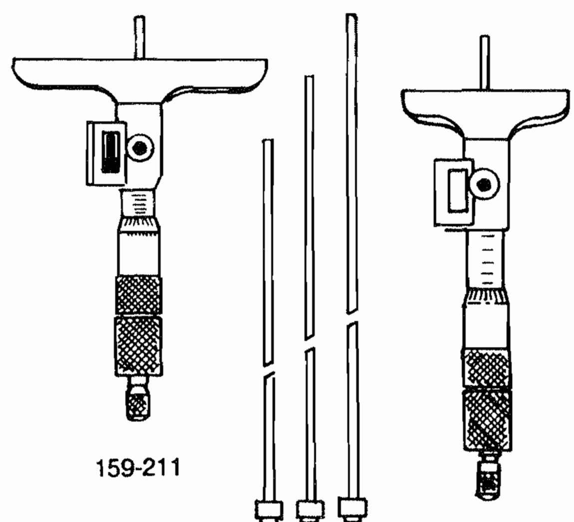
86

*Depth Micrometers

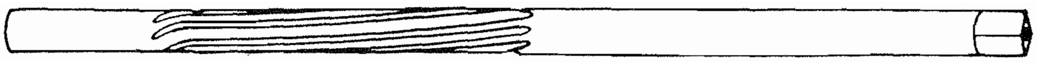
The Depth Micrometer is one of the basic measuring tools selected by machinists.

Rachet stop for consistent and repetitive measurements.

*NOTE: All precision measuring devices must have a current calibration that is traceable to the National Bureau of Standards.



87



88

Reamers, Rocker Shaft Support Boss

4903-1- .645" Roughing (.609" Pilot)
4903-2- .680" Roughing (.643" Pilot)
4903-3- .703" Finishing (Use with 4903-1 & 4903-2) (.678" Pilot)
4903-4- .708" Finishing (Use with 4903-1 4903-2 & 4903-3) (.701" Pilot)
4903-5- .723" Finishing (Use with 4903-1, 4903-2, 4903-3 & 4903-4) (.706" Pilot)

NOTE: 5129 SERIES ARE FOR STRAIGHT VALVE ENGINES ONLY.

5129-1- .753" Roughing (.718" Pilot)
5129-2- .788" Roughing (.751" Pilot)
5129-3- .813" Finishing (Use with 5129-1 & 5129-2) (.786" Pilot)
5129-4- .818" Finishing (Use with 5129-1 & 5129-3) (.815" Pilot)
5129-5- .833" Finishing (Use with 5129-1, 5129-2, 5129-3 & 5129-4) (.815" Pilot)

Reamer, Rocker Arm & Shaft Bushing

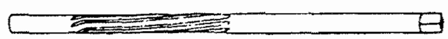
4905- .609" Std. (.594" Pilot)

Reamer, Rocker Shaft Bushing

5130- .751" Std (.707" Pilot)

Reamer, Rocker Arm Bushing

7232- .751" Std. (.732" Pilot)

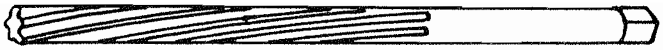


89

Reamers, Valve Guide Boss

Use at 275 RPM maximum

		USE MORSE ADAPTER
4914-1HS — .537"	.005" O.S. (.531" Pilot)	2689
4914-2HS — .542"	.010" O.S. (.534" Pilot)	2689
4914-3HS — .552"	.020" O.S. (.539" Pilot)	2689
4914-4HS — .547"	.015" O.S. (.539" Pilot)	2689
4914-5HS — .561"	.030" O.S. (.549" Pilot)	2689
4943-1HS — .631"	.005" O.S. (.624" Pilot)	2693
4943-2HS — .636"	.010" O.S. (.628" Pilot)	2693
4943-3HS — .646"	.020" O.S. (.633" Pilot)	2693
4943-4HS — .641"	.015" O.S. (.631" Pilot)	2693
4943-5HS — .656"	.030" O.S. (.645" Pilot)	2693



(90)

Engine Application Chart For Valve Guide Stem Hole Reamers

REAMERS				USE MORSE ADAPTER NO.
CARBIDE-TIPPED	HIGH-SPEED STEEL	CUTTING DIA.	PILOT DIA.	
2847-2CP	2847-2HP	.438	.422	2686
4913-1CP	4913-1HP	.344	.331	2684
4913-1CP	4913-1HP	.344	.331	2684
3606-CP	3606-HP	.375	.363	2684
2847-2CP	2847-2HP	.438	.422	2686
2847-1CP	2847-1HP	.436	.422	2686

Adapt square Shank Reamers to No. 2 or 3 Morse Taper

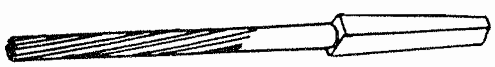
Part No.	Morse O.D.	Shank	Flats
2684	2	.323"	.242"
2686	3	.367"	.275"
2689	3	.480"	.360"
2693	3	.590"	.442"

4104 Reducer Sleeve, No. 2 Morse I.D. to No. 3 Morse O.D. sleeve only-will not fit reamer shank.

NOTE.....DO NOT use high-speed reamers on ni-resist guides.

Suggestions For Reaming Valve Guide Stem Holes

1. Use high quality cutting oil.
2. Reamers are made to cut right hand only-**do not** turn backwards even a partial turn!
3. If using power, run high-speed reamers at 400 RPM maximum, and carbide-tipped at 700 RPM maximum. High-speed steel reamers for hand cutting.
4. The #5221B universal cylinder holding fixture is recommended for stem hole reaming, using a drill press or vertical mill.



(91)

Plug Gauges, Valve Guide Stem Hole

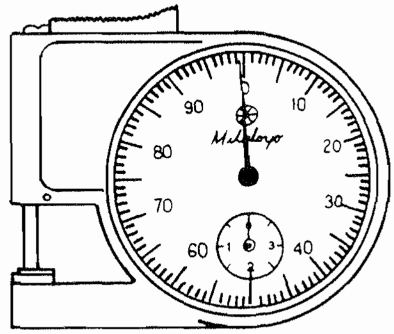
Go and No-go Gauges are used to check for new limits (and service limits where applicable). Gauges are heat-treated alloy steel, precision ground.

2848-1- .436" I.D. Guide
2848-2- .438" I.D. Guide
3615- .375" I.D. Guide

(92)

*Dial Thickness Gage

For use in measuring wall thickness in hard to reach areas.

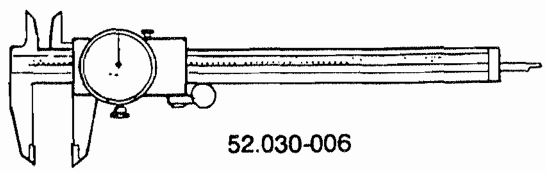


93

7308

*Precision Vernier Calipers

Precision Vernier instruments offer a wide range of precise tools for measuring accurately in thousandths of an inch. These include Vernier Calipers and Vernier Height gages in both the English and Metric Measure.



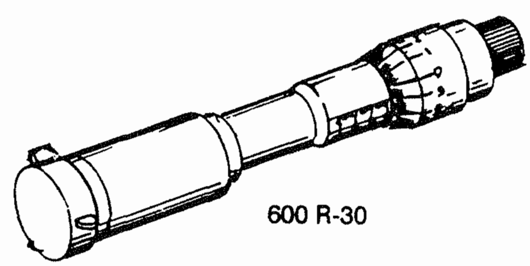
52.030-006

94

*Inside Measuring Instruments

Three measuring surfaces are lapped parallel to the longitudinal axis of the Micrometer, and stay aligned with the bore while measurements are taken.

Large ratchet stop provides constant measuring pressure to the wall surface, and insures repetitive reading to .0002" or .0001" (smaller ranges).



600 R-30

95

*NOTE: All precision measuring devices must have a current calibration that is traceable to the National Bureau of Standards.

*Alternator Analyzer

Voltage Regulator Tester

For field or bench use

* Designed to pinpoint developing problems before a total system breakdown occurs.

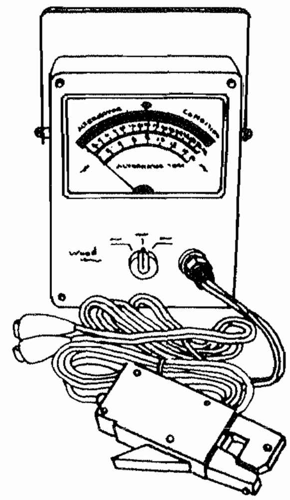
* Oscilloscope type performance with easy to use "ok" or "Defective" presentation.

* Detects failing diodes before normal indications occur.

EASY TO USE

* Inductive probe clamps over wire for alternator ripple test.

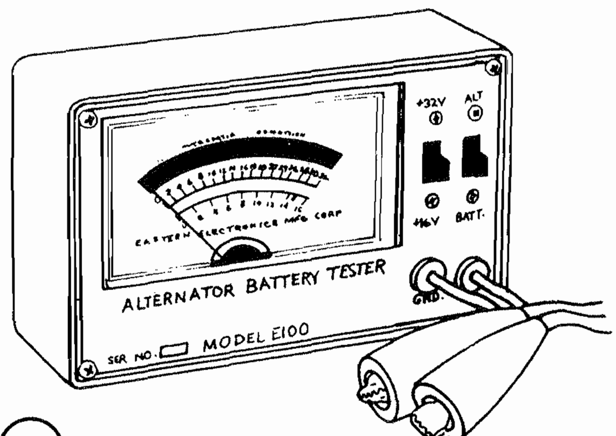
* Voltage regulator test leads clip on alternator output terminal and engine ground.



96

*Alternator/Regulator/ Battery Tester Model E100

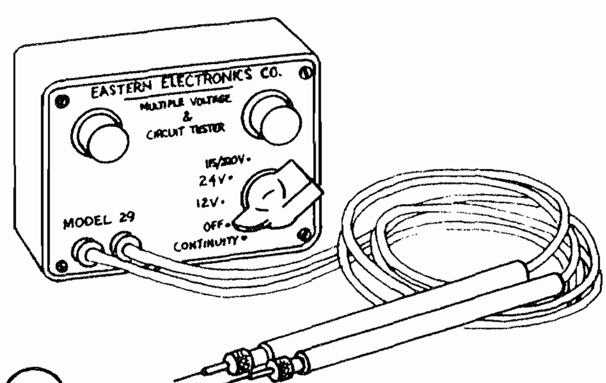
Designed to test alternators, regulators, batteries on 12 and 24 volt systems with currents up to 32 volts DC. Has a pointer zero adjustment screw on the face of the instrument. Circuitry is entirely solid state and no battery or power source is required. Power for the unit is derived from the systems under test.



97

*Multiple Voltage & Circuit Tester For 12 & 24 Volts Model 29

Designed to test continuity of circuits, shorts, diodes, live circuits both low and high voltage in aircraft ignition and electronic equipment. Reads both AC and DC in all positions. Has easy-to-see bright red signal lights, with bulbs replaceable by unscrewing lenses of face of tester.



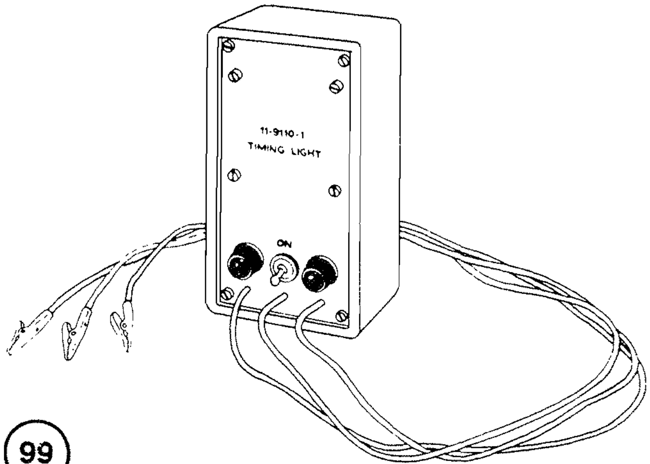
***WARNING . . . Keep equipment and personnel clear of prop area.**

98

*Aircraft Magneto Timing Light

P/N 11-9110-1

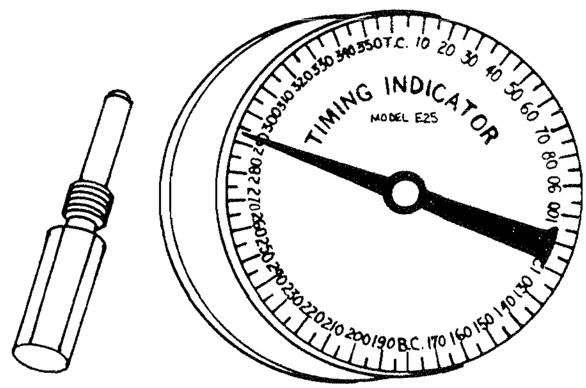
Designed for internal timing of "E Gap" and mag-to-engine timing. Precision solid state oscillator circuit sees coil primary winding as high impedance while checking continuity through contact points. When points open lights go out. Built rugged for years of reliable service. Uses four C-cell flashlight batteries.



99

*Aircraft Timing Indicator Model E25

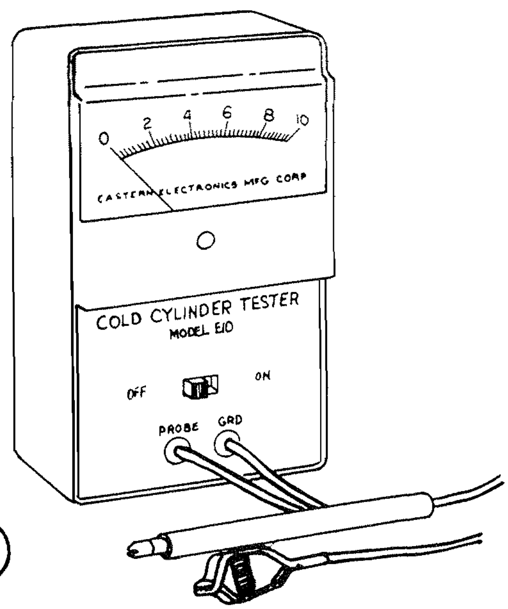
Improves the accuracy and speeds up the process of timing an aircraft magneto to the engine. Easily attached to the propeller spinner with mounting bands. Has top dead center locator.



100

*Cold Cylinder Test Model E10

Attach one wire with an alligator clamp and use another cable with a hand-held probe to test comparative temperatures from cylinder to cylinder in a matter of seconds. Spot source of rough running, mag drop or loss of power in a matter of minutes.



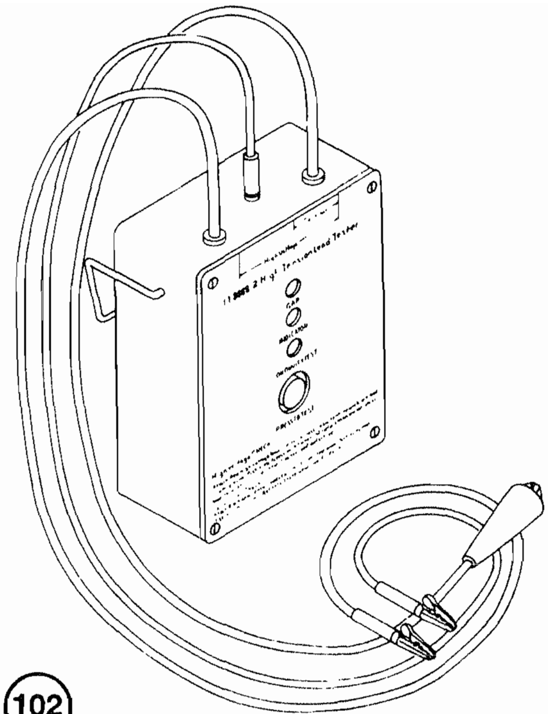
101

***WARNING . . . Keep equipment and personnel clear of prop area.**

High Tension Lead Tester Kit

P/N 11-8950-2

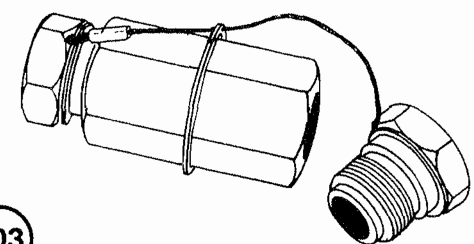
Designed for quick and simple troubleshooting of shielded ignition leads. Accurate on even the longest leads, high voltage pulses test insulation for leak. Built-in continuity lamp provides handy test of electrical connections. Uses two c-cell flashlight batteries. Includes top grain cowhide carrying case.



102

Master Orifice Tool
P/N 646953

Attach to differential cylinder pressure tester to check calibration and determine the low leakage limit. (Ref. TCM Service bulletin M84-15).



103

CYLINDER HEAD TEMPERATURE
EXHAUST GAS TEMPERATURE
TEST UNITS

*Alcor Portable
Digital EGT Unit

For use with Type "K" Thermocouple. This device is lightweight 9 volt LCD unit, with a disposable battery.

Temperature Range 1000^{o}-1800^{o}F.

Part Number 85328

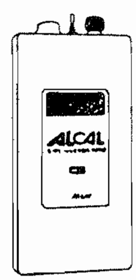
(104)

*Alcor Portable
Digital CHT Unit

This device is used with Type "J" Thermocouple. It is a lightweight 9 volt LCD unit, with disposable battery.

Temperature Range 200^{o}-600^{o}F.

Indication from 32^{o}-600^{o}F.



Part Number 85329

(105)

***WARNING . . . Keep equipment and personnel clear of prop area.**

INTENTIONALLY

LEFT

BLANK

CHAPTER 3

DETAILED ENGINE DESCRIPTION

Section Index

3-1 DESCRIPTION OF ENGINE MODEL CODE

DETAILED ENGINE DESCRIPTION
Example:
TSIO - 520 - BE (1)

Prefix

TS - Turbosupercharged

I - Fuel Injection

O - Horizontally Opposed Cylinder Configuration

Displacement 520 Cubic Inch Cylinder Volume Displacement

SUFFIX
The "BE" Letter Identifies the Model of Engine

(1) Specification Number

Refer to Specification Manual X30508A for Information

3-2 BASIC DESIGN FEATURE

The TSIO-520-BE engines are air cooled, having six horizontally opposed, overhead, inclined valve cylinders. The cylinder displacement of 520 cubic inches is achieved with an 5.25 inch bore and a 4.00 inch stroke. The TSIO-520-BE engine is turbosupercharged and has a 7.5 to 1 compression ratio. The TSIO-520-BE engine is fuel injected with a pressurized, balanced induction system. The crankshaft is equipped with pendulum type counterweight dampers that suppress torsional vibrations.

The TSIO-520-BE engine has a doweled six bolt hole configuration propeller flange. A mounting pad is provided to utilize a hydraulic controlled governor for the constant speed propeller.

The TSIO-520-BE engine is a wet sump design with a positive displacement oil pump installed on the lower aft portion of the crankcase. The desired oil pressure is maintained by a pressure relief valve located in the oil pump housing. Engine oil temperature is maintained by an oil temperature control valve located in the oil cooler. Engine cranking is accomplished by a geared right angle drive starter adapter and a direct current starter motor.

A gear driven alternator is installed on the right front side of the crankcase forward of the number 5 cylinder. The engine is equipped with two gear driven magnetos. The exhaust system is supplied by Teledyne Continental Motors.

3-3 LUBRICATION SYSTEM

Oil is drawn from the sump through the suction tube to the intake side of the engine driven, gear type, oil pump. From the outlet side of the pump, oil is directed to the full flow, replaceable oil filter. A bypass valve is incorporated in the filter in the event that the element becomes clogged. An oil pressure relief valve is incorporated in the oil pump housing.

From the filter discharge port, oil is directed through a crankcase passage to the oil cooler. In addition to facilities for temperature and oil pressure connections, 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 or directly to the crankcase passage to the rear of the camshaft, depending on the oil temperature. In this manner, engine oil temperature is maintained at 180°F.

Oil entering the engine is directed to the hollow camshaft, which serves as the engine main oil gallery. Grooves and drilled holes in the camshaft are located so as to afford proper lubrication through a system of orifices to the main bearings, lifters, idler gear bushing, accessory drive gear bushings and the starter drive gear bearing.

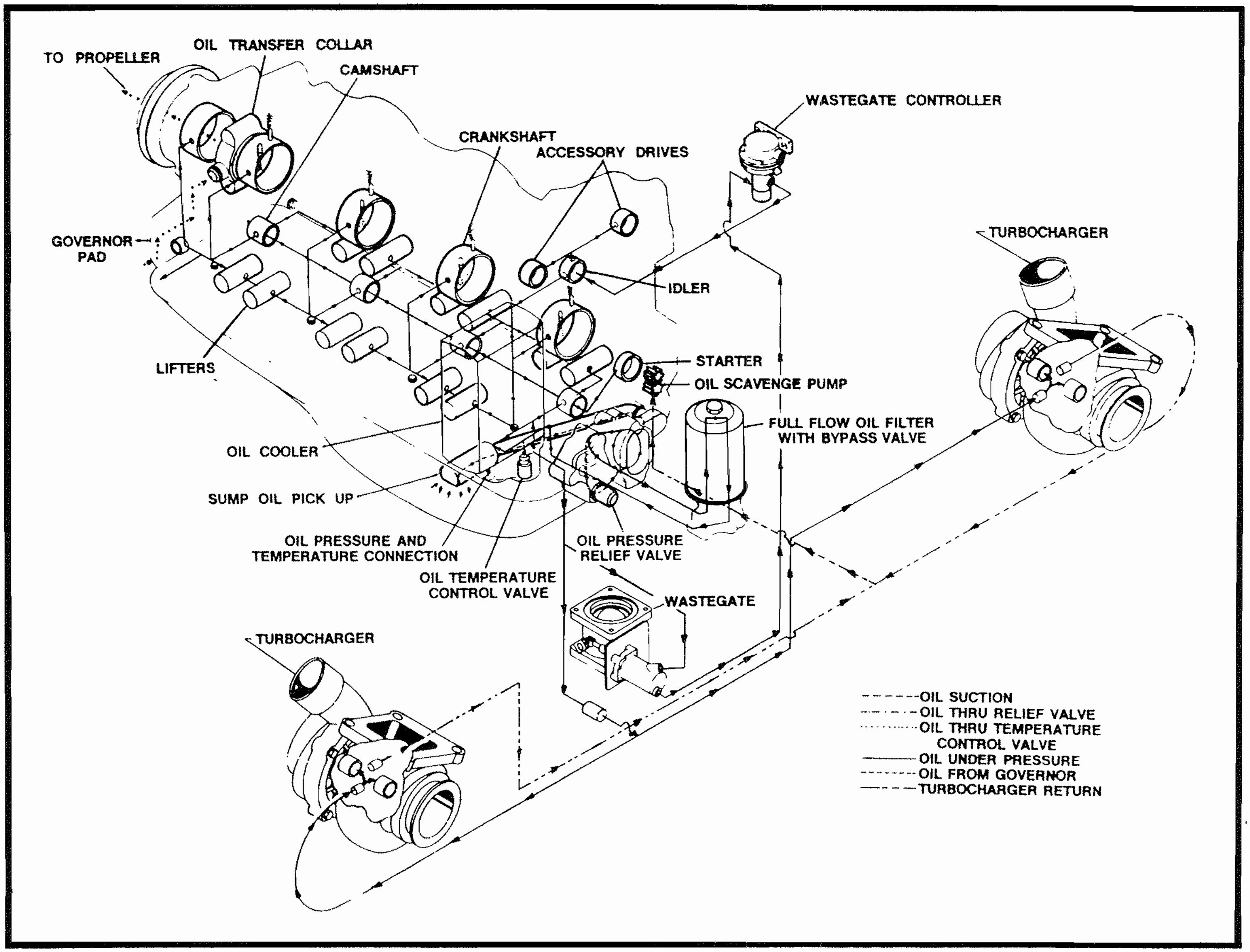


FIGURE 3-1. LUBRICATION SYSTEM SCHEMATIC.

Oil leaving the camshaft interior at the front of the crankcase is directed to the left main crankcase gallery. From there it is directed to the main thrust bearing and the governor drive gear.

From the governor drive gear, lubricating oil is directed from the left main gallery through drilled crankcase passages and free floating oil transfer collar to the crankshaft. Oil then travels through a transfer plug installed in the inside diameter of the crankshaft and is routed to the variable pitch propeller. Hydraulic valve lifters transfer oil from the main oil galleries to the cylinder overhead; roto coils are used on all valves to assure controlled positive rotation.

Oil transfer tubes and drain holes are provided to return oil to the sump.

3-4 INDUCTION SYSTEM

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

Refer to Pilots Operating Handbook for alternate air door operations.

The turbocharger compressor is a high volume air pump connected to the opposite end of the turbocharger turbine (see Turbocharger System). It increases the volume and pressure of air admitted to the cylinder for combustion. At high compressor discharge pressures, considerable heating of the induction air occurs, due to compression.

The aftercooler is a heat exchanger which lowers the temperature of the compressor discharge air to permit more efficient engine and turbocharger operation. The induction air passes through the core of the after cooler and transfers some of its heat to the cooling fins which are exposed to the relatively cooler ram air.

The manifold is an air distribution system mounted on top of the engine. It serves to carry induction air to the individual cylinder intake ports.

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

Overboost protection is provided by a pressure relief valve located between the compressor and the throttle. In the event of a wastegate or controller malfunction resulting in excessive discharge pressures, the relief valve will open to prevent excessive manifold pressure.

3-5 EXHAUST SYSTEM

The exhaust system used on the TSIO-520-BE engine consists of left hand and right hand exhaust; collector assembly which is composed of; elbow riser on cylinder's 5 & 6, tee riser on cylinder's 3 & 4, tee riser (with turbomounting flange) on cylinders 1 & 2, turbochargers tail pipes, exhaust bypass assembly, wastegate and control assembly. The exhaust collector assemblies are mounted to the cylinders, the turbochargers are mounted to the collectors and have mounting brackets from the turbocharger to the rear engine mounts, the balance tube is slip fit mounted to the no. 1 & 2 riser tees, the tail pipes are mounted on the turbochargers and the wastegate with actuator control assembly is mounted between the left/hand tail pipe and exhaust bypass assembly. The complete exhaust system is provided by Teledyne Continental Motors.

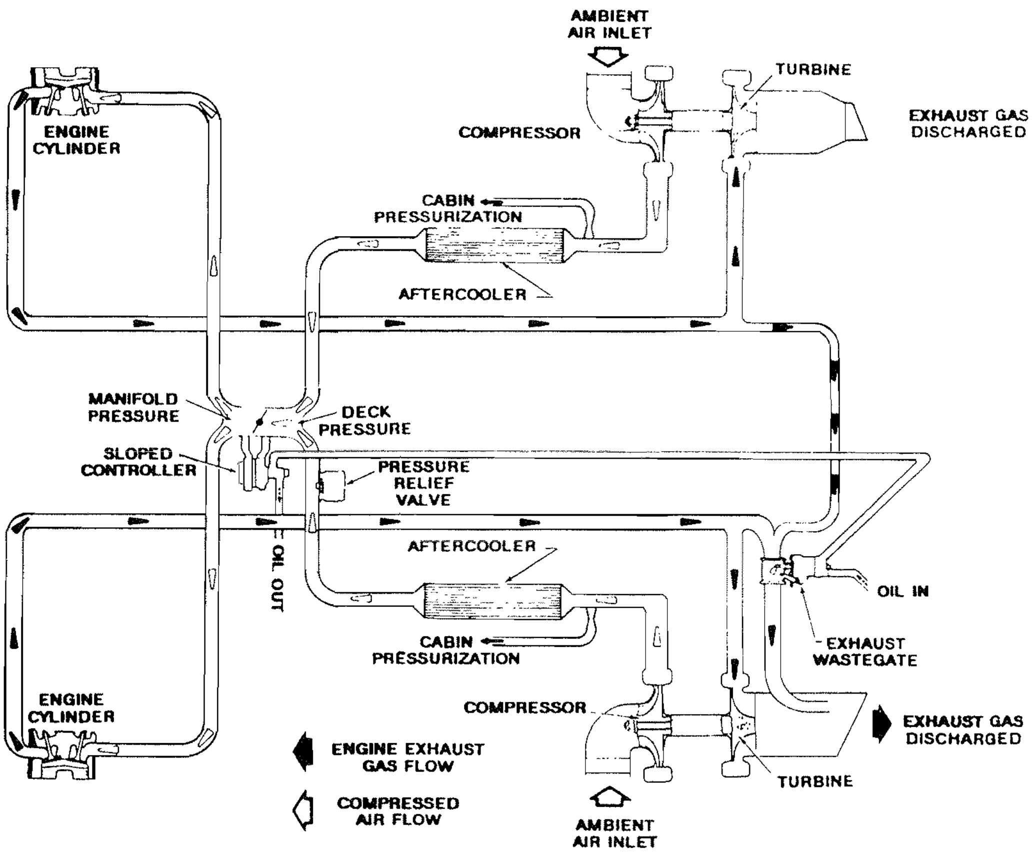


FIGURE 3-2. INDUCTION AND EXHAUST SYSTEM SCHEMATIC.

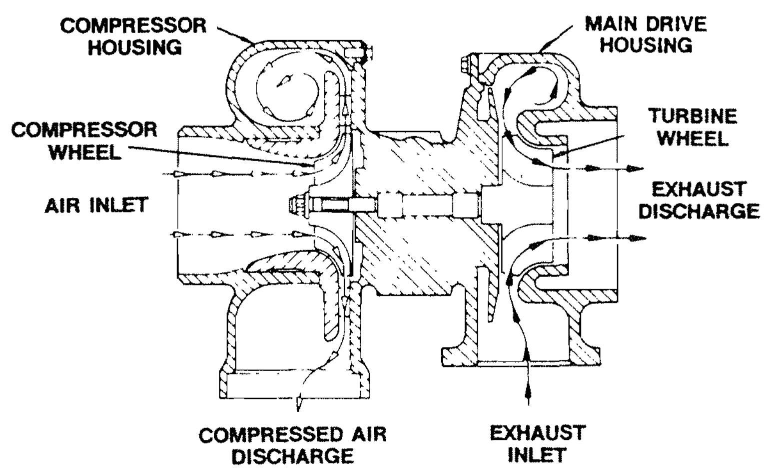


FIGURE 3-3. TURBOCHARGER SECTIONAL.

3-6 TURBOCHARGER SYSTEM

The function of the turbocharger system is to maintain a desired manifold pressure at a given throttle setting, regardless of varying conditions of ambient air temperature and pressure.

The complete turbocharger system consists of two turbines and compressor assemblies, wastegate assembly, a sloped pressure controller, two sonic venturi, and necessary hose, linkage and ducting required for a functional installation.

(2) sonic venturis permit the restricted flow of compressor air for aircraft cabin pressurization. When air flow through the unit reaches approximately 5 pounds per minute each, it becomes critical; that is, 5 pounds per minute each is the maximum flow the sonic venturi will permit regardless of pressure at the inlet. When air from the sonic venturis is not used for cabin pressurization, the air is bled into the nacelle.

3-7 IGNITION SYSTEM

Conventual twin ignition is provided by two magnetos. The left magneto fires the 1-3-5 lower and 2-4-6 upper spark plugs, while the right magneto fires the 1-3-5 upper and 2-4-6 lower spark plugs.

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

3-8 FUEL SYSTEM

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

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

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

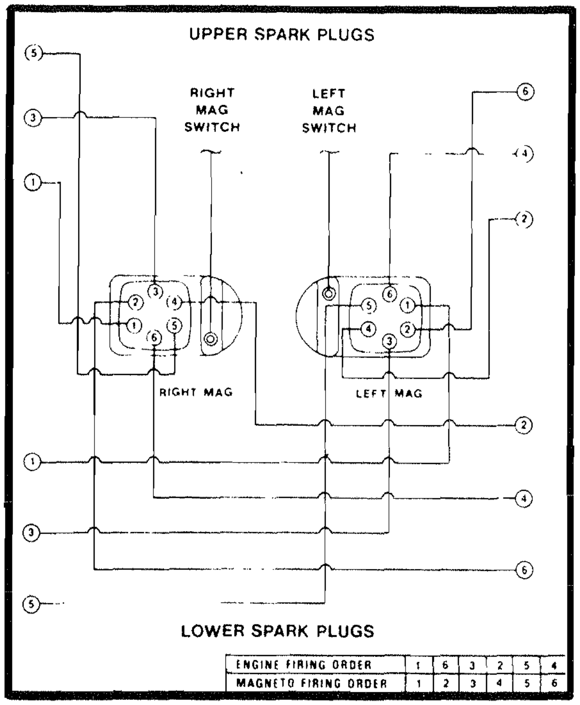


FIGURE 3-4. IGNITION WIRING DIAGRAM.

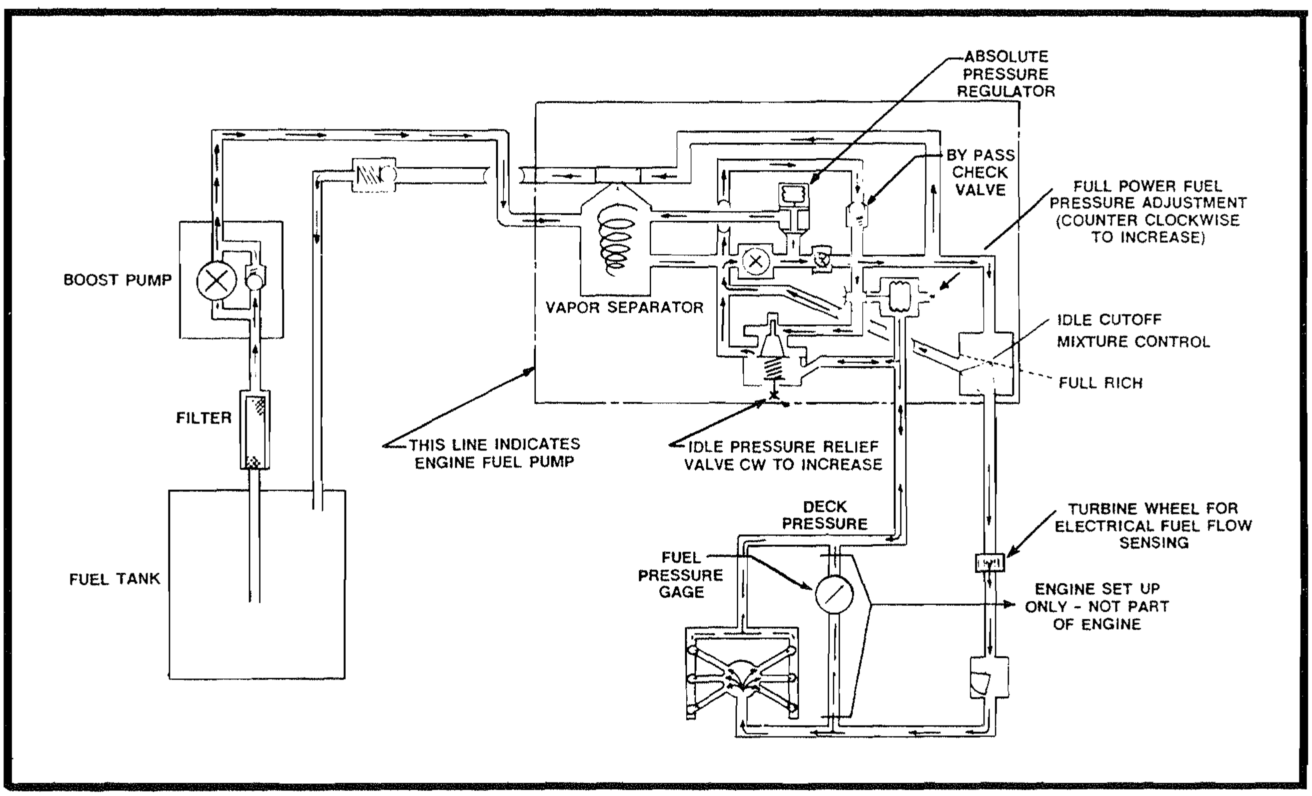


FIGURE 3-5. FUEL INJECTION SYSTEM SCHEMATIC.

The fuel metering unit/air throttle controls the amount of intake air admitted into the intake manifold and meters the proportionate amount of fuel to the fuel manifold valve. The assembly has two control units; one for air in the air throttle assembly, and one for the fuel control unit.

The manifold valve receives fuel from the metering unit. When fuel pressure reaches approximately 3.5 psi, the valve in the manifold valve opens and admits fuel to the six ports in the manifold valve (one port for each nozzle line). The manifold valve also serves to provide a clean cutoff of fuel to the cylinder when the engine is shut down.

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

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

Since the size of the fuel nozzles is fixed, the amount of fuel flowing through them is determined by the pressure applied. For this reason, fuel flow may be accurately determined by measuring the pressure at the manifold valve. (Refer to Chapter 13 Performance Charts).

All of the items described above are interdependent on each other to meter the correct amount of fuel according to the power being developed by the engine.

3-9 CYLINDERS

The externally finned aluminum cylinder heads are heated and threaded on to the steel alloy barrels. The valve guides and seats are pressed into the cylinder head. When the entire unit has cooled, a permanent cylinder assembly results. Replaceable helical coil inserts are installed in the spark plug ports.

3-10 VALVE TRAIN

Exhaust valves are faced with a special heat and corrosion-resistant material and the valve stems are chromed for wear resistance. Oil fed to the hydraulic valve lifters, under pressure from the main galleries, lubricate the lifter guide surfaces and fill the reservoirs inside the lifters. Oil from the lifters flows through the pushrods to the rocker arms. Each rocker arm directs a portion of its oil through a drilled orifice toward the respective valve stem. Oil is returned to the crankcase through the pushrod housings, which are sealed to the cylinder head and crankcase by rubber seals. Drain holes in the lifter guides direct returning oil to the sump.

CHAPTER 4

ENGINE SPECIFICATIONS AND OPERATING LIMITS

Section Index

4-3 GENERAL

The operating limits and specifications listed in this section are applicable to the TSIO-520-BE aircraft engine. Consult Chapters 6 and 7 for additional operating procedures.

4-2 ENGINE SPECIFICATIONS

Manufacturer . . . . Teledyne Continental Motors

Model TSIO-520-BE

Cylinders

- Arrangement . . . . Individual cylinders in a horizontally opposed position.
- Compression Ratio 7.5:1
- Firing Order 1-6-3-2-5-4
- Cylinder Head Temperature Maximum Allowable . . . . 460°F
- Number of cylinders 6

Numbering (Accessory toward propeller end):

- Right Side cylinders 1-3-5
- Left Side cylinders 2-4-6
- Bore (Inches) 5.25
- Stroke (Inches) 4.00
- Piston Displacement (cu. in.) 520

Dimensions

- Length . . . . 42.64 In.
- Width . . . . 42.50 In.
- Height . . . . 33.50 In.

Engine Weight - Dry (No oil in sump)

Complete Engine Includes:

Crankcase assembly, crankshaft assembly, camshaft assembly, valve drive train, cylinder assemblies, pistons, 6 connecting rod assemblies, oil sump assembly, inter-cylinder baffling, alternator, starter, starter adapter assembly, lubrication system (includes oil filter), accessory drives, ignition system (includes spark plugs), fuel injection system (includes starting primer), induction system, exhaust system, turbocharger system, all engine to engine attaching hardware, hoses clamps and fittings.

Total Weight . . . . 565.5 Lbs.
(Subject to production variation of + 2.5%)

Does not include:

Outer cylinder baffling, prop governor, airframe to engine control cables, attaching hardware, hose clamps and fittings.

Brake Horsepower

- Rated Maximum Continuous Operation 310
- Recommended Maximum for Cruising 232

4-3 OPERATING LIMITS

Crankshaft Speed - RPM

- Rated Maximum Continuous Operation 2600
- Rated Maximum Take-Off 2600
- Recommended Max. for Cruising (75% Power) 2400

Intake Manifold Pressure (In. Hg.)

- Maximum Take-Off .... 38.0 in. hg.
- Maximum Continuous .... 38.0 in. hg.
- Recommended Continuous Max. for Cruising .... See Performance Chart

Fuel Control System .... Continental Continuous Flow Injection

Unmetered Fuel Pressure (P.S.I.G.)

- Idle (700 RPM) .... 5.5 - 7.0
- Takeoff .... 23 - 26

Fuel-Avia. Gasoline-Min. Grade .... 100LL (Blue) or 100 (Green)

Oil Specification .... (Refer to Chapter 9 for Spec. MHS-24 or MHS-25)

- All Temperatures 15W-50
- 20W-50
- Below 50°F Ambient Air (Sea Level) .... SAE 30 or 10W-30
- Above 30°F Ambient Air (Sea Level) .... SAE 50

Oil Pressure

- Idle, Minimum, psi 10
- Normal Operation, psi .... 30 to 60

Oil Sump Capacity (U.S. Quarts) 8

- Usable Oil - Quarts 16° Nose Up 5
- Usable Oil - Quarts 10° Nose Down 4.5

Oil Consumption (Lb./BHP/Hr. Max. at rated power and RPM .... $\frac{.006 \times \% \text{ Power}}{100}$

Oil Temperature Limits

- Minimum for Take-Off .... 75°F
- Maximum Allowable .... 240°F
- Recommended Cruising .... 170°-200°F

Turbocharger

- T.I.T. - °F
  - Continuous .... 1750°
  - Peak - 30 Second Limit .... 1850°F
- Exhaust Pressure at Turbine Outlet inches Hg. Gage .... 2.0 In. Hg. above ambient
- Max. Speed - RPM (at Max. T.I.T.) - 1750° 122,000

Ignition Timing (Compression stroke, breaker opens)

Right Magneto, degrees BTC . . . . 24°

Left Magneto, degrees BTC . . . . 24°

4-4 ACCESSORIES

Magnetos (2) Slick Electro 6220 Pressurized Series.

The following spark plugs are approved for use on this engine:

AC	271, 273, 281, 2811R, 283, 28311R, 291, 293
Auto Life	PL350, SL350
Champion	RHB32E, RHB32N, RHB32P, RHB32W, RHB33E, RHB36P, RHB36W
Red Seal	LJ360

ACCESSORIES DRIVE RATIOS TO CRANKSHAFT (Viewing Drive)

	Accessory	Direction of Rotation*	Drive Ratio to Crankshaft
	Tachometer	CCW	.5:1
	Magneto	CCW	1.5:1
	Starter	CCW	48:1
	Alternator (Gear Dr.)	CW	3:1
**	Propeller Gov.	CW	1:1
	Fuel Pump (Injection)	CW	1:1
	Accessory Drives (2)	CW	1.5:1
***	Accy. Drive (Optional)	CCW	3:1

* "CW" - Clockwise and "CCW" - Counterclockwise

** This drive is a modified AND20010 and is supplied with cover plate only.

*** Belt Tension 60± 10 Lbs.

CHAPTER 5

UNPACKING, INSTALLATION, TESTING AND REMOVAL

Section Index

5-1 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 eyes, located at the top of the crankcase backbone. Take up slack on the hoist, then cut the steel banding strips 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.

Packaging Category "B" (Wooden Container)

1. Remove the four (4) 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 two engine lifting eyes located forward and aft of engine. 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.

5-2 PREPARATION FOR SERVICE

If the engine is **not** to be installed within five (5) days after unpacking, it should be represerved in accordance with procedures listed in Chapter 11.

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 cylinders. Remove the shipping plugs installed in the upper spark plug holes and inspect the cylinder bores with a flashlight or borescope for rust or contamination. Contact your Teledyne Continental Motors Distributor if any abnormal condition is noted.

Install the upper spark plugs finger tight and torque the lower spark plugs to 300-360 in. lbs. Do not lubricate spark plug threads prior to installation.

NOTE . . . Remove exhaust port protective plugs. Service the lubrication system with mineral (non-detergent) oil or Corrosion Preventive oil corresponding to (MIL-C-6529 Type II). See Chapter 4 for sump capacity.

Remove the shipping plate from the propeller governor pad forward of number 6 cylinder. Lubricate the governor shaft splines with engine oil; install a new gasket and then install the propeller governor control. Attach with plain washers, new lock washers, and torque the nuts to 180-220 inch pounds.

CAUTION . . . Align spline of governor drive gear and assure that the governor is fully seated to the crankcase prior to installing the attaching hardware. This will eliminate the possibility of misalignment forcing the drive gear off location within the crankcase.

Optional Accessories: Optional accessories such as hydraulic pumps, vacuum pumps, etc., may be installed on the magneto and accessory drive pads located on the upper rear portion of the crankcase. Remove the accessory drive covers and install new gaskets. Install accessories in accordance with the airframe manufacturer's instructions.

Install all airframe manufacturer required cooling baffles, hoses, fittings, brackets and ground straps in accordance with airframe manufacturers installation instructions.

5-3 ENGINE INSTALLATION INSTRUCTIONS (See Figures 5-1 through 5-5)

Install per airframe manufacturers instructions and the following generalized instructions. The engine should be hoisted just above the nacelle using the lifting eyes.

Before engine installation disconnect and plug hoses from wastegate actuator and turbochargers. Install caps on wastegate and turbocharger fittings to prevent entrance of foreign matter. Remove clamp from left-hand turbocharger tailpipe, remove the rod from right hand side of turbo bypass assembly, remove left hand tailpipe, wastegate, actuator, bypass as one assembly. Remove (2) nuts, (2) bolts from turbomounting bracket, remove (4) nuts, (4) bolts from turbomounting flange, remove (2) turbochargers, engine is now ready for installation on airframe.

NOTE . . . Install according to airframe manufacturer's instructions.

NOTE . . . Remove all protective covers, plugs, caps and identification tags as each item is connected or installed.

1. After engine is installed reinstall turbochargers, left-hand tailpipe, wastegate, actuator and bypass assembly. Reconnect hoses to controller and turbochargers, safety as required. (See Overhaul Manual X30574A chapter, Section 72-40 for proper "V" band clamp installation.)

NOTE . . . See airframe manufacturer's instructions for engine to airframe connections.

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

CAUTION . . . Do not install the ignition harness "B" nuts on the spark plugs until the propeller installation is completed. Failure to comply could result in bodily injury when the propeller is rotated during installation.

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

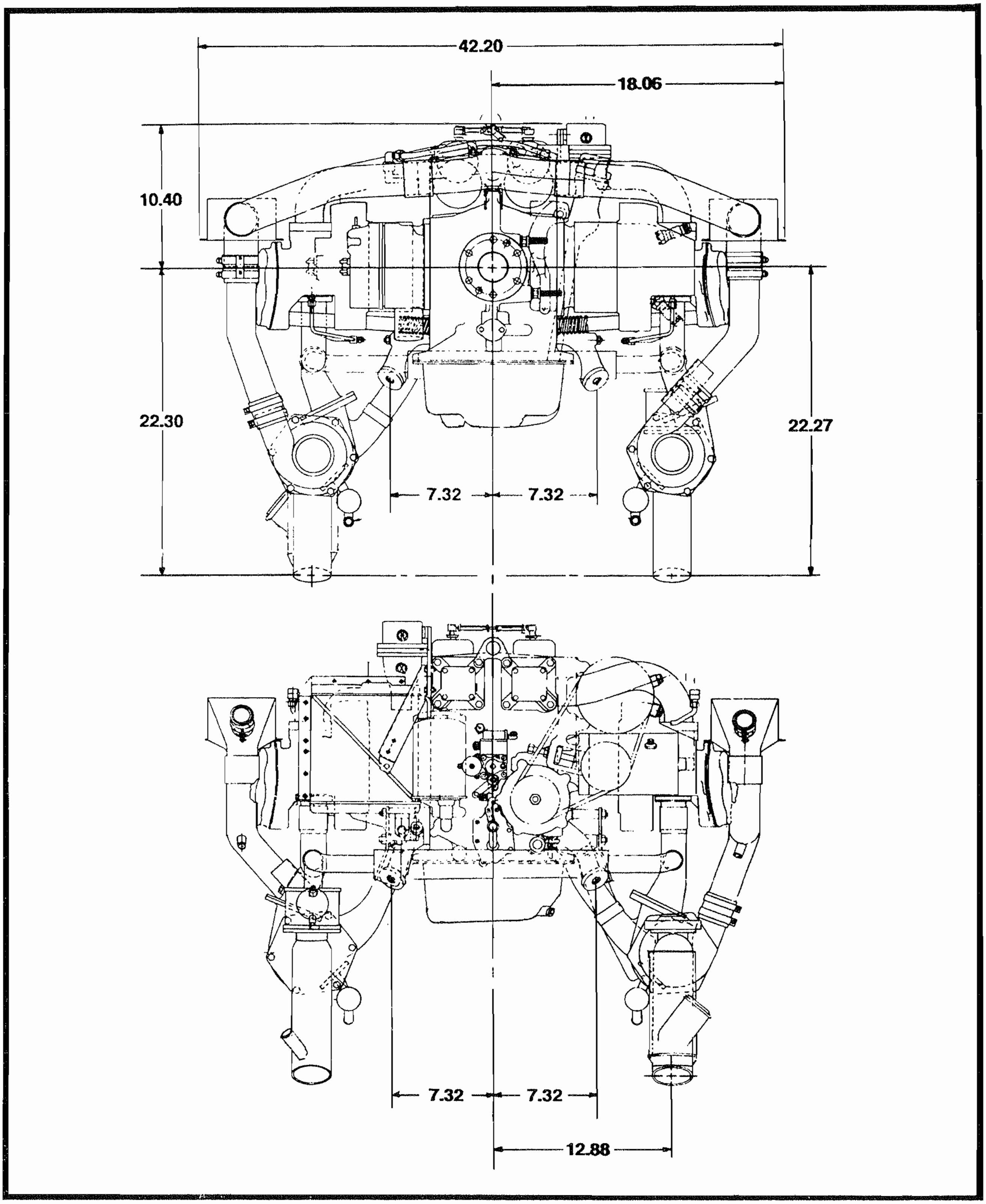


FIGURE 5-1. INSTALLATION DRAWING TSIO-520-BE

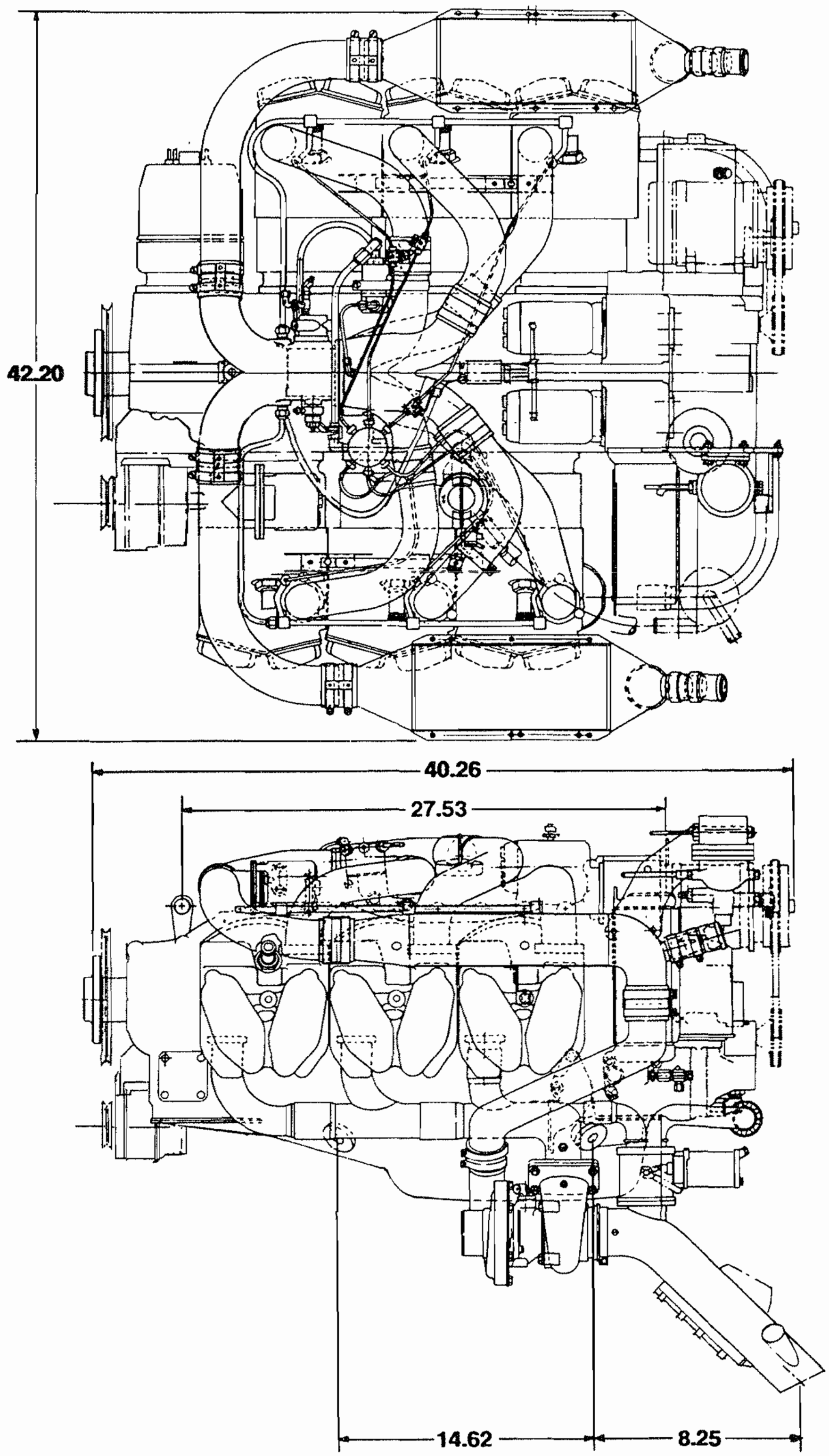


FIGURE 5-2. INSTALLATION DRAWING TSIO-520-BE

5-4 PREFLIGHT AND RUN-UP

The engine lubrication system must be pre-oiled prior to starting. This can be accomplished using a pressure oiling system installed into a main oil gallery or the oil pump. An acceptable alternate method is to use the engine starter to motor the engine with the top spark plugs removed until an oil pressure indication is noted.

NOTE . . . Recheck the oil level in the sump if the pre-oiling method was used. Do not operate the engine with more or less than the oil sump capacity. (8 quarts).

If the magneto attaching nuts were loosened or the magnetos rotated during engine installation, magneto to engine timing must be accomplished prior to starting.

Install and torque the upper spark plugs to 300-360 in. lbs. Install the ignition harness "B" nuts to the spark plugs in the order shown in Fig. 3-4. "B" nuts are identified for position, i.e. "1T" for number one top spark plug etc.

Start the engine in accordance with the procedures listed in Section VI or the airframe manufacturer's operator's manual.

Unmetered and metered fuel pressures should be adjusted prior to flight. Consult TCM Service Bulletins for detailed fuel system adjustment procedures and airframe procedures.

The engine has been tested at the factory and requires no further high power break-in on the ground. High power ground operation can be detrimental to cylinders, pistons, valves and rings.

5-5 FLIGHT TESTING

The engine has received a test cell run-in prior to leaving the factory, however a two hour flight test is recommended to assure that the piston rings have seated and that no induction system, exhaust system, oil or fuel system leaks exist prior to releasing the aircraft for normal service.

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 aircraft 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 altitude to gain optimum airspeed and cooling. Rich mixture should be used for all operations except lean for field elevation, (where applicable), and lean to maintain smoothness during climb in accordance with airframe manufacturers operating instructions.

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. Engine controls or aircraft altitude should be adjusted as required to maintain engine instrumentation within specifications.

The descent should be made at low cruise power settings, with careful monitoring of engine pressures and temperatures. Avoid long descents with cruise RPM and manifold pressure below 18" Hg.; if necessary decrease the RPM sufficiently to maintain manifold pressure.

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

The engine can now be operated in normal service in accordance with the aircraft flight manual.

5-6 ENGINE REMOVAL INSTRUCTIONS

(Use airframe manufacturer's instructions in conjunction.)

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

NOTE . . . If the engine is being removed to be placed in storage, accomplish steps listed in Chapter 11, in the section titled "Indefinite Storage" prior to removal.

1. Turn all cockpit switches and fuel selector valves OFF.
2. Disconnect the battery ground cable.
3. Disconnect the starter cable.
4. Tag and disconnect the engine wiring bundle from the following components.
    a. Magnetos
    b. Alternator
    c. Oil temperature bulb
    d. Cylinder head temperature bulb
    e. Remove all clamps attaching engine wire bundle to engine components and route clear of the engine.

Accomplish the following items:

1. Drain the engine oil from the sump. Replace drain plug and tighten.
2. Remove the propeller in accordance with airframe manufacturer's instructions.
3. Remove engine to airframe connections in accordance with airframe manufacturer's instructions.
4. Disconnect and plug hoses from wastegate actuator and turbochargers. Install caps on wastegate and turbocharger fittings to prevent entrance of foreign matter. Remove clamp from left-hand turbocharger tail pipe, remove tie rod from right hand side of turbo bypass assembly, remove left hand tailpipe, wastegate, actuator, bypass as one assembly. Remove (2) nuts, (2) bolts from turbomounting bracket, remove (4) nuts, (4) bolts from turbomounting flange, remove (2) turbochargers.

Attach a hoist to the engine lifting eye and relieve the weight from the engine mounts.

CAUTION . . . Place a suitable stand under the aircraft tail cone before removing the engine. The loss of weight may cause the tail to drop.

Remove the engine as follows:

1. Hoist engine vertically out of the engine compartment and clear of the aircraft.

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

2. Install engine on a transportation stand, dolly, or on the engine shipping container base.

5-7 GROUND HANDLING

After engine is removed from aircraft or 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.

5-8 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.

CHAPTER 6

NORMAL OPERATING PROCEDURES

Section Index

6-1 GENERAL

CAUTION . . . This section pertains to operation under standard environmental conditions. The pilot should thoroughly familiarize himself with Chapter 8, Abnormal Environmental Conditions. Whenever such abnormal conditions are encountered or anticipated, the procedures and techniques for normal operation should be tailored accordingly. For example, if the aircraft is to be temporarily operated in extreme cold or hot weather, consideration should be given to an early oil change and/or routine inspection servicing.

The life of your engine is determined by the care it receives. Follow the instructions contained in this manual carefully.

The engine received a run-in operation before leaving the factory. Therefore, no break-in schedule is required. Straight mineral oil (MIL-C-6529 Type II) should be used for the first oil change period (25 hours).

The minimum grade aviation fuel for this engine is 100LL (Blue) or 100 (Green). If the minimum grade required is not available, use a higher rating. Never use a lower rated fuel.

> **WARNING . . . The use of a lower octane rated fuel can cause pre-ignition and/or detonation which can damage an engine the first time high power is applied, possibly causing engine failure. This could most likely occur on takeoff. If the aircraft is inadvertently serviced with the wrong grade of fuel, then the fuel must be completely drained and the tank properly serviced, prior to engine operation.**

6-2 PRESTARTING

Before each flight the engine and propeller should be examined for damage, oil or fuel leaks, security and proper servicing.

1. Assure that fuel tanks contain proper type and quantity of fuel. (100LL-Blue, or 100 Green)

2. Drain a quantity of fuel from all sumps and strainers into a clean container. If water or foreign matter is noted, continue draining until only clean fuel appears.

3. Check oil level in sump.

6-3 STARTING

1. Fuel Selector - On.
2. Mixture - Full Rich.
3. Throttle - Full Forward.
4. Prop Control - Full forward.
5. Master Switch - On.
6. Ignition Switch - On.
7. Auxiliary Fuel Pump - Off.

8. Primer - On. (See Figure 6-1 for Priming Time)
Throttle-open approximately 1 inch. Engine starter until engine starts, then release.

NOTE . . . At temperatures below +20°, continue priming while cranking until engine starts.

When engine starts and accelerates thru 500 RPM:

9. Starter - Release.

10. Throttle - Advance slowly to obtain smooth engine operation. (1-3 minutes when temperature is below +20°.)

11. Primer - Release.

12. Auxiliary Fuel Pump - Low only as necessary to obtain smooth engine operation. (1-3 minutes when temperature is below +20°.)

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

6-4 COLD STARTS

Use the same procedure as for normal start, except that more prime will normally be necessary. After the engine begins running, it may be necessary to operate the primer intermittently for a few seconds in order to prevent the engine from stopping.

6-5 FLOODED ENGINE

1. Mixture Control - IDLE CUT-OFF
2. Throttle - 1/2 OPEN.
3. Master Switch - On.
4. Both Magnetos - On.
5. Start Switch - Start.
6. When engine starts, retard the throttle and slowly advance the mixture control to FULL RICH position.

6-6 HOT STARTS

Use the same procedure as for normal start, except have mixture control idle cut-off, throttle full open, and electric fuel pump on high for approximately 15 to 20 seconds. See Chapter, Section 8-4 Starting a Hot Engine.

6-7 GROUND WARM-UP

Teledyne Continental aircraft engines are aircooled and are dependent on the forward speed of the aircraft for cooling. To prevent overheating, it is important that the following rules be observed.

1. Head the aircraft into the wind.

2. Operate the engine on the ground with the propeller in "Full Increase" RPM position.

3. Avoid prolonged idling at low RPM. Fouled spark plugs can result from this practice.

4. Leave mixture in "Full Rich". (See "Ground Operation at HIgh Altitude Airports", Section 8 for exceptions.)

5. Warm-up. 900-1000 RPM.

6-8 PRE-TAKEOFF CHECK

1. Maintain engine speed at approximately 900 to 1000 RPM for at least one minute in warm weather, and as required during cold weather, to prevent cavitation in the oil pump and to assure adequate lubrication.

2. Advance throttle slowly until tachometer indicates an engine speed of approximately 1200 RPM. Allow additional warm-up time at this speed depending on ambient temperature. This time may be used for taxiing to takeoff position. The minimum allowable oil temperature for run-up is 75°.

CAUTION . . . Do not operate the engine at run-up speed unless oil temperature is 75°F. minimum and oil pressure is within specified limits of 30-60 PSI. Operation of the engine at high speeds before reaching minimum oil temperature may cause loss of oil pressure and engine damage.

3. Perform all ground operations with cowling flaps, (if installed), full open, with mixture control in "FULL RICH" position, dependent on field elevation, and propeller control set for maximum RPM (except for brief testing of propeller governor.)

4. Restrict ground operations to the time necessary for warm-up and testing.

5. Increase engine speed to 1700 RPM only long enough to perform the following checks:

a. Check Magnetos: The difference between the two magnetos operated individually should not differ more than 50 RPM with a maximum drop for either magneto of 150 RPM. Observe engine for excessive roughness during this check.

> **WARNING . . . Absence of RPM drop when checking magnetos may indicate a malfunction in the ignition circuit. Should the propeller be moved by hand (as during preflight) the engine may start and cause injury to personnel. This type of malfunction should be corrected prior to continued operation of the engine.**

CAUTION . . . Do not underestimate the importance of pre-takeoff magneto check. When operating on single ignition, some RPM drop should be noted. Normal indications are 25-75 RPM drop and slight engine roughness as each magneto is switch off. An RPM drop in excess of 150 RPM may indicate a faulty magneto or fouled spark plugs.

Minor spark plug fouling can usually be cleared as follows:

(1) Magnetos - Both On.

(2) Throttle - 2200 RPM.

(3) Mixture - Move toward idle cutoff until RPM peaks and hold for ten seconds. Return mixture to full rich.

(4) Magnetos - Recheck.

If the engine is not operating within specified limits, it should be inspected and repaired prior to continued operational service.

NOTE . . . Avoid prolonged single magneto operation to preclude fouling of the spark plugs.

b. Check throttle and propeller operation.

Move propeller governor control toward low RPM position and observe tachometer. Engine speed should decrease to minimum governing speed (200-300 RPM drop). Return governor *control to high speed position. Repeat this procedure two or three times to circulate warm oil into the propeller hub.*

Where applicable move propeller control to "feather" position. Observe for 300 RPM drop below minimum governing RPM, then return control to "full increase" RPM position.

CAUTION . . . Do not operate the engine at a speed in excess of 2000 RPM longer than necessary to test operation and observe engine instruments. Proper engine cooling depends upon forward speed of the aircraft. Discontinue testing if temperature or pressure limits are approached.

6. Instrument Indications.

a. Oil Pressure: The oil pressure relief valve will maintain pressure within the specified limits if the oil temperature is within the specified limits and if the engine is not excessively worn or dirty. Fluctuating or low pressure may be due to dirt in the oil pressure relief valve or congealed oil in the system. This should be corrected prior to continued operation of the engine.

b. Oil Temperatures: The oil cooler and oil temperature control valve will maintain oil temperature within the specified range unless the cooler oil passages or air channels are obstructed. Oil temperature above the prescribed limit may cause a drop in oil pressure, leading to rapid wear of moving parts in the engine.

c. Cylinder Head Temperature: Any temperature in excess of the specified limit may cause cylinder or piston damage. Proper cooling of cylinders depends on cylinder baffles being properly positioned on the cylinder heads and barrels, and other joints in the pressure compartment being tight so as to force air between the cylinder fins. Proper cooling also depends on operating practices. Fuel and air mixture ratio will affect cylinder temperature. Excessively lean mixture causes overheating even when the cooling system is in good condition. High power and low air speed, or any slow speed flight operation, may cause overheating by reducing the cooling air flow. The engine depends on the ram air flow developed by the forward motion of the aircraft for proper cooling.

6-9 POWER CONTROL

When increasing power, first increase the RPM with the propeller control and then increase manifold pressure with throttle. When decreasing power, throttle back to desired manifold pressure and then adjust to the desired RPM. Readjust manifold pressure after final RPM setting.

6-10 TAKEOFF

1. Position mixture to "FULL RICH". Where installed, cowl flaps should be positioned as specified by aircraft manufacturer.

2. Position propeller control in "FULL INCREASE" RPM position.

3. Position fuel boost pump switch as instructed by aircraft manufacturer.

4. Slowly advance the throttle to FULL OPEN position, carefully monitoring manifold pressure. For standard day temperatures and normal engine oil operating temperatures, manifold pressure should not exceed the maximum rated limit when the throttle is FULL OPEN. When taking off at full throttle and minimum engine oil temperature of 75°, an increase in manifold pressure above the rated maximum limit may occur due to the effect of cold oil upon the turbocharger control system. Under these conditions, a 1.0-2.0 inches Hg. increase in manifold pressure above the rated maximum limit is allowed for 2-3 minutes duration and need not be considered as detrimental to the engine. Do not continue to advance the throttle if it is apparent that overboost will occur beyond the limits specified above.

An increase in manifold pressure beyond the limits specified above indicates a need to have the turbocharger controller readjusted.

In cold weather, the waste gate valve may not open unless the oil temperature is above 75°F.

CAUTION . . . Avoid rapid throttle movement in order to reduce manifold pressure overboost.

NOTE . . . For operation from fields at higher altitudes, operation should be conducted with the mixture control leaned for maximum performance as defined by charts in the aircraft manual, or by an appropriately marked fuel gage. The leaner mixture is required to eliminate engine roughness.

CAUTION . . . Cylinder head and oil temperatures must never be allowed to exceed the limitations specified. Near-maximum temperatures should occur only when operating under adverse conditions, such as high power settings, low airspeed, extreme ambient temperature, etc. If excessive temperatures are noted, and cannot reasonably be explained, or if abnormal cowl flap and/or mixture settings are required to maintain temperatures, then an inspection should be performed to determine the cause. Possible causes of high temperatures may include broken or missing baffles, inoperative cowl flaps, sticking oil temperature control unit, or restricted fuel nozzles (resulting in lean-running cylinders.) Faulty instruments or thermocouples may cause erroneously high (or low) temperature indications. Refer to Chapter 10 of this manual and/or the aircraft overhaul manual for troubleshooting procedures.

6-11 CLIMB

1. Recommended power for normal climb is 75%.

2. Climb at 75% power and above must be done at "FULL RICH" mixture setting, with cowl flaps, if provided, set to maintain proper cylinder head and oil temperature.

3. During climb (immediately after takeoff) observe manifold pressure and, if necessary, retard throttle to stay below maximum manifold pressure limits (red line).

> **WARNING . . . Continuous overboost operation may damage the engine and require engine inspection. See Service Bulletin M67-12.**

NOTE . . . Generally, when the aircraft has been configured for climbout, engine power should be reduced. If power settings of greater than 75% NRP must be used, particular attention should be given to cylinder head, TIT, and oil temperatures, and mixture must be "FULL RICH".

> **WARNING . . . At power settings above 80% NRP, do not use the T.I.T. gage as an aid to mixture adjustment. If you attempt to determine the "peak" T.I.T. while the engine is operating at high power, burned valves, detonation, and possible engine failure can occur.**

NOTE . . . Exhaust gas temperature, in this installation, is measured at the turbine inlet (i.e. T.I.T.)

6-12 CRUISE

1. Set manifold pressure and RPM for cruise power selected.

2. After engine temperatures have stabilized at cruise condition (usually within 5 minutes), adjust mixture to lean cruise condition according to Chapter 13 of this manual.

NOTE , . . During high ambient temperature, a very low fluctuation in fuel flow may appear in the early flight stages, which is caused by excess vapor. If this occurs, operate the fuel boost pump as recommended by the aircraft manufacturer.

3. When a lean mixture setting is used, for cruise, and increased power is desired, the mixture control must be returned to the richer setting before changing the throttle or propeller setting. When reducing power, retard throttle, then adjust RPM and mixture.

4. If it is necessary to retard the throttles at altitudes above 10,000 ft., leaning of the fuel mixture may also be necessary to maintain satisfactory engine operation. The mixture must be returned to the richer setting before the throttle is returned to the high power positions.

NOTE . . . Rapid throttle movements may cause undershooting or overshooting the desired manifold pressure and a subsequent adjustment will be required after the turbochargers have stabilized. Gradual throttle movement will permit the turbochargers to keep pace with the change in power. On pressurized aircraft, slower manifold pressure adjustment will prevent sudden "spikes" in cabin altitude. At high altitude, large reductions in manifold pressure may cause some reduction of cabin pressure.

6-13 DESCENT

Descent from high altitude is to be accomplished at cruise power settings and mixture control positioned accordingly.

CAUTION . . . Rapid descents at high RPM and idle manifold pressure setting are to be avoided.

During Descent, monitor cylinder and oil temperature and maintain above the minimum specified limits.

NOTE . . . Avoid long descents at low manifold pressure as the engine can cool excessively and may not accelerate satisfactorily when power is reapplied. If power must be reduced for long periods, adjust propeller to minimum governing RPM and set manifold pressure no lower than necessary to obtain desired performance. If the outside air is extremely cold, it may be desirable to add drag to the aircraft in order to maintain engine power without gaining excess airspeed. Do not permit cylinder temperature to drop below 240°F.

6-14 LANDING

1. In anticipation of a go around and need for high power settings, the mixture control should be set in "FULL RICH" or "BEST POWER" position, depending on field elevation, before landing.

NOTE . . . Advance mixture slowly toward "FULL RICH". If engine roughness occurs, as may happen at very low throttle settings and high RPM, it may be desirable to leave the mixture control in a leaner than full rich position until the throttles are advanced above 15 inches of manifold pressure.

2. Operate the boost pump as instructed by aircraft manufacturer.

6-15 ENGINE SHUTDOWN

1. If boost pump has been on for landing, turn to "OFF".
2. Place mixture control in "IDLE CUTOFF".
3. Turn magnetos "OFF" after propeller stops rotating.

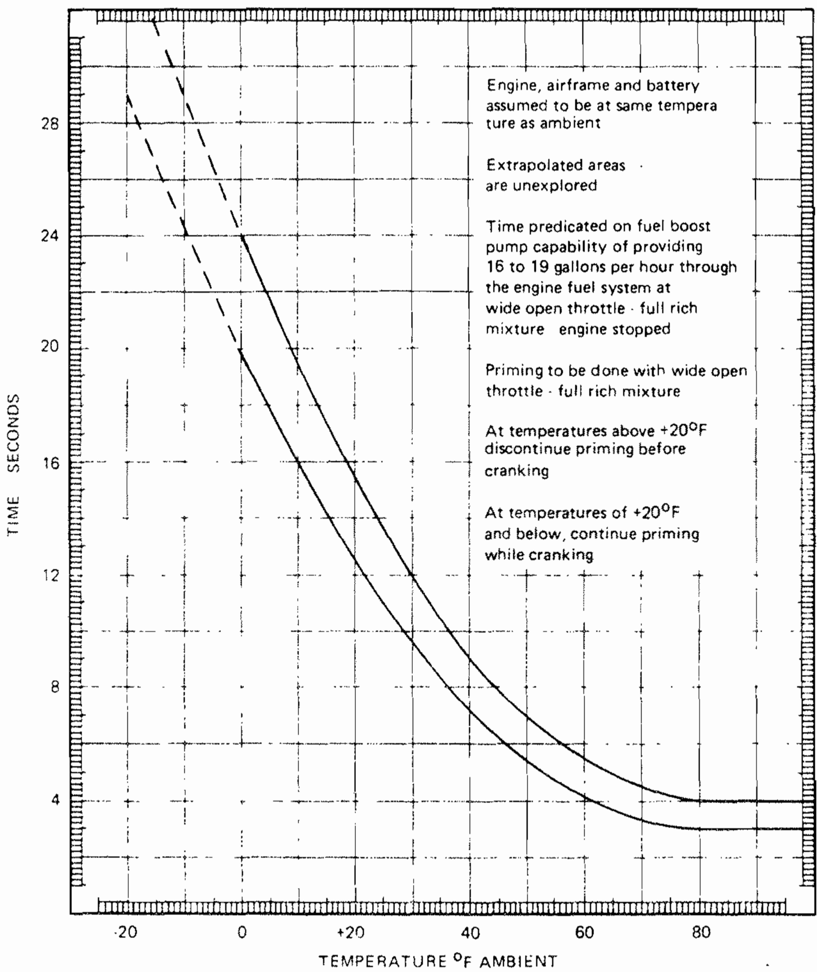


FIGURE 6-1. PRIMING TIME REQUIREMENT.

CHAPTER 7

EMERGENCY PROCEDURES

Section Index

7-1 ENGINE FIRE DURING START

If flames are observed in the induction or exhaust system during engine starting, proceed as follows:

1. Mixture Control - Move to the idle cut-off position.

2. Throttle Control - Move to the full open position.

3. Starter Switch - Hold in the cranking position until fire is extinguished.

7-2 GENERAL IN-FLIGHT INFORMATION

If a malfunction should occur in flight, certain remedial actions may eliminate or reduce the problem. Some malfunctions which might conceivably occur are listed in this section. Recommended corrective action is also included: however, it should be recognized that no single procedure will necessarily be applicable to every situation.

A thorough knowledge of the aircraft and engine systems will be an invaluable asset to the pilot in assessing a given situation and dealing with it accordingly.

7-3 ENGINE ROUGHNESS

Observe engine for visible damage or evidence of smoke or flame. Extreme roughness may be indicative of propeller blade problem. If any of these characteristics are noted, follow aircraft manufacturer's instructions.

1. Mixture - Adjust as appropriate to power setting being used. Do not arbitrarily go to Full RIch as the roughness may be caused by an overrich mixture.

2. Magnetos - Check On.

If engine roughness does not disappear after the above, the following steps should be taken to evaluate the ignition system.

1. Throttle - Reduce power until roughness becomes minimal.

2. Magnetos - Turn Off, then On, one at a time. If engine smooths out while running on single ignition, adjust power as necessary and continue. Do not operate the engine in this manner any longer than absolutely necessary. The airplane should be landed as soon as practical for engine repairs.

If no improvement in engine operation is noted while operating on either magneto alone, return all magneto switches to On.

CAUTION . . . The engine may quit completely when one magneto is switched off, if the other magneto is faulty. If this happens, close throttle to idle and move mixture to idle cutoff before turning magnetos on. This will prevent a severe backfire. When magnetos have been turned back on, advance mixture and throttle to previous setting.

> **WARNING . . . If roughness is severe or if the cause cannot be determined, engine failure may be imminent. In this case, it is recommended that the aircraft manufacturer's emergency procedure be employed. In any event, further damage may be minimized by operating at a reduced power setting.**

7-4 TURBOCHARGER FAILURE.

Turbocharger failure will be evidenced by inability of the engine to develop manifold pressure above ambient pressure. The engine will revert to "normally aspirated" and can be operated, but will produce less than its rated horsepower.

Readjust mixture as necessary to obtain fuel flow appropriate to manifold pressure and RPM.

> **WARNING . . . If turbocharger failure is a result of a loose, disconnected** or burned-through **exhaust, then a serious fire hazard exists. Follow the aircraft manufacturer's emergency instructions. If turbocharger failure occurs before takeoff, DO NOT fly the aircraft.** If failure **occurs in flight, and the choice is made to continue operating the engine, proceed as follows:**

NOTE . . . At altitudes above 15,000 feet an overrich mixture may result if the turbocharger fails and the engine may quit operating. If this occurs, employ the following procedure:

1. Mixture - Idle Cutoff.

2. Throttle - Full Open.

3. Propeller Control - Normal Cruise RPM.

4. Throttle - Retard to Cruise Position.

5. Mixture - Advance slowly. When the proper mixture ratio is reached, the engine will start. Continue to adjust the mixture control unit until the correct fuel flow for the manifold pressure and RPM is obtained.

NOTE . . . An interruption in fuel flow to the engine can cause engine power loss due to turbocharger "run-down". At high altitude, merely restoring fuel flow may not cause the engine to restart, because the mixture will be excessively rich. If the engine does not restart, there will be insufficient mass flow through the exhaust to turn the turbine. This condition may give indications similar to a turbocharger failure. If a power loss is experienced followed by surging of RPM, fuel flow, and manifold pressure, the following steps are recommended:

1. Mixture Control - Idle Cutoff.

2. Fuel Selector - Position so as to permit use of auxiliary fuel pumps (boost pumps).

3. Auxiliary Fuel Pump - On.

4. Throttle - Set to normal cruise position.

5. Propeller - Adjust normal cruise RPM.

6. Mixture - Enrich slowly from idle cutoff. Engine starting will be apparent by a surge of power. As the turbocharger begins to operate, manifold pressure will increase and mixture can be adjusted accordingly.

7. Auxiliary Fuel Pump - Positioned according to aircraft manufacturer's instructions.

8. Mixture - Readjust if necessary.

NOTE . . . If this procedure does not effect a restart, descent below 15,000 feet and repeat. If the engine still will not start, follow the emergency procedures outlined in the airframe manufacturers operating handbook.

7-5 HIGH CYLINDER HEAD TEMPERATURE

1. Mixture - Adjust to proper fuel flow for power being used.

2. Cowl Flaps - Open.

3. Airspeed - Increase.

If temperature cannot be maintained within limits, reduce power, land as soon as practical and have the malfunction evaluated or repaired (if required) before further flight.

7-6 HIGH OIL TEMPERATURE

NOTE . . . Prolonged high oil temperature indications will usually be accompanied by a drop in oil pressure. If oil pressure remains normal, a high temperature indication may be caused by a faulty gage or thermocouple. If the oil pressure drops as temperature increases, proceed as follows:

1. Cowl Flaps - Open.

2. Airspeed - Increase.

3. Power - Reduce if steps 1 and 2 do not lower oil temperature.

CAUTION . . . If these steps do not restore oil temperature to normal, an engine failure or severe damage can result. In this case it is recommended that the aircraft manufacturer's emergency instructions be followed.

7-7 LOW OIL PRESSURE

If the oil pressure drops without apparent reason from normal indication of 30 to 60 psi, monitor temperature and pressure closely. If oil pressure drops below 30 psi, an engine failure should be anticipated and the aircraft manufacturer's instructions should be followed.

7-8 IN-FLIGHT RESTARTING

CAUTION . . . Actual shutdown of an engine for practice or training purposes should be minimized. Whenever engine failure is to be simulated, it should be done by reducing power.

The following procedure is recommended for in-flight restarting.

1. Mixture - Advance to 3/4 FULL RICH.

2. Fuel Selector Valve - On.

3. Fuel Boost Pump - Per airframe manufacturer's instructions.

4. Magneto Switches - ON BOTH.

5. Throttle - NORMAL START POSITION (Open 1").

6. Propeller:

Without Unfeathering Accumulator:

a. Propeller Control - MOVE FROM FEATHER TO FULL DECREASE RPM.

b. Start Switch - START.

NOTE . . . The engine will run quite rough until the propeller leaves the feathering range. Expect a fairly rapid surge of power as the engine accelerates to minimum governing RPM.

c. Oil Pressure - Within limits, will probably be quite low if oil is cold. If no oil pressure is indicated, engine damage may occur if the restart is continued.

d. Throttle - Adjust to 15-20 inches manifold pressure until engine temperature reaches operating range. Adjust mixture as required.

With Unfeathering Accumulator:

a. Propeller Control - FORWARD OF FEATHERING DETENT UNTIL ENGINE ATTAINS 600 RPM; THEN BACK TO DETENT.

b. Oil Pressure - STABILIZED.

NOTE . . . If propeller does not unfeather or the engine does not turn, return the propeller control to the feather position and secure the engine.

c. Mixture - 3/4 FULL RICH.

7. Throttle - AS NECESSARY TO PREVENT OVERSPEED; Warm up at 15-20" Hg. manifold pressure. Adjust mixture as required for smoothness.

8. Oil Pressure, Oil and Cylinder Head Temperatures - NORMAL INDICATION.

9. Alternator Switch - On.

10. Power - AS REQUIRED.

7-9 ENGINE FIRE IN-FLIGHT

1. Follow air frame manufacturer's instructions

INTENTIONALLY

LEFT

BLANK

CHAPTER 8

ABNORMAL ENVIRONMENTAL CONDITIONS

Section Index

8-1 GENERAL

Three areas of operation may require special attention. These are (a) extreme cold weather, (b) extreme hot weather and (c) high density altitude ground operation. The following may be helpful to the operator in obtaining satisfactory engine performance under adverse conditions.

8-2 COLD WEATHER OPERATION (Ambient Temperature Below Freezing)

NOTE . . . Prior to operation and/or storage in cold weather assure engine oil viscosity is SAE 30, 10W30, 15W50 or 20W50. In the event of temporary cold weather operation, not justifying an oil change to SAE 30, consideration should be given to hangaring the aircraft between flights.

Engine starting during extreme cold weather is generally more difficult than during normal temperature conditions. Cold soaking causes the oil to become thicker (more viscous), making it more difficult for the starter to crank the engine. This results in a slow cranking speed and an abnormal drain on the battery capacity. At low temperatures, gasoline does not vaporize readily, further complicating the starting problem.

False starting (failure to continue running after starting) often results in the formation of moisture on the spark plugs due to condensation. This moisture can freeze and must be eliminated either by applying heat to the engine or removing and cleaning the spark plugs.

8-3 PREHEATING

The use of preheat and auxiliary power unit (APU) will facilitate starting during cold weather and is recommended when the engine has been cold soaked at temperatures of 20°F. and below in excess of 2 hours. Successful starts without these aids can be expected at temperatures below normal, provided the engine is in good condition and the ignition and fuel systems are properly maintained.

The following procedures are recommended for preheating, starting, warm-up, run-up and takeoff.

1. Select a high volume hot air heater. Small electric heaters which are inserted into the cowling opening do not appreciably warm the oil and may result in superficial preheating.

> **WARNING . . . Superficial application of preheat to a cold-soaked engine can cause damage to the engine.**

A minimum of preheat application may warm the engine enough to permit starting but will not de-congeal oil in the sump, lines, cooler, filter, etc.

Congealed oil in such lines may require considerable preheat. The engine may start and apparently run satisfactorily, but can be damaged from lack of lubrication due to congealed oil in various parts of the system. The amount of damage will vary and may not become evident for many hours. On the other hand, the engine may be severely damaged and could fail shortly following application of high power.

Proper procedures require thorough application of preheat to all parts of the engine. Hot air should be applied directly to the oil sump and external oil lines as well as the cylinders, air intake and oil cooler. Excessively hot air can damage non-metallic components such as seals. hoses and drive belts, so do not attempt to hasten the preheat process.

Before starting is attempted, turn the engine by hand or starter until it rotates freely. After starting, observe carefully for high or low oil pressure and continue the warm-up until the engine operates smoothly and all controls can be moved freely. Do not close the cowl flaps to facilitate warm-up as hot spots may develop and damage ignition wiring and other components.

2. Hot air should be applied primarily to the oil sump and filter area. Continue to apply heat for 15 to 30 minutes and turn the propeller, by hand, through 6 or 8 revolutions at 5 or 10 minute intervals.

3. Periodically feel the top of the engine and, when some warmth is noted, apply heat directly to the upper portion of the engine for approximately five minutes. This will provide sufficient heating of the cylinders and fuel lines to promote better vaporization for starting. If enough heater hoses are available, continue heating the sump area. Otherwise, it will suffice to transfer the source of heat from the sump to the upper part of the engine.

4. Start the engine immediately after completion of the preheating process. Since the engine will be warm, use normal starting procedure.

NOTE . . . Since the oil in the oil pressure gage line may be congealed, as much as 30 seconds may elapse before oil pressure is indicated. If oil pressure is not indicated within 30 seconds shut the engine down and determine the cause.

5. Operate the engine at 1000 RPM until some oil temperature is indicated. Monitor oil pressure closely during this time and be alert for a sudden increase or decrease. Retard throttle, if necessary to maintain oil pressure below 100 psi. If oil pressure drops suddenly to less than 30 psi, shut down the engine and inspect the lubrication system. If no damage or leaks are noted, preheat the engine for an additional 10 to 15 minutes before restarting.

6. Before takeoff, run up the engine to 1700 RPM. If necessary approach this RPM in increments to prevent oil pressure from exceeding 100 psi.

At 1700 RPM, adjust the propeller control to Full Decrease RPM until minimum governing RPM is observed, then return the control to Full Increase RPM. Repeat this procedure three or four times to circulate warm oil into the propeller dome.

NOTE . . . Continually monitor oil pressure during run up.

7. Check magnetos in the normal manner.

8. When the oil temperature has reached 100°F. and oil pressure does not exceed 80 psi at 1700 RPM, the engine has been warmed sufficiently to accept full rated power.

CAUTION . . . Do not close the cowl flaps in an attempt to hasten engine warm-up.

NOTE . . . Fuel flow will probably be on the high limit; however, this is normal and desirable since the engine will be developing more horsepower at substandard ambient temperatures.

If preheat is not used employ the same start procedures for a normal start (Chapter 6) except:

1. At temperatures below +20°F., continue priming while cranking until engine starts.

2. When engine starts and accelerates thru 500 RPM, release Starter.

3. Advance throttle slowly to obtain smooth engine operation.

4. Release primer.

5. Auxiliary Fuel Pump on low as necessary to obtain smooth engine operation.

6. Oil Pressure - Check. If none noted within 30 seconds, shut down engine and investigate.

Observe oil pressure for indication and warm-up engine at 1000 RPM. Ground operation and run up require no special techniques other than warming the engine sufficiently to maintain oil temperature and oil pressure within limits when full RPM is applied.

NOTE . . . Before applying power for takeoff, assure that oil pressure, oil temperature and cylinder head temperature are well within the normal operating range. When full power is applied for takeoff, assure that oil pressure is within limits and steady.

Any of the following engine conditions should be cause for concern, and are justification to discontinue the takeoff.

1. Low, high or surging RPM.
2. Fuel flow excessively high or low.
3. Any oil pressure indication other than steady within limits.
4. Engine roughness.

8-4 HOT WEATHER OPERATION (Ambient Temperature in Excess of 90°F.)

CAUTION . . . When operating in hot weather areas, be alert for higher than normal levels of dust, dirt or sand in the air. Inspect air filters frequently and be prepared to clean or replace them if necessary. Weather conditions can lift damaging levels of dust and sand high above the ground. If the aircraft is flown through such conditions, an oil change is recommended as soon as possible. Do not intentionally operate the engine in dust and/or sand storms. The use of dust covers on the cowling will afford additional protection for a parked aircraft.

Flight operation during hot weather usually presents no problem since ambient temperatures at flight altitudes are seldom high enough to overcome the cooling system used in modern aircraft design. There are, however, three areas of hot weather operation which will require special attention on the part of the operator. These are: (1) Starting a hot engine (2) Ground operation under high ambient temperature conditions and (3) Takeoff and initial climbout.

1. Starting a Hot Engine. After an engine is shutdown, the temperature of its various components will begin to stabilize; that is, the hotter parts such as cylinders and oil will cool, while other parts will begin to heat up due to lack of air flow, heat conduction, and heat radiation from those parts of the engine which are cooling. At some time period following engine shutdown the entire unit will stabilize near the ambient temperature. This time period will be determined by temperature and wind conditions and may be as much as several hours. This heat soaking is generally at the extreme from 30 minutes to one hour following shutdown. During this time, the fuel system will heat up causing the fuel in the pump and lines to "boil" or vaporize. During subsequent starting attempts, the fuel pump will initially be pumping some combination of fuel and fuel vapor. At the same time, the injection nozzle lines will be filled with varying amounts of fuel and vapor. Until the entire fuel system becomes filled with liquid fuel, difficult starting and unstable engine operation can normally be expected.

Another variable affecting this fuel vapor condition is the state of the fuel itself. Fresh fuel contains a concentration of volatile ingredients. The higher this concentration is, the more readily the fuel will vaporize and the more severe will be the problems associated with vapor in the fuel system. Time, heat or exposure to altitude will "age" aviation gasoline; that is, these volatile ingredients tend to dissipate. This reduces the tendency of fuel to vaporize and, may induce starting problems associated with fuel vapor if the volatile condition reaches a low enough level, starting may become difficult due to poor vaporization at the fuel nozzles, since the fuel must vaporize in order to combine with oxygen in the combustion process.

The operator, by being cognizant of these conditions, can take certain steps to cope with problems associated with hot weather/hot engine starting. The primary objective should be that of permitting the system to cool. Lower power settings during the landing approach when practical will allow some cooling prior to the next start attempt. Reducing ground operation to a minimum is desired to keep engine temperatures down. Cowl flaps should be opened fully while taxiing. The aircraft should be parked so as to face into the wind to take advantage of the cooling effect. Restarting attempts will be the most difficult from 30 minutes to one hour after shutdown. Following that interval the fuel vapor will be less pronounced and normally will present less of a restart problem.

2. Ground Operation in High Ambient Temperature Conditions. Oil and cylinder temperatures should be monitored closely during taxiing and engine run up. Operate with cowl flaps full open. Do not operate the engine at high RPM except for necessary operational checks. If takeoff is not to be made immediately following engine run up, the aircraft should be faced into the wind with the engine idling at 900-1000 RPM. It may be desirable to operate the fuel boost pumps to assist in suppressing fuel vaporization and provide more stable fuel pressure during taxiing and engine run up.

3. Takeoff and Initial Climbout. Temperatures should be closely monitored and sufficient airspeed must be maintained to provide proper cooling of the engine.

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

8-5 GROUND OPERATION AT HIGH ALTITUDE AIRPORTS

Idle fuel mixture will be rich at high altitudes. under extreme conditions it may be necessary to manually lean the mixture in order to sustain engine operation at low RPM. When practical, operate the engines at higher idling speed. Lean for best power for takeoff.

If higher than desired temperatures are experienced during the climb phase the pilot may elect to establish a lower angle of attack, or higher climb speed, consistent with safety and thereby provide increased cooling for the engine.

INTENTIONALLY

LEFT

BLANK

CHAPTER 9

SERVICING AND UNSCHEDULED MAINTENANCE

Section Index

9-1 SERVICING

The owner or operator is primarily responsible for maintaining the engine in an airworthy condition, including compliance with all applicable Airworthiness Directives as specified in Part 39 of the Federal Aviation Regulations and "Airworthiness Limitation" of this manual per FAR A33.4. It is further the responsibility of the owner or operator to ensure that the engine is inspected in conformity with the requirements of Parts 43 and 91 of the Federal Aviation Regulations. Teledyne Continental Motors has prepared this inspection guide to assist the owner or operator in meeting the foregoing responsibilities. This inspection guide is not intended to be all-inclusive, for no such guide can replace the good judgement of a certified airframe and power plant mechanic in the performance of his duties. As the person primarily responsible for the airworthiness of the airplane, the owner or operator should select only qualified personnel to maintain the airplane.

Fuel (Min. Grade) .... Aviation Grade 100 or 100LL

WARNING . . . The use of lower octane rated fuel can result in 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, then the fuel must be completely drained and the tank properly serviced.

Oil: (First 25 hours operation) .... Mineral (non-Detergent oil or Corrosion Preventive oil Corresponding to MIL-C-6529 Type II

Normal Service

All Temperatures 15W-50
.... 20W-50

Below 50°F. Ambient Air (Sea Level) .... SAE30 or 10W-30
Above 40°F. Ambient Air (Sea Level) .... SAE 50

Oil Sump Capacity: .... 8 U.S. Quarts

Oil Change Interval:

With integral screen or small filter .... 50 Hours
With large filter .... 100 Hours

Oil Filter Interval:

With Large or Small Filter .... 50 Hours

CAUTION... Use only oils conforming to Teledyne Continental Motors Specification MHS24 or MHS25 after break-in period.

9-2 APPROVED PRODUCTS

Use only lubricating oils conforming to TCM specification MHS-24D & MHS-25, lubricating oil, ashless dispersant. The marketers of the aviation lubricating oils listed below have supplied data to TCM indicating their products conform to all the requirements of TCM Specification MHS-24D or MHS-25.

In listing the products names, TCM makes no claim of verification of marketer's statements or claims. Listing is made in the order in which the data was received by TCM and is provided only for the convenience of the users.

NOTE . . . Since the airframe manufacturer furnishes certain parts which depend on engine oil for lubrication, they may restrict the use of some lubricating oils.

Supplier	Brand
MHS-25	
Mobil Oil Company	Mobil AV 1
MHS-24D	
BP Oil Corporation	BP Aero Oil
Castrol Limited (Australia)	Castrolaero 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
Pennzoil Company	Pennzoil Aircraft Engine Oil
Phillips Petroleum Company	Phillips 66 Aviation Oil, Type A
Phillips Petroleum Company	*X/C Aviation Multiviscosity Oil SAE 20W-50, SAE 20W-60
Quaker State Oil & Refining Co.	Quaker State AD Aviation Engine Oil
Red Ram Limited (Canada)	Red Ram X/C Aviation Oil 20W-050
Shell Canada Limited	Aeroshell Oil W, Aeroshell Oil W 15W-50
Shell Oil Company	Aeroshell Oil W. Aeroshell Oil W 15W-50 Anti Wear Formulation Aeroshell Oil W 15W-50
Sinclair Oil Company	Sinclair Avoil
Texaco Inc.	Texaco Aircraft Engine Oil - Premium AD
Union Oil Company of California	Union Aircraft Engine Oil HD

*NOTE . . . This does not include X/C II Aviation Oil.

NOTE . . . For further information see TCM Service Bulletin M87-12R1 or current revision as applicable.

NOTE . . . The following procedures and schedules are recommended for engines which are subjected to normal operation. If the aircraft is exposed to severe conditions, such as training, extreme weather, or infrequent operation, inspections should be more comprehensive and the hourly intervals should be decreased.

9-3 PREFLIGHT INSPECTION

Before each flight the engine and propeller should be examined for damage, oil leaks, proper servicing and security. Refer to the aircraft manual "Preflight Check List".

9-4 50 HOUR INSPECTION

Detailed information regarding adjustments, repair and replacement of components may be found in the appropriate Overhaul Manual. The following items should be checked during normal inspections:

1. Engine Conditions: **(Refer to Chapter 6)**	a. Magneto RPM drop:	Check
	b. Full Power RPM:	Check
	c. Full Power Manifold Pressure:	Check
	d. Full Power Fuel Flow:	Check
	e. Idle RPM:	Check

Record any values not conforming to engine specifications so that necessary repair or adjustment can be accomplished.

2. Oil Filter:	Replace filter, inspect cartridge.
3. Oil:	Change oil, if integral screen or small filter is used.
4. Air Filter:	Inspect and clean or replace as necessary.
5. High Tension Leads:	Inspect for chafing and deterioration.
6. Magnetos:	Check and adjust only if non-conformities were noted in Step 1.
7. Magneto Filter:	Inspect for color, if white O.K., if red or contaminated replace.
8. Visual:	Check hoses, lines, wiring, fittings, baffles, etc. for general condition.
9. Exhaust System:	Inspect for condition and leaks.
10. Adjustments & Repairs:	Perform service as required on any items that are not within specifications.
11. Engine Condition:	Run up and check as necessary for any items serviced in Step 10. Check engine for oil and fuel leaks before returning to service.

9-5 100 HOUR INSPECTION

Detailed information regarding adjustments, repair and replacement of components may be found in the appropriate Overhaul Manual. The following items should be checked during normal inspections:

1. Engine Conditions: **(Refer to Chapter 6 & 4)**
   - a. Magneto RPM drop: Check
   - b. Full Power RPM: Check
   - c. Full Power Manifold Pressure: Check
   - d. Full Power Fuel Flow: Check
   - e. Idle RPM: Check

Record any values not conforming to engine specifications so that necessary repair or adjustment can be accomplished.

2. Oil Filter:	Replace, inspect cartridge.
3. Oil:	Drain while engine is warm. Refill sump.
4. Valves/Cylinders:	Check compression (See Section 9-7 Cylinder Compression Check)
5. Cylinders, Fins, Baffles:	Inspect.
6. Spark Plugs:	Inspect, clean, regap (if necessary) reinstall. Rotate plugs from upper to lower positions and vice versa to lengthen plug life. (Refer to Overhaul Manual for reversal procedure.)
7. High Tension Leads:	Inspect for chafing and deterioration.
8. Magnetos:	Check. Adjust points and timing if necessary.

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 and spark plug life, smoother engine operation and less corrective maintenance between routine inspections.

NOTE . . . At each 500 hours, the magnetos are required to be disassembled and inspected according to Magneto Service Manual.

9. Magneto Filter:	Inspect for color, if white O.K., if red or contaminated replace.
10. Air Filter:	Inspect and clean or replace as necessary.
11. Alternator Air Door:	Check operation.
12. Throttle Shaft and Linkage:	Inspect for wear and lubricate.
13. Fuel Nozzles:	Inspect nozzles and vent manifold for leaks or damage.
14. Fuel & Oil Hoses & Lines:	Inspect for deterioration, leaks, chafing.
15. Fuel System:	Check. Adjust as necessary if pre-inspection run-up indicates problem. (See TCM Service Bulletin M-84-6R1 or current Revision as applicable and airframe manufacturers instructions for procedure). Inspect and lubricate.
16. Control Connections:	Inspect and lubricate.

17. Exhaust:	Check all joints for conditions and leaks.
18. Turbochargers:	Check freedom of rotation.
19. Wastegate:	Check operation and condition.
20. Adjustment & Repairs:	Perform service as required on any items that are not within specifications.
21. Engine Condition:	Perform complete run up. Check engine for fuel or oil leaks before returning to service.

NOTE . . . Refer to TSIO-520-BE Overhaul Manual X30574A or applicable Service Bulletins for proper procedures and limits.

9-6 UNSCHEDULED MAINTENANCE

Detailed information required for component part replacement, system adjustments, accessory replacement/repair, top overhaul etc., can be found in the "Related Publications" listed in Chapter 1.

No unscheduled maintenance of the categories listed above should be attempted without consulting the applicable related publications.

The Time Between Overhaul (TBO) for the TSIO-520-BE is 2000 hours. Those accessories supplied with this engine by TCM are considered to have the same TBO as the engine with the criteria for service and longevity as outlined in TCM TBO Service Bulletin 86-6R1 or current revisions as applicable.

9-7 CYLINDER COMPRESSION (Leakage) CHECK

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 the orifice will result. The differential pressure test is a regular part of the 100 hour or annual inspection on Teledyne Continental engines.

Reports of incorrect cylinder leakage check results caused by improver use of test equipment and/or by the use of faulty test equipment have been received.

To accurately accomplish a leakage check, use the following information on leakage and use of the Master Orifice Tool (Ref. Figure 9-1) to calibrate the leakage checking equipment used on Teledyne Continental engines.

LEAKAGE CHECKS

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

Static Seal

The static seal consists of the valve to valve seat seal, spark plug to spark plug port seals and cylinder head to barrel seal (Ref. Figure 9-2). No leakage of the static seal is permissible.

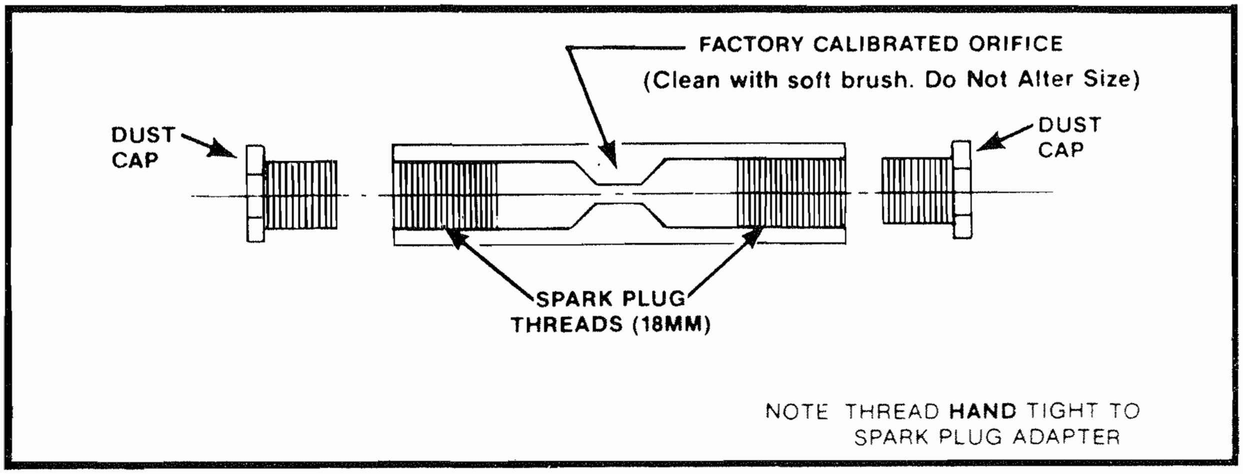
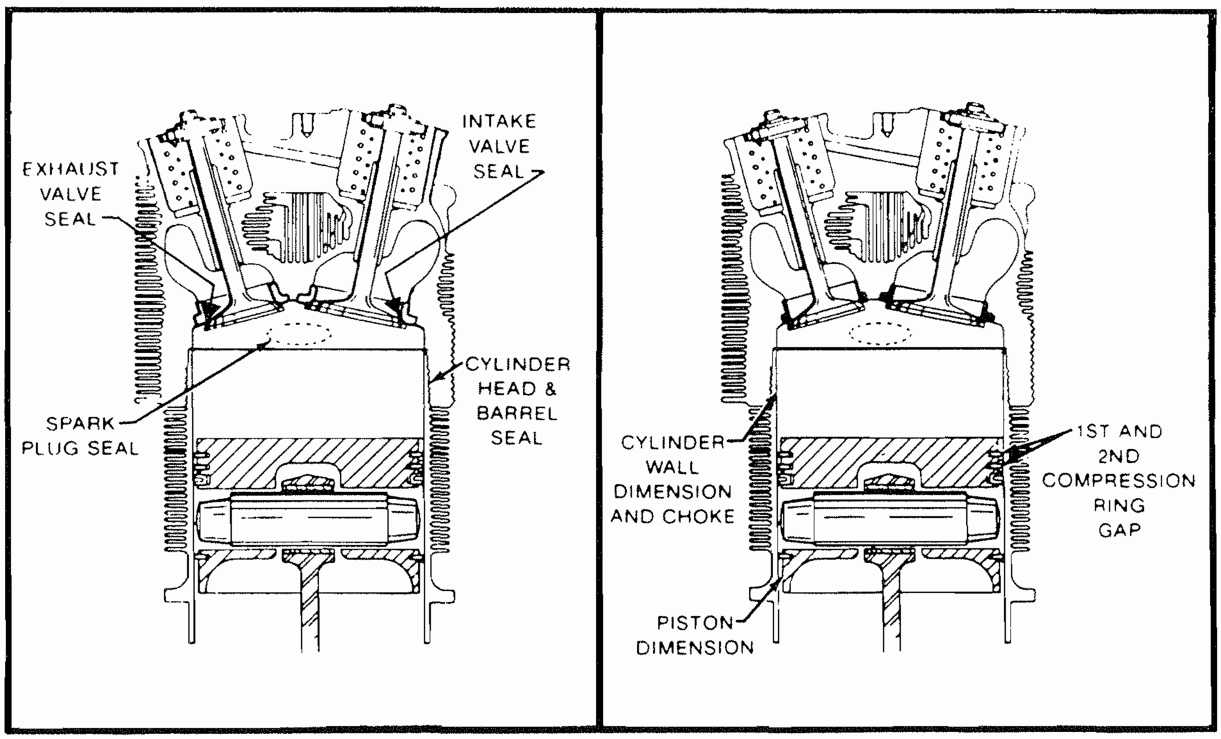


FIGURE 9-1. MASTER ORIFICE ASSEMBLY TOOL BORROUGHS P/N 646953.

Borroughs Tool & Equipment Corp.
2429 N. Burdick St.
Kalamazoo, MI 49007
Tel. 616/345-2700



STATIC SEAL **DYNAMIC SEAL**

FIGURE 9-2

Dynamic Seal

The dynamic seal consist of the piston rings to the cylinder wall seal (Ref. Figure 9-2). This seal leakage can vary from engine to engine by the cylinder displacement, cylinder choke, ring end gap and piston design.

EQUIPMENT

Testing equipment must be kept clean and checked periodically for accuracy as follows:

Using a line pressure of 100 to 120 p.s.i., close the cylinder pressure valve, then set the regulator pressure valve to 80 p.s.i. The pressure in both gages should stabilize with no leakage.

The restrictor orifice dimension in the differential pressure tester (Figure 9-3) 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 p.s.i. differential pressure.

Master Orifice Tool

For conformity in tester equipment, a Master Orifice Tool 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 p.s.i. to the tester with cylinder pressure valve closed. Turn the regulator pressure valve on, adjusting pressure to indicate 80 p.s.i.. Remove the dust caps from both ends of the Master Orifice Tool and install in cylinder spark plug adapter. Turn the cylinder pressure valve on and readjust regulator pressure gage to read 80 p.s.i.. At this time the cylinder pressure gage 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.

A schematic diagram of a typical differential pressure tester is shown in Figure 9-3.

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.

CAUTION . . . Magnetos and fuel must be shut off prior to test to ensure the engine cannot be accidentally fired.

1. Perform the test as soon as possible after the engine is shut down to ensure that the piston rings, cylinder walls, and other engine parts are well lubricated and at running tolerance.

2. Remove the most accessible spark plug from each cylinder.

3. 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.

4. Install an adapter in the spark plug hole and connect the differential pressure tester to the adapter (NOTE . . . Cylinder pressure valve is the Closed position). Slowly open the cylinder pressure valve and pressurize the cylinder not to exceed 20 p.s.i.. Continue rotating the engine against the pressure until the piston reaches top dead center (TDC). Reaching TDC is indicated by a flat spot or sudden decrease in force required to turn the crankshaft. If the crankshaft is rotated too far, backed 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.

CAUTION . . . Care must be exercised in opening the cylinder pressure valve, since sufficient air pressure will be built up in the cylinder to cause it to rotate the crankshaft if the piston is not at TDC. It is recommended that someone hold the propeller during check to prevent possible rotation.

5. Open the cylinder pressure valve completely. Check the regulator pressure gage and adjust, if necessary to 80 p.s.i.

6. Observe the pressure indicatior on the cylinder pressure gage. The difference between this pressure shown by the regulator pressure gage is the amount of leakage through the cylinder. If the cylinder pressure gage reading is higher than the previously determined master orifice calibrated pressure reading, proceed to the next cylinder leak check. If the cylinder gage reading is lower, proceed with the following.

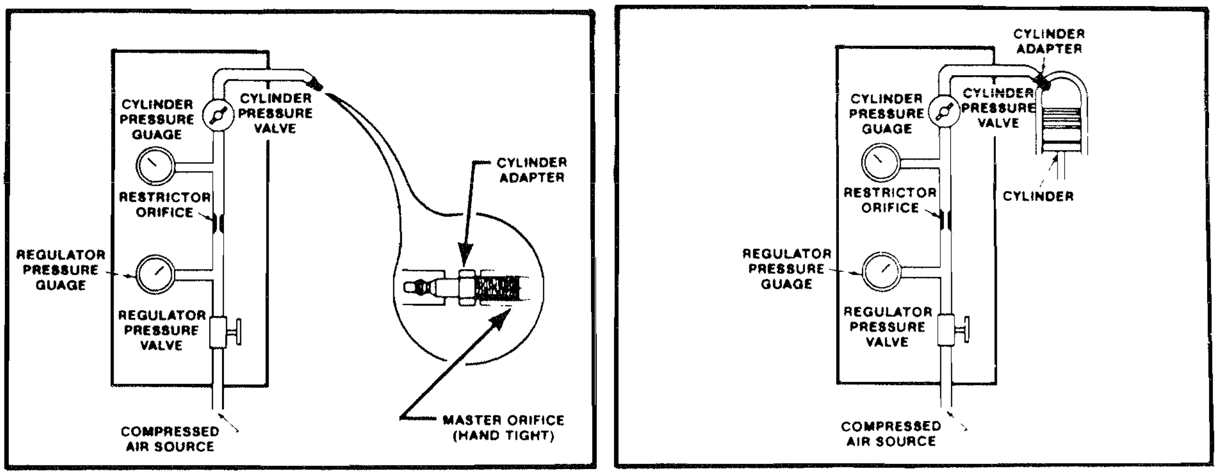


FIGURE 9-3. DIFFERENTIAL PRESSURE TESTER

Static Seal Check (See Figure 9-5)

7. The source of air leakage should first be checked for the static seal. Positive identification of static seal leakage is possible by listening for air flow sound at the exhaust or induction system cylinder port. When checking the cylinder head to barrel leakage, use a soapy solution between the fins and watch for bubbles. use a soapy solution also around both spark plugs seals for leakage. NO LEAKAGE IS ALLOWED IN STATIC SEALS.

8. If leakage is occurring in the intake or exhaust valve areas, in may be possible to correct a low reading by staking the valves. This is accomplished by placing a fiber drift on the rocker arm directly over the valve stem and tapping the drift several times with a hammer to dislodge any foreign material that may be between the valve face and seat.

CAUTION . . . When correcting a low reading in this manner, rotate the propeller so the piston will not be at TDC. This is necessary to prevent he valve from striking the top of the piston in some engines. Rotate the propeller again before rechecking leakage to reset the valves in the normal manner.

NOTE . . . When the rocker cover is removed, inspect valve springs, valve retainers and valve stem for wear. This may have contributed to the valve leakage.

9. If leakage is noted between the cylinder head and barrel, REPLACE THE CYLINDER. If leakage cannot be corrected at the valves by "staking", the cylinder must be removed and repaired before a Dynamic Seal Check.

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.

10. If the cylinder was removed for static leakage, replacement or repair, inspect piston ring gap and cylinder wall for tolerance (Ref. Dynamic Seal, Figure 9-2). Once the piston and the cylinder have been cleaned, inspected, and ring gap tolerance have been met, reassemble to the engine.

Dynamic Seal Check

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

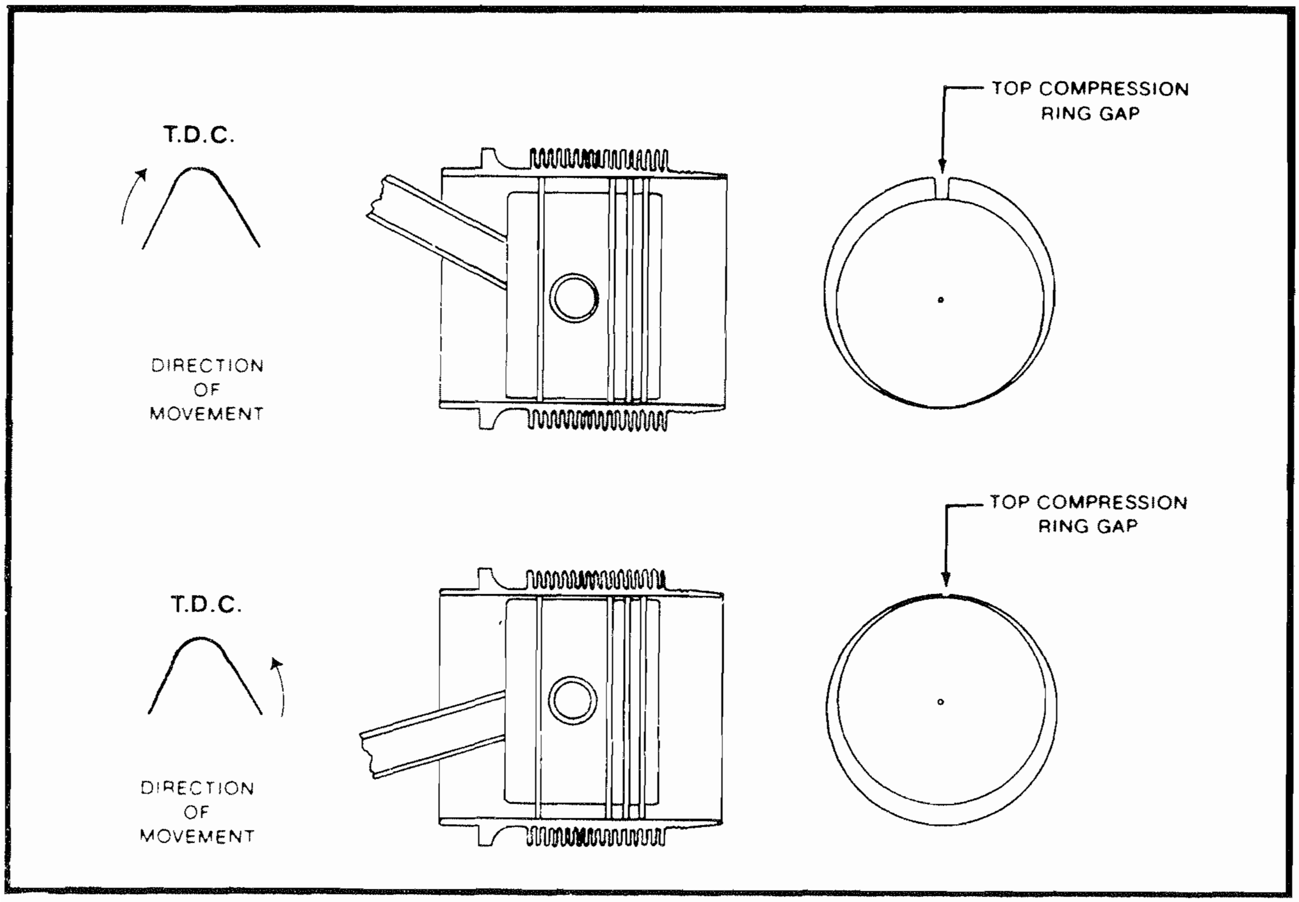


FIGURE 9-4.

12. If the leakage is below the previously determined low cylinder gage 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 (Figure 9-4). First assure that the piston and piston rings are centered. This may be accomplished by reducing regulator pressure to 20 p.s.i. and working piston through TDC several times, bringing the piston to TDC in the normal direction of engine rotation. Adjust regulated pressure to 80 p.s.i. and determine amount of loss. If the gage reading is higher than the previously determined master orifice calibrated reading, proceed to next cylinder to be test.

NOTE . . . Piston ring rotation within the ring land is a normal design characteristic. As illustrated in Figure 9-4, the compression ring location may have a direct bearing on the dynamic seal pressure check. Therefore, it's suggested the test be completed in the opposite direction if readings are below prescribed limits.

13. If recheck of cylinder pressure gage 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 cylinder should be accomplished as outlined in the engine overhaul manual and service bulletins.

<table>
<tr><th>FIRST CHECK</th><th>CHECK FOR</th><th>METHOD</th><th>1. DISCREPANCY</th><th>2. CORRECTIVE ACTION</th><th>2. CORRECTIVE ACTION</th></tr>
<tr><td rowspan="13">STATIC SEAL (NO LEAKAGE PERMISSIBLE)</td><td rowspan="4">Intake Valve to Seat Seal</td><td rowspan="4">Listen for air Flow in Intake Port</td><td>Carbon</td><td>Stake Valve</td><td></td></tr>
<tr><td>(Cracked Cylinder)</td><td>Replace Cylinder</td><td></td></tr>
<tr><td>Seat Worn or Burned</td><td>Grind or Replace</td><td rowspan="2">Reinspect</td></tr>
<tr><td>Valve Worn or Burned</td><td>Grind or Replace</td></tr>
<tr><td rowspan="4">Exhaust Valve to Seat Seal</td><td rowspan="4">Listen for air Flow in Exhaust Port</td><td>Carbon</td><td>Stake Valve</td><td></td></tr>
<tr><td>(Cracked Cylinder)</td><td>Replace Cylinder</td><td></td></tr>
<tr><td>Seat Worn or Burned</td><td>Grind or Replace</td><td rowspan="2">Reinspect</td></tr>
<tr><td>Valve Worn or Burned</td><td>Grind or Replace</td></tr>
<tr><td rowspan="2">Spark Plug (2) to Port Seal</td><td rowspan="2">Apply Soapy Solution Around Spark Plug</td><td>Loose Heli-coil</td><td>Replace Heli-coil</td><td>Reinspect</td></tr>
<tr><td>Cracked Cylinder</td><td>Replace Cylinder</td><td></td></tr>
<tr><td>Cylinder Head to Barrel Seal</td><td>Apply Soapy Solution Between Head and Barrel</td><td>Bubbles</td><td>Replace Cylinder</td><td></td></tr>
<tr><td>Cylinder Head Cracks</td><td>Apply Soapy Solutions Around Fins</td><td>Bubbles</td><td>Replace Cylinder</td><td></td></tr>
<tr><th>SECOND CHECK</th><th>CHECK FOR</th><th>METHOD</th><th>1. DISCREPANCY</th><th>2. CORRECTIVE ACTION</th><th>2. CORRECTIVE ACTION</th></tr>
<tr><td rowspan="4">DYNAMIC SEAL</td><td rowspan="4">Leakage by Piston Rings</td><td rowspan="3">Test Gauge below T olerance</td><td>Piston cracked or out of limits</td><td>Replace Piston</td><td rowspan="2"></td></tr>
<tr><td>Worn Rings</td><td>Replace Rings</td></tr>
<tr><td>Cylinder wall dimentions out of limits</td><td>Replace Cylinder</td><td></td></tr>
<tr><td>Test Gauge above Tolerance</td><td>None</td><td>None</td><td></td></tr>
</table>

FIGURE 9-5.

INTENTIONALLY

LEFT

BLANK

CHAPTER 10

TROUBLESHOOTING

Section Index

10-1 GENERAL INFORMATION

The troubleshooting chart which follows, discusses symptoms which can be diagnosed and interprets the results in terms of probable causes and the appropriate corrective action to be taken.

For additional information on more specific troubleshooting procedures, refer to Overhaul Manual and TCM Service Bulletins.

All engine maintenance should be performed by a qualified mechanic. Any attempt by unqualified personnel to adjust, repair or replace any parts, may result in damage to the engine.

> **WARNING . . . Operation of a malfunctioning engine without a preliminary examination 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.**

10-2 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.	Fill with correct grade of fuel.
	Improper starting procedure.	Refer to Pilot's Checklist for starting procedures and check for performance of each item.
	Cylinder overprimed. Engine flooded.	Place mixture levers in IDLE CUT-OFF position. Open throttle wide. Turn engine over several revolutions to clear cylinder.
	Induction system leak.	Tighten or replace loose or damaged hose connection.
	Excessive Starter slippage.	Replace starter adapter.
	Fuel system malfunction.	Isolate cause and correct. (See Troubleshooting the Fuel Injection System.)
	Ignition system malfunction.	Isolate cause and correct. (See Troubleshooting the Ignition System.)
	Manifold valve vent obstruction.	Repair or replace manifold valve.

TROUBLE	PROBABLE CAUSE	CORRECTION
Engine Will Not Run At Idling Speed	Propeller levers set in high pitch (DECREASE RPM).	Use low pitch (INCREASE RPM) position for all ground operations.
	Fuel injection system improperly adjusted.	See Troubleshooting the Fuel Injection System.
	Air leak in intake manifold.	Tighten loose connection or replace damaged part.
Rough Idling	Fuel injection system improperly adjusted.	See Troubleshooting the Fuel Injection System.
	Mixture levers set for improper mixture.	Use FULL RICH position for all ground operation, except high altitude airports.
	Fouled spark plugs.	Remove and clean, Adjust gaps.
	Hydraulic lifters fouled.	Remove and clean lifters. Inspect and clean oil filter at more frequent intervals.
	Burned or warped exhaust valves, worn seat, scored valve guides.	Repair cylinder.
Engine Runs Too Lean At Cruising Power	Improper manual leaning procedure.	Refer to Section 13 for proper fuel flow settings.
	Fuel flow reading too low.	Check fuel strainer for clogging. Clean screen.
	Fuel injection malfunction.	See Troubleshooting the Fuel Injection System.
Engine Runs Too Rich At Cruising Power	Restrictions in air intake passages.	Check passages and remove restrictions.
Engine Runs Too Lean Or Too Rich At Throttle Setting Other Than Cruise.	Fuel injection malfunction.	See Troubleshooting the Fuel Injection System.
Continuous Fouling Of Spark Plugs.	Piston rings excessively worn or broken.	Replace rings. Replace cylinder if damaged.
	Piston rings are not seated.	Hone cylinder walls, replace rings.

TROUBLE	PROBABLE CAUSE	CORRECTION
Engine Runs Rough At High Speed	Loose mounting bolts or damaged mount pads.	Tighten mounting bolts. Replace mount pads.
	Plugged fuel nozzle.	Clean.
	Propeller out of balance.	Remove and repair.
	Ignition system malfunction.	See Troubleshooting the Ignition System.
Continuous Missing At High Speed	Broken valve spring.	Replace.
	Plugged fuel nozzle.	Clean.
	Burned or warped valve.	Repair cylinder.
	Hydraulic lifter dirty or worn.	Remove and clean or replace.
Sluggish Operation And Low Power	Throttle not opening wide.	Check and adjust linkage. (See Rigging of Mixture and Throttle Controls.)
	Restrictions in air intake passages.	Check.
	Ignition system malfunction.	See Troubleshooting the Ignition System.
	Fuel injection malfunction.	See Troubleshooting the Fuel Injection System.
	Valve seats worn and leaking. Piston rings worn or stuck in grooves.	Borescope cylinders and check compression.
	Improperly adjusted waste gate valve.	See Troubleshooting the Exhaust System.
	Malfunctioning turbocharger.	See Troubleshooting the Exhaust System.
	Exhaust system gas leakage.	See Troubleshooting the Exhaust System.
High Cylinder Head Temperature	Low Octane fuel.	Drain tanks and replace with correct grade of fuel.
	Lean fuel/air mixture due to improper manual leaning procedure.	See "CORRECTION" under "Engine runs too lean at cruising power."
	Cylinder baffles loose or bent.	Check and correct.

TROUBLE	PROBABLE CAUSE	CORRECTION
High Cylinder Head Temperature	Dirt between cylinder fins.	Clean thoroughly.
	Excessive carbon deposits in cylinder head and on pistons.	Check ignition and fuel injection system.
	Magnetos out of time. No appreciable drop detected during pre-flight check.	Retime, internally and externally.
	Magneto distributor block contamination	Disassemble and repair as required or replace magneto.
High Cylinder Head Temperature.	Exhaust system gas leakage.	Locate and correct.
	Exhaust valve leaking.	Repair cylinder.
Oil Leaks	At front of engine; damaged crankshaft oil seal.	Replace.
	Around propeller mounting flange: damaged hub o-ring seal.	Replace.
	Around plugs, fittings and gaskets due to looseness or damage.	Tighten or replace.
Low Compression	Piston rings excessively worn.	Repair cylinder.
	Valve faces and seats worn.	Repair cylinder.
	Excessively worn cylinder walls.	Replace cylinder & piston rings.
Slow Engine Acceleration On A Hot Day	Mixture too rich.	Momentarily pull mixture control back until engine acceleration picks up, then set proper mixture.
Rough Idle At Airfields With Ground Elevation Of 3500 Feet Or Higher	Mixture too rich.	Pull mixture control back to where the engine operates the smoothest at IDLE RPM.
Slow Engine Acceleration At Airfields With A Ground Elevation Of 3500 Feet Or Higher.	Mixture too rich.	Adjust mixture per Chapter 13.
Engine Will Not Stop At Idle Cut-Off	Fuel manifold valve not seating tightly.	Repair or replace manifold valve.
High Engine Idle Pressure Impossible To Obtain.	Fuel manifold valve sticking closed.	Repair or replace manifold valve.

TROUBLE	PROBABLE CAUSE	CORRECTION
High Engine Idle Pressure Impossible To Obtain	Fuel manifold valve vent obstruction.	Repair or replace manifold valve.
Erratic Engine Operation	Fuel manifold valve sticking, or not free.	Repair or replace manifold valve.
Climbing to Altitudes Above 12,000 Feet, Engine Quilts When Power Reduced.	Fuel vaporization.	Operate fuel boost pump accord-to aircraft manufacturer's instructions. See fuel flow per Chapter 13.
Low Fuel Pressure	Restricted flow to fuel metering valve.	Check mixture control for full travel. Check for restrictions in fuel filters and lines, adjust control and clean filter. Replace damaged parts.
	Fuel control lever interference.	Check operation of throttle control and for possible contact with cooling shroud. Adjust as required to obtain correct operation.
	Incorrect fuel injector pump adjustment and operation.	Check and adjust using appropriate equipment. Replace defective pumps.
	Malfunctioing fuel injector pump relief valve.	Replace pump.
High Fuel Pressure	Restricted flow beyond fuel control assembly.	Check for restricted fuel nozzles or fuel manifold valve. Clean or replace nozzles. Replace malfunctioning fuel manifold valve.
	Malfunctioning relief valve operation in fuel injector.	Replace fuel injector pump.
	Restricted re-circulation passage in fuel injector pump.	Replace pump.
Fluctuating Fuel Pressure	Vapor in fuel system, excessive fuel temperature.	Normally, operating the auxiliary pump will clear system. Operate auxiliary pump and purge system.
	Fuel gage line leak or air in gage line.	Drain gage line and tighten connections.

TROUBLE	PROBABLE CAUSE	CORRECTION
Fluctuating Fuel Pressure	Restrictions in vapor separator vent.	Check for restriction in ejector jet of vapor separator cover. Clean jet with solvent (only). Do Not Use Wire as Probe. Replace malfunctioning parts.
Low Oil Pressure 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.
	High oil temperature.	Malfunctioning oil temperature control valve in oil cooler; oil cooler restriction. Replace valve or clean oil cooler.
	Leaking, damaged or loose oil line connections - Restricted screen or filter.	Check for restricted lines and loose connections, and for partially plugged oil filter or screens. Clean parts, tighten connections, and replace malfunctioning parts.
Engine Runs Rough At Speeds Above Idle	Improper fuel-air mixture.	Check manifold connections for leaks. Tighten loose connections. Check fuel control and linkage for setting and adjustment. Check fuel filters and screens for dirt. Check for proper pump pressure, and replace pump if malfunctioning.
	Restricted fuel nozzle.	Remove and clean all nozzles.
	Ignition system and spark plugs malfunctioning.	Clean and regap spark plugs. Check ignition cables for defects. Replace malfunctioning components.
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.
	Malfunctioning ignition system.	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. Spark plug gap to be 0.015 to 0.019 inch.

10-2 ENGINE TROUBLESHOOTING (continued)

TROUBLE	PROBABLE CAUSE	CORRECTION
(continued) Engine Lacks Power, Reduction In Maximum Manifold Pressure.	Loose or damaged intake manifold.	Inspect entire manifold system for possible leakage at connection Replace damaged components, tighten all connections and clamps.
	Fuel nozzles malfunctioning.	Check for restricted nozzles and lines and clean or replace as necessary.
Engine Has Poor Acceleration.	Idle mixture too lean.	Readjust idle mixture.
	Incorrect fuel-air mixture, worn control linkage, or restricted air cleaner	Tighten loose connections, replace worn elements of linkage, service air cleaner.
	Malfunctioning ignition system.	Check accessible cables and connections. Replace malfunctioning spark plugs.

10-3 IGNITION 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 Fails To Start Due to Ignition Trouble	Ignition switch OFF or grounded switch wires.	Turn switch On. Check for grounded wires.
	Spark plugs fouled, improperly gaped, or loose.	Remove and clean. Adjust to proper gap. Tighten to specified torque.
	Magnetos improperly timed to engine.	Refer to Installation of Magnetos and Ignition Timing for timing procedures.
	Shorted condenser.	Replace condenser.
	Magneto internal timing incorrect or timed for opposite rotation.	Install correctly timed magneto.

10-3 IGNITION TROUBLESHOOTING (continued)

TROUBLE	PROBABLE CAUSE	CORRECTION
Rough Idling	Spark plugs fouled or improperly gaped.	Clean spark plugs. Adjust spark plug gap.
	Weak condenser.	Replace condenser.
	Loose or improperly gaped spark plugs.	Tighten to specified torque. Adjust to proper gap.
	High tension leak in ignition harness.	Check for faulty inspection.
	Weak or burned out condenser as evidenced by burned or pitted breaker points.	Replace points and condenser.
Sluggish Operation And/Or Excessive RPM Drop.	Fouled or dead spark plugs.	Clean spark plugs. Replace dead spark plugs.
	Improperly gaped spark plugs.	Adjust to proper gap.
	Magnetos out of time with plugs.	Refer to Installation of Magnetos and Ignition Timing for proper timing procedure.
	Damaged magneto breaker points or condenser.	Replace points and condenser.
High Oil Temperature Indication	Low oil supply.	Replenish.
	Cooler air passages clogged.	Clean thoroughly.
	Cooler core plugged.	Remove cooler and flush thoroughly.

10-4 OIL SYSTEM 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 approximated ease of checking, not necessarily in order of probability.

TROUBLE	PROBABLE CAUSE	CORRECTION
High Oil Temperature Indication	Thermostat damaged or held open by solid matter.	Remove, clean valve and seat. If still inoperative, replace.
	Oil viscosity too high.	Drain and refill with correct seasonal weight. (See Sect. 4-3)

10-4 OIL SYSTEM TROUBLESHOOTING CHART (continued)

TROUBLE	PROBABLE CAUSE	CORRECTION
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.
Low Oil Pressure Indication.	Low oil supply.	Replenish.
	Oil viscosity too low.	Drain and refill with correct seasonal weight. (See Sec. 4-3)
	Foam in oil due to presence of alkaline solids in system.	Drain and refill with fresh oil. (It may be necessary to flush cooler core if presence of alkaline solids is due to a previous cleaning with alkaline materials).
	Malfunctioning pressure pump.	Replace pump.
	Malfunctioning pressure gage.	Check gage. Clean plumbing. Replace if required.
	Weak or broken oil pressure relief valve spring.	Replace spring. Adjust pressure to 30-60 psi by adjusting screw.

10-5 FUEL INJECTION SYSTEM 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 to probability.

TROUBLE	PROBABLE CAUSE	CORRECTION
Engine Will Not Start And No Fuel Flow Gage Indication	No fuel to engine.	Check tank fuel level.
	Mixture control improperly rigged.	Check mixture control for proper rigging.
	Engine not primed.	Auxiliary pump switch in PRIME position.
	Selector valve in wrong position.	Position selector valve to MAIN TANK position.
Engine Will Not Start With Fuel Flow Gage Indication	Engine flooded.	Reset throttle, clear engine of excess fuel, try another start.

10-5 FUEL INJECTION SYSTEM TROUBLESHOOTING CHART (continued)

TROUBLE	PROBABLE CAUSE	CORRECTION
Engine Will Not Start With Fuel Flow Gage Indication	No fuel to engine.	Loosen one line at nozzle. If no fuel shows, with fuel flow on gage, replace fuel manifold valve.
Rough Idle	Nozzle restricted.	Remove nozzles and clean.
	Improper idle mixture.	Adjust fuel-air control unit in accordance with adjustment procedures.
Poor Acceleration	Idle mixture incorrect.	Adjust fuel-air control unit in accordance with adjustment procedures.
	Unmetered fuel pressure too high.	Lower unmetered fuel pressure.
	Worn linkage.	Replace worn elements of linkage.
Engine Runs Rough	Restricted nozzle.	Remove and clean all nozzles.
	Improper mixture.	Improper pump pressure, replace pump.
Low Fuel Flow Gage indication	Restricted flow to metering valve.	Check mixture control for full travel. Check for clogged fuel filters.
	Inadequate flow from fuel pump.	Adjust engine-driven fuel pump.
High Fuel Flow Gage Indication	Restricted flow beyond metering valve.	Check for restricted nozzles or fuel manifold valve. Clean or replace as required.
	Restricted recirculation passage in fuel pump.	Replace engine-driven fuel pump.
Fluctuating or Erroneous Fuel Flow Indications	Vapor in system, excess fuel temperature.	If not cleared with auxiliary pump, check for clogged ejector jet in vapor separator cover. Clean only with solvent, no wires.
	Air in fuel flow gage line. Leak at gage connection.	Repair leak and purge line.
Poor Idle Cut-Off	Engine getting fuel.	Check mixture control is in full idle cut-off. Check auxiliary pump is OFF. If neither, replace manifold valve.

10-5 FUEL INJECTION SYSTEM TROUBLESHOOTING CHART (continued)

TROUBLE	PROBABLE CAUSE	CORRECTION
Unmetered Fuel Pressure	Internal orifices plugged.	Clean internal orifices injector pump.
Unmetered Fuel Pressure Drop	Relief valve stuck open	Repair or replace injector pump.
Very High Idle And Full Throttle Fuel Pressure Present	Relief valve stuck closed.	Repair or replace injector pump.
No Fuel Pressure	Check valve stuck open.	Repair or replace injector pump.

10-6 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 Wastegate valve.	To check the adjustment of the fixed wastegate valve, refer to the airframe service manual.
	Loose or damaged exhaust system.	Inspect entire exhaust system to turbocharger for cracks and leaking connections. Tighten 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 bearings. Replace turbocharger if damage is noted.
	Exhaust system gas leakage.	Inspect exhaust system for gas leakage, gaskets at cylinder exhaust ports, flexible bellows, gaskets at turbine inlet flanges, etc., and correct.
White Smoke Exhaust	Turbo coking, oil forced through seal turbine housing.	Clean or change turbocharger.

CHAPTER 11

ENGINE PRESERVATION AND STORAGE

Section Index

11-1 ENGINE PRESERVATION AFTER OVERHAUL

Engines in aircraft that are flown only occasionally tend to exhibit cylinder wall corrosion more than engines in aircraft that are flown frequently.

Of particular concern are new engines or engines with new or freshly honed cylinders after a top or major overhaul. In areas of high humidity, there have been instances where corrosion has been found in such cylinders after an inactive period of only a few days. When cylinders have been operated for approximately 50 hours, the varnish deposited on the cylinder walls offers some protection against corrosion. Hence, a two step program for flyable storage category is recommended.

Obviously, even proper steps must be taken on engines used infrequently to lessen the possibility of corrosion. This is especially true if the aircraft is based near the sea coast or in areas of high humidity and flown less than once a week.

In all geographical areas the best method of preventing corrosion of the cylinders and other internal parts of the engine, is to fly the aircraft at least once a week, long enough to reach normal operating temperatures, which will vaporize moisture and other by-products of combustion. In consideration of the circumstances mentioned, TCM has listed three reasonable minimum preservation procedures, that if implemented, will minimize the detriments of rust and corrosion. It is the owner's responsibility to choose a program that is viable to the particular aircraft's mission.

Aircraft engine storage recommendations are broken down into the following categories:

A. Flyable Storage (7 to 30 days)
B. Temporary Storage (up to 90 days)
C. Indefinite Storage

11-2 FLYABLE STORAGE (7 to 30 days)

1. Service aircraft per normal airframe manufacturer's instructions.

2. During flyable storage, the propeller should be rotated by hand every 7 days. Rotate the engine six revolutions, stop the propeller at 45° to 90° from the original position.

CAUTION . . . For maximum safety, accomplish engine rotation as follows:

a. Verify magneto switches are "OFF".

b. Throttle position "CLOSED".

c. Mixture control "IDLE-CUT-OFF".

d. Set brakes and block aircraft wheels.

e. Assure that aircraft tie-downs are installed and verify that the cabin door latch is open.

f. Do not stand within the arc of the propeller blades while turning the propeller.

3. If at the end of thirty (30) days the aircraft is not removed from storage, it should be flown for a minimum of thirty (30) minutes. If the aircraft cannot be flown, it should be represerved in accordance with Temporary Storage or Indefinite Storage.

11-3 TEMPORARY STORAGE (up to 90 days)

1. Preparation for storage.

a. Remove the top spark plug and spray atomized preservative oil, (Lubrication Oil-Contact and Volatile Corrosion-Inhibited, MIL-L-46002, Grade 1) at room temperature, through upper spark plug hole of each cylinder with the piston in approximately the bottom dead center position. Rotate crankshaft as opposite cylinders are sprayed. Stop crankshaft with none of the pistons at top dead center.

NOTE . . . Shown below are preservative oils recommended for use in Teledyne Continental engines for temporary and indefinite storage:

MIL-L-46002, Grade 1 Oil

NOX RUST VC1-105 - May be purchased through:
Rock Island Lubricant & Chemical Company
P.O. Box 5015
1320 1st Street
Rock Island, Illinois 61204
1-800-522-1150

b. 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.

c. Install spark plugs.

d. Spray preservative oil (approximately two ounces) through the oil filler tube.

e. Seal all engine openings exposed to the atmosphere using suitable plugs, or moisture resistant tape.

f. Engines installed in aircraft that are preserved for storage in accordance with this section should have a tag affixed to the propeller in a conspicuous place with the following notation on the tag: "DO NOT TURN PROPELLER - ENGINE PRESERVED".

2. Preparation for Service

a. Remove seals, tape, paper and streamers from all openings.

b. With bottom spark plugs removed, rotate the propeller several revolutions to remove preservative oil; re-install spark plugs.

c. Conduct a normal engine start.

d. Give the aircraft a thorough visual inspection prior to flight testing.

11-4 INDEFINITE STORAGE

1. Preparation for storage.

a. Drain the oil and refill with MIL-C-6529 Type II. Start engine and run until normal oil and cylinder head temperatures are reached. Fly the aircraft for thirty (30) minutes. Allow engine to cool to ambient temperature. Accomplish steps "1.a." and "1.b." of temporary storage.

b. Apply preservative to engine interior by spraying (approximately two ounces) through the oil filler tube.

2. Install dehydrator plugs MS27215-2, in each of the top spark plug holes, making sure that the contents of each plug is blue in color when installed. Protect and support the spark plug leads with AN-4060 protectors.

3. The TCM fuel injection system does not require any special preservation.

4. Place a bag of desiccant in the exhaust pipes and seal the openings with moisture resistant tape.

5. Seal the induction system with moisture resistant tape.

6. Seal the engine breather.

7. Attach a red streamer at each location where bags of desiccant are placed. Attach red streamers outside of the sealed areas.

8. Installed preserved engines should be conspicuously tagged: "DO NOT TURN PROPELLER-ENGINE PRESERVED". Preservation Date________________.

11-5 RETURNING ENGINE TO SERVICE

1. Remove the cylinder dehydrator plugs, tape, desiccant bags and streamers.

2. Drain the preservative oil and re-service with recommended lubricating oil.

3. Remove bottom plugs; rotate propeller to clear preservative oil from the cylinders.

WARNING . . . When returning the aircraft to service do not use the corrosion preventive oil reference on Section 11-3 paragraph 1.a for more than 25 hours.

4. Re-install the spark plugs and rotate the propeller by hand several revolutions to check for possible liquid lock. Start the engine.

5. Give the aircraft a thorough visual inspection and test flight per airframe manufacturer's instructions.

11-6 INDEFINITE STORAGE INSPECTION PROCEDURES

Aircraft prepared for indefinite storage should have the cylinder dehydrator plugs visually inspected every 30 days. The plugs should be changed as soon as their color changes. If the dehydrator plugs have changed color in one-half or more of the cylinders, all desiccant material on the engine should be replaced.

The cylinder bores of all engines prepared for indefinite storage should be re-sprayed with corrosion preventive oil every six (6) months, or less. Replace all desiccant and dehydrator plugs. Before spraying, the engine should be inspected for corrosion as follows: Inspect all cylinders through the spark plug hole. If cylinder exhibits rust stains, spray cylinder corrosion preventive oil and turn prop over six times, then re-spray all cylinders.

The above procedures are a general recommendation for our customers. Since local conditions differ and Teledyne Continental Motors has no control over the application, more stringent procedures may be required. Rust and corrosion prevention are the owner's responsibility.

CHAPTER 12

AIRWORTHINESS LIMITATIONS

AIRWORTHINESS LIMITATIONS

The Airworthiness Limitations Section is FAA-Approved and specifies maintenance required under §§43.16 and 91.163 of the Federal Aviation Regulations unless an alternative program has been FAA approved. This section is part of the type design of the TSIO-520-BE engine pursuant to §21.31 of the Federal Aviation Regulations.

1. Mandatory Replacement Times.

   Subject to additional information contained in FAA Approved Mandatory Service Bulletins issued after the date of certification, the TSIO-520-BE engine does not contain any components having mandatory replacement times required for type certification.

2. Mandatory Inspection Intervals.

   Subject to additional information contained in FAA Approved Mandatory Service Bulletins issued after the date of certification 50 hour and 100 hour, inspections as described in the TSIO-520-BE series overhaul manual and inspections mandated by the FAA under Part 43 and 91 of the Federal Aviation Regulations are required for type certification.

3. Other Related Procedures.

   Subject to additional information contained in FAA Approved Mandatory Service Bulletins issued after the date of certification, the TSIO-520-BE engine does not have any inspection-related or replacement time-related procedures required for type certification.

4. Distribution of Changes to Airworthiness Limitations.

   Changes to Airworthiness Limitations section constitute changes to the type design of the TSIO-520-BE engine and require FAA approval pursuant to Federal Aviation Regulations §§21.95, §21.97 or §21.99. Such changes will be published in FAA Approved Mandatory Service Bulletins, which are furnished to subscribers to TCM Service Bulletins and can be obtained by writing Teledyne Continental Motors, P. O. Box 90, Mobile, Alabama 36601, Attn: Publications Department.

CHAPTER 13

ENGINE PERFORMANCE AND CRUISE CONTROL

Section Index

Section **Page**

The curves in this chapter represent uninstalled performance and are provided as a reference in establishing power conditions for takeoff, climb and cruise operation. Refer to aircraft manufacturer's flight manual for tabular climb and cruise data.

13-1 CRUISE CONTROL BY PERFORMANCE CURVE

1. Set manifold pressure and RPM at cruise power selected.

2. Correct horsepower for inlet air temperature as follows:

   (TS = Standard Altitude Temperature)
   (1) Add 1% for each 6°F below TS.
   (2) Subtract 1% for each 6°F above TS

3. This engine is equipped with altitude compensating fuel pump which automatically provides the proper full rich mixture at any given altitude. Adjust mixture to lean out fuel flow for cruise settings according to applicable fuel flow vs. brake horsepower curve.

CAUTION . . . When increasing power, enrich mixture, advance RPM and adjust throttle in that order. When reducing power, retard throttle, then adjust RPM and mixture.

NOTE . . . It may be necessary to make minor readjustments to fuel flow (mixture) after changing RPM.

13-2 CRUISE CONTROL BY T.I.T.

If turbine inlet temperature indicator is used as an aid to leaning proceed as follows:

1. Adjust RPM for desired cruise setting.

2. Slowly move mixture control toward "lean" while observing T.I.T. gage. Note position on the instrument where the needle "peaks" or starts to drop as mixture is leaned further.

3. The maximum recommended cruise setting is 235 HP at 2400 RPM and 31.0" Hg. MAP with the mixture set at 25°F to 50°F lean of peak T.I.T. At cruise settings below 65% engine may be operated at peak T.I.T. or below if obtainable.

CAUTION . . . Do not operate with E.G.T. settings of 25°F on the lean side of peak E.G.T. at any power setting.

CAUTION . . . Do not attempt to adjust mixture by use of T.I.T. at settings above 75% of maximum power without consulting airframe manufacturers Pilots Operating Handbook. Also, remember that engine power will change with ambient conditions. Changes in altitude or outside air temperature will require adjustments in manifold pressure and fuel flow. (Refer to Charts Fuel Flow Vs. BHP.)

Gage fuel flow should fall between the maximum and minimum values on the curve. If not, the fuel injection system or instrumentation (including tachometer, manifold pressure, fuel flow gage or T.I.T. system) should be checked for maladjustments or calibration error.

Table of Performance Charts

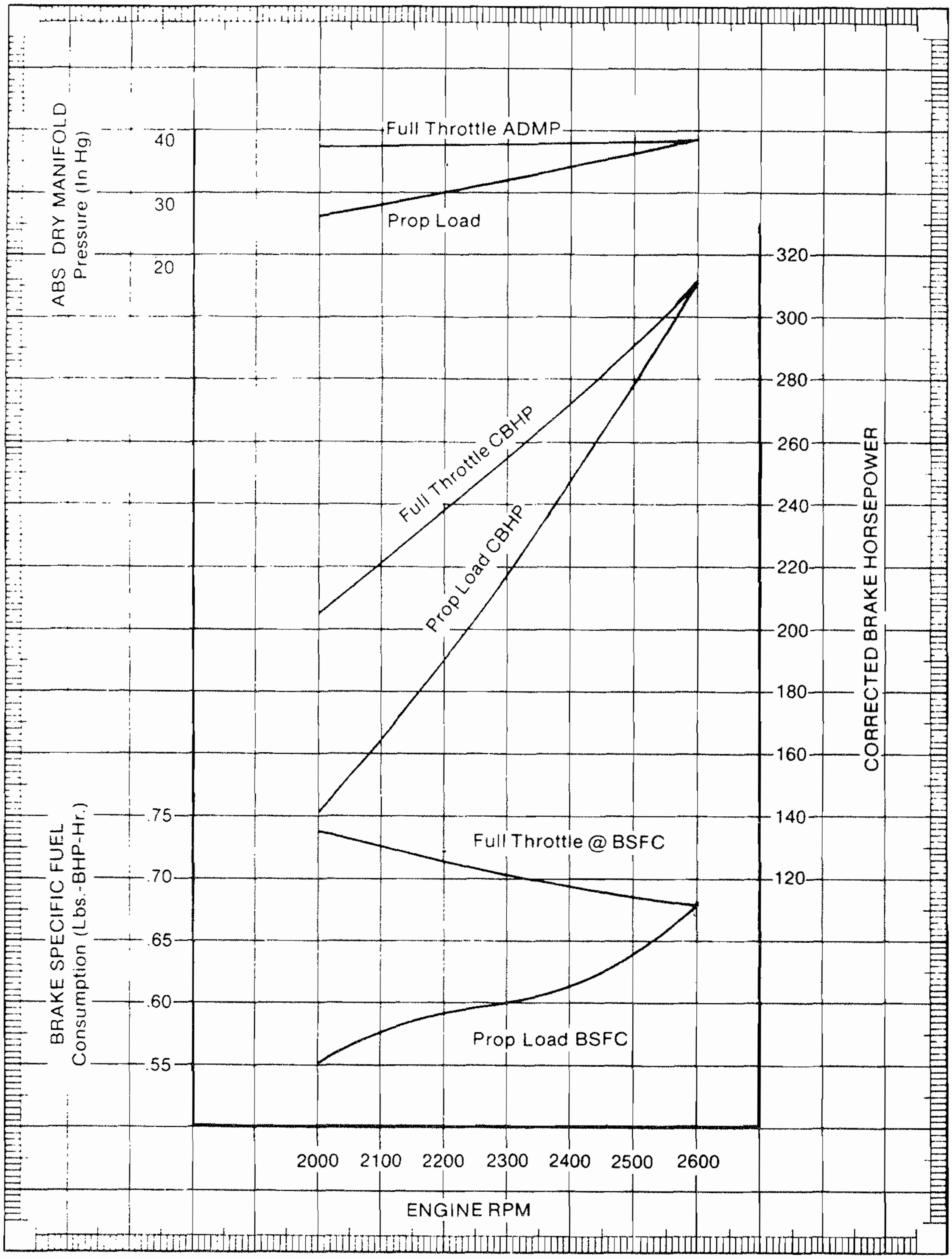


FIGURE 13-1. SEA LEVEL PERFORMANCE.

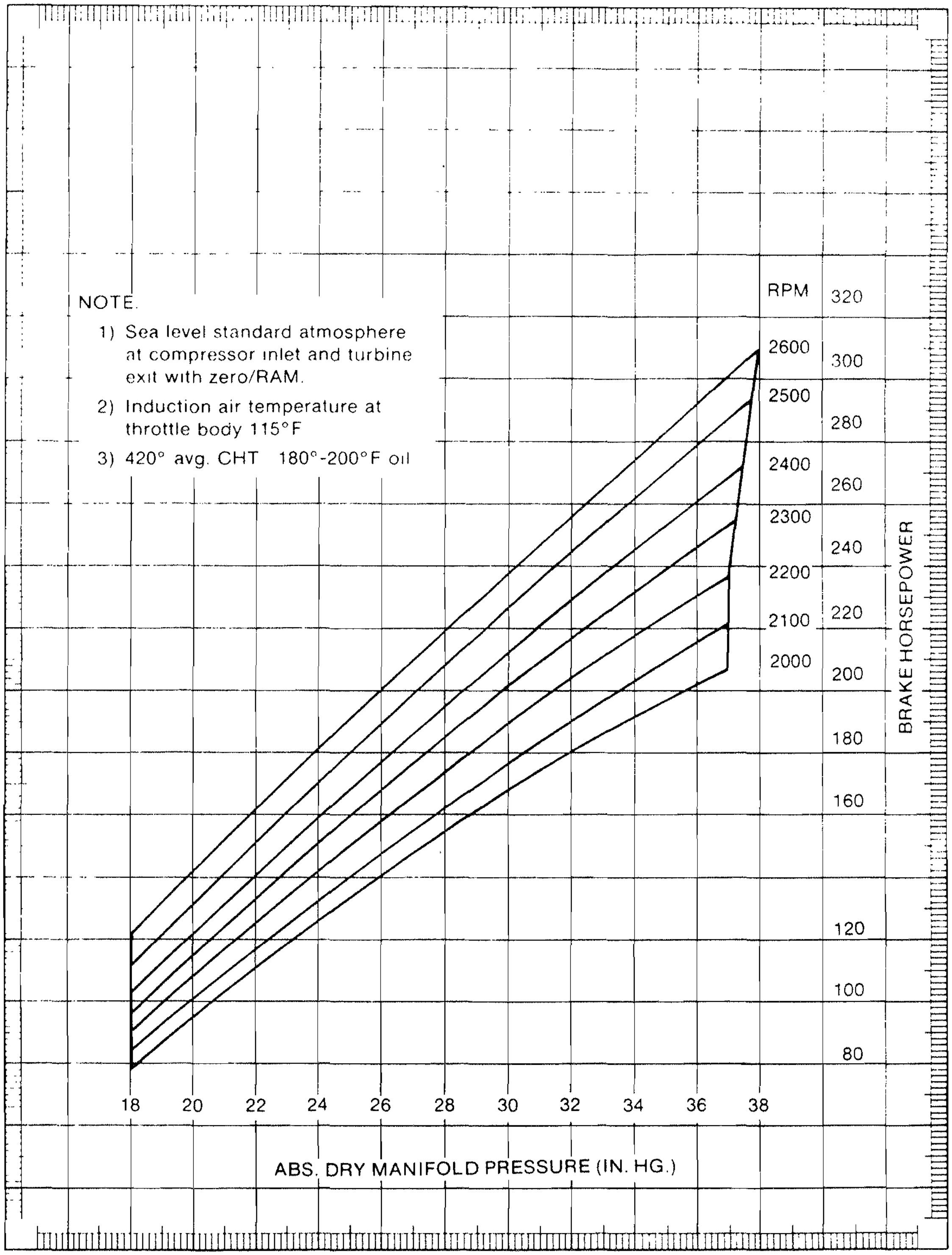


FIGURE 13-2. CONSTANT SPEED SEA LEVEL PERFORMANCE FULL RICH MIXTURE.

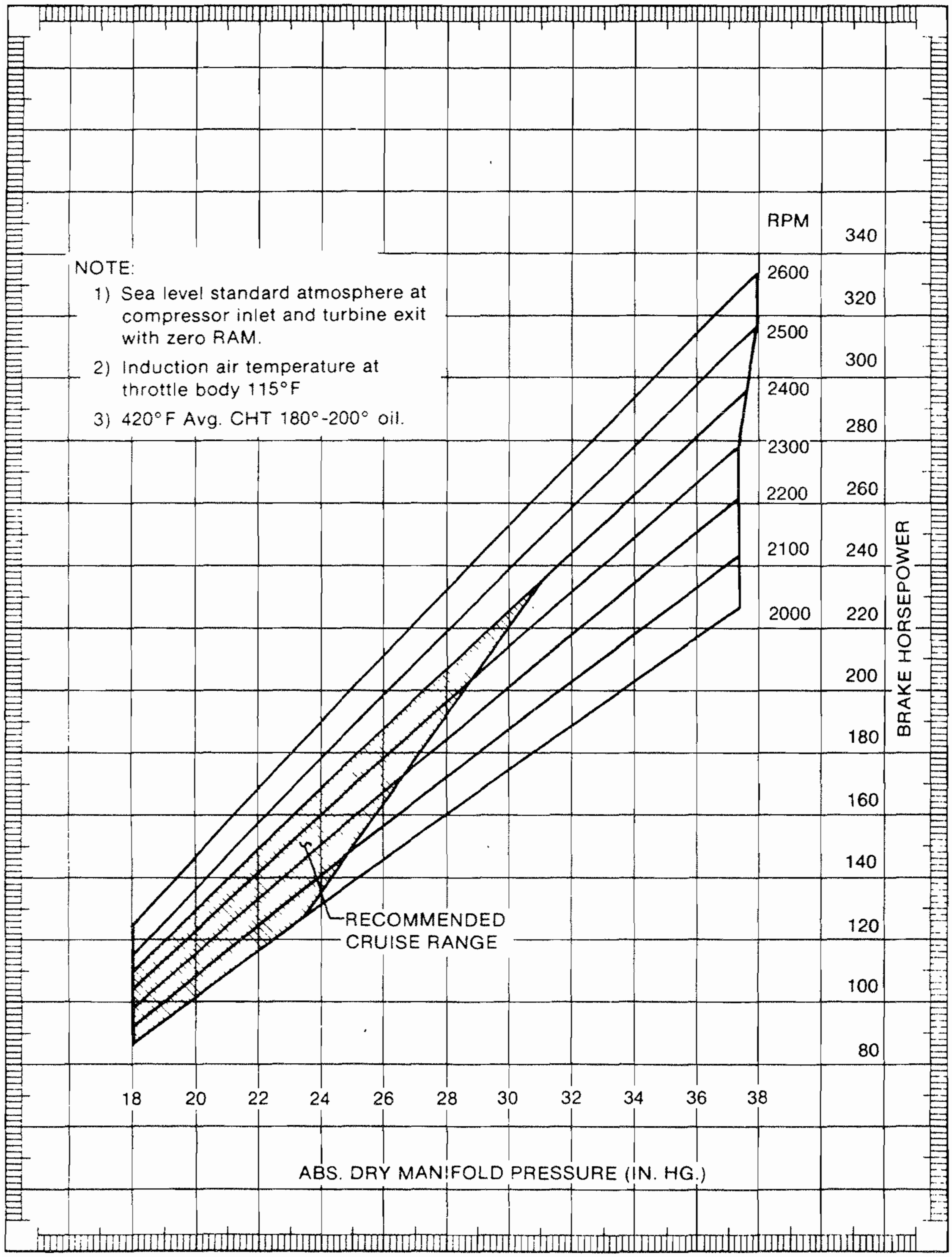


FIGURE 13-3. CONSTANT SPEED SEA LEVEL PERFORMANCE BEST POWER MIXTURE.

ESTIMATED UNINSTALLED ALTITUDE PERFORMANCE

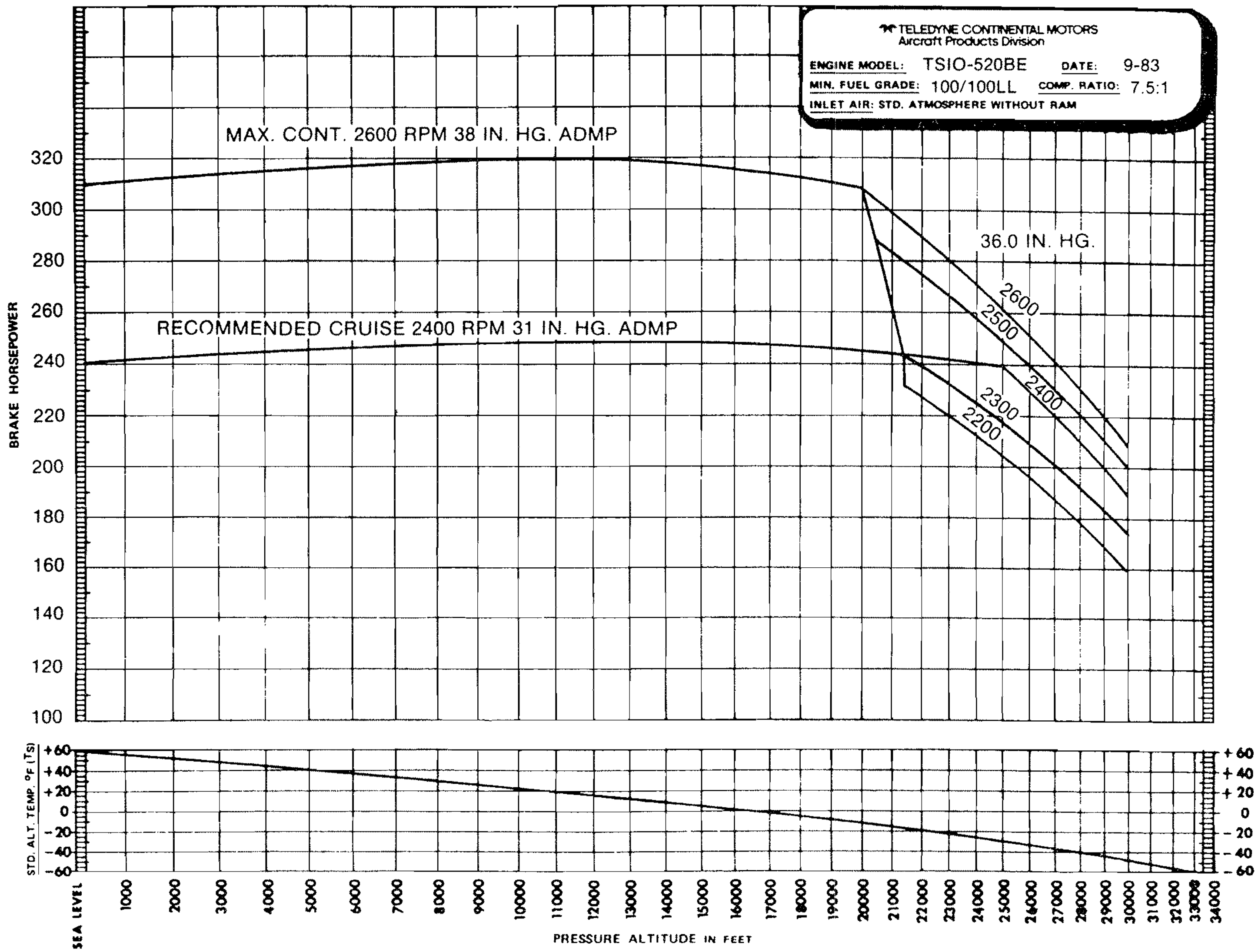


FIGURE 13-4. ALTITUDE PERFORMANCE.

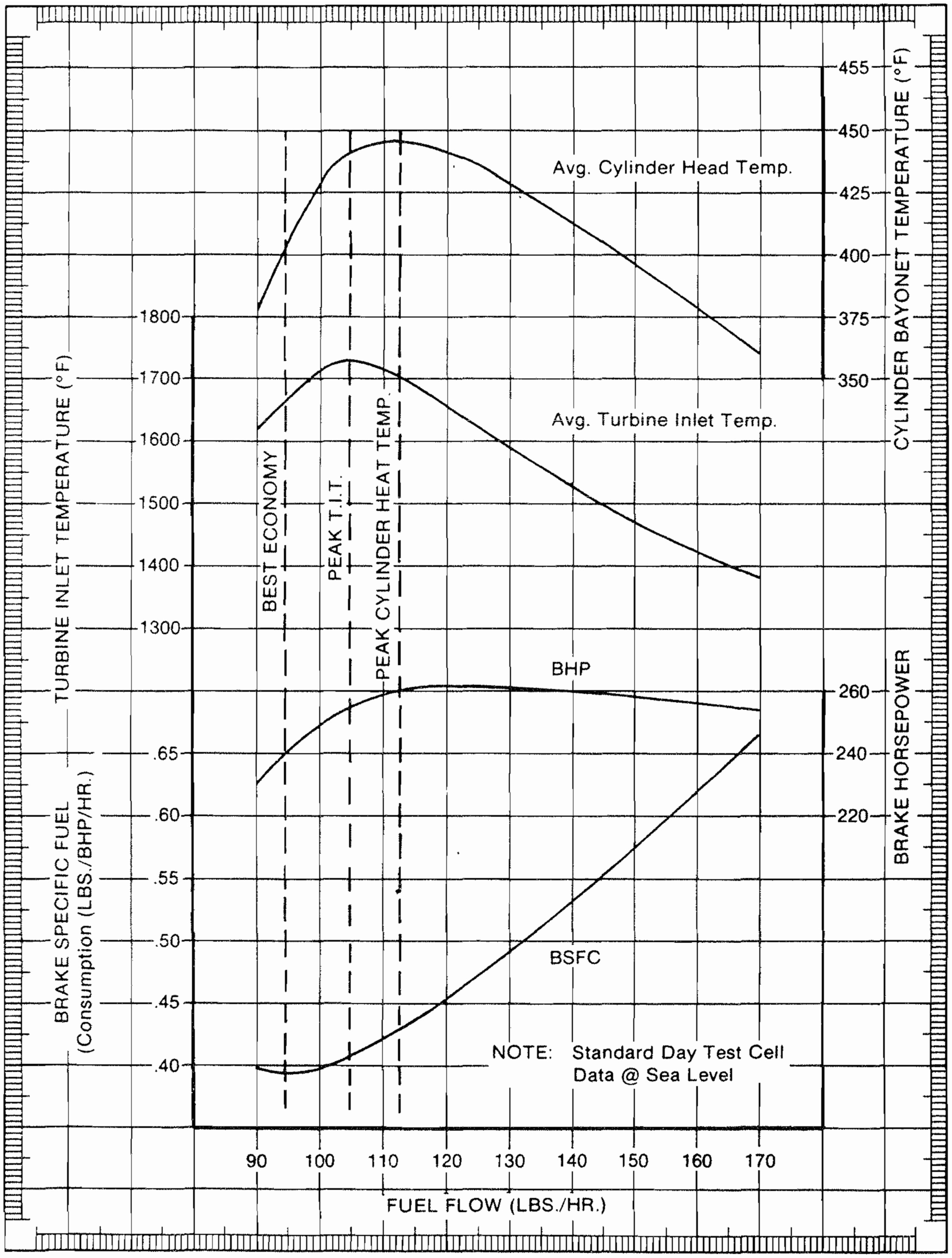


FIGURE 13-5. MIXTURE RATIO CURVE - 80% 2500 RPM AND 32.8" Hg. ADMP.

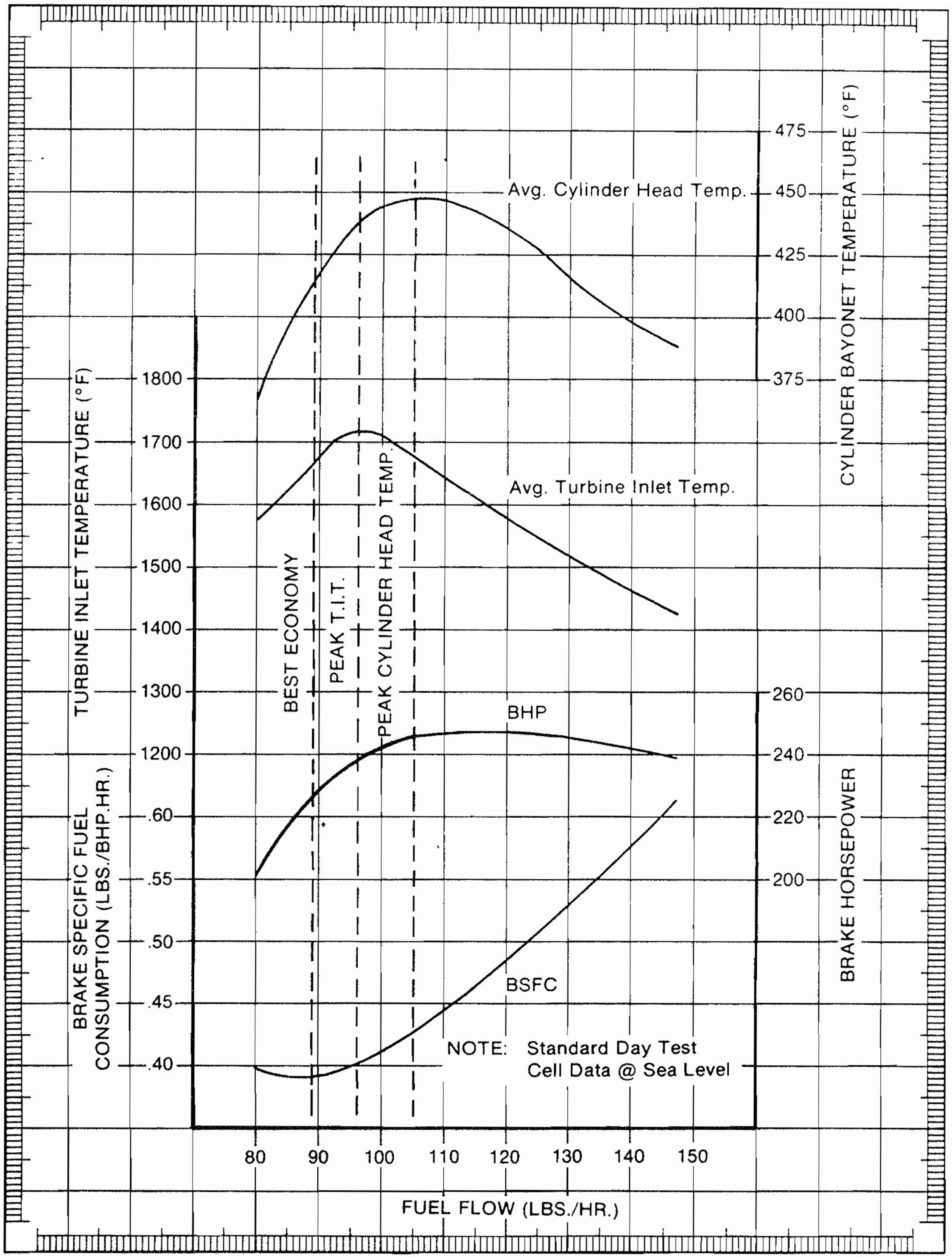


FIGURE 13-6. MIXTURE RATIO CURVE - 75% 2400 RPM AND 32.5" Hg. ADMP.

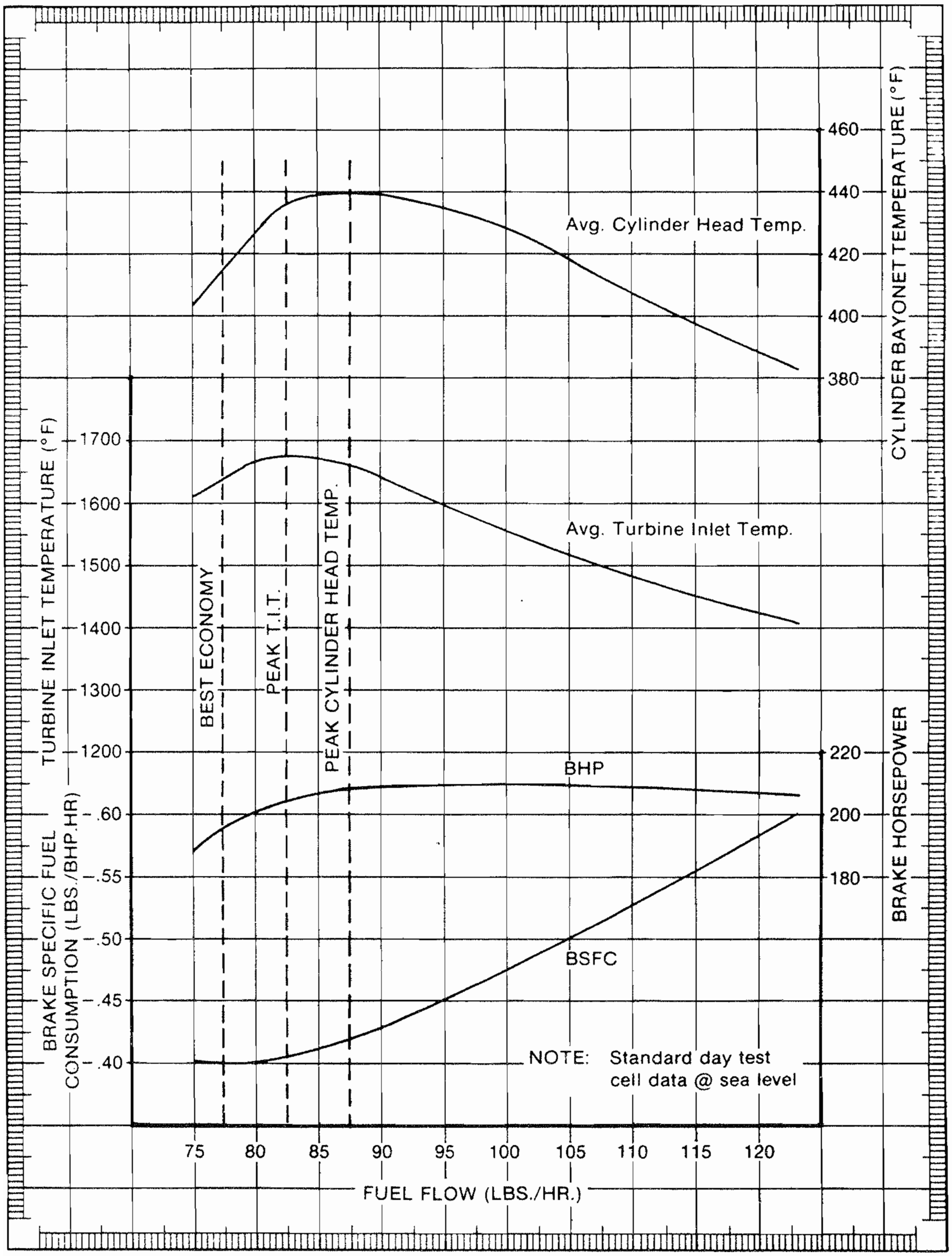


FIGURE 13-7. MIXTURE RATIO CURVE - 65% 2300 RPM AND 30.0" Hg. ADMP.

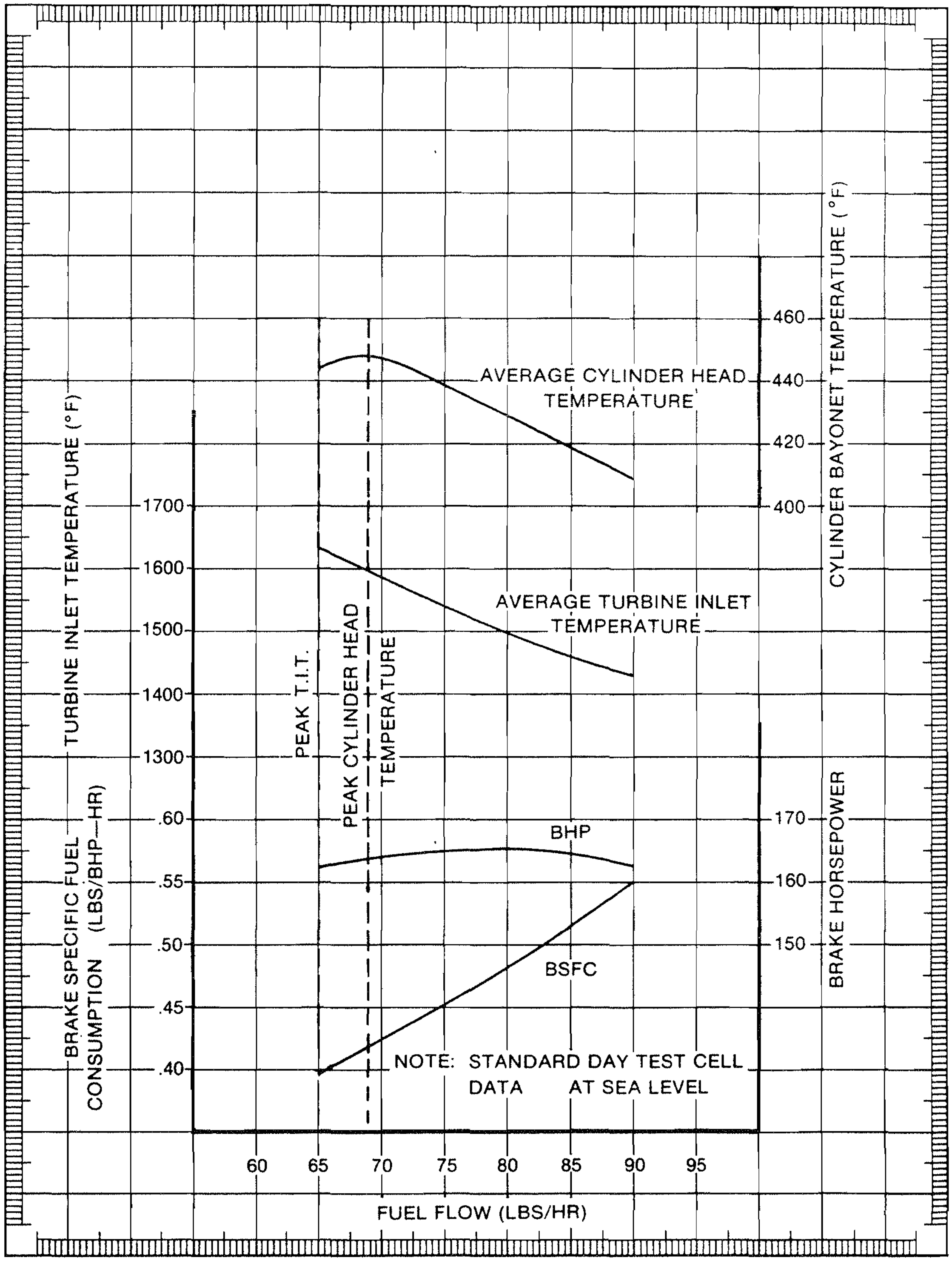


FIGURE 13-8. MIXTURE RATIO CURVE - 50% 2200 RPM AND 25.8" Hg. ADMP.

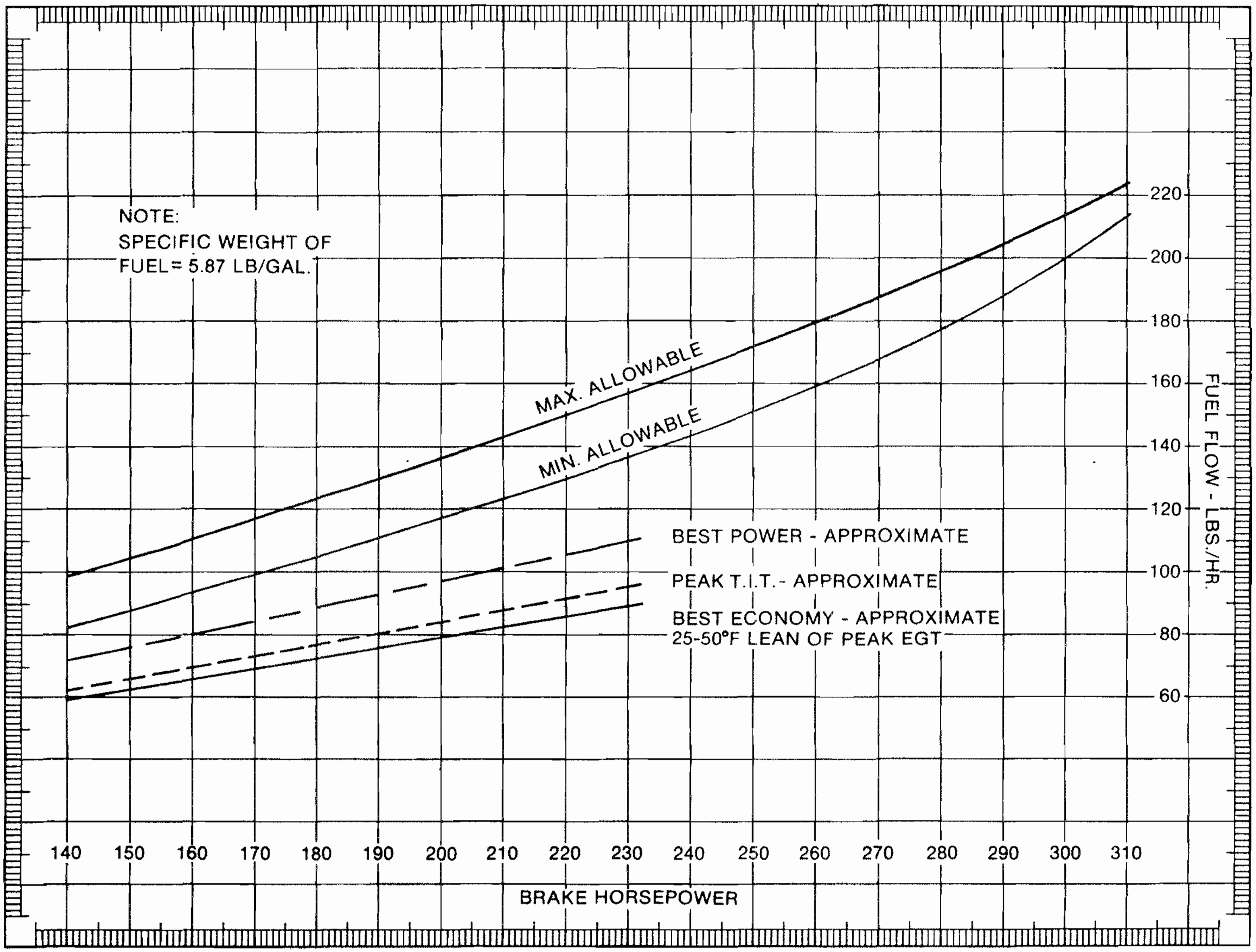


FIGURE 13-9. FUEL FLOW VS. BRAKE HORSEPOWER.

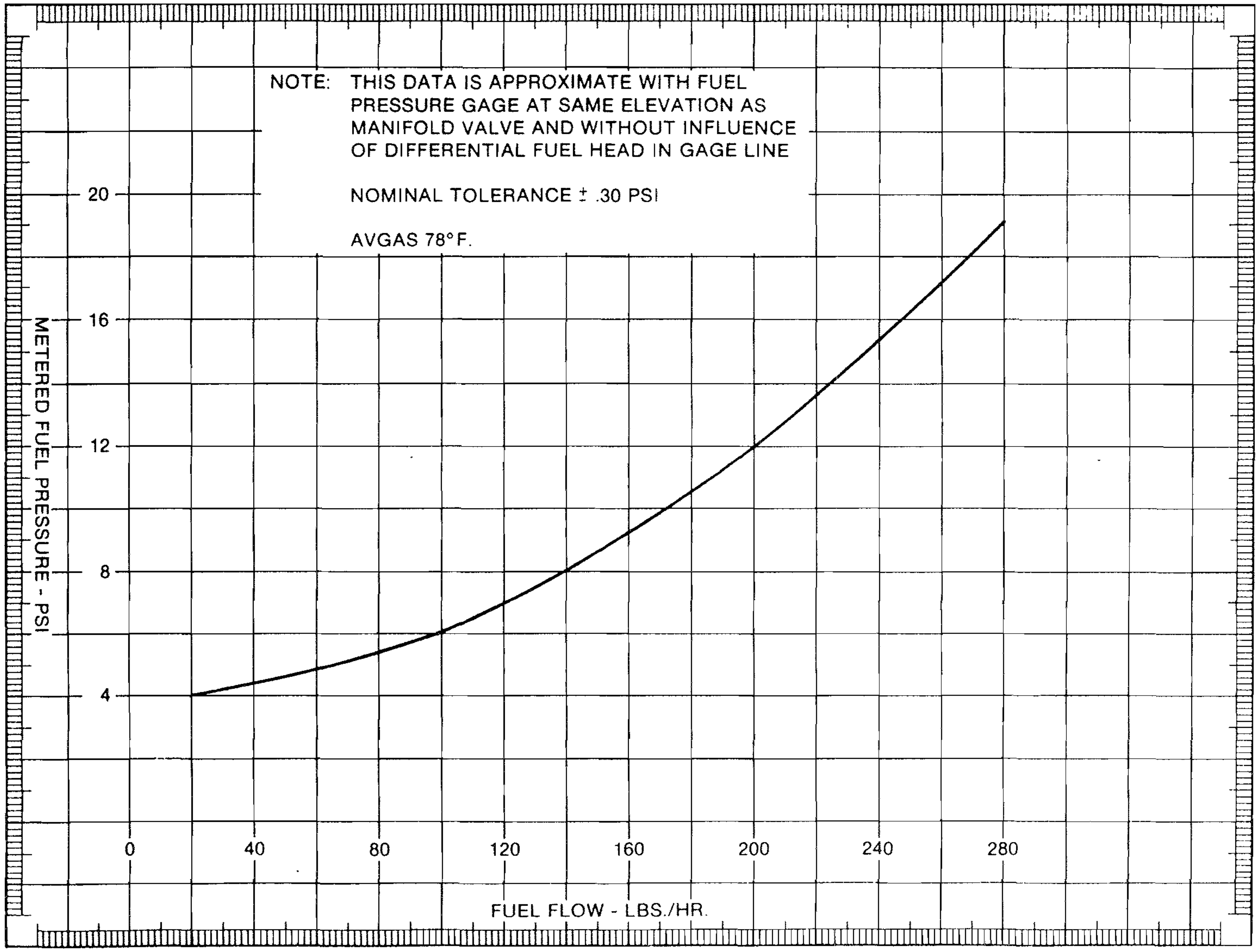


FIGURE 13-10. METERED FUEL PRESSURE VS. FUEL FLOW.

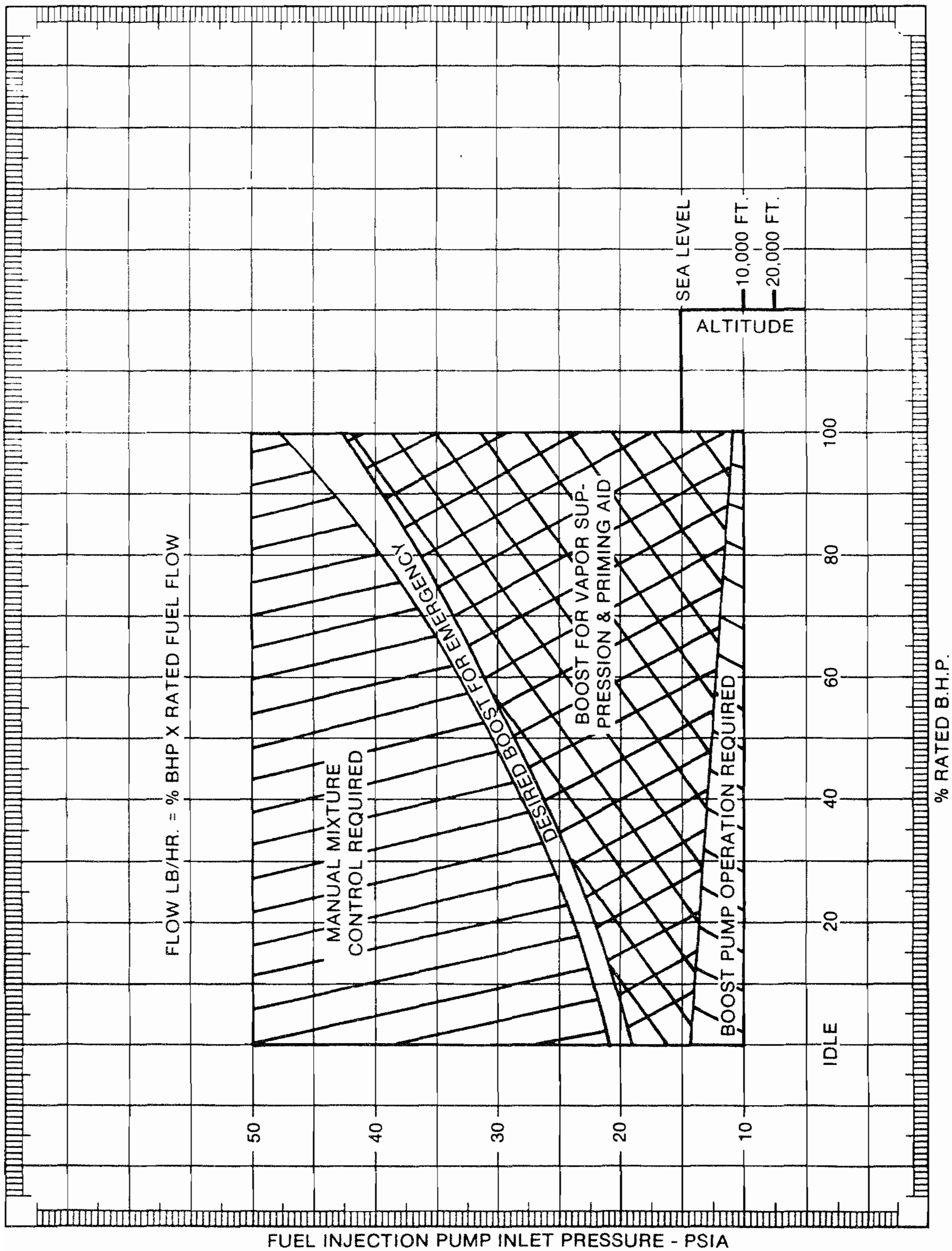


FIGURE 13-11. FUEL INJECTION FUEL PUMP PRESSURE PSIA VS. % RATED HORSEPOWER - 100 F AVGAS

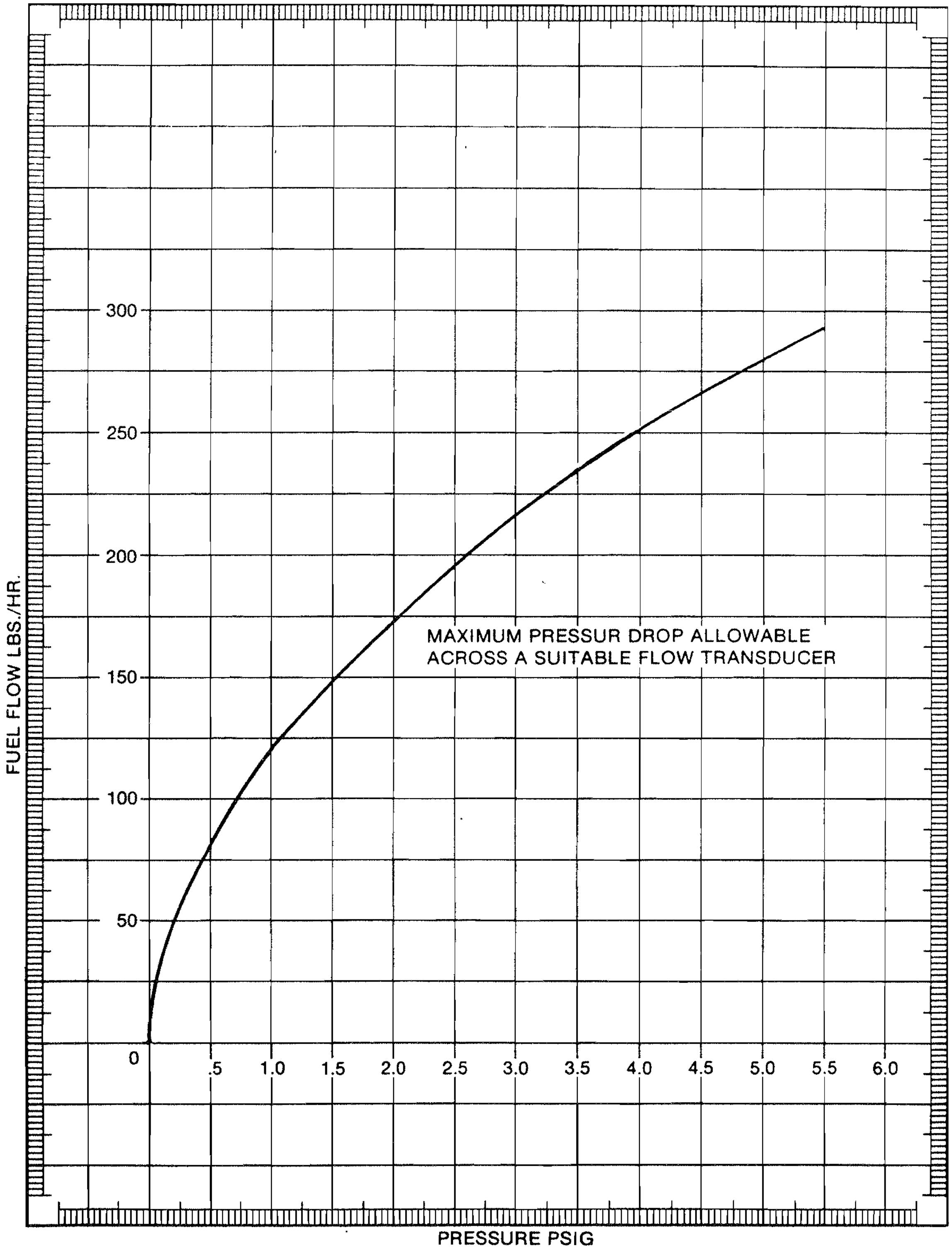


FIGURE 13-12. FUEL FLOW VS. PRESSURE DROP

INTENTIONALLY

LEFT

BLANK

Continental Motors, Inc.
www.continentalmotors.aero