Supersedure Notice

This manual revision replaces the front cover and list of effective pages for Publication Part No. X30041, dated September 1980. Previous editions are obsolete upon release of this manual.

Effective Changes for this Manual

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>September 1980</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>31 August 2011</td>
<td></td>
</tr>
</tbody>
</table>

List of Effective Pages

Document Title: IO-520 Series Engine Operator’s Manual
Publication Number: X30041
Initial Publication Date: September 1980

<table>
<thead>
<tr>
<th>Page Change</th>
<th>Page</th>
<th>Change</th>
<th>Page Change</th>
<th>Page</th>
<th>Change</th>
<th>Page Change</th>
<th>Page</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cover ..........</td>
<td>1</td>
<td></td>
<td>A ..........</td>
<td>1</td>
<td></td>
<td>i thru vi ..........</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1-1 thru 1-6 ..........</td>
<td>0</td>
<td></td>
<td>2-1 thru 2-10 ..........</td>
<td>0</td>
<td></td>
<td>3-1 thru 3-4 ..........</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>4-1 thru 4-24 ..........</td>
<td>0</td>
<td></td>
<td>5-1 thru 5-8 ..........</td>
<td>0</td>
<td></td>
<td>6-1 thru 6-10 ..........</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>7-1 thru 7-6 ..........</td>
<td>0</td>
<td></td>
<td>8-1 thru 8-6 ..........</td>
<td>0</td>
<td></td>
<td>9-1 thru 9-4 ..........</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>10-1 thru 10-8 ..........</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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

Copyright © 2011 Continental Motors, Inc. All rights reserved. This material may not be reprinted, republished, broadcast, or otherwise altered without the publisher’s written permission. This manual is provided without express, statutory, or implied warranties. The publisher will not be held liable for any damages caused by or alleged to be caused by use, misuse, abuse, or misinterpretation of the contents. Content is subject to change without notice. Other products and companies mentioned herein may be trademarks of the respective owners.
- NOTICE -

Teledyne Continental Motors (TCM) engine operating instructions are generated prior to and independently of the aircraft operating instructions established by the airframe manufacturer. TCM's operating instructions are developed using factory controlled parameters that are not necessarily the same as those specifications required to satisfy a specific aircraft / engine installation. Because of this difference the aircraft operator should use the airframe manufacturer's operating instructions found in the Pilots Operating Handbook (POH) while operating the aircraft unless otherwise specified by the original airframe manufacturer.
# TABLE OF CONTENTS

**PAGE**

**INTRODUCTION** .................................................. iv

**SECTION**

I  Operating Specifications and Limits ....................... 1-1
II  Normal Operating Procedures ............................... 2-1
III In-Flight Emergency Procedures .......................... 3-1
IV Engine Performance and Cruise Control ................... 4-1
V  Abnormal Environmental Conditions ........................ 5-1
VI Engine Description .............................................. 6-1
VII Servicing and Inspection ................................... 7-1
VIII Trouble Shooting ............................................. 8-1
IX Storage and Removal From Storage ......................... 9-1
X  Glossary ......................................................... 10-1
LIST OF ILLUSTRATIONS

<table>
<thead>
<tr>
<th>PAGE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BHP vs. Metered Fuel Pressure for IO-520-A, J 4-3</td>
</tr>
<tr>
<td>2</td>
<td>Sea Level Performance Curves for IO-520-A, J 4-4</td>
</tr>
<tr>
<td>3</td>
<td>Altitude Performance Curves for IO-520-A, J 4-5</td>
</tr>
<tr>
<td>4</td>
<td>Fuel Flow vs. BHP for IO-520-B, BA &amp; BB 4-6</td>
</tr>
<tr>
<td>5</td>
<td>Sea Level Performance Curves for IO-520-B, BA &amp; BB 4-7</td>
</tr>
<tr>
<td>6</td>
<td>Altitude Performance Curves for IO-520-B, BA &amp; BB 4-8</td>
</tr>
<tr>
<td>7</td>
<td>Fuel Flow vs. BHP for IO-520-C &amp; CB 4-9</td>
</tr>
<tr>
<td>8</td>
<td>Sea Level Performance Curves for IO-520-C &amp; CB 4-10</td>
</tr>
<tr>
<td>9</td>
<td>Altitude Performance Curves for IO-520-C &amp; CB 4-11</td>
</tr>
<tr>
<td>10</td>
<td>Fuel Flow vs. BHP for IO-520-D 4-12</td>
</tr>
<tr>
<td>11</td>
<td>Sea Level Performance Curves for IO-520-D 4-13</td>
</tr>
<tr>
<td>12</td>
<td>Altitude Performance Curves for IO-520-D 4-14</td>
</tr>
<tr>
<td>13</td>
<td>Fuel Flow vs. BHP for IO-520-E 4-15</td>
</tr>
<tr>
<td>14</td>
<td>Sea Level Performance for IO-520-E 4-16</td>
</tr>
<tr>
<td>15</td>
<td>Altitude Performance for IO-520-E 4-17</td>
</tr>
<tr>
<td>16</td>
<td>Fuel Flow vs. BHP for IO-520-F, K &amp; L 4-18</td>
</tr>
<tr>
<td>17</td>
<td>Sea Level Performance for IO-520-F, K &amp; L 4-19</td>
</tr>
<tr>
<td>18</td>
<td>Altitude Performance for IO-520-F, K &amp; L 4-20</td>
</tr>
<tr>
<td>19</td>
<td>Fuel Flow vs. BHP for IO-520-M, MB 4-21</td>
</tr>
<tr>
<td>20</td>
<td>Sea Level Performance for IO-520-M, MB 4-22</td>
</tr>
<tr>
<td>21</td>
<td>Altitude Performance for IO-520-M, MB 4-23</td>
</tr>
<tr>
<td>22</td>
<td>Lubrication System (Typical with Permold Crankcase) 6-3</td>
</tr>
<tr>
<td>23</td>
<td>Lubrication System (Typical with Sandcast Crankcase) 6-4</td>
</tr>
<tr>
<td>24</td>
<td>Wiring Diagram 6-6</td>
</tr>
<tr>
<td>25</td>
<td>Fuel System Schematic IO-520-M, MB 6-8</td>
</tr>
</tbody>
</table>

iii
INTRODUCTION

The operating instructions outlined in this manual have been developed from comprehensive evaluation of the engine performance in relation to its installation in an aircraft. Recommendations, cautions and warnings regarding operation of this engine are not intended to impose undue restrictions on operation of the aircraft, 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. Failure to observe the instructions contained in this manual constitutes unauthorized operation in areas unexplored during development of the engine, or in areas in which experience has proved to be undesirable or detrimental.

WARNING . . . In order to properly use this engine, the user must comply with all instructions contained herein. Failure to so comply will be deemed misuse, relieving the engine manufacturer of any responsibility. This manual contains no warranties, either expressed or implied. The purpose of the data presented is instruction, information and safety.
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.

Users are advised to keep up with the latest information by means of service bulletins, which are available for study at any approved Teledyne Continental Distributor or Dealer, or which are obtainable on an annual subscription basis. Subscription forms are available from the Distributor or from Teledyne Continental Motors, P. O. Box 90, Mobile, Alabama 36601, Attn: Publications Department.

WARNING ... This engine must be installed in accordance with all requirements and limitations listed in the Detail Specifications for Teledyne Continental Aircraft Engines. Any deviations caused by installation, or operation, such as acrobatic maneuvers will be deemed as misuse and Teledyne Continental Motors shall be relieved of any further responsibility.
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.

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 Section VII of this manual and/or the aircraft overhaul manual for trouble shooting procedures.

WARNING... Do not use any propeller that is not certified and specifically designed for operation on this engine.
Manufacturer ..................... Teledyne Continental Motors
Models ............................ IO-520-A, B, BA, BB, C, CB,
                              D, E, F, J, K, L, M, MB

Cylinders
Arrangement ............ Individual cylinders in a horizontally
                      opposed position.
Compression Ratio ........................................ 8.5:1
Firing Order ............................................. 1-6-3-2-5-4
*Cylinder Head Temperature
Maximum Allowable ..................................... 460°F.
Number .................................................. 6
Numbering (Accessory
toward propeller end):
   Right Side ........................................... 1-3-5
   Left Side ............................................. 2-4-6
Bore (Inches) ............................................ 5.25
Stroke (Inches) .......................................... 4.00
Piston Displacement (cu. in.) .......................... 520

Brake Horsepower
Rated Maximum Continuous Operation .................. 285
Rated Maximum Take-Off .................. 285 A-B-BA-BB-C-CB-J-M-MB
                                      300 D-E-F-K-L (5 Min. Max.)
Recommended Maximum for Cruising .................. 215
                                      (225 for IO-520-L)

Crankshaft Speed - RPM
Rated Maximum Continuous Operation .................. 2700
Rated Maximum Take-Off .......................... 2700 A-B-BA-BB-C-CB-J-M-MB
                                      2850 D-E-F-K-L
Recommended Max. for Cruising .................. 2500 A-B-BA-BB-C-CB-
                                      J-M-MB
                                      2550 D-K
                                      2600 L

* Indicates temperature measured by Bayonet
Thermocouple, Aeronautical Standard AS234
Element or equivalent, installed in boss in
bottom of cylinder head.
Intake Manifold Pressure (In. Hg.)
   Maximum Take-off .................................. Full Throttle
   Maximum Continuous .................................. 28.8
   Recommended Continuous Max.
       for Cruising .................................. See Performance Chart

Fuel Control System  ............. Continental Continuous Flow Injector.

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

Oil Specification ..................... Continental MHS-24B
   All Temperatures ................................. 15W-50
   20W-50
   Or if Temperatures Are:
   Below 40°F. ................................. SAE 30 or 10W-30
   Above 40°F. .................................. SAE 50

Ambient Air Temperature (Sea Level)

Oil Pressure
   Idle, Minimum, psi ................................. 10
   Normal Operation (psi) .............................. 30 to 60

Oil Sump Capacity (U.S. Qts.) .................. 12
   (10-520-J, L - 10)

Oil Level ........................................... * *

Oil Consumption (lb./BHP/hr, Maximum
   at rated power and RPM) .......................... $006 \times \%\text{ power}$

Oil Temperature Limits
   Minimum for Take-Off ............................. 75°F.
   Maximum Allowable ................................. 240°F.
   Recommended Cruising .............................. 170°F.

Ignition Timing (Compression stroke, breaker opens)
   Right Magneto, degrees BTC ........................ 22°
   Left Magneto, degrees BTC ........................ 22°
ACCESSORIES *

1. Models IO-520-A, D, E, F, J, K and L are eligible for installation with full flow oil filter if filter installation incorporates valve which opens at 12 to 16 psig. Oil filter housing is eligible for direct mounting oil filter equipment having a maximum weight of six pounds and overhang moment of 25 in.-lb.

2. These models of engines are eligible for installation of Automatic Priming Starting System, Equipment No. 6159.

3. The following magnetos equipped with an appropriate harness are eligible on these engines at the indicated weight change:

<table>
<thead>
<tr>
<th>Wt. Change</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>One each Bendix S6RN-201 and S6RN-205</td>
</tr>
<tr>
<td>+1 lb.</td>
<td>One each Bendix S6RN-1201 and S6RN-1205</td>
</tr>
<tr>
<td>+1 lb.</td>
<td>Two Bendix S6RN-25</td>
</tr>
<tr>
<td>+2 lb.</td>
<td>Two Slick Electro Model 662 or 680</td>
</tr>
<tr>
<td>+1 lb.</td>
<td>Two Bendix S6RN-1225</td>
</tr>
<tr>
<td>-3 lb.</td>
<td>Two Slick Electro Model 6210</td>
</tr>
</tbody>
</table>

4. The following spark plugs are approved for use on these engines:

<table>
<thead>
<tr>
<th>Type</th>
<th>Model Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>271, 273, 281, 281IR, 283, 283IR, 291, 293</td>
</tr>
<tr>
<td>Auto Lite</td>
<td>PL350, SL350</td>
</tr>
<tr>
<td>Champion</td>
<td>RHB32E, RHB32N, RHB32P, RHB32W, RHB33E, RHB36P, RHB36W</td>
</tr>
<tr>
<td>Red Seal</td>
<td>LJ360</td>
</tr>
</tbody>
</table>

5. Those engines which are designated with a suffix letter "B" (i.e., IO-520-BB) are interchangeable with those engines of the same model letter without the suffix letter (i.e., IO-520-B). Those engines which are designated without suffix letter (i.e., IO-520-B) are non-interchangeable with those engines which are designated with the suffix letter "B" (i.e., IO-520-BB).

6. Teledyne Crittenden alternator P/N 642056 and drive coupling P/N 642362 are eligible for use with applicable engine models. Alternator compatibility with aircraft must be accomplished by installer.
**ACCESSORIES * (continued)**

* See Parts Catalog for Engine Model Application.

**Accessories Drive Ratios to Crankshaft (Viewing Drive)**

<table>
<thead>
<tr>
<th>Accessory Drive</th>
<th>Rotation</th>
<th>Ratio</th>
<th>Engine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magneto (2)</td>
<td>CCW</td>
<td>1.5:1</td>
<td>ALL</td>
</tr>
<tr>
<td>Generator (belt dr.)</td>
<td>CCW</td>
<td>2.28:1</td>
<td>A-D-E-F-J-K-L</td>
</tr>
<tr>
<td>Alternator (direct dr.)</td>
<td>CCW</td>
<td>3:1</td>
<td>B-BA-BB-C-CB</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-M-MB</td>
</tr>
<tr>
<td>Starter</td>
<td>CCW</td>
<td>32:1</td>
<td>A-D-E-F-J-K-L</td>
</tr>
<tr>
<td></td>
<td>CCW</td>
<td>48:1</td>
<td>B-BA-BB-C-CB</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-M-MB</td>
</tr>
<tr>
<td>#Prop. Governor</td>
<td>CW</td>
<td>1:1</td>
<td>ALL</td>
</tr>
<tr>
<td></td>
<td>facing pad</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ and 20000 Dr. (2)</td>
<td>CW</td>
<td>1.5:1</td>
<td>ALL</td>
</tr>
<tr>
<td>Freon Compressor (Belt Drive)</td>
<td>CCW</td>
<td>3:1</td>
<td>BA-BB</td>
</tr>
</tbody>
</table>

**Oil Level is indicated by “CALIBRATION” marks on dipstick.**

**Modified AND 20010 pad. This drive supplied with cover plate only.**

**These drives applied with cover plate only.**
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>40.91 In.</td>
<td>37.97 In.</td>
<td>42.81 In.</td>
<td>36.86 In.</td>
<td>47.16 In.</td>
<td>40.91 In.</td>
<td>40.91 In.</td>
<td>40.91 In.</td>
<td>48.74 In.</td>
</tr>
<tr>
<td>Width</td>
<td>33.56 In.</td>
<td>33.56 In.</td>
<td>33.56 In.</td>
<td>33.56 In.</td>
<td>33.56 In.</td>
<td>33.56 In.</td>
<td>33.56 In.</td>
<td>33.56 In.</td>
<td>33.56 In.</td>
</tr>
<tr>
<td>Height</td>
<td>19.75 In.</td>
<td>27.32 In.</td>
<td>19.78 In.</td>
<td>23.79 In.</td>
<td>19.75 In.</td>
<td>19.75 In.</td>
<td>19.75 In.</td>
<td>23.25 In.</td>
<td>20.58 In.</td>
</tr>
</tbody>
</table>

**Detail Weights**

a. Basic Engine - Includes
- lubrication system, accessory drives, starter adapter, intake system, mounting brackets, cylinder, and four pendulum type dampers
- Spark Plugs (12)
- Magneto (2)
- Ignition Assembly (all weather)
- Basic Engine Weight (dry)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>412.43 Lbs.</td>
<td>406.65 Lbs.</td>
<td>398.72 Lbs.</td>
<td>411.43 Lbs.</td>
<td>411.43 Lbs.</td>
<td>411.43 Lbs.</td>
<td>411.43 Lbs.</td>
<td>412.80 Lbs.</td>
<td>397.1 Lbs.</td>
</tr>
<tr>
<td>Spark Plugs</td>
<td>3.00 Lbs.</td>
<td>3.00 Lbs.</td>
<td>3.00 Lbs.</td>
<td>3.00 Lbs.</td>
<td>3.00 Lbs.</td>
<td>3.00 Lbs.</td>
<td>3.00 Lbs.</td>
<td>3.00 Lbs.</td>
<td>3.0 Lbs.</td>
</tr>
<tr>
<td>Magneto (2)</td>
<td>12.88 Lbs.</td>
<td>12.31 Lbs.</td>
<td>12.31 Lbs.</td>
<td>12.88 Lbs.</td>
<td>10.50 Lbs.</td>
<td>12.88 Lbs.</td>
<td>11.50 Lbs.</td>
<td>12.88 Lbs.</td>
<td>10.5 Lbs.</td>
</tr>
<tr>
<td>Assembly</td>
<td>2.75 Lbs.</td>
<td>2.75 Lbs.</td>
<td>2.75 Lbs.</td>
<td>2.75 Lbs.</td>
<td>2.75 Lbs.</td>
<td>2.75 Lbs.</td>
<td>2.75 Lbs.</td>
<td>2.75 Lbs.</td>
<td>2.8 Lbs.</td>
</tr>
<tr>
<td>Weight (dry)</td>
<td>431.06 Lbs.</td>
<td>424.70 Lbs.</td>
<td>416.80 Lbs.</td>
<td>430.06 Lbs.</td>
<td>427.40 Lbs.</td>
<td>430.06 Lbs.</td>
<td>428.68 Lbs.</td>
<td>431.43 Lbs.</td>
<td>413.4 Lbs.</td>
</tr>
</tbody>
</table>

b. Basic Engine with Accessories
- Basic Engine
- Starter
- Generator
- Alternator
- Tach Drive
- Oil Cooler

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>431.06 Lbs.</td>
<td>424.70 Lbs.</td>
<td>416.80 Lbs.</td>
<td>430.06 Lbs.</td>
<td>427.40 Lbs.</td>
<td>430.06 Lbs.</td>
<td>428.68 Lbs.</td>
<td>431.43 Lbs.</td>
<td>413.4 Lbs.</td>
</tr>
<tr>
<td>Weight</td>
<td>17.00 Lbs.</td>
<td>16.40 Lbs.</td>
<td>16.40 Lbs.</td>
<td>17.00 Lbs.</td>
<td>16.00 Lbs.</td>
<td>17.00 Lbs.</td>
<td>17.75 Lbs.</td>
<td>17.75 Lbs.</td>
<td>16.0 Lbs.</td>
</tr>
<tr>
<td>Weight</td>
<td>17.91 Lbs.</td>
<td>17.91 Lbs.</td>
<td>17.91 Lbs.</td>
<td>23.50 Lbs.</td>
<td>17.91 Lbs.</td>
<td>17.91 Lbs.</td>
<td>17.91 Lbs.</td>
<td>17.91 Lbs.</td>
<td>17.91 Lbs.</td>
</tr>
<tr>
<td>Weight</td>
<td>12.31 Lbs.</td>
<td>10.75 Lbs.</td>
<td>11.62 Lbs.</td>
<td>12.31 Lbs.</td>
<td>11.62 Lbs.</td>
<td>12.31 Lbs.</td>
<td>11.62 Lbs.</td>
<td>12.31 Lbs.</td>
<td>11.62 Lbs.</td>
</tr>
<tr>
<td>Weight</td>
<td>1.00 Lbs.</td>
<td>1.00 Lbs.</td>
<td>1.00 Lbs.</td>
<td>1.38 Lbs.</td>
<td>1.00 Lbs.</td>
<td>1.00 Lbs.</td>
<td>1.00 Lbs.</td>
<td>1.00 Lbs.</td>
<td>1.00 Lbs.</td>
</tr>
<tr>
<td>Weight</td>
<td>7.50 Lbs.</td>
<td>7.38 Lbs.</td>
<td>7.38 Lbs.</td>
<td>7.50 Lbs.</td>
<td>7.50 Lbs.</td>
<td>7.50 Lbs.</td>
<td>7.50 Lbs.</td>
<td>7.50 Lbs.</td>
<td>5.25 Lbs.</td>
</tr>
</tbody>
</table>

Total Weight of Basic Engine and Accessories

| Weight          | 473.47 Lbs.| 460.80 Lbs.      | 451.3 Lbs.   | 472.47 Lbs.| 474.40 Lbs.| 472.47 Lbs.| 465.55 Lbs.| 466.74 Lbs.| 436.8 Lbs.   |
SECTION II
NORMAL OPERATING PROCEDURE

CAUTION . . . This section pertains to operation under average climatic conditions. The pilot should thoroughly familiarize himself with Section V, Abnormal Operating 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.

GENERAL.

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 need be followed. 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). In case the 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. This most likely occurs 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.
PRESTARTING.

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

1. Position the ignition switch to the “OFF” position.

2. Operate all controls and check for binding and full range of travel.

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

4. 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.

5. Check oil level in sump.

6. Check cowling for security.

STARTING.

1. Throttle - open approximately 1”.

2. Propeller Control - Full Increase RPM

3. Mixture Control-Full Rich

4. Fuel Boost Pump - Off

5. Battery - On

6. Magnetos - On

7. Boost pump or primer (according to installation) actuate approx 3 seconds to prime the cylinders. (If the engine is warm, little or no priming will be necessary).

8. Starter - Energize until engine begins to fire, then release.
NOTE . . . Initial starting ignition is provided by a special high voltage circuit operated by the starter switch, which fires the spark plugs and retards the ignition timing. Starting will be facilitated if the starter is released as soon as the engine starts so that normal ignition is provided by the magnetos.

9. Oil pressure - 10 psi minimum within 30 seconds.

CAUTION . . . Do not engage the starter when the engine is running as this will damage the starter.

CAUTION . . . If difficulty in starting is experienced, do not crank for longer than thirty seconds at a time as the starter motor may overheat. If the engine does not start after thirty seconds of cranking, allow 3 to 5 minute cooling period before continued attempts.

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 intermittantly for a few seconds in order to prevent the engine from stopping.

FLOODED ENGINE.

a. Mixture Control - IDLE CUT-OFF

b. Throttle - 1/2 OPEN

c. Magneto/Start Switch - START

d. When engine starts, return the Magneto/Start switch to BOTH. Retard the throttle and slowly advance the mixture control to FULL RICH position.

HOT STARTS.

Use the same procedure as for normal start, except do not prime and position the throttle about half open while cranking. When the engine begins to run, adjust the throttle to obtain 1000-1500 RPM for a few seconds, then as desired.
GROUND RUNNING; WARM-UP.

Teledyne Continental aircraft engines are aircooled and therefore 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 I, for exceptions.)

5. Warm-up 900-1000 RPM.

PRE-TAKEOFF CHECK.

1. Maintain engine speed at approximately 1000 to 1500 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°F.

_Caution... Do not operate the engine at run-up speed unless oil temperature is 75°F. minimum._

3. Perform all ground operations with cowling flaps, if installed full open, with mixture control in “FULL RICH” position 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: Move the ignition switch first to "R" position and note engine RPM, then move switch back to "BOTH" position to clear the other set of spark plugs. Then move the switch to "L" position and note RPM. 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.

If no drop in RPM is observed when operating on either magneto alone, the switch circuit should be inspected.

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 a 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 switched off. Absence of a magneto drop may be indicative of an open switch circuit or improperly timed magneto. 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. Run mixture to full rich.

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

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

b. Check throttle and propeller operation.

(1) 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.

(2) Where applicable move propeller 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.


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.

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. 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 operation 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 adequate cooling.

d. Battery Charging: The ammeter should indicate a positive charging rate until the power used for starting has been replaced by the battery charging circuit, unless the electrical load on the alternator is heavy enough to require its full output. The ammeter reading should return to the positive side as soon as the load is reduced. A low charging rate is normal after the initial recharging of the battery. A zero reading or negative reading with no battery load indicates a malfunction in the alternator or regulator system.

TAKEOFF.

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

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

c. Use full throttle to obtain rated power for takeoff. During takeoff, observe manifold pressure RPM, fuel flow, engine temperature and oil pressure. All should be within normal limits.

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 pressure gauge. The leaner mixture is required to eliminate engine roughness.
CLIMB.

a. All high power climb, except when operating from high altitude fields, must be done at "FULL RICH" mixture setting with cowl flaps, if provided, in the full open position.

b. During climb (immediately after take-off), observe manifold pressure, and retard throttle to stay below the 28.8 inch maximum manifold pressure setting (red line).

c. At reduction from take-off power for climb, follow aircraft manufacturer's recommendation for fuel pressure at power setting used.

CRUISE.

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

2. After engine temperatures have stabilized at cruise condition (usually within 5 minutes of operation), adjust mixture to lean cruise condition according to Section IV 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 on low boost.

3. When a cruise lean mixture setting is used, and increased power is desired, the mixture control must be returned to "FULL RICH" 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 position.

NOTE... Exhaust gas temperature may be used as an aid for mixture leaning in cruising flight at 75% power or less. To adjust the mixture, using this indicator, lean to establish the peak EGT as a reference point. At cruise speeds between 65% and 75%, operate at 25°F. rich of peak. Cruise operation at 65% or less may be at peak EGT.
DESCENT.

Adjust power as desired and monitor temperatures.

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

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 300°F. for periods exceeding five (5) minutes.

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.

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

STOPPING ENGINE.

1. If boost pump has been on for landing, turn to “OFF”.

2. Place mixture control in “IDLE CUTOFF”.

3. Turn magnetos “OFF”.

2-9
SECTION III
IN-FLIGHT EMERGENCY PROCEDURES

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.

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. Engine Instruments-Check. If abnormal indications appear, proceed according to Abnormal Engine Instrument Indications (this section).

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


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 and the engine repaired.

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.

ABNORMAL ENGINE INSTRUMENT INDICATIONS

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 and have the engine inspected before further flight.

HIGH OIL TEMPERATURE.

NOTE . . . Prolonged high oil temperature indications will usually be accompanied by a drop in oil pressure. If oil pressure remains normal, then a high temperature indication may be caused by a faulty gauge 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 to 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.**

**LOW OIL PRESSURE.**

If the oil pressure drops unexplainably from the normal indication of 30 to 60 psi, monitor temperature and pressure closely and have the engine inspected at termination of the flight. If oil pressure drops below 30 psi, an engine failure should be anticipated and the aircraft manufacturer's instructions for such should be followed.

**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.**

**CAUTION . . . A few minutes exposure to temperatures and airspeed at flight altitudes can have the same effect on an inoperative engine as hours of cold-soak in sub-Arctic conditions. If the engine must be restarted, consideration should be given to descending to warmer air. Closely monitor for excessive oil pressure as the propeller is unfeathered. Allow the engine to warm up at minimum governing RPM and 15 inches of manifold pressure.**

The following procedure is recommended for in-flight restarting:

1. Mixture - Advance to 3/4 FULL RICH.
3. Fuel Boost Pump - OFF.
4. Magneto Switches - ON BOTH.
5. Throttle - NORMAL START POSITION (Open 1").
6. Propeller:
WITHOUT UNFEATHERING ACCUMULATORS:

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.

WITH UNFEATHERING ACCUMULATORS:

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.

8. Throttle - AS NECESSARY TO PREVENT OVERSPEED; Warm up at 15-20" Hg manifold pressure.

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

10. Alternator Switch - ON.

11. Power - AS REQUIRED.
SECTION IV

ENGINE PERFORMANCE AND CRUISE CONTROL

The curves in this section 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.

CRUISE CONTROL BY PERFORMANCE CURVE.

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

2. To determine actual horsepower, employ the following procedure:
   a. Locate RPM and manifold pressure on altitude curve (point “A”).
   b. Locate RPM and manifold pressure on sea level curve (point “B”).
   c. Transfer “B” to sea level on altitude curve (point “C”).
   d. Draw line from “C” through “A”.
   e. Locate point “D” at pressure altitude and read horsepower.
   f. Correct horsepower for inlet air temperature as follows:
      (1) Add 1% for each 10°F. below TS.
      (2) Subtract 1% for each 10°F. above TS.

   (TS = Standard Altitude Temperature)

3. Adjust mixture to provide fuel flow for actual horsepower 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 manifold pressure and fuel flow (mixture) after changing RPM.

CRUISE CONTROL BY E.G.T.

If an exhaust gas temperature indicator is used as an aid to leaning, proceed as follows:

1. Adjust manifold pressure and RPM for desired cruise setting.

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

3. At cruise settings between 65% and 75% advance mixture control toward "rich" until EGT is 25°F. colder than peak. At cruise setting below 65% engine may be operated at peak EGT.

CAUTION . . . Do not attempt to adjust mixture by use of EGT at setting above 75% of maximum power. 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.

Gauge 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 gauge or EGT system) should be checked for maladjustment or calibration error.
FIG. 2. SEA LEVEL PERFORMANCE CURVES FOR IO-520-A & J.
FIG. 3. ALTITUDE PERFORMANCE CURVES FOR IO-520-A & J.
NOTE

1. MIXTURE CURVES SHOWN ARE BASED UPON PROP LOAD CURVE RPM ADJUSTMENT SETTINGS.

2. LEAN LIMIT CRUISE FUEL SCHEDULE CORRESPONDING TO:
   (a) MIXTURE LEANED TO 25°F RICH OF PEAK EGT FROM 75% POWER DOWN TO, BUT NOT INCLUDING, 65%.
   (b) MIXTURE LEANED TO PEAK EGT AT 65% POWER AND BELOW.

APPROX. BEST POWER MIXTURE

PROP LOAD FULL RICH LIMITS

25°F RICH OF PEAK EGT

MINIMUM ALLOWABLE FUEL FLOW

PEAK EGT MIXTURE
FIG. 5 SEA LEVEL PERFORMANCE CURVES FOR IO-520 B, BA & BB
FIG. 6 ALTITUDE PERFORMANCE CURVES FOR IO-520 B, BA & BB
FIG. 7 FUEL FLOW VS. BHP FOR IO-520-C & CB
FIG. 8 SEA LEVEL PERFORMANCE CURVES FOR IO-520-C & CB
FIG. 9 ALTITUDE PERFORMANCE CURVES FOR IO-520-C & CB
FIG. 10 FUEL FLOW VS. BHP FOR IO-520-D
FIG. 11.  SEA LEVEL PERFORMANCE CURVES FOR IO-520-D.
FIG. 13 FUEL FLOW VS. BHP FOR IO-520-E
FIG. 14. SEA LEVEL PERFORMANCE FOR IO-520-E.
NOTE: Mixture curves shown are based upon prop load curve RPM/AdmP power settings. Lean limit cruise fuel schedule corresponds to:

(a) Mixture leaned to 25°F rich to peak EGT from 75% power down to, but not including 65%.
(b) Mixture leaned to peak EGT at 65% power and below.

Approx. best power

Approx. sea level full rich

Approx. sea level, full lean

Approx. cause

Approx. cruise

BRAKE HORSEPOWER

FIG. 16 FUEL FLOW VS. BHP FOR IO-520-F, K & L
FIG. 17.  SEA LEVEL PERFORMANCE FOR IO-520-F, K & L
NOTE:
1. MIXTURE CURVES SHOWN ARE BASED UPON PROPER LOAD CURVE RPM/ADMP POWER SETTINGS.
2. LEAN LIMIT CRUISE FUEL SCHEDULE CORRESPONDS TO:
   a) MIXTURE LEANED TO 25°F RICH TO PEAK EGT FROM 75% POWER DOWN TO, BUT NOT INCLUDING 65%.
   b) MIXTURE LEANED TO PEAK EGT AT 85% POWER AND BELOW.
   c) MIXTURE LEANED TO PEAK EGT AT 55% POWER.

FIG. 19. FUEL FLOW VS. BHP FOR IO-520-M, MB
FIG. 20.  SEA LEVEL PERFORMANCE FOR IO-520-M, MB
FIG. 21. ALTITUDE PERFORMANCE FOR IO-520-M, MB
SECTION V
ABNORMAL ENVIRONMENTAL CONDITIONS

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

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 temperate conditions. Cold soaking causes the oil to become heavier (more viscous), making it more difficult for the battery 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 plugs.

PREHEATING.

The use of preheat and auxiliary power (battery cart) will facilitate starting during cold weather and is recommended when the engine has been cold soaked at temperatures of 10°F. and below. Successful starts without these aids can be expected at temperatures below normal, provided the aircraft 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 "bug eye" do not appreciably warm the oil and may result in superficial preheating.

**WARNING . . . Superficial application of preheat to a cold-soaked engine can have disastrous results.**

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. Typically, heat is applied to the upper portion of the engine for a few minutes after which the engine is started and normal operation is commenced. The operator may be given a false sense of security by indications of oil and cylinder temperatures as a result of preheat. Extremely hot air flowing over the cylinders and oil temperature thermocouples may lead one to believe the engine is quite warm; however, oil in the sump and filter are relatively remote and will not warm as rapidly as a cylinder, for example, even when heat is applied directly. Oil lines are usually "lagged" with material which does an excellent job of insulating.

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. Improper or insufficient application of preheat and the resulting oil and cylinder temperature indications may encourage the pilot to expedite his ground operation and commence a takeoff prematurely. This procedure only compounds an already bad situation.

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. The oil drain plug door or panel may provide access to these areas. 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 gauge line may be congealed, as much as 60 seconds may elapse before oil pressure is indicated. If oil pressure is not indicated within one minute, 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 throttles, 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.

5-3
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. If the aircraft manufacturer recommends checking the propeller feathering system, move the control to the Feather position but do not allow the RPM to drop more than 300 RPM below minimum governing speed.

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 cowl flaps in attempt to hasten engine warm-up.

NOTE . . . Fuel flow will likely 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 following start procedures:

1. Fuel Selector - Main tank or as instructed by aircraft manufacturer.

2. Battery Switch - On.


4. Throttle - Open.

5. Primer - Operate until fuel flow or fuel pressure shows maximum reading.

6. Throttle - Positioned to approximate 1000 - 1200 RPM position.

7. Starter - Engage.
8. Primer - Operate as necessary to facilitate firing. Continue to prime as necessary to sustain engine operation.

9. Throttle - Gradually retard to 800 - 1000 RPM for warm-up.

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, check that oil pressure, oil temperature and cylinder temperature are well within the normal operating range. When full power is applied for takeoff, insure that oil pressure is within limits and steady.

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

a. Low, high or surging RPM.

b. Fuel flow excessively high or low.

c. Any oil pressure indication other than steady and within limits.

d. Engine roughness.

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. In the event the aircraft should be flown through such conditions, an oil change is recommended as soon as is practical. Do not intentionally operate the engines in dust and/or sand storms. The use of dust covers on the cowling will afford additional protection for a parked aircraft.
In 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 worst 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 will be experienced.

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, up to a point, will result in reduced 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.

5-6
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. Low power settings during the landing approach will allow some cooling prior to the next start attempt. Ground operation tends to heat up the engine, therefore, minimizing this will be beneficial. 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 during the 30 minutes to one hour following that interval, the fuel vapor will be less pronounced and normally will present less of a restart problem.

Normal starting procedure should be used except that the throttle should be opened more while cranking.

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 engines at high RPM except for necessary operational checking. If takeoff is not to be made immediately following engine run up, the aircraft should be faced into the wind and the engine idled at 900 - 1000 RPM. It may be desirable to operate the fuel boost pumps to assist in suppressing fuel vapor and provide more stable fuel pressure during taxiing and engine run up.

3. Takeoff and Initial Climbout. Do not operate at maximum power any longer than necessary to establish the climb configuration recommended by the aircraft manufacturer. Temperatures should be closely monitored and sufficient airspeed maintained to provide adequate cooling of the engine.

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.
SECTION VI
ENGINE DESCRIPTION

The designation 10-520-(Letter) describes this engine as follows:

I:  Denotes “fuel injected”.

O:  Denotes “opposed”, and refers to the horizontally-opposed cylinder arrangement.

520: Denotes piston displacement in cubic inches.

Letter: Denotes “specific engine model and configuration”.

The 10-520 series are manufactured in two different crankcase configurations. They differ visually in that the “sandcast” version has provisions for a belt driven generator or alternator on the left side at the rear while the “permold” version has a gear driven alternator mounted on the right side at the front. The oil cooler locations are likewise reversed on the two styles. The “sandcast” case has the oil cooler mounted on the right side at the front while the “permold” case has the oil cooler mounted on the left side at the rear.

LUBRICATION SYSTEM FOR SANDCAST CRANKCASE.

a. The engine driven, gear type oil pump draws oil from the sump through the oil suction tube and crankcase oil passage. From the gear chamber oil is directed to the oil filter chamber and to the tachometer drive gear. A filter by-pass valve is incorporated in the pump housing in the event that the filter becomes clogged.

b. After leaving the pump, oil is directed through passages to the right crankcase oil gallery. Right side lifters, guides and valve mechanisms are lubricated by passages leading off this gallery. An oil temperature control valve is located at the front end of the right gallery to regulate oil temperature within specific limits. When oil reaches a temperature high enough to require cooling, the oil temperature control valve expands and blocks passage, directing oil to the oil cooler. From the oil temperature control valve cavity oil is directed to the camshaft passage. A groove around the front of the camshaft directs oil to the front camshaft bearing and left crankcase oil gallery.
c. Lubricating oil is directed to the governor drive gear and the propeller governor through passages off the left main gallery. Oil is channeled through a discharge port to the crankshaft oil transfer collar, which directs it to the crankshaft interior.

d. Passageways from the left crankcase gallery direct oil to the front, intermediate and rear main bearings.

e. Four drilled passages radiating from the rear main bearing conduct lubricating oil to right and left magneto and accessory drives and to starter shaftgear bearing. An intersecting passage directs oil to the idler gear support.

f. Oil is returned to the sump through a system of oil transfer tubes and drain holes.

LUBRICATION SYSTEM FOR PERMOLD CRANKCASE.

a. 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. Lubrication reaches the tachometer drive gears through oil passages drilled in the oil pump cover. An oil pressure relief valve is incorporated in the oil pump housing.

b. 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 175°F.

c. 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.
FIG. 22. LUBRICATION SYSTEM (TYPICAL WITH PERMOLD CRANKCASE).
FIG. 23. LUBRICATION SYSTEM (TYPICAL WITH SANDCAST CRANKCASE).
d. 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.

e. From the governor drive gear lubricating oil is directed to the
crankshaft oil transfer collar, which in turn directs oil to the interior of
the crankshaft.

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

INDUCTION SYSTEM.

The air induction system used on the IO-520 Series Engines consists
of intake tubes, a balance tube, connecting hoses, clamp assemblies
and a combination air throttle and fuel metering control. The air
throttle assembly may be located at the rear of the engine supported
be brackets, or below the oil sump supported by an inverted manifold
assembly or bolted to a cast aluminum oil sump. The air throttle on
the IO-520-M is airframe mounted and connected to the riser by a
flexible duct. The intake manifold and balance tube are mounted
below the cylinders. The intake duct and filter are provided by the
aircraft manufacturer.

IGNITION SYSTEM.

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

a. Torque from the engine crankshaft is transmitted through the
camshaft gear to the magneto drive coupling. The magneto coupling
incorporates an impulse coupling. As the rubber bushings in the
drive gear turns the coupling drive lugs, counterweighted latch
pawls, inside coupling cover, engage pin on the magneto case and
hold back the latch plate until 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, magnet and breaker to be delayed through a
lag angle of 30 degrees of drive gear rotation during the engine
cranking period. Two stop pins in the case and two lobes on the
breaker cam produce two sparks per revolution of the drive shaft.
After engine is started, counterweights hold the latch pawls clear of
the stop pins and the magnet shaft is driven at full advance.
b. In engine models which employ the retard breaker system, the left magneto incorporates dual breakers which retard ignition spark during engine cranking. During the engine cranking period the right magneto is grounded and inoperative. The retard breaker, in the left magneto, is actuated by the same cam as the main breaker, and is so located that its contacts will open at a predetermined number of degrees after the main breaker contacts open. A battery-operated starting vibrator furnishes electrical current to the magneto for retarded ignition starting regardless of engine cranking speed. The retarded ignition is in the form of a "shower" of sparks instead of a single spark as obtained from the impulse coupling magneto. When the engine starts and the ignition start switch is released to return to its "BOTH" position, the vibrator circuit and the retard breaker circuit becomes inoperative. Simultaneously the right magnetos are firing at full advance position.

![Wiring Diagram](image)

**FIG. 24. WIRING DIAGRAM.**
FUEL SYSTEM.

The fuel injection system is of a multi-nozzle continuous flow type which controls fuel flow to match engine air flow. Any change in air throttle position, engine speed, or a combination of both, causes changes in fuel flow in the correct relation to engine air flow. A manual mixture control and a pressure gauge indicating metered fuel flow are provided for precise leaning at any combination of altitude and power setting. As fuel flow is directly proportioned to metered fuel pressure, settings can be predetermined and fuel consumption can be accurately predicted.

The continuous flow system permits the use of a typical rotary vane pump with integral relief valve in place of a much more complex and more expensive plunger type pump. The relief valve maintains maximum fuel flow under full power conditions. With this system there is no need for an intricate mechanism for timing injection to the engine.

The fuel injector pump is equipped with a vapor separator where the vapor is separated from liquid fuel by swirling action. Vapor is returned to the fuel tank. The fuel injector pump forces liquid fuel into the fuel-air mixture control assembly.

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

a. The air throttle assembly includes a butterfly valve which controls the amount of air entering the intake manifold. This valve is controlled by a lever which is connected to the aircraft throttle control.

b. The fuel control assembly contains a metering valve and a mixture control valve. The metering valve is linked to the air throttle valve lever. The mixture control valve is linked to the cockpit mixture control. The fuel control also by-passes excess fuel back to the fuel injector pump inlet port.
FIG. 25. FUEL SYSTEM SCHEMATIC FOR 10-520
The fuel manifold valve contains a diaphragm chamber and necessary outlet ports which connect to the fuel injector lines. The spring-loaded diaphragm works with a ported plunger which distributes the precise amount of fuel, through fuel injector lines, to the fuel injector nozzles in the cylinders. Ambient air is used to vent the nozzles.

**CYLINDERS.**

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

**VALVES.**

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, lubricates the lifter guide surfaces and fills the reservoirs inside the lifters. Oil from the lifters which reaches the pushrod ends flows through the pushrods to the rocker arms. Each rocker directs a portion of its oil through a nozzle for 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.
SERVICING.

Maximum efficiency and engine service life can be expected when a sound inspection program is followed. Poor maintenance results in faulty engine performance and reduced service life. Efficient engine operation demands careful attention to cleanliness of air, fuel, oil and maintaining operating oil temperatures within the required limits.

Good common sense is still the rule, but certain basic maintenance and operational requirements, that we find widely disregarded, do determine, to a large degree, the service life of the modern aircraft engine.

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

**WARNING . . .** The use of a 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

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Oil Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Temperatures</td>
<td>15W-50</td>
</tr>
<tr>
<td></td>
<td>20W-50</td>
</tr>
<tr>
<td>Below 40°F.</td>
<td>SAE30 or 10W-30</td>
</tr>
<tr>
<td>Above 40°F.</td>
<td>SAE 50</td>
</tr>
<tr>
<td>Ambient Air Temperature (Sea Level)</td>
<td></td>
</tr>
</tbody>
</table>

Oil Sump Capacity:  
See Page 1-3

Oil Change Interval:  
With integral screen or small filter  
50 Hrs.  
With large filter  
100 Hrs.  

7.1
NOTE . . . The use of multi-viscosity oil is approved.

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

The marketers of the aviation lubricating oil listed below have supplied data to Teledyne Continental Motors indicating their products conform to all requirements of TCM Specification MHS-24. Lubricating Oil, Ashless Dispersant.

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

APPROVED PRODUCTS.

<table>
<thead>
<tr>
<th>Supplier</th>
<th>Brand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phillips Petroleum Company</td>
<td>Phillips 66 Aviation Oil, Type A</td>
</tr>
<tr>
<td>Shell Oil Company</td>
<td>Aeroshell Oil W</td>
</tr>
<tr>
<td>Continental Oil</td>
<td>Conoco Aero S</td>
</tr>
<tr>
<td>Texaco, Inc.</td>
<td>Texaco Aircraft Engine Oil - Premium AD</td>
</tr>
<tr>
<td>Mobil Oil Company</td>
<td>Mobil Aero Oil</td>
</tr>
<tr>
<td>Castro Limited (Australia)</td>
<td>Castrolaero AD Oil</td>
</tr>
<tr>
<td>Pennzoil Company</td>
<td>Pennzoil Aircraft Engine Oil</td>
</tr>
<tr>
<td>Sinclair Oil Company</td>
<td>Sinclair Avoil</td>
</tr>
<tr>
<td>Exxon Company, U.S.A.</td>
<td>Exxon Aviation Oil EE</td>
</tr>
<tr>
<td>BP Oil Corporation</td>
<td>BP Aero Oil</td>
</tr>
<tr>
<td>Quaker State Oil &amp; Refining Co.</td>
<td>Quaker State AD Aviation Engine Oil</td>
</tr>
<tr>
<td>Delta Petroleum Company</td>
<td>Delta Avoil Oil</td>
</tr>
<tr>
<td>Union Oil Company of California</td>
<td>Union Aircraft Engine Oil HD</td>
</tr>
<tr>
<td>Gulf Oil Company</td>
<td>Gulfpride Aviation AD</td>
</tr>
<tr>
<td>Phillips Petroleum Company</td>
<td>X/C Aviation Multiviscosity Oil SAE 20W-50</td>
</tr>
<tr>
<td>Red Ram Limited (Canada)</td>
<td>Red Ram X/C Aviation Oil 20W-50</td>
</tr>
<tr>
<td>Shell Oil Company</td>
<td>AEROSHELL Oil W SAE 15W/50</td>
</tr>
</tbody>
</table>
INSPECTIONS.

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 decreased.

DAILY INSPECTION (PREFLIGHT).

Before each flight the engine and propeller should be examined for damage, oil leaks, proper servicing and security. Ordinarily the cowling need not be opened for a daily inspection. Refer to the aircraft manual preflight check list.

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: Magneto RPM drop: Check
   Full Power RPM: Check
   Full Power Manifold Pressure: Check
   Full Power Fuel Flow: Check
   Idle RPM: Check

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

2. Oil Filter: Replace filter.

3. Air Filter: Inspect and clean to replace as necessary.


5. Magnetos: Check and adjust only if discrepancies were noted in Step 1.

6. General: Check hoses, lines, wiring, fittings, baffles, etc. for general condition.
7. Adjustments & Repairs: Perform service as required on any items found defective.

8. Engine Condition: Run up and check as necessary for any items serviced in Step 6. Check engine for oil and fuel leaks before returning to service.

100 HOUR INSPECTION.

Perform all items listed under 50 Hour inspection, and add the following:

1. Oil: Drain while engine is warm. Refill sump.

2. Valves/Cylinders: Check compression (Refer to Service Bulletin M73-19).


5. Fuel and Oil Hoses and Lines Inspect for deterioration, leaks, chafing.

6. Fuel Nozzles: Inspect nozzles and vent manifold for leaks or damage.

7. Exhaust: Check all joints for condition and leaks.

8. Alternate Air Door: Check operation.

9. Spark Plugs: Inspect, clean, regap (if necessary) reinstall. Rotate plugs from upper to lower positions and vice versa to lengthen plug life.

10. Oil Filter: Replace.
11. 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.

12. Oil Pressure Relief Valve: Inspect and clean.

13. Oil Temperature Control Unit: Inspect and clean.


15. Throttle Shaft and Linkage: Inspect for wear and lubricate.

16. High & Low Fuel Pump Outlet Pressure: Check. Adjust if necessary. (Refer to latest TCM Service Bulletin for Procedure)

17. Adjustments & Repairs: Perform service as required on any items found defective.

18. Engine Condition: Perform complete run up. Check engine for fuel or oil leaks before returning to service.

NOTE . . . Refer to IO-520 Overhaul Manual or applicable Service Bulletins for proper procedures and limits.
SECTION VIII

WARNING . . . Do not attempt to use this manual as a guide for performing repair or overhaul of the engine. The Engine Overhaul Manual and applicable Service Bulletins must be consulted for such operations.

TROUBLE SHOOTING

The trouble shooting 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 trouble shooting procedures, refer to Maintenance and Overhaul Manual.

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 defective engine without a preliminary examination can cause further damage to a disabled component and possible injury to personnel. By careful inspection and trouble shooting, such damage and injury can be avoided and, in addition, the causes of faulty operation can be determined without excessive disassembly.
This trouble shooting chart is provided as a guide. Review all probable causes given, check other listings of trouble with similar symptoms. Items are presented in sequence of the approximate ease of checking, not necessarily in order of probability.

### TROUBLE SHOOTING CHART

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Engine will not start</td>
<td>a. No Fuel gauge pressure - No fuel to engine</td>
<td>a. Check fuel control for proper position, auxiliary pump “ON” and operating, feed valves open. Fuel filters open, and tank fuel level.</td>
</tr>
<tr>
<td></td>
<td>b. Have gauge pressure - engine flooded.</td>
<td>b. Turn off auxiliary pump and ignition switch, set throttle to “FULL OPEN” and fuel control to “IDLE CUT-OFF”, and crank engine to clear cylinders of excess fuel. Repeat starting procedure.</td>
</tr>
<tr>
<td></td>
<td>c. Have gauge pressure - No fuel to engine</td>
<td>c. Check for bent or loose fuel lines. Loosen one line at fuel nozzle. If no fuel shows replace fuel manifold valve.</td>
</tr>
<tr>
<td>2. Engine starts but fails to keep running</td>
<td>a. Inadequate fuel to manifold valve</td>
<td>a. Set fuel control in “FULL RICH” position, turn auxiliary pump “ON”, check to be sure feed lines and filters are not restricted. Clean or replace defective components.</td>
</tr>
<tr>
<td></td>
<td>b. Defective ignition system</td>
<td>b. Check accessible ignition cables and connections. Tighten loose connections. Replace defective spark plugs.</td>
</tr>
<tr>
<td>TROUBLE</td>
<td>PROBABLE CAUSE</td>
<td>CORRECTIVE ACTION</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>---------------------------------------</td>
<td>------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>3. Engine runs rough at idle</td>
<td>a. Improper idle mixture adjustment</td>
<td>a. Readjust idle setting. Tighten adjustment nut to richen mixture and back off adjustment nut to lean mixture.</td>
</tr>
<tr>
<td></td>
<td>b. Fouled spark plugs</td>
<td>b. Remove and clean plugs, adjust gaps. Replace defective plugs.</td>
</tr>
<tr>
<td>4. Engine has poor acceleration</td>
<td>a. Idle mixture too lean</td>
<td>a. Readjust idle mixture as described in 3-a.</td>
</tr>
<tr>
<td></td>
<td>b. Incorrect fuel-air mixture,</td>
<td>b. Tighten loose connections, replace worn elements of linkage, service air cleaner.</td>
</tr>
<tr>
<td></td>
<td>worn control linkage, or restricted</td>
<td></td>
</tr>
<tr>
<td></td>
<td>air cleaner</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. Defective ignition system</td>
<td>c. Check accessible cables and connections. Replace defective spark plugs.</td>
</tr>
<tr>
<td>TROUBLE</td>
<td>PROBABLE CAUSE</td>
<td>CORRECTIVE ACTION</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continued</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>Restricted Fuel Nozzle</td>
<td>b. Remove and clean all nozzles.</td>
</tr>
<tr>
<td>c.</td>
<td>Ignition system and spark plugs defective</td>
<td>c. Clean and regap spark plugs. Check ignition cables for defects. Replace defective components.</td>
</tr>
<tr>
<td>6.</td>
<td>Engine lacks power, reduction in maximum manifold pressure or critical altitude</td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>Incorrectly adjusted throttle control, &quot;sticky&quot; linkage or dirty air cleaner</td>
<td>a. Check movement of linkage by moving control from idle to full throttle. Make proper adjustments and replace worn components. Service air cleaner.</td>
</tr>
<tr>
<td>b.</td>
<td>Defective ignition system</td>
<td>b. 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.</td>
</tr>
<tr>
<td>c.</td>
<td>Loose or damaged intake manifolding</td>
<td>c. Inspect entire manifold system for possible leakage at connections. Replace damaged components, tighten all connections and clamps.</td>
</tr>
<tr>
<td>d.</td>
<td>Fuel nozzles defective</td>
<td>d. Check for restricted nozzles and lines and clean or replace as necessary.</td>
</tr>
<tr>
<td>TROUBLE</td>
<td>PROBABLE CAUSE</td>
<td>CORRECTIVE ACTION</td>
</tr>
<tr>
<td>------------------</td>
<td>----------------------------------------------------</td>
<td>------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>7. Low fuel</td>
<td><strong>a. Restricted flow to fuel metering valve</strong></td>
<td>a. Check mixture control for full travel. Check for restrictions in fuel filters and lines, adjust control and clean filter. Replace damaged parts.</td>
</tr>
<tr>
<td>pressure</td>
<td><strong>b. Fuel control lever interference</strong></td>
<td>b. Check operation of throttle control and for possible contact with cooling shroud. Adjust as required to obtain correct operation.</td>
</tr>
<tr>
<td></td>
<td><strong>c. Incorrect fuel injector pump adjustment and operation</strong></td>
<td>c. Check and adjust using appropriate equipment. Replace defective pumps.</td>
</tr>
<tr>
<td></td>
<td><strong>d. Defective fuel injector pump relief valve</strong></td>
<td>d. Replace pump.</td>
</tr>
<tr>
<td>Pressure</td>
<td><strong>b. Defective relief valve operation in fuel injector</strong></td>
<td>b. Replace fuel injector pump.</td>
</tr>
<tr>
<td></td>
<td><strong>c. Restricted re-circulation passage in fuel injector pump</strong></td>
<td>c. Replace pump.</td>
</tr>
<tr>
<td>TROUBLE</td>
<td>PROBABLE CAUSE</td>
<td>CORRECTIVE ACTION</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-----------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>9. Fluctuating Fuel Pressure</td>
<td>a. Vapor in fuel system, excess fuel temperature</td>
<td>a. Normally, operating the auxiliary pump will clear system. Operate auxiliary pump and purge system.</td>
</tr>
<tr>
<td></td>
<td>b. Fuel gage line leak or air in gage line</td>
<td>b. Drain gauge line and tighten connections.</td>
</tr>
<tr>
<td></td>
<td>c. Restriction in vapor separator vent</td>
<td>c. Check for restriction in ejector jet of vapor separator cover. Clean jet with solvent (only). Do Not Use Wire As Probe. Replace defective parts.</td>
</tr>
<tr>
<td>10. Low oil pressure on engine gage</td>
<td>a. Insufficient oil in oil sump, oil dilution or using improper grade oil for prevailing ambient temperature.</td>
<td>a. Add oil, or change oil to proper viscosity.</td>
</tr>
<tr>
<td></td>
<td>b. High oil temperature</td>
<td>b. Defective vernatherm valve in oil cooler; oil cooler restriction. Replace valve or clean oil cooler.</td>
</tr>
<tr>
<td></td>
<td>c. Leaking, damaged or loose oil line connections - Restricted screen or filter</td>
<td>c. Check for restricted lines and loose connections, and for partially plugged oil filter or screens. Clean parts, tighten connections, and replace defective parts.</td>
</tr>
</tbody>
</table>
SECTION IX

STORAGE AND REMOVAL FROM STORAGE

A. FLYABLE STORAGE (7 to 30 DAYS).

1. Preparation for Storage. If an aircraft, which as been in operation, is to be stored much longer than a week under normal climatic conditions, and if periodic running to circulate the oil will not be carried out, it is advisable to prepare the engine for storage in the following manner:

a. Operate the engine until the oil temperature reaches the normal range. Drain the oil supply from the sump as completely as possible, and replace the drain plug.

b. Fill the sump to the full mark on the dipstick gage with MIL-C-6529 Type II oil which will mix with normal oil, which is suitable as a lubricant, and will provide protection against corrosion.

c. Run the engine at least five minutes at a speed between 1000 and 1200 RPM with the oil temperature and cylinder head temperature in the normal operating range.

2. During Flyable Storage.

a. Each seven days during flyable storage, the propeller shall be rotated by hand without running the engine. After rotating the engine six revolutions, stop the propeller 45° to 90° from the position it was in.

b. If at the end of the thirty (30) days the aircraft will not be removed from storage, the engine shall be started and run. The preferred method will be to fly the aircraft for thirty (30) minutes. If flying is impractical, a ground run shall be made of thirty (30) minute duration, and up to, but not exceeding normal oil and cylinder temperatures.

3. Preparation for Service.
a. If the engine has a total time of more than twenty-five (25) hours, the MIL-C-6529 oil shall be drained after a ground warm-up. Install the TCM recommended oil before flight. It should be noted that MIL-C-6529 Type II is the TCM recommended oil for the first twenty-five (25) hours of flight.

B. TEMPORARY STORAGE (UP to 90 DAYS).

1. Preparation for Storage.

a. Remove top and bottom spark plugs and atomize spray 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 the down position. Rotate crankshaft as each pair of cylinders is sprayed. Stop crankshaft with no piston at top position.

NOTE . . . Shown below are some approved preservative oils recommended for use in Teledyne Continental engines for temporary storage.

MIL-L-46002, Grade 1 Oils:

Nucle Oil 105 -Daubert Chemical Co.
4700 S. Central Avenue
Chicago, Illinois

Petrotect VA -Pennsylvania Refining Co.
Butler, Pennsylvania

b. Re-spray each cylinder without rotating crank. To thoroughly cover all surfaces of the cylinder interior, move the nozzle or the spray gun from the top to the bottom of the cylinder.

c. Reinstall spark plugs.

d. Apply preservative to engine interior by spraying the above specified oil (approximately 2 ounces) through the oil filler tube.

e. Seal all engine openings exposed to the atmosphere using suitable plugs, or non-hygroscopic tape, and attach red streamers at each point.
f. Engines, with propellers installed, 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 plugs removed, hand turn propeller several revolutions to clear excess preservative oil, then reinstall plugs.

c. Conduct normal start up procedure.

d. Give the aircraft a thorough cleaning, visual inspection and test flight.
ADMP - Absolute dry manifold pressure. It is used in establishing base-line standards of engine performance. Manifold pressure is the absolute pressure in the intake manifold; it is expressed in inches of mercury. ("Hg).

AMBIENT - A term used to denote a condition of the 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 so called 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 200 horsepower while burning 100 pounds of fuel per hours, has a BSFC of .5.

\[
\frac{\text{Fuel consumption in PPH}}{\text{Brake horsepower}} = \frac{100}{200} = .5
\]

COLD SOAKING - Prolonged exposure of an object to cold temperatures so that its temperature throughout approaches that of ambient.
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.

E.G.T. - 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 size and shape of the exhaust system. Atmospheric pressure also affects back pressure.

FOUR CYCLE — Short for “Four Stoke 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 an engine or component. Especially one through which oil is flowed.

“Hg” - “Inches of Mercury”. A standard for measuring pressure, especially atmospheric pressure or manifold pressure.

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 and pressure.

LEAN LIMIT MIXTURE - The leanest mixture fuel-air ratio, permitted for any given power condition. It is not necessarily the leanest mixture at which the engine will run.

MANIFOLD PRESSURE - Absolute pressure as measured in the intake manifold. Usually measured in inches of mercury absolute.

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.

NRP - Normal Rated Power.

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 UNIT - A thermostatic unit used to divert oil through or around the oil cooler, as necessary to maintain oil temperature within desired limits.

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 withstand 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.

PRESSURE ALTITUDE - Altitude, usually expressed in feet, (using absolute pressure [static] as a reference) equivalent to altitude above the standard sea level reference plane (29.92" Hg).

PROPELLER LOAD CURVE - A plot of horsepower, fuel flow, or manifold pressure versus RPM through the full power range of one engine using a fixed pitch propeller or a constant speed propeller running on the low pitch stops. This curve is established or determined during design and development of the engine.

PROPELLER PITCH - The angle between the mean chord of the propeller and the plane of rotation.
RAM - Increased air pressure due to forward speed.

RATED POWER - The maximum horsepower at which an engine is approved for operation. Rated power may be expressed in horsepower or percent.

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 any 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.

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.

TBO - Time Between Overhauls. Usually expressed in operating hours.

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 T.D.C.

THERMAL EFFICIENCY - Regarding engines, the percent of total heat generated which is converted into useful power.

TORQUE - Twisting moment, or leverage, stated in pounds-foot (or pounds-inch).
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.

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 "normally aspirated" engine will always have a volumetric efficiency of slightly less than 100% whereas superchargers permit volumetric efficiencies in excess of 100%.