REPRINT

MODEL 150 SERIES
1969 THRU 1976
SERVICE MANUAL

2 JULY 1990

D971-3-13

THIS REPRINT

CONSISTS OF THE BASIC MANUAL, DATED 1 JULY 1972; CHANGE 1, DATED 1 JUNE 1973; CHANGE 2, DATED 1 JULY 1974; CHANGE 3, DATED 15 JUNE 1975; AND TEMPORARY CHANGE NO. 1, DATED 18 OCTOBER 1977.
SERVICE MANUAL

1969 thru 1976

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WICHITA, KANSAS, USA

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TEMPORARY REVISION NUMBER 3

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REASON FOR TEMPORARY REVISION

1. To Revise The Inspection Charts By Adding A Requirement To Inspect All Fluid Carrying Lines And Hoses In The Cabin And Wing Areas. To Revise The Special Inspection Items Section; Add A Component Time Limits Section And A Fuel Quantity Indicating System Operational Test.

FILING INSTRUCTIONS FOR THIS TEMPORARY REVISION

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TEMPORARY REVISION NUMBER 2

DATED 7 January 2000

MANUAL TITLE  MODEL 150 SERIES 1969 THRU 1976 SERVICE MANUAL

MANUAL NUMBER - PAPER COPY  D971-3-13  AEROFICHE  D971-3-13AF

TEMPORARY REVISION NUMBER - PAPER COPY  D971-3TR2  AEROFICHE  N/A

MANUAL DATE  1 JULY 1972  REVISION NUMBER  3  DATE  15 JUNE 1975

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SECTION  PAGE  AEROFICHE FICHE/FRAME  SECTION  PAGE  AEROFICHE FICHE/FRAME
2  22A  Added
2  26A  Added
18  4A  Added

REASON FOR TEMPORARY REVISION

To include the inspection requirements of Cessna Service Bulletin SEB99-18.

To provide additional information for the stop drilling of cracks that originate at the trailing edge of control surfaces with corrugated skins.

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**REASON FOR TEMPORARY REVISION**

1. To revise procedure to incorporate both Stewart Warner and Rochester fuel gage transmitter calibration.
2. To revise procedures to incorporate both electrically and pressure controlled oil temperature and oil pressure gages.
3. To add table to aid in trouble shooting the oil temperature gage.

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Change . . . . 3 . . 15 June 1975

**TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 346, CONSISTING OF THE FOLLOWING:**

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Change 1
CROSS REFERENCE LISTING OF POPULAR NAME VS. MODEL NUMBERS AND SERIALS

All aircraft, regardless of manufacturer, are certificated under model number designations. However, popular names are often used for marketing purposes. To provide a consistent method of referring to the various aircraft, model numbers will be used in this publication unless names are required to differentiate between versions of the same basic model. The following table provides a cross reference listing of popular name vs. model numbers.

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FOREWORD

This manual contains factory-recommended procedures and instructions for ground handling, servicing, and maintaining Cessna Model 150-Series aircraft. This includes the Models 150, Reims 150, Reims/Cessna F150, 150 Aerobat, and Reims/Cessna F150 Aerobat. The Reims versions of the Model 150 is identical to the Model 150 except that it is powered by a O-200-A Rolls Royce engine. Besides serving as a reference for the experienced mechanic, this book also covers step-by-step procedures for the less experienced man. This manual should be kept in a handy place for ready reference. If properly used, it will better enable the mechanic to maintain Cessna 150-Series aircraft and thereby establish a reputation for reliable service.

The information in this manual is based on data available at the time of publication, and is supplemented and kept current by service letters and service news letters published by Cessna Aircraft Company. These are sent to all Cessna Dealers so that they have the latest authoritative recommendations for servicing Cessna aircraft. Therefore, it is recommended that Cessna owners utilize the knowledge and experience of the factory-trained Dealer Service Organization.

In addition to the information in this Service Manual, a group of vendor publications is available from the Cessna Service Parts Center, which describe complete disassembly, overhaul, and parts breakdown of some of the various vendor equipment items. A listing of the available publications is issued periodically in service letters.

Information for Nav-O-Matic Autopilots, Electronic Communications, and Navigation Equipment are not included in this manual. These manuals are available from the Cessna Service Parts Center.
1-1. GENERAL DESCRIPTION.

1-2. MODEL 150 AND F150-SERIES.

1-3. DESCRIPTION. Cessna Model 150 and F150-Series aircraft, described in this manual, are high-wing monoplanes of all-metal, semimonocoque construction. These aircraft are equipped with a fixed tricycle landing gear. Through 1970 Models, they are equipped with flat spring-steel main landing gear struts and a steerable nose gear. Beginning with 1971 Models, these aircraft are equipped with tubular spring-steel main gear struts and a steerable nose gear. The steerable nose gear is equipped with an air/hydraulic fluid strut. Two-place seating is standard, and a double-width, fold-up auxiliary rear seat may be installed as optional equipment. Each Model 150 and F150-Series aircraft is equipped with a four-cylinder, horizontally opposed, air-cooled Continental or Rolls Royce engine, driving an all-metal, fixed-pitch propeller. These aircraft feature a "wrap around" rear window and a swept-back fin and rudder.

1-4. MODEL A150 AND FA150-SERIES.

1-5. DESCRIPTION. Aerobatic Model A150 and FA150-Series aircraft are a modification of the currently produced Model 150. Structure has been "beefed-up" in some areas in order to meet requirements of the Acrobatic Category, FAR Part 23. In addition to the "beef-up", quick-release cabin doors, two-strap shoulder harnesses, and aerobatic paint design are standard. Only momentary inverted flight is approved, therefore no inverted system is offered. Removable seat and back cushions are provided to allow occupants to use either a seat-pack or back-pack type parachute during aerobatic maneuvers.

1-6. AIRCRAFT SPECIFICATIONS. Leading particulars of these aircraft, with dimensions based on gross weight, are given in figure 1-1. If these dimensions are used for constructing a hangar or computing clearances, remember that such factors as nose gear strut inflation, tire pressures, tire sizes, and load distribution may result in some dimensions that are considerably different from those listed.

1-7. STATIONS. Station diagrams are shown in figures 1-2 and 1-3 to assist in locating equipment when a written description is inadequate or impractical.

1-8. TORQUE VALUES. A chart of recommended nut torque values is shown in figure 1-4. These torque values are recommended for all installation procedures contained in this manual, except where other values are stipulated. They are not to be used for checking tightness of installed parts during service.
Figure 1-1. Aircraft Specifications

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<th>Value</th>
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<tr>
<td>FUEL CAPACITY</td>
<td></td>
</tr>
<tr>
<td>Standard Wing (Total)</td>
<td>26 gal.</td>
</tr>
<tr>
<td>Standard Wing (Usable)</td>
<td>22.5 gal.</td>
</tr>
<tr>
<td>Long-Range Wing (Total)</td>
<td>38 gal.</td>
</tr>
<tr>
<td>Long-Range Wing (Usable)</td>
<td>35 gal.</td>
</tr>
<tr>
<td>OIL CAPACITY</td>
<td></td>
</tr>
<tr>
<td>Without External Filter</td>
<td>6 qt</td>
</tr>
<tr>
<td>With External Filter</td>
<td>7 qt</td>
</tr>
<tr>
<td>ENGINE MODEL (Fixed Pitch)</td>
<td>CONTINENTAL O-200 Series</td>
</tr>
<tr>
<td>MAIN WHEEL TIRES</td>
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</tr>
<tr>
<td>Pressure</td>
<td>21 psi</td>
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<tr>
<td>NOSE WHEEL TIRE (Standard)</td>
<td>5.00 x 5, 4-Ply Rating</td>
</tr>
<tr>
<td>Pressure</td>
<td>30 psi</td>
</tr>
<tr>
<td>NOSE WHEEL TIRE (Optional)</td>
<td>15 x 6, 6.00 x 6, 4-Ply Rating</td>
</tr>
<tr>
<td>Pressure</td>
<td>35 psi</td>
</tr>
<tr>
<td>AILERON TRAVEL</td>
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</tr>
<tr>
<td>Up</td>
<td>20°, +2°, -0°</td>
</tr>
<tr>
<td>Down</td>
<td>14°, +2°, -0°</td>
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<tr>
<td>WING FLAP TRAVEL</td>
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</tr>
<tr>
<td>Right</td>
<td>20°, 30°, +0°, -2°</td>
</tr>
<tr>
<td>Left</td>
<td>20°, 30°, +0°, -2°</td>
</tr>
<tr>
<td>RUDDER TRAVEL (Measured parallel to water line)</td>
<td>0° to 40° ±2°</td>
</tr>
<tr>
<td>Right</td>
<td>23°, -0°, +0°, -2°</td>
</tr>
<tr>
<td>Left</td>
<td>23°, -0°, +0°, -2°</td>
</tr>
<tr>
<td>ELEVATOR TRAVEL</td>
<td></td>
</tr>
<tr>
<td>Up (Thru 1974)</td>
<td>25° ±1°</td>
</tr>
<tr>
<td>Up (Beginning with 1975)</td>
<td>23°, +1°, -0°</td>
</tr>
<tr>
<td>Down</td>
<td>15° ±1°</td>
</tr>
<tr>
<td>ELEVATOR TRIM TAB TRAVEL</td>
<td></td>
</tr>
<tr>
<td>Up</td>
<td>10° ±1°</td>
</tr>
<tr>
<td>Down</td>
<td>20° ±1°</td>
</tr>
<tr>
<td>PRINCIPAL DIMENSIONS</td>
<td></td>
</tr>
<tr>
<td>Wing Span (Conventional Wing Tip)</td>
<td>32' 8-1/2&quot;</td>
</tr>
<tr>
<td>Wing Span (Conical-Camber Wing Tip)</td>
<td>33' 2&quot;</td>
</tr>
<tr>
<td>Length (With Large Spinner) (Thru 1970)</td>
<td>23' 9&quot;</td>
</tr>
<tr>
<td>Length (With Small Spinner) (Thru 1970)</td>
<td>23' 9&quot;</td>
</tr>
<tr>
<td>Length (With Large Spinner) (Beginning with 1971)</td>
<td>23' 8-1/2&quot;</td>
</tr>
<tr>
<td>Length (With Small Spinner) (Beginning with 1971)</td>
<td>23' 0&quot;</td>
</tr>
<tr>
<td>Fin Height (Maximum with Nose Gear Depressed and Flashing Beacon Installed on Fin (Thru 1974))</td>
<td>8' 0&quot;</td>
</tr>
<tr>
<td>Fin Height (Maximum with Nose Gear Depressed and Flashing Beacon Installed on Fin) (Beginning with 1975).</td>
<td>8' 6&quot;</td>
</tr>
<tr>
<td>Track Width (Thru 1970)</td>
<td>6' 6-1/2&quot;</td>
</tr>
<tr>
<td>Track Width (Beginning with 1971)</td>
<td>7' 7-1/4&quot;</td>
</tr>
<tr>
<td>Tail Span</td>
<td>10' 0&quot;</td>
</tr>
<tr>
<td>BATTERY LOCATION</td>
<td>Firewall</td>
</tr>
</tbody>
</table>
Figure 1-2. Fuselage Stations

Figure 1-3. Wing Stations
### RECOMMENDED NUT TORQUES

The torque values stated are pound-inches, related only to steel nuts on oil-free cadmium plated threads.

<table>
<thead>
<tr>
<th>TAP SIZE</th>
<th>FINE THREAD SERIES</th>
<th>COARSE THREAD SERIES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TENSION TORQUE</td>
<td>SHEAR TORQUE</td>
</tr>
<tr>
<td></td>
<td>STD (NOTE 1) ALT (NOTE 2)</td>
<td>STD (NOTE 3) ALT (NOTE 2)</td>
</tr>
<tr>
<td>8-36</td>
<td>12-15</td>
<td>7-9</td>
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<tr>
<td>10-32</td>
<td>20-25</td>
<td>12-15</td>
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<td>1/4-28</td>
<td>50-70</td>
<td>50-75</td>
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<td>3/8-24</td>
<td>100-140</td>
<td>100-150</td>
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<td>7/16-20</td>
<td>160-190</td>
<td>160-260</td>
</tr>
<tr>
<td>1/2-20</td>
<td>450-500</td>
<td>450-560</td>
</tr>
<tr>
<td>9/16-18</td>
<td>800-1000</td>
<td>800-1070</td>
</tr>
<tr>
<td>5/8-18</td>
<td>1100-1300</td>
<td>1100-1600</td>
</tr>
<tr>
<td>3/4-16</td>
<td>2300-2500</td>
<td>2300-3350</td>
</tr>
<tr>
<td>7/8-14</td>
<td>2500-3000</td>
<td>2500-4650</td>
</tr>
<tr>
<td>1-14</td>
<td>3700-5500</td>
<td>3700-6850</td>
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<td>1-1/8-12</td>
<td>5000-7000</td>
<td>5000-10000</td>
</tr>
<tr>
<td>1-1/4-12</td>
<td>9000-11000</td>
<td>9000-16700</td>
</tr>
<tr>
<td>8-32</td>
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<td>25-30</td>
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<td>5/16-18</td>
<td>80-90</td>
<td>48-55</td>
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<tr>
<td>3/8-16</td>
<td>160-185</td>
<td>95-100</td>
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<td>7/16-14</td>
<td>235-255</td>
<td>140-155</td>
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<tr>
<td>1/2-13</td>
<td>400-480</td>
<td>240-290</td>
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<td>9/16-12</td>
<td>500-700</td>
<td>300-420</td>
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<td>5/8-11</td>
<td>700-900</td>
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<td>3/4-10</td>
<td>1150-1800</td>
<td>700-950</td>
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<td>3300-4000</td>
</tr>
<tr>
<td>1-1/4-8</td>
<td>6500-8000</td>
<td>4000-5000</td>
</tr>
</tbody>
</table>

### NOTES

1. Covers AN310, AN315, AN345, AN363, MS20365, MS21042, MS21044, MS21045 and MS21046.
2. When using AN310 or AN320 castellated nuts where alignment between the bolt and cotter pin slots is not reached using normal torque values, use alternate torque values or replace the nut.
3. Covers AN316, AN320, MS20364 and MS21245.
4. Covers AN363, MS20365, MS21042, MS21043, MS21044, MS21045 and MS21046.

**CAUTION**

DO NOT REUSE SELF-LOCKING NUTS.

The above values are recommended for all installation procedures contained in this manual, except where other values are stipulated. They are not to be used for checking tightness of installed parts during service.

---

Figure 1-4. Torque Values
## Recommended Nut Torques

**Note**

The torque values stated are pound-inches, related only to oil-free cadmium plated threads.

### Fine Thread Series

<table>
<thead>
<tr>
<th>Type of Nut</th>
<th>Tension</th>
<th>Shear</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>STD (NOT 1)</td>
<td>ALT (NOTE 2)</td>
</tr>
<tr>
<td></td>
<td>torq</td>
<td>torq</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tap Size</th>
<th>Tension</th>
<th>Shear</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-36</td>
<td>12-15</td>
<td>7-9</td>
</tr>
<tr>
<td>10-32</td>
<td>20-25</td>
<td>12-15</td>
</tr>
<tr>
<td>1/4-28</td>
<td>50-75</td>
<td>30-40</td>
</tr>
<tr>
<td>5/16-24</td>
<td>100-140</td>
<td>60-85</td>
</tr>
<tr>
<td>3/8-24</td>
<td>160-190</td>
<td>95-110</td>
</tr>
<tr>
<td>7/16-20</td>
<td>450-500</td>
<td>270-300</td>
</tr>
<tr>
<td>1/2-20</td>
<td>480-690</td>
<td>290-410</td>
</tr>
<tr>
<td>9/16-18</td>
<td>800-1000</td>
<td>480-600</td>
</tr>
<tr>
<td>5/8-18</td>
<td>1100-1300</td>
<td>660-780</td>
</tr>
<tr>
<td>3/4-16</td>
<td>2300-2500</td>
<td>1300-1500</td>
</tr>
<tr>
<td>7/8-14</td>
<td>2500-3000</td>
<td>1500-1800</td>
</tr>
<tr>
<td>1-14</td>
<td>3700-5500</td>
<td>2200-3300</td>
</tr>
<tr>
<td>1-1/8-12</td>
<td>5000-7000</td>
<td>3000-4200</td>
</tr>
<tr>
<td>1-1/4-12</td>
<td>9000-11000</td>
<td>5400-6600</td>
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</table>

### Coarse Thread Series

<table>
<thead>
<tr>
<th>Type of Nut</th>
<th>Tension</th>
<th>Shear</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>STD (NOTE 4)</td>
<td>ALT (NOTE 5)</td>
</tr>
<tr>
<td></td>
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<td>torq</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tap Size</th>
<th>Tension</th>
<th>Shear</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-32</td>
<td>12-15</td>
<td>7-9</td>
</tr>
<tr>
<td>10-24</td>
<td>20-25</td>
<td>12-15</td>
</tr>
<tr>
<td>1/4-20</td>
<td>40-50</td>
<td>25-30</td>
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<td>5/16-18</td>
<td>80-90</td>
<td>48-55</td>
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<tr>
<td>3/8-16</td>
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<tr>
<td>1/2-13</td>
<td>400-480</td>
<td>240-290</td>
</tr>
<tr>
<td>9/16-12</td>
<td>500-700</td>
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<td>7/8-9</td>
<td>2200-3000</td>
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<td>1-8</td>
<td>3700-5000</td>
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<tr>
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<td>3300-4000</td>
</tr>
<tr>
<td>1-1/4-8</td>
<td>6500-8000</td>
<td>4000-5000</td>
</tr>
</tbody>
</table>

### Notes

1. Covers AN310, AN315, AN345, AN362, AN363, AN366, MS20365, "1452", "EB", "UWN", "Z1200", NAS679, MS21044, MS21042, MS21045 and other self-locking nuts.
2. When using AN310 or AN320 castellated nuts where alignment between bolt and cotter pin is not reached using normal torque values, use alternate torque values or replace nut.
3. Covers AN316, AN320, AN7502 and MS20364.
4. Covers AN310, AN340, AN366, MS20365, and other self-locking anchor nuts.
5. Covers AN316, AN320 and MS20364.

The above values are recommended for all installation procedures contained in this book except where other values are stipulated. They are not to be used for checking tightness of installed parts during service.

---

Figure 1-4. Torque Values
2-1. GROUND HANDLING.

2-2. TOWING. Moving the aircraft by hand is accomplished by using the wing struts and landing gear struts as push points. A tow bar attached to the nose gear should be used for steering and maneuvering the aircraft on the ground. When no tow bar is available, press down at the horizontal stabilizer front spar adjacent to the fuselage to raise the nose wheel off the ground. With the nose wheel clear of the ground, the aircraft can be turned by pivoting it about the main wheels.

When towing the aircraft, never turn the nose wheel more than 30 degrees either side of center or the nose gear will be damaged. Do not push on control surfaces or outboard empennage surfaces. When pushing on the tailcone, always apply pressure at a bulkhead to avoid buckling the skin.

TOW BAR: PART NUMBER 0501019-1 IS AVAILABLE FROM THE CESSNA SERVICE PARTS CENTER.

NOTE
Use tow bar carefully to avoid scarring finish on speed fairing.

Figure 2-1. Tow Bar
NOTE

Corresponding points on both upper door sills may be used to level the aircraft laterally.

Prior to 1971 Models, reference points for leveling the aircraft longitudinally are the top of the tailcone between rear window and vertical fin.

Beginning with 1971 Models, reference points for longitudinal leveling of aircraft are two screws on left side of tailcone at zero waterline. These are indicated in illustration by A

(Also refer to paragraph 2-5)
JACKING INFORMATION

<table>
<thead>
<tr>
<th>ITEM NUMBER</th>
<th>TYPE AND NUMBER</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Block (Jack point not available)</td>
<td>1x4x4 padded with 1/4&quot; rubber</td>
</tr>
<tr>
<td>2</td>
<td>Jack</td>
<td>Any short jack of capable capacity</td>
</tr>
<tr>
<td>3</td>
<td>Universal tail stand</td>
<td>Any tail stand of capable capacity</td>
</tr>
<tr>
<td>4</td>
<td>Cessna #SE-576 (41-1/2&quot; high)</td>
<td>Universal jack stand (FOR USE WITH ITEM 2)</td>
</tr>
<tr>
<td>5</td>
<td>Cessna #10004-98</td>
<td>Jack point *(SEE CAUTION)</td>
</tr>
<tr>
<td>6</td>
<td>Cessna #0411215-1</td>
<td>Jack point # (SEE NOTE 5)</td>
</tr>
<tr>
<td>7</td>
<td>Cessna #0441215-1</td>
<td>Part of step bracket †</td>
</tr>
<tr>
<td>8</td>
<td>#2-170 Basic jack</td>
<td>Closed height: 69 1/2 inches; extended</td>
</tr>
<tr>
<td></td>
<td>#2-70 Slide tube</td>
<td>height: 92&quot; (Insert slide tube extension</td>
</tr>
<tr>
<td></td>
<td>(Use with item 1)</td>
<td>into basic jack)</td>
</tr>
</tbody>
</table>

1. Wing jacks are placed under front spar of wing just outboard of wing strut, and must extend far enough to raise wheels off ground, and must be of adequate strength.

2. Attach a suitable stand to the tie-down ring. Be sure tail stand weighs enough to keep tail down and under all conditions that it is strong enough to support any weight that might be placed on it (place shot bags or sand bags on tail stand). In addition, the base of adjustable tail stand is to be filled with concrete for additional weight as a safety factor.

3. Operate jacks evenly until desired height is reached.

CAUTION

When using universal jack point (10004-98), flexibility of the gear strut will cause the main wheel to slide inboard as the wheel is raised, tilting the jack. The jack must be lowered for a second operation. Jacking both wheels simultaneously with universal jack points is not recommended. Universal jack point may be used to raise only one main wheel. DO NOT USE brake casting as a jack point.

4. Items (4), (5) and (6) are available from the Cessna Service Parts Center.

5. On tubular gear aircraft, the only fairing requiring removal is the fuselage-to-tube gear fairing. Jack pad is inserted on tube in area between fuselage and upper end of tube fairing, then jack aircraft as required.

* Thru Serials 15072003, A15000276, F15000658 and FA1500081.
# Serials 15073004 thru 15073284, A15000277 thru A15000324, F15000659 thru F15000833 and FA1500082 thru FA15000166.
† Beginning with Serials 15073285, A15000325, F15000834 and FA15000167.

Figure 2-2. Jacking and Leveling (Sheet 2 of 2)
2-3. HOISTING. The aircraft may be lifted with a hoist of two-ton capacity by using hoisting rings, which are optional equipment, or by means of suitable slings. The front sling should be hooked to each upper engine mount at the firewall, and the aft sling should be positioned around the fuselage at the first bulkhead forward of the leading edge of the stabilizer. If the optional hoisting rings are used, a minimum cable length of 60 inches for each cable is required to prevent bending of the eyebolt-type hoisting rings. If desired, a spreader jig may be fabricated to apply vertical force to the eyebolts.

2-4. JACKING. Refer to figure 2-2 for jacking procedures.

2-5. LEVELING. Corresponding points on both upper door sills may be used to level the aircraft laterally. Prior to the 1971 models, the reference point for leveling the aircraft longitudinally is the top of the tailcone between the rear window and vertical fin. Beginning with the 1971 models, the reference points for longitudinal leveling of the aircraft are the two screws on the left side of the tailcone at zero waterline.

2-6. PARKING. Parking precautions depend principally on local conditions. As a general precaution, set parking brake or chock the wheels and install the controls lock. In severe weather and high wind conditions, tie down the aircraft as outlined in paragraph 2-7 if a hangar is not available.

2-7. TIE-DOWN. When mooring the aircraft in the open, head into the wind if possible. Secure control surfaces with the internal control lock and set brakes.

**CAUTION**

Do not set parking brakes during cold weather when accumulated moisture may freeze the brakes or when the brakes are overheated.

After completing the preceding, proceed to moor the aircraft as follows:

a. Tie ropes, cables, or chains to the wing tie-down fittings located at the upper end of each wing strut. Secure the opposite ends of ropes, cables, or chains to ground anchors.

b. Secure a tie-down rope (no chains or cables) to the exposed portion of the engine mount and secure opposite end of rope to a ground anchor.

c. Secure the middle of a rope to the tail tie-down ring. Pull each end of rope away at a 45 degree angle and secure to ground anchors at each side of tail.

d. Secure control lock on pilot control column. If control lock is not available, tie pilot control wheel back with front seat belt.

e. These aircraft are equipped with a spring-loaded steering system which affords protection against normal wind gusts. However, if extremely high wind gusts are anticipated, additional external locks may be installed.

2-8. FLYABLE STORAGE. Flyable storage is defined as a maximum of 30 days non-operational storage and/or the first 25 hours of intermittent engine operation.

**NOTE**

The aircraft is delivered from Cessna with a Corrosion Preventive Aircraft Engine Oil (MIL-C-6529, Type II, RUST BAN). This engine oil is a blend of aviation grade straight mineral oil and a corrosion preventive compound. This engine oil should be used for the first 50 hours of engine operation. In the event it is necessary to add oil during the first 25 hours of operation, use only aviation grade straight mineral oil of the correct viscosity.

During the 30 day non-operational storage or the first 25 hours of intermittent engine operation, every seventh day the propeller shall be rotated through five revolutions, without running the engine. If the aircraft is stored outside, tie-down in accordance with paragraph 2-7. In addition, the pitot tube, static air vents, air vents, openings in the engine cowling, and other similar openings shall have protective covers installed to prevent entry of foreign material. After 30 days, aircraft should be flown for 30 minutes or ground run-up until oil has reached operating temperature.

2-9. RETURNING AIRCRAFT TO SERVICE. After flyable storage, returning the aircraft to service is accomplished by performing a thorough pre-flight inspection. At the end of the first 25 hours of engine operation, drain engine oil, clean oil screens and change external oil filter element. Service engine with correct grade and quantity of engine oil. Refer to figure 2-4 and paragraph 2-21 for correct grade of engine oil.

2-10. TEMPORARY STORAGE. Temporary storage is defined as aircraft in a non-operational status for a maximum of 90 days. The aircraft is constructed of corrosion resistant alclad aluminum, which will last indefinitely under normal conditions if kept clean, however, these alloys are subject to oxidation. The first indication of corrosion on unpainted surfaces is in the form of white deposits or spots. On painted surfaces, the paint is discolored or blistered. Storage in a dry hangar is essential to good preservation and should be procured if possible. Varying conditions will alter the measures of preservation, but under normal conditions in a dry hangar, and for storage periods not to exceed 90 days, the following methods of treatment are suggested:

a. Fill fuel tanks with correct grade of gasoline.

b. Clean and wax aircraft thoroughly.

c. Clean any oil or grease from tires and coat tires with a tire preservative. Cover tires to protect against grease and oil.

d. Either block up fuselage to relieve pressure on tires or rotate wheels every 30 days to change supporting points and prevent flat spotting the tires.

e. Lubricate all airframe items and seal or cover all openings which could allow moisture and/or dust to enter.
NOTE

The aircraft battery serial number is recorded in the aircraft equipment list. To assure accurate warranty records, the battery should be re-installed in the same aircraft from which it was removed. If the battery is returned to service in a different aircraft, appropriate record changes must be made and notification sent to the Cessna Claims Department.

f. Remove battery and store in a cool dry place; service the battery periodically and charge as required.

NOTE

An engine treated in accordance with the following may be considered protected against normal atmospheric corrosion for a period not to exceed 90 days.

g. Disconnect spark plug leads and remove upper and lower spark plugs from each cylinder.

NOTE

The preservative oil must be Lubricating Oil-Contact and Volatile, Corrosion Inhibited, MIL-L-46002, Grade 1 or equivalent. The following oils are approved for spraying operations by Teledyne Continental Motors, Nuio Oil 105 - Daubert Chemical Co., 4700 So. Central Ave., Chicago, Illinois, Petratect VA - Pennsylvania Refining Co., Butler Pennsylvania, Ferro-Gard 1009G - Ranco Laboratories, Inc., 3617 Brownsville Rd., Pittsburg, Pennsylvania.

h. Using a portable pressure sprayer, atomize spray preservative oil through the upper spark plug hole of each cylinder with the piston in a down position. Rotate crankshaft as each pair of cylinders is sprayed.

i. After completing step "h," rotate crankshaft so that no piston is at a top position. If the aircraft is to be stored outside, stop two-bladed propeller so that blades are as near horizontal as possible to provide maximum clearance with passing aircraft.

j. Again spray each cylinder without moving the crankshaft to thoroughly cover all interior surfaces of the cylinder above the piston.

k. Install spark plugs and connect spark plug leads.

l. Apply preservative oil to the engine interior by spraying approximately two ounces of the preservative oil through the oil filler tube.

m. Seal all engine openings exposed to the atmosphere using suitable plugs or non-hygroscopic tape. Attach a red streamer at each point that a plug or tape is installed.

n. If the aircraft is to be stored outside, perform the procedures outlined in paragraph 2-7. In addition, the pitot tube, static source vents, air vents, openings in the engine cowling and other similar openings should have protective covers installed to prevent entry of foreign material.

o. Attach a warning placard to the propeller to the effect that the propeller shall not be moved while the engine is in storage.

2-11. INSPECTION DURING STORAGE.

a. Inspect airframe for corrosion at least once a month and remove dust collections as frequently as possible. Clean and wax as required.

b. Inspect the interior of at least one cylinder through the spark plug hole for corrosion at least once a month.

NOTE

Do not move crankshaft when inspecting interior of cylinder for corrosion.

c. If at the end of the 90 day period, the aircraft is to be continued in non-operational storage, again perform the procedural steps "g thru o" of paragraph 2-10.

2-12. RETURNING AIRCRAFT TO SERVICE. After temporary storage, use the following procedures to return the aircraft to service.

a. Remove aircraft from blocks and check tires for proper inflation. Check for proper nose gear strut inflation.

b. Check battery and install.

c. Check that oil sump has proper grade and quantity of engine oil.

d. Service induction air filter and remove warning placard from propeller.

e. Remove materials used to cover openings.

f. Remove, clean, and gap spark plugs.

g. While spark plugs are removed, rotate propeller several revolutions to clear excess rust preventive oil from cylinders.

h. Using a portable pressure sprayer, atomize spray preservative oil through the upper spark plug hole of each cylinder with the piston in a down position. Rotate crankshaft as each pair of cylinders is sprayed.

i. After completing step "h," rotate crankshaft so that no piston is at a top position. If the aircraft is to be stored outside, stop two-bladed propeller so that blades are as near horizontal as possible to provide maximum clearance with passing aircraft.

j. Again spray each cylinder without moving the crankshaft to thoroughly cover all interior surfaces of the cylinder above the piston.

k. Install spark plugs and connect spark plug leads.

l. Apply preservative oil to the engine interior by spraying approximately two ounces of the preservative oil through the oil filler tube.

m. Seal all engine openings exposed to the atmosphere using suitable plugs or non-hygroscopic tape. Attach a red streamer at each point that a plug or tape is installed.

n. If the aircraft is to be stored outside, perform the procedures outlined in paragraph 2-7. In addition, the pitot tube, static source vents, air vents, openings in the engine cowling and other similar openings should have protective covers installed to prevent entry of foreign material.

o. Attach a warning placard to the propeller to the effect that the propeller shall not be moved while the engine is in storage.

2-13. INDEFINITE STORAGE. Indefinite storage is defined as aircraft in a non-operational status for an indefinite period of time. Engines treated in accordance with the following may be considered protected against normal atmosphere corrosion, provided the procedures outlined in paragraph 2-14 are performed at the intervals specified.

a. Operate engine until oil temperature reaches normal operating range. Drain engine oil sump and reinstall drain plug.

b. Fill oil sump to normal operating capacity with corrosion preventive mixture which has been thoroughly mixed and pre-heated to a minimum of 221°F at the time it is added to the engine.
Corrosion preventive mixture consists of one part compound MIL-C-6529, Type I, mixed with three parts new lubricating oil of the grade recommended for service. Continental Motors Corporation recommends Cosmoline No. 1223, supplied by E. F. Houghton & Co., 305 W. LeHigh Avenue, Philadelphia, Pa. During all spraying operation corrosion mixture is pre-heated to 221° to 250°F.

c. Immediately after filling the oil sump with corrosion preventive mixture, fly the aircraft for a period of time not to exceed a maximum of 30 minutes.

d. With engine operating at 1200 to 1500 rpm and induction air filter removed, spray corrosion preventive mixture into induction airbox, at the rate of one-half gallon per minute, until heavy smoke comes from exhaust stack, then increase the spray until the engine is stopped.

**CAUTION**

Injecting corrosion-preventive mixture too fast can cause a hydrostatic lock.

e. Do not rotate propeller after completing step "d."

f. Remove all spark plugs and spray corrosion-preventive mixture, which has been pre-heated to 221° to 250°F, into all spark plug holes to thoroughly cover interior surfaces of cylinders.

g. Install lower spark plug or install solid plugs, and install dehydrator plugs in upper spark plug holes. Be sure that dehydrator plugs are blue in color when installed.

h. Cover spark plug lead terminals with shipping plugs (AN4060-1) or other suitable covers.

i. With throttle in full open position, place a bag of desiccant in the carburetor intake and seal opening with moisture resistant paper and tape.

j. Place a bag of desiccant in the exhaust tailpipe(s) and seal openings with moisture resistant tape.

k. Seal cold air inlet to the heater muff with moisture resistant tape.

l. Seal engine breather by inserting a protex plug in the breather hose and clamping in place.

m. Seal all other engine openings exposed to atmosphere using suitable plugs or non-hygroscopic tape.

**NOTE**

Attach a red streamer to each place plugs or tape is installed. Either attach red streamers outside of the sealed area with tape or to the inside of the sealed area with safety wire to prevent wicking of moisture into the sealed area.

n. Drain corrosion-preventive mixture from engine sump and reinstall drain plug.

The corrosion-preventive mixture is harmful to paint and should be wiped from painted surfaces immediately.

o. Attach a warning placard on the throttle control knob, to the effect that the engine contains no lubricating oil. Placard the propeller to the effect that it should not be moved while the engine is in storage.

p. Prepare airframe for storage as outlined in paragraph 2-10 thru step "f."

**NOTE**

As an alternate method of indefinite storage, the aircraft may be serviced in accordance with paragraph 2-10 providing the aircraft is run-up at maximum intervals of 60 days and then reserviced per paragraph 2-10.

2-14. INSPECTION DURING STORAGE. Aircraft in indefinite storage shall be inspected as follows:

a. Inspect cylinder protex plugs each 7 days.

b. Change protex plugs if their color indicates an unsafe condition.

c. If the dehydrator plugs have changed color in one half of the cylinders, all desiccant material in the engine shall be replaced with new material.

d. Every 6 months respray the cylinder interiors with corrosion-preventive mixture.

**NOTE**

Before spraying, inspect the interior of one cylinder for corrosion through the spark plug hole and remove at least one rocker box cover and inspect the valve mechanism.

2-15. RETURNING AIRCRAFT TO SERVICE. After indefinite storage, use the following procedure to return the aircraft to service:

a. Remove aircraft from blocks and check tires for correct inflation. Check for correct nose gear strut inflation.

b. Check battery and install.

c. Remove all materials used to seal and cover openings.

d. Remove warning placards posted at throttle and propeller.

e. Remove and clean engine oil screen, then reinstall and safety. On aircraft that are equipped with an external oil filter, install new filter element.

f. Remove oil sump drain plug and drain sump. Install and safety drain plug.

**NOTE**

The corrosion-preventive mixture will mix with the engine lubricating oil, so flushing the oil system is not necessary. Draining the oil sump will remove enough of the corrosion-preventive mixture.
g. Service and install the induction air filter.

h. Remove dehydrator plugs and spark plugs or
plugs installed in spark plug holes and rotate pro-
peller by hand several revolutions to clear corrosio-
preventive mixture from cylinders.

i. Clean, gap, and install spark plugs. Torque
plugs to the value listed in Section 11.

j. Check fuel strainer. Remove and clean filter
screen. Check fuel tanks and fuel lines for moisture
and sediment, and drain enough fuel to eliminate.

k. Perform a thorough pre-flight inspection, then
start and warm-up engine.

l. Thoroughly clean aircraft and flight test air-
craft.

2-16. SERVICING.

2-17. Servicing requirements are shown in figure
2-4. The following paragraphs supplement this
figure by adding details not included in the figure.

2-18. FUEL. Fuel tanks should be filled immedi-
ately after flight to lessen moisture condensation.
Tank capacities are listed in Section 1. The recom-
mended fuel grade to be used is given in figure 2-4.

2-19. FUEL DRAINS are located in the fuel tanks,
fuel line, fuel strainer, and carburetor. Drain plugs
are installed in the fuel tanks, fuel line forward of
ON-OFF valve, and carburetor. The strainer drain
valve is an integral part of the fuel strainer assembly.
The strainer drain is equipped with a control which
is located adjacent to the oil dipstick. Access to the
control is through the oil dipstick access door. Re-
move drain plugs and open strainer drain at the in-
tervals specified in figure 2-4. Also, during daily
inspection of the fuel strainer, if water is found in
the strainer drain, there is a possibility that the wing
tank sumps or fuel line contain water. Therefore,
all fuel drain plugs should be removed and all water
drained from the system. To activate drain valve
for fuel sampling, place cup up to valve and depress
valve with rod protruding from cup. See figure 12-3.

2-20. CARBURETOR DRAIN PLUG INSPECTION.

In order to prevent the possibility of thread sealant
contamination in the carburetor float chamber,
cleaning and inspection of the carburetor should be
accomplished at each 100-hour inspection and any-
time water in the fuel is suspected.

a. With the fuel valve OFF, remove carburetor
drain plug and clean off any sealant present on the
end of the plug or in the threads on the plug.

b. Inspect drain plug hole in the carburetor and re-
move any sealant remaining in the hole.

c. Turn fuel valve to ON to flush float chamber
and drain plug chamber while probing drain plug hole
to ascertain that all residue of sealant material is dis-
lodged and washed out of the chamber. Flushing
operation should last 15 to 30 seconds.

d. A second flushing should then be accomplished
and the drained fuel retained for inspection to insure
that no sealant particles are present.

e. Install drain plug as follows:

1. Install drain plug in carburetor 1-1/2 to 2
turns.

2. Apply sealant to drain plug threads (use

NS-40 (RAS-4) or equivalent).

3. Tighten and safety drain plug.

e. Turn fuel valve ON and inspect for evidence of
fuel leakage.

2-21. ENGINE OIL. Check engine lubricating oil
with the oil dipstick five to ten minutes after the en-
gine has been stopped. Engine oil should be drained
while the engine is still hot so that more positive
draining is obtained. Refer to the inspection charts
for required intervals for oil and filter changes.

Change oil every 6 months even though less than the
specified hours have accumulated. Reduce these peri-
ods for prolonged operation in dusty areas, in cold
climate where sludging conditions exist, or where
short flights and long idle periods are encountered,
which cause sludging conditions. Always change oil
and install a new filter element or clean screens
whenever oil on dipstick appears dirty.

NOTE

On aircraft equipped with an oil cooler, draw oil cooler at each oil change period.
When oil cooler is drained and after the
first engine run-up, check oil with dipstick
and add oil as required to bring oil in the
sump to the desired level.

Oil capacity is six quarts total with a normal oper-
ating capacity of five quarts for flights of less than
three hours. For extended flight, fill to the six
quart level on the dipstick. DO NOT operate with
less than the minimum for flight quantity of four
quarts. If the engine is equipped with an external
oil filter, an additional quart of oil is required when
the filter element is changed. When adding or chang-
ing engine oil, use aviation grade oil in accordance
with figure 2-4.

NOTE

New or newly-overhauled engines should be
operated on aviation grade straight mineral
oil until the first oil change. If an ashless
dispersant oil is used in a new or newly-over-
hauling engine, high oil consumption may be
experienced. The anti-friction additives in
ashless dispersant oils will retard "break-
in" of the piston, rings and cylinder walls.
This condition can be avoided by the use of
straight mineral oil. The aircraft is delivered
from Cessna with a Corrosion Preventive Air-
craft Engine Oil (MIL-C-6529, Type II, RUST
BAN). If oil must be added during the first 25
hours, use only aviation grade straight mineral
oil (non-detergent) conforming to Specification
No. MIL-L-6082. After the first 25 hours of
operation, drain engine oil sump and clean both
the oil suction strainer and oil pressure screen.
If an optional oil filter is installed, change fil-
ter element at this time. Refill sump with
straight mineral oil (non-detergent) and use
until a total of 50 hours have accumulated or
oil consumption has stabilized, then change
to ashless dispersant oil, conforming with
Continental Motors Specification MHS-24
and revisions and supplements thereto and with current Continental Aircraft Engine Service Bulletins.

Ashless dispersant oil, conforming with Continental Motors Specification MHS-24 and revisions and supplements thereto and with current Continental Aircraft Engine Service Bulletins, must be used at the oil change after 50 hours of operation. When changing engine oil, remove and clean oil screens, or install a new filter element on aircraft equipped with an external oil filter. An oil quick-drain valve may be installed. This valve provides a quick and cleaner method of draining the engine oil. The valve is installed in the oil drain port of the oil sump and allows the oil to be drained by inserting a hose over the fitting end and pushing up to lock the valve open, causing the oil to drain through the hose into a container. To drain the engine oil, proceed as follows:

a. Operate engine until oil temperature is a normal operating temperature.

b. (With Quick-Drain Valve.) Attach a hose to the quick-drain valve in the oil sump. Push up on quick-drain valve until it locks open, and allow oil to drain through hose into container.

c. (Without Quick-Drain Valve.) Remove oil drain plug from oil sump and allow oil to drain into a container.

d. After engine oil has drained, close quick-drain valve and remove hose, or install and safety drain plug.

e. Remove and clean oil screens, or change external oil filter element.

f. On aircraft equipped with an oil cooler, remove cooler drain plug and drain oil cooler at each oil change. After oil cooler has drained, install and safety drain plug.

g. Service engine with correct quantity and grade of engine oil. (See figure 2-4).

NOTE

When oil cooler is drained or external filter element is changed and after the first engine run-up, check oil with dipstick and add oil as required to bring oil in the sump to the desired level.

2-22. ENGINE INDUCTION AIR FILTER. The induction air filter keeps dust and dirt from entering the induction system. The value of maintaining the air filter in a good clean condition can never be overstressed. More engine wear is caused through the use of dirty or damaged air filter than is generally believed. The frequency with which the filter should be removed, inspected, and cleaned will be determined primarily by aircraft operating conditions. A good general rule however, is to remove, inspect and clean the filter at least every 50 hours of engine operating time and more frequently if warranted by operating conditions. Some operators prefer to hold a spare induction air filter at their home base of operation so that a clean filter is always readily available for use. Under extremely dusty conditions, daily servicing of the filter is recommended. Two types of filters are used. One is a flock-coated, oiled filter and the other is a dry, paper-media filter.

NOTE

The aircraft is equipped with the flock-coated, oiled filter when it leaves the factory. However, new filters ordered from the Cessna Service Parts Center will be the dry, paper-media filter with an improved element.

To service the flock-coated, oiled filter, proceed as follows:

a. Remove filter from aircraft.

b. Wash filter thoroughly in solvent (Federal Specification P-S-661 or equivalent). Wash with soiled face down in solvent.

c. Drain and dry filter, then dip flock-coated screen filter in the same grade of oil used in the engine and allow excess oil to drain from the filter.

d. Be sure airbox is cleaned, inspect filter. If filter is damaged, install a new filter.

NOTE

A damaged filter may have broken filtering panels or the flock coating may be missing from the filtering panels, which will allow unfiltered air to enter the induction system. Any filter that appears doubtful, shall have a new filter installed in its place.

e. Install filter at entrance to air box with gasket on aft face of filter frame and with air flow arrow on filter pointed in the correct direction.

To service the dry type filter, proceed as follows:

a. Remove filter from aircraft.

NOTE

Use care to prevent damage to filter element when cleaning filter with compressed air.

b. Clean filter by blowing with compressed air (not over 100 psi) from direction opposite of normal airflow. Arrows on filter case indicate direction of normal airflow.

CAUTION

Do not use solvent or cleaning fluids to wash filter. Use only a water and household detergent solution when washing the filter.

c. After cleaning as outlined in step "b", the filter may be washed, if necessary, in a solution of warm water and a mild household detergent. A cold water solution may be used.
NOTE

The filter assembly may be cleaned with compressed air a maximum of 30 times or it may be washed a maximum of 20 times. A new filter should be installed after using 500 hours of engine operating time or one year, whichever should occur first. However, a new filter should be installed at anytime it is damaged. A damaged filter may have sharp or broken edges in the filtering panels which would allow unfiltered air to enter the induction system. Any filter that appears doubtful, shall have a new filter installed in its place.

d. After washing, rinse filter with clear water until rinse water draining from filter is clear. Allow water to drain from filter and dry with compressed air (not over 100 psi).

NOTE

The filtering panels of the filter may become distorted when wet, but they will return to their original shape when dry.

e. Be sure air box is clean, inspect filter. If filter is damaged, install a new filter.

f. Install filter at entrance to air box with gasket on aft face of filter frame and with air flow arrow on filter frame pointed in the correct direction.

2-23. VACUUM SYSTEM FILTER. The vacuum system central air filter keeps dust and dirt from entering the vacuum operated instruments. Change central air filter element every 500 hours of operating time and whenever suction gage reading drops below 4.6 inches of mercury. Also, do not operate the vacuum system with the filter removed, or a vacuum line disconnected as particles of dust or other foreign matter may enter the system and damage the gyro.

2-24. BATTERY. Battery servicing involves adding distilled water to maintain the electrolyte level even with the horizontal baffle plate or split ring at the bottom of the filler holes, checking cable connections, and neutralizing and cleaning off any spilled electrolyte or corrosion. Use bicarbonate of soda (baking soda) and clean water to neutralize electrolyte or corrosion. Follow with a thorough flushing with clean water. Do not allow bicarbonate of soda to enter battery. Brighten cable and terminal connections with a wire brush, then coat with petroleum jelly before connecting cables. Check the battery every 50 hours (or at least every 30 days), oftener in hot weather. Add only distilled water, not acid or "rejuvenators", to maintain electrolyte level in the battery. Inspect the battery box and surrounding area and clean and remove any evidence of corrosion. Refer to Section 16 for detailed battery removal, installation, and testing.

2-25. TIRES. Maintain tire pressure at the air pressure specified in figure 1-1. When checking tire pressure, examine tires for wear, cuts, bruises, and slippage. Remove oil, grease and mud from tires with soap and water.

Figure 2-3. Tie-Down Details
NOTE
Recommended tire pressures should be maintained. Especially in cold weather, remember that any drop in temperature of the air inside a tire causes a corresponding drop in air pressure.

2-26. NOSE GEAR SHOCK STRUT. The nose gear shock strut requires periodic checking to ascertain that the strut is filled with hydraulic fluid and is inflated to the correct air pressure. To fill the nose gear strut with hydraulic fluid and inflate with air, proceed as follows:
   a. Remove filler valve cap and depress valve core to completely deflate nose strut.
   b. Remove filler valve from strut.
   c. With nose gear strut compressed to its shortest length, fill strut with hydraulic fluid to the bottom of the filler hole.
   d. Raise nose of aircraft, extend and compress strut several times to expel any entrapped air, then lower nose of aircraft and repeat step "c".
   e. With strut compressed to its shortest length, install filler valve assembly.
   f. With nose wheel off ground, inflate strut. Shock strut pressure is listed in figure 1-1.

NOTE
The nose landing gear shock strut will normally require only a minimum amount of service. Maintain the strut extension pressure, as shown in figure 1-1. Lubricate landing gear as shown in figure 2-5. Check the landing gear daily for general cleanliness, security of mounting, and for hydraulic fluid leakage. Keep machined surfaces wiped free of dirt and dust, using a clean lint-free cloth saturated with MIL-H-5606 hydraulic fluid or kerosene. All surfaces should be wiped free of excessive hydraulic fluid.

2-27. NOSE GEAR SHIMMY DAMPENER. The shimmy dampener should be serviced at least every 50 hours. The shimmy dampener must be filled completely with fluid, free of entrapped air, to serve its purpose. To service the shimmy damper, proceed as follows:
   a. Remove shimmy dampener from aircraft.
   b. While holding the dampener in a vertical position with fitting end pointed downward, pull fitting end of the dampener shaft to its limit of travel.
   c. While holding dampener in this position, fill dampener through open end of cylinder.
   d. Push the shaft upward slowly to seal off the filler hole.
   e. Clean dampener with solvent. Be sure to keep the shaft protruding through the filler hole until dampener is installed on the aircraft.
   f. Install dampener on aircraft.

NOTE
Keep shimmy dampener, especially the exposed portions of the dampener piston shaft, clean to prevent collection of dust and grit which could cut the seals in the damper barrel. Keep machined surfaces wiped free of dirt and dust, using a clean lint-free cloth saturated with MIL-H-5606 hydraulic fluid or kerosene. All surfaces should be wiped free of excessive hydraulic fluid.

2-28. HYDRAULIC BRAKE SYSTEMS. Check brake master cylinders and refill with hydraulic fluid as specified in the inspection charts. Bleed the brake system of entrapped air whenever there is a spongy response to the brake pedals. Refer to paragraph 5-58 for filling and bleeding the brake system.

2-29. CLEANING.

2-30. Keeping the aircraft clean is important. Besides maintaining the trim appearance of the aircraft, cleaning lessens the possibility of corrosion and makes inspection and maintenance easier.

2-31. WINDSHIELD AND WINDOWS should be cleaned carefully with plenty of fresh water and a mild detergent, using the palm of the hand to feel and dislodge any caked dirt or mud. A sponge, soft cloth, or chamois may be used, but only as a means of carrying water to the plastic. Rinse thoroughly, then dry with a clean moist chamois. Do not rub the plastic with a dry cloth as this builds up an electrostatic charge which attracts dust. Oil and grease may be removed by rubbing lightly with a soft cloth moistened with Stoddard solvent.

CAUTION
Do not use gasoline, alcohol, benzene, acetone, carbon tetrachloride, fire extinguisher fluid, de-icer fluid, lacquer thinner, or glass window cleaning spray. These solvents will soften and craze the plastic.

After washing, the plastic windshield and windows should be cleaned with an aircraft windscreen cleaner. Apply the cleaner with soft cloths and rub with moderate pressure. Allow the cleaner to dry, then wipe it off with soft flannel cloths. A thin, even coat of wax, polished out by hand with soft flannel cloths, will fill in minor scratches and help prevent further scratching. Do not use a canvas cover on the windshield or windows unless freezing rain or sleet is anticipated since the cover may scratch the plastic surface.

2-32. PLASTIC TRIM. The instrument panel, plastic trim, and control knobs need only be wiped with a damp cloth. Oil and grease on the control wheel and control knobs can be removed with a cloth moistened with Stoddard solvent. Volatile solvents, such as mentioned in paragraph 2-31, must never be used since they soften and craze the plastic.

2-33. PAINTED SURFACES. The painted exterior surfaces of the aircraft, under normal conditions, require a minimum of polishing and buffing. Approximately 15 days are required for acrylic or lacquer paint to cure completely; in most cases, the curing
HYDRAULIC FLUID:
SPEC. NO. MIL-H-5606

RECOMMENDED FUEL:

**CAUTION**
* Compliance with conditions stated in Continental aircraft engine Service Bulletins M74-6 and M75-2 and supplements or revisions thereto, are recommended when using alternate fuel.

FUEL: MINIMUM: 80/87 Aviation Grade
**ALTERNATES:**
1. 100/130 Low Lead Avgas (with lead content limited to a maximum of 2 cc Tetraethyllead per gallon)
2. 100/130 Higher Lead Avgas (with lead content limited to a maximum of 4.6 cc Tetraethyllead per gallon)

RECOMMENDED ENGINE OIL:

AVIATION GRADE:
ABOVE 40°F SAE 40
BELOW 40°F SAE 20

Aviation Grade ashless dispersant oil conforming to Continental Motors Specification MHS-24 and all revisions and supplements thereto must be used except as noted in paragraph 2-21. Refer to Continental Aircraft Engine Service Bulletin M74-19 and any superseding bulletins, revisions, or supplements thereto for further recommendations.

Figure 2-4. Servicing (Sheet 1 of 3)
3 FUEL TANK FILLER
Service after each flight. Keep full to retard condensation. Refer to paragraph 2-18 for details.

4 FUEL TANK SUMP DRAINS
If quick-drain valves are installed, drain off any water and sediment before first flight of the day.

6 PITOT AND STATIC PORTS
Check for obstructions before first flight of the day.

10 FUEL STRAINER
Drain off any water and sediment before the first flight of the day. Refer to paragraph 2-19 for details.

13 INDUCTION AIR FILTER
Inspect and service under dusty conditions. Refer to paragraph 2-22 for details.

16 OIL DIPSTICK
Check oil on preflight. Add oil as necessary. Refer to paragraph 2-21 for details.

18 OIL FILLER CAP:
Whenever oil is added, check that filler cap is tight and oil filler door is secure.

FIRST 25 HOURS

15, 17 ENGINE OIL SYSTEM
Refill with straight mineral oil, non-detergent, and use until a total of 50 hours have accumulated or oil consumption has stabilized, then change to ashless dispersant oil.

50 HOURS

13 INDUCTION AIR FILTER
Clean filter per paragraph 2-22. Replace as required.

14 BATTERY
Check electrolyte level and clean battery compartment each 50 hours or each 30 days.

15, 17 ENGINE OIL SYSTEM
Change oil each 50 hours if engine is NOT equipped with external oil filter; if equipped with external oil filter, change filter element each 50 hours and oil at each 100 hours, or every 6 months.

12 SHIMMY DAMPENER
Check fluid level and refill as required with hydraulic fluid. Refer to paragraph 2-27 for details.

7 TIRES
Maintain correct tire inflation as listed in figure 1-1. Also refer to paragraph 2-25 for details.

Figure 2-4. Servicing (Sheet 2 of 3)
11 NOSE GEAR SHOCK STRUT
   Keep strut filled and inflate to correct pressure. Refer to paragraph 2-26 for details.

5 SHUT-OFF VALVE DRAIN
   Remove plug and drain off any water or sediment. Also refer to paragraph 2-19.

10 FUEL STRAINER
   Disassemble and clean strainer bowl and screen.

1 VACUUM RELIEF FILTER
   Change each 1000 hours, or to coincide with engine overhauls.

4 FUEL TANK SUMP DRAINS
   If quick-drain valves are not installed, remove plugs and drain off any water or sedi-
   ment. Reinstall plugs and safety. Also refer to paragraph 2-19.

9 BRAKE MASTER CYLINDERS
   Check fluid level and refill as required with hydraulic fluid. Refer to paragraph 2-28
   for details.

2 VACUUM SYSTEM CENTRAL AIR FILTER
   Replace every 500 hours.

8 GROUND SERVICE RECEPTACLE
   Connect to 12-volt DC, negative-ground power unit. Refer to Section 11 for
   details.
period will have been completed prior to delivery of the aircraft. In the event that polishing or buffing is required within the curing period, it is recommended that the work be done by an experienced painter. Generally, the painted surfaces can be kept bright by washing with water and mild soap, followed by a rinse with water and drying with cloths or chamois. Harsh or abrasive soaps or detergents which could cause corrosion or make scratches should never be used. Remove stubborn oil and grease with a cloth moistened with Stoddard solvent. After the curing period, the aircraft may be waxed with a good automotive wax. A heavier coating of wax on the leading edges of the wing and tail and on the engine nose cap will help reduce the abrasion encountered in these areas.

2-34. ALUMINUM SURFACES. The aluminum surfaces require a minimum of care, but should never be neglected. The aircraft may be washed with clean water to remove dirt and may be washed with nonalkaline grease solvents to remove oil and/or grease. Household type detergent soap powders are effective cleaners, but should be used cautiously since some of them are strongly alkaline. Many good aluminum cleaners, polishes, and waxes are available from commercial suppliers of aircraft products.

2-35. ENGINE AND ENGINE COMPARTMENT. The engine should be kept clean since dirty cooling fins and baffle plates can cause overheating of the engine. Also, cleaning is essential to minimize any danger of fire and provide for easier inspection of components. The entire engine cowling may be removed to facilitate engine and interior cowling cleaning. Wash down the engine and components with a suitable solvent, such as Stoddard solvent or equivalent, then dry thoroughly with compressed air.

CAUTION

Particular care should be given to electrical equipment before cleaning. Solvent should not be allowed to enter magnetos, starters, alternators, voltage regulators, and the like. Hence, these components should be protected before saturating the engine with solvent. Any fuel, oil, and air openings should be covered before washing the engine with solvent. Caustic cleaning solutions should not be used. After cleaning engine re-lubricate all control arms and moving parts.

2-36. UPHOLSTERY AND INTERIOR. Keeping the upholstery and interior clean prolongs upholstery fabric and interior trim life. To clean the interior, proceed as follows:

a. Empty all ash trays and refuse containers.
b. Brush or vacuum clean the upholstery and carpet to remove dust and dirt.
c. Wipe leather and plastic trim with a damp cloth.
d. Soiled upholstery fabrics and carpet may be cleaned with a foam-type detergent used according to the manufacturer's instructions.
e. Oil spots and stains may be cleaned with household spot removers, used sparingly. Before using any solvent, read the instructions on the container and test it on an obscure place in the fabric to be cleaned. Never saturate the fabric with volatile solvent; it may damage the padding and backing material.
f. Scrape sticky material from fabric with a dull knife, then spot clean the area.

2-37. PROPELLER. Wash hub and blades with a soft cloth and Stoddard cleaning solvent or equivalent, then dry thoroughly with compressed air. The propeller should be wiped occasionally with an oily cloth, then wiped with a dry cloth. In salt water areas this will assist in corrosion proofing the propeller.

2-38. WHEELS. The wheels should be washed periodically and examined for corrosion, chipped paint, and cracks or dents in the wheel halves or in the flanges or hubs. If defects are found remove and repair in accordance with Section 5. Discard cracked wheel halves, flanges or hubs and install new parts.

2-39. LUBRICATION.

2-40. Lubrication requirements are shown in figure 2-5. Before adding grease to grease fittings, wipe dirt from fitting. Lubricate until grease appears around parts being lubricated, and wipe excess grease from parts. The following paragraphs supplement figure 2-5 by adding details.

2-41. TACHOMETER DRIVE SHAFT. Refer to Section 15 for details on lubrication of shaft.

2-42. WHEEL BEARINGS. Clean and repack the wheel bearings at the first 100-hour inspection and at each 500-hour inspection thereafter. If more than the usual number of take-offs and landings are made, extensive taxing is required, or the aircraft is operated in dusty areas or under seacoast conditions, cleaning and lubrication of the wheel bearings shall be accomplished at each 100-hour inspection.

2-43. NOSE GEAR TORQUE LINKS. Lubricate nose gear torque links every 50 hours. When operating in dusty conditions, more frequent lubrication is required.

2-44. WING FLAP ACTUATOR.

a. On aircraft prior to Serials 15072630, F15000739, A15000278 and FA15000133 not modified by Service Kit SK150-37B and SK150-41, proceed as follows:

1. At each 100 hour inspection, inspect wing flap actuator jack screw and ball retainer assembly for lubrication, and lubricate if required. Also, remove, clean and lubricate jack screw whenever actuator slippage is experienced. If lubrication is required, proceed as follows:

a. Gain access to actuator by removing appropriate inspection plates on lower surface of wing.
b. Expose jack screw by operating flaps to full-down position.
c. Wipe a small amount of lubricant from jack screw with a rag and examine for condition. Lubricant should not be dirty, sticky, gummy or frothy in appearance.
d. Inspect wiped area on jack screw for presence of hard scale deposit. Previous wiping action will have exposed bare metal if no deposit is present.
e. If any of the preceding conditions exist, clean and relubricate jack screw as outlined in steps "f" thru"r".

f. Remove actuator from aircraft as outlined in Section 7.

g. Remove all existing lubricant from jack screw and torque tube by running the nut assembly to the end of the jack screw away from the gearbox, and soaking the nut assembly and jack screw in Stoddard solvent.

**NOTE**

Care must be taken to prevent solvent from entering gearbox. The gearbox lubricant is not affected and should not be disturbed.

h. After soaking, clean entire length of jack screw with a wire brush, rinse with solvent and dry with compressed air.

**NOTE**

Do not disassemble nut and ball retainer assembly.

i. Relubricate jack screw with MIL-G-21164 (Molybdenum Disulfide Grease) as outlined in steps "j" thru "m".

j. Rotate nut down screw toward the motor.

k. Coat screw and thread end of nut with grease and run nut to full extension.

l. Repeat the process and pack lubricant in the cavity between the nut and ball retainer assembly at the threaded end of the nut.

m. Repeat the process and work nut back and forth several times.

n. Remove excess grease.

o. Reinstall actuator in aircraft per Section 7.

b. On aircraft prior to Serials 15072630, F15000739, A15000278 and F15000133 which have been modified by Service Kit SK150-37B, proceed as follows:

1. At each 100 hour inspection, expose jack screw by operating flaps to full-down position, and inspect wing flap actuator jack screw for proper lubrication. If lubrication is required, proceed as follows:
   a. Clean jack screw with solvent rag, if necessary, and dry with compressed air.
   b. Relubricate jack screw with MIL-G-21164 (Molybdenum Disulfide Grease) as required.
   c. On aircraft beginning with Serials 15072630, F15000739, A15000278 and FA15000133 and aircraft modified by SK150-41, clean and lubricate wing flap actuator jack screw each 100 hours as follows:
      1. Expose jack screw by operating flaps to full-down position.
      2. Clean jack screw threads with solvent rag and dry with compressed air.

**NOTE**

It is not necessary to remove actuator from aircraft to clean or lubricate threads.

3. With oil can, apply light coat of No 10 weight non-detergent oil to threads of jack screw.

**SHOP NOTES:**

____________________________________________________________________________________

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____________________________________________________________________________________
FREQUENCY (HOURS)  METHOD OF APPLICATION

50  100  500  1000

WHERE NO INTERVAL IS SPECIFIED, LUBRICATE AS REQUIRED AND WHEN ASSEMBLED OR INSTALLED.

NOTE

The military specifications listed are not mandatory, but are intended as guides in choosing satisfactory materials. Products of most reputable manufacturers meet or exceed these specifications.

LUBRICANTS

<table>
<thead>
<tr>
<th>Code</th>
<th>Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PG</td>
<td>SS-G-659</td>
<td>POWDERED GRAPHITE</td>
</tr>
<tr>
<td>GR</td>
<td>MIL-G-81322</td>
<td>GENERAL PURPOSE GREASE</td>
</tr>
<tr>
<td>GH</td>
<td>MIL-G-23827</td>
<td>AIRCRAFT AND INSTRUMENT GREASE</td>
</tr>
<tr>
<td>GL</td>
<td>MIL-G-21164</td>
<td>MOLYBDENUM DISULFIDE GREASE</td>
</tr>
<tr>
<td>OG</td>
<td>MIL-L-7870</td>
<td>GENERAL PURPOSE OIL</td>
</tr>
<tr>
<td>PL</td>
<td>VV-P-236</td>
<td>PETROLATUM</td>
</tr>
<tr>
<td>GS</td>
<td>MIL-S-8860</td>
<td>DC4 (DOW CORNING)</td>
</tr>
<tr>
<td>GP</td>
<td></td>
<td>NO. 10-WEIGHT, NON-DETERGENT OIL</td>
</tr>
</tbody>
</table>

Figure 2-5. Lubrication (Sheet 1 of 3)
BUSHINGS AND OILITE BEARINGS


elevator trim tab actuator

needle bearings

CONTROL "Y"

aileron bellcrank

also refer to inspection chart in this section and to section 9 of this manual

rotated 180°

cabin door window

insert grooves

wing flap indicator

BATTERY

CONTROL WHEEL SHAFT UNIVERSALS

Figure 2-5. Lubrication (Sheet 2 of 3)
Sealed bearings require no lubrication.

Do not lubricate roller chains or cables except under seacoast conditions. Wipe with a clean, dry cloth.

Lubricate unsealed pulley bearings, rod ends, Oilite bearings, pivot and hinge points, and any other friction point obviously needing lubrication, with general purpose oil every 1000 hours or oftener if required.

Paraffin wax rubbed on seat rails will ease sliding the seats fore and aft.

Lubricate door latching mechanism with MIL-G-81322A general purpose grease, applied sparingly to friction points, every 1000 hours or oftener, if binding occurs. No lubrication is recommended on the rotary clutch.
I  INSPECTION REQUIREMENTS.

As required by Federal Aviation Regulations, all civil aircraft of U.S. registry must undergo a complete inspection (annual) each twelve calendar months. In addition to the required ANNUAL inspection, aircraft operated commercially (for hire) must also have a complete aircraft inspection every 100 hours of operation.

In lieu of the above requirements, an aircraft may be inspected in accordance with a progressive inspection schedule, which allows the work load to be divided into smaller operations that can be accomplished in shorter time periods.

Therefore, the Cessna Aircraft Company recommends PROGRESSIVE CARE for aircraft that are being flown 200 hours or more per year, and the 100 HOUR inspection for all other aircraft.

II  INSPECTION CHARTS.

The following charts show the recommended intervals at which items are to be inspected.

As shown in the charts, there are items to be checked each 50 hours, each 100 hours, each 200 hours, and also Special Inspection items which require servicing or inspection at intervals other than 50, 100 or 200 hours.

a. When conducting an inspection at 50 hours, all items marked under EACH 50 HOURS would be inspected, serviced or otherwise accomplished as necessary to insure continuous airworthiness.

b. At each 100 hours, the 50 hour items would be accomplished in addition to the items marked under EACH 100 HOURS as necessary to insure continuous airworthiness.

c. An inspection conducted at 200 hour intervals would likewise include the 50 hour items and 100 hour items in addition to those at EACH 200 HOURS.

d. The numbers appearing in the SPECIAL INSPECTION ITEMS column refer to data listed at the end of the inspection charts. These items should be checked at each inspection interval to insure that applicable servicing and inspection requirements are accomplished at the specified intervals.

e. A complete aircraft inspection includes all 50, 100 and 200 hour items plus those Special Inspection Items which are due at the time of the inspection.

III  INSPECTION PROGRAM SELECTION.


1. IF THE AIRCRAFT IS FLOWN LESS THAN 200 HOURS ANNUALLY.
   a. IF FLOWN FOR HIRE
      An aircraft operating in this category must have a complete aircraft inspection each 100 hours and each 12 calendar months of operation. A complete aircraft inspection consists of all 50, 100, 200 and Special Inspection Items shown in the inspection charts as defined in paragraph II above.

   b. IF NOT FLOWN FOR HIRE
      An aircraft operating in this category must have a complete aircraft inspection each 12 calendar months (ANNUAL). A complete aircraft inspection consists of all 50, 100, 200 and Special Inspection Items shown in the inspection charts as defined in paragraph II above. In addition, it is recommended that between annual inspections, all items be inspected at the intervals specified in the inspection charts.
2. IF THE AIRCRAFT IS FLOWN MORE THAN 200 HOURS ANNUALLY.

   Whether flown for hire or not, it is recommended that aircraft operating in this category be placed on the CESSNA PROGRESSIVE CARE PROGRAM. However, if not placed on Progressive Care, the inspection requirements for aircraft in this category are the same as those defined under paragraph III 1. (a) and (b).

Cessna Progressive Care may be utilized as a total concept program which insures that the inspection intervals in the inspection charts are not exceeded. Manuals and forms which are required for conducting Progressive Care inspections are available from the Cessna Service Parts Center.

IV INSPECTION GUIDE LINES.

(a) MOVABLE PARTS for: lubrication, servicing, security of attachment, binding, excessive wear, safetying, proper operation, proper adjustment, correct travel, cracked fittings, security of hinges, defective bearings, cleanliness, corrosion, deformation, sealing and tension.

(b) FLUID LINES AND HOSES for: leaks, cracks, dents, kinks, chafing, proper radius, security, corrosion, deterioration, obstruction and foreign matter.

(c) METAL PARTS for: security of attachment, cracks, metal distortion, broken spotwelds, corrosion, condition of paint and any other apparent damage.

(d) WIRING for: security, chafing, burning, defective insulation, loose or broken terminals, heat deterioration and corroded terminals.

(e) BOLTS IN CRITICAL AREAS for: correct torque in accordance with torque values given in the chart in Section 1, when installed or when visual inspection indicates the need for a torque check.

NOTE

Torque values listed in Section 1 are derived from oil-free cadmium-plated threads, and are recommended for all installation procedures contained in this book except where other values are stipulated. They are not to be used for checking tightness of installed parts during service.

(f) FILTERS, SCREENS & FLUIDS for: cleanliness, contamination and/or replacement at specified intervals.

(g) AIRCRAFT FILE.

Miscellaneous data, information and licenses are a part of the aircraft file. Check that the following documents are up-to-date and in accordance with current Federal Aviation Regulations. Most of the items listed are required by the United States Federal Aviation Regulations. Since the regulations of other nations may require other documents and data, owners of exported aircraft should check with their own aviation officials to determine their individual requirements.

To be displayed in the aircraft at all times:
1. Aircraft Airworthiness Certificate (FAA Form 8100-2).
2. Aircraft Registration Certificate (FAA Form 8050-3).
3. Aircraft Radio Station License, if transmitter is installed (FCC Form 556).

To be carried in the aircraft at all times:
1. Weight and Balance, and associated papers (Latest copy of the Repair and Alteration Form, FAA Form 337, if applicable).
2. Aircraft Equipment List.

To be made available upon request:
(b) ENGINE RUN-UP.

Before beginning the step-by-step inspection, start, run up and shut down the engine in accordance with instructions in the Owner's Manual. During the run-up, observe the following, making note of any discrepancies or abnormalities:

1. Engine temperatures and pressures.
2. Static rpm.
4. Engine response to changes in power.
5. Any unusual engine noises.
6. Fuel selector and/or shut-off valve; operate engine(s) on each tank (or cell) position and OFF position long enough to ensure shut-off and/or selector valve functions properly.
7. Idling speed and mixture; proper idle cut-off.
8. Alternator and ammeter.
10. Fuel flow indicator.

After the inspection has been completed, an engine run-up should again be performed to determine that any discrepancies or abnormalities have been corrected.

SHOP NOTES:

________________________________________________________________________
________________________________________________________________________
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________________________________________________________________________
________________________________________________________________________

2-20 Change 1
IMPORTANT
READ ALL INSPECTION REQUIREMENTS PARAGRAPHS PRIOR TO USING THESE CHARTS.

PROPELLER
1. Spinner
2. Spinner bulkhead
3. Blades
4. Bolts and/or nuts
5. Hub

ENGINE COMPARTMENT
Check for evidence of oil and fuel leaks, then clean entire engine and compartment, if needed, prior to inspection.

1. Engine oil, screen, filler cap, dipstick, drain plug and external filter element
2. Oil cooler
3. Induction air filter
4. Induction airbox, air valves, doors and controls
5. Cold and hot air hoses
6. Engine baffles
7. Cylinders, rocker box covers and push rod housings
8. Crankcase, oil sump, accessory section and front crankshaft seal
9. Hoses, metal lines and fittings
10. Intake and exhaust systems
11. Ignition harness
12. Spark plugs
13. Compression check
14. Crankcase and vacuum system breather lines
15. Electrical wiring
16. Vacuum pump and oil separator
17. Vacuum relief valve filter (cabin area)
18. Engine controls and linkage
19. Engine shock mounts, mount structure and ground straps
20. Cabin heat valves, doors and controls
21. Starter, solenoid and electrical connections

SPECIAL INSPECTION ITEM
EACH 200 HOURS
EACH 100 HOURS
EACH 50 HOURS

Change 1 2-21
<table>
<thead>
<tr>
<th>SPECIAL INSPECTION ITEM</th>
<th>EACH 200 HOURS</th>
<th>EACH 100 HOURS</th>
<th>EACH 50 HOURS</th>
</tr>
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<tbody>
<tr>
<td>22. Starter brushes, brush leads and commutator</td>
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<td></td>
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<tr>
<td>23. Alternator and electrical connections</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>24. Alternator brushes, brush leads, commutator or slip ring</td>
<td></td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>25. Voltage regulator mounting and electrical leads</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26. Magnetos (externally) and electrical connections</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27. Magnetos timing</td>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>28. Carburetor and drain plug</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29. Firewall</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30. Engine cowling</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FUEL SYSTEM**

1. Fuel strainer, drain valve and control
2. Fuel strainer screen and bowl
3. Fuel tank vents, caps and placards
4. Fuel tanks, sump drains and fuel line drains
5. Drain fuel and check tank interior, attachment and outlet screens
6. Fuel vent valves
7. Vent line drain
8. Fuel shut-off valve and placards
9. Fuel valve drain plug
10. Engine primer
11. Perform a fuel quantity indicating system operational test. Refer to Section 15 for detailed accomplishment instructions.

**LANDING GEAR**

1. Main gear wheels and fairings
2. Nose gear wheel, torque links, steering tubes, boots and fairing
3. Wheel bearings
4. Nose gear strut and shimmy dampener (service as required)
5. Tires
6. Brake fluid, lines and hoses, linings, discs, brake assemblies and master cylinders
7. Parking brake system
8. Main gear springs
9. Nose steering arm lubrication ............................................................
10. Torque link lubrication ...................................................................
11. Parking brake and toe brakes - operational check ..............................

AIRFRAME
1. Aircraft exterior .............................................................................
2. Aircraft structure ...........................................................................
3. Windows, windshield, doors and seals .............................................
4. Seat belt and shoulder harness ......................................................
5. Seat stops, seat rails, upholstery, structure and mounting ..............
6. Control “Y” bearings, sprockets, pulleys, cables, chains and turnbuckles .................................................................
7. Control lock, control wheel and control “Y” mechanism .................
8. Instruments and markings ..............................................................
9. Gyros central air filter .....................................................................
10. Magnetic compass compensation ...................................................
11. Instrument wiring and plumbing .....................................................
12. Instrument panel, shock mounts, ground straps, cover, decals and labeling .................................................................
13. Defrosting, heating and ventilating systems and controls ............
14. Cabin upholstery, trim, sun visors and ashtrays .............................
15. Area beneath floor, lines, hose, wires and control cables .............
16. Lights, switches, circuit breakers, fuses, and spare fuses ..............
17. Exterior lights ..............................................................................
18. Pitot and static systems ...............................................................
19. Stall warning unit and pitot heater ................................................
20. Radios, radio controls, avionics and flight instruments .................
21. Antennas and cables ....................................................................
22. Battery, battery box and battery cables ........................................
23. Battery electrolyte ........................................................................
24. Emergency locator transmitter .....................................................
25. Inspect all fluid carrying lines and hoses in the cabin and wing areas for leaks, damage, abrasion, and corrosion ..............................
CONTROL SYSTEMS

In addition to the items listed below, always check for correct direction of movement, correct travel and correct cable tension.

1. Cables, terminals, pulleys, pulley brackets, cable guards, turnbuckles and fairleads
2. Chains, terminals, sprockets and chain guards
3. Trim control wheels, indicators, actuator and bungee
4. Travel stops
5. Decals and labeling
6. Flap control switch, flap rollers and tracks, flap indicator
7. Flap motor, transmission, limit switches, structure, linkage, bellcranks, etc.
8. Elevator and trim tab hinges, tips and control rods
9. Elevator trim tab actuator lubrication and tab free-play inspection
10. Rudder pedal assemblies and linkage
11. Skins (external) of control surfaces and tabs
12. Internal structure of control surfaces
13. Balance weight attachment
14. Flap actuator jack screw threads
SPECIAL INSPECTION ITEMS

1. First 25 hours: Use mineral oil confirming with MIL-C-6529 Type II for the first 25 hours of operation or until oil consumption has stabilized, or six months, whichever occurs first. If oil consumption has not stabilized in this time, drain and replenish the oil and replace the oil filter. After the oil consumption has stabilized, change to an ashless dispersant oil, refer to Teledyne Continental Service Information Letter SIL99-2, or latest revision for a current listing of lubricants authorized by TCM. Change oil each 25 hours if engine is NOT equipped with external oil filter; if equipped with an external oil filter, change oil filter element and oil at each 50 hours of operation or every six months, whichever occurs first. Refer to the latest edition of the TCM engine operator/maintenance manual for the latest oil change intervals and inspection procedures.

2. Clean filter per paragraph 2-22. Replace as required.

3. Replace engine compartment hoses per the following schedule:
   A. Cessna Installed Flexible Fluid Carrying Rubber Hoses; replace every 5 years or at engine overhaul, whichever occurs first.
   B. Cessna Installed Flexible Fluid Carrying Teflon Hoses (AE3663819BXXXX series hose), replace every 10 years or at engine overhaul, whichever occurs first.
   C. TCM Installed Engine Compartment Flexible Fluid Carrying Hoses, refer to Teledyne Continental Service Bulletin SB97-6 or latest revision for hose replacement intervals.

4. General inspection every 50 hours. Refer to Section 11 for 100 hour inspection.

5. Each 1000 hours, or at engine overhaul, whichever occurs first.

6. Each 50 hours for general condition and freedom of movement. These controls are not repairable, replace throttle and mixture controls at each engine overhaul.

7. Each 500 hours.

8. Internal Timing:

   For airplanes equipped with Slick 4100 series magnetos:

   These magnetos cannot be overhauled in the field. The coil, capacitor, and breaker assembly are non-replaceable. These magnetos shall be removed from service upon reaching 800 hours total time in service.

   For airplanes equipped with Slick 4300 Series magnetos or TCM/Bendix magnetos:

   Refer to the applicable service manual and service bulletins for internal timing procedures and service intervals.

   Magneto-To-Engine Timing: First 50 hours, first 100 hours and each 200 hours thereafter.

9. First 100 hours and each 500 hours thereafter. More often if operated under prevailing wet or dusty conditions.

10. Replace each 500 hours.

11. Check electrolyte level and clean battery compartment each 50 hours or 30 days, whichever occurs first.

12. Refer to Section 16 of this manual.
13. Replacement or overhaul of the actuator is required each 1000 hours and/or 3 years, whichever comes first. Refer to figure 2-5 for grease specifications.

NOTE: Refer to Section 9 of this service manual and Cessna Single Engine Service Letter SE73-25, or latest revision, for free-play limits, inspection, replacement and/or repair information.

14. Refer to paragraph 2-44 for detailed instructions for various serial ranges.

15. Fuel quantity indicating system operational test is required every 12 months. Refer to Section 15 for detailed accomplishment instructions.

16. Inspect each 50 hours for general condition and security. Replacement is required every 10 years.

17. Every 2 years, or anytime components are added or removed which have the potential to affect the magnetic accuracy and/or variation of the compass calibration, or anytime the accuracy of the compass is in question. If required, refer to AC 43. 13-1B for compass swing procedures.

2-45. COMPONENT TIME LIMITS

1. General
   
   A. Most components listed throughout Section 2 should be inspected as detailed elsewhere in this section and repaired, overhauled or replaced as required. Some components, however, have a time or life limit, and must be overhauled or replaced on or before the specified time limit.

   NOTE: The terms overhaul and replacement as used within this section are defined as follows:

   Overhaul - Item may be overhauled as defined in FAR 43.2 or it can be replaced.

   Replacement - Item must be replaced with a new item or a serviceable item that is within its service life time limit or has been rebuilt as defined in FAR 43.2.

   B. This section provides a list of items which must be overhauled or replaced at specific time limits. Table 1 lists those items which Cessna has mandated must be overhauled or replaced at specific time limits. Table 2 lists component time limits which have been established by a supplier to Cessna for the supplier’s product.

   C. In addition to these time limits, the components listed herein are also inspected at regular time intervals set forth in the Inspection Charts, and may require overhaul/replacement before the time limit is reached based on service usage and inspection results.

2. Cessna-Established Replacement Time Limits

   A. The following component time limits have been established by The Cessna Aircraft Company.

   Table 1: Cessna-Established Replacement Time Limits

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>REPLACEMENT TIME</th>
<th>OVERHAUL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restraint Assembly Pilot, Copilot, and Passenger Seats</td>
<td>10 years</td>
<td>NO</td>
</tr>
<tr>
<td>Trim Tab Actuator</td>
<td>1,000 hours or 3 years, whichever occurs first</td>
<td>YES</td>
</tr>
</tbody>
</table>

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### COMPONENTS AND REPLACEMENT TIMES

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>REPLACEMENT TIME</th>
<th>OVERHAUL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacuum System Filter</td>
<td>500 hours</td>
<td>NO</td>
</tr>
<tr>
<td>Vacuum System Hoses</td>
<td>10 hours</td>
<td>NO</td>
</tr>
<tr>
<td>Pitot and Static System Hoses</td>
<td>10 years</td>
<td>NO</td>
</tr>
<tr>
<td>Vacuum Relief/Regulator Valve Filter (if installed)</td>
<td>500 hours</td>
<td>NO</td>
</tr>
<tr>
<td>Engine Compartment Flexible Fluid Carrying Teflon Hoses (Cessna-Installed) Except Drain Hoses (Drain hoses are replaced on condition)</td>
<td>10 years or engine overhaul, whichever occurs first (Note 1)</td>
<td>NO</td>
</tr>
<tr>
<td>Engine Compartment Flexible Fluid Carrying Rubber Hoses (Cessna-Installed) Except Drain Hoses (Drain hoses are replaced on condition)</td>
<td>5 years or engine overhaul, whichever occurs first (Note 1)</td>
<td>NO</td>
</tr>
<tr>
<td>Engine Air Filter</td>
<td>500 hours or 36 months, whichever occurs first (Note 9)</td>
<td>NO</td>
</tr>
<tr>
<td>Engine Mixture, Throttle, and Propeller Controls</td>
<td>At engine TBO</td>
<td>NO</td>
</tr>
<tr>
<td>Engine Driven Dry Vacuum Pump Drive Coupling (Not lubricated with engine oil)</td>
<td>6 years or at vacuum pump replacement, whichever occurs first</td>
<td>NO</td>
</tr>
<tr>
<td>Engine Driven Dry Vacuum Pump (Not lubricated with engine oil)</td>
<td>500 hours</td>
<td>NO</td>
</tr>
<tr>
<td>Standby Dry Vacuum Pump</td>
<td>500 hours or 10 years, whichever occurs first (Note 10)</td>
<td>NO</td>
</tr>
</tbody>
</table>

### Supplier-Established Replacement Time Limits

A. The following component time limits have been established by specific suppliers and are reproduced as follows:

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>REPLACEMENT TIME</th>
<th>OVERHAUL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELT Battery</td>
<td>Note 3</td>
<td>NO</td>
</tr>
<tr>
<td>Vacuum Manifold</td>
<td>Note 4</td>
<td>NO</td>
</tr>
<tr>
<td>Magnetos</td>
<td>Note 5</td>
<td>YES</td>
</tr>
<tr>
<td>Engine</td>
<td>Note 6</td>
<td>YES</td>
</tr>
</tbody>
</table>

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7 October 2003
COMPONENT REPLACEMENT OVERHAUL

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>REPLACEMENT TIME</th>
<th>OVERHAUL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine Flexible Hoses (TCM Installed)</td>
<td>Note 2</td>
<td>NO</td>
</tr>
<tr>
<td>Auxiliary Electric Fuel Pump</td>
<td>Note 7</td>
<td>YES</td>
</tr>
<tr>
<td>Propeller</td>
<td>Note 8</td>
<td>YES</td>
</tr>
</tbody>
</table>

NOTES:

Note 1: This life limit is not intended to allow flexible fluid-carrying Teflon or rubber hoses in a deteriorated or damaged condition to remain in service. Replace engine compartment flexible Teflon (AE366819BXXX series hose) fluid-carrying hoses (Cessna-installed only) every ten years or at engine overhaul, whichever occurs first. Replace engine compartment flexible rubber fluid-carrying hoses (Cessna-installed only) every five years or at engine overhaul, whichever occurs first (this does not include drain hoses). Hoses which are beyond these limits and are in a serviceable condition, must be placed on order immediately and then be replaced within 120 days after receiving the new hose from Cessna.

Note 2: For TCM engines, refer to Teledyne Continental Service Bulletin SB97-6, or latest revision.

Note 3: Refer to FAR 91.207 for battery replacement time limits.

Note 4: Refer to Airborne Air & Fuel Product Reference Memo No. 39, or latest revision, for replacement time limits.

Note 5: For airplanes equipped with Slick magnetos, refer to Slick Service Bulletin SB2-80C, or latest revision, for time limits.
For airplanes equipped with TCM/Bendix magnetos, refer to Teledyne Continental Motors Service Bulletin No. 643, or latest revision, for time limits.

Note 6: Refer to Teledyne Continental Service Information Letter SIL98-9, or latest revision, for time limits.

Note 7: Refer to Cessna Service Bulletin SEB94-7 Revision 1/Dukes Inc. Service Bulletin NO. 0003, or latest revision.

Note 8: Refer to the applicable McCauley Service Bulletins and Overhaul Manual for replacement and overhaul information.

Note 9: The air filter may be cleaned, refer to Section 2 of this service manual for servicing instructions. For airplanes equipped with an air filter manufactured by Donaldson, refer to Donaldson Aircraft Filters Service Instructions P46-9075 for detailed servicing instructions.
The address for Donaldson Aircraft Filters is:
Customer Service
115 E. Steels Corners RD
Stow OH. 44224

Do not overservice the air filter, overservicing increases the risk of damage to the air filter from excessive handling. A damaged/worn air filter may expose the engine to unfiltered air and result in damage/excessive wear to the engine.

Note 10: Replace engine driven dry vacuum pump not equipped with a wear indicator every 500 hours of operation, or replace according to the vacuum pump manufacturer’s recommended inspection and replacement interval, whichever occurs first.
Replace standby vacuum pump not equipped with a wear indicator every 500 hours of operation or 10 years, whichever occurs first, or replace according to the vacuum pump manufacturer’s recommended inspection and replacement interval, whichever occurs first.
For a vacuum pump equipped with a wear indicator, replace pump according to the vacuum pump manufacturer’s recommended inspection and replacement intervals.
SECTION 3
FUSELAGE

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<th>Section</th>
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3-1. FUSELAGE.

3-2. WINDSHIELD AND WINDOWS.

3-3. DESCRIPTION. The windshield and windows are single-piece acrylic plastic panels set in sealing strips and held by formed retaining strips secured to the fuselage with screws and rivets. Polarite No. 579.6 sealing compound used in conjunction with a felt seal is applied to all edges of windshield and windows with exception of wing root area. The wing root fairing has a heavy felt strip which completes the windshield sealing.

3-4. CLEANING. (Refer to Section 2.)

3-5. WAXING. Waxing will fill in minor scratches in clear plastic and help protect the surface from further abrasion. Use a good grade of commercial wax applied in a thin, even coat. Bring wax to a high polish by rubbing lightly with a clean, dry flannel cloth.

3-6. REPAIRS. Damaged window panels and windshield may be removed and replaced if damage is extensive. However, certain repairs as prescribed in the following paragraphs can be made successfully without removing damaged part from aircraft. Three types of temporary repairs for cracked plastic are possible. No repairs of any kind are recommended on highly-stressed or compound curves where repair would be likely to affect pilot's field of vision. Curved areas are more difficult to repair than flat areas and any repaired area is both structurally and optically inferior to the original surface.

3-7. SCRATCHES. Scratches on clear plastic surfaces can be removed by hand-sanding operations followed by buffing and polishing, if steps below are followed carefully.

a. Wrap a piece of No. 320 (or finer) sandpaper or abrasive cloth around a rubber pad or wood block.

b. Rub surface around scratch with a circular motion, keeping abrasive constantly wet with clean water to prevent scratching surface further. Use minimum
pressure and cover an area large enough to prevent formation of "bull's-eyes" or other optical distortions.

**CAUTION**

Do not use a coarse grade of abrasive. No. 320 is of maximum coarseness.

b. Continue sanding operation, using progressively finer grade abrasives until scratches disappear.

c. When scratches have been removed, wash area thoroughly with clean water to remove all gritty particles. The entire sanded area will be clouded with minute scratches which must be removed to restore transparency.

d. Apply fresh tallow or buffing compound to a motor-driven buffing wheel. Hold wheel against plastic surface, moving it constantly over damaged area until cloudy appearance disappears. A 2000-foot-per-minute surface speed is recommended to prevent overheating and distortion. (Example: 750 rpm polishing machine with a 10 inch buffing bonnet.)

e. When buffing is finished, wash area thoroughly and dry with a soft flannel cloth. Allow surface to cool and inspect area to determine if full transparency has been restored. Apply a thin coat of hard wax and polish surface lightly with a clean flannel cloth.

**NOTE**

Rubbing plastic surface with a dry cloth will build up an electrostatic charge which attracts dirt particles and may eventually cause scratching of surface. After wax has hardened, dissipate this charge by rubbing surface with a slightly damp chamois. This will also remove dust particles which have collected while wax is hardening.

f. Minute hairline scratches can often be removed by rubbing with commercial automobile body cleaner or fine-grade rubbing compound. Apply with a soft, clean, dry cloth or imitation chamois.

3-8. CRACKS. (Refer to figure 3-1.)

a. When a crack appears, drill a hole at end of crack to prevent further spreading. Hole should be approximately 1/8 inch in diameter, depending on length of crack and thickness of material.

b. Temporary repairs to flat surfaces can be accomplished by placing a thin strip of wood over each side of surface and inserting small bolts through wood and plastic. A cushion of sheet rubber or aircraft fabric should be placed between wood and plastic on both sides.

c. A temporary repair can be made on a curved surface by placing fabric patches over affected areas. Secure patches with aircraft dope, Specification No. MIL-D-5549; or lacquer, Specification No. MIL-L-7178. Lacquer thinner, Specification No. MIL-T-6094 can also be used to secure patch.
NOTE

BEGINNING WITH AIRCRAFT SERIALS
15073143, A1500318, F15000819 AND
FA1500162

1. Fuselage Skin 7. Overhead Cabin Window
2. Felt Seal 8. Rear Window
3. Inner Retainer 9. External Centerstrip
4. Windshield 10. Doubler
5. Outer Retainer 11. Cover
6. Cabin Top Skin 12. Sealer

Apply Presstite No. 579.6 sealer to all edges of windshield and windows under outer retainer (5).

Figure 3-2. Windshield and Rear Window

Change 3  3-3
lacing material. This type of repair is used as a temporary measure ONLY, and as soon as facilities are available, panel should be replaced.

3-9. WINDSHIELD. (Refer to figure 3-2.)

3-10. REMOVAL.
   a. Drill out rivets securing front retainer strip.
   b. Remove wing fairings over windshield edges.

   NOTE
   Remove and tape compass clear of work area. Do not disconnect electrical wiring.
   c. Pull windshield straight forward, out of side and top retainers. Remove top retainer if necessary.

3-11. INSTALLATION,
   a. Apply felt strip and sealing compound or sealing tape to all edges of windshield to prevent leaks.
   b. Reverse steps in preceding paragraph for installation.
   c. When installing a new windshield, check fit and carefully file or grind away excess plastic.
   d. Use care not to crack windshield when installing. If not previously removed, top retainer may be removed if necessary. Starting at upper corner and gradually working windshield into position is recommended.

   NOTE
   Screws and self-locking nuts may be used instead of rivets which fasten front retaining strip to cowl deck. If at least No. 6 screws are used, no loss of strength will result.

3-12. WINDOWS.

3-13. MOVABLE. (Refer to figure 3-3.) Movable windows, hinged at the top are installed in the cabin doors.

3-14. REMOVAL AND INSTALLATION.
   a. Disconnect window stop (4).
   b. Remove pins from window hinges (8).
   c. Reverse preceding steps for installation. To remove frame from plastic panel, drill out blind rivets at frame splice. When replacing plastic panel in frame, ensure sealing strip and an adequate coating of Presstite No. 579.6 sealing compound is used around all edges of panel. Refer to Section 19 before painting the inside of the window frame.

3-15. WRAP-AROUND REAR. (Refer to figure 3-2.) The rear window is a one-piece acrylic plastic panel set in sealing strips and held in place by retaining strips.

3-16. REMOVAL AND INSTALLATION.
   a. Remove upholstery as necessary to expose retainer strips inside cabin.
   b. Remove external centerstrip (9).
   c. Drill out rivets to remove outer retainer (5).
   d. Remove window by lifting aft edge and pulling window aft. If difficulty is encountered, rivets securing inner retainers (3) may also be drilled out and retainers loosened or removed as necessary.
   e. Reverse preceding steps for installation. Apply sealing strips and an adequate coating of sealing compound to prevent leaks. When installing a new window, use care not to crack panel and file or grind away excess plastic.

3-17. OVERHEAD. (Refer to figure 3-2.) Overhead cabin windows, located in the cabin top, may be installed. These windows are one-piece acrylic plastic panels set in sealing strips and held in place by retaining strips.

3-18. REMOVAL AND INSTALLATION.
   a. Remove headliner and trim panels.
   b. Drill out rivets as necessary to remove retainer strips.
   c. Reverse preceding steps for installation. Apply sealing strips and an adequate coating of sealing compound to prevent leaks. When installing a new window, use care not to crack panel and file or grind away excess plastic.

3-19. CABIN DOORS. (Refer to figure 3-3.)

3-20. REMOVAL AND INSTALLATION. On models except A150-Series, removal of cabin doors is accomplished by removing the screws which attach the hinges or by removing the hinge pins. If the permanent hinge pins are removed from door hinges, they may be replaced by clevis pins secured with cotter pins or new pins may be installed and "spin-bradded." On A150-Series, the hinge pins are of the jettisonable type, which may be removed by pulling the emergency door release. On all 150-Series aircraft, when fitting a new door, some trimming and reforming of the door skin and door edges may be necessary to achieve a good fit.

3-21. ADJUSTMENT. Cabin doors should be adjusted so skin fairs with fuselage skin. Slots at latch plate permit re-positioning of striker plate. Depth of latch engagement may be changed by adding or removing washers or shims between striker plate and doorpost.

3-22. WEATHERSTRIP. A weatherstrip is cemented around all edges of door. New weatherstrip may be applied after mating surfaces of weatherstrip and door are clean, dry and free from oil or grease. Apply a thin, even coat of adhesive to each surface and allow to dry until tacky before pressing strip in place. Minnesota Mining and Manufacturing Co. No. EC880 cement is recommended.

3-23. WEDGE ADJUSTMENT. Wedges at upper forward edge of door aid in preventing air leaks at this point. They engage as door is closed. Several attaching holes are located in wedges and holes which gives best results should be selected.
NOTE
Condition of cabin door hinges should be inspected at 1500 hours to prevent hinge failure.

Detail A
Cabin door release handle pull should be a maximum of 45 lbs.

Detail B
ROTATED 180°

Detail C

Figure 3-3. Cabin Door and Movable Window

Change 2 3-5
BEGINNING WITH SERIALS 15077001, A1500615 AND SOME LATER MODEL FRENCH AIRCRAFT

NOTE

BEGINNING WITH AIRCRAFT SERIALS 15073049, A1500309, F15000819 AND FA1500182

NOTE

Inside handle lock is used on right door only.

NOTE

New inside handle lock with dual detent at 15074080, A1500336, F15000904 AND FA1500192.

1. Inside Handle
2. Draw Bar
3. Mounting Plate
4. Spacer
5. Rotary Clutch
6. Nutplate
7. Roll Pin
8. Bolt
9. Pivot Pin
10. Housing
11. Outside Handle
12. Escutcheon
13. Spring Washer
14. Inside Lock

Figure 3-4. Cabin Door Latch
3-24. CABIN DOOR LATCHES. (Refer to figure 3-4.)

3-25. DESCRIPTION. The cabin door latch utilizes a rotary clutch for positive bolt engagement. As door is closed, teeth on underside of bolt engage gear teeth on clutch. The clutch gear rotates in one direction only and holds door closed. Flush-mounted outside and inside door handles are used to actuate door latches.

3-26. ADJUSTMENT. Adjustment of latch or clutch cover is afforded by oversize and/or slotted holes. This adjustment ensures sufficient gear-to-bolt engagement and proper alignment.

NOTE

Lubricate door latch per Section 2. No lubrication is recommended for rotary clutch.

3-27. LOCK. In addition to an interior lock, a cylinder and key type lock is installed on left door. If lock is to be replaced, the new one may be modified to accept original key. This is desirable, as the same key is used for ignition switch and cabin door lock. After removing old lock from door, proceed as follows:

a. Remove lock cylinder from new housing.

b. Insert original key into new cylinder and file off any protruding tumblers flush with cylinder. Without removing key, check that cylinder rotates freely in housing.

c. Install lock assembly in door and check lock operation with door open.

d. Destroy new key and disregard code number on cylinder.

3-28. SEATS. (Refer to figure 3-5 and 3-6.)

3-29. PILOT AND COPILOT.

A. ADJUSTABLE BACK/STATIONARY BOTTOM.

B. RECLINING BACK/FORE-AND-AFT ADJUSTABLE BOTTOM.

C. RECLINING BACK/FORE AND AFT AND VERTICALLY ADJUSTABLE BOTTOM.

3-30. DESCRIPTION. The standard pilot and copilot seat is comprised of an adjustable double-width seat back and two stationary single-width seat bottoms thru 1972 models. Beginning with 1973 models the standard and optional seats are individual seats for the pilot and copilot positions. The seats adjust fore and aft on seat rails and the backs are two position adjustable. Beginning with 1976 Models, optional pilot and copilot seats feature a fore and aft adjustment plus a 3 position vertical adjustment.

NOTE

The vertically adjustable seat is spring loaded to the high position and is adjusted upward with no weight on the seat.

Stops are provided to limit the travel on fore and aft adjustable seats.

3-31. REMOVAL AND INSTALLATION. (Standard seat thru 1972 models).

a. Unlatch top of seat back, release spring-loaded pins at bottom of seat back and remove from aircraft.

b. Pivot seat bottoms forward and lift up to free pins from cabin floor.

(Standard and optional seats beginning with 1973).

c. Remove seat stops from rails.

d. Slide seat fore-and-aft to disengage seat rollers from rails and lift seat out.

e. Reverse preceding steps for installation. Ensure all seat stops are reinstalled.

WARNING

It is extremely important that seat stops are installed, since acceleration and deceleration could possibly permit seat to become disengaged from seat rails and create a hazardous situation, especially during take-off and landing.

3-32. AUXILIARY.

3-33. DESCRIPTION. The double-width auxiliary seat is permanently bolted to the cabin structure and offers no adjustment provisions. The seat structure is mounted on hinge brackets with pivot bolts, thus allowing seat to be pivoted upward for more baggage area.

3-34. REMOVAL AND INSTALLATION.

a. Remove bolts securing seat structure to hinge brackets.

b. Unsnap seat back from aft cabin wall.

c. Lift seat out.

d. Reverse preceding steps for installation.

3-35. REPAIR. Replacement of defective parts is recommended in repair of seats. However, a cracked framework may be welded, provided crack is not in an area of stress concentration (close to a hinge or bearing point). The square-tube framework is 6061 aluminum, heat-treated to a T-6 condition. Use a heliarc weld on these seats, as torch welds will destroy heat-treatment of frame structure.

3-36. CABIN UPHOLSTERY. Due to the wide selection of fabrics, styles and colors, it is impossible to depict each particular type of upholstery. The following paragraphs describe general procedures which will serve as a guide in removal and replacement of upholstery. Major work, if possible, should be done by an experienced mechanic. If work must be done by a mechanic unfamiliar with upholstery practices, the mechanic should make careful notes during removal of each item to facilitate its replacement later.

3-37. MATERIALS AND TOOLS. Materials and tools will vary with job. Scissors for trimming upholstery to size and a dull-bladed putty knife for wedging material beneath retainer strips are the only tools required for most trim work. Use industrial rubber cement to hold soundproofing mats and fabric edges in place. Refer to Section 18 for thermo-plastic repairs.

Change 3 3-7

AIRCRAFT SERIALS 15071510 THRU 15072628, A1500102 THRU A1500276, F15000680 THRU F15000738 AND FA1500001 THRU FA1500121

1. Seat Bottom
2. Seat Back
3. Frame
4. Latch Arm
5. Release Handle
6. Release Pin
7. Bracket
8. Brace
9. Roller
10. Bushing
11. Recline Knob
12. Fore/Aft Adjustment Handle
13. Spring
14. Adjustment Pin
15. Plate
16. Doubler
17. Vertical Adjustment Handle
18. Return Spring

Figure 3-5. Forward Seats (Sheet 1 of 3)
RECLINING BACK/
FORE-AND-AFT
ADJUSTABLE
BOTTOM (OPTIONAL
ON 150 AND F150
15072629 THRU 15073658
AND F15000739 THRU
F15000863) (STANDARD
ON 150, F150, A150 AND
FA150 BEGINNING WITH
15073659, F15000864,
A1500277 AND FA1500122

Figure 3-5. Forward Seats (Sheet 2 of 3)
3-38. SOUNDPROOFING. The aircraft is insulated with spun glass mat-type insulation and a sound deadener compound applied to inner surfaces of skin in most areas of cabin and baggage compartment. All soundproofing material should be replaced in its original position if it is removed. A soundproofing panel is placed in gap between wing and fuselage and held in place by wing root fairings.
1. Bottom Frame
2. Seat Bottom
3. Safety Belt
4. Seat Back
5. Seat Back Support
6. Belt Anchor
7. Frame Bracket
8. Spacer

Figure 3-6. Auxiliary Seat

3-39. CABIN HEADLINER. (Refer to figure 3-7)

3-40. REMOVAL AND INSTALLATION.
   a. Detail A.
      1. Remove sun visors, all inside finish strips and plates, doorpost upper shields, front spar trim shield, dome light console and any other visible retainers securing headliner.
      2. Work edges of headliner free from metal teeth which hold fabric.
      3. Starting at front of headliner, work headliner down, removing screws through metal tabs which hold wire bows to cabin top. Pry loose outer ends of bows from retainers above doors. Detach each wire bow in succession.

NOTE

Always work from front to rear when removing headliner.

4. Remove headliner assembly and bows from aircraft.

NOTE

Due to difference in length and contour of wire bows, each bow should be tagged to assure proper location in headliner.

5. Remove spun glass soundproofing panels.

Change 3 3-11
NOTE
The lightweight soundproofing panels are held in place with industrial rubber cement.

6. Reverse preceding steps for installation. Before installation, check all items concealed by headliner for security. Use wide cloth tape to secure loose wires to fuselage and to seal openings in wing roots. Straighten tabs bent during removal of headliner.

7. Apply cement to inside of skin in areas where soundproofing panels are not supported by wire bows and press soundproofing in place.

8. Insert wire bows into headliner seams and secure two bows at rear of headliner. Stretch material along edges to properly center, but do not stretch it tight enough to destroy ceiling contours or distort wire bows. Secure edges of headliner with metal teeth.

9. Work headliner forward, installing each wire bow in place with metal tabs. Wedge ends of wire bows into the retainer strips. Stretch headliner just taut enough to avoid wrinkles and maintain a smooth contour.

10. When all bows are in place and fabric edges are secured, trim off excess fabric and reinstall all items removed.

   b. Detail B.

   1. Remove sun visors, all inside finish strips and plates, overhead console, upper doorpost shields and any other visible retainers securing headliner.

   2. Remove molding from fixed windows.

   3. Remove screws securing headliner and carefully take down headliner.

   4. Remove spun glass soundproofing panels above headliner.

NOTE
The lightweight soundproofing panels are held in place with industrial rubber cement.

5. Reverse preceding steps for installation. Before installation, check all items concealed by headliner for security. Use wide cloth tape to secure loose wires to fuselage and to seal openings in wing roots.
When installing front seat safety belts be sure the belt half with the buckle is installed on the outboard side of the seat.
1. Cover
2. Mirror
3. Grommet
4. Nut
5. Washer
6. Deck Skin
7. Glare Shield

THRU 15073658, A1500342, F15000864 AND FA1500166

BEGINNING WITH 15073659, A1500343, F15000864 AND FA1500167

Figure 3-9. Rear View Mirror Installation

3-41. UPHOLSTERY SIDE PANELS. Removal of upholstery side panels is accomplished by removing seats for access, then removing parts attaching panels. Remove screws, retaining strips, arm rests and ash trays as required to free the various panels. Automotive type spring clips attach most door panels. A dull putty knife makes an excellent tool for prying the clips loose. When installing upholstery side panels, do not over-tighten sheet metal screws. Larger screws may be used in enlarged holes as long as the area behind the hole is checked for electrical wiring, fuel lines and other components which might be damaged by using a longer screw.

3-42. CARPETING. Cabin area and baggage compartment carpeting is held in place by rubber cement, sheet metal screws or retaining strips. When fitting a new carpet, use old one as a pattern for trimming and marking screw holes.

3-43. BAGGAGE COMPARTMENT UPHOLSTERY. A washable plastic held in place by screws and retainers is used in the baggage compartment. Cargo tie-down and/or seat belt brackets must be removed as necessary to facilitate upholstery removal.

3-44. SAFETY PROVISIONS.

3-45. CARGO TIE-DOWNS. Cargo tie-downs are used to ensure baggage cannot enter seating area during flight. A baggage net can be secured to aft cabin wall and cabin floor for baggage security.

3-46. SAFETY BELTS. Safety belts, bolted to the cabin structure are provided for each seat. Belts should be replaced if frayed or cut, latches are defective or stitching is broken. Attaching parts should be replaced if excessively worn or defective. Refer to figure 3-8.

3-47. SHOULDER HARNESS. Shoulder harnesses may be installed in the aircraft. The latches require no lubrication. Component parts should be replaced as outlined in preceding paragraph. Refer to figure 3-8.

3-48. INERTIA REEL SHOULDER HARNESS. Beginning with 15075782 and F15001134 Inertia reel shoulder harnesses may be installed. The inertia reel allows free movement for the seat occupant but will lock when subjected to a sudden load. Proper operation of the reel can be checked by applying a quick jerk to the belt, inertia reel should lock and hold. Figure 3-8 sheet 2 may be used as a guide for removal and installation.

3-49. REAR VIEW MIRROR. A rear view mirror may be installed on the cowl deck above the instrument panel. Figure 3-9 illustrates details and may be used as a guide for removal and installation.

SHOP NOTES:

Change 3  3-15/(3-16 blank)
4-1. WINGS AND EMPENNAGE.

4-2. WINGS. (Refer to figure 4-1.)

4-3. DESCRIPTION. Each all-metal wing is a semi-cantilever, semimonocoque type, with two main spars and suitable ribs for the attachment of the skin. Skin panels are riveted to ribs, spars and stringers to complete the structure. An all-metal, piano-hinged aileron, flap and a detachable wing tip are mounted on each wing assembly. A single metal fuel tank is mounted between the wing spars at the inboard end of each wing. The leading edge of the left wing may be equipped with landing and taxi lights (thru 1970 Models). Colored navigation lights are mounted at each wing tip.

4-4. REMOVAL. Wing removal is most easily accomplished if four men are available to handle the wing. Otherwise, the wing should be supported with a sling or maintenance stand when the fastenings are loosened.

f. Support wing at outboard end and disconnect strut at wing fitting. Tie the strut up with wire to prevent it from swinging down and straining strut-to-fuselage fitting. Loosen lower strut fairing and slide it up the strut, the strut may then be lowered without damage.

NOTE
It is recommended that flap be secured in streamlined position with tape during wing removal to prevent damage, since flap will swing freely.

g. Mark position of wing attachment eccentric bushings (refer to figure 4-1); these bushings are used to rig out "wing heaviness".

h. Remove nuts, washers, bushings and bolts attaching wing spars to fuselage.

NOTE
It may be necessary to rock the wing slightly while pulling attaching bolts, or to use a long drift punch to drive out attaching bolts.

i. Remove wing and lay on padded stand.

4-5. REPAIR. A damaged wing panel may be repaired in accordance with instructions outlined in Section 18. Extensive repairs of wing skin or structure are best accomplished using the wing repair jig, which may be obtained from Cessna. The wing jig serves not only as a holding fixture, making work on the wing easier, but also assures absolute alignment of the repaired wing.

4-6. INSTALLATION.

a. Hold wing in position and install bolts, bushings, washers and nuts attaching wing spars to fuselage...
Five washers (21) are installed under the nut on the front spar-to-fuselage fitting.

Beginning with the 1971 Models, the landing and taxi lights are located in the nose cowl.

Figure 4-1. Wing Installation
fittings. Be sure eccentric bushings are positioned as marked.

b. Install bolts, spacers, and nuts to secure upper and lower ends of wing strut to wing and fuselage fittings.

c. Route flap and aileron cables, using guide wires. (See note in paragraph 4-4.)

d. Connect:
   1. Electrical wires at wing root disconnects.
   2. Fuel lines at wing root. (Refer to precautions outlined in paragraph 12-3.)
   3. Pitot line (if left wing is being installed).
   4. Wing leveler vacuum tube, if installed, at wing root.

e. Rig aileron system. (Section 6.)

f. Rig flap system. (Section 7.)

g. Refuel wing tank and check for leaks. (Refer to precautions outlined in paragraph 12-3.)

h. Check operation of wing tip and landing and taxi lights. (thru 1970 Models).

i. Install wing root fairings.

NOTE

Beginning with 1972 Models, a extruded fillet sealant (576.1 Permagum: Pressite Engineering Company) of equivalent is applied between cabin top skin and wing skin, also across top of lower strut fitting at skin cutout. Gap between windshield and wing leading edge is sealed with (Polyken 230 or Polyken 231; Kendall-Polyken Division, Tuck 92T, Technical Tape Corporation) or equivalent.

k. Install all wing inspection plates, interior panels and upholstery.

4-7. ADJUSTMENT (CORRECTING "WING-HEAVY" CONDITION. (See figure 4-1.) If considerable control wheel pressure is required to keep the wings level in normal flight, a wing-heavy condition exists.

a. Remove wing fairing strip on the "lighter" side of the airplane.

b. Loosen nut (10) and rotate bushings (8) simultaneously until the bushings are positioned with the thick side of the eccentric down. This will raise the trailing edge of the wing, thus increasing wing-heavity to balance heavity in the opposite wing.

c. Tighten nut and reinstall fairing strip.

d. Test-fly the aircraft. If the wing-heavy condition still exists, remove fairing strip on the "lighter" wing, loosen nut and rotate bushings simultaneously until the bushings are positioned with the thick side of the eccentric down. This will raise the trailing edge of the wing, thus increasing wing-heavity to balance heavity in the opposite wing.

e. Tighten nut, install fairing strip, and repeat test flight.

4-8. WING STRUTS. (See figure 4-2.)

4-9. DESCRIPTION. Each wing has a single lift strut which transmits a part of the wing load to the lower portion of the fuselage. The strut consists of a streamlined tube riveted to two end fittings for attachment at the fuselage and wing.

4-10. REMOVAL AND INSTALLATION.

a. Remove screws from strut fairings and slide fairings along strut.

b. Remove fuselage and wing inspection plates at strut junction points.

c. Support wing securely, then remove nut and bolt securing strut to fuselage.

d. Remove nut, bolt, and spacer used to attach strut to wing, then remove strut from aircraft.

e. Reverse preceding steps to install strut.

4-11. REPAIR. Wing strut repair is limited to replacement of tie-downs and attaching parts. A badly dented, cracked, or deformed wing strut should be replaced.

4-12. FIN. (See figure 4-3.)

4-13. DESCRIPTION. The fin is primarily of metal construction, consisting of ribs and spars covered with skin. Fin tips are of ABS or glass fiber construction. Hinge brackets at the fin rear spar attach the rudder.

4-14. REMOVAL AND INSTALLATION. A fin may be removed without first removing the rudder. However, for access and ease of handling, the rudder may be removed by following procedures outlined in Section 10.

a. Remove fairings on either side of fin.

b. Disconnect flashing beacon lead, tail navigation light lead, antennas and antenna leads, and rudder cables, if rudder has not been removed.

c. Remove bolts attaching rear fin brackets to horizontal stabilizer.

d. Remove bolts attaching front fin brackets to fuselage; remove fin.

e. Install fin by reversing preceding steps. Be sure to check and reset rudder and elevator travel if any stop bolts were removed or settings disturbed.

4-15. REPAIR. Fin repair should be accomplished in accordance with applicable instructions outlined in Section 18.

4-16. HORIZONTAL STABILIZER. (See figure 4-4.)

4-17. DESCRIPTION. The horizontal stabilizer is primarily of all-metal construction, consisting of ribs and spars covered with skin. Stabilizer tips
4-18. REMOVAL AND INSTALLATION.
   a. Remove elevators and rudder in accordance with procedures outlined in Sections 8 and 10.
   b. Remove vertical fin in accordance with procedures outlined in paragraph 4-14.
   c. Disconnect elevator trim control cables at clevis and turnbuckle inside tailcone, remove pulleys which route the aft cables into horizontal stabilizer, and pull cables out of tailcone.
   d. Remove bolts securing horizontal stabilizer to fuselage.
   e. Remove horizontal stabilizer.
   f. Install horizontal stabilizer by reversing preceding steps. Rig control systems as necessary. Check operation of tail navigation light and flashing beacon.

4-19. REPAIR. Horizontal stabilizer repair should be accomplished in accordance with applicable instructions outlined in Section 18.
NOTE
Fairing (1) and Dorsal (2) are riveted to fuselage.

THRU 1970 MODELS

BEGINNING WITH 1971 MODELS

1. Fairing
2. Dorsal
3. R. H. Tail Fairing
4. L. H. Tail Fairing
5. Fin
6. Flashing Beacon
7. Tip
8. Upper Rudder Hinge
9. Center Rudder Hinge
10. Lower Rudder Hinge
11. Horizontal Stabilizer
12. Bolt
13. Nutplate
14. Nut
15. Fuselage
16. Washer

THRU AIRCRAFT SERIALS
15075504, F15001133, A1500478 AND FA1500261.

Figure 4-3. Vertical Fin (Sheet 1 of 2)
Figure 4-3. Vertical Fin (Sheet 2 of 2)

BEGINNING WITH AIRCRAFT SERIALS 15075505, F15001134, A1500479 AND FA1500262.

★ THRU 15075579, A1500481, F15001203 AND FA1500291.

● BEGINNING WITH 15075580, A1500481, F15001204 AND FA1500292.
Figure 4-4. Horizontal Stabilizer

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Stabilizer Tip</td>
</tr>
<tr>
<td>2.</td>
<td>Stabilizer</td>
</tr>
<tr>
<td>3.</td>
<td>Stop Bolt</td>
</tr>
<tr>
<td>4.</td>
<td>Fitting</td>
</tr>
<tr>
<td>5.</td>
<td>Nut</td>
</tr>
<tr>
<td>6.</td>
<td>Washer</td>
</tr>
<tr>
<td>7.</td>
<td>Fuselage</td>
</tr>
<tr>
<td>8.</td>
<td>Screw</td>
</tr>
<tr>
<td>9.</td>
<td>Bolt</td>
</tr>
<tr>
<td>10.</td>
<td>Upper Right Fairing</td>
</tr>
<tr>
<td>11.</td>
<td>Upper Left Fairing</td>
</tr>
<tr>
<td>12.</td>
<td>Elevator Outboard Hinge</td>
</tr>
<tr>
<td>13.</td>
<td>Bushing</td>
</tr>
</tbody>
</table>
5-1. LANDING GEAR.

5-2. DESCRIPTION. Flat spring-steel main landing gear struts are installed on 1969 thru 1970 model aircraft. This installation is illustrated in figure 5-1, sheet 1. Beginning with 1971 models, tubular spring-steel main gear struts are installed, and are illustrated on sheet 2 of figure 5-1. All models are equipped with air/oil (oleo) strut and fork, incorporating a shimmy damper. The nose wheel is steerable with the rudder pedals up to a maximum pedal deflection, after which it becomes free-swiveling up to a maximum travel of 30 degrees each side of center. Through use of the brakes, the aircraft can be pivoted about the outer wing strut fitting. Nose and main wheel speed fairings are available for installation.
## 5-3. TROUBLE SHOOTING.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIRCRAFT LEANS TO ONE SIDE.</td>
<td>Incorrect tire inflation.</td>
<td>Inflate to pressure specified in figure 1-1.</td>
</tr>
<tr>
<td></td>
<td>Landing gear attaching parts not tight.</td>
<td>Tighten loose parts; replace defective parts with new parts.</td>
</tr>
<tr>
<td></td>
<td>Landing gear spring excessively sprung.</td>
<td>Remove and install new part(s).</td>
</tr>
<tr>
<td></td>
<td>Incorrect shimming at inboard end of spring strut.</td>
<td>Install shims as required. Refer to paragraph 5-6 for limitations.</td>
</tr>
<tr>
<td></td>
<td>Bent axles.</td>
<td>Install new part(s).</td>
</tr>
<tr>
<td>TIIRES WEAR EXCESSIVELY.</td>
<td>Incorrect tire inflation.</td>
<td>Inflate to pressure specified in figure 1-1.</td>
</tr>
<tr>
<td></td>
<td>Main wheels out of alignment. (Flat Gear.)</td>
<td>Align in accordance with paragraph 5-23.</td>
</tr>
<tr>
<td></td>
<td>Main wheels out of alignment. (Tubular Gear)</td>
<td>Remove and install new part(s).</td>
</tr>
<tr>
<td></td>
<td>Landing gear spring excessively sprung.</td>
<td>Remove and install new part(s).</td>
</tr>
<tr>
<td></td>
<td>Incorrect shimming at inboard end of spring strut.</td>
<td>Install shims as required. Refer to paragraph 5-6 for limitations.</td>
</tr>
<tr>
<td></td>
<td>Bent axles.</td>
<td>Install new part(s).</td>
</tr>
<tr>
<td></td>
<td>Dragging brakes.</td>
<td>Refer to paragraph 5-46.</td>
</tr>
<tr>
<td></td>
<td>Wheel bearings too tight.</td>
<td>Adjust properly.</td>
</tr>
<tr>
<td></td>
<td>Wheels out of balance.</td>
<td>Correct in accordance with paragraph 5-24.</td>
</tr>
<tr>
<td></td>
<td>Loose torque links.</td>
<td>Add shims or install new parts as required.</td>
</tr>
<tr>
<td>WHEEL BOUNCE EVIDENT ON SMOOTH SURFACE.</td>
<td>Out of balance condition.</td>
<td>Refer to paragraph 5-24.</td>
</tr>
</tbody>
</table>
5-4. MAIN LANDING GEAR. Figure 5-1 illustrates the main landing gear, both flat spring and tubular. The illustrations should be used in conjunction with the following procedures during removal and installation of component parts. Disassembly, inspection and repair, and reassembly of the various main wheel configurations are described in separate paragraphs for each configuration. The solid wheels having two wheel halves are manufactured by Cleveland Aircraft Products Co. and webbed wheels having two flanges and a hub are manufactured by McCauley Industrial Corporation. The Cleveland wheels are shown in figure 5-3. The McCauley wheels have either aluminum flanges or steel flanges as shown in figure 5-3A. The aluminum flanges are attached to the wheel hub by thru-bolts and nuts as shown in figure 5-3A and the steel flanges are attached to the wheel hub by cap-screws as shown in figure 5-3A. During assembly of the main wheels the thru-bolt nuts or cap-screws, as applicable, shall be tightened evenly and torqued to the value specified in figure 5-2A.

5-5. REMOVAL (FLAT.) (See sheet 1 of figure 5-1.) The following procedural steps remove the landing gear as a complete assembly. Refer to applicable paragraphs for removal of the individual components. 
   a. Remove floorboard access covers over spring-strut being removed.
   b. Hoist or jack aircraft in accordance with Section 2.
   c. Remove screws and allow external fairing plate and seal to slide down spring-strut.
   d. Drain hydraulic brake fluid from brake line on strut being removed.
   e. Disconnect hydraulic brake line at fitting where brake line comes through fuselage skin. Cap or plug disconnected fittings.
   f. Remove bolt attaching wedge at outboard landing gear fitting and pry wedge and shims out of fuselage. Retain shims and wedge.
   g. Remove bolt attaching inboard end of the strut to the inboard fitting and pull entire gear assembly out of fuselage. Note shim(s) placed under inboard end of strut and mark them to be sure they are installed correctly at installation of strut.

5-6. INSTALLATION (FLAT.) (See sheet 1 of figure 5-1.) The following procedural steps install the landing gear as a complete assembly. Refer to applicable paragraphs for installation of the individual components.
   a. Slide external fairing plate and seal over upper end of landing gear spring-strut.

NOTE

Shims are installed under inboard end of the spring-strut as required to level the wings within a total tolerance of three inches. Maximum number of shims permissible is three.

b. Slide spring strut into place and work shims in position under inboard end of strut. Install bolt to secure inboard end of strut.

SHOP NOTES:
Shims (P/N 0741022-1) are used between outboard forging (21) and wedge (20) when installing the landing gear spring strut.
Apply Y-8560 (3M Corporation) polyurethane tape (1" wide) to upper and lower surface of spring and above and below step bracket to prevent chafing of spring fairing.

TUBULAR GEAR
BEGINNING WITH
1971 MODELS

* Torque elbow to a maximum of 60 lb in.
Lube/seal with Liquid-O-Ring #404:
(Oil Center Research, P. O. Box 51971,
Lafayette, Louisiana 70500).

BEGINNING WITH THE
FOLLOWING SERIALS:
15072400
A150000280
F15000082

* Washers installed
beginning with
15072004
A1500227
F15000082

BEGINNING WITH 15072400,
A150000280, A1500227 &
FA15000082, jack pad is
provided in bottom of
step bracket (9).

1. Bolt
2. Inboard Forging
3. Outboard Forging
4. Bushing
5. Bushing Retainer
6. Brake line
7. Spring-Strut
8. Step
9. Step Bracket
10. Axle
11. Brake Torque Plate
12. Wheel Assembly
13. Hub Cap
14. Brake Assembly
15. Fuselage Fairing
16. Spring-Strut Fairing
17. Fairing Cap
18. Clamp
19. Brake Fairing

Figure 5-1. Main Landing Gear (Sheet 2 of 2)
c. Position wedge and shims at outboard landing gear fitting and tap securely in place and install wedge attaching bolt. Avoid excessive pounding of wedges to prevent deforming supporting structure.

d. Install seal and external fairing plate with attaching screws.

e. Connect hydraulic brake line, and fill and bleed brakes as outlined in paragraph 5-58.

f. Install floorboard access covers.

g. Lower aircraft.

5-7. REMOVAL. (TUBULAR.) (See sheet 2 of figure 5-1.) The following procedural steps remove the landing gear as a complete assembly. Refer to applicable paragraphs for removal of the individual components.

a. Remove floorboard access covers over spring-strut being removed.

b. Hoist or jack aircraft in accordance with Section 2.

c. Remove screws attaching fairing and allow fairing to slide down spring-strut.

d. Drain hydraulic brake fluid from brake line on strut being removed.

e. Disconnect hydraulic brake line at fitting where brake line comes through fuselage skin. Cap or plug disconnected fittings.

f. Remove nut, washer, and bolt attaching inboard end of spring-strut to the inboard landing gear bulkhead fitting.

g. Pull spring-strut from fitting and bushing. Use care when removing spring-strut to prevent damage to the hydraulic brake line. The spring-strut is a compression fit in the bushing in the outboard landing gear bulkhead.

h. Form a small fillet of the adhesive at all edges of the bonded surfaces. Remove excess adhesive with lacquer thinner.

i. Allow the adhesive to cure thoroughly according to the manufacturer's recommendations before flexing the gear spring strut or applying loads to the step.

j. Paint gear spring strut and step bracket after the curing is completed.

5-8. INSTALLATION (TUBULAR.) (See sheet 2 of figure 5-1.) The following steps install the landing gear as a complete assembly. Refer to applicable paragraphs for installation of the individual components.

a. Re-install all parts removed from strut.

b. Apply Dow Corning Compound DC7 to approximately 11 inches on upper end of spring-strut.

c. Slide spring-strut into place through bushing in outboard spring-strut fitting and into spring-strut inboard fitting.

d. Align spring-strut in inboard fitting and install bolt through fitting and spring-strut. Install washer and nut on bolt and tighten to torque value listed in Section 1.

e. Connect hydraulic brake line to fitting. Fill and bleed brake system in accordance with paragraph 5-58.

f. Install fairing.

g. Lower aircraft and install floorboard access covers.

5-9. STEP BRACKET INSTALLATION.

NOTE

The step bracket is secured to the landing gear spring strut with EA9309, or a similar epoxy base adhesive.

a. Mark position of the bracket so that the new step bracket will be installed in approximately the same position on the strut.

b. Remove all traces of the original bracket and adhesive as well as any rust, paint, or scale with a wire brush and coarse sandpaper.

c. Leave surfaces slightly roughened or abraded, but deep scratches or nicks should be avoided.

d. Clean surfaces to be bonded together thoroughly. If a solvent is used, remove all traces of the solvent with a clean, dry cloth. It is important that the bonding surfaces be clean and dry.

e. Check fit of the step bracket on the spring strut. A small gap is permissible between bracket and spring strut.

f. Mix adhesive (EA9309) in accordance with manufacturer's directions.

g. Spread a coat of adhesive on bonding surfaces, and place step bracket in position on the spring strut. On the flat spring strut, tap the bracket upward on the strut to insure a good tight fit of the bracket on spring strut. On the tubular strut, clamp bracket to strut to insure a good tight fit.

h. Form a small fillet of the adhesive at all edges of the bonded surfaces. Remove excess adhesive with lacquer thinner.

i. Allow the adhesive to cure thoroughly according to the manufacturer's recommendations before flexing the gear spring strut or applying loads to the step.

j. Paint gear spring strut and step bracket after the curing is completed.

5-10. MAIN WHEEL SPEED FAIRING REMOVAL AND INSTALLATION. (Refer to figure 5-2.)

a. Remove screws attaching stiffener and inboard side of wheel speed fairing to attach plate, which is bolted to the axle.

b. Remove bolt securing outboard side of fairing to axle nut.

c. Loosen scraper, if necessary, and work speed fairing from the wheel.

d. Reverse preceding steps to install wheel speed fairings.

e. After installation, check scraper-to-tire clearance for a minimum of 0.25-inch to a maximum of 0.38-inch. Elongated holes are provided in the scraper for clearance adjustments.

NOTE

Refer to Cessna Service Kit SK182-12 for repair of wheel speed fairings used on 1969 and 1970 Model aircraft.

CAUTION

Always check scraper-to-tire clearance after installing speed fairing, whenever a tire has been changed, and whenever scraper adjustment has been disturbed. If the aircraft is flown from surfaces with mud, snow, or ice, the speed fairing should be checked to make sure there is no accumulation which could prevent normal wheel rotation. Wipe fuel and oil from the speed fairings to prevent stains and deterioration.
1. Fairing Plate
2. Speed Fairing
3. Wheel Scraper
4. Fairing Support Nut
5. Hub Cap
6. Stiffener
7. Fairing Doubler
8. Axle
9. Brake Torque Plate

Figure 5-2. Main Wheel Speed Fairing (Sheet 1 of 2)
5-10A. REMOVAL AND INSTALLATION OF MAIN LANDING GEAR FAIRINGS.

a. To remove cap fairings, proceed as follows:
   1. Remove screws attaching fairing to spring strut fairing.
   2. Remove bolt and nut attaching clamp to spring-strut.
   3. Slide clamp down tubular strut; remove cap fairing.

b. To remove fuselage fairing, proceed as follows:
   1. Remove screws attaching fairing to fuselage.
   2. Slide fairing down spring-strut fairing.
   3. Reverse preceding steps for installation.

c. To remove spring-strut fairing, proceed as follows:
   1. Remove cap fairing as outlined in step "a".
   2. Remove fuselage fairing as outlined in step "b".
   3. Remove screws from nutplates along strut.
   4. Spring fairing over tubular strut.
   5. Reverse preceding steps for installation.

NOTE
Clamp may be sprung open over tubular strut for removal.

4. Reverse preceding steps to install cap fairing.

SHOP NOTES:
5-11. MAIN WHEEL REMOVAL (See figure 5-1.)

NOTE

It is not necessary to remove the main wheel to reline brakes or remove brake parts, other than the brake disc on torque plate.

a. Hoist or jack aircraft as outlined in Section 2.
b. Remove speed fairing, if installed, in accordance with paragraph 5-10.
c. Remove hub caps, cotter pin and axle nut.
d. Remove bolts and washers attaching brake back plate to brake cylinder and remove back plate.
e. Pull wheel from axle.

5-12. MAIN WHEEL DISASSEMBLY (Cleveland Wheel).

a. Remove valve core and deflate tire. Break tire beads loose from wheel rim.

WARNING

Injury can result from attempting to separate wheel halves with the tire inflated. Avoid damaging wheel flanges when breaking tire beads loose. A scratch, gouge, or nick may cause wheel failure.

b. Remove thru-bolts and separate wheel halves, removing tire, tube, and brake disc.
c. Remove the grease seal rings, felts, and bearing cones from the wheel halves.

NOTE

The bearing cups (races) are a press fit in the wheel halves and should not be removed unless a new part is to be installed. To remove bearing cups, heat wheel half in boiling water for 30 minutes, or in an oven not to exceed 149°C (300°F). Using an arbor press, if available, press out the bearing cup and press in the new bearing cup while the wheel half is still hot.

d. Clean and pack bearing cones with clean aircraft wheel bearing grease (Section 2).
e. Assemble bearing cones, grease seal felts, and rings into wheel halves.
f. Inflate tire to seat tire beads, then adjust to correct tire pressure. Refer to Section 1.

5-13. MAIN WHEEL INSPECTION AND REPAIR (Cleveland Wheel).

a. Clean all metal parts and grease seal felts in solvent and dry thoroughly.
b. Inspect wheel halves for cracks. Cracked wheel halves shall be discarded and new parts used. Sand out nicks, gouges, and corroded areas. When the protective coating has been removed, the area should be cleaned thoroughly, primed with zinc chromate and painted with aluminum lacquer.
c. If excessively warped or scored, or worn to a thickness of 0.190-inch, brake disc should be replaced with a new part. Sand smooth small nicks and scratches.
d. Carefully inspect bearing cones and cups for damage and discoloration. After cleaning, pack bearing cones with clean aircraft wheel bearing grease (Section 2) before installing in wheel half.

5-14. MAIN WHEEL REASSEMBLY. (Cleveland Wheel).

a. Insert thru-bolts through brake disc and position disc in the inner wheel half, using the thru-bolts to guide the disc. Ascertian that the disc is bottomed in the wheel half.
b. Position tire and tube on outboard wheel half with the tube inflation valve through hole in wheel half.
c. Place the inner wheel half in position on outboard wheel half. Apply a light force to bring wheel halves together. While maintaining the light force assemble a washer and nut on one thru-bolt and tighten snugly. Assemble the remaining washers and nuts on the thru-bolts and torque to the value stipulated in the chart in figure 5-2A.

CAUTION

Uneven or improper torque of thru-bolt nuts can cause failure of bolts, with resultant wheel failure.

d. Clean and pack bearing cones with clean aircraft wheel bearing grease (Section 2).
e. Assemble bearing cones, grease seal felts, and rings into wheel halves.
f. Inflate tire to seat tire beads, then adjust to correct tire pressure. Refer to Section 1.

5-15. MAIN WHEEL DISASSEMBLY (McCauley Wheel).

a. Remove valve core and deflate tire and tube. Break tire beads loose from wheel flanges.

WARNING

Injury can result from attempting to remove wheel flanges with the tire and tube inflated. Avoid damaging wheel flanges when breaking tire beads loose. A scratch, gouge or nick in wheel flange could cause wheel failure.

b. Remove thru-bolt nuts and washers or cap screws from outboard wheel flange.
c. Remove thru-bolts and washers or cap screws from inboard wheel flange.
d. Remove brake disc.
e. Separate wheel flanges from wheel hub. Retain spacers on each side of wheel hub.
f. Remove wheel hub from tire.
g. Remove retainer rings and remove grease seal retainers, grease seal felts, and bearing cones.

NOTE

The bearing cups (races) are a press fit in the wheel hub and should not be removed unless a new part is to be installed. To remove the bearing cup, heat wheel hub in boiling water for 30 minutes, or in an oven not to exceed 121°C (250°F). Using an arbor press, if available, press out the bearing cup and press in the new bearing cup while the wheel hub is still hot.

Change 3 5-8A
### LANDING GEAR WHEEL THRU-BOLT NUT AND CAPSCREW TORQUE VALUES

<table>
<thead>
<tr>
<th>MAIN GEAR</th>
<th>NOSE GEAR</th>
<th>WHEEL NUMBER</th>
<th>SIZE</th>
<th>MANUFACTURER</th>
<th>NUT/CAPSCREW TORQUE</th>
<th>WHEEL HALF/FLANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td></td>
<td>C163001-0103</td>
<td>6.00 X 6</td>
<td>CLEVELAND</td>
<td>150 lb-in</td>
<td>MAGNESIUM</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td>C163001-0104</td>
<td>6.00 X 6</td>
<td>CLEVELAND</td>
<td>90 lb-in</td>
<td>ALUMINUM</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td>C163002-0101</td>
<td>6.00 X 6</td>
<td>MC CAULEY</td>
<td>90-100 lb-in</td>
<td>ALUMINUM</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td>C163003-0101</td>
<td>6.00 X 6</td>
<td>MC CAULEY</td>
<td>*190-200 lb-in</td>
<td>STEEL</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td>C163002-0201</td>
<td>5.00 X 5</td>
<td>MC CAULEY</td>
<td>90-100 lb-in</td>
<td>ALUMINUM</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td>1241156-12</td>
<td>5.00 X 5</td>
<td>CLEVELAND</td>
<td>90 lb-in</td>
<td>MAGNESIUM</td>
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<tr>
<td>X</td>
<td></td>
<td>C163003-0201</td>
<td>5.00 X 5</td>
<td>MC CAULEY</td>
<td>90-100 lb-in</td>
<td>STEEL</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td>C163003-0401</td>
<td>5.00 X 5</td>
<td>MC CAULEY</td>
<td>*190-200 lb-in</td>
<td>STEEL</td>
</tr>
</tbody>
</table>

*Capscrew

Figure 5-2A. Main and Nose Wheel Thru-Bolt Nut and Capscrew Torque Values

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### 5-16. MAIN WHEEL INSPECTION AND REPAIR (McCauley Wheel)

a. Clean all metal parts, grease seal felts, and mylar spacers in cleaning solvent and dry thoroughly.

b. Inspect wheel flanges, and wheel hub for cracks. Cracked wheel flanges or hub shall be discarded and new parts installed. Sand out smooth nicks, gouges, and corroded areas. When the protective coating has been removed, the area should be cleaned thoroughly, primed with zinc chromate and painted with aluminum lacquer.

c. If excessively warped or scored, or worn to a thickness of 0.190-inch, brake disc should be replaced with a new part. Sand smooth small nicks and scratches.

d. Carefully inspect bearing cones and cups for damage and discoloration. After cleaning, pack bearing cones with clean aircraft wheel bearing grease (Section 2) before installing in wheel hub.

e. Tighten thru-bolt nuts evenly and torque to the value stipulated in figure 5-2A.

f. Clean and pack bearing cones with clean aircraft wheel bearing grease. (Refer to Section 2.)

g. Assemble bearing cones, grease seal felts, and retainers into wheel hub.

h. Inflate tire to seat tire beads, then adjust to correct tire pressure. See figure 1-1 for correct tire pressure.

---

### 5-17A. MAIN WHEEL REASSEMBLY (McCauley Wheel - Steel Flange)

a. Place wheel hub in tire and tube with tube inflation stem in cutout of wheel hub.

b. Place spacer and wheel flange on inboard side of wheel hub (opposite of tube inflation stem), then with washer under head of thru-bolt, insert bolt thru brake disc, wheel flange, and wheel hub.

c. Place spacer and wheel flange on outboard side of wheel hub with valve inflation stem through cutout in wheel flange.

d. Install washers and nuts on thru-bolts.

---

### CAUTION

Be sure that spacers and wheel flanges are seated on flange of wheel hub. Uneven or improper torque of thru-bolt nuts can cause failure of bolts, with resultant wheel failure.

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### CAUTION

Be sure that spacers, wheel flanges and brake disc are seated on flange of wheel hub. Uneven or improper torque of capscrews can cause failure of capscrews or hub threads with resultant wheel failure.
NOTE
Tighten thru-bolt nuts evenly to the torque value specified in figure 5-2A.

CLEVELAND WHEEL AND BRAKE

1. Snap Ring
2. Grease Seal Ring
3. Grease Seal Felt
4. Grease Seal Ring
5. Bearing Cone
6. Outboard Wheel Half
7. Tire
8. Tube
9. Inboard Wheel Half
10. Bearing Cup
11. Washer
12. Nut
13. Brake Disc
14. Torque Plate
15. Pressure Plate
16. Anchor Bolt
17. Brake Cylinder
18. Thru-Bolt
19. Bleeder Valve
20. Washer
21. O-Ring
22. Brake Piston
23. Brake Lining
24. Rivet
25. Back Plate

Figure 5-3. Main Wheel and Brake (Cleveland)
Steel-flange
Aluminum-flange

NOTE
Tighten thru-bolt nuts or capscrews evenly to the torque value specified in figure 5-2A.

Beginning with 15074510 and A1500402, McCauley steel-flange main wheels replace McCauley aluminum-flange main wheels.

1. Snap Ring
2. Grease Seal Retainer (Outboard)
3. Grease Seal Felt (Outboard)
4. Grease Seal Retainer (Outboard)
5. Bearing Cone
6. Wheel Flange
7. Spacer
8. Tire
9. Tube
10. Wheel Hub
11. Bearing Cup (Race)
12. Grease Seal Retainer (Inboard)
13. Grease Seal Felt (Inboard)
14. Brake Disc
15. Torque Plate
16. Pressure Plate
17. Anchor Bolt
18. Brake Cylinder
19. Bleeder Valve
20. O-Ring (Piston)
21. Brake Piston
22. Brake Lining
23. Thru-Bolt
24. Back Plate
25. Screw

Figure 5-3A. Main Wheel and Brake (McCauley)

5-10 Change 3
d. Tighten capscrews evenly and torque to the value specified in figure 5-2A.

e. Place spacer and wheel flange on outboard side of wheel hub and align valve stem cutout in wheel flange.

f. Place washer under head of each capscrew, insert capscrew thru wheel flange and spacer and start capscrews into wheel hub threads.

**CAUTION**

Be sure that spacers and wheel flanges are seated on flange of wheel hub. Uneven or improper torque of capscrews can cause failure of the capscrews, or hub threads with resultant wheel failure.

g. Tighten capscrews evenly and torque to values specified in figure 5-2A.

h. Clean and pack bearing cones with clean aircraft wheel bearing grease. (Refer to Section 2 for grease type.)

i. Assemble bearing cones, grease seal felts and retainer into wheel hub.

j. Inflate tire to seat tire beads, then adjust to correct tire pressure. Refer to figure 1-1 for correct tire pressure.

5-16. MAIN WHEEL INSTALLATION.

a. Place wheel assembly on axle.

b. Install axle nut and tighten axle nut until a slight bearing drag is obvious when the wheel is rotated. Back off nut to nearest castellation and install cotter pin.

c. Place brake back plate in position and secure with bolts and washers.

d. Install hub cap. Install speed fairing (if used) as outlined in paragraph 5-10.

**CAUTION**

Always check scraper-to-tire clearance after installing speed fairings, whenever a tire has been changed, and whenever scraper adjustment has been disturbed. If the aircraft is flown from surfaces with mud, snow, or ice, the fairing should be checked to make sure there is no accumulation which could prevent normal wheel rotation. Refer to paragraph 5-10 for correct scraper-to-tire clearance.

5-19. MAIN WHEEL AXLE REMOVAL (FLAT GEAR).

a. Remove speed fairings, if installed, in accordance with paragraph 5-10.

b. Remove wheel in accordance with paragraph 5-11.

c. Disconnect, drain, and plug or cap the hydraulic brake line at the wheel brake cylinder.

d. Remove four nuts, washers, and bolts securing axle, brake components, and speed fairing mounting plate (if used) to spring strut.

**NOTE**

When removing axle from spring-strut, note number and position of the wheel alignment shims between axle and spring-strut. Mark these shims or tape them together carefully so they can be installed in exactly the same position to ensure wheel alignment is not disturbed.

5-20. MAIN WHEEL AXLE INSTALLATION (FLAT GEAR).

a. Secure axle and brake components to spring-strut, making sure that wheel alignment shims and speed fairing mounting plate (if used) are installed in their original position. Ascertain that bushings in brake torque plate are installed in the upper mounting holes.

b. Install wheel assembly on axle in accordance with paragraph 5-18.

c. Connect hydraulic brake line to wheel brake cylinder.

d. Fill and bleed affected brake system in accordance with paragraph 5-58.

e. Install speed fairing (if used) in accordance with paragraph 5-10.

5-21. MAIN WHEEL AXLE REMOVAL (TUBULAR).

Refer to figure 5-4.

**NOTE**

Axles are bonded to the struts of tubular gear aircraft with (3M) EC2216 adhesive. The bond is too strong to allow the axle to be removed without first weakening the bond strength. The only methods of weakening the bond are with heat or cryogenic cold; heat being the most practical. A temperature of approximately 500°F is sufficient to weaken the bond so the axle can be removed. This is still a low enough temperature to prevent damage to the tubular strut, but will age the aluminum axle. Therefore, the axle will have to be replaced.

a. Remove speed fairings, if installed, in accordance with procedures outlined in paragraph 5-10.

b. Remove wheels as outlined in paragraph 5-11.

c. Disconnect, drain, and cap or plug hydraulic brake line at the wheel brake cylinder.

d. Remove cotter pin, nut and bolt attaching axle to spring strut.

e. Remove brake components and speed fairing plate from axle.

f. Remove axle as follows:
Do not place tape in direct contact with tubular gear spring.

Due to aging of the aluminum axle, caused by the heating tape, a new axle will have to be installed.

1. Axle
2. Tubular Gear Strut
3. Electrical Heating Tape
4. Plug

Figure 5-4. Main Wheel Axle Removal

5-21. MAIN WHEEL AXLE REMOVAL (TUBULAR).

Refer to figure 5-4.

NOTE

Axles are bonded to the struts of tubular gear aircraft with (3M) EC2216 adhesive. The bond is too strong to allow the axle to be removed without first weakening the bond strength. The only methods of weakening the bond are with heat or cryogenic cold; heat being the most practical. A temperature of approximately 500°F is sufficient to weaken the bond so the axle can be removed. This is still a low enough temperature to prevent damage to the tubular strut, but will age the aluminum axle. Therefore, the axle will have to be replaced.

a. Remove speed fairings, if installed, in accordance with procedures outlined in paragraph 5-10.
   b. Remove wheels as outlined in paragraph 5-11.
   c. Disconnect, drain, and cap or plug hydraulic brake line at the wheel brake cylinder.
   d. Remove cotter pin, nut and bolt attaching axle to spring strut.
   e. Remove brake components and speed fairing plate from axle.
   f. Remove axle as follows:

   NOTE

Axle should be removed from strut, using electric heating tape, which is available from Curtin Scientific Company, 6550 East 42nd St., P.O. Box 147, Tulsa, Oklahoma 74101. Tape should conform to the following: 192 watts, 24" long, 1" wide, flexible and heavily insulated.

1. Wrap heating tape around axle from base head to outer end of axle and tie it on with string provided with tape.

   NOTE

   Do not place tape in direct contact with tubular gear spring.

   2. Plug electric tape into 110 volt wall socket and heat for 20 to 30 minutes.
   3. Unplug tape and remove from axle. Remove axle by striking axle base head with a few sharp blows.
   4. Clean any old adhesive off landing gear spring with a wire brush. Brush strokes should run lengthwise along the spring. After old adhesive has been removed, wipe with clean rag saturated with acetone or alcohol. Immediately wipe dry with a clean, lint free cloth.

   NOTE

   Due to aging of the aluminum axle, caused by the heating tape, a new axle will have to be installed.

5-22. MAIN WHEEL AXLE INSTALLATION (TUBULAR).

   a. Prior to installing new axle, wipe outer surface of tubular gear and inside surface of axle with solvent, drying immediately with a clean, lint free cloth.
   b. Install new axles as follows:

   1. Mix EA9309, EC2216 or equivalent adhesive, in accordance with instructions in package. Spread adhesive thinly and evenly on outer surface of landing gear spring in area that will be covered by axle.
2. Place axle on gear spring and rotate axle to assure even coverage between inner surface of axle and outer surface of spring.
3. Install retaining bolt, washers, nut and cotter pin. Tighten nut securely.
4. Allow 24 hours at 75°F. for adhesive to cure, or 30 minutes at 250°F., if heating equipment is available.

5. Install brake components and speed fairing plate on axle, using four bolts, washers and nuts.
6. Install wheel assembly on axle in accordance with paragraph 5-18.
7. Connect hydraulic brake line to wheel brake cylinder.
8. Fill and bleed affected brake system in accordance with paragraph 5-58.
9. Install speed fairing, if used, in accordance with paragraph 5-10.

5-23. MAIN WHEEL ALIGNMENT (FLAT GEAR). Correct main wheel alignment is obtained through the use of tapered shims between the flange of the axle and spring-strut. See figure 5-5 for procedure to use in obtaining wheel alignment. Wheel shims part numbers and the correction imposed on the wheel by the various shims are listed in sheet 2 of figure 5-5.

NOTE

Failure to obtain acceptable wheel alignment through the use of the shims indicate a deformed main gear spring-strut or spring-strut attaching bulkhead out of alignment.

5-23A. MAIN WHEEL ALIGNMENT (TUBULAR). (Refer to figure 1-1.)

5-24. WHEEL BALANCING. Since uneven tire wear is usually the cause of wheel unbalance, replacing the tire probably will correct this condition. Tire and tube manufacturing tolerances permit a specified amount of static unbalance. The light-weight point of the tire is marked with a red dot on the tire sidewall and the heavy-weight point of the tube is marked with a contrasting color line (usually near the inflation valve stem). When installing a new tire, place these marks adjacent to each other. If a wheel shows evidence of unbalance during service, it may be statically balanced. Wheel balancing equipment is available from the Cessna Service Parts Center.

5-25. NOSE GEAR. The steerable nose wheel mounted on an air-oil shock strut comprises the nose gear. The shock strut is secured to the tubular engine mount. Nose wheel steering is accomplished by two spring-loaded push-pull tubes linking the nose gear steering collar to the rudder pedal bars. A hydraulic fluid-filled shimmy damper is provided to minimize nose wheel shimmy. A nose wheel speed fairing may be installed as optional equipment. The various configurations of these optional nose wheel speed fairings are illustrated in figure 5-7. Disassembly, inspection and repair, and reassembly of the various nose wheel configurations are described in separate paragraphs for each configuration. The solid wheels having two wheel halves are manufactured by Cleveland Aircraft Products Co. and webbed wheels having two flanges and a hub are manufactured by McCauley Industrial Corporation. The Cleveland wheels are shown in figure 5-8. The McCauley wheels have either aluminum flanges or steel flanges as shown in figure 5-8A. The aluminum flanges are attached to the wheel hub by thru-bolts and nuts as shown in figure 5-8A. The steel flanges are attached to the wheel hub by either thru-bolts or capscrews as shown in figure 5-8A. During assembly of the nose wheel, the thru-bolt nuts or capscrews, as applicable, shall be tightened evenly and torqued to the value specified in figure 5-2A.

5-26. TROUBLE SHOOTING.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABILE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOSE WHEEL SHIMMY.</td>
<td>Nose strut attaching bolts loose.</td>
<td>Tighten nose strut attaching bolts.</td>
</tr>
<tr>
<td></td>
<td>Loose or worn nose wheel steering linkage.</td>
<td>Tighten. Replace defective parts with new parts.</td>
</tr>
<tr>
<td></td>
<td>Nose wheel out of balance.</td>
<td>Refer to paragraph 5-36.</td>
</tr>
<tr>
<td></td>
<td>Wheel bearings too loose.</td>
<td>Adjust properly.</td>
</tr>
<tr>
<td></td>
<td>Defective shimmy damper.</td>
<td>Repair, or install new shimmy damper.</td>
</tr>
<tr>
<td></td>
<td>Shimmy damper fluid low.</td>
<td>Refer to Section 2.</td>
</tr>
<tr>
<td></td>
<td>Loose torque links.</td>
<td>Add shims, or install new parts as required.</td>
</tr>
</tbody>
</table>

Change 3 5-13
Refer to Figure 1-1 for toe-in and camber.

Place carpenter's square against straightedge and let it touch wheel just below axle nut.

Aluminum plates, approximately 18" square, placed under wheels.

Note: Grease between plates.

Rock wheels before checking wheel alignment.

Block straightedge against tires just below axle height.

Top view of toe-in check:
Measure toe-in at edges of wheel flange. Difference in measurements is toe-in for one wheel. (half of total toe-in.)

Carpenter's square

Straightedge

Front view of camber check:
Measure camber by reading protractor level held vertically against outboard flanges of wheel.

Positive camber

Negative camber

Inboard

Forward

Note:
Setting toe-in and camber within these tolerances while the cabin and fuel tanks are empty will give approximately zero toe-in and zero camber at gross weight. Therefore, if normal operation is at less than gross weight and abnormal tire wear occurs, realign the wheels to attain the ideal setting for the load conditions. Refer to sheet 2 of this figure for shims availability and their usage. Always use the least number of shims possible to obtain the desired result.

Figure 5-5. Main Wheel Alignment (Sheet 1 of 2)
<table>
<thead>
<tr>
<th>SHIM PART NO.</th>
<th>POSITION OF THICKEST CORNER OR EDGE OF SHIM</th>
<th>CORRECTION IMPOSED ON WHEEL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>TOE-IN</td>
</tr>
<tr>
<td>0541157-1</td>
<td>AFT</td>
<td>.06&quot;</td>
</tr>
<tr>
<td></td>
<td>FWD</td>
<td>-----</td>
</tr>
<tr>
<td>0541157-2</td>
<td>UP</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>DOWN</td>
<td>-----</td>
</tr>
<tr>
<td>0541157-3</td>
<td>AFT</td>
<td>.12&quot;</td>
</tr>
<tr>
<td></td>
<td>FWD</td>
<td>-----</td>
</tr>
<tr>
<td>0541111-2</td>
<td>UP &amp; FWD</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>UP &amp; AFT</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>DOWN &amp; FWD</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>DOWN &amp; AFT</td>
<td>.15&quot;</td>
</tr>
<tr>
<td>0441139-5</td>
<td>UP &amp; FWD</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>UP &amp; AFT</td>
<td>.12&quot;</td>
</tr>
<tr>
<td></td>
<td>DOWN &amp; FWD</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>DOWN &amp; AFT</td>
<td>.11&quot;</td>
</tr>
<tr>
<td>044M39-6</td>
<td>UP &amp; FWD</td>
<td>-----</td>
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<td>UP &amp; AFT</td>
<td>.24&quot;</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
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<td>.03&quot;</td>
</tr>
<tr>
<td></td>
<td>UP &amp; AFT</td>
<td>.06&quot;</td>
</tr>
<tr>
<td></td>
<td>DOWN &amp; FWD</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>DOWN &amp; AFT</td>
<td>-----</td>
</tr>
</tbody>
</table>

Figure 5-5. Main Wheel Alignment (Sheet 2 of 2)

5-26. TROUBLE SHOOTING (Cont.)

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOSE STRUT DOES NOT HOLD</td>
<td>Defective or loose air</td>
<td>Check gasket and tighten</td>
</tr>
<tr>
<td>AIR PRESSURE.</td>
<td>filler valve.</td>
<td>loose valve.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Install new valve if</td>
</tr>
<tr>
<td></td>
<td></td>
<td>defective.</td>
</tr>
<tr>
<td>HYDRAULIC FLUID LEAKAGE</td>
<td>Defective strut seals</td>
<td>Install new seals.</td>
</tr>
<tr>
<td>FROM NOSE STRUT.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5-27. NOSE GEAR REMOVAL AND INSTALLATION. (See figure 5-6.)
  a. Remove engine cowling for access.
  b. Weight or tie-down tail of aircraft to raise nose wheel off the floor.
  c. Disconnect nose wheel steering tubes from nose gear steering collar.
  d. Remove screws attaching hose clamps to strut.
  e. Remove air filler valve core and deflate strut completely and telescope strut to its shortest length.

**WARNING**

Be sure the strut is deflated completely before removing bolt or roll pin at top of strut.

f. Remove roll pin at top of strut and remove bolt which clamps strut to lower part of engine mount.
  g. Pull the strut assembly down out of engine mount fitting.
  h. To install the nose gear, reverse the preceding steps. Always install roll pin before clamping strut in lower portion of engine mount to prevent misalignment. Tighten clamp bolt in lower portion of engine mount fitting to 120 ± 20 lb-in.

5-28. NOSE WHEEL SPEED FAIRING REMOVAL AND INSTALLATION.
  a. Weight or tie-down tail of aircraft to raise nose wheel off the floor.
  b. Remove nose wheel axle stud.
c. Remove bolt securing cover plate and fairing to strut. Remove cover plate.

**WARNING**

Do not remove bolt attaching tow-bar spacers, unless strut has been deflated completely.

d. Slide speed fairing up and remove nose wheel. Loosen scraper as necessary.
e. Rotate speed fairing 90 degrees and work fairing down over the fork to remove.
f. Install speed fairing by reversing the preceding steps. Tighten axle stud until a slight bearing drag is obvious when the wheel is rotated. Back off nut to the nearest castellation and install cotter pins.

NOTE

Strut pressure capacity is listed in figure 1-1, or can be found on the placard on the nose gear strut.

REFER TO FIGURE 5-9

REFER TO FIGURE 5-10

REFER TO FIGURE 5-11

Figure 5-8. Nose Gear Installation
g. If shock strut was deflated, service after installation has been completed (see Section 2).

**CAUTION**

Always check scraper clearance after installing speed fairing, whenever a tire has been changed, and whenever scraper adjustment has been disturbed. Set clearance between tire and scraper for a minimum of 0.25 inch to a maximum of 0.38 inch. Elongated holes in the scraper are provided for adjustment. If the aircraft is flown from surfaces with mud, snow, or ice, the speed fairings should be checked to make sure there is no accumulation which could prevent normal wheel rotation. Wipe fuel and oil from speed fairing to prevent stains and deterioration of the fairing.

5-31. NOSE WHEEL INSPECTION AND REPAIR (Cleveland Wheel).

a. Clean all metal parts and grease seal felts in solvent and dry thoroughly.

b. Inspect wheel halves for cracks. Cracked wheel halves shall be discarded and new parts used. Sand out nicks, gouges, and corroded areas. When protective coating has been removed, the area should be cleaned thoroughly, primed with zinc chromate and painted with aluminum lacquer.

c. Carefully inspect bearing cones and cups for damage and discoloration. After cleaning, pack bearing cones with clean aircraft wheel bearing grease (Section 2) before installing in wheel half.

5-32. NOSE WHEEL REASSEMBLY (Cleveland Wheel).

a. Insert tube in tire, aligning index marks on tire and tube.

b. Place tire and tube on wheel half and position valve stem through hole in wheel half.

c. Insert thru-bolts, position other wheel half, and secure with nuts and washers. Take care to avoid pinching tube between wheel halves. Tighten thru-bolt nuts to the torque values stipulated in figure 5-2A.

**CAUTION**

Uneven or improper torque on the thru-bolt nuts may cause bolt failure with resultant wheel failure.

d. Clean and pack bearing cones with clean aircraft wheel bearing grease (Section 2).

e. Assemble bearing cones, seals, and retainers into the wheel halves.

f. Inflate tire to seat tire beads, then adjust to correct pressure (figure 1-1).

5-33. NOSE WHEEL DISASSEMBLY (McCauley Wheel with Thru-bolts).

a. Remove hub caps, completely deflate tire and break tire beads loose at wheel rim.

**WARNING**

Injury can result from attempting to separate wheel halves with the tire inflated. Avoid damaging wheel flanges when breaking tire beads loose.

b. Remove thru-bolts and separate wheel halves.

c. Remove tire and tube from wheel halves.

d. Remove bearing retaining rings, grease felt seals and bearing cones.

**NOTE**

The bearing cups (races) are a press fit in the wheel halves and should not be removed unless a new part is to be installed. To remove bearing cups, heat wheel halves in boiling water for 30 minutes, or in an oven not to exceed 149°C (300°F). Using an arbor press, if available, press out the bearing cup and press in the new bearing cup while the wheel half is still hot.

b. Remove thru-bolt nuts and washers.

c. Remove thru-bolts and separate wheel flanges from wheel hub. Retain spacers between wheel flanges and wheel hub.

d. Remove wheel hub from tire and tube.

e. Remove retainer rings and remove grease seal retainers, grease seal felts, and bearing cones from wheel hub.
5. Axle Stud

Figure 5-7. Nose Wheel Speed Fairing
1. Snap Ring
2. Grease Seal Ring
3. Grease Seal Felt
4. Bearing Cone
5. Female Wheel Half
6. Tire
7. Tube
8. Male Wheel Half
9. Bearing Cup
10. Thru-Bolt

Tighten thru-bolt nuts evenly to the torque value specified in figure 5-2A.

**NOTE**

The bearing cups (races) are a press fit in the wheel hub and should not be removed unless a new part is to be installed. To remove the bearing cup, heat wheel hub in boiling water for 30 minutes, or in an oven not to exceed 121°C (250°F). Using an arbor press, if available, press out the bearing cup and press in the new bearing cup while the wheel hub is still hot.

**5-34. NOSE WHEEL INSPECTION AND REPAIR**

a. Clean all metal parts, grease seal felts, and mylar spacers in cleaning solvent and dry thoroughly.
b. Inspect wheel flanges, and wheel hub for cracks. Cracked wheel flanges or hub shall be discarded and new parts installed. Sand out smooth nicks, gouges, and corroded areas. When the protective coating has been removed, the area should be cleaned thoroughly, primed with zinc chromate and painted with aluminum lacquer.
c. Carefully inspect bearing cones and cups for damage and discoloration. After cleaning, pack bearing cones with clean aircraft wheel bearing grease (Section 2) before installing in wheel hub.

**5-35. NOSE WHEEL REASSEMBLY** (McCauley Wheel with Thru-bolts).

a. Insert tube in tire, aligning index marks on tire and tube.
b. Place wheel hub in tire with valve stem in cutout of wheel hub.
c. Place spacer and wheel flange on one side of wheel hub and with washer under head of thru-bolt insert bolt through wheel flange and wheel hub.
d. Place spacer and wheel flange on other side and align valve stem in cutout in wheel flange.
e. Install washers and nuts on thru-bolts.

**CAUTION**

Be sure that spacers and wheel flanges are seated on flange of wheel hub. Uneven or improper torque of the thru-bolt nuts can cause failure of the bolts, with resultant wheel failure.
f. Tighten thru-bolt nuts evenly and torque to the values stipulated in figure 5-2A.
g. Clean and pack bearing cones with clean aircraft wheel bearing grease (Section 2).
h. Assemble bearing cones, grease seal felts and retainers into wheel hub.
i. Inflate tire to seat tire beads, then adjust to correct tire pressure. See figure 1-1 for correct tire pressure.

**5-35A. NOSE WHEEL DISASSEMBLY** (McCauley Wheel with Capscrews).

a. Remove hub caps, completely deflate tire and break tire beads loose at wheel flanges.

**WARNING**

Injury can result from attempting to remove wheel flanges with tire and tube inflated. Avoid damaging wheel flanges when breaking tire beads loose. A scratch, gouge or nick in wheel flange could cause wheel failure.
Steel-flange

NOTE

Tighten thru-bolt nuts or capscrews evenly to the torque value specified in figure 5-2A.

Beginning with 15074404 and A1500390, McCauley steel-flange nose wheels replace McCauley aluminum-flange nose wheels.

1. Retainer Ring
2. Grease Felt Retainer
3. Bearing Cone
4. Wheel Flange
5. Spacer
6. Tire
7. Tube
8. Wheel Hub
9. Wheel Flange
10. Thru-Bolt
11. Grease Felt Retainer
12. Bearing Cone
13. Capscrew

McCAULEY NOSE WHEEL

b. Remove capscrews and washers.
c. Separate wheel flanges from wheel hub. Retain spacers on each side of wheel hub.
d. Remove wheel hub from tire.
e. Remove retainer rings and remove grease seal retainers, grease seal felts and bearing cones.

NOTE

The bearing cups (races) are a press-fit in the wheel hub and should not be removed unless a new part is to be installed. To remove the bearing cup, heat wheel hub in boiling water for 30 minutes, or in an oven not to exceed 121°C(250°F). Using an arbor press, if available, press in the new bearing cup while the wheel hub is still hot.

5-35B. NOSE WHEEL INSPECTION AND REPAIR (McCauley Wheel with Capscrews).
Refer to paragraph 5-34.

5-35C. NOSE WHEEL REASSEMBLY (McCauley Wheel with Capscrew).
a. Insert tube in tire, aligning index marks on tire and tube.
b. Place wheel hub in tire with valve stem in cutout of wheel hub.
c. Place spacer and wheel flange on one side of wheel hub.
d. Place washer under head of each capscrew, insert capscrew thru wheel flange and spacer and start capscrews into wheel hub threads.
e. Tighten capscrews evenly and torque to the value specified in figure 5-2A.
f. Place spacer and wheel flange on other side of wheel hub and align valve stem in cutout in wheel flange.
g. Place washer under head of each capscrew, insert capscrew thru wheel flange and spacer and start capscrews into wheel hub threads.

CAUTION

Be sure that spacers and wheel flanges are seated on flange of wheel hub. Uneven or improper torque of capscrews can cause failure of the capscrews or hub threads with resultant wheel failure.

Be sure that spacers and wheel flanges are seated on flange of wheel hub. Uneven or improper torque of capscrews can cause failure of the capscrews or hub threads with resultant wheel failure.
NOTE

Use shims as required between steering arm assembly (3) and washer (1) to provide a snug fit with retainer ring (4) installed. Also, adjust rod end (2) to provide dimension shown in Section A-A.

Figure 5-9. Nose Gear Shock Strut
h. Tighten capscrews evenly and torque to the value specified in figure 5-2A.

i. Clean and pack bearing cones with clean aircraft wheel bearing grease. (Refer to Section 2 for grease type.)

j. Assemble bearing cones, grease seal felts and retainers into wheel hub.

k. Inflate tire to seat tire beads, then adjust to correct tire pressure (refer to Section 1).

5-36. WHEEL BALANCING. Refer to paragraph 5-24 for wheel balancing information.

5-37. NOSE GEAR SHOCK STRUT DISASSEMBLY. (See figure 5-9.) The following procedures apply to the nose gear shock strut after it has been removed from the aircraft, and the speed fairing and nose wheel have been removed. In many cases, separation of the upper and lower strut will permit inspection and parts installation without removal or complete disassembly of the strut.

**WARNING**

Be sure strut is completely deflated before removing lock ring in lower end of upper strut, or disconnecting torque links.

- a. Remove shimmy damper.
- b. Remove torque links. Note position of washers, shims, and spacers.
- c. Remove lock ring from groove inside lower end of upper strut. A small hole is provided at the lock ring groove to facilitate removal of the lock ring.

**NOTE**

Hydraulic fluid will drain from strut as lower strut is pulled from upper strut.

d. Using a straight sharp pull, separate upper and lower struts. Invert lower strut and drain hydraulic fluid.

e. Remove lock ring and bearing at upper end of lower strut assembly. Note top side of bearing.

- f. Slide packing support ring, scraper ring, retaining ring, and lock ring from lower strut, noting relative position and top side of each ring; wire together if desired.

- g. Remove O-rings and back-up rings from packing support ring.

- h. Remove bolt securing tow bar spacers and slide torque link fitting from lower strut.

**NOTE**

Bolt attaching tow bar spacers also holds base plug in place.

- i. Remove bolt attaching fork to strut barrel, and remove base plug and metering pin from lower strut. Remove O-rings and metering pin from base plug.

**NOTE**

Lower strut barrel and fork are a press fit, drilled on assembly. Separation of these parts is not recommended, except for installation of a new part.

- j. Pull orifice piston support from upper strut. Remove O-ring and filler valve.

- k. Remove retaining ring securing steering collar to upper strut. Slide steering collar, shims, and washer from upper strut. Note number of shims between washer and steering collar.

5-38. NOSE GEAR SHOCK STRUT REASSEMBLY. (See figure 5-9.)

- a. Thoroughly clean all parts in cleaning solvent and inspect them carefully. All worn or defective parts and all O-rings and back-up rings must be replaced with new parts.

- b. Assemble the shock strut by reversing the order of the procedure outlined in paragraph 5-37 with the exception that special attention must be paid to the following procedures.

- c. Sharp metal edges should be smoothed with No. 400 emery paper, then thoroughly cleaned with solvent.

- d. Used sparingly, Dow Corning Compound DC4 is recommended for O-ring lubrication. All other internal parts should be liberally coated with hydraulic fluid during reassembly.

**NOTE**

Cleanliness and proper lubrication, along with careful workmanship are important during assembly of the nose gear shock strut.

- e. When installing steering collar, lubricate needle bearings in collar in accordance with instructions outlined in Section 2. If needle bearing is defective, install new steering collar assembly. Use shims as required between steering collar assembly and washer to provide a snug fit with steering collar retaining ring installed. Shims of variable thickness are available from the Cessna Service Parts Center as follows:

<table>
<thead>
<tr>
<th>Shims</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1243030-5</td>
<td>0.06 inch</td>
</tr>
<tr>
<td>1243030-6</td>
<td>0.012 inch</td>
</tr>
<tr>
<td>1243030-7</td>
<td>0.020 inch</td>
</tr>
</tbody>
</table>

- f. When installing the rod ends in the steering collar, adjust to the dimensions shown in figure 5-9.

- g. When installing the lock ring in lower end of upper strut, position lock ring so that one of its ends covers the small access hole in the lock ring groove at the bottom of the upper strut.

- h. Temporary bolts or pins of correct diameter and length are useful tools for holding parts in correct relation to each other during assembly and installation.

- i. After assembly of shock strut, install strut in aircraft in accordance with paragraph 5-27.

- j. After installation of shock strut, fill and inflate shock strut as outlined in Section 2.

5-39. TORQUE LINKS. The torque links are illustrated in figure 5-10, which may be used as a guide for disassembly and reassembly. Torque links keep the lower strut aligned with the nose gear steering system, but permit shock strut action. Torque link
Tighten bolts (8) to 20-25 pounds-inches, then safety the bolts by bending tips of safety lug (10).

Tighten nuts (7) snugly, then tighten to align next castellation with cotter pin hole.

Shims (3) are used as required to remove any looseness to assist in preventing nose wheel shimmy.

Figure 5-10. Torque Links

bushings should not be removed except for replacement of parts; replace if excessively worn. Always deflate shock strut before disconnecting torque links.

5-40. SHIMMY DAMPENER. The shimmy dampener provided for the nose gear offers resistance to shimmy by forcing hydraulic fluid through small orifices in a piston. The dampener piston shaft is secured to a stationary part and the housing is secured to the nose wheel steering collar which moves as the nose wheel is turned right or left, causing relative motion between the dampener shaft and housing. The shimmy dampener is shown in figure 5-11, which may be used as a guide for disassembly and reassembly. When assembling the shimmy dampener, install new O-rings. Lubricate parts with clean hydraulic fluid during assembly. Shimmy dampener servicing procedures are outlined in Section 2.

Figure 5-11. Nose Gear Shimmy Dampener
5-41. NOSE WHEEL STEERING SYSTEM. Nose wheel steering is accomplished through the use of the rudder pedals. Spring-loaded steering rod assemblies connect the nose gear steering collar to arms on the rudder bars. Steering is afforded up to approximately 10 degrees each side of neutral, after which brakes may be used to gain a maximum deflection of 30 degrees right or left of center. A flexible boot seals the fuselage entrance of the steering rod assembly.

5-42. STEERING ROD ASSEMBLY. The steering rod assembly is spring-loaded and should not be disassembled internally. The steering rods are connected by a clevis to the rod ends extending from the nose gear steering collar and to an arm on the rudder pedal crossbars.

5-43. NOSE WHEEL STEERING ADJUSTMENT. Since the nose wheel steering and rudder system are interconnected, adjustment to one system may affect the other system. Section 10 of this manual contains rigging instructions for the rudder system as well as the nose wheel steering system.

5-44. BRAKE SYSTEM.

5-45. GENERAL DESCRIPTION. The hydraulic brake system consists of two master cylinders, located just forward of the pilot rudder pedals, brake lines and hose connecting each master cylinder to its wheel brake cylinder, and the single-disc, floating-cylinder type brake assembly, located at each main landing gear wheel.

5-46. TROUBLE SHOOTING.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRAGGING BRAKES.</td>
<td>Brake pedal binding.</td>
<td>Check and adjust properly.</td>
</tr>
<tr>
<td></td>
<td>Parking brake linkage holding</td>
<td>Check and adjust properly.</td>
</tr>
<tr>
<td></td>
<td>brake pedal down.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Worn or broken piston return spring</td>
<td>Repair or Install a new cylinder.</td>
</tr>
<tr>
<td></td>
<td>(In master cylinder.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insufficient clearance at Lock-</td>
<td>Adjust as shown in figure 5-12.</td>
</tr>
<tr>
<td></td>
<td>O-Seal or incorrect adjustment of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>cylinder overall length.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Restriction in hydraulic lines or</td>
<td>Drain brake line and clear the inside of the</td>
</tr>
<tr>
<td></td>
<td>restriction in compensating port in</td>
<td>brake line with filtered compressed air. If</td>
</tr>
<tr>
<td></td>
<td>master brake cylinder.</td>
<td>cleaning the lines fails to give satisfactory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>results, the master cylinder may be faulty</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and should be repaired.</td>
</tr>
<tr>
<td></td>
<td>Worn, scored, or warped brake disc.</td>
<td>Install new disc and brake linings.</td>
</tr>
<tr>
<td></td>
<td>Damaged or accumulated dirt</td>
<td>Clean and repair or install new parts as</td>
</tr>
<tr>
<td></td>
<td>restricting free movement</td>
<td>necessary.</td>
</tr>
<tr>
<td></td>
<td>of wheel brake parts.</td>
<td></td>
</tr>
<tr>
<td>BRAKES FAIL TO OPERATE.</td>
<td>Leak in system.</td>
<td>If brake master cylinders or wheel cylinder</td>
</tr>
<tr>
<td></td>
<td></td>
<td>assemblies are leaking, repair or install</td>
</tr>
<tr>
<td></td>
<td></td>
<td>new parts.</td>
</tr>
<tr>
<td></td>
<td>Air in system.</td>
<td>Bleed system.</td>
</tr>
<tr>
<td></td>
<td>Lack of fluid in master cylinders.</td>
<td>Fill and bleed system.</td>
</tr>
<tr>
<td></td>
<td>Master cylinder defective.</td>
<td>Repair or install new parts.</td>
</tr>
</tbody>
</table>
5-47. BRAKE MASTER CYLINDERS. The brake master cylinders, located just forward of the pilot rudder pedals, are actuated by applying pressure at the top of the rudder pedals. A small reservoir is incorporated into each master cylinder for the fluid supply. When dual brakes are installed, mechanical linkage permits the copilot pedals to operate the master cylinders.

5-48. BRAKE MASTER CYLINDER REMOVAL AND INSTALLATION.
   a. Remove bleeder screw at wheel brake assembly and drain hydraulic fluid from brake cylinders.
   b. Remove front seats and rudder bar shield for access to the brake master cylinders.
   c. Disconnect parking brake linkage and disconnect brake master cylinders from rudder pedals.
   d. Disconnect brake master cylinders at lower attach points.
   e. Disconnect hydraulic hose from brake master cylinders and remove cylinders.
   f. Plug or cap hydraulic fittings, hose and lines to prevent entry of foreign matter.
   g. Reverse the preceding steps to install brake master cylinders, then fill and bleed brake system in accordance with paragraph 5-58.

5-49. BRAKE MASTER CYLINDER REPAIR. Figure 5-12 may be used as a guide during disassembly, repair and reassembly of the brake master cylinders. Repair is limited to installation of new parts, cleaning, and adjustment. Use clean hydraulic fluid (MIL-H-5606) as a lubricant during assembly of the cylinders.

5-50. HYDRAULIC BRAKE LINES are rigid tubing, except for flexible hose used at the brake master cylinders and at the wheel brake cylinders on some models. A separate line is used to connect each brake master cylinder to its corresponding wheel brake cylinder.

5-51. WHEEL BRAKE ASSEMBLIES. The wheel brake assemblies use a disc which is attached to the main wheel with the wheel thru-bolts or cap screws and a floating brake assembly. (Refer to figure 5-3.)

5-52. WHEEL BRAKES REMOVAL. Wheel brake assemblies can be removed by disconnecting the brake hose and removing the brake back plate. See figure 5-3 for brake assembly affected. The brake disc is removed after the wheel is removed and disassembled. To remove the torque plate, remove wheel and axle or wheel only as outlined in applicable paragraphs in this Section. Refer to figure 5-3 for disassembly of either wheel brake assembly.

5-53. WHEEL BRAKE INSPECTION AND REPAIR.
   a. Clean all parts except brake linings and O-rings in dry cleaning solvent and dry thoroughly.
   b. New O-rings are usually installed at each time they are removed. If O-ring re-use is necessary, they should be wiped with a clean cloth saturated in hydraulic fluid and inspected for damage.

   NOTE
   Thorough cleaning is important. Dirt and chips are the greatest single cause of malfunctions in the hydraulic brake system.

   c. Check brake lining for deterioration and maximum permissible wear. See paragraph 5-56.
   d. Inspect brake cylinder bore for scoring. A scored cylinder will leak or cause rapid O-ring wear.
   Install new brake cylinder.
   e. If the anchor bolts on the brake assembly are nicked or gouged, they shall be sanded smooth to prevent binding with the pressure plate or torque plate. When new anchor bolts are to be installed, press out old bolts and drive bolts in with a soft mallet.
   f. Inspect wheel brake disc for a minimum thickness of 0.190-inch. If brake disc is below minimum thickness, install a new part.

5-54. WHEEL BRAKE REASSEMBLY. Lubricate parts with clean hydraulic fluid and assemble components with care to prevent damage to O-rings. Refer to figure 5-3 during assembly of wheel brakes.

5-55. WHEEL BRAKE INSTALLATION. Place brake assembly in position with pressure plate in place, then install back plate. If torque plate was removed, install as the axle is installed or install on axle. If the brake disc was removed from the wheel, install as wheel is assembled.

5-56. CHECKING BRAKE LINING WEAR. New brake lining should be installed when they are worn to a minimum thickness of 3/32-inch. Visually compare a 3/32-inch strip of material held adjacent to each lining to measure the thickness of the lining. The shank end of correct size drill bit makes an excellent tool for checking minimum thickness of the brake linings.

5-57. BRAKE LINING INSTALLATION. (See figure 5-3.)
   a. Remove bolts securing back plate and remove back plate.
   b. Pull the brake cylinder out of torque plate and slide pressure plate off anchor bolts.
   c. Place back plate on a table with lining side down flat. Center a 9/64-inch (or slightly smaller) punch in the rolled rivet, and hit the punch sharply with a hammer. Punch out all rivets securing the linings to the back plate and pressure plate in the same manner.

   NOTE
   A rivet setting kit, Part No. R561, is available from the Cessna Service Parts Center. This kit consists of an anvil and punch.
   d. Clamp the flat side of the anvil in a vise.
NOTE

Filler plug (17) must be vented so pressure cannot build up in the reservoir during brake operation. Remove plug and drill 1/16" hole, 30° from vertical, if plug is not vented.

0.040 ± 0.005 INCH

DO NOT DAMAGE LOCK-O-SEAL

1. Clevis
2. Jam Nut
3. Piston Rod
4. Cover
5. Setscrew
6. Cover Boss
7. Body
8. Reservoir
9. O-Ring
10. Cylinder
11. Piston Return Spring
12. Nut
13. Piston Spring
14. Piston
15. Lock-O-Seal
16. Compensating Sleeve
17. Filler Plug
18. Screw
19. Washer
20. Spacer
21. Spring
22. Plate

Figure 5-12. Brake Master Cylinder (Sheet 1 of 2)
1. Shaft
2. Gasket
3. Bushing
4. Cover Plate
5. Vented Filler Plug
6. Snap Ring
7. Parking Brake Lever
8. Spring
9. Lock Nut
10. Clevis
11. Bolt
12. Spacer
13. Snap Ring
14. Bolt and Lockwasher Assembly
15. Thrust Collar
16. O-Ring
17. Piston
18. O-Ring
19. Spring
20. Snap Ring
21. Spring
22. Brake Housing

NOTE

With cylinder in a released condition, adjust clevis (10) to provide an overall length of 8.00 ± .06 inches. This measurement is made from centerline of hole in mounting boss to centerline of hole in clevis.

When installing fitting in cylinder, use S-1465-1 tape on fitting threads and tighten fitting to 30-40 lb-in.

Figure 5-12. Brake Master Cylinder (Sheet 2 of 2)
e. Align new lining on back plate and place brake rivet in hole with rivet head in the lining. Place the head against the anvil.
f. Center the rivet setting punch on the lips of the rivet. While holding the back plate down firmly against the lining, hit punch with a hammer to set the rivet. Repeat blows on the punch until lining is firmly against back plate.
g. Realign the lining on the back plate and install and set rivets in the remaining holes.
h. Install a new lining on pressure plate in the same manner.
i. Position pressure plate on anchor bolts and place cylinder in position so that anchor bolts slide into the torque plate.
j. Install back plate with bolts and washers.

5-58. BRAKE SYSTEM BLEEDING. Bleeding with a clean hydraulic pressure source connected to the wheel cylinder bleeder is recommended.
a. Remove brake master cylinder filler plug and screw flexible hose with appropriate fitting into the filler hole at top of the master cylinder. Immers the free end of the flexible hose in a container with enough hydraulic fluid to cover the end of the hose.
b. Connect a clean hydraulic pressure source, such as a hydraulic hand pump or Hydro Fill unit, to the bleeder valve in the wheel cylinder.
c. As fluid is pumped into the system, observe the immersed end of the hose at the master brake cylinder for evidence of air bubbles being forced from the brake system. When bubbling has ceased, remove bleeder source from wheel cylinder and tighten the bleeder valve.

NOTE

Ensure that the free end of the hose from the master cylinder remains immersed during the entire bleeding process.

5-59. PARKING BRAKE SYSTEM. (See figure 5-13.) The parking brake system consists of a control knob on the instrument panel which is connected to linkage at the master brake cylinders. At the brake master cylinders, the control operates locking plates which trap pressure in the system after the master cylinder piston rods have been depressed by toe-operation of the rudder pedals. To release the parking brake, depress the pedals and push the control knob full in.

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**Figure 5-13. Brake Systems**
6-1. AILERON CONTROL SYSTEM. (Refer to figure 6-1.)

6-2. DESCRIPTION. The aileron control system is comprised of push-pull rods, bellcranks, cables, pulleys, sprockets and roller chains, all of which, link the control wheels to the ailerons. A control "Y" interconnects the control wheels to the aileron cables.

6-3. TROUBLE SHOOTING.

NOTE

Due to remedy procedures in the following trouble shooting chart it may be necessary to re-rig system, refer to paragraph 6-15.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOST MOTION IN CONTROL WHEELS.</td>
<td>Loose control cables.</td>
<td>Adjust cables to proper tension.</td>
</tr>
<tr>
<td></td>
<td>Broken pulley or bracket, cable off pulley or worn rod end bearings.</td>
<td>Replace worn or broken parts, install cables correctly.</td>
</tr>
<tr>
<td></td>
<td>Sprung bellcrank.</td>
<td>Replace bellcrank.</td>
</tr>
<tr>
<td></td>
<td>Loose chains.</td>
<td>Adjust chain tension.</td>
</tr>
</tbody>
</table>
### TROUBLE SHOOTING (Cont.)

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESISTANCE TO CONTROL WHEEL MOVEMENT.</td>
<td>Cables too tight.</td>
<td>Adjust cables to proper tension.</td>
</tr>
<tr>
<td></td>
<td>Pulleys binding or cable off.</td>
<td>Replace defective pulleys. Install cables correctly.</td>
</tr>
<tr>
<td></td>
<td>Bellcrank distorted or damaged.</td>
<td>Replace bellcrank.</td>
</tr>
<tr>
<td></td>
<td>Clevis bolts in system too tight.</td>
<td>Loosen, then tighten properly and safety.</td>
</tr>
<tr>
<td></td>
<td>Rusty chain or chain binding with sprocket.</td>
<td>Replace chain or defective parts.</td>
</tr>
<tr>
<td>CONTROL WHEELS NOT LEVEL WITH AILERONS NEUTRAL.</td>
<td>Improper adjustment of chains or cables.</td>
<td>Adjust in accordance with paragraph 6-15.</td>
</tr>
<tr>
<td></td>
<td>Improper adjustment of aileron push-pull rods.</td>
<td>Adjust in accordance with paragraph 6-15.</td>
</tr>
<tr>
<td>DUAL CONTROL WHEELS NOT COORDINATED.</td>
<td>Chains improperly adjusted.</td>
<td>Adjust in accordance with paragraph 6-15.</td>
</tr>
<tr>
<td>INCORRECT AILERON TRAVEL.</td>
<td>Push-pull rods not adjusted properly.</td>
<td>Adjust in accordance with paragraph 6-15.</td>
</tr>
<tr>
<td></td>
<td>Worn bellcrank stop bushings on bellcrank slots.</td>
<td>Replace worn parts.</td>
</tr>
</tbody>
</table>

### 6-4. CONTROL "Y". (Refer to figure 6-2.)

6-5. DESCRIPTION. The control "Y" transforms rotation of the control wheels into pulling motion on the aileron cables by means of sprockets and chains. The "Y" is pivoted at the lower end to operate the elevator control system.

6-6. REMOVAL AND INSTALLATION.

a. Remove control cover and carpeting as necessary to gain access to lower end of control "Y".

b. Release cable tension by loosening turnbuckle (index 3, figure 6-1).

c. Remove bolt (17) attaching control link (14).

d. Remove bolts (8) securing control wheel tubes (9) to universal joints (7).

e. Remove bolts securing cable ends to control arm (5).

f. Remove pivot bolt (16) and remove control "Y".

g. Reverse preceding steps for installation.

h. Rig aileron system in accordance with applicable paragraph in this section, safety turnbuckle and re-install all items removed in step "a".

6-2
SERIALS 15076621, A1500587, F15001249 AND FA1500282. MAINTAIN PROPER CONTROL

1. Right Direct Cable 7. Pulley
2. Direct Cable Turnbuckle 8. Clip
3. Carry-Thru Cable Turnbuckle 9. Fairlead
4. Pulley Bracket 10. Carry-Thru Cable
5. Bushing 11. Left Direct Cable
6. Cable Guard 12. Spacer

NOTE

Shaded pulleys are used in this system only.

NOTE

Carry-thru cable turnbuckle may be located at either the right or left aileron bellcrank.

* BEGINNING WITH AIRCRAFT SERIALS 15076621, A1500587, F15001249 AND FA1500282.

1. Right Direct Cable 7. Pulley
2. Direct Cable Turnbuckle 8. Clip
3. Carry-Thru Cable Turnbuckle 9. Fairlead
4. Pulley Bracket 10. Carry-Thru Cable
5. Bushing 11. Left Direct Cable
6. Cable Guard 12. Spacer

Figure 6-1. Aileron Control System

CAUTION

MAINTAIN PROPER CONTROL CABLE TENSION,

CABLE TENSION:
40 LBS ± 10 LBS ON AILERON CARRY-THRU CABLE (AT AVERAGE TEMPERATURE FOR THE AREA.) REFER TO FIGURE 1-1 FOR TRAVEL.
When dual controls are installed, spacer (4) is replaced with a universal joint to which the right control wheel is attached.

Chains are to have minimum amount of tension which will remove slack from chains.

* Use as required for maximum .005 inch end play per side.

* Left and right bolts are to be parallel.

Figure 6-2. Control "Y" Installation
of aileron bellcranks (11) in each wing when control wheels are neutral, with correct tension on aileron carry-thru cable (16). Push-pull rods (7) are then adjusted to rig ailerons neutral.

Carry-thru cable turnbuckle (index 3, figure 6-1) may be located at either the right or left aileron bellcrank. Direct cable turnbuckles are located at bellcranks.

Stop bushings (17) should be centered in slots of aileron bellcranks (11) in each wing when control wheels are neutral, with correct tension on aileron carry-thru cable (16). Push-pull rods (7) are then adjusted to rig ailerons neutral.

Brass washers (10) may be used as shims between lower end of bellcrank and wing channel (8). Retain these shims. Tape open ends of bellcrank to prevent dust and dirt from entering bellcrank needle bearings (6).

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6-7. AILERON BELLCRANK. (Refer to figure 6-3.)

6-8. REMOVAL.
   a. Remove access plate inboard of each bellcrank on underside of wing.
   b. Relieve control cable tension by loosening turnbuckle barrel (index 3, figure 6-1).
   c. Disconnect control cables from bellcrank. Retain all spacers (15).
   d. Disconnect aileron push-pull rod (7) at bellcrank.
   e. Remove nut, washer and bolt securing bellcrank stop bushing (17) and bellcrank (11) to wing structure.
   f. Remove bellcrank through access opening, using care bushing (5) is not dropped from bellcrank.

6-9. INSTALLATION.
   a. Place bushing (5) and stop-bushing (17) in bellcrank and position bellcrank in wing.
   b. Install brass washers (10) between lower end of bellcrank and wing channel (8) to shim out excess clearance.
   c. Install bellcrank pivot bolt (4), washers and nut.
   d. Position bellcrank stop-bushing (17) and install attaching bolt (18), washers and nut.
6-10. CABLES AND PULLEYS. (Refer to figure 6-1.)

6-11. REMOVAL AND INSTALLATION.
   a. Position aileron hinges between skin and auxiliary spar reinforcements and install screws and nuts as required.
   b. Attach push-pull rod to aileron.
   c. Check aileron travel and alignment, rig if necessary, in accordance with applicable paragraph in this section.

NOTE

If rigging was correct and push-pull rod adjustment was not disturbed, it should not be necessary to rig system.

6-12. AILERONS. (Refer to figure 6-3.)

6-13. REMOVAL.
   a. Disconnect push-pull rod (7) at aileron.
   b. Remove screws and nuts attaching aileron hinges (2) to trailing edge of wing.
   c. Using care, pull aileron out and down to slide hinges from under wing skin and auxiliary spar reinforcements.

6-14. INSTALLATION.
   a. Position aileron hinges between skin and auxiliary spar reinforcements and install screws and nuts attaching hinges to trailing edge of wing.
   b. Attach push-pull rod to aileron.

NOTE

Adjust chain turnbuckles (6) to minimum tension required to remove slack.

c. Tape a bar across both control wheels to hold them in neutral position.
d. (Refer to figure 6-3.) Adjust turnbuckles at bellcranks (11) so stop bushings (17) are centered in bellcrank slots with 40 ± 10 pounds tension on carry-thru cable (16). Disregard tension on direct cables, which will be different than tension on carry-thru cable.

e. Adjust push-pull rod (7) at each aileron until ailerons are neutral with reference to the trailing edge of wing flaps. Be sure wing flaps are fully up when making this adjustment. Tighten push-pull rod jam nuts.

f. Safety all turnbuckles by the single-wrap method using 0.040-inch monel safety wire.

g. Remove bar from control wheels and install all parts removed for access.

h. Check ailerons for correct travel, using inclinometer shown in figure 6-4.

WARNING

Be sure ailerons move in correct direction when operated by control wheel.

SHOP NOTES:
7-1. WING FLAP CONTROL SYSTEM. (Refer to figure 7-1.)

7-2. DESCRIPTION. The wing flap control system is comprised of an electric motor and transmission assembly, drive pulleys, push-pull rods, cables, pulleys and a flap position indicator. Power from the motor and transmission assembly is transmitted to the flaps by a system of drive pulleys, cables and push-pull rods. Electrical power to the motor is controlled by a 3-position switch mounted on the instrument panel. The flap position indicator is calibrated to show degrees of extension.

7-3. OPERATIONAL CHECK.
   a. Operate flaps through their full range of travel, observing for uneven or jumpy motion, binding and lost motion in system. Ensure flaps are moving together through their full range of travel.
   b. THRU AIRCRAFT SERIALS 15072639, F15000738, A15000277 AND FA15000132 WHEN NOT MODIFIED IN ACCORDANCE WITH FIGURE 7-2, SHEET 3. Attempt to overrun travel extremes and check for transmission freewheeling at flaps extended position. Check up-limit switch actuation at flaps retracted position.
   c. BEGINNING WITH AIRCRAFT SERIALS 15072630, F15000739, A15000278, FA15000133 AND ALL AIR-

CRAFT MODIFIED IN ACCORDANCE WITH FIGURE 7-2, SHEET 3. Check for positive sheet off of motor at the flap travel extremes, FLAP MOTOR MUST STOP OR DAMAGE WILL RESULT.
   d. Check flaps for sluggishness in operation. In flight at 100 mph, indicated airspeed, flaps should fully extend in approximately 9 seconds and retract in approximately 5 seconds. On the ground, with engine running, the flaps should extend or retract in approximately 6 seconds.
   e. With flaps full UP, mount an inclinometer on one flap and set to 0°. Lower flaps to full DOWN position and check flap angle as specified in figure 1-1. Check approximate mid-range percentage setting against degrees as indicated on inclinometer. Repeat the same procedure for the opposite flap.

   f. Remove access plates adjacent to flap drive pulleys and attempt to rock pulleys to check for bearing wear.
   g. Inspect flap rollers and tracks for evidence of binding or defective parts.

NOTE

An inclinometer for measuring control surface travel is available from the Cessna Service Parts Center. Refer to figure 6-4.
7-4. TROUBLE SHOOTING.

**NOTE**

Due to remedy procedures in the following trouble shooting chart it may be necessary to re-rig system, refer to paragraphs 7-16 and 7-19.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOTH FLAPS FAIL TO MOVE.</td>
<td>Blown fuse.</td>
<td>Check visually. Replace fuse.</td>
</tr>
<tr>
<td></td>
<td>Defective switch.</td>
<td>Place jumper across switch. Replace if defective.</td>
</tr>
<tr>
<td></td>
<td>Defective motor.</td>
<td>Remove and bench test motor. Replace if defective.</td>
</tr>
<tr>
<td></td>
<td>Broken or disconnected wires.</td>
<td>Run a continuity check. Connect or repair wiring.</td>
</tr>
<tr>
<td></td>
<td>Defective or disconnected transmission.</td>
<td>Connect or replace transmission.</td>
</tr>
<tr>
<td></td>
<td>Defective limit switch.</td>
<td>Check continuity of switches. Replace switches found defective.</td>
</tr>
<tr>
<td>BINDING IN SYSTEM AS FLAPS ARE RAISED AND LOWERED.</td>
<td>Cables not riding on pulleys.</td>
<td>Check visually. Route cables correctly over pulleys.</td>
</tr>
<tr>
<td></td>
<td>Bind in drive pulleys.</td>
<td>Check drive pulleys in motion. Replace drive pulleys found defective.</td>
</tr>
<tr>
<td></td>
<td>Broken or binding pulleys.</td>
<td>Check pulleys for free rotation or breaks. Replace defective pulleys.</td>
</tr>
<tr>
<td></td>
<td>Frayed cable.</td>
<td>Check visually. Replace defective cable.</td>
</tr>
<tr>
<td></td>
<td>Flaps binding on tracks.</td>
<td>Observe flap tracks and rollers. Replace defective parts.</td>
</tr>
<tr>
<td>LEFT FLAP FAILS TO MOVE.</td>
<td>Disconnected or broken cable.</td>
<td>Check cable tension. Connect or replace cable.</td>
</tr>
<tr>
<td></td>
<td>Disconnected push-pull rod.</td>
<td>Check visually. Attach push-pull rod.</td>
</tr>
<tr>
<td>INCORRECT FLAP TRAVEL.</td>
<td>Incorrect rigging.</td>
<td>Refer to paragraph 7-16.</td>
</tr>
<tr>
<td></td>
<td>Defective limit switch.</td>
<td>Check continuity of switches. Replace switches found defective.</td>
</tr>
<tr>
<td>FLAPS FAIL TO RETRACT.</td>
<td>Defective or disconnected UP-LIMIT switch.</td>
<td>Check continuity of switch. Connect or replace limit switch.</td>
</tr>
<tr>
<td>FLAPS FAIL TO EXTEND.</td>
<td>Defective or disconnected DOWN-LIMIT switch.</td>
<td>Check continuity of switch. Connect or replace limit switch.</td>
</tr>
</tbody>
</table>
THRU AIRCRAFT SERIALS
15074399, A15000387, F150-00943 AND FA15000211

REFER TO FIGURE 7-2

1. Drive Pulley
2. Direct Cable
3. Retract Cable
4. Turnbuckle
5. Bracket
6. Bushing
7. Cable Guard
8. Pulley
9. Switch
10. Clamp
11. Wire
12. Tubing
13. Support Clamp
14. Trim
15. Indicator Pointer
16. Spring

NOTES

* Secure wire (11) by wrapping around screw two times.

* Lubricate wire (11) in accordance with Section 2.

CAUTION

MAINTAIN PROPER CONTROL CABLE TENSION.

CABLE TENSION:
30 LBS ± 10 LBS (AT AVERAGE TEMPERATURE FOR THE AREA.)
REFER TO FIGURE 1-1 FOR TRAVELS.

Figure 7-1. Wing Flap Control System
7-5. FLAP MOTOR AND TRANSMISSION ASSEMBLY.

7-6. REMOVAL AND INSTALLATION.

a. THRU AIRCRAFT SERIALS 15072629, F15000738, A15000277 AND FA15000132 WHEN NOT MODIFIED IN ACCORDANCE WITH SK150-37 AND WHEN NOT MODIFIED IN ACCORDANCE WITH FIGURE 7-2, SHEET 3. (Refer to figure 7-2, sheet 1.)

1. Run flaps to full DOWN position.
2. Disconnect battery cables at the battery and insulate cable terminals as a safety precaution.
3. Remove access plates adjacent to drive pulley and motor assembly on right wing.

NOTE

Remove motor (10), transmission (8), hinge assembly (11) and actuating tube (5) from aircraft as a unit.

4. Remove bolt (21) securing actuating tube (5) to drive pulley (14).
5. Screw actuating tube (5) IN toward transmission (8) by hand to its shortest length.
6. Remove bolt (1) securing flap motor hinge (11) to wing. Retain brass washer between hinge and wing structure for use on reinstallation.
7. Disconnect motor electrical wiring (9) at quick-disconnects.
8. Disconnect electrical wiring at up-limit switch (3).
9. Using care, work assembly from wing through access opening.
10. Reverse the preceding steps for reinstallation. If the hinge assembly (11) was removed from the transmission (8) for any reason, ensure the short end of hinge is reinstalled toward the top.
11. Complete an operational check as outlined in paragraph 7-3 and re-rig system in accordance with paragraph 7-16.

b. THRU AIRCRAFT SERIALS 15072629, F15000738, A15000277 AND FA15000132 WHEN MODIFIED IN ACCORDANCE WITH SK150-37 AND WHEN NOT MODIFIED IN ACCORDANCE WITH FIGURE 7-2, SHEET 3. (Refer to figure 7-2, sheet 2.)

1. Complete steps 1, 3 and 4 of subparagraph "a."
2. Run flap motor to place actuating tube (5) IN to its shortest length.
3. Complete steps 2, 6, 7, 8, 9, 10 and 11 of subparagraph "a."

7-7. REPAIR. Repair consists of replacement of motor, transmission, coupling, actuating tube and associated hardware. Bearings in hinge assembly may also be replaced. Lubricate as outlined in Section 2.

7-8. DRIVE PULLEYS. (Refer to figure 7-2.)

7-9. REMOVAL AND INSTALLATION.

a. Remove access plate adjacent to drive pulley (14) in right wing.

b. Unzip or remove headliner as necessary for access to turnbuckles (index 4, figure 7-1), remove safety wire and loosen turnbuckles.

c. Remove bolt (20) securing flap push-pull rod (15) to drive pulley (14) and lower RIGHT flap gently.

d. Remove bolt (21) securing actuating tube (5) to drive pulley (14) and lower LEFT flap gently. Retain bushing.

e. Remove cable locks (13) securing control cables to drive pulley (14). Tag cables for reference on reinstallation.

f. Remove bolt (12) attaching drive pulley (14) to wing structure.

g. Using care, remove drive pulley through access opening, being careful not to drop bushing. Retain brass washer between drive pulley and wing structure for use on reinstallation. Tape open ends of drive pulley after removal to protect bearings.

h. To remove left wing drive pulley, use this same procedure omitting step "d."

1. Reverse the preceding steps for reinstallation. Rig system in accordance with paragraph 7-16, safety turnbuckles and reinstall all items removed for access.

7-10. REPAIR. Repair is limited to replacement of bearings. Cracked, bent or excessively worn drive pulleys must be replaced. Lubricate bearings as outlined in Section 2.

7-11. FLAPS. (Refer to figure 7-3.)

7-12. REMOVAL AND INSTALLATION.

a. Run flaps to full DOWN position.

b. Remove access plates (1) from top leading edge of flap.

c. Disconnect push-pull rod (6) at flap bracket (7).

d. Remove bolts (5) at each flap track. As flap is removed from wing, all washers, rollers and bushings will fall free. Retain these for reinstallation.

e. Reverse the preceding steps for reinstallation. If push-pull rod (6) adjustment is not disturbed, re-rigging of system should not be necessary. Check flap travel and rig in accordance with paragraph 7-16, if necessary.

7-13. REPAIR. Flap repair may be accomplished in accordance with instructions outlined in Section 18.

7-14. CABLES AND PULLEYS. (Refer to figure 7-1.)

7-15. REMOVAL AND INSTALLATION.

a. Remove access plates, fairings, headliner and upholstery as necessary for access.

b. If the direct cable (2) is to be removed, disconnect clamp (10) and slowly release indicator wire (11) until spring (16) tension is relieved.

c. Remove safety wire, relieve cable tension, disconnect turnbuckles (4) and carefully lower LEFT flap.

d. Disconnect cables at drive pulleys, remove

7-4 Change 1
NOTE

Use Grade "C" Loctite sealant on threads of setscrew (6) after final adjustment.

Figure 7-2. Flap Motor and Transmission Installation (Sheet 1 of 3)
AIRCRAFT SERIALS 15061533 THRU 15072629, F15000001 THRU F15000738, A15000001 THRU A15000277 AND FA15000001 THRU FA15000132 WHEN MODIFIED IN ACCORDANCE WITH SK150-37

BEGINNING WITH AIRCRAFT SERIALS 15072630, F15000739, A15000278 AND FA15000133

Figure 7-2. Flap Motor and Transmission Installation (Sheet 2 of 3)
SK150-41 AND THIS FLAP ACTUATOR INSTALLATION IS EFFECTIVE ONLY WHEN USED AS A REPLACEMENT SPARE, OR ON PRODUCTION FLAP ACTUATOR INSTALLATIONS PRIOR TO AIRCRAFT SERIALS 15072690, F150-00739, A15000278 AND FA15000133

Figure 7-2. Flap Motor and Transmission Installation (Sheet 3 of 3)
Bushings (4), rollers (3) and spacers (9) are first positioned through slots in flap tracks, then are secured to the flap roller supports (2) with attaching bolts, washers and nuts. Nylon plug buttons (11) prevent wing flap from chafing wing trailing edge.

Position spacers (9) and direction of bolts (5) as required to provide adequate flap clearance at wing root, flap well skin and aileron. Some lateral movement of flap is inherent due to the width of rollers. This movement should be considered when positioning spacers and direction of bolts.

Figure 7-3. Flap Installation
cable guards and pulleys as necessary to work cables free of aircraft.

NOTE

To ease routing of cables, a length of wire may be attached to the end of cable being withdrawn from the aircraft. Leave wire in place, routed through structure; then attach the cable being installed and use wire to pull cable into position.

e. Reverse the preceding steps for reinstallation.

f. After cables are routed in position, install pulleys and cable guards. Ensure cables are positioned in pulley grooves before installing guards.

g. Re-rig flap system in accordance with paragraph 7-16 and safety turnbuckles.

h. Re-rig indicating system in accordance with paragraph 7-19 and reinstall all items removed in step "a."

7-16. RIGGING.

a. (Refer to figure 7-1.) Unzip or remove headliner as necessary for access to turnbuckles (4).

b. Disconnect indicator wire clamp (10) and slowly release indicator wire (11) until spring (16) tension is relieved.

c. Remove safety wire, relieve cable tension, disconnect turnbuckles (4) and carefully lower LEFT flap.

d. (Refer to figure 7-2.) Disconnect push-pull rods (15) at drive pulleys (14) in both wings and lower RIGHT flap gently.

e. Disconnect actuating tube (5) from drive pulley (14).

NOTE

If control cables are not connected to left and right drive pulleys, actuating tube (5) and push-pull rods (15) must be disconnected before installing cables. If drive pulleys (14) are not installed, attach control cables before installing drive pulleys in the wings as illustrated in figure 7-4.

f. Adjust both push-pull rods (15) to 8.83±.12 inches between centers of rod end bearings and tighten locknuts on both ends. Connect push-pull rods to flaps and drive pulleys.

NOTE

Temporarily connect cables at turnbuckles (index 4, figure 7-1) and test flaps by hand to ensure both flaps extend and retract together. If they will not, the cables are incorrectly attached to the drive pulleys. Ensure that the right drive pulley rotates clockwise when viewed from below, as the flaps are extended. Tag cables for reference and disconnect turnbuckles again.
g. THRU AIRCRAFT SERIALS 15072629, F15000738, A15000277 AND FA15000132 WHEN NOT MODIFIED IN ACCORDANCE WITH SK150-37 AND WHEN NOT MODIFIED IN ACCORDANCE WITH FIGURE 7-2, SHEET 3. (Refer to figure 7-2, sheet 1.) Screw actuating tube (5) IN toward transmission (8) by hand to its shortest length (flaps full up position). Loosen setscrew (6) securing actuating tube (5) to nut and ball assembly, hold nut and ball assembly so that it will not move, hold RIGHT flap in the full UP position and adjust actuating tube (5) IN or OUT as necessary to align with attachment hole in drive pulley (14). Tighten setscrew (6) and secure tube to drive pulley with bolt (21).

h. THRU AIRCRAFT SERIALS 15072629, F15000738, A15000277 AND FA15000132 WHEN MODIFIED IN ACCORDANCE WITH SK150-37 AND WHEN NOT MODIFIED IN ACCORDANCE WITH FIGURE 7-2, SHEET 3. (Refer to figure 7-2, sheet 2.) Operate flap motor until actuating tube (5) is IN to its shortest length (flaps full up position). Hold RIGHT flap in the full UP position and check actuating tube (5) to drive pulley (14) attachment holes for alignment. Operate flap motor toward the DOWN position until bolt (21) can be installed freely. Loosen setscrew (6) and rotate nut and ball assembly IN against transmission (8). Tighten setscrew (6) and bolt (21).

i. BEGINNING WITH AIRCRAFT SERIALS 15072630, F15000739, A15000278, FA15000133 AND ALL AIRCRAFT MODIFIED IN ACCORDANCE WITH FIGURE 7-2, SHEET 3. (Refer to figure 7-2, sheets 2 and 3.) Screw actuating tube (5) IN toward transmission (8) by hand to .12±.05 inches between switch actuating collar (30) and transmission as illustrated in figure 7-2, VIEW B-B. Loosen setscrew (6) securing actuating tube (5) to switch actuating collar (30), hold actuating collar to maintain .12±.05", hold RIGHT flap in the full UP position and adjust actuating tube (5) IN or OUT as necessary to align with attachment hole in drive pulley (14). Tighten setscrew (6) and secure tube to drive pulley with bolt (21).

NOTE

If actuating tube (5) is too long to allow attachment to drive pulley after completion of steps "g", "h" and "i", proceed to step "j."

j. Disconnect push-pull rod (15) at drive pulley (14), then connect actuating tube (5) to drive pulley.

k. Manually hold RIGHT flap in full UP position and readjust push-pull rod (15) to align with attachment hole in drive pulley. Connect push-pull rod and tighten locknuts.

NOTE

The right flap and actuator must be correctly rigged before cables and left flap can be rigged.

l. THRU AIRCRAFT SERIALS 15072629, F15000738, A15000277 AND FA15000132 WHEN NOT MODIFIED IN ACCORDANCE WITH FIGURE 7-2, SHEET 3. After completion of step "k", with flap in full UP position, adjust up-limit switch clamp (7) to operate switch (3) and shut-off electrical power to motor at this position.

m. BEGINNING WITH AIRCRAFT SERIALS 15072630, F15000739, A15000278 AND FA15000133 AND ALL AIRCRAFT MODIFIED IN ACCORDANCE WITH FIGURE 7-2, SHEET 3. After completion of step "k", with flaps in full UP position, loosen setscrew (27) and slide up-limit switch adjustment block (28) on support (31) to operate switch and shut-off electrical power to motor at this position. Tighten setscrew (27).

n. Manually hold LEFT flap full UP and connect control cables at turnbuckles (index 4, figure 7-1). Remove reference tags previously installed in step "f" as turnbuckles are connected.

o. With flaps full UP, adjust turnbuckles to obtain 30±10 pounds tension on cables. Adjust retract cable (19) first.

NOTE

Ensure cables are positioned in pulley grooves and cable ends are positioned correctly at drive pulleys before tightening turnbuckles.

p. Disconnect push-pull rod at left drive pulley. Run motor to extend flaps approximately 20° and check tension on each flap cable. If necessary, re-adjust turnbuckles to maintain 30±10 pounds tension on each cable and safety turnbuckles.

q. Fully retract right flap. Manually hold left flap in full UP position and readjust push-pull rod to align with attaching hole in drive pulley. Connect push-pull rod and tighten locknuts.

NOTE

An inclinometer for measuring control surface travel is available from the Cessna Service Parts Center. Refer to figure 6-4.

r. Mount an inclinometer on one flap and adjust to 0°. Extend flaps and check down angle as follows:

s. THRU AIRCRAFT SERIALS 15072629, F15000738, A15000277 AND FA15000132 WHEN NOT MODIFIED IN ACCORDANCE WITH FIGURE 7-2, SHEET 3. After completion of steps "a" thru "r", the flap down angle should be as specified in figure 1-1. Repeat down angle check on opposite flap.

t. BEGINNING WITH AIRCRAFT SERIALS 15072630, F15000739, A15000278, FA15000133 AND ALL AIRCRAFT MODIFIED IN ACCORDANCE WITH FIGURE 7-2, SHEET 3. After completion of steps "a" thru "r", adjust down-limit switch (32) to operate and shut-off electrical power to motor at degree of travel.
specified in figure 1-1. Repeat down angle check on opposite flap. Check operation of limit switches for positive shut-off through several cycles.

NOTE

Since the flap rollers may not bottom in the flap tracks with flaps fully extended, some free play may be noticed in this position.

u. Connect and re-rig indicating system in accordance with paragraph 7-19, perform an operational check in accordance with paragraph 7-3, check all locknuts for tightness, all turnbuckles are safed and reinstall all items removed for access.

7-17. INDICATING SYSTEM. (Refer to figure 7-1.)

7-18. DESCRIPTION. The mechanical indicating system consists of a tubing-enclosed flexible wire attached to the flap direct cable at one end and to a pointer at the other end. Movement of the flap direct cable pulls the pointer along a scale to indicate flap position as the flaps are extended. Opposite movement of the flap direct cable permits a return spring, attached to the pointer, to pull pointer in the opposite direction as the flaps are raised.

7-19. RIGGING.

a. Operate flaps to full UP position.

b. Open zipper or remove headliner as necessary for access.

c. Loosen clamp (10) securing flexible wire (11) to flap direct cable (2) and adjust wire as required to place pointer at 0° (flaps up) position on indicator. Wrap wire (11) around clamp bolt a minimum of 2 times and tighten bolt.

d. Cycle flaps to check proper operation of indicating system.

e. Close zipper or replace headliner removed in step "b."

Change 1 7-11/(7-12 blank)
SECTION 8
ELEVATOR CONTROL SYSTEM

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<tr>
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<td>8-2</td>
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</tbody>
</table>

8-1. ELEVATOR CONTROL SYSTEM.

8-2. DESCRIPTION. The elevators are operated by power transmitted from the control wheels through a series of cables, bellcranks and a push-pull tube.

The rear bellcrank serves as an interconnect between the elevators and a bearing point for the travel stop bolts. An elevator trim tab is installed on the right elevator and is described in Section 9.

8-3. TROUBLE SHOOTING.

NOTE

Due to remedy procedures in the following trouble shooting chart it may be necessary to re-rig system, refer to paragraph 8-14.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO RESPONSE TO CONTROL WHEEL FORE-AND-AFT MOVEMENT.</td>
<td>Forward or aft end of push-pull tube disconnected.</td>
<td>Attach push-pull tube correctly.</td>
</tr>
<tr>
<td></td>
<td>Cables disconnected.</td>
<td>Attach cables and rig system in accordance with paragraph 8-14.</td>
</tr>
<tr>
<td>BINDING OR JUMPY MOTION FELT IN MOVEMENT OF ELEVATOR SYSTEM.</td>
<td>Defective forward or rear bellcrank pivot bearing.</td>
<td>Replace bellcrank.</td>
</tr>
<tr>
<td></td>
<td>Cables slack.</td>
<td>Adjust to tension specified in figure 8-1.</td>
</tr>
<tr>
<td></td>
<td>Cables not riding correctly on pulleys.</td>
<td>Route cables correctly over pulleys.</td>
</tr>
<tr>
<td></td>
<td>Nylon grommet on instrument panel binding.</td>
<td>Replace grommet.</td>
</tr>
<tr>
<td></td>
<td>Defective control &quot;y&quot; pivot bearing.</td>
<td>Replace bearing.</td>
</tr>
<tr>
<td></td>
<td>Defective elevator hinges or lubrication needed.</td>
<td>Replace defective hinges. Lubricate per Section 2.</td>
</tr>
<tr>
<td></td>
<td>Clevis bolts too tight.</td>
<td>Readjust to eliminate bolt binding.</td>
</tr>
<tr>
<td></td>
<td>Lubrication needed.</td>
<td>Lubricate piano hinges.</td>
</tr>
<tr>
<td></td>
<td>Defective pulleys or cable guards.</td>
<td>Replace defective parts and install guards properly.</td>
</tr>
</tbody>
</table>
8-3. TROUBLE SHOOTING (Cont).

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELEVATORS FAIL TO ATTAIN</td>
<td>Stops incorrectly set.</td>
<td>Rig system in accordance with paragraph 8-14.</td>
</tr>
<tr>
<td>PRESCRIBED TRAVEL</td>
<td>Cables tightened unevenly.</td>
<td>Rig system in accordance with paragraph 8-14.</td>
</tr>
<tr>
<td>Interference at firewall or</td>
<td>Interference at firewall or</td>
<td>Rig system in accordance with paragraph 8-14.</td>
</tr>
<tr>
<td>instrument panel.</td>
<td>instrument panel.</td>
<td></td>
</tr>
</tbody>
</table>

8-4. ELEVATORS. (Refer to figure 8-2.)

8-5. REMOVAL AND INSTALLATION.

NOTE
This procedure is written primarily for the right elevator since the trim tab is attached to this elevator.

a. Disconnect trim tab push-pull tube (2) at tab actuator.
b. Remove bolts (8) securing elevators to bellcrank (7).

c. Remove bolts (10) from elevator hinges.
d. Using care, remove elevator.
e. To remove left elevator use same procedure, omitting step "a".
f. Reverse preceding steps for installation. Rig system in accordance with applicable paragraph in this section if necessary.

8-6. REPAIR. Repair may be accomplished as outlined in Section 18. Hinge bushings may be replaced as necessary. If repair has affected static balance, check and rebalance as required.

8-7. BELLCRANKS.

8-8. FORWARD. (Refer to figure 8-1.)

8-9. REMOVAL AND INSTALLATION.
a. Remove seats, upholstery and access plates as necessary.
b. Relieve cable tension at turnbuckles (10) and disconnect cables from bellcrank (14).
c. Disconnect push-pull tube (15) from bellcrank.
d. Remove pivot bolt (13) and remove bellcrank.
e. Reverse preceding steps for installation. Rig system in accordance with applicable paragraph in this section, safety turnbuckles and reinstall all items removed in step "a".

8-10. REAR. (Refer to figure 8-2.)

8-11. REMOVAL AND INSTALLATION.
a. Remove rudder. (Refer to Section 10.)
b. Remove seats, upholstery and access plates as necessary for access to turnbuckles (index 10, figure 8-1).
c. Relieve cable tension at turnbuckles and disconnect cables from rear bellcrank (7).
d. Remove bolts (8) securing elevators to bellcrank.
e. Remove bellcrank pivot bolt and slide bellcrank from between tube assemblies (6).

NOTE
It may be necessary to remove one of the attaching bolts (10) for clearance when removing the bellcrank pivot bolt.

f. Reverse preceding steps for installation. Rig system in accordance with applicable paragraph in this section, safety turnbuckles and reinstall all items removed in step "b".

8-12. CABLES AND PULLEYS. (Refer to figure 8-1.)

8-13. REMOVAL AND INSTALLATION.
a. Remove seats, upholstery and access plates as necessary.
b. Relieve cable tension at turnbuckles (10).
c. Disconnect cables at forward bellcrank links (12).
d. Disconnect cables at rear bellcrank (9).
e. Remove fairleads, cable guards and pulleys as necessary to work cables free of aircraft.

NOTE
To ease routing of cables, a length of wire may be attached to end of cable before being withdrawn from aircraft. Leave wire in place, routed through structure, attach cable being installed and pull cable into position.
THRU AIRCRAFT SERIALS
15074661, F15001023, A150-00415 AND FA15000211

BEGINNING WITH AIRCRAFT SERIALS 15074662,
F15001024, A15000416 AND FA15000212

REFER TO FIGURE 6-2

*The travel-stop bolts (6) are safetied beginning with aircraft serials 15072569, A15000263,
F15000759 and FA15000162.

Figure 8-1. Elevator Control System (Sheet 1 of 2)
BEGINNING WITH AIRCRAFT SERIALS 15074662, F150001024, A15000416 AND FA15000212

Detail A1

Detail B1

Detail D1

Figure 8-1. Elevator Control System (Sheet 2 of 2)
Castellated nuts and pins replace existing nuts on push-pull tube (2) attach bolts beginning with aircraft serials 15071905, A15000198, F15000620 and FA15000062.

- Thru aircraft serials 15072435, F15000778, A15000256 and FA15000161
- Beginning with aircraft serials 15072436, F15000779, A15000257 and FA15000162

1. Clevis
2. Push-Pull Tube
3. Horn Assembly
4. Trim Tab
5. Bearing
6. Tube Assembly
7. Bellcrank
8. Bolt
9. Spacer
10. Bolt
11. Bushing

- Castellated nuts and pins beginning with aircraft serials 15071622, F15000700, A15000130 and FA15000040

Figure 8-2. Elevator Installation

Change 3 8-5
f. After cable is routed in position, install pulleys and cable guards. Ensure cable is positioned in pulley groove before installing guards.
g. Rig system in accordance with applicable paragraph in this section, safety turnbuckles and re-install all items removed in step "a".

8-14. RIGGING. (Refer to figure 8-1.)

**NOTE**

An inclinometer for measuring control surface travel is available from Cessna Service Parts Center. Refer to figure 6-4.

a. Locate neutral position of elevators by streamlining elevators with stabilizer.

b. Place an inclinometer on one elevator and set to zero.
c. Adjust elevator stops (6) to attain travel specified in Section 1.
d. Remove seats, upholstery and access plates as necessary for access to turnbuckles (10).
e. Adjust cables to 30 ± 10 pounds tension by tightening turnbuckles (10). Ensure control "Y" does not contact instrument panel in full-up position or firewall in full-down position.
f. Safety turnbuckles and re-install all items removed in step "d".

**WARNING**

Be sure elevators move in correct direction when operated by control wheel.

**SHOP NOTES:**

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8-6  Change 3
SECTION 9
ELEVATOR TRIM CONTROL SYSTEM

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9-1. ELEVATOR TRIM CONTROL SYSTEM. (Refer to figure 9-1.)

9-2. DESCRIPTION. The elevator trim tab, located on the right elevator, is controlled by a trim wheel mounted in the lower instrument panel. Power to operate the tab is transmitted from the trim control wheel by means of chains, cables and an actuator. A mechanical pointer, adjacent to the trim wheel indicates tab position. A "nose-up" setting results in a tab-down position.

9-3. TROUBLE SHOOTING.

NOTE

Due to remedy procedures in the following trouble shooting chart it may be necessary to re-rig system, refer to paragraph 9-12.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRIM CONTROL WHEEL MOVES WITH EXCESSIVE RESISTANCE.</td>
<td>Cable tension too high.</td>
<td>Adjust tension.</td>
</tr>
<tr>
<td></td>
<td>Pulleys binding or rubbing.</td>
<td>Repair or replace as necessary.</td>
</tr>
<tr>
<td></td>
<td>Cables not in place on pulleys.</td>
<td>Install cables correctly.</td>
</tr>
<tr>
<td></td>
<td>Trim tab hinge binding.</td>
<td>Lubricate or replace hinge as necessary.</td>
</tr>
<tr>
<td></td>
<td>Defective trim tab actuator.</td>
<td>Replace actuator.</td>
</tr>
<tr>
<td></td>
<td>Rusty chain.</td>
<td>Replace rusty chain.</td>
</tr>
<tr>
<td></td>
<td>Damaged sprocket.</td>
<td>Replace damaged sprockets.</td>
</tr>
<tr>
<td></td>
<td>Bent sprocket shaft.</td>
<td>Replace bent sprocket shafts.</td>
</tr>
</tbody>
</table>
8-3. TROUBLE SHOOTING (Cont).

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOST MOTION BETWEEN CONTROL WHEEL AND TRIM TAB.</td>
<td>Cable tension too low.</td>
<td>Adjust tension.</td>
</tr>
<tr>
<td></td>
<td>Broken pulley.</td>
<td>Replace defective pulley.</td>
</tr>
<tr>
<td></td>
<td>Cables not in place on pulleys.</td>
<td>Install cables correctly.</td>
</tr>
<tr>
<td></td>
<td>Worn trim tab actuator.</td>
<td>Remove and replace worn actuator.</td>
</tr>
<tr>
<td></td>
<td>Actuator attachment loose.</td>
<td>Tighten.</td>
</tr>
<tr>
<td>TRIM INDICATOR FAILS TO INDICATE CORRECT TRIM POSITION.</td>
<td>Indicator incorrectly engaged on wheel track.</td>
<td>Reset indicator.</td>
</tr>
<tr>
<td>INCORRECT TRIM TAB TRAVEL.</td>
<td>Stop blocks loose or incorrectly adjusted.</td>
<td>Adjust stop blocks on cables.</td>
</tr>
</tbody>
</table>

9-4. TRIM TAB. (Refer to figure 8-2.)

9-5. REMOVAL AND INSTALLATION.

a. Disconnect push-pull tube (2) from horn assembly (3).
b. Drill out rivets attaching hinge to elevator.
   
   **NOTE**
   
   After tab has been removed and if hinge pin is to be removed, it is necessary to spread the cramped ends of the hinge before driving out pin. When a pin has been installed, crimp ends of hinge to prevent pin from working out.

c. Reverse preceding steps for installation.

9-6. TRIM TAB ACTUATOR.

9-7. REMOVAL AND INSTALLATION. (Refer to figure 9-1.)

   **CAUTION**

   Position a support stand under tail tie-down ring to prevent tailcone from dropping while working inside.

   a. Remove baggage compartment aft wall for access.
   b. Remove safety wire and relieve cable tension at turnbuckle (15).
   
   c. Disconnect push-pull tube (12) from actuator (9).
   d. Remove access plate from underside of right hand stabilizer beneath actuator.
   e. Remove chain guard (8) and disengage chain (8A) from actuator sprocket.
   f. Remove screws (8B) and spacers (10) attaching actuator clamps to stabilizer structure (11) and carefully work actuator out through access opening.
   g. Reverse the preceding steps for reinstallation. Rig trim system in accordance with paragraph 9-12, safety turnbuckle (15) and reinstall all items removed for access.

9-7A. DISASSEMBLY. (Refer to figure 9-2.)

   a. Remove actuator in accordance with paragraph 9-7.
   b. Disassemble actuator assembly (1) as illustrated in Detail A as follows:
      1. Remove chain guard (3) if not previously removed in step "e" of paragraph 9-7.
      2. Using suitable punch and hammer, remove groov-pins (8) securing sprocket (5) to screw (9) and remove sprocket from screw.
      3. Unscrew threaded rod end (15) and remove rod end from actuator.
      4. Remove groov-pins (10) securing bearings (6 and 14) at the housing ends.
      5. Lightly tap screw (9) toward the sprocket end of housing, remove bearing (6) and collar (7).
      6. Lightly tap screw (8) in the opposite direction from sprocket end, remove bearing (14), O-ring (13) and collar (7).
REFER TO FIGURE 9-2

* Safety wired on some aircraft.

Detail A

Detail B

Detail C

Detail D

Detail E

Detail F

Detail G

CAUTION

MAINTAIN PROPER CONTROL CABLE TENSION.

1. Bracket
2. Bearing
3. Trim Wheel
4. Chain
5. Sprocket
6. Roll Pin
7. Indicator
8. Chain Guard
8A. Chain
8B. Screw
9. Actuator
10. Spacer
11. Stabilizer Structure
12. Push-Pull Tube
13. Pulley (Tab Up)
13A. Pulley (Tab Down)
14. Clevis
15. Turnbuckle
16. Elevator Tab Stop Block
17. Cable Guard
18. Fairlead

CABLE TENSION:
10 TO 20 LBS (AT AVERAGE TEMPERATURE FOR THE AREA.)
REFER TO FIGURE 1-1 FOR TRAVEL.

Figure 9-1. Elevator Trim Control System (Sheet 1 of 2)
Figure 9-1. Elevator Trim Control System (Sheet 2 of 2)

9-4 Change 3
7. It is not necessary to remove retaining rings (11).

9-7B. CLEANING, INSPECTION AND REPAIR.

(Refer to figure 9-2.)

a. DO NOT remove bearing (16) from threaded rod end (15) unless replacement of bearing is necessary.
b. Clean all component parts, except bearing (16), by washing in Stoddard solvent or equivalent. Do not clean sealed bearing (16).
c. Inspect all component parts for obvious indications of damage such as stripped threads, cracks, deep nicks and dents.
d. Check bearings (6 and 14), screw (9) and threaded rod end (15) for excessive wear and scoring. Dimensions of the parts are as follows:

<table>
<thead>
<tr>
<th>BEARING (6)</th>
<th>INSIDE DIAMETER</th>
<th>INSIDE DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.373&quot; MIN.</td>
<td>0.380&quot; MAX.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BEARING (14)</th>
<th>INSIDE DIAMETER</th>
<th>SMALL HOLE</th>
<th>LARGE HOLE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.248&quot; MIN.</td>
<td>0.253&quot; MAX.</td>
<td>0.373&quot; MIN.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THREADED ROD END</th>
<th>OUTSIDE DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTSIDE DIAMETER</td>
<td>(SHANK)</td>
</tr>
<tr>
<td></td>
<td>0.242&quot; MIN.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCREW (9)</th>
<th>OUTSIDE DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.367&quot; MIN.</td>
</tr>
</tbody>
</table>

NOTE

Relative linear movement between internal threaded screw (9) and bearing (14) should be 0.004 to 0.010 inch at room temperature.

e. Insert screw (9), with assembled parts, into housing (12) until bearing (6) is flush with the end of housing.

9-7C. REASSEMBLY. (Refer to figure 9-2.)

a. Always discard the following items and install new parts during reassembly:

1. Bearings (6 and 14).
2. Groov-Pins (8 and 10).
3. C-Ring (13).
4. Nuts (2).

b. During reassembly, lubricate collars (7), screw (9) and threaded rod end (15) in accordance with Section 2.
c. Press sprocket (5) into the end of screw (9), align groov-pin holes and install new groov-pins (8).
d. Slip bearing (6) and collar (7) on screw (9) and slide them down against sprocket (5).

e. With bearing (6) flush with end of housing (12), carefully drill bearing so the drill will emerge from the hole on the opposite side of housing (12). DO NOT ENLARGE HOLES IN HOUSING.

g. Press new groov-pins (10) into pin holes.
h. Insert collar (7), new O-ring (13) and bearing (14) into opposite end of housing (12). Complete steps "f" and "g" for bearing (14).
j. If a new bearing (16) is required, a new bearing may be pressed into the boss. Be sure force bears against the outer race of bearing.
k. Screw the threaded rod end (15) into screw (9).
l. Install retaining rings (11), if they were removed.
m. Test actuator assembly by rotating sprocket (5) with fingers while holding threaded rod end (15). The threaded rod end should travel in and out smoothly with no indication of binding.

9-7D. TRIM TAB FREE-PLAY INSPECTION.

a. Place elevators and trim tab in the neutral position.
b. Using moderate pressure, move the trim tab trailing edge up and down by hand to check free-play.
c. A maximum of .112" (total motion up and down) measured at the trim tab trailing edge is permissible. The trim tab free-play is less than .112", the system is within prescribed limits.
e. If the trim tab free-play is more than .112", check the following items for looseness while moving the trim tab up and down.

1. Check push-pull tube to trim tab horn assembly attachment for looseness.
2. Check push-pull tube to actuator assembly threaded rod end attachment for looseness.
3. Check actuator assembly threaded rod end for looseness in the actuator assembly.
f. If looseness is apparent while checking steps e-1 and e-2, repair by installing new parts.
g. If looseness is apparent while checking step e-3, refer to paragraphs 9-6 through 9-7C.

Change 3    9-4A/(9-4B blank)
1. With elevators in neutral, set trim tab to neutral (streamlined).
2. Position stop block (3) against turnbuckle and secure to cable B.
3. Place inclinometer on trim tab and run tab to DOWN TRAVEL limit listed in Section 1.
4. Position stop block (2) against stop block (3) and secure to cable A.
5. Run trim tab to UP TRAVEL limit listed in Section 1, place stop block (1) against stop block (2) and secure to cable B.
9-8. TRIM TAB CONTROL WHEEL. (Refer to figure 9-1.)

9-9. REMOVAL AND INSTALLATION.
   a. Relieve cable tension at turnbuckle (15).

   **CAUTION**
   Position a support stand under tail tie-down ring to prevent tailcone from dropping while working inside.

   b. Disengage chain from sprocket (5).
   c. Remove cotter pin at each end of trim wheel shaft.
   d. Slide shaft assembly into either bearing (2) as far as possible.
   e. Carefully deform brackets (1) and slide shaft assembly free of bearings (2).
   f. Reverse preceding steps for installation. Rig system in accordance with applicable paragraph in this section, safety turnbuckle and reinstall all items removed for access.

9-10. CABLES AND PULLEYS. (Refer to figure 9-1.)

9-11. REMOVAL AND INSTALLATION.
   a. Remove seats, upholstery and access plates as necessary.
   b. Disconnect cables at turnbuckle (15) and clevis (14).
   c. Remove fairlead, cable guards and pulleys as necessary to work cables free of aircraft.

   **NOTE**
   To ease routing of cables, a length of wire may be attached to end of cable before being withdrawn from aircraft. Leave wire in place, routed through structure, attach cable being installed and pull cable into position.

   d. After cable is routed in position, install pulleys and cable guards. Ensure cable is positioned in pulley groove before installing guards.
   e. Rig system in accordance with applicable paragraph in this section, safety turnbuckle and reinstall all items removed in step "a."

9-12. RIGGING. (Refer to figure 9-1.)

   **CAUTION**
   Position a support stand under tail tie-down ring to prevent tailcone from dropping while working inside.

   a. Remove rear baggage compartment panel and access plates as necessary.
   b. Loosen travel stop blocks (16) on cables.

   c. Disconnect actuator (9) from push-pull tube (12).
   d. Check cable tension and readjust turnbuckle (15) if necessary.

   **NOTE**
   If chains and/or cables are being installed, permit actuator screw to rotate freely as chains and cables are connected. Set cable tension.

   e. Rotate trim wheel (3) full forward (nose down). Ensure that indicator (7) does not restrict wheel movement. If necessary, reposition indicator using a thin screwdriver to pry trailing leg of indicator out of groove.

   **NOTE**
   Full forward (nose down) position of trim wheel is where further movement is prevented by chain or cable ends contacting sprockets or pulleys.

   f. With elevator and trim tab both in neutral (streamlined), place inclinometer on tab and set to zero.

   **NOTE**
   An inclinometer for measuring control surface travel is available from Cessna Service Parts Center. Refer to figure 6-4.

   g. Rotate actuator screw in or out as required to place tab up with a maximum of 2° overtravel, with actuator screw connected to push-pull tube (12).
   h. Rotate trim wheel to position tab up and down, readjusting actuator screw as required to obtain overtravel in both directions.
   i. Position stop blocks (16) and adjust as illustrated in figure 9-3 to limit travel to the degree specified in Section 1.
   j. Check that trim wheel indicator travels same distance from ends of slot in cover. Reposition trailing leg of indicator if necessary (refer to step "e").
   k. Safety turnbuckle and reinstall all items removed in step "a."

   **WARNING**
   Be sure trim tab moves in correct direction when operated by trim wheel. Nose down trim corresponds to tab up position.
10-1. RUDDER CONTROL SYSTEM. (Refer to figure 10-1.)

10-2. DESCRIPTION. Rudder control is maintained through use of conventional rudder pedals which also control nose wheel steering. The system is comprised of rudder pedals, cables and pulleys, all of which link the pedals to the rudder and nose wheel steering. Beginning with 1975 Models, rudder is vertically extended 6 inches and balance weight repositioned as depicted in figure 10-3.

10-3. TROUBLE SHOOTING.

NOTE
Due to remedy procedures in the following trouble shooting chart it may be necessary to re-rig system, refer to paragraph 10-11.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUDDER DOES NOT RESPOND TO PEDAL MOVEMENT.</td>
<td>Broken or disconnected cables.</td>
<td>Connect or replace cables.</td>
</tr>
<tr>
<td>BINDING OR JUMPY MOVEMENT OF RUDDER PEDALS.</td>
<td>Cables too tight.</td>
<td>Adjust cable tension in accordance with paragraph 10-11.</td>
</tr>
<tr>
<td></td>
<td>Cables not riding properly on pulleys.</td>
<td>Route cables correctly over pulleys.</td>
</tr>
<tr>
<td></td>
<td>Binding, broken or defective pulleys or cable guards.</td>
<td>Replace defective pulleys and install guards properly.</td>
</tr>
<tr>
<td></td>
<td>Pedal bars need lubrication.</td>
<td>Refer to Section 2.</td>
</tr>
<tr>
<td></td>
<td>Defective rudder bar bearings.</td>
<td>Replace bearing blocks.</td>
</tr>
<tr>
<td></td>
<td>Defective rudder hinge bushings or bellcrank bushings.</td>
<td>Replace defective bushings.</td>
</tr>
<tr>
<td></td>
<td>Clevis bolts too tight.</td>
<td>Readjust to eliminate binding.</td>
</tr>
<tr>
<td></td>
<td>Steering rods not adjusted properly.</td>
<td>Rig system in accordance with paragraph 10-11.</td>
</tr>
<tr>
<td>LOST MOTION BETWEEN RUDDER PEDALS AND RUDDER.</td>
<td>Insufficient cable tension.</td>
<td>Adjust cable tension in accordance with paragraph 10-11.</td>
</tr>
<tr>
<td>INCORRECT RUDDER TRAVEL.</td>
<td>Incorrect rigging.</td>
<td>Rig system in accordance with paragraph 10-11.</td>
</tr>
</tbody>
</table>
Safety wire travel stop screws (8) beginning with aircraft serials 15072569, F15000759, A15000263, and FA15000162.

*CAUTION*

MAINTAIN PROPER CONTROL CABLE TENSION.

CABLE TENSION: REFER TO RIGGING PARAGRAPH IN THIS SECTION. REFER TO FIGURE 1-1 FOR TRAVEL.
Figure 10-1. Rudder Control System (Sheet 2 of 2)

Detail A1

Detail D1

Detail E1

Detail G1

Change 3 10-2A/(10-2B blank)
1. Brake Link Pin  
2. Pedal  
3. Anti-Rattle Spring  
4. Pivot Shaft  
5. Fuselage Structure  
6. Pedal Arm  
7. Brake Torque Tube  
8. Bearing  
9. Bellcrank  
10. Bracket  
11. Master Cylinder  
12. Brake Link  
13. Left Rudder Bar  
14. Return Spring  
15. Bearing Block  
16. Right Rudder Bar  

Figure 10-2. Rudder Pedals Installation
NOTE

Doublers are added to the rudder hinge halves beginning with aircraft serials 15072577, F150-00139, A15000268 and FA15000122


1. Lower Hinge Half
2. Bushing
3. Upper Hinge Half
4. Bolt
5. Balance Weight
6. Navigation Light
7. Trim Tab
8. Bellcrank
9. Stop
10. Quick-Disconnect

Figure 10-3. Rudder Installation

10-4. RUDDER PEDAL ASSEMBLY. (Refer to figure 10-2.)

10-5. REMOVAL AND INSTALLATION.
a. Remove carpeting, shields and soundproofing from pedal and tunnel areas as necessary.
b. Disconnect master cylinders (11) at pilot rudder pedals.
c. Disconnect parking brake cables at master cylinders.
d. Remove rudder pedals (2) and brake links (12).
e. Relieve cable tension at clevises (index 5, figure 10-1).
f. Disconnect cables, return springs and steering tubes from rudder bars.
g. Remove bolts securing bearing blocks (15) and work rudder bars out of tunnel area.

NOTE

Rudder bar assemblies should be checked for excessive wear before installation. The bearing blocks are nylon and require no lubrication unless binding occurs. A few drops of general purpose oil should eliminate such binding.

h. Reverse preceding steps for installation. Rig system in accordance with applicable paragraph in this section, safety clevises and reinstall all items removed in step "a".

10-6. RUDDER. (Refer to figure 10-3.)

10-7. REMOVAL AND INSTALLATION.
a. Disconnect tail navigation light quick-disconnect (10).
b. Relieve cable tension at clevises (index 5, figure 10-1) and disconnect clevises from rudder bellcrank (8).
c. With rudder supported, remove hinge bolts (4) and lift rudder free of vertical fin.
d. Reverse preceding steps for installation. Rig system in accordance with applicable paragraph in this section and safety clevises.

10-8. REPAIR. Repair may be accomplished as outlined in Section 18. Hinge bushings may be replaced as necessary.
1. Establish neutral position of rudder by clamping straightedge (such as wooden 2 X 4) on each side of fin and rudder and blocking trailing edge of rudder half the distance between straightedges as shown.

2. Tape a length of soft wire to one elevator in such a manner that it can be bent to index with a point on rudder trailing edge just above the lower rudder tip (rudder butt).

3. Using soft lead pencil, mark rudder at point corresponding to soft wire indexing point (neutral).

4. Remove straightedges.

5. Hold rudder against right, then left, rudder stop. Measure distance from pointer to pencil mark on rudder in each direction of travel. Distance should be between 6.04" and 6.60".

**Figure 10-4. Checking Rudder Travel**

10-9. CABLES AND PULLEYS. (Refer to figure 10-1.)

10-10. REMOVAL AND INSTALLATION.
   a. Remove seats, upholstery and access plates as necessary.
   b. Disconnect cable at rudder bar (10) and bellcrank (7).
   c. Remove cable guards, pulleys and fairleads as necessary to work cables free of aircraft.

   **NOTE**

   To ease routing of cables, a length of wire may be attached to end of cable before being withdrawn from aircraft. Leave wire in place, routed through structure, attach cable being installed and pull cable into position.

   d. After cable is routed in position, install pulleys fairleads and cable guards. Ensure cable is positioned in pulley groove before installing guard.
   e. Rig system in accordance with applicable para-

   graph in this section, safety clevises and reinstall all items removed in step "a".

10-11. RIGGING. (Refer to figure 10-1.)
   a. Adjust travel stops (8) to attain travel specified in Section 1. Figure 10-4 illustrates correct travel and one method of checking.
   b. Disconnect nose wheel steering tubes (index 6, figure 5-6) from nose strut.
   c. Adjust cables at clevises (5) to align rudder and pedals in neutral position, 6.00 inches from firewall and pedal pivot shafts (index 4, figure 10-2). This step automatically determines cable tension through use of return springs (14).

   **NOTE**

   Due to thickness of insulation on firewall, it is recommended that a piece of 1/16 inch welding rod be ground to a sharp point and notched at the 6.00 inch dimension. Pierce insulation on firewall and use notch to measure proper dimension.
d. Tie down or weight tail to raise nose wheel free of ground.

   e. Center nose gear against external stop.

   f. Extend steering tubes until free play is removed. DO NOT COMPRESS SPRINGS.

   g. Adjust steering tube rod ends to 1.25 inch dimension between steering arm assembly and bolt hole as illustrated in figure 5-9 and tighten jam nuts.

   h. Adjust steering tube clevises to align with rod end bearings.

   j. Safety cable clevises and install all parts removed for access.

NOTE

On aircraft WITHOUT rudder trim tab, a flight test may determine the need for rigging rudder slightly off-center. Such correction should be made by tightening one rudder cable at clevis and loosening the opposite one an equal amount, thus keeping nosewheel steering system and rudder pedals aligned while rudder is shifted minutely. DO NOT attempt to rig rudder by adjusting nosewheel steering system.

On aircraft WITH rudder trim tab, flight test aircraft to determine if ground adjustment of fixed trim tab is necessary. DO NOT rig rudder "off-center" unless trim tab does not provide adequate correction.

SHOP NOTES:

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WARNING

Be sure rudder moves in correct direction when operated by pedals.
11-1. ENGINE COWLING.

11-2. The engine cowling is comprised of an upper and lower cowl segment. A large access door on the upper cowl provides access to the fuel strainer drain, oil filler cap, and oil dipstick. Instead of attaching directly to the fuselage, the cowling attaches to shock mounts which are attached to the fuselage. Quick-release fasteners are used at the cowling-to-shock mount attach points to facilitate detachment of the cowling at the firewall. Screws fasten the upper and lower cowl segments together at the nose cap and quick-release fasteners are used along the side parting surfaces to hold cowling segments together.

11-3. REMOVAL AND INSTALLATION. Removal and installation of the engine cowling is accomplished by removing the attaching screws at the nose cap dividing surfaces and releasing the quick-release fasteners at side parting surfaces and at shock mounts of firewall. Disconnect electrical wiring to landing light in nose cap cowling. Disconnect any air duct and control linkage which interferes with removal of the cowling. When installing the cowling, be sure to connect any items disconnected during removal. Make sure that baffle seals are turned in the correct direction to confine and direct airflow around the engine. The vertically installed seals fold forward and the side seals fold upward.
NOTE

When new shock mounts or brackets are being installed, careful measurements should be made to position these parts correctly on the firewall. The service parts are not pre-drilled. Install shock mounts on brackets so that cowling and shock mount is correctly aligned. Sheet aluminum may be used as shims between bracket halves to provide cowling contour.

11-4. CLEANING AND INSPECTION. Wipe the inner surfaces of the cowling segments with a cloth saturated with cleaning solvent (Federal Specification PS-661 or equivalent). If the inside surface of the cowling is coated heavily with oil and dirt, allow solvent to soak until foreign material can be removed. Wash painted surfaces of cowling with a solution of mild soap and water and rinse thoroughly. After washing, a coat of wax applied to painted surfaces is recommended to prolong paint life. After cleaning, inspect cowling for dents, cracks, and loose rivets or spot welds. Repair all defects to prevent spread of damage.

11-5. REPAIR. If cowling skins are extensively damaged, new complete sections of the cowling should be installed. Standard insert-type patches may be used for repair if repair parts are formed to fit contour of cowling. Small cracks may be stop-drilled and small dents straightened if they are reinforced on the inner surface with a doubler of the same material. Damaged reinforcement angles should be replaced with new parts. Due to their small size, new reinforcement angles are easier to install than to repair the damaged part.

Figure 11-1. Engine Cowling
11-6. ENGINE.

11-7. An air-cooled, horizontal-opposed, low-compression, direct-drive, four-cylinder Continental O-200-A series engine driving a fixed-pitch propeller is used to power the aircraft. The cylinders, numbered from rear to front, are staggered to permit a separate throw on the crankshaft for each connecting rod. The right rear cylinder is number 1 and cylinders on the right side are identified by odd numbers 1 and 3. The left rear cylinder is number 2 and the cylinders on the left side are identified as 2 and 4. Refer to paragraph 11-8 for detailed engine data. For repair and overhaul of the engine, refer to the applicable publication issued by the engine manufacturer.

11-8. ENGINE DATA.

Aircraft Model
MODEL (Continental)
Rated Horsepower at RPM
Number of Cylinders
Displacement
Bore
Stroke
Compression Ratio
Magneto(s)
Right Magneto
Left Magneto
Firing Order
Spark Plugs
Torque
Carburetor (Marvel-Schebler)
Alternator
Starter (12-Volt)
Tachometer
Oil Sump Capacity
With External Filter
Oil Pressure (psi)
Normal
Minimum Idling
Oil Temperature
Normal Operating
Maximum
Cylinder Head Temperature
Normal Operating
Maximum
Direction of Crankshaft Rotation (viewed from rear)
Dry Weight - with Accessories

150J, K, L & M
O-200-A
100 at 2750
4 Horizontally-Opposed
200.91 Cubic Inches
4.6825 Inches
3.875 Inches
7.00:1
Slick No. 4001
Fires 24° (+1 -0°) BTC 1-3-2-4 Upper
Fires 24° (+1 -0°) BTC 1-3-2-4 Lower
1-3-2-4
18MM (Refer to current Continental active factory approved spark plug chart)
330±30 Lb-In.
MA-3-SPA
14-Volt, 60-Ampere
Automatic Engagement
Mechanical
6 U.S. Quarts
7 U.S. Quarts
30-60
10
Within Green Arc
Red Line (225°F.)
Within Green Arc
Red Line
Clockwise
200 lb (Weight is approximate and will vary with optional accessories installed)

D971C3-13 Temporary Change 1
October 18, 1977

11-3
## TROUBLE SHOOTING

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ENGINE WILL NOT START.</strong></td>
<td>Fuel tank empty.</td>
<td>Fill with proper grade of gasoline.</td>
</tr>
<tr>
<td></td>
<td>Improper use of starting procedures.</td>
<td>Review starting procedure.</td>
</tr>
<tr>
<td></td>
<td>Fuel shut-off valve in OFF position.</td>
<td>Turn shut-off valve ON.</td>
</tr>
<tr>
<td></td>
<td>Carburetor screen or fuel strainer</td>
<td>Remove and clean thoroughly. Remove moisture.</td>
</tr>
<tr>
<td></td>
<td>plugged.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Engine flooded.</td>
<td>Refer to paragraph 11-67.</td>
</tr>
<tr>
<td></td>
<td>Defective ignition system.</td>
<td>Refer to paragraph 11-47.</td>
</tr>
<tr>
<td></td>
<td>Excessive induction air leaks.</td>
<td>Correct the cause of leaks.</td>
</tr>
<tr>
<td></td>
<td>Insufficient priming (puffs of white</td>
<td>Prime more. In cold weather draw plunger slowly back, push hard. Check</td>
</tr>
<tr>
<td></td>
<td>smoke and weak combustion).</td>
<td>pump output at priming jet.</td>
</tr>
<tr>
<td></td>
<td>Defective magneto switch or grounded</td>
<td>Check continuity. Repair or replace switch or wiring.</td>
</tr>
<tr>
<td></td>
<td>magneto &quot;P&quot; leads.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Defective carburetor.</td>
<td>Repair or replace carburetor.</td>
</tr>
<tr>
<td></td>
<td>Spark plugs fouled or improperly gapped</td>
<td>Remove and clean: check gaps and insulators. Use new gaskets. Check</td>
</tr>
<tr>
<td></td>
<td></td>
<td>cables to persistently fouled plugs. Replace defective plugs.</td>
</tr>
<tr>
<td></td>
<td>Magneto impulse coupling failure.</td>
<td>Repair or install new magneto.</td>
</tr>
<tr>
<td></td>
<td>Spark plugs loose.</td>
<td>Using new gaskets, tighten to specified torque.</td>
</tr>
<tr>
<td></td>
<td>Water in fuel system.</td>
<td>Drain fuel tank sumps, fuel lines, fuel strainer and carburetor.</td>
</tr>
<tr>
<td></td>
<td>Excessive starter slippage.</td>
<td>Replace starter adapter.</td>
</tr>
<tr>
<td><strong>ENGINE WILL NOT RUN AT IDLING SPEED.</strong></td>
<td>Idle speed or idle mixture incorrectly adjusted.</td>
<td>Refer to paragraph 11-37.</td>
</tr>
<tr>
<td></td>
<td>Carburetor idling jet plugged.</td>
<td>Clean carburetor and fuel strainer.</td>
</tr>
<tr>
<td></td>
<td>Air leak in intake manifold.</td>
<td>Tighten loose connections or replace damaged parts.</td>
</tr>
<tr>
<td></td>
<td>Spark plugs fouled by oil escaping past piston rings.</td>
<td>Top overhaul engine.</td>
</tr>
<tr>
<td><strong>ROUGH IDLING.</strong></td>
<td>Idling mixture and/or mixture control improperly adjusted.</td>
<td>Refer to paragraph 11-37 and 11-53.</td>
</tr>
<tr>
<td>TROUBLE</td>
<td>PROBABLE CAUSE</td>
<td>REMEDY</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>----------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>ROUGH IDLING (cont.)</td>
<td>Manual mixture control set for lean mixture.</td>
<td>Use full rich mixture for all ground operation.</td>
</tr>
<tr>
<td></td>
<td>Priming pump leaking.</td>
<td>Repair or replace.</td>
</tr>
<tr>
<td></td>
<td>Small air leak into induction system.</td>
<td>With mixture control at IDLE CUT-OFF, ignition switch OFF and throttle open, brush soap lather around tube joints and carburetor mount flange, one at a time, and turn propeller backwards to check for bubbles at points of leakage. Tighten connections or replace damaged gasket or seal.</td>
</tr>
<tr>
<td></td>
<td>Leaking accelerating pump.</td>
<td>Repair or install new carburetor.</td>
</tr>
<tr>
<td></td>
<td>Defective engine.</td>
<td>Check compression and listen for unusual engine noises. Engine repair is required.</td>
</tr>
<tr>
<td>ENGINE RUNS TOO LEAN AT CRUISING POWER.</td>
<td>Manual mixture control in wrong position.</td>
<td>Rig control in accordance with paragraph 11-53.</td>
</tr>
<tr>
<td></td>
<td>Carburetor partially restricted.</td>
<td>Remove and clean.</td>
</tr>
<tr>
<td>ENGINE RUNS TOO RICH AT CRUISING POWER.</td>
<td>Manual mixture control in wrong position.</td>
<td>Rig control in accordance with paragraph 11-53.</td>
</tr>
<tr>
<td></td>
<td>Restriction in air scoop or filter partially restricted.</td>
<td>Remove restriction. Clean filter.</td>
</tr>
<tr>
<td></td>
<td>Carburetor air heat valve open.</td>
<td>Rig in accordance with paragraph 11-54.</td>
</tr>
<tr>
<td>ENGINE DOES NOT ACCELERATE PROPERLY.</td>
<td>Cold engine.</td>
<td>Warm up longer.</td>
</tr>
<tr>
<td></td>
<td>Mixture control set for lean mixture.</td>
<td>Set control at full RICH position.</td>
</tr>
<tr>
<td></td>
<td>Restriction in carburetor air intake.</td>
<td>Remove restriction and clean filter.</td>
</tr>
<tr>
<td></td>
<td>Restriction in carburetor jets, low float level, plugged fuel screen.</td>
<td>Clean and repair carburetor.</td>
</tr>
<tr>
<td></td>
<td>Idling setting too lean.</td>
<td>Refer to paragraph 11-37.</td>
</tr>
<tr>
<td>TROUBLE</td>
<td>PROBABLE CAUSE</td>
<td>REMEDY</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
<td>--------</td>
</tr>
<tr>
<td>ENGINE DOES NOT SHUT OFF WITH MANUAL MIXTURE CONTROL IN IDLE CUTOFF POSITION.</td>
<td>Fuel leakage thru primer.</td>
<td>Repair or install new primer.</td>
</tr>
<tr>
<td></td>
<td>Linkage does not permit idle cutoff lever to reach OFF position.</td>
<td>Rig in accordance with paragraph 11-53.</td>
</tr>
<tr>
<td>ENGINE RUNS ROUGH AT HIGH SPEED.</td>
<td>Loose mounting bolts or rubber bushings defective.</td>
<td>Tighten bolts or replace mount bushings.</td>
</tr>
<tr>
<td></td>
<td>Propeller out of balance.</td>
<td>Remove and balance.</td>
</tr>
<tr>
<td></td>
<td>Spark plug gasket leaking, gap too large or insulator damaged.</td>
<td>Replace damaged parts.</td>
</tr>
<tr>
<td></td>
<td>Ignition cable insulation damaged.</td>
<td>Test for leakage at high voltage. Replace damaged ignition lead.</td>
</tr>
<tr>
<td></td>
<td>Excessively lean fuel-air mixture.</td>
<td>Clean fuel strainer, carburetor screen and carburetor main jet.</td>
</tr>
<tr>
<td>SLUGGISH OPERATION AND LOW POWER.</td>
<td>Throttle not opening completely.</td>
<td>Rig per paragraph 11-52.</td>
</tr>
<tr>
<td></td>
<td>Spark plugs fouled or improperly gapped.</td>
<td>Remove, clean and regap or install new plugs.</td>
</tr>
<tr>
<td></td>
<td>Carburetor air heat valve open.</td>
<td>Rig in accordance with paragraph 11-54.</td>
</tr>
<tr>
<td></td>
<td>Damaged contact breaker or capacitor.</td>
<td>Overhaul magneto.</td>
</tr>
<tr>
<td></td>
<td>Fuel-air mixture too rich or too lean.</td>
<td>Overhaul and adjust carburetor.</td>
</tr>
<tr>
<td>HIGH CYLINDER HEAD TEMPERATURE.</td>
<td>Low grade of fuel.</td>
<td>Drain and fill with correct grade of fuel. Refer to Section 2.</td>
</tr>
<tr>
<td></td>
<td>Lean fuel-air mixture.</td>
<td>Refer to Owner’s Manual for correct leaning procedure.</td>
</tr>
<tr>
<td></td>
<td>Excessive carbon deposits in cylinder head and on pistons.</td>
<td>Install new cylinders and piston rings or new engine.</td>
</tr>
<tr>
<td></td>
<td>Cylinder baffles loose or bent.</td>
<td>Check all baffles and correct.</td>
</tr>
<tr>
<td></td>
<td>Dirt between cylinder fins.</td>
<td>Clean thoroughly.</td>
</tr>
<tr>
<td>HIGH OIL TEMPERATURE.</td>
<td>Low oil supply.</td>
<td>Replenish.</td>
</tr>
<tr>
<td></td>
<td>Oil viscosity too high.</td>
<td>Refer to Section 2 for seasonal grades.</td>
</tr>
<tr>
<td></td>
<td>Prolonged high speed operation on ground.</td>
<td>Hold ground running above 1500 rpm to a minimum.</td>
</tr>
<tr>
<td>TROUBLE</td>
<td>PROBABLE CAUSE</td>
<td>REMEDY</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>LOW OIL PRESSURE.</td>
<td>Low oil supply.</td>
<td>Replenish.</td>
</tr>
<tr>
<td></td>
<td>Oil viscosity too low.</td>
<td>Drain and refill with correct</td>
</tr>
<tr>
<td></td>
<td></td>
<td>seasonal grade. Refer to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Section 2.</td>
</tr>
<tr>
<td></td>
<td>Sludge or foreign material in relief valve.</td>
<td>Remove and clean valve parts.</td>
</tr>
<tr>
<td></td>
<td>Foam in oil due to emulsification of alkaline</td>
<td></td>
</tr>
<tr>
<td></td>
<td>solids.</td>
<td>Drain and refill with fresh oil.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Refer to Section 2 for seasonal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>grade.</td>
</tr>
<tr>
<td></td>
<td>Defective pressure gage.</td>
<td>Check with known good gage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Replace defective gage.</td>
</tr>
<tr>
<td></td>
<td>Oil pump defective.</td>
<td>Remove and inspect. Examine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>engine. Metal particles from</td>
</tr>
<tr>
<td></td>
<td></td>
<td>damaged pump may have entered</td>
</tr>
<tr>
<td></td>
<td></td>
<td>engine oil passages.</td>
</tr>
<tr>
<td></td>
<td>Oil congealed in gage line.</td>
<td>Disconnect line at engine and gage;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>flush with kerosene. Pre-fill</td>
</tr>
<tr>
<td></td>
<td></td>
<td>line with kerosene and install.</td>
</tr>
<tr>
<td></td>
<td>Oil pressure line broken, disconnected or</td>
<td>Inspect, replace or connect line.</td>
</tr>
<tr>
<td></td>
<td>pinched.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internal leak, burned bearings, or damaged</td>
<td>Major overhaul.</td>
</tr>
<tr>
<td></td>
<td>gasket.</td>
<td></td>
</tr>
<tr>
<td>OIL LEAK AT FRONT OF</td>
<td>Damaged crankshaft seal.</td>
<td>Replace.</td>
</tr>
<tr>
<td>ENGINE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OIL LEAK AT PUSH ROD</td>
<td>Damaged push rod housing oil seal.</td>
<td>Replace.</td>
</tr>
<tr>
<td>HOUSING.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOW COMPRESSION.</td>
<td>Cylinder wall worn out-of-round and choke</td>
<td>Replace cylinder and rings.</td>
</tr>
<tr>
<td></td>
<td>reduced.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intake valves guides worn.</td>
<td>Top overhaul.</td>
</tr>
<tr>
<td></td>
<td>Valves seats and faces worn.</td>
<td>Top overhaul.</td>
</tr>
<tr>
<td></td>
<td>Piston rings excessively worn.</td>
<td>Top overhaul.</td>
</tr>
<tr>
<td></td>
<td>Valves sticking in guides.</td>
<td>Top overhaul.</td>
</tr>
</tbody>
</table>
11-10. REMOVAL. If the engine is to be placed in storage or returned to the manufacturer for overhaul, proper preparatory steps should be taken prior to beginning the removal procedure. Refer to Indefinite Storage in Section 2 for preparation of the engine for storage. The following engine removal procedure is based upon the engine being removed from the aircraft with the engine mount attached to the firewall and all engine hose and lines being disconnected at the firewall. The reason for engine removal will determine where components are to be disconnected.

NOTE

Tag each item disconnected to aid in identifying wires, hose, lines and control linkage when engine is being installed. Protect openings, exposed as a result of removing or disconnecting units, against entry of foreign material by installing covers or sealing with tape.

a. Place all cabin switches and fuel valves in the OFF position.
b. Remove engine cowling. (See paragraph 11-3.)
c. Open battery circuit by disconnecting battery cable(s) at the battery. Insulate cable terminal(s) as a safety precaution.
d. Disconnect ignition switch primary ("P") leads at the magneto.

e. Drain engine oil from sump.
f. Remove propeller and spinner. (See Section 13.)

NOTE

During the following procedures, remove any clamps which secure controls, wires, hose, or lines to the engine, engine mount, or attached brackets, so that they will not interfere with removal of the engine. Omit any of the items which are not present on a particular engine installation.

g. Disconnect throttle and mixture control at carburetor. Pull these controls free of engine and engine mount, using care not to damage them by bending too sharply. Note position, size and number of attaching washers and spacers.
h. Disconnect carburetor heat control from arm on carburetor air intake housing assembly. Remove clamps and pull control aft clear of the engine.
i. Disconnect wires and cables as follows:

CAUTION

When disconnecting starter cable, do not permit starter terminal bolt to rotate. Rotation of the bolt could break the conductor between terminal and field coils causing the starter to be inoperative.

1. Starter electrical cable at starter.
2. Electrical wires and wire shielding ground at alternator.
3. Tachometer drive shaft at adapter on engine.
4. Remove all clamps attaching wires and cables to the engine or engine mount. Pull all wires and cables aft to clear the engine.
5. Disconnect and cap or plug lines and hose as follows:
   a. Vacuum hose at firewall.

WARNING

Residual fuel and oil draining from disconnected lines and hose is a fire hazard. Use care to prevent accumulation of such fuel and oil when lines or hose are disconnected.

2. Oil pressure hose at firewall.
3. Oil temperature bulb at engine.
4. Primer line to engine at firewall.
5. Fuel hose to engine at fuel strainer on firewall.
6. Remove all clamps attaching lines and hose to engine or engine mount which interferes with engine removal from engine mount.

CAUTION

Attach a tail stand to the tail tie-down fitting before removing the engine. The loss of engine weight will allow the tail to drop. Do not raise engine higher than necessary when removing engine-to-mount bolts. Raising the engine too high places a strain on the attach bolts and hinders their removal.

k. Attach a hoist to the lifting lug on top of the engine and take up engine weight on hoist.
   1. Remove bolts attaching engine-to-mount. Note direction of bolt installation and position and numbers of washers. Balance the engine by hand as the last of the bolts are removed. Remove ground straps at lower mount legs as bolts are removed.

CAUTION

Hoist engine slowly and ascertain that all items attaching engine and accessories to engine mount and airframe are disconnected.

m. Carefully guide disconnected components out of engine assembly.
11-11. CLEANING. The engine may be cleaned with a suitable solvent, such as Stoddard solvent, or equivalent, then dried thoroughly.

**CAUTION**

Particular care should be given to electrical equipment before cleaning. Solvent should not be allowed to enter magnetos, starter, alternator, and the like. Hence, protect these components before saturating the engine with solvent. Cover any fuel, oil and air openings on the engine and accessories before washing the engine with solvent. Caustic cleaning solutions should be used cautiously and should always be properly neutralized after their use.

11-12. ACCESSORIES REMOVAL. Removal of engine accessories for overhaul or for engine replacement involves stripping the engine of parts, accessories, and components to reduce the engine assembly to the bare engine. During removal, carefully examine removed items and tag defective parts for repair or replacement with a new part.

**NOTE**

Items easily confused with similar items should be tagged to provide a means of identification when being installed on a new engine. All openings exposed by the removal of an item should be closed by installing a suitable cover or cap over the opening. This will prevent entry of foreign particles. If suitable covers are not available, tape may be used to cover the opening.

11-13. INSPECTION. For specific items to be inspected refer to engine manufacturer's manual.

a. Visually inspect the engine for loose nuts, bolts, cracks and fin damage.

b. Inspect baffles, baffle seals and brackets for cracks, deterioration and breakage.

c. Inspect all hoses for internal swelling, chafing through protective plys, cuts, breaks, stiffness, damaged threads and loose connections. Excessive heat on hoses will cause them to become brittle and easily broken. Hoses and lines are most likely to crack or break near the end fittings and support points.

d. Inspect for color bleaching of the end fittings or severe discoloration of the hoses.

**NOTE**

Avoid excessive flexing and sharp bends when examining hoses for stiffness.

e. All flexible fluid carrying hoses in the engine compartment should be replaced at engine overhaul or every five years, whichever occurs first.

f. For major engine repairs, refer to the manufacturer’s overhaul and repair manual.

11-14. ENGINE BUILD-UP. Engine build-up consists of installation of parts, accessories and components to the basic engine to build-up an engine unit ready for installation on the aircraft. All safety wire, lockwashers, panuts, elastic stop nuts, gaskets and rubber connections should be new parts.

11-15. INSTALLATION. Before installing the engine on the aircraft, install any items that were removed from the engine after it was removed from the aircraft.

**NOTE**

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

a. Hoist engine assembly to a point near the engine mount.

b. Route controls, lines and hose in place as the engine is positioned near the engine mount.

c. Install shock-mounts as shown in figure 11-2 and install engine-to-mount bolts. Be sure ground straps are in place at lower engine mount. Tighten engine-to-mount bolts to torque value shown in figure 11-2.

d. Remove hoist and stand placed under tail tie-down fitting.

e. Route throttle and mixture controls to the carburetor and connect, using washers and spacers as noted in step "g" of paragraph 11-10.

**NOTE**

Throughout the aircraft fuel system, from the tanks to the carburetor, use Never-Seez RAS-4, (Snap-On Tools Corporation, Kenosha, Wisconsin) or MIL-T-5544 thread compound as a thread lubricant or to seal a leaking connection. Apply compound to male fitting, omitting the first two threads. Always be sure that the compound, the residue of a previously used compound, or any other foreign material does not enter the fuel system.

f. Connect lines and hose as follows:

1. Fuel hose at fuel strainer on firewall.

2. Primer line to engine at firewall.

3. Oil temperature bulb at engine.

4. Oil pressure hose at firewall.

5. Install all clamps attaching lines and hose to engine, engine mount, or attached brackets.

g. Connect wires and cables as follows:

1. Electrical wires and wire shielding ground at alternator.

**CAUTION**

When connecting starter cable, do not permit starter terminal bolt to rotate. Rotation of the bolt could break the conductor between terminal and field coils causing the starter to be inoperative.

2. Starter electrical cable at starter.
3. Tachometer drive shaft at engine. Be sure drive cable engages drive in adapter on engine. Torque housing attach nut to 100 lb-in.

4. Install all clamps attaching wires and cables to engine, engine mount, or attached brackets.

h. Route carburetor heat control to arm on carburetor air intake housing assembly. Install clamps and rig in accordance with paragraph 11-54.

i. Install propeller and spinner. (Refer to Section 13 for affected aircraft model.)

j. Make a magneto switch wire ground-out and continuity check. Connect magneto switch wires to the magnetos.

**WARNING**

Be sure magneto switch is in OFF position when connecting switch wires to magnetos.

k. Service engine with proper grade and quantity of engine oil. Refer to paragraph 2-11C if engine is new, newly overhauled, or has been in storage.

l. Make sure all switches are in the OFF position, and connect battery cable(s) to battery.

m. Rig throttle, mixture, and carburetor heat controls in accordance with paragraph 11-51 through 11-54.

n. Check engine installation for security, correct routing of controls, lines, hose and tightness of all components.

o. Install engine cowling. Clean and install carburetor air filter. Be sure all hot and cold air ducts are installed and connected.

p. Perform engine run-up and make final adjustments on engine controls.

11-15A. FLEXIBLE FLUID HOSES.

11-15B. LEAK TEST.

a. After each 50 hours of engine operation, all flex-
ible fluid hoses in the engine compartment should be checked for leaks as follows:
1. Examine the exterior of hoses for evidence of leakage or wetness.
2. Hoses found leaking should be replaced.
3. Refer to paragraph 11-13 for detailed inspection procedures for flexible hoses.

11-15C. REPLACEMENT
a. Hoses should not be twisted on installation. Pressure applied to a twisted hose may cause failure or loosening of the nut.
b. Provide as large a bend radius as possible.
c. Hoses should have a minimum of one-half inch clearance from other lines, ducts, hoses or surrounding objects or be butterfly clamped to them.
d. Rubber hoses will take a permanent set during extended use in service. Straightening a hose with a bend having a permanent set will result in hose cracking. Care should be taken during removal so that hose is not bent excessively, and during reinstallation to assure hose is returned to its original position.
e. Refer to AC 43.13-1, Chapter 10, for additional installation procedures for flexible fluid hose assemblies.

11-15D. STATIC RUN-UP PROCEDURES. In a case of suspected low engine power, a static RPM run-up should be conducted as follows:
  a. Run-up engine, using take-off power and mixture settings, with the aircraft facing 90° right and then left to the wind direction.
  b. Record the RPM obtained in each run-up position.
    NOTE
    Daily changes in atmospheric pressure, temperature and humidity will have a slight effect on static run-up.
  c. Average the results of the RPM obtained. Thru 1974 models it should be within 50 RPM of 2550 RPM. Beginning with 1975 models it should be within 50 RPM of 2510 RPM.
  d. If the average results of the RPM obtained are lower than stated above, the following recommended checks may be performed to determine a possible deficiency.
    1. Check carburetor heat control for proper rigging. If partially open it would cause a slight power loss.
    2. Check magneto timing, spark plugs and ignition harness for settings and conditions.
    3. Check condition of induction air filter. Clean if necessary.

11-16. BAFFLES.
11-17. The sheet metal baffles installed on the engine directs the cooling air flow around the cylinders and other engine components to provide optimum engine cooling. These baffles incorporate rubber-asbestos composition seals at points of contact with the engine cowling to help confine and direct cooling air to the desired area. The baffles, air blast tubes and air scoops are accurately positioned to maintain engine cooling efficiency and their removal will cause improper air circulation and engine overheating.

11-18. CLEANING AND INSPECTION. Engine baffles should be cleaned with a suitable solvent to remove dirt and oil.
    NOTE
    The rubber-asbestos seals are oil and grease resistant but should not be soaked in solvent for long periods.

Inspect baffles for cracks in the metal and/or torn seals. Replace defective parts.

11-19. REMOVAL AND INSTALLATION. Removal and installation on the various baffle segments is possible with the cowling removed. Be sure that any replacement baffles and seals are installed correctly and that they seal to direct the cooling air in the correct direction.

11-20. REPAIR. Baffles ordinarily should be replaced if damaged or cracked. However, small plate reinforcements riveted to the baffle will often prove satisfactory both to the strength and cooling requirements of the unit.

11-21. ENGINE MOUNT.
11-22. The engine mount is composed of sections of tubing welded together and reinforced with welded gussets. The purpose of the engine mount is to support the engine and attach the engine to the airframe. The engine is attached to the mount with shock-mount assemblies which absorb engine vibrations. The engine mount also supports the nose gear shock strut.

11-23. REMOVAL AND INSTALLATION. Removal of the engine mount necessitates removal of the engine and nose landing gear, followed by removal of the bolts attaching the engine mount to the fuselage structure. When installing an engine mount, tighten mount-to-fuselage bolts to the torque value listed in figure 11-2. Install landing gear as outlined in paragraph 5-23. The engine, engine mount and nose gear may be removed from the aircraft and then engine and nose gear removed from the mount.

11-24. REPAIR. Perform engine mount repair as outlined in Section 18. The mount should be painted with heat-resistant black enamel after welding or whenever original finish has been removed.

11-25. SHOCK-MOUNT PADS. The rubber and metal shock-mounts are designed to reduce transmission of engine vibrations to the airframe. The rubber parts should be wiped with a clean dry cloth. Inspect metal parts for cracks and excessive wear due to aging and deterioration. Inspect rubber parts...
for swelling, cracking, or a pronounced set of the part. Install with new parts all parts that show evidence of wear or damage.

11-26. ENGINE OIL SYSTEM.

11-27. A wet-sump, pressure-lubricating oil system is used in the O-200-A series engines. Oil in the sump passes through a sump pick-up tube, through the suction screen in the tube, to the suction side of the oil pump. From the pressure side of the oil pump, oil is fed through the pressure oil screen, or external full-flow oil filter, into the left oil gallery. The oil flows forward through the left gallery, across the crankcase, through the passages connected by the camshaft front journal groove, and into the right gallery. The oil pressure relief valve closes the rear end of the right gallery. The galleries pressure-feed the main bearings, cam shaft bearings, and hydraulic tappets. Connecting rod bearings are lubricated from the main bearings through drilled passages in the crankshaft. Valve mechanisms are lubricated through hollow push-rods from the tappets. Cylinder walls, piston pins, and connecting rod bushings are spray-lubricated by oil escaping from the connecting rod and main bearings. Gears in the crankcase cover cavity are lubricated by spray from the rear main and rear camshaft bearings. Drilled passages from the crossover oil gallery lubricates the vacuum pump adapter pad mounted at the front lower side of the engine. Throughout the engine, oil is returned to the sump by gravity. The external full-flow oil filter is discussed in paragraph 11-29.

Figure 11-3. Engine Oil Schematic
<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO OIL PRESSURE.</td>
<td>No oil in sump.</td>
<td>Fill sump with proper grade and quantity of oil. Refer to Section 2.</td>
</tr>
<tr>
<td></td>
<td>Oil pressure line broken, disconnected or pinched.</td>
<td>Replace or connect.</td>
</tr>
<tr>
<td></td>
<td>Oil pump defective.</td>
<td>Remove and inspect. Examine engine. Metal particles from damaged pump may have entered engine oil passages.</td>
</tr>
<tr>
<td></td>
<td>Defective oil pressure gage.</td>
<td>Check with another gage. Replace if defective.</td>
</tr>
<tr>
<td></td>
<td>Oil congealed in gage line.</td>
<td>Disconnect line at engine and gage; flush with kerosene. Pre-fill with kerosene and install.</td>
</tr>
<tr>
<td></td>
<td>Relief valve defective.</td>
<td>Remove and check for dirty or defective parts. Clean and install; replace defective parts.</td>
</tr>
<tr>
<td>LOW OIL PRESSURE.</td>
<td>Low oil supply.</td>
<td>Replenish. Refer to Section 2.</td>
</tr>
<tr>
<td></td>
<td>Low viscosity oil.</td>
<td>Drain sump and refill with proper grade and quantity of oil.</td>
</tr>
<tr>
<td></td>
<td>Oil pressure relief valve spring weak or broken. Dirt on seat.</td>
<td>Replace weak or broken spring. Clean plunger and seat.</td>
</tr>
<tr>
<td></td>
<td>Defective oil pump.</td>
<td>Remove and inspect. Examine engine. Metal particles from damaged pump may have entered engine oil passages.</td>
</tr>
<tr>
<td></td>
<td>Secondary result of high oil temperature.</td>
<td>Observe oil temperature gage for high indication. Determine and correct reason for high oil temperature.</td>
</tr>
<tr>
<td></td>
<td>Plugged oil screen.</td>
<td>Remove and clean screen.</td>
</tr>
<tr>
<td></td>
<td>Oil pressure gage defective.</td>
<td>Check with another gage. Replace if defective.</td>
</tr>
<tr>
<td></td>
<td>Oil pressure relief valve plunger sticking.</td>
<td>Remove and clean plunger.</td>
</tr>
<tr>
<td></td>
<td>Oil pump suction tube screen plugged or internal oil leak.</td>
<td>Engine overhaul required.</td>
</tr>
<tr>
<td>HIGH OIL PRESSURE.</td>
<td>High viscosity oil.</td>
<td>Drain sump and refill with proper grade and quantity of oil.</td>
</tr>
<tr>
<td></td>
<td>Defective oil pressure gage.</td>
<td>Check with another gage. Replace if defective.</td>
</tr>
<tr>
<td></td>
<td>Relief valve defective.</td>
<td>Remove and check for dirty or defective parts. Clean and install; replace defective parts.</td>
</tr>
<tr>
<td>TROUBLE</td>
<td>PROBABLE CAUSE</td>
<td>REMEDY</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------------------------------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>LOW OIL TEMPERATURE</td>
<td>Defective oil temperature gage or temperature bulb.</td>
<td>Check with another gage. If reading is normal, aircraft gage is defective. If reading is similar temperature bulb is defective. Replace defective part/or parts.</td>
</tr>
<tr>
<td>HIGH OIL TEMPERATURE</td>
<td>Excessive rate of climb.</td>
<td>Avoid low airspeed.</td>
</tr>
<tr>
<td></td>
<td>Lean fuel-air mixture.</td>
<td>Avoid excessive lean mixture operation.</td>
</tr>
<tr>
<td></td>
<td>Vernatherm control valve damaged or held open by solid matter.</td>
<td>Remove. Clean valve and seat. If still inoperative, replace.</td>
</tr>
<tr>
<td></td>
<td>Low oil supply.</td>
<td>Replenish.</td>
</tr>
<tr>
<td></td>
<td>Oil viscosity too high. Dirty or diluted oil.</td>
<td>Drain and fill sump with proper grade and quantity.</td>
</tr>
<tr>
<td></td>
<td>Prolonged high speed operation on the ground.</td>
<td>Hold ground running above 1500 rpm to a minimum.</td>
</tr>
<tr>
<td></td>
<td>Defective oil temperature gage.</td>
<td>Check with another gage. If second reading is normal, aircraft gage is defective. Replace gage.</td>
</tr>
<tr>
<td></td>
<td>Defective oil temperature bulb.</td>
<td>Check for correct oil pressure, oil level and cylinder head temperature. If they are correct, check oil temperature gage for being defective; if similar reading is observed, bulb is defective. Replace bulb.</td>
</tr>
</tbody>
</table>

11-29. FULL-FLOW OIL FILTER. An external oil filter may be installed on the engine. The filter and filter adapter replaces the internal oil pressure screen. Provisions are provided in the oil filter adapter cover for the oil temperature bulb. The filter adapter incorporates a bypass valve. If the filter element should become clogged, the bypass valve will open, allowing pressure oil to flow to the engine oil passages.

11-30. FILTER ELEMENT REMOVAL AND INSTALLATION. (See figure 11-4.)

NOTE
New filter element kits are available from the Cessna Service Parts Center.

a. Remove engine cowling as necessary for access.
b. Remove both safety wires from filter can and unscrew hollow stud to detach filter assembly from adapter as a unit. Remove from aircraft discarding upper gasket. Oil will drain from filter assembly as assembly is removed from adapter.
c. Press downward on hollow stud to remove from filter element and can. Discard metal gasket.
d. Lift lid from can, and discard lower gasket.
e. Pull filter element from can.

NOTE
Before discarding removed filter element, remove the outer perforated paper cover; using a sharp knife, cut through the folds of the filter element at both ends, close to the metal caps. Then carefully unfold the pleated element and examine the material trapped in the filter element for evidence of internal engine damage such as chips or particles from bearings. In new or newly overhauled engines, some small particles or metallic shavings might be found, these are generally of no consequence and should not be confused with particles produced by impacting, abrasion, or pressure. Evidence of internal engine damage found in the oil filter element justifies further examination to determine the cause.

f. Wash lid, hollow stud and can in cleaning solvent and dry with compressed air.
NOTE

DO NOT SUBSTITUTE AUTOMOTIVE GASKETS FOR ANY GASKETS USED IN THIS ASSEMBLY. USE ONLY APPROVED GASKETS LISTED IN THE PARTS CATALOG.

1. O-Ring
2. Adapter Nut
3. Outlet Valve
4. Bypass Valve
5. Adapter
6. O-Ring
7. Plug
8. Lid Gasket (Upper)
9. Thread Insert
10. Lid
11. Lid Gasket (Lower)
12. Filter Element
13. Filter Can
14. Safety Wire Tab (Upper)
15. Safety Wire Tab (Lower)
16. Metal Gasket
17. Hollow Stud

Figure 11-4. Full-Flow Oil Filter
NOTE

When installing a new filter element, it is important that all gaskets are clean, lubricated, and positioned properly, and that the correct amount of torque is applied to the filter hollow stud. If the hollow stud is under-torqued, oil leakage will occur. If the hollow stud is over-torqued, the filter can might possibly be deformed, again causing oil leakage.

Lubricate rubber grommets in each end of new filter element, upper and lower gaskets, and metal gasket with clean engine oil or general purpose grease before installing. Dry gaskets can cause false torque readings, again resulting in oil leakage.

Before assembly, place a straightedge across bottom of filter can. Check for distortion or out-of-flat condition greater than 0.010 inch. Install a new can if either of these conditions exists.

After installing a new upper gasket on the lid, turn lid over. If gasket falls, try a different gasket and repeat test. If this gasket falls off, install a new lid.

g. Inspect adapter gasket seat for gouges, deep scratches, wrench marks, and mutilation. If any of these conditions are found, install a new adapter.
h. Place a new filter element in can and insert hollow stud with a new metal gasket in place, through the can and filter element.
i. Position a new lower gasket inside flange of lid. Place lid in position on can.
j. Install filter assembly on adapter with a new upper gasket in place. While holding can to prevent it from turning, tighten hollow stud and torque to 20-25 lb-ft (240-300 lb-in), using a torque wrench.
k. Install parts removed for access, and service the engine with proper grade and quantity of engine oil. One additional quart of oil is required each time filter element is changed.
l. Start engine and check for proper oil pressure. Check for oil leaks after warming up engine.
m. Again check for oil leakage after engine has been run at a high power setting (preferably a flight around the field).
n. Check to make sure that the filter has not been in contact with adjacent parts due to engine torque.
o. While engine is still warm, recheck torque on hollow stud, then safety hollow stud to bracket on can, and safety adapter nut to other bracket on filter can.

ALL DIMENSIONS ARE INCHES

MATERIAL: 4130 (Rc. 35-38)

Figure 11-5. Wrench Adapter Fabrication
11-31. ADAPTER REMOVAL. (See figure 11-4.)
   a. Remove filter can as outlined in paragraph 11-30.

   NOTE
   A special wrench adapter (Part No. SE709) for the adapter nut, is available from the Cessna Service Parts Center, or one may be made as shown in figure 11-5.

   b. Note angular position of adapter, then remove safety wire and loosen adapter nut.
   c. Unscrew adapter and remove adapter from engine. Discard adapter O-ring.

11-32. DISASSEMBLY, INSPECTION, AND ASSEMBLY. Figure 11-4 shows the relative position of the internal parts of the filter adapter and may be used as a guide during installation of parts. The bypass valve is to be installed as a complete unit, with the valve being staked three places. A new heliotype thread insert in the adapter may be installed although special tools are required. Follow instructions of the tool manufacturer for their use. Inspect threads on adapter and in engine for damage. Clean adapter in solvent and dry with compressed air.

   a. Assemble adapter nut and new O-ring on adapter in sequence illustrated in figure 11-4.
   b. Lubricate O-ring on adapter with clean engine oil. Tighten adapter nut until O-ring is centered in its groove on the adapter.
   c. Apply an anti-seize compound sparingly to the adapter threads, then simultaneously screw adapter and adapter nut into engine until O-ring seats against engine boss without turning adapter nut. Rotate adapter to approximate angular position noted during removal of adapter. Do not tighten adapter nut at this time.
   d. Temporarily install filter assembly on adapter, and position so adequate clearance with adjacent parts is attained. Maintaining this position of the adapter, tighten adapter nut to 50-60 lb-ft (600-700 lb-in) and safety. Use a torque wrench when tightening adapter nut.
   e. Using new gaskets, install filter assembly as outlined in paragraph 11-30. Be sure to service engine oil system.

11-33. ADAPTER INSTALLATION.
   a. Assemble adapter nut and new O-ring on adapter in sequence illustrated in figure 11-4.
   b. Lubricate O-ring on adapter with clean engine oil. Tighten adapter nut until O-ring is centered in its groove on the adapter.
   c. Apply an anti-seize compound sparingly to the adapter threads, then simultaneously screw adapter and adapter nut into engine until O-ring seats against engine boss without turning adapter nut. Rotate adapter to approximate angular position noted during removal of adapter. Do not tighten adapter nut at this time.
   d. Temporarily install filter assembly on adapter, and position so adequate clearance with adjacent parts is attained. Maintaining this position of the adapter, tighten adapter nut to 50-60 lb-ft (600-700 lb-in) and safety. Use a torque wrench when tightening adapter nut.
   e. Using new gaskets, install filter assembly as outlined in paragraph 11-30. Be sure to service engine oil system.

11-34. ENGINE FUEL SYSTEM.
   a. Assemble adapter nut and new O-ring on adapter in sequence illustrated in figure 11-4.
   b. Lubricate O-ring on adapter with clean engine oil. Tighten adapter nut until O-ring is centered in its groove on the adapter.
   c. Apply an anti-seize compound sparingly to the adapter threads, then simultaneously screw adapter and adapter nut into engine until O-ring seats against engine boss without turning adapter nut. Rotate adapter to approximate angular position noted during removal of adapter. Do not tighten adapter nut at this time.
   d. Temporarily install filter assembly on adapter, and position so adequate clearance with adjacent parts is attained. Maintaining this position of the adapter, tighten adapter nut to 50-60 lb-ft (600-700 lb-in) and safety. Use a torque wrench when tightening adapter nut.
   e. Using new gaskets, install filter assembly as outlined in paragraph 11-30. Be sure to service engine oil system.

11-35. The engine is equipped with a carburetor mounted at the lower side of the engine. The carburetor is of the plain-tube fixed-jet type, and has such features as an enclosed accelerating pump mechanism, simplified fuel passages to prevent vapor locking, idle cut-off to prevent starting of the engine accidentally, and manual mixture control for leaning. For overhaul and repair of the carburetor refer to the manufacturer's overhaul and repair manual.

11-36. CARBURETOR REMOVAL AND INSTALLATION.
   a. Place fuel shut-off valve in the OFF position.
   b. Remove engine cowling and drain fuel strainer.
   c. Disconnect flexible ducts from each side of intake airbox.
   d. Disconnect carburetor heat control at arm on airbox. Remove clamp securing control to airbox.
   e. Remove bolts and screws attaching airbox to carburetor and engine bracket.
   f. Disconnect throttle and mixture controls from arms on carburetor. Note EXACT position, size and number of washers and spacers for reference on re-installation.
   g. Disconnect and plug fuel line at carburetor.
   h. Remove nuts and washers attaching carburetor to intake manifold. Remove carburetor and mounting gasket.
   i. Reverse the preceding steps for reinstallation.

   NOTE
   Engine idle speed may vary among different engines. An engine should idle smoothly, without excessive vibration, and the idle speed should be high enough to maintain idling oil pressure and to preclude any possibility of engine stoppage in flight when the throttle is closed.

   b. Advance throttle to increase engine speed to 1000 rpm.
   c. Pull mixture control knob slowly and steadily toward the idle cut-off position, observing tachometer, then return control full in position before engine stops.
   d. Adjust mixture adjusting screw at upper end of carburetor intake throat to obtain a slight and momentary gain of 25 rpm maximum at 1000 rpm engine speed as mixture control is moved from full in toward idle cut-off position. Return control to full rich to prevent engine stoppage.
   e. If mixture is set too LEAN, engine speed will drop immediately, thus requiring a richer mixture. Turn adjusting screw out (counterclockwise) for a richer mixture.
   f. If mixture is set too RICH, engine speed will increase above 25 rpm, thus requiring a leaner mixture. Turn adjusting screw in (clockwise) for a leaner mixture.
NOTE
After each adjustment to the idle mixture, run engine up to approximately 2000 rpm to clear engine of excess fuel to obtain a correct idle speed.

11-38. INDUCTION AIR SYSTEM.

11-39. Ram air to the engine enters the induction airbox through an opening in the forward part of the lower engine cowling nose cap. The air is filtered through a filter which is located at the opening in the nose cap. From the induction airbox the filtered air is directed to the inlet of the carburetor, mounted on the lower side of the engine, and through the carburetor, where fuel is mixed with the air, to the intake manifold. From the intake manifold, the fuel-air mixture is distributed to each cylinder by separate intake pipes. The intake pipes are attached to the intake manifold with hose and clamps and to the cylinder with a two bolt flange which is sealed with a gasket. The induction airbox contains a valve, operated by the carburetor heat control in the cabin, which permits air from an exhaust heated source to be selected in the event carburetor icing or filter icing should be encountered.

11-40. REMOVAL AND INSTALLATION.
   a. Remove airbox and carburetor as outlined in paragraph 11-36.
   b. Remove intake pipes by disconnecting hose and removing nuts and washers attaching pipes to cylinders.
   c. Installation of the system is the reverse of the preceding steps. Use new gaskets at installation.

11-41. IGNITION SYSTEM.

11-42. Sealed, lightweight Slick magnetos are used on the engine. Both magnetos are equipped with impulse couplings. The magnetos MUST NOT BE DISASSEMBLED. Internal timing is fixed and the breaker points are not adjustable. Timing marks are provided on the distributor gear and distributor block, visible through the air vent holes, for timing to the engine. A timing hole is provided in the bottom of the magneto adjacent to the magneto flange. A timing pin (or 0.093 inch 6-penny nail) can be inserted through this timing hole into the mating hole in the magneto rotor shaft to lock the magneto approximately in the proper firing position. Slick lightweight ignition harness is used with the lightweight magnetos. For ignition harness repair refer to the manufacturer's Service Manual.

WARNING

During all magneto maintenance, always take proper precautions to make sure the engine can not fire or start when the propeller is moved.
11-43. MAGNETO REMOVAL. Remove high-tension outlet plate, disconnect primary lead, and remove nuts and washers securing magneto to the engine. Note the approximate angular position at which the magneto is installed, then remove the magneto.

11-44. INTERNAL TIMING. Internal timing is accomplished during manufacture of the magneto. Since these magnetos are NOT TO BE DISASSEMBLED, there is no internal timing involved.

11-45. REPLACEMENT INTERVAL. These magnetos cannot be overhauled in the field. The coil, capacitor, and breaker assembly are non-replaceable. As a good maintenance practice, and to have the benefit of good ignition at all times, it is recommended that the magnetos be removed at 900 hours of magneto time, and install new exchange magnetos.

11-46. MAGNETO INSTALLATION AND TIMING TO ENGINE. The magneto must be installed with its timing marks correctly aligned, with number one cylinder on its compression stroke, and with the number one piston at its advanced firing position. Refer to paragraph 11-8 for the advanced firing position of number one piston. To locate the compression stroke of the number one cylinder, remove the lower spark plug from number two, three, and four cylinder and remove the upper spark plug from number one cylinder. Place the thumb of one hand over the spark plug hole of number one cylinder and rotate crankshaft in the direction of normal rotation until the compression stroke is indicated by positive pressure inside the cylinder lifting the thumb off the spark plug hole. After the compression stroke is obtained, locate number one piston at its advanced firing position. Locating the advanced firing position of number one piston may be obtained by rotating the crankshaft opposite to its normal direction of rotation until it is approximately 30 degrees before top center (BTC) on the compression stroke of number one cylinder. Then, rotate crankshaft in normal direction of rotation to align the correct timing mark on the outer surface of the crankshaft flange, with the parting surface of the crankcase below the crankshaft as the reference point, making sure the final motion of the crankshaft is in the direction of normal rotation.

NOTE

Various other methods and equipment may be used to arrive at the number one piston advanced firing position. One such method is: An accurate top center indicator which screws into a spark plug mounting hole, and a pendulum pointer mounted on a 360-degree timing disc may be used. The timing disc should be adapted to fit over the end of the propeller spinner in such a manner that it may be rotated as necessary.

In all cases, it must be definitely determined that No. 1 cylinder is at the correct firing position, on its compression stroke, when the crankshaft is rotated in its normal direction of rotation.

After the engine has been placed to the correct firing position, install and time magneto to the engine in the following manner.

a. Remove the timing (vent) plug from the bottom of the magneto. The vent plug in the top of the magneto need not be removed.

b. Rotate magneto shaft until timing mark on rotor is visible through the vent plug hole. Impulse coupling pawls must be depressed to turn magneto shaft in normal direction of rotation.

c. Establish that the magneto is at number one firing position. It is possible for the timing mark to be visible while firing position is 180 degrees from number one firing position.

NOTE

It is necessary to "spark" the magneto to establish the correct firing position. The outlet plate with spark-plug leads must be installed on the magneto. Hold number one spark plug lead (see figure 11-6) close to magneto case, or ground the magneto and hold the number one spark plug lead close to a good ground. Rotate impulse coupling in normal direction of rotation until a spark occurs at this lead. (Impulse coupling pawls must be depressed to turn magneto shaft in normal direction of rotation.) Turn impulse coupling backward a few degrees, until timing marks on rotor is centered in vent plug hole and install timing pin (or 0.093 inch 6-penny nail) through hole in bottom of magneto next to the flange and into the mating hole in the rotor shaft. This locks the magneto approximately in firing position while installing it on the engine.

d. Keep timing mark centered in vent plug hole during installation.

e. Be sure magneto gaskets are in place and that engine is in correct firing position, then install magneto(s) at the angle noted during removal, tighten mounting nuts finger tight.

CAUTION

Remove timing pin from magneto, if installed. Be sure to remove this pin before rotating crankshaft.

f. Connect one lead of timing light to the capacitor terminal at the rear of the magneto and ground lead of timing light to a good ground.

g. Rotate propeller opposite to normal direction of rotation a few degrees (approximately 5 degrees) to close magneto contact points.

NOTE

Do not rotate propeller back far enough to engage impulse coupling, or propeller will have to be rotated in normal direction of rotation until impulse coupling releases, then backed up a few degrees before the firing position.

h. Slowly advance propeller (tap forward with minute movements as firing position is approached)
Figure 11-7. Ignition Schematic

FIRING ORDER 1-3-2-4
in normal direction of rotation until timing light indicates position at which contact points break. The contact points should break at the advanced firing position of number one cylinder. Loosen mounting nuts slightly and rotate magneto case to make contact points break at the correct position. Tighten mounting nuts.

i. After tightening magneto mounting nuts, recheck timing. Make sure both magnetos are set to fire at the same time. Remove timing equipment and connect spark plug leads and ignition switch leads.

NOTE

Beginning with the number one outlet, the magneto fires at each successive outlet in a counterclockwise direction, looking at the outlets. Connect number one magneto outlet to number one cylinder spark plug lead, number two outlet to the next cylinder to fire, etc. Engine firing order is listed in paragraph 11-8.

11-46A. MAGNETO CHECK. Advanced timing settings in some cases, is the result of the erroneous practice of bumping magnetos up in timing in order to reduce RPM drop on single ignition. NEVER ADVANCE TIMING BEYOND SPECIFICATIONS IN ORDER TO REDUCE RPM DROP. Too much importance is being attached to RPM drop in single ignition. RPM drop on single ignition is a natural characteristic of dual ignition design. The purpose of the following magneto check is to determine that all cylinders are firing. If all cylinders are not firing, the engine will run extremely rough and cause for investigation will be quite apparent. The amount of RPM drop is not necessarily significant and will be influenced by ambient air temperature, humidity, airport altitude, etc. In fact, absence of RPM drop should be cause for suspicion that the magneto timing has been bumped up and is set in advance of the setting specified. Magneto checks should be performed on a comparative basis between individual right and left magneto performance.

a. Start and run engine until the oil and cylinder head temperatures are in the normal operating ranges.

b. Advance engine speed to 1700 rpm.

c. Turn the ignition switch to the "R" position and note the rpm drop, then return the switch to the "BOTH" position to clear the opposite set of plugs.

d. Turn the switch to the "L" position and note the rpm drop, then return the switch to the "BOTH" position.

e. The rpm drop should not exceed 150 rpm on either magneto or show greater than 75 rpm differential between magnetos. A smooth rpm drop-off past normal is usually a sign of a too lean or too rich mixture. A sharp rpm drop-off past normal is usually a sign of a fouled plug, a defective harness lead or out of time. If there is doubt concerning operation of the ignition system, rpm checks at a leaner mixture setting or at higher engine speeds will usually confirm whether a deficiency exists.

NOTE

An absence of rpm drop may be an indication of faulty grounding of one side of the ignition system, a disconnected ground lead at magneto or possibly the magneto timing is set too far in advance.

11-47. MAINTENANCE. Magneto-to-engine timing should be checked at the first 50 hours, first 100 hours, and thereafter at each 200 hours. If timing to the engine is not within plus zero degrees and minus two degrees, the magneto should be timed to the engine.

NOTE

If ignition trouble should develop, spark plugs and ignition wiring should be checked first. If the trouble appears definitely to be associated with a magneto, the following may be used to help disclose the source of trouble.

a. Remove high-tension outlet plate and check distributor block for moisture.

b. If any moisture is evident, lightly wipe with a soft, dry, lint-free cloth. Reinstall outlet plate.

NOTE

Since these magnetos MUST NOT BE DISASSEMBLED, new magnetos should be installed if the moisture check does not remedy the trouble.

11-48. SPARK PLUGS. Two 18-mm spark plugs are installed in each cylinder and screw into heli-coil type thread inserts. The spark plugs are shielded to prevent spark plug noise in the radio and the spark plugs have an internal resistor to provide longer terminal life. Spark plug life will vary with operating conditions. A spark plug that is kept clean and properly gapped will give better and longer service than one that is allowed to collect lead deposits and is improperly gapped. The correct spark plug and gap setting is given in paragraph 11-8.

NOTE

At each 100-hour inspection, remove, clean, inspect, and regap all spark plugs. Install lower spark plugs in upper portion of cylinder and install upper spark plugs in lower portion of cylinders at each 100-hour inspection.

Since deterioration of lower spark plugs is usually more rapid than that of the upper spark plugs, rotating them helps prolong spark plug life.

11-49. ENGINE CONTROLS.

11-50. Engine controls of the push-pull type include the throttle, mixture, and carburetor heat controls. The engine controls are equipped with position-locking devices which prevent vibration-induced "creeping" of the controls.
a. Pull throttle control out (idle position) and remove throttle control knob.
b. Screw jam nut all the way down (clockwise) and install throttle knob. Screw knob securely against the jam nut. Do not back jam nut out. This will prevent bottoming and possible damage to the staked connection.

c. Disconnect throttle control at the carburetor throttle arm, push throttle control in until jam nut contacts friction lock. While the friction lock is loose, then pull control out approximately 1/8 inch for cushion. Note position of larger washer at carburetor end of control. Install washer in same position when connecting control to arm.
d. Tighten friction lock, being careful not to change position of the throttle.
e. Move throttle arm on the carburetor to full open, adjust rod end at end of throttle control to fit, and connect to arm on carburetor.
f. Release friction lock and check full travel of arm on carburetor. If further adjustment is required, make all adjustments at the carburetor end of control.

11-53. MIXTURE CONTROL.

NOTE
Refer to the inspection chart in Section 2 for inspection and/or replacement interval for the throttle control.

Before rigging throttle control shown in figure 11-8, check that staked connection between rigid conduit and flexible conduit is secure. If any indication of looseness or breakage is apparent, install new throttle control before continuing rigging procedure.

11-22  Change 1
11-54. CARBURETOR HEAT CONTROL.
   a. Loosen clamp securing the control to the bracket on the airbox.
   b. Push control full in, then pull it out approximately 1/8 inch from panel for cushion.
   c. Shift the control housing in its clamp so that the valve lever is full forward, with valve seating inside airbox. Tighten clamp in this position.
   d. Pull out on the control and check that the air valve inside the airbox seats in the opposite direction.
   e. Check that bolt and nut on the air throttle lever secures the control wire and that the bolt will swivel in the lever.
   f. Bend the wire tip 90 degrees to prevent it from becoming withdrawn if the attaching nut should become loose.

   NOTE

   Refer to the inspection chart in Section 2 for inspection and/or replacement interval for the carburetor heat control.

11-55. STARTING SYSTEM.

11-56. The automatically engaged starting system
employs an electric starter motor mounted at the rear of the accessory housing. A starter solenoid is activated by the ignition key on the instrument panel. When the solenoid is activated, its contacts close and electrical current energizes the starter motor. Initial rotation of the starter motor engages the starter through an overrunning clutch in the starter adapter.

11-57. TROUBLESHOOTING.

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<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
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<tr>
<td>STARTER WILL NOT OPERATE.</td>
<td>Defective master switch or circuit.</td>
<td>Install new switch or wires.</td>
</tr>
<tr>
<td></td>
<td>Defective starter switch or switch circuit.</td>
<td>Install new switch or wires.</td>
</tr>
<tr>
<td></td>
<td>Defective starter motor.</td>
<td>Remove, repair or install new starter motor.</td>
</tr>
<tr>
<td>STARTER MOTOR RUNS, BUT DOES NOT TURN CRANKSHAFT.</td>
<td>Defective overrunning clutch or drive.</td>
<td>Install new starter adapter.</td>
</tr>
<tr>
<td></td>
<td>Starter motor shaft broken.</td>
<td>Install new starter motor.</td>
</tr>
<tr>
<td>STARTER MOTOR DRAGS.</td>
<td>Low battery.</td>
<td>Charge or install new battery.</td>
</tr>
<tr>
<td></td>
<td>Starter switch or relay contacts burned or dirty.</td>
<td>Install serviceable unit.</td>
</tr>
<tr>
<td></td>
<td>Defective starter motor power cable.</td>
<td>Install new cable.</td>
</tr>
<tr>
<td></td>
<td>Loose or dirty connections.</td>
<td>Remove, clean and tighten all terminal connections.</td>
</tr>
<tr>
<td></td>
<td>Defective starter motor.</td>
<td>Check starter motor brushes, brush spring tension, thrown solder on brush cover. Repair or install new starter motor.</td>
</tr>
<tr>
<td></td>
<td>Dirty or worn commutator.</td>
<td>Clean and turn commutator.</td>
</tr>
</tbody>
</table>

11-58. REMOVAL AND INSTALLATION.  
a. Remove cowling as required for access.  

**CAUTION**  
When disconnecting or connecting the starter cable, do not permit starter terminal bolt to rotate. Rotation of the terminal bolt could break the conductor between terminal and field coils causing the starter motor to be inoperative.

b. Disconnect starter power cable at starter. Insulate terminal on power cable to prevent accidental shorting.

c. Remove three Palsnuts and three hex head nuts attaching starter adapter to crankcase cover studs.

d. Cut safety wire and remove two bolts threaded through crankcase into starter.

e. Tap starter gently to loosen gasket and remove starter and adapter with a straight rearward movement.

f. Clean any gasket which may be stuck to starter, starter adapter, or crankcase cover.
g. When installing starter, work a non-hardening gasket paste into both sides of a new gasket, and position starter and adapter assembly against crankcase pad.

h. Install three plain washers and hex head nuts on studs and install bolts through crankcase.

**CAUTION**

Tighten bolts and nuts evenly to prevent warping adapter cover.

i. Install new Palnuts on cover studs and lock wire on bolt heads.

j. Connect starter power cable to starter.

11-59. PRIMARY MAINTENANCE. The starting circuit should be inspected at regular intervals, the frequency of which should be determined by the amount of service and conditions under which the equipment is operated. Inspect the battery and wiring. Check battery for fully charged condition, proper electrolyte level with approved water and terminals for cleanliness. Inspect wiring to be sure that all connections are clean and tight and that the wiring insulation is sound. Check that the brushes slide freely in their holders and make full contact on the commutator. When brushes are worn to one-half of their original length, install new brushes (compare brushes with new brushes). Check the commutator for uneven wear, excessive glazing or evidence of excessive arcing. If the commutator is only slightly dirty, glazed, or discolored, it may be cleaned with a strip of No. 00 or No. 000 sandpaper. If the commutator is rough or worn, it should be turned in a lathe and the mica undercut. Inspect the armature shaft for rough bearing surfaces. New brushes should be properly seated when installing by wrapping a strip of No. 0 sandpaper around the commutator (with sanding side out) 1-1/4 to 1-1/2 times maximum. Drop brushes on sandpaper covered commutator and turn armature slowly in the direction of normal rotation. Clean sanding dust from motor after sanding operations.

11-60. EXHAUST SYSTEM. The exhaust system consists of a muffler for each bank of cylinders with an exhaust pipe from each cylinder to the muffler on that side of the engine. The muffler assemblies are enclosed in shrouds which captures ram air to be heated by the exhaust gases in the muffler. This heated air is used to heat the aircraft cabin and to furnish heated air for carburetor heat at the engine intake system. A tail pipe from each muffler routes exhaust gases overboard through the lower cowling.

11-61. REMOVAL.

a. Remove engine cowling as required for access.

b. Disconnect flexible ducts from shrouds on muffler assemblies.

c. Disconnect braces from muffler and tail pipe assemblies.

d. Remove nuts and washers securing the exhaust stack assemblies to the cylinders.

e. Remove exhaust stack assembly.

11-62. INSPECTION of the exhaust system shall be thorough because the cabin heating system uses air heated by the heat exchangers of the exhaust system. Since exhaust systems of this type are subject to burning, cracking, and general deterioration from alternate thermal stresses and vibration, inspection is very important and should be accomplished every 100-hours of operation. In addition, an inspection of the exhaust system shall be performed anytime exhaust fumes are detected in the cabin area.

a. Remove engine cowling, and loosen or remove shrouds so that ALL surfaces of the exhaust system can be visually inspected. Especially check areas adjacent to welds. Look for exhaust gas deposits in surrounding areas, indicating that exhaust gas is escaping through a crack or hole.

b. For a more thorough inspection, or if fumes have been detected in the cabin, the following inspection is recommended:

1. Remove exhaust pipe and mufflers.

2. Use rubber expansion plugs to seal openings.

3. Using a manometer or gage, apply approximately 1-1/2 psi (3 inches of mercury) air pressure while the muffler and each exhaust pipe is submerged in water. All leaks will appear as bubbles and can be readily detected.

4. It is recommended that any exhaust pipe or muffler found defective be replaced with a new part before the next flight.

c. Install exhaust system.

11-63. INSTALLATION. Reverse procedure outlined in paragraph 11-61 to install exhaust system. Be sure there is one new copper-asbestos gasket between each exhaust pipe and it's mounting pad on the cylinder. Make sure clamps attaching mufflers to exhaust pipes are tight and all air ducts are installed.

11-64. EXTREME WEATHER MAINTENANCE.

11-65. COLD WEATHER. Cold weather starting is made easier with the installation of the engine primer system and ground service receptacle. The primer system is a manually operated type. Fuel is supplied by a line from the fuel strainer to the plunger type...
primer. Operating the primer plunger in the cabin forces fuel to the engine. Fuel is delivered to the intake manifold above the carburetor, therefore, priming the intake manifold. Crushed or broken primer lines should be replaced with new parts. Primer lines should be properly clamped to prevent vibration and chafing. With the ground service receptacle installed, an external power source may be connected to assist in cold weather or low battery starting. Refer to paragraph 11-66 for use of the ground service receptacle.

The following may also be used to assist engine starting in extreme cold weather. After the last flight of the day, drain the engine oil into a clean container so the oil can be preheated. Cover the engine to prevent ice or snow from collecting inside the cowling. When preparing the aircraft for flight or engine run-up after these conditions have been followed, preheat the drained oil.

**WARNING**

Do not heat oil above 121°C (250°F). A flash fire may result. Before pulling the propeller through, ascertain that magneto switch is in OFF position to prevent the engine from firing.

After preheating the oil, gasoline may be mixed with the heated oil in a ratio of 1 part gasoline to 12 parts oil before pouring into the engine oil sump. If the free air temperature is below -29°C (-20°F), the engine compartment should be preheated with a ground heater. After the engine compartment has been preheated, inspect all engine drain and vent lines for presence of ice. After this procedure has been complied with, pull propeller through several revolutions by hand before starting the engine.

**CAUTION**

Due to the desludging effect of the diluted oil, engine operation should be observed closely during the initial warm-up of the engine. Engines that have a considerable amount of operational hours accumulated since their last dilution period may be seriously affected by the dilution process. This is caused by the diluted oil dislodging sludge and carbon deposits within the engine. This residue will collect in the oil sump and possibly clog the screened inlet to the oil pump. Small deposits may actually enter the oil pump and be trapped by the pressure oil filter screen. Partial or, in some cases, complete loss of engine lubrication may result from either condition. If these conditions are anticipated after oil dilution, the engine should be operated for several minutes at normal operating temperatures and then stopped and inspected for evidence of sludge and carbon deposits in the oil sump and oil filter screen. Future occurrence of this condition can be prevented by diluting the oil prior to each oil change. This will prevent the build-up accumulation of the sludge and carbon deposits within the engine.

**WARNING**

11-66. GROUND SERVICE RECEPTACLE. With the ground service receptacle installed, the use of an external power source is recommended for cold weather and low battery starting and lengthy maintenance work on the aircraft electrical systems. The battery and external power circuits have been designed to completely eliminate the need to "jumper" across the battery contactors to close it. A special fused circuit in the external power system supplies the needed "jumper" across the contacts so that with a "dead" battery and an external power source applied, turning the master switch ON will close the battery contactor.

**CAUTION**

Be certain that the polarity of any external power source is correct (positive to positive and negative to negative). A polarity reversal will result in immediate damage to the electrical and electronic circuits of the aircraft.

11-67. HOT WEATHER. Engine mis-starts characterized by weak, intermittent explosions followed by pulls of black smoke from the exhaust are caused by over-priming or flooding. This situation is more apt to develop in hot weather or when the engine is hot. If it occurs, repeat the starting routine with the throttle approximately one-half OPEN, and the mixture control in IDLE CUT-OFF. As the engine fires, move the mixture control to full RICH and decrease the throttle setting to desired idling speed.

Engine mis-starts characterized by sufficient power to disengage the starter but dying after three to five revolutions are the result of an excessively lean mixture after the start. This can occur either in warm or cold temperatures. Repeat the starting routine with additional priming.

**CAUTION**

Never operate the starting motor more than 12 seconds at a time. Allow starter motor to cool between cranking periods to avoid overheating. Longer cranking periods will shorten the life of the starter.

11-68. DUSTY CONDITIONS. Dust inducted into the intake system of the engine is probably the greatest single cause of early engine wear. When operating under high dust conditions, the induction air filter should be serviced daily as outlined in paragraph 2-17.

11-69. SEACOAST AND HUMID AREAS. In salt water areas, special care should be taken to keep the engine and accessories clean to prevent oxidation. In humid areas, fuel and oil should be checked frequently and drained of condensed moisture.

11-70. HAND CRANKING. A normal hand-cranking procedure may be used to start the engine.
12-1. FUEL SYSTEM.

12-2. DESCRIPTION. Fuel is gravity-fed from the metal wing tanks, through a shut-off valve and a fuel strainer, to the carburetor. Positive ventilation is provided by a vent line and check valve assembly located in the left wing tank and a crossover line connecting the two tanks together. The vent line from the check valve assembly extends overboard through the lower wing skin adjacent to the left wing strut. A fuel line drain is located between the shut-off valve and the strainer.

12-3. PRECAUTIONS.

NOTE

There are certain general precautions and rules concerning the fuel system which should be observed when performing the operations and procedures in this section. These are as follows:

a. During all fueling, defueling, tank purging, and tank repairing or disassembly, ground the aircraft to a suitable ground stake.

b. Residual fuel draining from lines and hose constitutes a fire hazard. Use caution to prevent the accumulation of fuel when lines or hose are disconnected.

c. Cap open lines and cover connections to prevent thread damage and the entrance of foreign matter.

Throughout the aircraft fuel system, from the tanks to the carburetor, use NS-40 (RAS-4) (Snap-On-Tools Corp., Kenosha, Wisconsin), MIL-T-5544 (Thread Compound Antiseize, Graphite Petrolatum), USP Petrolatum or engine oil as a thread lubricator or to seal a leaking connection. Apply sparingly to male threads only, omitting the first two threads, exercising extreme caution to avoid "stringing" sealer across the end of the fitting. Always ensure that a compound, the residue from a previously used compound, or any other foreign material cannot enter the system.
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<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO FUEL TO CARBURETOR.</td>
<td>Fuel shut-off valve not turned on.</td>
<td>Turn valve on. (Safety in ON position.)</td>
</tr>
<tr>
<td></td>
<td>Fuel tanks empty.</td>
<td>Service with proper grade and amount of fuel.</td>
</tr>
<tr>
<td></td>
<td>Fuel line disconnected or broken.</td>
<td>Connect or repair fuel lines.</td>
</tr>
<tr>
<td></td>
<td>Inlet elbow or inlet screen in carburetor plugged.</td>
<td>Clean and/or replace.</td>
</tr>
<tr>
<td></td>
<td>Fuel tank outlet strainers plugged.</td>
<td>Remove and clean strainers and flush out fuel tanks.</td>
</tr>
<tr>
<td></td>
<td>Defective fuel shut-off valve.</td>
<td>Replace shut-off valve.</td>
</tr>
<tr>
<td></td>
<td>Plugged fuel strainer.</td>
<td>Remove and clean strainer and screen.</td>
</tr>
<tr>
<td></td>
<td>Fuel line plugged.</td>
<td>Clean out or replace fuel line.</td>
</tr>
<tr>
<td>FUEL STARVATION AFTER STARTING.</td>
<td>Partial fuel flow from the preceding causes.</td>
<td>Use the preceding remedies.</td>
</tr>
<tr>
<td></td>
<td>Plugged fuel vent.</td>
<td>See paragraph 12-11.</td>
</tr>
<tr>
<td></td>
<td>Water in fuel.</td>
<td>Drain fuel tank sumps, fuel lines and fuel strainer.</td>
</tr>
<tr>
<td>NO FUEL QUANTITY INDICATION.</td>
<td>Fuel tanks empty.</td>
<td>Service with proper grade and amount of fuel.</td>
</tr>
<tr>
<td></td>
<td>Blown fuse.</td>
<td>Replace blown fuse.</td>
</tr>
<tr>
<td></td>
<td>Loose connections or open circuit.</td>
<td>Tighten connections; repair or replace wiring. Refer to Section 20.</td>
</tr>
<tr>
<td></td>
<td>Defective fuel quantity indicator or transmitter.</td>
<td>Refer to Section 15.</td>
</tr>
<tr>
<td>PRESSURIZED FUEL TANK</td>
<td>Plugged bleed hole in fuel vent.</td>
<td>Check per paragraph 12-11.</td>
</tr>
</tbody>
</table>

SHOP NOTES:
Figure 12-1. Fuel System Schematic
Thru 15073658, A1500342, F15000863 and FA1500166, handle (7) is safetied to the lower mounting bolt. Beginning with 15073659, A1500343, F15000864 and FA1500167, handle (7) is safetied to a bolt, located in the floorboard. The handle is safetied in the "ON" position with .018" dia. mild steel safety wire (tag wire), which will break easily if handle must be turned "OFF" in an emergency.

All fuel hoses should be replaced at engine overhaul or after 5 years, whichever comes first.

A PRIOR TO 150-70840 & F150-0620

B BEGINNING WITH 150-70840 & F150-0620

Shut-off valve (9) should be replaced and not repaired.

Figure 12-2. Fuel System
Hinge for vent valve (12) must be at top. Tube for valve extends into fuel tank, then forward and slightly upward.

Figure 12-3. Fuel Tank (Sheet 1 of 2)
Apply Dow Corning Silastic RTV 732, General Electric RTV-102 (white) or Devcon Silite 100 (white) in a bead around filler neck (9) at adapter (6). Also, apply sealant in a bead around screws referenced in Section C-C.

For ground strap installation, see sheet 1.

Hinge for vent valve (12) must be at top. Tube for valve extends into fuel tank, then forward and slightly upward.

Remove shims (28) when required to increase tension of leaf spring (29).

Figure 12-3. Fuel Tank (Sheet 2 of 2)
12-5. FUEL TANKS.

12-6. DESCRIPTION. A rigid metal tank is installed in the inboard panel of each wing. Sump drain plugs, one in each tank, are provided for draining trapped water and sediment.

12-7. REMOVAL AND INSTALLATION.
   a. Remove sump drain plug and drain fuel from applicable tank. (Observe precautions in paragraph 12-3.)
   b. Remove fuel tank cover by removing attaching screws.
   c. Remove wing root fairings.
   d. Disconnect and plug or cap all fuel and vent lines from tank. Remove fittings as necessary for clearance when removing tank.
   e. Disconnect electrical lead and ground strap from fuel quantity transmitter.
   f. Disconnect straps securing fuel tank and remove tank. Use care to avoid damage to protruding fittings and hose connections when removing the tank.
   g. To install tank, reverse the preceding steps. Be sure grounding is secure in accordance with figure 12-3.

12-8. FUEL QUANTITY TRANSMITTERS. Fuel quantity transmitters are installed in the top of fuel tanks. A complete description, along with procedures for removal, installation and adjustment are contained in Section 15.

12-9. FUEL VENTS.

12-10. DESCRIPTION. A vent line is installed in the outboard end of the left fuel tank and extends overboard down through the lower wing skin. The inboard end of the vent line extends into the fuel tank, then forward and slightly upward. A vent valve is installed on the inboard end of the vent line inside the fuel tank, and a crossover vent line connects the two tanks for positive ventilation.

12-11. CHECKING. Field experience has demonstrated that the fuel vent can become plugged, with possible fuel starvation of the engine or collapse of the fuel tanks. Also, the bleed hole in the vent valve assembly could possibly become plugged, allowing pressure from expanding fuel to pressurize the tanks. The following procedure may be used to check the vent and bleed hole in the valve assembly.
   a. Attach a rubber tube to the end of vent line beneath the wing.
   b. Blow into tube to slightly pressurize the tanks. If air can be blown into tanks, vent line is open.
   c. After tank is slightly pressurized, insert end of rubber tube into a container of water and watch for a continuous stream of bubbles, which indicates the bleed hole in valve assembly is open and relieving pressure.
   d. After completion of step "c", blow into tube again to slightly pressurize the tank, and loosen, but do not remove filler cap on opposite wing to check tank crossover line. If pressure escapes from filler cap, crossover line is open.

12-12. FUEL SHUT-OFF VALVE. (See figure 12-2.)

12-13. DESCRIPTION. The fuel shut-off valve is a two-position ON-OFF valve, located in the floor area between the pilot and copilot positions. Thru 1972 Models, the handle is safetied to the lower mounting bolt. Beginning with 1973 Models, the handle is safetied to a bolt, located in the floorboard. The handle is safetied in the "ON" position with .018" diameter mild steel wire (tag wire), which will break easily if the handle must be turned OFF in an emergency. It is recommended that the valve be replaced and not repaired.

12-14. REMOVAL AND INSTALLATION.
   a. Completely drain all fuel from wing tanks, fuel lines, strainer, and shut-off valve. (Observe the precautions in paragraph 12-3.)
   b. Remove shut-off valve handle.
   c. Remove copilot's seat and access plate under seat.
   d. Disconnect and cap all fuel lines at shut-off valve.
   e. Remove bolts attaching shut-off valve and remove valve.
   f. Reverse the preceding steps for installation.

12-15. FUEL STRAINER. (See figure 12-5.)

12-16. DESCRIPTION. The fuel strainer is mounted at the firewall in the lower engine compartment. The strainer is equipped with a quick-drain valve which provides a means of draining trapped water and sediment from the fuel system. The quick-drain control is located adjacent to the oil dipstick and is accessible through the oil dipstick door.

NOTE

The fuel strainer can be disassembled, cleaned and reassembled without removing the assembly from the aircraft. (Refer to paragraph 12-20.)

12-17. DISASSEMBLY AND ASSEMBLY. (See figure 12-5.)
   a. Remove drain tube, safety wire, nut and washer at bottom of filter bowl, and remove bowl.
   b. Carefully unscrew standpipe and remove.
NOTE

The fuel vent line protruding beneath the wing near the wing strut must be correctly aligned to avoid possible icing of the vent tube.

A 150 AND F150

B A150 AND FA150

1. Wing Strut
2. Wing Skin
3. Bracket
4. Clamp
5. Grommet
6. Vent Tube

* PRIOR TO SERIAL NO. 15067851
PRIOR TO SERIAL NO. F150-0360

* SERIAL NO. 15067851 AND ALL SERVICE PARTS
SERIAL NO. F150-0360 AND ALL SERVICE PARTS

VENT LINE MUST BE PARALLEL TO WING CHORD LINE. TOLERANCE UP 5°, DOWN 0°.

Figure 12-4. Fuel Vent Location

P-S-661, or equivalent) and dry with compressed air.

d. Using a new gasket between filter screen and top assembly, install screen and standpipe. Tighten standpipe only finger tight.
e. Using all new O-rings, install bowl. Note that step-washer at bottom of bowl is installed so that step seats against O-ring.
f. Turn shut-off valve to "ON" position, check for leaks and proper operation.
g. Torque bottom nut (15) to 25-30 lb-in., and safety wire to top assembly of strainer. Wire must have right-hand wrap, at least 45 degrees.
h. Connect drain tube.

12-18. PRIMING SYSTEM. (See figure 12-2.)

12-19. DESCRIPTION. The priming system is comprised of a manually-operated primer located on the instrument panel, and a line from the primer to the intake manifold. Operation of the plunger forces fuel directly into the engine intake manifold.

12-20. REMOVAL AND INSTALLATION.
a. Disconnect and cap all lines at primer.
b. Unscrew knurled nut and remove plunger from pump body.
c. Remove pump body from instrument panel.

NOTE

Visually inspect primer lines for crushed, kinked, or broken condition. Ensure proper clamping to prevent fatigue due to vibration and chafing.

d. Prior to installing a primer, check for proper pumping action and positive fuel shut-off in the locked position.
e. Reverse preceding steps for installation.

SHOP NOTES:
NOTE
Torque nut (15) to 25-30 lb in.

1. Spring
2. Washer
3. Plunger
4. Top
5. Drain Control
6. Plate
7. O-Ring
8. Gasket
9. Filter
10. Retainer Ring
11. Standpipe
12. O-Ring
13. Bowl
14. O-Ring
15. Nut
16. Drain Line

Figure 12-5. Fuel Strainer
SECTION 13
PROPELLER

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<td>Installation (Beginning with 1971 Models)</td>
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13-1. PROPELLER.

13-2. DESCRIPTION. An all-metal, fixed-pitch propeller, equipped with a spinner, is used on the aircraft. Several types of spinner installations are used, depending on the type and model-year of the aircraft. Refer to figures 13-1 and 13-2 for the different installations of the propellers and spinners.

13-3. REPAIR. Repair of a metal propeller first involves evaluating the damage and determining whether the repair is to be a major or minor one. Federal Aviation Regulations, Part 43 (FAR 43), and Federal Aviation Agency Advisory Circular No. 43.13 (FAR AC No. 43.13), define major and minor repairs, alterations and who may accomplish them. When making repairs or alterations to a propeller, FAR 43, FAA AC No. 43.13 and the propeller manufacturer's instructions must be observed. The propeller manufacturer's Service Manual may be obtained from the Cessna Service Parts Center.

13-4. REMOVAL. (THRU 1970 MODELS.) (Refer to figure 13-1.)

WARNING

Be sure magneto switch is in OFF position before turning propeller.

a. Remove spinner.

NOTE

The small spinner mounting bracket (3) is attached with two of the propeller mounting bolts (6). The early large spinner (9) is attached to two spinner bulkheads. These bulkheads are secured by the propeller mounting bolts (6) and will be freed by removal of the bolts as the propeller is removed. The later large spinner (10) is attached to the rear bulkhead with a forward supporting bulkhead. Note the number of shims (11) behind the forward bulkhead upon removal and retain these shims. The rear bulkhead is secured by the propeller mounting bolts (6) and is removed as the propeller is removed. The later large spinner, bulkheads and attaching parts are used as spare parts for the early large spinner.

b. Remove safety wire from mounting bolt heads (6).

c. Remove bolts and pull propeller forward to remove. Use care to avoid damage to bulkheads as propeller is removed.

13-5. INSTALLATION. (THRU 1970 MODELS.) (Refer to figure 13-1.)

a. Clean mating surfaces of propeller, crankshaft flange and spinner bulkheads.

WARNING

Be sure magneto switch is in OFF position before turning crankshaft.

b. Locate top center of number one piston on its compression stroke. Align the top center mark on the crankshaft flange with parting surface of the crankcase below the crankshaft.

c. With propeller blades in vertical position, rotate blades 30 degrees clockwise looking aft.

d. Install propeller and spinner bulkheads. The spinner bulkheads must be positioned so propeller blades will emerge from the spinner with ample clearance.

e. Tighten the mounting bolts (6) evenly to a torque value of 300-320 lb-in (thru 1969 models) and 300-360 lb-in (beginning with 1970 models).

f. Safety wire propeller mounting bolts (6). Do not allow safety wire to cross the top of bolt head as this would interfere with the installation of forward spinner bulkhead and shims.

g. Install spinner. When installing the later type spinner and bulkheads, add shims as required (maximum of 4) behind forward bulkhead to provide a snug fit between bulkhead and spinner when the rear bulkhead attachment holes are aligned.

13-6. REMOVAL. (Beginning with 1971 Models) (Refer to figure 13-2.)

a. Remove spinner (1).

b. On aircraft serials 15072004 thru 15075781, A1500227 thru A15000523, F15000523 thru F15001143 and FA15000082 and on, proceed as follows:

1. Remove forward bulkhead (3*). Retain any shims (4*) between bulkhead and propeller.

WARNING

Be sure magneto switch is in OFF position before turning propeller.

2. Remove safety wire from mounting bolt heads (10*).
AIRCRAFT SERIALS 15069309 THRU 15072003
AND F15000390 THRU F15000658

TORQUE PROPELLER MOUNTING BOLTS TO
300-320 LB-IN THRU AIRCRAFT SERIALS
15071128 AND F15000529
TORQUE PROPELLER MOUNTING BOLTS TO
300-360 LB-IN BEGINNING WITH AIRCRAFT
SERIALS 15071129, F15000530, A15000001
AND FA15000001

NOTE

This installation obsolete and no longer
available. Replaced by the installation
shown below. Refer to Cessna Service

AIRCRAFT SERIALS 15069309 THRU 15071710,
A15000001 THRU A15000149, F15000390 THRU
F15000595 AND FA15000001 THRU FA15000026

INSTALL PROPELLER TO TRAIL TOP DEAD
CENTER 30 DEGREES.

Figure 13-1. Propeller and Spinner Installation (Sheet 1 of 2)
3. Remove bolts and washers and pull propeller forward to remove.

**NOTE**

The aft spinner bulkhead (6) is installed between propeller (5) and spacer (8), and is removed as the propeller is removed.

4. Using a punch through holes in forward face of propeller, drive 2 dowel pins (7) aft to separate propeller and spacer, freeing the aft spinner bulkhead.
   c. Beginning with aircraft serials 15075782, A1500525 and F15001144, proceed as follows:
      1. Remove safety wire from mounting bolt heads (10#).
      2. Remove bolts and washers and remove forward bulkhead (10#).

**WARNING**

Be sure magneto switch is in OFF position before turning propeller.

**NOTE**

The aft spinner bulkhead (6) is installed between propeller (5) and spacer (8), and is removed as the propeller is removed.

3. Using a punch through the holes in forward face of propeller, drive two dowel pins (7) aft to separate propeller and spacer, freeing aft spinner bulkhead.

13-7. INSTALLATION. (Beginning with 1971 Models.) (Refer to figure 13-2.)
   a. Clean mating surfaces of propeller, crankshaft
flange, spacer and spinner bulkhead.

b. Position aft spinner bulkhead between propeller and spacer, and drive dowel pins into position to attach propeller, spacer and spinner bulkhead. Bulkhead must be positioned so that propeller blades emerge with ample clearance.

NOTE

Be sure magneto switch is in OFF position before turning crankshaft.

c. Locate top center of number one piston on its compression stroke. Align the top center mark on the crankshaft flange with parting surface of the crankcase below the crankshaft.

d. With propeller blades in vertical position, rotate blades 30 degrees clockwise (looking aft).

e. On aircraft serials 15072004 thru 15075781, A15000227 thru A15000523, F15000659 thru F15001143 and FA15000082 and on proceed as follows:

1. Install propeller on crankshaft flange and tighten bolts evenly and torque to 300-360 lb-in.

2. Safety wire propeller mounting bolts (10). Do not allow safety wire to cross the top of bolt heads as this would interfere with the installation of forward spinner bulkhead and shims.

3. Install forward bulkhead and spinner. Add shims as required (maximum of 4) behind forward bulkhead to provide a snug fit between bulkhead and spinner when the rear bulkhead attachment holes are aligned.

f. Beginning with aircraft serials 15075782, A15000224 and F15001144, proceed as follows:

1. Install propeller on crankshaft flange.

2. Install forward spinner bulkhead, tighten bolts evenly and torque to 300-360 lb-in.

3. Safety wire propeller mounting bolts. Safety wire must be installed around bolt heads and not over bolt heads.

4. Install spinner.

SHOP NOTES:
14-1. UTILITY SYSTEMS.

14-2. HEATING SYSTEM.

14-3. DESCRIPTION. The heating system is comprised of the heat exchange section of the exhaust muffler, a shut-off valve, mounted on the right forward side of the firewall, a push-pull control on the instrument panel, outlets, and flexible ducting connecting the system.

14-4. OPERATION. Ram air is ducted through an engine baffle inlet and heat exchange section of the exhaust muffler, to the shut-off valve at the firewall. The heated air flows from the shut-off valve into a duct across the aft side of the firewall, where it is distributed into the cabin. The shut-off valve operated by a push-pull control marked "CABIN HEAT," located on the instrument panel, regulates the volume of heated air entering the system. Pulling the control full out supplies maximum flow, and pushing control in gradually decreases flow, shutting off flow completely when the control is pushed full in.

14-5. TROUBLE SHOOTING. Most of the operational troubles in the heating, defrosting, and ventilating systems are caused by sticking or binding air valves and their controls, damaged air ducting, or defects in the exhaust muffler. In most cases, valves or controls can be freed by proper lubrication. Damaged or broken parts must be repaired or replaced. When checking controls, ensure valves respond freely to control movement, that they move in the correct direction, and that they move through their full range of travel and seal properly. Check that hose are properly secured, and replace hose that are burned, frayed or crushed. If fumes are detected in the cabin, a thorough inspection of the exhaust system should be accomplished. Refer to applicable paragraph in Section 11 for this inspection. Since any holes or cracks may permit exhaust fumes to enter the cabin, replacement of defective parts is imperative because fumes constitute an extreme danger. Seal any gaps in shut-off valves at the firewall with Pro-Seal #700 (Coast Pro-Seal Co., Los Angeles, California) compound, or equivalent compound.

14-6. REMOVAL, INSTALLATION AND REPAIR. Figure 14-1 illustrates the heating, defrosting, and ventilating systems, and may be used as a guide during removal, installation and repair of heating system components. Burned, frayed, or crushed hose must be replaced with new hose, cut to length and installed in the original routing. Trim hose winding shorter than the hose to allow clamps to be fitted. Defective air valves must be repaired or replaced. Check for proper operation of valves and their controls after repair or replacement.
When the optional winterization kit is installed, heated air is supplied by both the left and right exhaust mufflers.

---

Figure 14-1. Heating, Defrosting, and Ventilating Systems (Sheet 1 of 2)

THRU 1970 MODELS

1. Defroster Outlet
2. Defroster Hose
3. Plenum Chamber
4. Left Exhaust Muffler
5. Right Exhaust Muffler
6. Air Scoop
7. Inlet Hose
8. Induction Air Hose
9. Heater Hose
10. "Y" Fitting
11. Heater Hose
12. Tee Fitting
13. Cabin Heat Control
14. Cabin Air Control
15. Knob
16. Washer
17. Cap
18. Seal
19. Spacer
20. Outlet Assembly
21. Seal
22. Bullet Catch
23. Screw
24. Felt Washer
25. Tube Assembly
26. Elbow Assembly
27. Nut
28. Clamp
29. Deflector
30. Retainer
31. Firewall
32. Adapter
33. Insert
34. Clamp Bolt
35. Bellcrank
36. Housing
37. Spring
38. Arm Assembly
39. Roll Pin
40. Scoop Door
41. Hinge Pin
42. Fuselage Skin
43. Seal
44. Doubler

NOTE (REFER TO SHEET 2)
1. Knob  22. Distributor Assembly
2. Washer  23. Clamp
4. Seal  25. Insert
5. Spacer  26. Deflector
6. Outlet Assembly  27. Firewall
7. Seal  28. Housing
8. Bullet Catch  29. Spring
9. Screw  30. Arm Assembly
10. Felt Washer  31. Roll Pin
11. Tube Assembly  32. Clamp Bolt
12. Elbow Assembly  33. Nut
13. Tinnerman Nut  34. Cotter Pin
14. Cabin Air Control  35. Valve Body
15. Defroster Outlet  36. Pin
16. Cabin Heat Control  37. Scoop Door
17. Defroster Hose  38. Fuselage Skin
18. Left Exhaust Muffler  39. Screen
19. Air Scoop  40. Duct
20. Inlet Hose
21. Heater Hose

* REFER TO SHEET 1 FOR EFFECTIVE SERIALS

BEGINNING WITH 1971 MODELS

Figure 14-1. Heating, Defrosting, and Ventilating Systems (Sheet 2 of 2)
14-7. DEFROSTER SYSTEM.

14-8. DESCRIPTION. The defrosting system is comprised of a duct across the aft side of the firewall, a defroster outlet, mounted on the left side of the cowl deck immediately aft of the windshield, and flexible ducting connecting the system.

14-9. OPERATION. Air from the duct across the aft side of the firewall flows through a flexible duct to the defroster outlet. The temperature and volume of this air is controlled by the settings of the heater system control.

14-10. TROUBLE SHOOTING. Since the defrosting system depends on proper operation of the heating system, refer to paragraph 14-5 for trouble shooting the heating and defrosting system.

14-11. REMOVAL, INSTALLATION AND REPAIR. Figure 14-1 may be used as a guide for removal, installation and repair of defrosting system components. Cut hose to length and install in the original routing. Trim hose winding shorter than the hose to allow clamps to be fitted. A defective defroster outlet must be repaired or replaced.

14-12. VENTILATING SYSTEM.

14-13. DESCRIPTION. The ventilating system is comprised of an airscoop mounted in the inboard leading edge of each wing, an adjustable ventilator mounted on each side of the cabin near the upper corners of the windshield, a fresh airscoop door mounted on the right side of the fuselage, a control knob on the instrument panel and flexible ducting connecting the system.

14-14. OPERATION. Air received from scoops mounted in the inboard leading edges of the wings is ducted to adjustable ventilators mounted on each side of the cabin near the upper corners of the windshield. Forward cabin ventilation is provided by a fresh airscoop door mounted on the right side of the fuselage, just forward of the copilot seat. The scoop door is operated by a control in the instrument panel marked "CABIN AIR." Fresh air from the scoop door is routed to the duct across the aft side of the firewall, where it is distributed into the cabin. As long as the "CABIN HEAT" control is pushed in, no heated air can enter the firewall duct; therefore, when the "CABIN AIR" control is pulled out, only fresh air from the scoop will flow through the duct into the cabin. As the "CABIN HEAT" control is gradually pulled out, more and more heated air will blend with the fresh air from the scoop and be distributed into the cabin. Either one, or both of the controls may be set at any position from full open to full closed.

14-15. TROUBLE SHOOTING. Most of the operational troubles in the ventilating system are caused by sticking or binding of the inlet scoop door or its control. Check the airscoop filter elements in the wing leading edges for obstructions. Also, check the filter elements in the inlet scoop door (1971 Models). The elements may be removed and cleaned or replaced. Since air passing through the filters is emitted into the cabin, do not use a cleaning solution which would contaminate cabin air. The filters may be removed to increase air flow. However, their removal will cause a slight increase in noise level.

14-16. REMOVAL, INSTALLATION AND REPAIR. Figure 14-1 may be used as a guide for removal, installation and repair of the ventilating system components. A defective ventilator or scoop door must be repaired or replaced. Check for proper operation of ventilating controls after installation or repair.

SHOP NOTES:
SECTION 15
INSTRUMENTS AND INSTRUMENT SYSTEMS

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15-1. INSTRUMENTS AND INSTRUMENT SYSTEMS.

15-2. GENERAL. This section describes typical instrument installations and their respective operating systems. Emphasis is placed on trouble shooting and corrective measures only. It does NOT deal with specific instrument repairs since this usually requires special equipment and data and should be handled by instrument specialists. Federal Aviation Regulations require malfunctioning instruments be sent to an approved instrument overhaul and repair station or returned to manufacturer for servicing. Our concern here is with preventive maintenance on various instrument systems and correction of system faults which result in instrument malfunctions. The descriptive material, maintenance and trouble shooting information in this section is intended to help the mechanic determine malfunctions and correct them, up to the defective instrument itself, at which point an instrument technician should be called in. Some instruments, such as fuel quantity and oil pressure gages, are so simple and inexpensive, repairs usually will be more costly than a new instrument. On the other hand, aneroid and gyro instruments usually are well worth repairing. The words "replace instrument" in the text, therefore, should be taken only in the sense of physical replacement in aircraft. Whether replacement is to be with a new instrument, an exchange one, or original instrument is to be repaired must be decided on basis of individual circumstances.
BEGINNING WITH 1974 MODELS THRU 1973 MODELS

Detail A

NOTE POSITION OF GROUND STRAP ON PANEL AND SEQUENCE OF ATTACHING PARTS WHEN REMOVING AND INSTALLING SHOCK PANEL.

1. Shock Mounted Panel
2. Radio Switch Panel
3. Rear View Mirror
4. Fuel and Engine Instruments
5. Heating and Ventilation Controls
6. Engine Controls
7. Switch and Circuit Breaker Panel
8. Shock Mount
9. Ground Strap
10. Retainer Ball
11. Panel
12. Retainer Ball Seat
13. Spacer
14. Decorative Cover
15. Pile
16. Hook
17. Grommet
18. Pin

Figure 15-1. Typical Instrument Panel (Sheet 1 of 2)
BEGINNING WITH 1976 MODELS

Figure 15-1. Typical Instrument Panel (Sheet 2 of 2)

Change 3  15-2A/(15-2B blank)
15-3. INSTRUMENT PANEL. (Refer to figure 15-1.)

15-4. DESCRIPTION. The instrument panel assembly consists of a stationary and shock-mounted panel. The stationary panel contains fuel and engine instruments, which are NOT sensitive to vibration. The shock-mounted panel contains major flight instruments such as horizontal and directional gyroscopic instruments that are affected by vibration. Most of the instruments are screw-mounted on the panel backs.

15-5. REMOVAL AND INSTALLATION. The stationary panel is secured to engine mount stringers and a forward fuselage bulkhead and ordinarily is not considered removable. The shock-mounted panel is secured to stationary panel with rubber shock-mounted assemblies. To remove shock-mounted panel proceed as follows:
   a. Unscrew threaded buttons securing decorative cover to panel and remove cover.
   b. Remove nuts from shock-mounts, tag and disconnect instrument wiring and plumbing and pull panel straight back.
   c. Reverse preceding steps for installation. Ensure ground strap is properly installed.

15-6. SHOCK MOUNTS. Service life of instruments is directly related to adequate shock-mounting of panel. If removal of panel is necessary, check mounts for deterioration.

15-7. INSTRUMENTS. (Refer to figure 15-1.)

15-8. REMOVAL. Most instruments are secured to panel with screws inserted through panel face. To remove an instrument, remove decorative cover, disconnect wiring or plumbing to instrument, remove mounting screws and take instrument out from behind, or in some cases, from front of panel. Instrument clusters are installed as units and are secured by a screw at each end. A cluster must be removed from panel to replace an individual gage.

NOTE

Thru 1975 models the clusters are located directly above the glove box. Removal of the cluster will be simpler if the glove box is removed first. Beginning with 1976 models, the instrument cluster is located below the pilots control column.

In all cases when an instrument is removed, disconnected lines or wires should be protected. Cap open lines and cover pressure connections on instrument to prevent thread damage and entrance of foreign matter. Wire terminals should be insulated or tied up so accidental grounding or short-circuiting will not occur.

15-9. INSTALLATION. Generally, installation procedure is the reverse of removal procedure. Ensure mounting screw nuts are tightened firmly, but do not overtighten, particularly on instruments having plastic cases. The same rule applies to connecting plumbing and wiring.

NOTE

All instruments (gages and indicators), requiring a thread seal or lubricant, shall be installed using teflon tape on male fittings only. This tape is available through Cessna Service Parts Center.

When replacing an electrical gage in an instrument cluster assembly, avoid bending pointer or dial plate. Distortion of dial or back plate could change calibration of gages.

15-10. PITOT AND STATIC SYSTEMS. (Refer to figure 15-2.)

15-11. DESCRIPTION. The pitot system conveys ram air pressure to the airspeed indicator. The static system vents vertical speed indicator, altimeter and airspeed indicator to atmospheric pressure through plastic tubing connected to a static port. A static line sump is installed at source button to collect condensation in static system. A pitot tube heater may be installed. The heating element is controlled by a switch at instrument panel and powered by the electrical system.

15-12. MAINTENANCE. Proper maintenance of pitot and static system is essential for proper operation of altimeter, vertical speed and airspeed indicators. Leaks, moisture and obstructions in pitot system will result in false airspeed indications, while static system malfunctions will affect readings of all three instruments. Under instrument flight conditions, these instrument errors could be hazardous. Cleanliness and security are the principal rules for system maintenance. The pitot tube and static ports MUST be kept clean and unobstructed.

15-13. STATIC PRESSURE SYSTEM INSPECTION AND LEAKAGE TEST. The following procedure outlines inspection and testing of static pressure system, assuming altimeter has been tested and inspected in accordance with current Federal Aviation Regulations.
   a. Ensure static system is free from entrapped moisture and restrictions.
   b. Ensure no alterations or deformations of airframe surface have been made which would affect the relationship between air pressure in static pressure system and true ambient static air pressure for any flight configuration.
   c. Attach a source of suction to static pressure source opening. Figure 15-3 shows one method of obtaining suction.
   d. Slowly apply suction until altimeter indicates a 1000-foot increase in altitude.

CAUTION

When applying or releasing suction, do not exceed range of vertical speed indicator or airspeed indicator.
Do not overtighten screws (6) and do not lubricate any parts.

Use spacers (10) as required for adequate friction on ring assembly (8).

Figure 15-2. Pitot-Static Systems

1. Static Line
2. Static Sump
3. Flange
4. Static Port Washer
5. Cover
6. Mounting Screw
7. Retainer
8. True Airspeed Ring
9. Instrument Panel
10. Spacer
11. Airspeed Indicator
12. Altimeter
13. Vertical Speed Indicator
14. Pitot Line
15. Heater Element
16. Mast Body
17. Connector
18. Pitot Tube
e. Cut off suction source to maintain a "closed" system for one minute. Leakage shall not exceed 100 feet of altitude loss as indicated on altimeter.

f. If leakage rate is within tolerance, slowly release suction source.

NOTE

If leakage rate exceeds maximum allowable, first tighten all connections, then repeat leakage test. If leakage rate still exceeds maximum allowable, use following procedure.

g. Disconnect static pressure lines from airspeed indicator and vertical speed indicator. Use suitable fittings to connect lines together so altimeter is the only instrument still connected into static pressure system.

h. Repeat leakage test to check whether static pressure system or the bypassed instruments are cause of leakage. If instruments are at fault, they must be repaired by an "appropriately rated repair station" or replaced. If static pressure system is at fault, use following procedure to locate leakage.

i. Attach a source of positive pressure to static source opening. Figure 15-3 shows one method of obtaining positive pressure.

CAUTION

Do not apply positive pressure with airspeed indicator or vertical speed indicator connected to static pressure system.

j. Slowly apply positive pressure until altimeter indicates a 500-foot decrease in altitude and maintain this altimeter indication while checking for leaks. Coat line connections and static source flange with solution of mild soap and water, watching for bubbles to locate leaks.

k. Tighten leaking connections. Repair or replace parts found defective.

1. Reconnect airspeed and vertical speed indicators into static pressure system and repeat leakage test per steps "c" thru "f".

15-14. PITOT SYSTEM INSPECTION AND LEAKAGE TEST. To check pitot system for leaks, place a piece of tape over small hole in lower aft end of pitot tube, fasten a piece of rubber or plastic tubing over pitot tube, close opposite end of tubing and slowly roll up tube until airspeed indicator registers in cruise range. Secure tube and after a few minutes recheck airspeed indicator. Any leakage will have reduced the pressure in system, resulting in a lower airspeed indication. Slowly unroll tubing before removing it, so pressure is reduced gradually. Otherwise instrument may be damaged. If test reveals a leak in system, check all connections for tightness.

15-15. BLOWING OUT LINES. Although pitot system is designed to drain down to pitot tube opening, condensation may collect at other points in system and produce a partial obstruction. To clear line, disconnect at airspeed indicator. Using low pressure air, blow from indicator end of line toward pitot tube.

CAUTION

Never blow through pitot or static lines toward instruments.

Like pitot lines, static pressure lines must be kept clear and connections tight. All models have a static source sump which collects moisture and keeps system clear. However, when necessary, disconnect static line at first instrument to which it is connected, then blow line clear with low-pressure air. Check all static pressure line connections for tightness. If hose or hose connections are used, check for general condition and clamps for security. Replace hose which have cracked, hardened or show other signs of deterioration.

15-16. REMOVAL AND INSTALLATION OF COMPONENTS. (Refer to figure 15-2.) To remove pitot mast remove four mounting screws on side of connector (17) and pull mast out of connector far enough to disconnect pitot line (14). Electrical connections to heater assembly (if installed) may be disconnected through wing access opening just inboard of mast. Pitot and static lines are removed in the usual manner, after removing wing access plates, lower wing fairing strip and upholstery as required. Installation of tubing will be simpler if a guide wire is drawn in as tubing is removed from wing. The tubing may be removed intact by drawing it out through cabin and right door. When replacing fittings of pitot and static pressure lines, use anti-seize compound sparingly on male threads of both metal and plastic connections. Avoid excess compound which might enter lines. Tighten connections firmly, but avoid overtightening and distorting fittings. If twisting of plastic tubing is encountered when tightening fittings, VV-P-236 (USP Petrolatum), may be applied sparingly between tubing and fittings.
15-17. TROUBLE SHOOTING--PITOT STATIC SYSTEM.

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<tbody>
<tr>
<td>LOW OR SLUGGISH AIRSPEED INDICATION</td>
<td>Pitot tube obstructed, leak or obstruction in pitot line.</td>
<td>Test pitot tube and line for leaks or obstructions. Blow out tube and line, repair or replace damaged line.</td>
</tr>
<tr>
<td>(Normal altimeter and vertical speed.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INCORRECT OR SLUGGISH RESPONSE.</td>
<td>Leaks or obstruction in static line.</td>
<td>Test line for leaks and obstructions. Repair or replace line, blow out obstructed line.</td>
</tr>
<tr>
<td>(all three instruments.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

15-18. TRUE AIRSPEED INDICATOR. A true airspeed indicator may be installed. This indicator, equipped with a conversion ring, may be rotated until pressure altitude is aligned with outside air temperature, then airspeed indicated on the instrument is read as true airspeed on the adjustable ring. Refer to figure 15-2 for removal and installation. Upon installation, before tightening mounting screws (6), calibrate instrument as follows: Rotate ring (8) until 120 mph on the adjustable ring aligns with 120 mph on the indicator. Holding this setting, move retainer (7) until 60°F aligns with zero pressure altitude, then tighten mounting screws (6) and replace decorative cover (5).

NOTE

Beginning with 1976 models, true airspeed indicators are graduated in knots. Therefore, on these aircraft, use 105K instead of 120MPH in the above calibration procedure.

15-19. TROUBLE SHOOTING--AIRSPEED INDICATOR.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAND FAILS TO RESPOND.</td>
<td>Pitot pressure connection not properly connected to pressure line from pitot tube.</td>
<td>Test line and connection for leaks. Repair or replace damaged line, tighten connections.</td>
</tr>
<tr>
<td></td>
<td>Pitot or static lines clogged.</td>
<td>Check line for obstructions. Blow out lines.</td>
</tr>
<tr>
<td>INCORRECT INDICATION OR HAND OSCILLATES.</td>
<td>Leak in pitot or static lines.</td>
<td>Test lines and connections for leaks. Repair or replace damaged lines, tighten connections.</td>
</tr>
<tr>
<td></td>
<td>Defective mechanism or leaking diaphragm.</td>
<td>Substitute known-good indicator and check reading. Replace instrument.</td>
</tr>
<tr>
<td>HAND VIBRATES.</td>
<td>Excessive vibration.</td>
<td>Check panel shock mounts. Replace defective shock mounts.</td>
</tr>
<tr>
<td></td>
<td>Excessive tubing vibration.</td>
<td>Check clamps and line connections for security. Tighten clamps and connections, replace tubing with flexible hose.</td>
</tr>
</tbody>
</table>
NOTE

Air bulb with check valves may be obtained locally from a surgical supply company. This is the type used in measuring blood pressure.

THICK-WALLED PRESSURE BLEED-OFF SCREW (CLOSED)

PRESSURE

AIR BULB WITH CHECK VALVES

CLAMP

THICK-WALLED SURGICAL HOSE

CHECK VALVE

TO APPLY SUCTION:

1. Squeeze air bulb to expel as much air as possible.
2. Hold suction hose firmly against static pressure source opening.
3. Slowly release air bulb to obtain desired suction, then pinch hose shut tightly to trap suction in system.
4. After leak test, release suction slowly by intermittently allowing a small amount of air to enter static system. To do this, tilt end of suction hose away from opening, then immediately tilt it back against opening. Wait until vertical speed indicator approaches zero, then repeat. Continue to admit this small amount of air intermittently until all suction is released, then remove test equipment.

TO APPLY PRESSURE:

CAUTION

Do not apply positive pressure with airspeed indicator or vertical speed indicator connected into static system.

1. Hold pressure hose firmly against static pressure source opening.
2. Slowly squeeze air bulb to apply desired pressure to static system. Desired pressure may be maintained by repeatedly squeezing bulb to replace any air escaping through leaks.
3. Release pressure by slowly opening pressure bleed-off screw, then remove test equipment.

Figure 15-3. Static Test Equipment
### 15-20. TROUBLE SHOOTING--ALTIMETER

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>INSTRUMENT FAILS TO OPERATE.</td>
<td>Static line plugged.</td>
<td>Check line for obstructions. Blow out lines.</td>
</tr>
<tr>
<td></td>
<td>Defective mechanism.</td>
<td>Substitute known-good altimeter and check reading. Replace instrument.</td>
</tr>
<tr>
<td>INCORRECT INDICATION.</td>
<td>Hands not carefully set.</td>
<td>Reset hands with knob.</td>
</tr>
<tr>
<td></td>
<td>Leaking diaphragm.</td>
<td>Substitute known-good altimeter and check reading. Replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Pointers out of calibration.</td>
<td>Compare reading with known-good altimeter. Replace instrument.</td>
</tr>
<tr>
<td>HAND OSCILLATES.</td>
<td>Static pressure irregular.</td>
<td>Check lines for obstruction or leaks. Blow out lines, tighten connections.</td>
</tr>
<tr>
<td></td>
<td>Leak in airspeed or vertical speed indicator installations.</td>
<td>Check other instruments and system plumbing for leaks. Blow out lines, tighten connections.</td>
</tr>
</tbody>
</table>

### 15-21. TROUBLE SHOOTING--VERTICAL SPEED INDICATOR.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>INSTRUMENT FAILS TO OPERATE.</td>
<td>Static line plugged.</td>
<td>Check line for obstructions. Blow out lines.</td>
</tr>
<tr>
<td></td>
<td>Static line broken.</td>
<td>Check line for damage, connections for security. Repair or replace damaged line, tighten connections.</td>
</tr>
<tr>
<td>INCORRECT INDICATION.</td>
<td>Partially plugged static line.</td>
<td>Check line for obstructions. Blow out lines.</td>
</tr>
<tr>
<td></td>
<td>Ruptured diaphragm.</td>
<td>Substitute known-good indicator and check reading. Replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Pointer off zero.</td>
<td>Reset pointer to zero.</td>
</tr>
<tr>
<td>POINTER OSCILLATES.</td>
<td>Partially plugged static line.</td>
<td>Check line for obstructions. Blow out lines.</td>
</tr>
</tbody>
</table>
15-21. TROUBLE SHOOTING--VERTICAL SPEED INDICATOR. (Cont)

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>POINTER OSCILLATES. (cont.)</td>
<td>Leak in static line.</td>
<td>Test lines and connections for leaks. Repair or replace damaged lines, tighten connections.</td>
</tr>
<tr>
<td></td>
<td>Leak in instrument case.</td>
<td>Substitute known-good indicator and check reading. Replace instrument.</td>
</tr>
<tr>
<td>HAND VIBRATES.</td>
<td>Excessive vibration.</td>
<td>Check shock mounts. Replace defective shock mounts.</td>
</tr>
<tr>
<td></td>
<td>Defective diaphragm.</td>
<td>Substitute known-good indicator and check for vibration. Replace instrument.</td>
</tr>
</tbody>
</table>

15-22. TROUBLE SHOOTING--PITOT TUBE HEATER.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TUBE DOES NOT HEAT OR CLEAR ICE.</td>
<td>Switch turned &quot;OFF.&quot;</td>
<td>Turn switch &quot;ON.&quot;</td>
</tr>
<tr>
<td></td>
<td>Blown fuse.</td>
<td>Check fuse. Replace fuse.</td>
</tr>
<tr>
<td></td>
<td>Break in wiring.</td>
<td>Test for open circuit. Repair wiring.</td>
</tr>
<tr>
<td></td>
<td>Heating element burned out.</td>
<td>Check resistance of heating element. Replace element.</td>
</tr>
</tbody>
</table>

15-23. PITOT TUBE ALIGNMENT. (Refer to figure 15-2.) For correct airspeed indication pitot tube (18) must be properly aligned. Open end of tube must be perpendicular to longitudinal axis of aircraft. A template like the one shown in figure 15-4 will prove the most convenient means of checking alignment. Prior to using template, check that pitot tube parallels row of rivets just outboard of tube. A straightedge may be placed along row of rivets to check the alignment. The template fits over the wing leading edge and should conform to the illustration. The illustration has been drawn carefully to actual size and may be traced directly on a piece of carbon paper between the printed page and the template material, then trace contours.

15-24. VACUUM SYSTEM. (Refer to figure 15-5.)

15-25. DESCRIPTION. Suction to operate the gyro is provided by a dry-type engine-driven vacuum pump, gear-driven through a spline-type coupling. A suction relief valve, to control system pressure, is connected between the pump inlet and the instruments. In the cabin, the vacuum line is routed from gyro instruments to the relief valve at the firewall. A central air filtering system is utilized. The reading of the suction gage indicates net difference in suction before and after air passes through a gyro. This differential pressure will gradually decrease as the central air filter becomes dirty, causing a lower reading on the suction gage.
WING CONTOUR
(Cut out)

PITOT TUBE CONTOUR

Figure 15.4. Pitot Tube Alignment Template
## 15-26. TROUBLE SHOOTING--VACUUM SYSTEM

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORMAL SUCTION GAGE READING, SLUGGISH OR ERRATICGYRO RESPONSE.</td>
<td>Instrument air filters clogged.</td>
<td>Check operation with filters removed. Replace filters.</td>
</tr>
<tr>
<td>LOW SUCTION GAGE READINGS.</td>
<td>Leaks or restriction between instruments and relief valve, relief valve out of adjustment, defective pump.</td>
<td>Check lines for leaks, disconnect and test pump. Repair or replace lines, adjust or replace relief valve, repair or replace pump.</td>
</tr>
<tr>
<td></td>
<td>Central air filter dirty.</td>
<td>Check operation with filter removed. Clean or replace filter.</td>
</tr>
</tbody>
</table>

## 15-27. TROUBLE SHOOTING--GYROS.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>HORIZON BAR FAILS TO RESPOND.</td>
<td>Central filter dirty.</td>
<td>Check filter. Clean or replace filter.</td>
</tr>
<tr>
<td></td>
<td>Suction relief valve improperly adjusted.</td>
<td>Adjust or replace relief valve.</td>
</tr>
<tr>
<td></td>
<td>Faulty suction gage.</td>
<td>Substitute known-good suction gage and check gyro response. Replace suction gage.</td>
</tr>
<tr>
<td></td>
<td>Vacuum pump failure.</td>
<td>Check pump. Replace pump.</td>
</tr>
<tr>
<td></td>
<td>Vacuum line kinked or leaking.</td>
<td>Check lines for damage and leaks. Repair or replace damaged lines. Tighten connections.</td>
</tr>
<tr>
<td>HORIZON BAR DOES NOT SETTLE.</td>
<td>Defective mechanism.</td>
<td>Substitute known-good gyro and check indication. Replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Insufficient vacuum.</td>
<td>Adjust or replace relief valve.</td>
</tr>
<tr>
<td></td>
<td>Excessive vibration.</td>
<td>Check panel shock-mounts. Replace defective shock-mounts.</td>
</tr>
</tbody>
</table>

15-11
<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>HORIZON BAR OSCILLATES OR VIBRATES EXCESSIVELY.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central filter dirty.</td>
<td>Check filter. Clean or replace filter.</td>
<td></td>
</tr>
<tr>
<td>Suction relief valve improperly adjusted.</td>
<td>Adjust or replace relief valve.</td>
<td></td>
</tr>
<tr>
<td>Faulty suction gage.</td>
<td>Substitute known-good suction gage and check gyro indication. Replace suction gage.</td>
<td></td>
</tr>
<tr>
<td>Defective mechanism.</td>
<td>Substitute known-good gyro and check indication. Replace instrument.</td>
<td></td>
</tr>
<tr>
<td>Excessive vibration.</td>
<td>Check panel shock-mounts. Replace defective shock-mounts.</td>
<td></td>
</tr>
<tr>
<td>EXCESSIVE DRIFT IN EITHER DIRECTION.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central air filter dirty.</td>
<td>Check filter. Clean or replace filter.</td>
<td></td>
</tr>
<tr>
<td>Low vacuum, relief valve improperly adjusted.</td>
<td>Adjust or replace relief valve.</td>
<td></td>
</tr>
<tr>
<td>Faulty suction gage.</td>
<td>Substitute known-good suction gage and check gyro indication. Replace suction gage.</td>
<td></td>
</tr>
<tr>
<td>Vacuum pump failure.</td>
<td>Check pump. Replace pump.</td>
<td></td>
</tr>
<tr>
<td>Vacuum line kinked or leaking.</td>
<td>Check lines for damage and leaks. Repair or replace damaged lines, tighten connections.</td>
<td></td>
</tr>
<tr>
<td>DIAL SPINS IN ONE DIRECTION CONTINUOUSLY.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating limits have been exceeded.</td>
<td>Replace instrument.</td>
<td></td>
</tr>
<tr>
<td>Defective mechanism.</td>
<td>Substitute known-good gyro and check indication. Replace instrument.</td>
<td></td>
</tr>
</tbody>
</table>

SHOP NOTES:
AIRCRAFT SERIALS THRU 15072628 AND A15000276 AND EARLY F150 AND FA150 MODELS

NOTE
Do not grease vacuum pump spline upon installation.

BEGINNING WITH 15077001, A1500615 AND SOME LATER FRENCH AIRCRAFT

1. Vacuum Pump
2. Overboard Line
3. Hose
4. Suction Gage
5. Gyro Horizon
6. Directional Gyro
7. Relief Valve
8. Adjustment Screw
9. Firewall
10. Wing Nut
11. Filter Element
11A. Filter Element (Throwaway)
12. Filter Bracket
13. Sta-Strap
14. Tube

AIRCRAFT SERIALS 15072629 AND ON AND A15000277 AND ON AND LATER F150 AND FA150 MODELS

Figure 15-5. Vacuum System
15-28. TROUBLE SHOOTING--VACUUM PUMP.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>OIL IN DISCHARGE.</td>
<td>Damaged engine drive seal.</td>
<td>Replace gasket.</td>
</tr>
<tr>
<td>HIGH SUCTION.</td>
<td>Suction relief valve filter clogged.</td>
<td>Check filter for obstructions. Clean or replace filter.</td>
</tr>
<tr>
<td>LOW SUCTION.</td>
<td>Relief valve leaking.</td>
<td>Replace relief valve.</td>
</tr>
<tr>
<td></td>
<td>Vacuum pump failure.</td>
<td>Substitute known-good pump and check pump suction. Replace vacuum pump.</td>
</tr>
<tr>
<td>LOW PRESSURE.</td>
<td>Safety valve leaking.</td>
<td>Replace safety valve.</td>
</tr>
<tr>
<td></td>
<td>Vacuum pump failure.</td>
<td>Substitute known-good pump and check pump pressure. Replace vacuum pump.</td>
</tr>
</tbody>
</table>

15-29. REMOVAL AND INSTALLATION OF COMPONENTS. The various components of vacuum system are secured by conventional clamps, mounting screws and nuts. To remove a component, remove mounting screws and disconnect inlet and discharge lines. When replacing a vacuum system component, ensure connections are made correctly. Use no thread-lube on any connections. Teflon tape may be used on male threads. Avoid over-tightening connections. Before re-installing a vacuum pump, place mounting pad gasket over studs. After installing pump, before connecting plumbing, start engine and check for evidence of oil in the discharge which would indicate a leaking engine drive seal.

15-30. CLEANING. In general, low-pressure, dry compressed air should be used in cleaning vacuum system components. Suction relief valve, exposed to engine oil and dirt, should be washed with Stoddard solvent, then dried with a low-pressure air blast. Check hose for collapsed inner liners as well as external damage.

**CAUTION**

Never apply compressed air to lines or components installed in aircraft. The excessive pressures will damage gyro's. If an obstructed line is to be blown out, disconnect at both ends and blow from instrument panel out.

15-31. VACUUM RELIEF VALVE ADJUSTMENT. A suction gage reading of 5.3 inches of mercury is desirable for gyro instruments. However, a range of 4.8 to 5.4 inches of mercury is acceptable. To adjust the relief valve, remove control air filter, run engine to 1900 rpm on the ground and adjust relief valve to 5.3 ± 0.1 inches of mercury.

**CAUTION**

Do not exceed maximum engine temperature. Be sure filter element is clean before installing. If reading drops noticeably, install new filter element.

15-32. ENGINE INDICATORS.

15-33. TACHOMETER.

15-34. DESCRIPTION. The tachometer used on Cessna single-engine aircraft is a mechanical indicator driven at half crankshaft speed by a flexible shaft. Most tachometer difficulties will be found in the drive-shaft. To function properly, shaft housing must be free of kinks, dents and sharp bends. There should be no bend on a radius shorter than six inches and no bend within three inches of either terminal. If a tachometer is noisy or pointer oscillates, check cable housing for kinks, sharp bends and damage. Disconnect cable at tachometer and pull it out of housing. Check cable for worn spots, breaks and kinks.

**NOTE**

Before replacing a tachometer cable in housing, coat lower two thirds with AC Type ST-840 speedometer cable grease or Lubriplate No. 110. Insert cable in housing as far as possible, then slowly rotate to make sure it is seated in engine fitting. Insert cable in tachometer, making sure it is seated in drive shaft, then reconnect housing and torque to 50 pound-inches (at instrument).
15-35. OIL PRESSURE GAGE

15-36. DESCRIPTION. On some airplanes, a Bourdon tube-type oil pressure gage is installed. This is a direct-reading instrument, operated by a pressure pickup line connected to the engine main oil gallery. The oil pressure line from the instrument to the engine should be filled with kerosene, especially during cold weather operation, to obtain immediate oil indication. Electrically actuated gage, which utilize a pressure sending bulb are installed on some airplanes.

15-37. TROUBLE SHOOTING -- OIL PRESSURE GAGE (DIRECT READING)

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAGE DOES NOT REGISTER.</td>
<td>Pressure line clogged.</td>
<td>Check line for obstructions. Clean line.</td>
</tr>
<tr>
<td></td>
<td>Pressure line broken.</td>
<td>Check line for leaks and damage. Repair or replace damaged line.</td>
</tr>
<tr>
<td></td>
<td>Fractured Bourdon tube.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Gage pointer loose on staff.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Damaged gage movement.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td>GAGE POINTER FAILS TO RETURN TO ZERO.</td>
<td>Foreign matter in line.</td>
<td>Check line for obstructions. Clean line.</td>
</tr>
<tr>
<td></td>
<td>Foreign matter in Bourdon tube.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Bourdon tube stretched.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td>GAGE DOES NOT REGISTER PROPERLY.</td>
<td>Faulty mechanism.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td>GAGE HAS ERRATIC OPERATION.</td>
<td>Worn or bent movement.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Foreign matter in Bourdon tube.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Dirty or corroded movement.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Pointer bent and rubbing on dial, dial screw or glass.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Leak in pressure line.</td>
<td>Check line for leaks and damage. Repair or replace damaged line.</td>
</tr>
</tbody>
</table>

15-38. OIL TEMPERATURE GAGE.

15-39. DESCRIPTION. On some airplanes, the oil temperature gage is a Bourdon tube-type pressure instrument connected by armored capillary tubing to a temperature bulb in the engine. The temperature bulb, capillary tube and gage are filled with fluid and sealed. Expansion and contraction of fluid in the bulb with temperature changes operates the gage. Checking capillary tube for damage and fittings for security is the only maintenance required. Since the tube's inside diameter is small, small dents and kinks which would be acceptable in larger tubing may partially or completely close off the capillary, making the gage inoperative. Some airplanes equipped with gages that are electrically actuated and are not adjustable. On airplanes equipped with electrically actuated gages, refer to Table 1, on page 15-18A/B.
15-40. FUEL QUANTITY INDICATING SYSTEM.

15-41. DESCRIPTION. The magnetic type fuel quantity indicators are used in conjunction with a float-operated variable-resistance transmitter in each fuel tank. The full position of float produces a minimum resistance through transmitter, permitting maximum current flow through the fuel quantity indicator and maximum pointer deflection. As fuel level is lowered, resistance in transmitter is increased, producing a decreased current flow through fuel quantity indicator and a smaller pointer deflection.

15-41A. REMOVAL AND INSTALLATION OF FUEL QUANTITY TRANSMITTERS.

a. Drain fuel from tank. (Observe precautions in Section 12.

b. Remove access plate above fuel tank for access to transmitter.

c. Disconnect electrical lead and ground strap from transmitter.

d. Remove screws attaching transmitter and carefully work transmitter from tank. DO NOT BEND FLOAT ARM.

e. Install transmitter by reversing preceding steps, using new gaskets around opening in fuel tank and under screw heads.

f. Service fuel tanks. Check for leaks and correct quantity indication.

NOTE

Ensure transmitter is properly grounded in accordance with Section 12.

15-42. TROUBLE SHOOTING.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAILURE TO INDICATE.</td>
<td>No power to indicator or transmitter. (Pointer stays below E.)</td>
<td>Check fuse and inspect for open circuit. Replace fuse, repair or replace defective wire.</td>
</tr>
<tr>
<td></td>
<td>Grounded wire. (Pointer stays above F.)</td>
<td>Check for partial ground between transmitter and gage. Repair or replace defective wire.</td>
</tr>
<tr>
<td></td>
<td>Low voltage.</td>
<td>Check voltage at indicator. Correct voltage.</td>
</tr>
<tr>
<td></td>
<td>Defective indicator.</td>
<td>Substitute known-good indicator. Replace indicator.</td>
</tr>
<tr>
<td>OFF CALIBRATION.</td>
<td>Defective indicator.</td>
<td>Substitute known-good indicator. Replace indicator.</td>
</tr>
<tr>
<td></td>
<td>Defective transmitter.</td>
<td>Substitute known-good transmitter. Recalibrate or replace.</td>
</tr>
<tr>
<td></td>
<td>Low or high voltage.</td>
<td>Check voltage at indicator. Correct voltage.</td>
</tr>
<tr>
<td>STICKY OR SLUGGISH OPERATION.</td>
<td>Defective indicator.</td>
<td>Substitute known-good indicator. Replace indicator.</td>
</tr>
<tr>
<td></td>
<td>Low voltage.</td>
<td>Check voltage at indicator. Correct voltage.</td>
</tr>
<tr>
<td>ERRATIC READINGS.</td>
<td>Loose or broken wiring on indicator or transmitter.</td>
<td>Inspect circuit wiring. Repair or replace defective wire.</td>
</tr>
<tr>
<td></td>
<td>Defective indicator or transmitter.</td>
<td>Substitute known-good component. Replace indicator or transmitter.</td>
</tr>
<tr>
<td></td>
<td>Defective master switch.</td>
<td>Replace switch.</td>
</tr>
</tbody>
</table>
Torque compass mount screw 10-15 lb inches to prevent rotation in flight.

15-43. TRANSMITTER ADJUSTMENT.
(Refer to page 15-18A/B)

15-44. HOURMETER.

15-45. DESCRIPTION. The hourmeter is electrically operated and is actuated by a pressure switch in the oil pressure gage line. Electrical power is supplied through a one-amp fuse from the electrical clock circuit and therefore, will operate independent of the master switch.

15-46. MAGNETIC COMPASS. (Refer to figure 15-6.)

15-47. DESCRIPTION. The magnetic compass is liquid-filled, with expansion provisions to compensate for temperature changes. It is equipped with compensating magnets adjustable from front of case. The compass is internally lighted, controlled by the panel lights rheostat. No maintenance is required on compass except on occasional check on a compass rose for adjustment of compensation and replacement of lamp.
15-48. ACCELEROMETER.  

15-49. DESCRIPTION. The Aerobat offers an accelerometer to assist pilot in performing precision aerobatics. The accelerometer continuously indicates g forces being imposed on aircraft. The dial display utilizes three pointers: one pointer indicates instantaneous acceleration, another records maximum positive acceleration, and the third records maximum negative acceleration. Maximum instrument markings range from 10G to 5G. A "PUSH TO SET" knob, located on lower left corner of instrument, is used to reset "Maximum Positive" and "Maximum Negative" pointers. If dual Nav/Coms are installed, the accelerometer is installed in a housing above instrument panel on pilot's side. When aircraft is equipped with single Nav/Com, accelerometer is installed in the vacant Omni indicator instrument space.

15-50. STALL WARNING SYSTEM. (Refer to figure 15-7.)

15-51. DESCRIPTION. The system is composed of an adjustable plate on left wing leading edge, connected to a reed type horn by means of plastic tubing. The horn is actuated approximately 5 to 10 miles per hour above stalling speed as a negative air pressure area at wing leading edge causes a reverse flow of air through horn. By moving adjustable plate (6) up, actuation of horn will occur at a higher speed and moving plate down causes actuation to occur at a slower speed. Center adjustable plate opening in wing leading edge upon installation, then flight test aircraft, observing horn actuation during stall. Re-adjust plate to obtain desired results if necessary. Approximately 3/32 inch adjustment of plate will change speed at which horn actuation occurs by 5 miles per hour. To test horn operation, cover opening in plate (6) with a clean cloth, such as a handkerchief and apply a slight suction by mouth to draw air through horn.

NOTE

Bug screen (7) should be inspected and cleaned periodically.

1. Doorpost Cover
2. Horn Assembly
3. Scoop
4. Adapter
5. Felt Seal
6. Adjustable Plate
7. Screen

Figure 15-7. Stall Warning System
15-43. TRANSMITTER ADJUSTMENT.

WARNING: USING THE FOLLOWING FUEL TRANSMITTER CALIBRATION PROCEDURES ON COMPONENTS OTHER THAN THE ORIGINALLY INSTALLED (STEWART WARNER) COMPONENTS WILL RESULT IN A FAULTY FUEL QUANTITY READING.

15-43A. STEWART WARNER GAGE TRANSMITTER CALIBRATION.

Chances of transmitter calibration changing in normal service is remote; however it is possible that the float arm or the float arm stops may become bent if the transmitter is removed from the fuel cell/tank. Transmitter calibration is obtained by adjusting float travel. Float travel is limited by the float arm stops.

WARNING: USE EXTREME CAUTION WHILE WORKING WITH ELECTRICAL COMPONENTS OF THE FUEL SYSTEM. THE POSSIBILITY OF ELECTRICAL SPARKS AROUND AN "EMPTY" FUEL CELL CREATES A HAZARDOUS SITUATION.

Before installing transmitter, attach electrical wires and place the master switch in the "ON" position. Allow float arm to rest against lower float arm stop and read indicator. The pointer should be on E (empty) position. Adjust the float arm against the lower stop so pointer indicator is on E. Raise float until arm is against upper stop and adjust upper stop to permit indicator pointer to be on F (full). Install transmitter in accordance with paragraph 15-41 A.

15-43B. ROCHESTER FUEL GAGE TRANSMITTER.

Do not attempt to adjust float arm or stop. No adjustment is allowed.

15-43C. FUEL QUANTITY INDICATING SYSTEM OPERATIONAL TEST.

WARNING: REMOVE ALL IGNITION SOURCES FROM THE AIRPLANE AND VAPOR HAZARD AREA. SOME TYPICAL EXAMPLES OF IGNITION SOURCES ARE STATIC ELECTRICITY, ELECTRICALLY POWERED EQUIPMENT (TOOLS OR ELECTRONIC TEST EQUIPMENT - BOTH INSTALLED ON THE AIRPLANE AND GROUND SUPPORT EQUIPMENT), SMOKING AND SPARKS FROM METAL TOOLS.

WARNING: OBSERVE ALL STANDARD FUEL SYSTEM FIRE AND SAFETY PRACTICES.

1. Disconnect all electrical power from the airplane. Attach maintenance warning tags to the battery connector and external power receptacle stating:

   DO NOT CONNECT ELECTRICAL POWER, MAINTENANCE IN PROGRESS.

2. Electrically ground the airplane.

3. Level the airplane and drain all fuel from wing fuel tanks.

4. Gain access to each fuel transmitter float arm and actuate the arm through the transmitter's full range of travel.

   A. Ensure the transmitter float arm moves freely and consistently through this range of travel. Replace any transmitter that does not move freely or consistently.

   WARNING: USE EXTREME CAUTION WHILE WORKING WITH ELECTRICAL COMPONENTS OF THE FUEL SYSTEM. THE POSSIBILITY OF ELECTRICAL SPARKS AROUND AN "EMPTY" FUEL CELL CREATES A HAZARDOUS SITUATION.
B. While the transmitter float arm is being actuated, apply airplane battery electrical power as required to ensure that the fuel quantity indicator follows the movement of the transmitter float arm. If this does not occur, troubleshoot, repair and/or replace components as required until the results are achieved as stated.

NOTE: Stewart Warner fuel quantity indicating systems can be adjusted. Refer to this section for instructions for adjusting Stewart Warner fuel indicating systems. Rochester fuel quantity indicating system components are not adjustable, only component replacement or standard electrical wiring system maintenance practices are permitted.

5. With the fuel selector valve in the "OFF" position, add unusable fuel to each fuel tank.

6. Apply electrical power as required to verify the fuel quantity indicator indicates "EMPTY".
   A. If "EMPTY" is not indicated, adjust, troubleshoot, repair and/or replace fuel indicating components as required until the "EMPTY" indication is achieved.

   NOTE: Stewart Warner fuel quantity indicating systems can be adjusted. Refer to this section for instructions for adjusting Stewart Warner fuel indicating systems. Rochester fuel quantity indicating system components are not adjustable, only component replacement or standard electrical wiring system maintenance practices are permitted.

7. Fill tanks to capacity, apply electrical power as required and verify that the fuel quantity indicators indicate "FULL".
   A. If "FULL" is not indicated, adjust, troubleshoot, repair and/or replace fuel indicating components as required until the "FULL" indication is achieved.

   NOTE: Stewart Warner fuel quantity indicating systems can be adjusted. Refer to this section for instructions for adjusting Stewart Warner fuel indicating systems. Rochester fuel quantity indicating system components are not adjustable, only component replacement or standard electrical wiring system maintenance practices are permitted.

8. Install any items and/or equipment removed to accomplish this procedure, remove maintenance warning tags and connect the airplane battery.

15-43D. OIL TEMPERATURE INDICATING SYSTEM RESISTANCE TABLE.

The following table is provided to assist in the troubleshooting the oil temperature indicating system components.

Select the oil temperature sending unit part number that is used in your airplane from the left column and the temperature from the column headings. Read the ohms value under the appropriate temperature column.

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Type</th>
<th>72°F</th>
<th>120°F</th>
<th>165°F</th>
<th>220°F</th>
<th>250°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1630-1</td>
<td>Oil Temp</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>46.4 Ω</td>
</tr>
<tr>
<td>S1630-3</td>
<td>Oil Temp</td>
<td>620.0</td>
<td></td>
<td>52.4 Ω</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1630-4</td>
<td>Oil Temp</td>
<td>620.0</td>
<td></td>
<td>52.4 Ω</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1630-5</td>
<td>Oil Temp</td>
<td></td>
<td>192.0 Ω</td>
<td></td>
<td>34.0 Ω</td>
<td></td>
</tr>
<tr>
<td>S2335-1</td>
<td>Oil Temp</td>
<td>990.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
15-48. ACCELEROMETER.

15-49. DESCRIPTION. The Aerobat offers an accelerometer to assist pilot in performing precision aerobatics. The accelerometer continuously indicates g forces being imposed on aircraft. The dial display utilizes three pointers; one pointer indicates instantaneous acceleration, another records maximum positive acceleration and the third records maximum negative acceleration. Maximum instrument markings range from 10G to 5G. A "PUSH TO SET" knob, located on lower left corner of instrument, is used to reset "Maximum Positive" and "Maximum Negative" pointers. If dual Nav/Coms are installed, the accelerometer is installed in a housing above instrument panel on pilot's side. When aircraft is equipped with single Nav/Com, accelerometer is installed in the vacant Omni indicator instrument space.

15-50. STALL WARNING SYSTEM. (Refer to figure 15-7.)

15-51. DESCRIPTION. The system is composed of an adjustable plate on left wing leading edge, connected to a reed type horn by means of plastic tubing. The horn is actuated approximately 5 to 10 miles per hour above stalling speed as a negative air pressure area at wing leading edge causes a reverse flow of air through horn. By moving adjustable plate (6) up, actuation of horn will occur at a higher speed and moving plate down causes actuation to occur at a slower speed. Center adjustable plate opening in wing leading edge upon installation, then flight test aircraft, observing horn actuation during stall. Re-adjust plate to obtain desired results if necessary. Approximately 3/32 inch adjustment of plate will change speed at which horn actuation occurs by 5 miles per hour. To test horn operation, cover opening in plate (6) with a clean cloth, such as a handkerchief and apply a slight suction by mouth to draw air through horn.

NOTE

Bug screen (7) should be inspected and cleaned periodically.
15-52. TURN-AND-SLIP INDICATOR.

is an electrically operated instrument powered by the aircraft electrical system, therefore, operating only when the master switch is ON.

15-53. DESCRIPTION. The turn-and-slip indicator

15-54. TROUBLE SHOOTING.

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<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDICATOR POINTER FAILS TO RESPOND.</td>
<td>Internal fuse blown.</td>
<td>Check wiring for continuity, check voltage at indicator. Replace fuse, if fuse still blows, replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Master switch &quot;OFF&quot; or switch defective.</td>
<td>Check switch &quot;ON.&quot; Replace defective switch.</td>
</tr>
<tr>
<td></td>
<td>Broken or grounded lead to indicator.</td>
<td>Check circuit wiring. Repair or replace defective wiring.</td>
</tr>
<tr>
<td></td>
<td>Indicator not grounded.</td>
<td>Check ground wire. Repair or replace defective wire.</td>
</tr>
<tr>
<td></td>
<td>Defective mechanism.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td>HAND SLUGGISH IN RETURNING TO ZERO.</td>
<td>Defective mechanism.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Low voltage.</td>
<td>Check voltage at indicator. Correct voltage.</td>
</tr>
<tr>
<td>POINTER DOES NOT INDICATE PROPER TURN.</td>
<td>Defective mechanism.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td>HAND DOES NOT SIT ON ZERO.</td>
<td>Gimbal and rotor out of balance.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Hand incorrectly sits on rod.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Sensitivity spring adjustment pulls hand off zero.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td>IN COLD TEMPERATURES, HAND FAILS TO RESPOND OR IS SLUGGISH.</td>
<td>Oil in indicator becomes too thick.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Insufficient bearing end play.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Low voltage.</td>
<td>Check voltage at indicator. Correct voltage.</td>
</tr>
<tr>
<td>NOISY GYRO.</td>
<td>High voltage.</td>
<td>Check voltage at indicator. Correct voltage.</td>
</tr>
<tr>
<td></td>
<td>Loose or defective rotor bearings.</td>
<td>Replace instrument.</td>
</tr>
</tbody>
</table>
15-55. TUR\textsuperscript{N} COORDINATOR.

15-56. DESCRIPTION. The turn coordinator is an electrically operated, gyroscopic, roll-rate turn indicator. Its gyro simultaneously senses rate of motion roll and yaw axes which is projected on a single indicator. The gyro is a non-tumbling type requiring no caging mechanism and incorporates an a.c. brushless spin motor with a solid state inverter.

15-57. TROUBLE SHOOTING.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDICATOR DOES NOT RETURN TO CENTER.</td>
<td>Friction caused by contamination in the indicator damping.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Friction in gimbal assembly.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td>DOES NOT INDICATE A STANDARD RATE TURN (TOO SLOW).</td>
<td>Low voltage.</td>
<td>Measure voltage at instrument. Correct voltage.</td>
</tr>
<tr>
<td></td>
<td>Inverter frequency changed.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td>NOISY MOTOR.</td>
<td>Faulty bearings.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td>ROTOR DOES NOT START.</td>
<td>Faulty electrical connection.</td>
<td>Check continuity and voltage. Correct voltage or replace faulty wire.</td>
</tr>
<tr>
<td></td>
<td>Inverter malfunctioning.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Motor shorted.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Bearings frozen.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td>IN COLD TEMPERATURES, HAND FAILS TO RESPOND OR IS SLUGGISH.</td>
<td>Oil in indicator becomes too thick.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Insufficient bearing end play.</td>
<td>Replace instrument.</td>
</tr>
<tr>
<td></td>
<td>Low voltage.</td>
<td>Check voltage at instrument. Correct voltage.</td>
</tr>
<tr>
<td>NOISY GYRO.</td>
<td>High voltage.</td>
<td>Check voltage to instrument. Correct voltage.</td>
</tr>
<tr>
<td></td>
<td>Loose or defective rotor bearings.</td>
<td>Replace instrument.</td>
</tr>
</tbody>
</table>
Figure 15-8. Wing Leveler Control System

NOTE

Refer to figure 15-5 for vacuum relief valve installation for 1972 Models AND ON.

NOTE

Restrictor valve (13), inverter (17) and turn coordinator (15) must be replaced as a matched set. DO NOT adjust restrictor. Detail A is applicable to aileron and rudder cables.

USED WITH GYROS

USED WITHOUT GYROS
15-58. ELECTRIC CLOCK.

15-59. DESCRIPTION. The electric clock is connected to the battery through a one-ampere fuse mounted adjacent to the battery box. The clock electrical circuit is separate from the aircraft electrical system and will operate when master switch is OFF.

15-60. WING LEVELER. (Refer to figure 15-8.)

15-61. DESCRIPTION. The wing leveler control system, consisting of a turn coordinator (15), pneumatic servos (2), connecting cables (3 and 7) and hose (1, 4 and 5) may be installed. The turn coordinator gyro senses changes in roll attitude, then electrically meters vacuum power from the engine-driven vacuum pump to the cylinder-piston servos, operating ailerons for longitudinal stability. In addition to aileron servos, two servos are connected to the rudder cables and provide lateral (yaw) stability that prevents excessive changes in heading in turbulent air. Manual control of system is afforded by the roll trim knob (16). Roll trim should not be used to correct faulty rigging or "wing heaviness." Manual override of system may be accomplished without damage to aircraft or system. The ON-OFF valve (14) controls vacuum supply to distributor valve, but does not affect electrically operated turn coordinator gyro. Installation of wing leveler does not change vacuum relief valve (18) settings. Refer to appropriate publication issued by the manufacturer for trouble shooting procedures.

15-62. RIGGING.

a. Loosen connector (8) and clamp (10).
b. Move aileron to full up position.
c. Move clamp (10) outboard until spring (9) is extended to 6.50 inches from hole in servo cable end to hole in clamp and tighten screw and nut.

NOTE

After completion of step "c", servo seal should be taut but not stretched.

d. Move connector (8) outboard until sleeve contacts servo cable end, then back off approximately .06 inch and torque connector to 70-90 pound-inches.
e. The rudder servos are rigged in same manner as aileron servos except hold full rudder and pull servo cable to extend the inactive servo until taut but not stretched, then secure cable. Hold opposite full rudder and rig remaining servo in similar manner.

SHOP NOTES:

__________________________________________________________

__________________________________________________________

__________________________________________________________

__________________________________________________________

__________________________________________________________

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## SECTION 16
### ELECTRICAL SYSTEMS

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<td>Trouble Shooting</td>
<td>16-34</td>
</tr>
<tr>
<td>Electrical Load Analysis Chart</td>
<td>16-36</td>
</tr>
</tbody>
</table>

### 16-1. ELECTRICAL SYSTEMS.

### 16-2. GENERAL.
This section contains service information necessary to maintain the Aircraft Electrical Power Supply System, Battery and External Power Supply System, Alternator Power System, Aircraft Lighting System, Pitot Heater, Stall Warning, Cigar Lighter and Electrical Load Analysis.

### 16-3. ELECTRICAL POWER SUPPLY SYSTEM.

16-4. DESCRIPTION.
Electrical energy for the aircraft is supplied by a 14-volt, direct-current, single-wire, negative ground electrical system. A 12-volt battery supplies power for starting and furnishes a reserve source of power in the event of alternator failure. An engine-driven alternator is the normal source of power during flight and maintains a battery charge controlled by a voltage regulator. An external power source receptacle is offered as optional equipment to supplement the battery alternator system for starting and ground operation.
16-4A. BUS BAR.

16-4B. DESCRIPTION. Electrical power for electrical equipment and electrical installations is supplied through a bus bar. The bus bar is mounted on the lower side of the fuse holders through 15073961, A1500361, F15000903 and FA1500191. On these aircraft, Single-Engine Service Letter, SE72-34, Dated November 17, 1972 should be complied with to provide additional protection against accidental shorting. Beginning with 15073962, A1500362, F15000904 and FA1500192, the bus bar is relocated to the top of the fuse holders.

16-5. MASTER SWITCH.

16-6. DESCRIPTION. On 1969 models the operation of the battery and alternator systems is controlled by a master switch. The switch is a rocker type with double-pole, single-throw contacts. The switch, when operated, connects the battery contactor coil to ground and the alternator field circuit to the battery, activating the power systems. On 1970 models and on a new master switch is utilized. This switch is a interlocking split rocker with the battery mode on the right hand side and the alternator mode on the left hand side. This arrangement allows the battery to be on the line without the alternator, however, operation of the alternator without the battery on the line is not possible. The switch is labeled "BAT" and "ALT" below the switch and is located on the left hand side of the switch panel.

16-7. AMMETER.

16-8. DESCRIPTION. The ammeter is connected between the battery and the aircraft bus. The meter indicates the amount of current flowing either to or from the battery. With a low battery and the engine operating at cruise speed the ammeter will show the full alternator output when all electrical equipment is off. When the battery is fully charged and cruise RPM is maintained with all electrical equipment off, the ammeter will show a minimum charging rate.

16-9. BATTERY POWER SYSTEM.

16-10. BATTERY.

16-11. DESCRIPTION. The battery is 12 volts and is approximately 25 ampere-hour capacity. The battery is mounted on the forward side of the firewall and is equipped with non-spill filler caps.

16-12. TROUBLE SHOOTING THE BATTERY POWER SYSTEM.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>BATTERY WILL NOT SUPPLY POWER TO BUS OR IS INCAPABLE OF CRANKING ENGINE.</td>
<td>Battery discharged.</td>
<td>1. Measure voltage at &quot;BAT&quot; terminal of battery contactor with master switch and a suitable load such as a taxi light turned on. Normal battery will indicate 11.5 volts or more. If voltage is low, proceed to step 2. If voltage is normal, proceed to step 3.</td>
</tr>
<tr>
<td></td>
<td>Battery faulty.</td>
<td>2. Check fluid level in cells and charge battery at 20 amps for approximately 30 minutes or until the battery voltage rises to 15 volts. Check battery with a load type tester. If tester indicates a good battery, the malfunction may be assumed to be a discharged battery. If the tester indicates a faulty battery, replace the battery.</td>
</tr>
<tr>
<td></td>
<td>Faulty contactor or wiring between contactor or master switch.</td>
<td>3. Measure voltage at master switch terminal (smallest) on contactor with master switch closed. Normal indication is zero volts. If voltage reads zero, proceed to step 4. If a voltage reading is obtained check wiring between contactor and master switch. Also check master switch.</td>
</tr>
</tbody>
</table>
### 16-12. TROUBLE SHOOTING THE BATTERY POWER SYSTEM (cont.)

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>BATTERY WILL NOT SUPPLY POWER TO BUS OR IS INCAPABLE OF CRANKING ENGINE (cont).</td>
<td>Open coil on contactor.</td>
<td>4. Check continuity between &quot;BAT&quot; terminal and master switch terminal of contactor. Normal indication is 16 to 24 ohms (Master switch open). If ohmmeter indicates an open coil, replace contactor. If ohmmeter indicates a good coil, proceed to step 5.</td>
</tr>
<tr>
<td></td>
<td>Faulty contactor contacts.</td>
<td>5. Check voltage on &quot;BUS&quot; side of contactor with master switch closed. Meter normally indicates battery voltage. If voltage is zero or intermittent, replace contactor. If voltage is normal, proceed to step 6.</td>
</tr>
<tr>
<td></td>
<td>Faulty wiring between contactor and bus.</td>
<td>6. Inspect wiring between contactor and bus. Repair or replace wiring.</td>
</tr>
</tbody>
</table>

#### 16-13. REMOVAL AND INSTALLATION (Refer to figure 16-1.)

- a. Remove top half of cowl.
- b. Remove the battery box cover.
- c. Disconnect the ground cable from the negative battery terminal.

**CAUTION**

Always remove the battery ground cable first and replace it last to prevent accidental short circuits.

- d. Disconnect the cable from the positive terminal of the battery.
- e. Lift the battery out of the battery box.
- f. To replace the battery, reverse this procedure.

#### 16-14. CLEANING THE BATTERY. For maximum efficiency the battery and connections should be kept clean at all times.

- a. Remove the battery and connections in accordance with the preceding paragraph.
- b. Tighten battery cell filler caps to prevent the cleaning solution from entering the cells.
- c. Wipe the battery cable ends, battery terminals and the entire surface of the battery with a clean cloth moistened with a solution of bicarbonate of soda (baking soda) and water.
- d. Rinse with clear water, wipe off excess water and allow battery to dry.
- e. Brighten up cable ends and battery terminals with emery cloth or a wire brush.
- f. Install the battery according to the preceding paragraphs.
- g. Coat the battery terminals with petroleum jelly or an ignition spray product to reduce corrosion.

#### 16-15. ADDING ELECTROLYTE OR WATER TO THE BATTERY

A battery being charged and discharged with use will decompose the water from the electrolyte by electrolysis. When the water is decomposed hydrogen and oxygen gases are formed which escape into the atmosphere through the battery vent system. The acid in the solution chemically combines with the plates of the battery during discharge or is suspended in the electrolyte solution during charge. Unless the electrolyte has been spilled from a battery, acid should not be added to the solution. The water, however will decompose into gases and should be replaced regularly. Add distilled water as necessary to maintain the electrolyte level with the horizontal baffle plate or the split ring on the filler neck inside the battery. When "dry charged" batteries are put into service fill as directed with electrolyte. When the electrolyte level falls below normal with use, add only distilled water to maintain the proper level. The battery electrolyte contains approximately 25% sulphuric acid by volume. Any change in this volume will hamper the proper operation of the battery.
CAUTION

Do not add any type of "battery rejuvenator" to the electrolyte. When acid has been spilled from a battery, the acid balance may be adjusted by following instructions published by the Association of American Battery Manufacturers.

16-16. TESTING THE BATTERY. The specific gravity of the battery may be measured with a hydrometer to determine the state of battery charge. If the hydrometer reading is low, slow-charge the battery and retest. Hydrometer readings of the electrolyte must be compensated for the temperature of the electrolyte. Some hydrometers have a built-in thermometer and conversion chart. The following chart shows the battery condition for various hydrometer readings with an electrolyte temperature of 80°F.

<table>
<thead>
<tr>
<th>READINGS</th>
<th>BATTERY CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.280 Specific Gravity ................ 100% Charged</td>
<td></td>
</tr>
<tr>
<td>1.250 Specific Gravity ................ 75% Charged</td>
<td></td>
</tr>
<tr>
<td>1.220 Specific Gravity ................ 50% Charged</td>
<td></td>
</tr>
<tr>
<td>1.190 Specific Gravity ................ 25% Charged</td>
<td></td>
</tr>
<tr>
<td>1.160 Specific Gravity ................ Practically Dead</td>
<td></td>
</tr>
</tbody>
</table>

NOTE

All readings shown are for an electrolyte temperature of 80°F. For higher temperatures the readings will be slightly lower. For cooler temperatures the readings will be slightly higher. Some hydrometers will have a built-in temperature compensation chart and a thermometer. If this type tester is used, disregard this chart.

If a specific gravity reading indicates that the battery is not fully charged, the battery should be charged at approximately 20 amperes for 30 minutes, or until the battery voltage rises to 15 volts. After charging, a load type tester will give more meaningful results. A specific gravity check can be used after charging but the check cannot spot cells which short under load, broken connectors between plates of a cell, etc.

16-17. CHARGING THE BATTERY. When the battery is to be charged, the level of the electrolyte should be checked and adjusted by adding distilled water to cover the tops of the internal battery plates. Remove the battery from the aircraft and place in a well ventilated area for charging.

WARNING

When a battery is being charged, hydrogen and oxygen gases are generated. Accumulation of these gases can create a hazardous explosive condition. Always keep sparks and open flame away from the battery. Allow unrestricted venti- lation of the battery area during charging.

The main points of consideration during a battery charge are excessive battery temperature and violent gassing. Under a reasonable rate of charge (20 amperes or less) the battery temperature should not rise over 125°F, nor should gassing be so violent that acid is blown from the vents.

16-18. BATTERY BOX.

16-19. DESCRIPTION. The battery is completely enclosed in a box which is painted with acid proof paint. The box has a vent tube which protrudes through the bottom of the aircraft allowing battery gases and spilled electrolyte to escape. The battery box is riveted to the forward side of the firewall.

16-20. REMOVAL AND INSTALLATION. (Refer to figure 16-1). The battery box is riveted to mounting brackets on the firewall. When a battery box is installed and riveted into place, all rivets and scratches inside the box should be painted with acid-proof lacquer, Part No. CES1054-381, available from the Cessna Service Parts Center.

16-21. MAINTENANCE. The battery box should be inspected and cleaned periodically. The box and cover should be cleaned with a strong solution of bicarbonate of soda (baking soda) and water. Hard deposits may be removed with a wire brush. When all corrosive deposits have been removed from the box, flush it thoroughly with clean water.

WARNING

Do not allow acid deposits to come in contact with skin or clothing. Serious acid burns may result unless the affected area is washed immediately with soap and water. Clothing will be ruined upon contact with battery acid.

Inspect the cleaned box and cover for physical damage and for areas lacking proper acid proofing. A badly damaged or corroded box should be replaced. If the box or lid require acid proofing, paint the area with acid proof lacquer, Part No. CES1054-381, available from the Cessna Service Parts Center.

16-22. BATTERY CONTACTOR.

16-23. DESCRIPTION. The battery contactor is bolted to the side of the battery box. The contactor is a plunger type contactor which is actuated by turning the master switch on. When the master switch is off, the battery is disconnected from the electrical system. A silicon diode is used to eliminate spiking of transistorized radio equipment. The large terminal of the diode connects to the battery terminal of the battery contactor. The small terminal of the
NOTE
BEGINNING WITH AIRCRAFT SERIALS 15073741, A15000345, F15000904 AND FA15000192 a vented battery contactor is installed.

1. Battery Box Cover
2. Battery
3. Battery Box
4. Positive Battery Cable
5. Wire to Clock Fuse
6. Wire to Master Switch
7. Diode Assembly
8. Washer
9. Nut
10. Battery Contactor
11. Sta-Strip
12. Cover
13. Starter Cable
14. Battery Ground Strap

Figure 16-1. Battery, Battery Box and Battery Contactor Installations

Change 1 16-5
diode and the master switch wire connect to the minus terminal of the contactor coil. A nylon cover is installed on the terminals to prevent accidental short circuits. Refer to figure 16-1.

16-24. REMOVAL AND INSTALLATION (Refer to figure 16-1). a. Open battery box and disconnect ground cable from negative battery terminal. Pull cable clear of battery box. b. Remove the nut, lockwasher and the two plain washers securing the battery cables to the battery contactor. c. Remove the nut, lockwasher and the two plain washers securing the wire which is routed to the master switch. d. Remove the bolt, washer and nut securing each side of the battery contactor to the battery box. The contactor will then be free for removal. e. To replace the contactor, reverse this procedure.

16-25. BATTERY CONTACTOR CLOSING CIRCUIT. This circuit consists of a 5 amp fuse, a resistor and a diode installed across the battery contactor. This serves to shunt a small charge around the battery contactor when the battery is too dead to energize the contactor by itself.

16-26. GROUND SERVICE RECEPTACLE. 16-27. DESCRIPTION. A ground service receptacle is offered as optional equipment to permit the use of external power for cold weather starting or when performing lengthy electrical maintenance.

NOTE
Before connecting an external power source, it is important that the master switch be turned "ON." This will close the battery contactor and enable the battery to absorb transient voltages which otherwise might damage the electronic equipment. It will also provide excitation of the alternator field in the event that the battery is completely dead.

16-28. REMOVAL AND INSTALLATION (Refer to figure 16-2). a. Open battery box and disconnect the ground cable from the negative terminal of the battery and pull the cable from the battery box. b. Remove the nuts, washers and ground strap from the studs of the receptacle and remove the battery cable. c. Remove the screws and nuts holding the receptacle. The receptacle will then be free from the bracket. d. To install a ground service receptacle, reverse this procedure. Be sure to place the ground strap on the negative stud of the receptacle.

16-29. ALTERNATOR POWER SYSTEM. 16-30. DESCRIPTION. The alternator system consists of an engine driven alternator, a voltage regulator mounted on the left hand side of the firewall and a circuit breaker located on the instrument panel. The system is controlled by the left hand portion of the split rocker, master switch labeled "ALT." Beginning with 1972 models an over-voltage sensor switch and red warning light labeled "HIGH VOLTAGE" are incorporated to protect the system. (Refer to paragraph 16-36). The aircraft battery supplies the source of power for excitation of the alternator.

16-31. ALTERNATOR. 16-32. DESCRIPTION. The alternator is three phase, delta connected with integral silicon diode rectifiers. The alternator is rated at 14 volts at 60 amperes continuous output. The moving center part of the alternator (rotor) consists of an axial winding with radial interlocking poles which surround the winding. With excitation applied to the winding through slip rings the pole pieces assume magnetic polarity. The rotor is mounted in bearings and rotates inside the stator which contains the windings in which ac is generated. The stator windings are three-phase, delta connected and are attached to two diode plates, each of which contains three silicon diodes. The diode plates are connected to accomplish full-wave, rectification of ac. The resulting dc output is applied to the aircraft bus and sensed by the voltage regulator. The regulator controls the excitation applied to the alternator field thus controlling the output of the alternator.

16-33. REMOVAL AND INSTALLATION. a. Ensure that master switch is off and the negative lead is disconnected from the battery. b. Remove wiring from the alternator and label. c. Remove screw and nut holding blast tube to support strap clamp, blast tube will then be free for removal. d. Remove nuts and washers from alternator mounting bolts. e. Remove alternator. f. To replace alternator, reverse this procedure.

16-34. ALTERNATOR FIELD CIRCUIT PROTECTION. The 2-amp automatic resetting circuit breaker located in the removable electrical switch and fuse panel below the shock panel is provided to protect the alternator field circuit.

16-35. ALTERNATOR REVERSE VOLTAGE DAMAGE. The alternator is very susceptible to reverse polarity current because of the silicon diodes. The diodes, having a very high resistance to reverse current flow, are used without any cutout relay such as used on a generator system. The alternator diodes are arranged with their cathodes connected to the aircraft bus bar which is positive and no back current will flow. If the polarity of the battery is reversed, the diodes will offer no resistance to the current flow. The current rating of the diodes is exceeded and diode failure may result.
THRU 1975 MODELS

BEGINNING WITH 1976 MODELS

1. Nut
2. Washer
3. Ground Strap
4. Bracket
5. Firewall
6. Doubler
7. Cover Plate
8. Receptacle
9. Screw
10. Power Cable
11. Fuse-Clock
12. Fuse-Battery Contactor Closing Circuit
13. Lockwasher
14. Insulating Washer
15. Spacer
16. Wire to Battery Contactor (Bat. Side)
17. Solder Terminal
18. Diode
19. Wire to Battery Contactor
20. Resistor
21. Wire to Clock

Figure 16-2. Ground Service Receptacle and Battery Contactor Closing Circuit Installations
WARNING

On models manufactured prior to mid 1971 should alternator thru-bolt loosening or breaking occur, Cessna Service Letter SE71-40 dated November 24, 1971 should be complied with. On models manufactured after mid 1971 a new high strength thru-bolt and a K shaped retainer are installed. Torque bolts 45 to 55 pound-inches.

Detail A

1. Blast Tube
2. Blast Tube Support
3. Lockwasher
4. Screw
5. Support Strap
6. Nut
7. Alternator Assy
8. Bolt
9. Clamp Half
10. Clamp

Figure 16-3. Alternator Installation
16-36. OVER-VOLTAGE WARNING SYSTEM.

16-37. DESCRIPTION. The over-voltage system consists of an over-voltage sensor switch and a red warning light labeled "HIGH VOLTAGE". The over-voltage sensor is attached to the wire bundle behind the instrument panel and the light is located on the right hand side of the instrument panel. When an over-voltage tripoff occurs the over-voltage sensor turns off the alternator system and the red warning light comes on. The ammeter will show a discharge. Turn off both sections of the master switch to recycle the over-voltage sensor. If the over-voltage condition was transient, the normal alternator charging will resume and no further action is necessary. If the over-voltage tripoff recurs, then a generating system malfunction has occurred such that the electrical accessories must be operated from the aircraft battery only. Conservation of electrical energy must be practiced until the flight can be terminated. The over-voltage light filament may be tested at any time by turning off the "Alternator" portion of the master switch and leaving the battery portion on. This test does not induce an over-voltage condition on the electrical system. On models prior to aircraft serial 15073084, A1500313 and F1500769, should nuisance trip-outs occur caused by voltage spikes or transient voltage, Cessna Single-engine Service Letter SE72-15 dated April 21, 1972 should be complied with.

NOTE
The over-voltage sensor switch contains solid state devices. Observe proper polarity before supplying power. Grounding the orange lead or interconnecting orange and black leads will destroy the device. When removal is required for replacement, identify (tag) wiring and follow the wiring diagram in Section 20 for rewiring.

16-38. TROUBLE SHOOTING THE ALTERNATOR SYSTEM.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMMETER INDICATES HEAVY DISCHARGE WITH ENGINE NOT RUNNING OR ALTERNATOR CIRCUIT BREAKER OPENS WHEN MASTER SWITCH IS TURNED ON.</td>
<td>Shorted radio noise filter or shorted wire.</td>
<td>1. Remove cable from output terminal of alternator. Check resistance from end of cable to ground (MASTER SWITCH MUST BE OFF). If resistance does not indicate a direct short, proceed to step 4. If resistance indicates a direct short, proceed to step 2.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Remove cable connections from radio noise filter. Check resistance from the filter input terminal to ground. Normal indication is infinite resistance. If reading indicates a direct short, replace filter. If no short is evident, proceed to step 3.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Check resistance from ground to the free ends of the wires which were connected to the radio noise filter (or alternator if no noise filter is installed). Normal indication does not show a direct short. If a short exists in wires, repair or replace wiring.</td>
</tr>
<tr>
<td></td>
<td>Shorted diodes in alternator.</td>
<td>4. Check resistance from output terminal of alternator to alternator case. Reverse leads and check again. Resistance reading may show continuity in one direction but should show an infinite reading in the other direction. If an infinite reading is not obtained in at least one direction, repair or replace alternator.</td>
</tr>
<tr>
<td>TROUBLE</td>
<td>PROBABLE CAUSE</td>
<td>REMEDY</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>ALTERNATOR SYSTEM WILL NOT KEEP BATTERY CHARGED.</td>
<td>Regulator faulty or improperly adjusted.</td>
<td>1. Start engine and adjust for 1500 RPM. Ammeter should indicate a heavy charge rate with all electrical equipment turned off. Rate should taper off in 1-3 minutes. A voltage check at the bus should indicate a reading consistent with the voltage vs temperature chart on page 16-10. If charge rate tapers off very quickly and voltage is normal, check battery for malfunction. If ammeter shows a low charge rate or any discharge rate, and voltage is low, proceed to step 2.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Stop engine, remove cowl, and remove cover from voltage regulator. Turn master switch ON/OFF several times and observe field relay in regulator. Relay should open and close with master switch and small arc should be seen as contacts open. If relay is inoperative, proceed to step 3. If relay operates, proceed to step 4.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Check voltage at &quot;S&quot; terminal of regulator with master switch closed. Meter should indicate bus voltage. If voltage is present, replace regulator. If voltage is not present, check wiring between regulator and bus.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Remove plug from regulator and start engine. Momentarily jumper the &quot;A+&quot; and &quot;F&quot; terminals together on the plug. Ship's ammeter should show heavy rate of charge. If heavy charge rate is observed, replace regulator. If heavy charge rate is not observed, proceed to step 5.</td>
</tr>
<tr>
<td></td>
<td>Faulty wiring between alternator and regulator, or faulty alternator.</td>
<td>5. Check resistance from &quot;F&quot; terminal of regulator to &quot;F&quot; terminal of alternator. Normal indication is a very low resistance. If reading indicates no, or poor continuity, repair or replace wiring from regulator to alternator.</td>
</tr>
</tbody>
</table>
### 16-38. TROUBLE SHOOTING THE ALTERNATOR SYSTEM (Cont.)

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ALTERNATOR SYSTEM WILL NOT KEEP BATTERY CHARGED (Cont.)</strong></td>
<td>Faulty wiring between alternator and regulator, or faulty alternator (Cont.).</td>
<td>6. Check resistance from &quot;F&quot; terminal of alternator to alternator case. Normal indication is 6-7 ohms. If resistance is high or low, repair or replace alternator.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7. Check resistance from case of alternator to airframe ground. Normal indication is very low resistance. If reading indicates no, or poor continuity, repair or replace alternator ground wiring.</td>
</tr>
<tr>
<td><strong>ALTERNATOR OVERCHARGES BATTERY - BATTERY USE EXCESSIVE WATER.</strong></td>
<td>Regulator faulty or improperly adjusted.</td>
<td>Check bus voltage with engine running. Normal indication agrees with voltage vs temperature chart on page 16-13. Observe ship's ammeter, ammeter should indicate near zero after a few minutes of engine operation. Replace regulator.</td>
</tr>
<tr>
<td><strong>OVER-VOLTAGE WARNING LIGHT ON.</strong></td>
<td>Regulator faulty or improperly adjusted. Faulty sensor switch.</td>
<td>1. With engine running turn off and on battery portion of the master switch. If the light stays on shut down engine then turn on the &quot;BAT&quot; and &quot;ALT&quot; portions of the master switch. Check for voltage at the &quot;S&quot; terminal of the voltage regulator. If voltage is present adjust or replace regulator. If voltage is not present check master switch and wiring for short or open condition. If wiring and switch are normal replace sensor.</td>
</tr>
</tbody>
</table>

### 16-39. VOLTAGE REGULATOR.

16-40. DESCRIPTION. The alternator voltage regulator contains two relays. One relay is actuated by the aircraft master switch and connects the regulator to the battery. The second relay is a two-stage, voltage sensitive device which is used to control the current applied to the field winding of the alternator. When the upper set of contacts on the voltage regulator relay are closed, full bus voltage is applied to the field. This condition will exist when the battery is being charged or when a very heavy load is applied to the system. When the upper contacts open, as the voltage begins to rise toward normal bus voltage, the voltage to the alternator field is reduced through a resistor network in the base of the regulator thus reducing the output from the alternator. As the voltage continues to rise, assuming a very light load on the system, the lower contacts will close and ground the alternator field and shut the alternator completely off. Under lightly loaded conditions the voltage relay will vibrate between the intermediate charge rate and the lower (completely off) contacts. Under a moderate load, the relay will vibrate between the intermediate charge rate and the upper (full output) contacts. The voltage relay is temperature compensated so that the battery is supplied with the proper charging voltage for all operating temperatures. With the battery fully charged (ship's ammeter indicating at or near zero) and a moderate load applied to the system (a taxi light turned on) the voltage at the bus bar should be within the range shown according to the air temperature on the following chart:
Figure 16-4. Voltage Regulator Installation

1. Voltage Regulator
2. Screw
3. Filter-Radio Noise
4. Housing
5. Wire Shields to Ground
6. Wire to Alternator "F"
7. Wire to Alternator "A+"
8. Wire to Filter
9. Wire to Master Switch
10. Nut
11. Lockwasher
12. Shield - Ground
13. Wire to Alternator Ground
14. Wire to Over-voltage Light
poor voltage regulation and/or excessive radio noise may result.

16-42. AIRCRAFT LIGHTING SYSTEM.

16-43. DESCRIPTION. The aircraft lighting system consists of landing and taxi lights, navigation lights, anti-collision strobe lights, flashing beacon light, dome and instrument flood lights, control wheel map light, compass and radio dial lights.

16-44. ELECTRICAL SWITCH AND FUSE PANEL.

16-45. DESCRIPTION. Thru 1975 models a removable electrical switch and fuse panel is located below the shock panel. All electrical switches (except flap switch), fuses, radio light rheostat, circuit breaker and ignition switch are located in this panel. The complete panel unit is removable from the instrument panel by the removal of four screws. The panel unit wiring is connected to the instrument panel wire harness with quick disconnect mating connectors. New type rocker switches with spade type slip-on terminals and "push-in" plug button type mounting are introduced in this panel. Beginning with 1976 models the fuses are replaced with circuit breakers located on the lower right hand side of the instrument panel. The switch portion of the panel is no longer removable.

16-47. TROUBLE SHOOTING.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>LANDING AND TAXI LIGHT(S) OUT.</td>
<td>Short circuit in wiring.</td>
<td>1. Inspect fuse/circuit breaker. If open, proceed to step 2. If OK, proceed to step 3.</td>
</tr>
<tr>
<td></td>
<td>Defective wiring.</td>
<td>2. Test each circuit separately until short is located. Repair or replace wiring.</td>
</tr>
<tr>
<td></td>
<td>Defective switch.</td>
<td>3. Check voltage at lights with master and landing and taxi light switches ON. Should read battery voltage. Replace switch.</td>
</tr>
<tr>
<td>LANDING AND/OR TAXI LIGHT OUT.</td>
<td>Lamp burned out.</td>
<td>1. Test lamp with ohmmeter or new lamp. Replace lamp.</td>
</tr>
<tr>
<td></td>
<td>Open circuit in wiring.</td>
<td>2. Test wiring for continuity. Repair or replace wiring.</td>
</tr>
<tr>
<td>FLASHING BEACON DOES NOT LIGHT.</td>
<td>Short circuit in wiring.</td>
<td>1. Inspect fuse/circuit breaker. If open, proceed to step 2. If OK, proceed to step 3.</td>
</tr>
<tr>
<td></td>
<td>Defective wiring.</td>
<td>2. Test circuit until short is located. Repair or replace wiring.</td>
</tr>
<tr>
<td></td>
<td>Lamp burned out.</td>
<td>3. Test lamp with ohmmeter or a new lamp. Replace lamp. If lamp is good, proceed to step 4.</td>
</tr>
<tr>
<td>TROUBLE</td>
<td>PROBABLE CAUSE</td>
<td>REMEDY</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>---------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>FLASHING BEACON DOES NOT LIGHT (Cont.)</td>
<td>Open circuit in wiring.</td>
<td>4. Test circuit from lamp to flasher for continuity. If no continuity is present, repair or replace wiring. If continuity is present, proceed to step 5.</td>
</tr>
<tr>
<td></td>
<td>Defective switch.</td>
<td>5. Check voltage at flasher with master and beacon switch on. Should read battery voltage. Replace switch. If voltage is present, proceed to step 6.</td>
</tr>
<tr>
<td></td>
<td>Defective flasher.</td>
<td>6. Install new flasher.</td>
</tr>
<tr>
<td>FLASHING BEACON CONSTANTLY LIT.</td>
<td>Defective flasher.</td>
<td>1. Install new flasher.</td>
</tr>
<tr>
<td>ALL NAV LIGHTS OUT.</td>
<td>Short circuit in wiring.</td>
<td>1. Inspect fuse/circuit breaker. If open, proceed to step 2. If OK, proceed to step 3.</td>
</tr>
<tr>
<td></td>
<td>Defective wiring.</td>
<td>2. Isolate and test each nav light circuit until short is located. Repair or replace wiring.</td>
</tr>
<tr>
<td></td>
<td>Defective switch.</td>
<td>3. Check voltage at nav light with master and nav light switches on. Should read battery voltage. Replace switch.</td>
</tr>
<tr>
<td>ONE NAV LIGHT OUT.</td>
<td>Lamp burned out.</td>
<td>1. Inspect lamp. Replace lamp.</td>
</tr>
<tr>
<td></td>
<td>Open circuit in wiring.</td>
<td>2. Test wiring for continuity. Repair or replace wiring.</td>
</tr>
<tr>
<td>ONE ANTI-COLLISION STROBE LIGHT DOES NOT LIGHT. THRU 1972 MODELS.</td>
<td>Flash tube burned out.</td>
<td>Test with new flash tube. Replace flash tube.</td>
</tr>
<tr>
<td></td>
<td>Faulty wiring.</td>
<td>Test for continuity. Repair or replace.</td>
</tr>
<tr>
<td></td>
<td>Faulty trigger head.</td>
<td>Test with new trigger head. Replace trigger head.</td>
</tr>
<tr>
<td></td>
<td>Faulty power supply.</td>
<td>Listen for whine in power supply to determine if power is operating.</td>
</tr>
<tr>
<td></td>
<td>Faulty switch.</td>
<td>Test for continuity. Repair or replace.</td>
</tr>
<tr>
<td>TROUBLE</td>
<td>PROBABLE CAUSE</td>
<td>REMEDY</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
<td>--------</td>
</tr>
<tr>
<td>BOTH ANTI-COLLISION STROBE LIGHTS WILL NOT LIGHT, THRU 1972 MODELS. (Cont.)</td>
<td>Faulty wiring.</td>
<td>Test for continuity. Repair or replace.</td>
</tr>
<tr>
<td>ONE ANTI-COLLISION STROBE LIGHT WILL NOT LIGHT, BEGINNING WITH 1973 MODELS.</td>
<td>Flash tube burned out.</td>
<td>Test with new tube. Replace flash tube.</td>
</tr>
<tr>
<td></td>
<td>Faulty power supply.</td>
<td>Listen for whine in power supply to determine if power is operating.</td>
</tr>
<tr>
<td></td>
<td>Faulty wiring.</td>
<td>Test for continuity. Repair or replace.</td>
</tr>
<tr>
<td></td>
<td>Faulty trigger head.</td>
<td>Test with new trigger head. Replace trigger head.</td>
</tr>
<tr>
<td></td>
<td>Faulty switch.</td>
<td>Test for continuity. Repair or replace.</td>
</tr>
<tr>
<td></td>
<td>Faulty wiring.</td>
<td>Test for continuity. Repair or replace.</td>
</tr>
<tr>
<td>DOME LIGHT TROUBLE.</td>
<td>Short circuit in wiring.</td>
<td>1. Inspect circuit breaker. If circuit breaker is open, proceed to step 2. If circuit breaker is OK, proceed to step 3.</td>
</tr>
<tr>
<td></td>
<td>Defective wiring.</td>
<td>2. Test circuit until short is located. Repair or replace wiring.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Test for open circuit. Repair or replace wiring. If no short or open circuit is found, proceed to step 4.</td>
</tr>
<tr>
<td></td>
<td>Lamp burned out.</td>
<td>4. Test lamp with ohmmeter or new lamp. Replace lamp.</td>
</tr>
<tr>
<td></td>
<td>Defective switch.</td>
<td>5. Check for voltage at dome light with master and dome light switch on. Should read battery voltage. Replace switch.</td>
</tr>
<tr>
<td>TROUBLE</td>
<td>PROBABLE CAUSE</td>
<td>REMEDY</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>INSTRUMENT LIGHTS WILL NOT LIGHT.</td>
<td>Short circuit in wiring.</td>
<td>1. Inspect fuse/circuit breaker. If open, proceed to step 2. If OK, proceed to step 3.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Test circuit until short is located. Repair or replace wiring.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Test for open circuit. Repair or replace wiring. If no short or open circuit is found, proceed to step 4.</td>
</tr>
<tr>
<td></td>
<td>Defective wiring.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Check voltage at instrument light with master switch on. Should read battery voltage with rheostat turned full clockwise and voltage should decrease as rheostat is turned counterclockwise. If no voltage is present or voltage has a sudden drop before rheostat has been turned full counterclockwise, replace rheostat.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Defective rheostat.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Test lamp with ohmmeter or new lamp. Replace lamp.</td>
</tr>
<tr>
<td></td>
<td>Lamp burned out.</td>
<td></td>
</tr>
<tr>
<td>CONTROL WHEEL MAP LIGHT WILL NOT LIGHT THRU 1970 AIRCRAFT ONLY.</td>
<td>Nav light switch turned off.</td>
<td>1. Nav light switch has to be ON before map light will light.</td>
</tr>
<tr>
<td></td>
<td>Short circuit in wiring.</td>
<td>2. Check lamp fuse on terminal board located on back of stationary panel with ohmmeter. If fuse is open, proceed to step 3. If fuse is OK, proceed to step 4.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Test circuit until short is located. Repair or replace wiring.</td>
</tr>
<tr>
<td></td>
<td>Defective wiring.</td>
<td>4. Test for open circuit. Repair or replace wiring. If a short or open circuit is not found, proceed to step 5.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Defective map light assembly.</td>
<td>5. Check voltage at map light assembly with master and nav switches on. If battery voltage is present, replace map light assembly.</td>
</tr>
</tbody>
</table>

**CAUTION**

Failure to observe polarity shown on wiring diagrams 11.7.0, will result in immediate failure of the transistor on the map light circuit board assembly.
<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTROL WHEEL MAP NAV LIGHT WILL NOT LIGHT 1971 AIRCRAFT &amp; ON.</td>
<td>Nav light switch turned off.</td>
<td>1. Nav light switch has to be ON before map light will light.</td>
</tr>
<tr>
<td></td>
<td>Short circuit in wiring.</td>
<td>2. Check lamp fuse on terminal board located on back of stationary panel with ohmmeter. If fuse is open, proceed to step 3. If fuse is OK, proceed to step 4.</td>
</tr>
<tr>
<td></td>
<td>Defective wiring.</td>
<td>3. Test circuit until short is located. Repair or replace wiring.</td>
</tr>
<tr>
<td></td>
<td>Defective map light assembly.</td>
<td>4. Test for open circuit. Repair or replace wiring. If a short or open circuit is not found, proceed to step 5.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Check voltage at map light assembly with master and nav switches on. If battery voltage is present, replace map light assembly.</td>
</tr>
</tbody>
</table>

**SHOP NOTES:**

---

Change 1 16-16A/(16-16B blank)
Figure 16-5. Landing and Taxi Light Installation and Adjustment (Sheet 1 of 5)
Figure 16-5. Landing and Taxi Light Installation and Adjustment (Sheet 2 of 5)
NOTE
To adjust the landing light, add AN960-10 and/or AN960-10L washers (Ref item 10) as required between plate (7) and support bracket assy (8).

VIEW A-A

AIRCRAFT 15000739 THRU 15074012, A1500277 THRU A1500362, F15000739 THRU F15000903 AND FA1500122 THRU FA1500191

Detail A

1. Screw
2. Washer
3. Light Cover
4. Adjustment Screws
5. Bracket
6. Lamp
7. Plate
8. Support Brkt Assy
9. Nosecap
10. Washer
11. Nut
12. Mounting Screw

Figure 16-5. Landing and Taxi Light Installation and Adjustment (Sheet 3 of 5)
NOTE
To adjust the landing light, add AN960-10 and/or AN960-10L washers (Ref item 10) as required between plate (7) and support bracket assy (8).

NOTE
BEGINNING WITH 15074013, A1500393, F15000904 AND FA1500192, aluminum light brackets are replaced with steel brackets and a silicon rubber gasket is installed.

Figure 16-5. Landing and Taxi Light Installation and Adjustment (Sheet 4 of 5)
1. Bracket Assembly
2. Tinnerman Screw
3. Bracket
4. Lamp
5. Gasket
6. Plate
7. Adjustment Screw
8. Nosecap
9. Washer
10. Spacer
11. Mounting Screw

Figure 16-5. Landing and Taxi Light Installation and Adjustment (Sheet 5 of 5)
16-47. LANDING AND TAXI LIGHTS. (THRU 1970 MODELS)

16-48. DESCRIPTION. The landing and taxi lights are mounted in the leading edge of the left wing. A clear plastic cover provides weather protection for the lamps and is shaped to maintain the leading edge curvature of the wing. The landing light lamp is mounted on the inboard side and adjusted to throw its beam further forward than the taxi light. The landing and taxi lights are each controlled by a separate rocker type switch located on the instrument panel.

16-49. REMOVAL AND INSTALLATION. (Refer to figure 16-5).
   a. Remove the 18 screws securing the landing light window assembly (1) and the assembly will then be free for removal.
   b. Remove the four attaching screws (6) from the bracket assembly and remove the bracket.
   c. Remove the two screws securing the wiring to the lamp contacts and remove the lamp.
   d. Install new lamp and reassemble.

   NOTE
   Do not reposition the landing and taxi light adjustment screws (2). If readjustment is required refer to figure 16-5.

   c. Remove the two screws securing the wiring to the lamp contacts and remove the lamp.
   d. Install new lamp and reassemble. For reassembly reverse the above procedure.

16-50. LANDING AND TAXI LIGHT (1971 MODELS AND ON).

16-51. DESCRIPTION. The landing and taxi light is mounted in the forward end of the engine cowling. This position facilitates the use of one lamp as both a landing and taxi light. A light cover provides weather protection for the lamp installation and is shaped to fit the nose cap on the engine cowling. The landing and taxi light is controlled by a rocker type switch located on the instrument panel.

16-52. REMOVAL AND INSTALLATION. Use figure 16-5 as a guide when removing or installation of this lamp.
   a. Remove the 6 screws (1) and washers (2) securing the light cover (3) to the nose cap (8). The assembly will then be free for removal.
   b. Remove the 3 attaching screws (11) from the bracket assembly and remove the bracket.

   NOTE
   Do not reposition the landing and taxi light adjustment screws (4) if readjustment is required refer to figure 16-5.

   c. Remove the two screws securing the wiring to the lamp contacts and remove the lamp.
   d. Install new lamp and reassemble. For reassembly reverse the above procedure.

16-52A. DUAL LANDING AND TAXI LIGHTS. (OPTIONAL BEGINNING WITH 1974 MODELS).

16-52B. DESCRIPTION. The landing and taxi lights are mounted in the lower nose cowl. The left lamp is used for taxi and the right for landing. The lamps are controlled by individual rocker type switches located on the instrument panel.

16-52C. REMOVAL AND INSTALLATION (Refer to figure 16-5).
   a. Remove screws (9) and pull landing and taxi light assembly forward from cowl.
   b. Disconnect lamp leads from lamp.
   c. Remove screws (7) from plate (6), for lamp to be replaced, and remove lamp assembly from bracket assembly (1).
   d. Remove screws (2) and disassemble lamp assembly. Remove lamp.
   e. Install new lamp and reassemble. For reassembly reverse the preceding steps.

   NOTE
   When removing left hand (taxi light) note position of spacer and washers for reinstallation.

16-53. NAVIGATION LIGHTS.

16-54. DESCRIPTION. The navigation lights are located on each wing tip and the top edge of the vertical fin. The lights are controlled by a rocker type switch located on the instrument panel.

16-55. REMOVAL AND INSTALLATION. For removal and installation of navigation lights refer to figure 16-6.

16-56. ANTI-COLLISION STROBE LIGHTS.

16-57. DESCRIPTION. A white strobe light is installed on each wing tip and lights are vibration resistant and operate on the principle of a capacitor
Figure 16-6. Navigation and Anti-Collision Strobe Lights Installation (Sheet 1 of 2)

THRU 1970 ONLY

THRU 1972 MODELS

BEGINNING WITH 1973 MODELS

1. Electrical leads
2. Cap
3. Washer
4. Insulated Washer
5. Spring
6. Insulator
7. Wing Tip
8. Wing Navigation Light
9. Flash Tube Assembly
10. Seal
11. Screw
12. Lens Retainer
13. Bulb
14. Lens
15. Mount
16. Tail Navigation Light
17. Gasket
18. Power Supply
19. Nut
20. Washer
21. Screw
22. Wing Light Wires
23. Light Switch and Grd Wires
24. Wing Tip Rib

Figure 16-6. Navigation and Anti-Collision Strobe Lights Installation (Sheet 2 of 2)
* THRU 1972 MODELS
* BEGINNING WITH 1973 MODELS

BEGINNING WITH AIRCRAFT SERIAL 15074397, A1500386, F15001004 AND FA1500210 the 100 watt lamp is replaced by a 125 watt lamp.

When inserting lamp into socket always use a handkerchief or a tissue to prevent getting fingerprints on the lamp.

NOTE 1972 MODELS
Fingerprints on lamp may shorten the life of the lamp.

NOTE
Dummy load resistor (18) was incorporated on mid 1970 MODELS AND ON.

Detail A
To flashing beacon light switch

Detail B

Detail C

1. Dome
2. Gasket
3. Lamp
4. Clamp Assembly
5. Screw
6. Plate - Mounting
7. Socket Assembly
8. Shield
9. Plate Assy - Mounting
10. Nutplate
11. Tip Assembly - Fin
12. Housing - Plug
13. Housing - Cap
14. Grommet
15. Nutplate
16. Flasher Assembly
17. Nut
18. Dummy Load (1.5 Ohm Resistor)
19. Inspection Plate

Figure 16-7. Flashing Beacon Light Installation

Change 2 16-23
discharge into a xenon tube, producing an extremely high intensity flash. Thru 1972 models energy is supplied to the strobe lights from a power supply mounted just aft of the baggage curtain, on the left side of the aircraft. Beginning with 1973 models an individual power supply is mounted on each wing tip rib.

16-58. REMOVAL AND INSTALLATION. Use figure 16-5 as a guide for removal and installation of the anti-collision strobe light components.

**WARNING**

This anti-collision system is a high voltage device. Do not remove or touch tube assembly while in operation. Wait at least 5 minutes after turning off power before starting work.

16-59. FLASHING BEACON.

16-60. DESCRIPTION. The flashing beacon light is attached to a thermoformed plastic mounting on the vertical fin. The flashing beacon is an iodine-vapor lamp electrically switched by a solid-state flasher assembly. The flasher assembly is located in the aft section of the tailcone. The switching frequency of the flasher assembly operates the beacon at approximately 45 flashes per minute. On late 1970 models and on, a 1.5 ohm, 75 watt resistor is installed to eliminate a pulsing effect on the cabin lighting and ammeter.

16-61. REMOVAL AND INSTALLATION. For removal and installation of the flashing beacon refer to figure 16-7.

16-62. INSTRUMENT AND DOME LIGHTS.

16-63. DESCRIPTION. On 1969 models the instrument and dome lights are mounted in the overhead console and provide non-glare instrument flood lighting and cabin lighting. The instrument flood light consists of a red lens and a single bulb that is controlled by a dimming rheostat mounted on the right side of the overhead console. On 1970 models and on, the instrument and dome light console has been redesigned to provide greater head clearance and is incorporated as an integral part of the Ensolite headliner. The dimming rheostat is located on the switch panel. The dome light consists of a frosted lens and a single bulb controlled by a rocker switch located on the switch panel. On 1971 models the speaker installation has been incorporated into the overhead console.

16-63A. TRANSISTORIZED LIGHT DIMMING (Refer to figure 16-8A).

16-63B. DESCRIPTION. Beginning with 1976 models a remotely located, two-circuit transistorized dimming assembly is installed to control instrument lighting. One circuit controls the compass light, map light and instrument flood light. The other circuit controls the radio lighting. A concentric knob arrangement on the instrument panel controls the system. The center portion of the knob controls the remainder of the system. Refer to figure 16-8A for removal and installation of the dimming assembly.

**SHOP NOTES:**

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16-24 Change 3
<table>
<thead>
<tr>
<th></th>
<th>THRU 1969 MODELS</th>
<th>Detail A</th>
<th>1970 MODELS ONLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nut</td>
<td>6</td>
<td>11. Adjustment Shield</td>
</tr>
<tr>
<td>2</td>
<td>Grommet</td>
<td>7</td>
<td>12. Rheostat</td>
</tr>
<tr>
<td>3</td>
<td>Bracket</td>
<td>8</td>
<td>13. Knob</td>
</tr>
<tr>
<td>4</td>
<td>Screw</td>
<td>9</td>
<td>14. Support</td>
</tr>
<tr>
<td>5</td>
<td>Reflector</td>
<td>10</td>
<td>15. Cover Assembly</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 16-8. Instrument and Dome Light Console Installation (Sheet 1 of 2)
NOTE

*Screw or nut may be installed.

Figure 16-8. Instrument and Dome Light Console Installation (Sheet 2 of 2)
Figure 16-8A. Transistorized Light Dimming Installation

1. Mounting Bracket
2. Mounting Screw
3. Heat Sink
4. Connector

5. Washer
6. Screw
7. Transistor
8. Insulator

Change 3 16-26A/(16-26B blank)
16-64. REMOVAL AND INSTALLATION. For removal and installation of instrument and dome lights refer to figure 16-8.

16-65. COMPASS AND RADIO DIAL LIGHTING.

16-66. DESCRIPTION. The compass and radio dial lights are contained within the individual units. The compass light is controlled by the instrument light dimming rheostat located in the overhead console on the 1969 models. Beginning with 1970 models the instrument light dimming rheostat is located on the instrument panel. The radio dial lights are controlled by the radio dial light rheostat located on the instrument panel.

16-67. CONTROL WHEEL MAP LIGHT.

16-68. DESCRIPTION. An optional control wheel map light may be installed in the aircraft. The map light is mounted on the underside of the control wheel and light intensity is controlled by a thumb operated rheostat. For dimming, the rheostat should be turned clockwise.

CAUTION

Thru 1970 aircraft only, failure to observe polarity shown on wiring diagram in Section 20, will result in immediate failure of the transistor on the map light circuit board assembly.

16-69. REMOVAL AND INSTALLATION (THRU 1970 MODELS). (Refer to figure 16-9).

a. For easy access to the map light assembly, rotate the control wheel 90°.

b. Remove the four screws from the map light circuit board. The map light assembly will then be free for removal from the control wheel.

c. Label the wires connecting to the map light circuit board assembly and remove the screws securing the wires to the circuit board assembly.

d. To install the map light assembly, reverse this procedure.

16-70. REMOVAL AND INSTALLATION (1971 MODELS AND ON). (Refer to figure 16-9).

a. For easy access to the map light assembly, rotate the control wheel 90°.

b. Remove the screws (9), spacers (8) and shield (10) on 1972 Models and on.

c. Remove screws (7), inserts (11) and on 1972 Models and on, shield (10).

d. Label the map light assembly wires at the terminal block, then remove the screws securing the wires to the terminal block.

e. For reassembly, reverse this procedure.

16-71. PITOT HEATER.

16-72. DESCRIPTION. An electrical heater unit may be installed in the pitot tube. The heater offsets the possibility of ice formation on the pitot tube. The heater is integrally mounted in the pitot tube and is operated by a rocker switch on the instrument panel. (Refer to figure 16-10).

16-73. CIGAR LIGHTER.

16-74. DESCRIPTION. The cigar lighter (located on the instrument panel) is equipped with a thermal-actuated circuit breaker which is attached to the rear of the cigar lighter. The circuit breaker will open if the lighter becomes jammed in the socket or held in position too long. The circuit breaker may be reset by inserting a small probe into the .078 diameter hole in the back of the circuit breaker and pushing lightly until a click is heard.

CAUTION

Make sure master switch is "OFF" before inserting probe into circuit breaker on cigar lighter to reset.

SHOP NOTES:
Figure 16-9. Control Wheel Map Light Installation (Sheet 1 of 2)
NOTE

ITEMS 5, 6, and 7 ARE USED ONLY WHEN MAP LIGHT IS NOT INSTALLED.

1. Stationary Panel Assembly
2. Control Wheel Assembly
3. Spacer
4. Map Light Assembly
5. Terminal Block
6. Cover (1972 & ON)
7. Screw
8. Spacer (1972 & ON)
9. Screw (1972 & ON)
10. Shield (1972 & ON)
11. Insert (1972 & ON)
12. Cover (1972 & ON)
13. Clamp
14. Cable Assembly
15. Grommet
16. Nut
17. Fuse
18. Lock Washer
19. Lamp
20. Rheostat

Figure 16-9. Control Wheel Map Light Installation (Sheet 2 of 2)
1. Pitot Tube
2. Heater Element

16-10. Pitot Heater System

SHOP NOTES:
16-76. DESCRIPTION. The ELT is a self-contained, solid state unit, having its own power supply, with an externally mounted antenna. The C589510-0209 transmitter is designed to transmit simultaneously on dual emergency frequencies of 121.5 and 243.0 Megahertz. The C589510-0211 transmitter used for Canadian registry, operates on 121.5 only. The unit is mounted in the tailcone, aft of the baggage curtain on the right hand side. The transmitters are designed to provide a broadcast tone that is audio modulated in a swept manner over the range of 1600 to 300 Hz in a distinct, easily recognizable distress signal for reception by search and rescue personnel and others monitoring the emergency frequencies. Power is supplied to the transmitter by a battery-pack which has the service life of the batteries placarded on the batteries and also on the outside end of the transmitter. ELT's thru early 1974 models, were equipped with a battery-pack containing six magnesium "D" size dry cell batteries wired in series. (See figure 16-15) Mid 1974 thru early 1975, ELT's are equipped with a battery-pack containing four "in-line" lithium "D" size batteries wired in series. Early 1975 and on ELT's are equipped with a battery-pack containing four lithium "D" size batteries which are stacked in two's (See figure 16-16). The ELT exhibits line of sight transmission characteristics which correspond approximately to 100 miles at a search altitude of 10,000 feet. When battery inspection and replacement schedules are adhered to, the transmitter will broadcast an emergency signal at rated power (75 MW-minimum), for a continuous period of time as listed in the following table.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>6 Cell Magnesium Battery Pack</th>
<th>4 Cell Lithium Battery Pack</th>
</tr>
</thead>
<tbody>
<tr>
<td>+130°F</td>
<td>89 hrs</td>
<td>115 hrs</td>
</tr>
<tr>
<td>+ 70°F</td>
<td>95 hrs</td>
<td>115 hrs</td>
</tr>
<tr>
<td>- 4°F</td>
<td>49 hrs</td>
<td>95 hrs</td>
</tr>
<tr>
<td>- 40°F</td>
<td>23 hrs</td>
<td>70 hrs</td>
</tr>
</tbody>
</table>

Battery-packs have a normal shelf life of five to ten years and must be replaced at 1/2 of normal shelf life in accordance with TSO-C91. Cessna specifies 3 years replacement of magnesium (6-cell) battery-packs and 5 years replacement of lithium (4-cell) battery packs.

16-77. OPERATION. A three position switch on the forward end of the unit controls operation. Placing the switch in the ON position will energize the unit to start transmitting emergency signals. In the OFF position, the unit is inoperative. Placing the switch in the ARM position will set the unit to start transmitting emergency signals only after the unit has received a 5g (tolerances are +2g and -0g) impact force, for a duration of 11-16 milliseconds.

16-78. CHECKOUT INTERVAL:

100 HOURS.

a. Turn aircraft master switch ON.

b. Turn aircraft transceiver ON and set frequency on receiver to 121.5 MHz.

c. Remove the ELT's antenna cable from the ELT unit.

d. Place the ELT's function selector switch in the ON position for 5 seconds or less. Immediately replace the ELT function selector switch in the ARM position after testing ELT.

e. Test should be conducted only within the time period made up of the first five minutes after any hour.

TESTS WITH THE DIGITAL THERMOMETER ARE NOT RECOMMENDED.

Tests with the antenna connected should be approved and confirmed by the nearest control tower.

16-79. EMERGENCY LOCATOR TRANSMITTER.

Do not leave the emergency locator transmitter in the ON position longer than 5 seconds or you may activate downed aircraft procedures by C.A.P., D.O.T. or F.A.A. personnel.

WARNING

Magnesium (6-cell) battery-packs (excluding 4 cell lithium battery-packs) after prolonged continuous use (1 hour) in a sealed environment give off explosive gas. If your ELT has operated for this time period or longer, as a precautionary measure, loosen the ELT cover screws, lift the cover to break air tight seal and let stand for 15 minutes before tightening screws. Keep sparks, flames and lighted cigarettes away from battery-pack.

NOTE

After relatively short periods of inactivation, the magnesium (6-cell) battery-pack develops a coating over its anode which drastically reduces self discharge and thereby gives the cell an extremely long storage life. This coating will exhibit a high resistance to the flow of electric current when the battery is first switched on. After a short while (less than 15 seconds), the battery current will completely dissolve this coating and enable the battery to operate normally. If this coating is present when your ELT is activated, there may be a few seconds delay before the transmitter reaches full power.
PLACARD LOCATED ON UPPER R. H. CORNER OF BAGGAGE CURTAIN

1. Tailcone Skin
2. Bracket
3. Transmitter
4. Battery Pack
5. Seal
6. Cover
7. Connector
8. Arm Switch
9. Co-axial Cable
10. Sta-strap
11. Antenna
12. Doubler
13. Rubber Washer
14. Rubber Boot
15. Metal Strap
16. Suppressor

**NOTE**

Metal Strap (15) must be positioned so that latch is on top of transmitter as installed in the aircraft and not across transmitter cover.

17. Placard
18. Fabric Fastener - Hook
19. Fabric Fastener - Pile

Figure 16-11. Emergency Locator Transmitter Installation
NOTE

After accumulated test or operation time equals 1 hour, battery-pack replacement is required.

f. Check calendar date for replacement of battery-pack. This date is supplied on a sticker attached to the outside of the ELT case and to each battery.

16-78. REMOVAL AND INSTALLATION OF TRANSMITTER. (Refer to figure 16-11.)

a. Remove baggage curtain to gain access to the transmitter and antenna.

b. Disconnect co-axial cable from end of transmitter.

c. Depending upon the particular installation, either cut four sta-straps and remove transmitter or cut sta-strap securing antenna cable and unlatch metal strap to remove transmitter.

NOTE

Transmitter is also attached to the mounting bracket by velcro strips; pull transmitter to free from mounting bracket and velcro.

NOTE

To replace velcro strips, clean surface thoroughly with clean cloth saturated in one of the following solvents: Trichloric thylene, Aliphatic Naphthas, Methyl Ethyl Ketone or Enmar 6094 Lacquer Thinner. Cloth should be folded each time the surface is wiped to present a clean area and avoid redepositing of grease. Wipe surface immediately with clean dry cloth, do not allow solvent to dry on surface. Apply Velcro #40 adhesive to each surface in a thin even coat and allow to dry until quite tacky, but no longer transfers to the finger when touched (usually between 5 and 30 minutes). Porous surfaces may require two coats. Place the two surfaces in contact and press firmly together to insure intimate contact. Allow 24 hours for complete cure.

d. To reinstall transmitter, reverse preceding steps.

NOTE

An installation tool is required to properly secure sta-straps on units installed with sta-straps. This tool may be purchased locally or ordered from the Panduit Corporation, Tinley Park, Ill., part number GS-2B (Conforms to MS90397-1).

CAUTION

Ensure that the direction of flight arrows (placarded on the transmitter) are pointing towards the nose of the aircraft.

16-80. REMOVAL AND INSTALLATION OF ANTENNA. (Refer to figure 16-11.)

a. Disconnect co-axial cable from base of antenna.

b. Remove the nut and lockwasher attaching the antenna base to the fuselage and the antenna will be free for removal.

c. To reinstall the antenna, reverse the preceding steps.

NOTE

Upon reinstallation of antenna, cement rubber boot (14) using RTV102, General Electric Co. or equivalent, to antenna whip only; do not apply adhesive to fuselage skin or damage to paint may result.

CAUTION

In-service 6 cell magnesium battery-pack powered ELT's require the installation of a static electricity suppressor in the antenna cable to prevent the possibility of damage to the case of the ELT. Refer to Cessna Avionics Service Letter AV74-16 and figure 16-11.

16-81. REMOVAL AND INSTALLATION OF MAGNESIUM SIX (6) CELL BATTERY-PACK. (Refer to figure 16-12.)

NOTE

Since replacement 6 cell magnesium battery-packs are no longer available, when in-service units require replacement, use the 4 cell lithium battery-pack. Refer to paragraph 16-82.

16-82. REMOVAL AND INSTALLATION OF LITHIUM FOUR (4) CELL BATTERY-PACK. (Refer to figure 16-13.)

NOTE

Transmitters equipped with the 4 cell battery-pack can only be replaced with another 4 cell battery-pack.
a. After the transmitter has been removed from aircraft in accordance with para. 16-79, place the transmitter switch in the OFF position.

b. Remove the nine screws attaching the cover to the case and then remove the cover to gain access to the battery-pack.

NOTE

Retain the rubber "O" ring gasket, rubber washers and screws for reinstallation.

c. Disconnect the battery-pack electrical connector and remove battery-pack.

d. Place new battery-pack in the transmitter with four batteries as shown in the case in figure 16-13.

e. Connect the electrical connector as shown in figure 16-13.

NOTE

Before installing the new 4 cell battery-pack, check to ensure that its voltage is 11.2 volts or greater.

**CAUTION**

If it is desirable to replace adhesive material on the 4 cell battery-pack, use only 3M Jet Melt Adhesive #3738. Do not use other adhesive materials since other materials may corrode the printed circuit board assembly.

f. Replace the transmitter cover by positioning the rubber "O" ring gasket, if installed, on the cover and pressing the cover and case together. Attach cover with nine screws and rubber washers.

g. Remove the old battery-pack placard from the end of transmitter and replace with new battery-pack placard supplied with the new battery-pack.

**CAUTION**

Be sure to enter the new battery-pack expiration date in the aircraft records. It is also recommended this date be placed in your ELT Owner's Manual for quick reference.

**SHOP NOTES:**

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16-83. TROUBLE SHOOTING. Should your Emergency Locating Transmitter fail the 100 Hours performance checks, it is possible to a limited degree to isolate the fault to a particular area of the equipment. In performing the following trouble shooting procedures to test peak effective radiated power, you will be able to determine if battery replacement is necessary or if your unit should be returned to your dealer for repair.
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<th>PROBABLE CAUSE</th>
<th>REMEDY</th>
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| *POWER LOW    | Low battery voltage.         | 1. Set toggle switch to off.  
                                    2. Remove plastic plug from the remote jack and by means of a Switchcraft #750 jackplug, connect a Simpson 260 model voltmeter and measure voltage. If the battery-pack voltage on the 6-cell magnesium battery pack transmitter is 10.8 volts or less, and on the 4-cell lithium battery pack transmitters is 11.2 volts or less, the battery pack is below specification. |
|               |                              | 3. If the battery-pack voltage meets the specifications in step 2, the battery-pack is O.K. If the battery is O.K., check the transmitter as follows:  
                                    a. Remove the voltmeter.  
                                    b. By means of a switchcraft 750 jackplug and 3 inch maximum long leads, connect a Simpson Model 1223 ammeter to the jack.  
                                    c. Set the toggle switch to ON and observe the ammeter current drain. If the current-drain is in the 85-100 ma range, the transmitter or the co-axial cable is faulty. |
|               | Faulty transmitter.          | 4. Check co-axial antenna cable for high resistance joints. If this is found to be the case, the cable should be replaced. |
|               | Faulty co-axial antenna cable. | *This test should be carried out with the co-axial cable provided with your unit. |

**SHOP NOTES:**

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## ELECTRICAL LOAD ANALYSIS CHART
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† Negligible
* Optional on the Standard Model 150
** Optional on the Standard, Trainer and F150
## STRUCTURAL REPAIR

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18-1. STRUCTURAL REPAIR.

18-2. REPAIR CRITERIA. Although this section outlines repair permissible on structure of the aircraft, the decision of whether to repair or replace a major unit of structure will be influenced by such factors as time and labor available, and by a comparison of labor costs with the price of replacement assemblies. Past experience indicates that replacement, in many cases, is less costly than major repair. Certainly, when the aircraft must be restored to its airworthy condition in a limited length of time, replacement is preferable. Restoration of a damaged aircraft to its original design strength, shape, and alignment involves careful evaluation of the damage, followed by exacting workmanship in performing the repairs. This section suggests the extent of structural repair practicable on the aircraft, and supplements Federal Aviation Regulation, Part 43. Consult the factory when in doubt about a repair not specifically mentioned here.

18-3. EQUIPMENT AND TOOLS.

18-4. SUPPORT STANDS. Padded, reinforced saw-horse or tripod type support stands, sturdy enough to support any assembly placed upon them, must be used to store a removed wing or tailcone. Plans for local fabrication of support stands are contained in figure 18-1. The fuselage assembly, from the tailcone to the firewall must NOT be supported from the underside, since the skin bulkheads are not designed for this purpose. Adapt support stands to fasten to the wing-attach points or landing gear attach-points when supporting a fuselage.

18-5. FUSELAGE REPAIR JIGS. Whenever a repair is made which could affect structural alignment, suitable jigs must be used to assure correct alignment of major attach points, such as fuselage, firewall, wing and landing gear. These fuselage repair jigs are obtained from the factory.

18-6. WING JIGS. These jigs serve as a holding fixture during extensive repair of a damaged wing, and locates the root rib, leading edge and tip rib of the wing. These jigs are also obtained from the factory.

18-7. WING, HORIZONTAL STABILIZER ANGLE-OF-INCIDENCE AND WING TWIST.

18-8. The following chart lists wing angle-of-incidence and wing twist and horizontal stabilizer angle-of-incidence. Stabilizers do not have twist. Wings have a constant angle from the wing root to the strut fitting station. All twist in the wing panel is between the strut fitting and the tip rib. The amount of twist between these points is the difference between the angle-of-incidence at the root and the angle-of-incidence at the tip. Refer to figure 18-2 for instructions for checking wing twist.

<table>
<thead>
<tr>
<th>WING</th>
<th>Angle-of-incidence, Root</th>
<th>Angle-of-incidence, Tip</th>
<th>Twist (Washout)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+1°</td>
<td>0°</td>
<td>1°</td>
</tr>
</tbody>
</table>

18-9. REPAIR MATERIALS. Thickness of a material on which a repair is to be made can easily be determined by measuring with a micrometer. In general, material used in Cessna aircraft covered in this manual is made from 2024 aluminum alloy, heat treated to -T3, -T4, or -T42 condition. If the type of material cannot readily be determined, 2024-T3 may be used in making repairs, since the strength of -T3 is greater than -T4 or -T42 (-T4 and -T42 may be used interchangeably, but they may not be substituted for -T3). When necessary to form a part with a smaller bend radius than the standard cold bending radius for 2024-T4, use 2024-0 and heat treat to 2024-T4 after forming. The repair material used in making a repair must equal the gauge of the material being repaired unless otherwise noted. It is often practical to cut repair pieces from service parts listed in the Parts Catalog. A few components (empennage tips, for example) are fabricated from thermo-formed plastic or glass-fiber constructed material.

18-10. WING.

18-11. DESCRIPTION. The wing assemblies are a semicantilever type employing semimonocoque type of structure. Basically, the internal structure consists of built-up front and rear spar assemblies, a formed auxiliary spar assembly and formed sheet metal nose, intermediate, and trailing edge ribs. Stressed skin, riveted to the rib and spar structures, completes the rigid structure. Access openings (hand holes with removable cover plates) are located in the underside of the wing between the wing root and tip section. These openings afford access to aileron bellcranks, flap bellcranks, electrical wiring, strut attach fittings, control cables and pulleys, and control disconnect points.

18-12. WING SKIN.

18-13. NEGLIGIBLE DAMAGE. Any smooth dents in the wing skin that are free from cracks, abrasions and sharp corners, which are not stress wrinkles and do not interfere with any internal structure or mechanism, may be considered as negligible damage. In areas of low stress intensity, cracks, deep scratches, or deep, sharp dents, which after trimming or stop-drilling can be enclosed by a two-inch circle, can be considered negligible if the damaged area is at least one diameter of the enclosing circle away from all existing rivet lines and material edges. Stop drilling is considered a temporary repair and a permanent repair must be made as soon as practicable.

18-14. REPAIRABLE DAMAGE. Figure 18-4 outlines typical repair to be employed in patching skin. Before installing a patch, trim the damaged area to form a rectangular pattern, leaving at least a one-half inch radius at each corner, and de-burr. The sides of the hole should lie span-wise or chord-wise. A circular patch may also be used. If the patch is in an area where flush rivets are used, make a flush patch type of repair; if in an area where slotted rivets...
are not used, make an overlapping type of repair. Where optimum appearance and airflow are desired, the flush patch may be used. Careful workmanship will eliminate gaps at butt-joints; however, an epoxy type filler may be used at such joints.

18-15. DAMAGE NECESSITATING REPLACEMENT OF PARTS. If a skin is badly damaged, repair must be made by replacing an entire skin panel, from one structural member to the next. Repair seams must be made to lie along existing structural members and each seam must be made exactly the same in regard to rivet size, spacing, and pattern as the manufactured seams at the edges of the original sheet. If the manufactured seams are different, the stronger must be copied. If the repair ends at a structural member where no seam is used, enough repair panel must be used to allow an extra row of staggered rivets, with sufficient edge margin, to be installed.

18-16. WING STRINGERS.

18-17. NEGLIGIBLE DAMAGE. Refer to paragraph 18-13.

18-18. REPAIRABLE DAMAGE. Figure 18-5 outlines a typical wing stringer repair. Two such repairs may be used to splice a new section of stringer material in position, without the filler material.

18-19. DAMAGE NECESSITATING REPLACEMENT OF PARTS. If a stringer is so badly damaged that more than one section must be spliced, replacement is recommended.

18-20. WING AUXILIARY SPARS.

18-21. NEGLIGIBLE DAMAGE. Refer to paragraph 18-13.

18-22. REPAIRABLE DAMAGE. Figure 18-6 illustrates a typical auxiliary spar repair.

18-23. DAMAGE NECESSITATING REPLACEMENT OF PARTS. If damage to an auxiliary spar would require a repair which could not be made between adjacent ribs, the auxiliary spar must be replaced.

18-24. WING RIBS.

18-25. NEGLIGIBLE DAMAGE. Refer to paragraph 18-13.

18-26. REPAIRABLE DAMAGE. Figure 18-6 illustrates a typical wing rib repair.

18-27. DAMAGE NECESSITATING REPLACEMENT OF PARTS. Leading and trailing edge ribs that are extensively damaged can be replaced. However, due to the necessity of unfastening an excessive amount of skin in order to replace the rib, they should be repaired if practicable. Center ribs, between the front and rear spar should always be repaired if practicable.

18-28. WING SPARS.

18-29. NEGLIGIBLE DAMAGE. Due to the stress which wing spars encounter, very little damage can be considered negligible. All cracks, stress wrinkles, deep scratches, and sharp dents must be repaired. Smooth dents, light scratches and abrasions may be considered negligible.

18-30. REPAIRABLE DAMAGE. Figure 18-7 illustrates typical spar repairs. It is often practical to cut repair pieces from service parts listed in the Parts Catalog. Service Kits are available for certain types of spar repairs.

18-31. DAMAGE NECESSITATING REPLACEMENT OF PARTS. Damage so extensive that repair is not practicable requires replacement of a complete wing spar. Also refer to paragraph 18-2.

18-32. AILERONS.

18-33. NEGLIGIBLE DAMAGE. Refer to paragraph 18-13.

18-34. REPAIRABLE DAMAGE. Figure 18-3A may be used as a guide to repair damage to aileron skins. It is recommended that all material used for the repair be cut from spare parts of the same gauge and corrugation spacing. Repair should extend from the leading edge to the trailing edge. Following the repair, the aileron must be balanced. Refer to paragraph 18-36 and figure 18-3A for balancing. If damage would require a repair which could not be made between adjacent ribs, refer to paragraph 18-35.

18-35. DAMAGE NECESSITATING REPLACEMENT OF PARTS. If the damage would require a repair which could not be made between adjacent ribs, complete skin panels must be replaced. Ribs and spars may be repaired, but replacement is generally preferable. Where extensive damage has occurred, replacement of the aileron assembly is recommended. After repair and/or replacement, balance aileron in accordance with paragraph 18-36 and figure 18-3.

18-36. AILERON BALANCING. Following repair, replacement or painting, the aileron must be balanced. Complete instructions for fabricating balancing fixtures and mandrels and their use are given in figure 18-3.

18-37. WING FLAPS.

18-38. NEGLIGIBLE DAMAGE. Refer to paragraph 18-13.

18-39. REPAIRABLE DAMAGE. Flap repairs should be similar to aileron repairs discussed in paragraph 18-34. A flap leading edge repair is shown in figure 18-10.

18-40. DAMAGE NECESSITATING REPLACEMENT OF PARTS. Flap repairs which require replacement of parts should be similar to aileron repairs discussed in paragraph 18-35. Since the flap is not considered a moveable control surface, no balancing is required.
18-33A. CRACKS IN CORRUGATED AILERON SKINS (Continued from page 18-3.)

1. It is permissible to stop drill crack(s) that originate at the trailing edge of the control surface provided the crack is not more than 2 inches in length.

2. Stop drill crack using a #30 (.128 inch) drill.

3. A crack may only be stop drilled once.

   NOTE: A crack that passes through a trailing edge rivet and does not extend to the trailing edge of the skin may be stop drilled at both ends of the crack.

4. Any control surface that has a crack that progresses past a stop drilled hole shall be repaired. Refer to paragraphs 18-33, -34, and -35 as applicable for repair information.

5. A control surface that has any of the following conditions shall have a repair made as soon as practicable:
   A. A crack that is longer than 2 inches.
   B. A crack that does not originate from the trailing edge or a trailing edge rivet.
   C. Cracks in more than six trailing edge rivet locations per skin.

   Refer to paragraphs 18-33, -34, and -35 as applicable for repair information.

6. Affected control surfaces with corrugated skins and having a stop drilled crack that does not extend past the stop drilled hole, may remain in service without additional repair.

18-38A. CRACKS IN CORRUGATED FLAP SKINS (Continued from page 18-3.)

1. It is permissible to stop drill crack(s) that originate at the trailing edge of the control surface provided the crack is not more than 2 inches in length.

2. Stop drill crack using a #30 (.128 inch) drill.

3. A crack may only be stop drilled once.

   NOTE: A crack that passes through a trailing edge rivet and does not extend to the trailing edge of the skin may be stop drilled at both ends of the crack.

4. Any control surface that has a crack that progresses past a stop drilled hole shall be repaired. Refer to paragraphs 18-38, -39, and -40 as applicable for repair information.

5. A control surface that has any of the following conditions shall have a repair made as soon as practicable:
   A. A crack that is longer than 2 inches.
   B. A crack that does not originate from the trailing edge or a trailing edge rivet.
   C. Cracks in more than six trailing edge rivet locations per skin.

   Refer to paragraphs 18-38, -39, and -40 as applicable for repair information.

6. Affected control surfaces with corrugated skins and having a stop drilled crack that does not extend past the stop drilled hole, may remain in service without additional repair.

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7 January 2000
18-41. WING LEADING EDGE.

18-42. NEGLIGIBLE DAMAGE. Refer to paragraph 18-13.

18-43. REPAIRABLE DAMAGE. A typical leading edge skin repair is shown in figure 18-9. An epoxy-type filler may be used to fill gaps at butt-joints. To facilitate repair, extra access holes may be installed in the locations noted in figure 18-11. If the damage would require a repair which could not be made between adjacent ribs, refer to the following paragraph.

18-44. DAMAGE NECESSITATING REPLACEMENT OF PARTS. For extensive damage, complete leading edge skin panels must be replaced. To facilitate replacement, extra access holes may be installed in the locations noted in figure 18-11.

18-45. ELEVATORS AND RUDDER.

18-46. NEGLIGIBLE DAMAGE. Refer to paragraph 18-13. The exception to negligible damage on the elevator surfaces is the front spar, where a crack appearing in the web at the hinge fittings or in the structure which supports the overhanging balance weight is not considered negligible. Cracks in the overhanging tip rib, in the area at the front spar intersection with the web of the rib, also cannot be considered negligible.

18-47. REPAIRABLE DAMAGE. Skin patches illustrated in figure 18-4 may be used to repair skin damage. Following repair, the elevators and rudder must be balanced. Refer to paragraph 18-49 and figure 18-3 for balancing the elevators and rudder. If damage would require a repair which could not be made between adjacent ribs, see the following paragraph.

18-48. DAMAGE NECESSITATING REPLACEMENT OF PARTS. If the damaged area would require a repair which could not be made between adjacent ribs, complete skin panels must be replaced. Ribs and spars may be repaired, but replacement is generally preferable. Where extensive damage has occurred, replacement of the entire assembly is recommended. After repair and/or replacement, balance elevators and rudder in accordance with paragraph 18-49 and figure 18-3.

18-49. ELEVATOR AND RUDDER BALANCING. Following repair, replacement or painting, the elevators and rudder must be balanced. Complete instructions for fabricating balancing fixtures and mandrels and their use are given in figure 18-3.

18-50. FIN AND STABILIZER.

18-51. NEGLIGIBLE DAMAGE. Refer to paragraph 18-13.

18-52. REPAIRABLE DAMAGE. Skin patches illustrated in figure 18-4 may be used to repair skin damage. Access to the dorsal area of the fin may be gained by removing the horizontal closing rib at the bottom of the fin. Access to the internal fin structure is best gained by removing skin attaching rivets on one side of the rear spar and ribs, and springing back the skin. Access to the stabilizer structure may be gained by removing skin attaching rivets on one side of the rear spar and ribs, and springing back the skin. If the damaged area would require a repair which could not be made between adjacent ribs, or a repair would be located in an area with compound curves, see the following paragraph.

18-53. DAMAGE NECESSITATING REPLACEMENT OF PARTS. If the damaged area would require a repair which could not be made between adjacent ribs, or the repair would be located in an area with compound curves, complete skin panels must be replaced. Ribs and spars may be repaired, but replacement is generally preferable. Where damage is extensive, replacement of the entire assembly is recommended.

18-54. FUSELAGE.

18-55. DESCRIPTION. The fuselage is of semi-monocoque construction, consisting of formed bulkheads, longitudinal stringers, reinforcing channels, and skin panels.

18-56. NEGLIGIBLE DAMAGE. Refer to paragraph 18-13. Mild corrosion appearing upon alclad surfaces does not necessarily indicate incipient failure of the base metal. However, corrosion of all types must be carefully considered, and approved remedial action taken. Small cans appear in the skin structure of all metal aircraft. It is strongly recommended however, that wrinkles which appear to have originated from other sources, or which do not follow the general appearance of the remainder of the skin panels, be thoroughly investigated. Except in the landing gear bulkhead areas, wrinkles occurring over stringers which disappear when the rivet pattern is removed, may be considered negligible. However, the stringer rivet holes may not align perfectly with the skin holes because of a permanent "set" in the stringer. If this is apparent, replacement of the stringer will usually restore the original strength characteristics of the area.

NOTE

Wrinkles occurring in the skin of the main landing gear bulkhead areas must not be considered negligible. The skin panel must be opened sufficiently to permit a thorough examination of the lower portion of the landing gear bulkhead and its tie-in structure.

Wrinkles occurring in open areas which disappear when the rivets at the edge of the sheet are removed, or a wrinkle which is hand removable, may often be repaired by the addition of a 1/2 x 1/2 x .060 inch 2024-T4 extruded angle, riveted over the wrinkle and extended to within 1/16 to 1/8 inch of the nearest structural members. Rivet pattern should be identical to existing manufactured seam at edge of sheet. Negligible damage to stringers, formed skin flanges, bulkhead channels, and like parts is similar to that for the wing skin, given in paragraph 18-13.
18-57. REPAIRABLE DAMAGE. Fuselage skin repairs may be accomplished in the same manner as wing skin repairs outlined in paragraph 18-14. Stringers, formed skin flanges, bulkhead channels and similar parts may be repaired as shown in figure 18-5.

18-58. DAMAGE NECESSITATING REPLACEMENT OF PARTS. Fuselage skin major repairs may be accomplished in the same manner as the wing repairs outlined in paragraph 18-15. Damaged fittings must be replaced. Seat rails serve as structural parts of the fuselage and must be replaced if damaged.

18-59. BULKHEADS.

18-60. LANDING GEAR BULKHEADS. Since these bulkheads are highly stressed members, irregularly formed to provide clearance for control cables, fuel lines, etc., the patch-type repairs will be, for the most part, impractical. Minor damage, consisting of small nicks or scratches, may be repaired by dressing out the damaged area, or by replacement of rivets. Any other such damage must be repaired by replacing the landing gear support assembly as an aligned unit.

18-61. REPAIR AFTER HARD LANDING. Buckled skin or floorboards, and loose or sheared rivets in the area of the main gear support will give evidence of damage to the structure from an extremely hard landing. When such evidence is present, the entire support structure must be examined, and all support forgings must be checked for cracks, using a dye penetrant and proper magnification. Bulkheads in the damaged area must be checked for alignment, and deformation of the bulkhead webs must be determined with the aid of a straightedge. Damaged support structure, buckled floorboards and skins, and damaged or questionable forgings must be replaced.

18-62. REPLACEMENT OF HI-SHEAR RIVETS. Hi-shear rivet replacement with close tolerance bolts or other commercial fasteners of equivalent strength properties is permissible. Holes must not be elongated, and the Hi-shear substitute must be a smooth push fit. Forgings may be spot-faced the least amount necessary for proper seating of fasteners.

18-63. FIREWALL DAMAGE. Firewalls may be repaired by removing the damaged material and splicing in a new section. The new portion must be lapped over the old material, sealed with Pro-Seal #700 (Coast Pro-Seal Co., Chemical Division, 2235 Beverly Blvd, Los Angeles, California) compound or equivalent, and secured with stainless steel rivets. Damaged or deformed angles and stiffeners may be repaired as shown in figure 18-12, or they may be replaced. A severely damaged firewall must be replaced as a unit.

18-64. ENGINE MOUNT.

18-65. DESCRIPTION. The mount for the aircraft engine is constructed of 4130 chrome-molybdenum steel tubing. A truss structure, fastened to the fire-wall at four points, supports a cradle arrangement. This cradle arrangement with its supporting lugs, forms the base for rubber shock mounted engine supports.

18-66. GENERAL CONSIDERATIONS. All welding on the engine mount must be of the highest quality since the tendency of vibration is to accentuate any minor defect present and cause fatigue cracks. Engine mount members are preferably repaired by using a larger diameter replacement tube, telescoped over the stub of the original member using fishmouth and rosette type welds. However, reinforced 30-degree scarf welds in place of the fishmouth welds are considered satisfactory for engine mount repair work.

18-67. ENGINE MOUNT SUPPORT CRADLE DAMAGE. Minor damage such as a crack adjacent to an engine attaching lug may be repaired by rewelding the cradle tube and extending a gusset past the damaged area. Extensively damaged parts must be replaced.

18-68. DAMAGE INVOLVING ENGINE MOUNTING LUGS AND ENGINE MOUNT TO FUSELAGE ATTACHING FITTINGS. Engine mounting lugs and engine mount-to-fuseelage attaching fittings should not be repaired but must be replaced.

18-69. BAFFLES. Baffles ordinarily require replacement if damaged or cracked. However, small plate reinforcements riveted to the baffle will often prove satisfactory both to the strength and cooling requirements of the unit.

18-70. ENGINE COWLING.

18-71. REPAIR OF COWLING SKINS. If extensively damaged, complete sections of cowling must be replaced. Standard insert-type skin patches, however, may be used if repair parts are formed to fit. Small cracks may be stop-drilled and dents straightened if they are reinforced on the inner side with a doubler of the same material.

18-72. REPAIR OF REINFORCEMENT ANGLES. Cowl reinforcement angles, if damaged, must be replaced. Due to their small size they are easier to replace than to repair.

18-73. REPAIR OF THERMO-FORMED PLASTIC COMPONENTS. Repair of punctures or holes in the thermo-formed plastics is performed by trimming out the damaged area, removing any paint, and installing an overlapping, beveled, or flush patch of identical material. Doublers may be installed behind the patch where additional strength is desired. MEK, or any commercially available solvent that will soften and dissolve the plastic, may be used as the bonding agent. Dissolving some of the plastic shavings in the solvent will furnish additional working time. Moderate pressure is recommended for best results. Curing time will vary with the agent used, but repairs should not be strained until fully cured. Cracks can be repaired by saturating the crack itself with the solvent, then filling with an
epoxy filler or a paste made of the plastic shavings and the solvent. Again, the crack may be reinforced with a doubler on the back side for additional strength. After the repair has been made, the area may be sanded smooth and painted. Parts that are extensively damaged require replacement instead of repair.

18-74. REPAIR OF GLASS-FIBER CONSTRUCTED COMPONENTS. Glass-fiber constructed components on the aircraft may be repaired as stipulated in instructions furnished in Service Kit SK182-12. Observe the resin manufacturer's recommendations concerning mixing and application of the resin. Epoxy resins are preferable for making repairs, since epoxy compounds are usually more stable and predictable than polyester and, in addition, give better adhesion.
MEASURING WING TWIST

If damage has occurred to a wing, it is advisable to check the twist. The following method can be used with a minimum of equipment, which includes a straightedge (32'' minimum length of angle, or equivalent), three modified bolts for a specific wing, and a protractor head with level.

1. Check chart for applicable dimension for bolt length (A or B).
2. Grind bolt shanks to a rounded point as illustrated, checking length periodically.
3. Tape two bolts to straightedge according to dimension C.
4. Locate inboard wing station to be checked and make a pencil mark approximately one-half inch aft of the lateral row of rivets in the wing leading edge spar flange.
5. Holding straightedge parallel to wing station (staying as clear as possible from "cans"), place longer bolt on pencil mark and set protractor head against lower edge of straightedge.
6. Set bubble in level to center and lock protractor to hold this reading.
7. Omitting step 6, repeat procedure for each wing station, using dimensions specified in chart. Check to see that protractor bubble is still centered.
8. Proper twist is present in wing if protractor readings are the same (parallel). Forward or aft bolt may be lowered from wing .10 inch maximum to attain parallelism.

Figure 18-2. Measuring Wing Twist
BALANCING PROCEDURES

1. Balance control surfaces in an enclosed draft free area.

2. Control surface to be balanced must be in the final flight configuration, painted (if applicable) trim tabs installed, and all foreign matter removed from inside control surface.

3. If control surface is to be painted remove all existing paint prior to repainting and rebalancing. Good workmanship and standard repair practices should not result in excessive additional balance weight.

4. Place balancing mandrels (detail B) on a table or other suitable FLAT, LEVELED surface. Mandrels must be placed at $90^\circ$ to the hinge line of the control surface.

5. On control surfaces with the piano type hinges, insert inboard and outboard hinges into slotted ends of the balancing mandrels, making sure that balancing mandrels are $90^\circ$ to the hinge line. On control surfaces with the bearing type hinge point, bolts or pins are inserted through the attaching brackets, then placed on the knife edges of the mandrels as illustrated in (detail H).

6. AILERONS.
   a. (1) Block up the trailing edge of the aileron until a spirit-level protractor placed on the front face of the aileron spar at W.S. 138.00 (± 6.00), (detail E), indicates $57^\circ 10'$, (detail D).

   (2) ALTERNATE METHOD:
   Measure the vertical distance from the aileron hinge point to the leveled surface. Subtract 1.80 inches, then block up trailing edge of the aileron to this measurement.

   b. With the aileron blocked in position place the balancing beam (detail A) at W. S. 138.00, ($90^\circ$ to the hinge line), and adjust the trailing edge support on the balancing beam (detail D) until the beam is level. If the aileron has not been disturbed during this operation, the beam is now parallel to the aileron chord line at W.S. 138.00 (detail D).

   NOTE
   The above procedure must be performed with care. Small angular discrepancies will produce large balancing errors.

   c. Remove balancing beam and balance the beam by itself at the knife edges by adding washers as shown, (detail C).

   d. Place the balancing beam on the aileron in its original position, then remove the blocks from beneath the trailing edge.

   e. Place the sliding weight (detail D) on the forward end of the balancing beam, moving it along the beam until the beam is again level. A small, lightweight, spirit level may be used for this purpose provided it is symmetrical about its bubble reference and this reference is placed on the beam directly over the aileron hinge line (detail D).

   f. If aileron is correctly balanced, the position of the sliding weight with respect to the aileron hinge line, will produce a moment about the hinge line somewhere within the underbalance tolerance listed in the chart on (Sheet 5 of 5).

   g. If modification of the aileron balance weight is necessary to correct an out-of-tolerance condition, the balance weight can be lightened by drilling out part of the weight on the inboard end. The weight can be increased by a reasonable amount by ordering additional weight and gang channel listed in the applicable Parts Catalog, and installing next to the existing weight the minimum amount necessary for correct balance. The minimum amount that must be installed, however, must contain at least two attaching rivets. If this minimum amount results in an over-balanced condition, the new weight and/or old weights can be lightened.
7. RUDDER AND ELEVATORS.
   a. With the rudder/elevator set upon a FLAT, LEVELED surface, block up the trailing edge until
      a center line through the attaching bolt and the trailing edge is equal distance from the leveling
      surface (detail H).

   b. Place the balancing beam (detail A) on the rudder/elevator near the center attaching bracket,
      (90° to the hinge line). Adjust the trailing edge support on the balancing beam (detail H) until
      the beam is level. If the rudder/elevator has not been disturbed during this operation, the
      beam is now parallel to the chord line of the rudder/elevator.

   NOTE

   The above procedure must be performed with care. Small angular
discrepancies will produce large balancing errors.

c. Mark position of the balancing beam, then remove and balance the beam by itself at the knife
   edges by adding washers as shown in (detail C).

d. Place the balancing beam on the rudder/elevator in its original position, then remove the
   block from beneath the trailing edge.

e. Place the sliding weight (detail H) on the forward end of the balancing beam, move it along
   the beam until the beam is again level. A small, lightweight, spirit level may be used for
   this purpose provided it is symmetrical about its bubble reference and this reference is
   placed on the beam directly over the rudder/elevator hinge line (detail H).

   f. If the rudder/elevator is correctly balanced, the position of the sliding weight with respect to
      the rudder/elevator hinge line, will produce a moment about the hinge line somewhere within
      the underbalance tolerance listed in the chart on (Sheet 5 of 5).

g. If modification of the rudder/elevator balance weight is necessary to correct an out-of-balance
   condition, the balance weight can be lightened by drilling out part of the weight. The weight
   can be increased by fusing bar stock solder to the weight after removal from rudder/elevator.

BALANCING BEAM

Four-foot length of extruded channel
Mark graduations in inches.
Grind weight to slide along beam, grind
ends to obtain exactly one pound, and
mark center of weight.

Fabricate vertically adjustable
trailing edge support that will
slide along beam.

Attach knife edges and
mark at mid-point.

Detail A

Figure 18-3. Control Surface Balancing (Sheet 2 of 5)
**Figure 18-3. Control Surface Balancing (Sheet 3 of 5)**

1/16" SLOT: 3/4" DEEP
(To fit aileron hinge)

KNIFE EDGE - 1"

After locating trailing edge support, balance by adding washers and/or nuts.

**Detail C**

18" 4"
6-1/2"

BALANCING MANDREL

SPIRIT-LEVEL PROTRACTOR

SLIDING WEIGHT

KNIFE EDGES

TRAILING EDGE SUPPORT

Hinge Point

LEVELED SURFACE

57° 10'

AILERON

CHORD LINE AT AILERON MIDSANP (W.S. 138.00)

* "d" - 1.80 INCHES

**Detail D**

ALTERNATE METHOD
Before making trailing edge measurement make sure that the trailing edge of the aileron is straight in this area.

AILERON

53.5 INCHES

WING STATION 84.5

WING STATION 138.00

**Detail E**

PIANO HINGE

BALANCING MANDREL

53.5 INCHES
A balance in this range is "underbalance".

A balance in this range is "overbalance".

Figure 18-3. Control Surface Balancing (Sheet 4 of 5)
CONTROL SURFACE BALANCE REQUIREMENTS

NOTE

Unpainted values are not limits which must be met. They are given as guides, in order that the unbalance of the control surface in the final aircraft configuration may be predicted. If the control surface in the unpainted condition falls within the unpainted limit, the mechanic may feel confident that the control surface will be acceptable after painting. However, if the surface in the unpainted condition exceeds the unpainted limit, the balance must be checked again after final painting to assure that the control surface falls within the painted unbalance limit. Refer to GENERAL NOTES on sheet 3 for specific conditions.

DEFINITIONS:

UNDERBALANCE is defined as the condition that exists when the control surface is trailing edge heavy, and is symbolized by a plus (+).

OVERBALANCE is defined as the condition that exists when the control surface is leading edge heavy, and is symbolized by a minus (-).

CONTROL: AILERON

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CONTROL: RUDDER

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CONTROL: RIGHT ELEVATOR

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Figure 18-3. Control Surface Balancing (Sheet 5 of 5)
Figure 18-3A. Corrugated Skin Repair

- Use existing rivet pattern and rivet size.
- Cut out damaged area.
- Patch may overlap or be inserted under existing aileron skin.

**Legend:**
- Original part
- Repair patch in cross section
PATCHES AND DOUBLERS — 2024-T3 ALCALD

3.00 DIA. HOLE

PATCH REPAIR FOR 3 INCH DIAMETER HOLE

MS20470AD4 RIVETS 16 REQD

2.00 DIA. HOLE

PATCH REPAIR FOR 2 INCH DIAMETER HOLE

MS20470AD4 RIVETS 8 REQD

1.00 DIA. HOLE

PATCH REPAIR FOR 1 INCH DIAMETER HOLE

Figure 18-4. Skin Repair (Sheet 1 of 6)
SECTION THRU ASSEMBLED PATCH

**A-A**

**OVERLAPPING RECTANGULAR PATCH**

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<tr>
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<th>REPAIR PARTS</th>
<th>REPAIR PARTS IN CROSS SECTION</th>
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**RIVET TABLE**

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Figure 18-4. Skin Repair (Sheet 2 of 6)
For optimum appearance and airflow, use flush rivets, dimpled skin and patch, and countersunk doubler.

**NOTE**

**SECTION THRU ASSEMBLED PATCH**

**A-A**

- **EDGE MARGIN = 2 X RIVET DIA.**
- **PATCH = 2024-T3 ALCLAD**

**DOUBLER = 2024-T3 ALCLAD**

**FLUSH RECTANGULAR PATCH**

- **CIRCULAR FLUSH PATCH IS SIMILAR**

**RIVET TABLE**

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Figure 18-4. Skin Repair (Sheet 3 of 6)
DOUBLER Countersink doublers, and dimple skin and patch.

**SKIN PATCH**

- **A-A**
  - 2024-T4 ALCLAD

- **EXISTING SKIN**
  - CARRY EXISTING RIVET PATTERN THRU PATCH

- **EDGE DISTANCE** 2D MIN.

- **.50 R. MIN. TYPICAL**

### RIVET TABLE

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<td>.051</td>
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- **PATCH** 2024-T3 ALCLAD

- **FLUSH PATCH AT STRINGER/BULKHEAD INTERSECTION**

**NOTE**

- Repair Parts
- Repair Parts in Cross Section

**NOTE**

This procedure is not recommended in areas where stringers are riveted to bulkheads.

*Figure 18-4. Skin Repair (Sheet 4 of 6)*
Figure 18-4. Skin Repair (Sheet 5 of 6)
FUSELAGE SKIN
CLean Out DAMAGED AREA

PICK UP EXISTING SKIN RIVET PATTERN

10 RIVETS EACH SIDE OF DAMAGED AREA

FILLER — 2024-T4 ALCLAD

1/4" EDGE MARGIN

DOUBLER — 2024-T4 ALCLAD

MS20470AD4 RIVETS

Figure 18-4. Skin Repair (Sheet 6 of 6)
DOUBLER — 2024-T4 ALCLAD

1/4" EDGE MARGIN

RIVET SPACING TO MATCH PATTERN IN SKIN

6 RIVETS EACH SIDE OF DAMAGED AREA

CLEAN OUT DAMAGED AREA

FILLER — 2024-T4 ALCLAD

STRINGER

A-A

MS20470AD4 RIVETS

SKIN

Figure 18-5. Stringer and Channel Repair (Sheet 1 of 4)
Figure 18-5. Stringer and Channel Repair (Sheet 3 of 4)
Figure 18-5. Stringer and Channel Repair (Sheet 4 of 4)
Figure 18-6. Rib Repair (Sheet 2 of 2)
CLEAN OUT DAMAGED AREA

3/8" RADIUS

3/8" EDGE MARGIN (TYPICAL)

MS20470AD4 RIVETS

Figure 18-7. Wing Spar Repair (Sheet 1 of 3)
NOTE

This repair applies to either front or rear spar if the spar is a single channel.

FILLER — 2024-T4 ALCLAD

CLEAN OUT DAMAGED AREA

1/4" EDGE MARGIN (TYP.)

DOUBLER — 2024-T3 ALCLAD

3 ROWS RIVETS EACH SIDE OF DAMAGED AREA

ANGLE
2024-T4 ALCLAD
7/8 x 7/8 x .064

1/4" MINIMUM EDGE MARGIN

1/4" EDGE MARGIN (TYP.)

3/4" RIVET SPACING
(TYPICAL ALL PARTS)

DOUBLER — 2024-T4 ALCLAD

MS20470AD4 RIVETS

ORIGINAL PARTS

REPAIR PARTS

REPAIR PARTS IN CROSS SECTION

WING SPAR

WING SKIN

Figure 18-7. Wing Spar Repair (Sheet 2 of 3)
3/4" RIVET SPACING

1/4" EDGE MARGIN

FILLER — 2024-T4 ALCALD

CLEAN OUT DAMAGED AREA

ANGLE — 2024-T4 ALCALD

MS20470AD4 RIVETS

ORIGINAL PARTS
REPAIR PARTS
REPAIR PARTS IN CROSS SECTION

Figure 18-7. Wing Spar Repair (Sheet 3 of 3)
DOUBLER — 2024-T4 ALCLAD

CLEAN OUT DAMAGED AREA

SPACING

A-A

REPAIR — PARS 20 RIVETS EACH SIDE OF DAMAGED AREA

FILLER — 2024-T4 ALCLAD

Spar

WING SKIN

18-29

MS20470AD4 RIVETS

1/4" EDGE MARGIN

3/4" RIVET SPACING

20 RIVETS EACH SIDE OF DAMAGED AREA

Figure 18-8. Auxiliary Spar Repair

ORIGINAL PARTS

REPAIR PARTS

REPAIR PARTS IN CROSS SECTION
NOTES:

1. Dimple leading edge skin and filler material; countersink the doubler.

2. Use MS20426AD4 rivets to install doubler.

3. Use MS20426AD4 rivets to install filler, except where bucking is impossible. Use CR162-4 Cherry (blind) rivets where regular rivets cannot be bucked.

4. Contour must be maintained; after repair has been completed, use epoxy filler as necessary and sand smooth before painting.

5. Vertical size is limited by ability to install doubler clear of front spar.

6. Lateral size is limited to seven inches across trimmed out area.

7. Number of repairs is limited to one in each bay.

Figure 18-9. Leading Edge Repair
1" MAXIMUM RIVET SPACING

1/4" MINIMUM EDGE MARGIN

TRIM OUT DAMAGED AREA

FLAP LEADING EDGE SKIN

REPAIR DOUBLER TO BUTT AGAINST CORRUGATED SKIN AT TOP AND BOTTOM OF FLAP

1/4" MINIMUM EDGE MARGIN

DOUBLER — 2024-T3
ALCLAD. 020

FLUSH PATCH SIMILAR TO THIS MAY BE USED IF NEEDED.

1/8" DIA. RIVETS

Figure 18-10. Flap Leading Edge Repair
PRECAUTIONS

1. Add the minimum number of access holes necessary.
2. Any circular or rectangular access hole which is used with approved optional equipment installa-
tions may be added in lieu of the access hole illustrated.
3. Use landing light installations instead of access holes (thru 1970 Models) where possible. Do not
add access holes at outboard end of wing; remove wing tip instead.
4. Do not add an access hole in the same bay where one is already located.
5. Locate new access holes near the center of a bay (spanwise).
6. Locate new access holes forward of the front spars as close to the front spar as practicable.
7. Locate new access holes aft of the front spar between the first and second stringers aft of the
spars. When installing the doubler, rotate it so the two straight edges are closest to the stringers.
8. Alternate bays, with new access holes staggered forward and aft of the front spar, are pre-
ferred.
9. A maximum of five new access holes in each wing is permissible; if more are required, contact
the Cessna Service Department.
10. When a complete leading edge skin is being replaced, the wing should be supported in such a
manner so that wing alignment is maintained.

a. Establish exact location for inspection cover and inscribe centerlines.
b. Determine position of doubler on wing skin and center over centerlines. Mark the ten rivet
hole locations and drill to size shown.
c. Cutout access hole, using dimension shown.
d. Flex doubler and insert through access hole, and rivet in place.
e. Position cover and secure, using screws as shown.

Figure 18-11. Access Hole Installation
Figure 18-12. Firewall Angle Repair
NOTE

This Section contains standard factory materials listing and area of application. For paint number and color, refer to Aircraft Trim Plate and Parts Catalog. In all cases determine the type of paint on the aircraft as some types of paint are not compatible. Materials may be obtained from the Cessna Service Parts Center.

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<th>FRENCH TRAINER</th>
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Refer to page 2 for notes.
NOTES

1. Used on exterior airframe and main gear fairings, also nose gear fairing beginning with 1970 Models.
3. Used to paint inside door facing beginning with aircraft 15074710, A1500421, F15001014 and FA1500212.
4. Used with acrylic lacquer or lacquer on aluminum surfaces.
5. Used with epoxy paint.
6. Used to thin lacquer paint and for burndown.
7. Used to thin acrylic paint and for burndown.
8. Used with epoxy (Du Pont).
9. Used with epoxy (Emar).
10. Used to clean aircraft exterior prior to priming.

NOTE

Do not paint Pitot Tube, Gas Caps or Antenna covers which were not painted at the factory.

CAUTION

When stripping paint from the aircraft, avoid stripper coming in contact with ABS parts. These areas should be cleaned with soap and water and/or Naphtha. Do not use strong solvents such as Xylol, Toluol, or Lacquer Thinners. Once clean, exterior ABS parts are ready for the acrylic lacquer topcoat. Do Not wash prime ABS parts.
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<tr>
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### LIGHTING

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NOTES:

1. TERMINAL 42281-2 (00719) ON CONDUCTOR TERMINAL 2-52931-2 (00719) ON SHIELD & WIRE.

2. WIRE MATERIAL PER 5-1534-8-9.

3. OBSERVE POLARITY SYMBOL ON DIODE, WHEN INSTALLING ON SW TERM OR DIODE WILL FAIL WHEN SYSTEM IS ENERGIZED.

4. "D" PREFIX IS USE BECAUSE THESE WIRES ARE ALSO IN OT70750.

WIRE TABLE:

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EQUIPMENT TABLE:

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</table>

EDAR 00938 (SR5437)
NOTES:
1. THIS Dwg IS FOR REF INFO ONLY. FOR Wiring, WIRE & TERMINAL REQUIREMENTS SEE APPROPRIATE PAGES OF ORIGIqAL.
NOTE:

WIRING DIAGRAM SHOWN IS FOR USE WHEN AN OPTICAL ELECTRIC CLOCK IS INSTALLED. WHEN ELECTRIC CLOCK IS NOT INSTALLED, WIRE A/DMP DP2 CONNECTS PRESSURE SWITCH TO FUSEHOLDER. INSTALL 5-1091-1 FUSE AND 5-1690-22 FUSEHOLDER.
NOTES:

1. ALL WIRING SHOWN FURNISHED WITH C661003-0401.
NOTES:

1. Pins are CRIMP type and furnished by vendor with connector.
2. Transmitter connector housing is PART OF TRANS-HOLDER, unless ALLY.
3. For wiring, DIAL-MAP of 20D.
4. Attache both transmitter and encoding altimeter to the No. 3 fuse.
NOTES:

1. TERMINALS OR WIRES FOR OPT EQUIPMENT SHALL BE PROTECTED AGAINST SHORTING WHEN OPT EQUIPMENT IS NOT INSTALLED.

DOME LT
LA 15

THRU 15072003/ F1500648

THRU 15072004/ F1500649/ ON

SER 15074851

TRAILER SER. 15074851

BUS BAR

THRU SER 15074850, A1500429/F1500261

SER 15074851, A1500430/F1500262/ ON

SUPERBKE 0410001 P 111.2
SUPERENDED BY 0410401 111.1

Change 3
20-21

EDR 1500485 (054233) 04.15.19

COMMERCIAL AIRCRAFT DIV.
3600 E. PAVVIE
WICHITA, KANSAS

Cessna Aircraft Co.

CONTRACT NO.

NO.

NAME DATE

04100011

C 71379 0410011

SUPERBKE 0410401 P 111.1

PROJECT NO.

117241

MATERIAL LOT TERMINALS 0410401 111.1

PART NO.

DESCRIPTION

0410401 111.1

CUSTOM GEESAY LIGHTS

EQUIPMENT TABLE

Cessna Aircraft Co.

COMMERICAL AIRCRAFT DIV.
3600 E. PAVVIE
WICHITA, KANSAS

Cessna Aircraft Co.

CONTRACT NO.

NO.

NAME DATE

04100011

C 71379 0410011

SUPERBKE 0410401 P 111.1

PROJECT NO.

117241

MATERIAL LOT TERMINALS 0410401 111.1

PART NO.

DESCRIPTION

0410401 111.1

CUSTOM GEESAY LIGHTS

EQUIPMENT TABLE
NOTES:
1. INSTALL 5-1436-1 PIN ON BLK WIRE OF COMPASS & 5-1436-1 SOCKET ON WHITE OF COMPASS.
2. INSTALL 5-1436-2 SOCKET ON BLK WIRE OF INSTRUMENT LIGHT.
NOTES:
1. THIS DRAWING IS STANDARD EQUIPMENT ON FRENCH AIRCRAFT AND OPTIONAL EQUIPMENT ON DOMESTIC.

WIRE TABLE

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<thead>
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EQUIPMENT TABLE

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</table>
NOTES:

1. TERMINATE RETRACTILE CABLE AT TERMINAL BLOCK END WITH 32075.5 SERIES (0079) ON CENTER CONDUCTOR & 32962.6 SERIES (0079) ON BRAID SHEILD. SOLDER CABLE TO CIRCUIT BOARD AS SHOWN.

2. WARNING: FAILURE TO OBSERVE POLARITY SHOWN ON THIS DIAGRAM WILL RESULT IN IMMEDIATE FAILURE OF 2N2220 TRANSISTOR (49471) ON THE CIRCUIT BOARD ASSEMBLY.
NOTES:

1) THREE CONDUCTOR CABLE, BELDEN(70502)
   PART NO. 9770 OR EQUIVALENT TO BE USED

WIRE TABLE

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INACTIVE

WING TIP STROBE LIGHT
(Optional)

WIRE TABLE

Change 3
20-33

P11.8

COMMERCIAL AIRCRAFT DIV.
BRIDGEMARK WICHITA, KANSAS

Cessna Aircraft Co.

EQUIPMENT TABLE

CER-8000 IS APPLICABLE TO VENDOR CODES PER 8-1000
CEB-80200-CESNA SPEC. NO. 6-23-6 OR CERTIFICATE/CESSNA SPEC

SUPERRED
SUPERRED BY:

P 04-0011

Part No.

SUPERREDER

Proj.

K3

WIRE

DRAWN

CHECK

DATE

SIGN

CODE

RESID

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### WIRING TABLE

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<td>4</td>
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<td>25</td>
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#### WIRING DIAGRAM - BUS BREAKER

- PB: Mst. SW.
- RA1 Alt.
- DA2 Ammeter
- EBI Fuel Ind.
- FA1 Turn Cord.
- YEL(CO) Inst. LTs.
- RED/WHT Encd. Alt.
- FA1 Teb. Ind.
- LA1 Dome LTs.
- LD1 Nav. LTs.
- LF1 Bck. LT.
- FSI Pitot Mt.
- LD8 Strobe
- LE1 Ldg. LTs
- LC1 Taxi LTs
- HC1 Cigar Lighter
- SAS Start
- CC1 Flap
NOTES:
1. Pins are crimp type and are furnished by vendor with connector.
2. Transponder connector housing is part of transponder cable Assy.
3. For wiring diagram of 500 transponder, refer to 89020-43.
4. Attach both transponder and encoding altimeter to the no. 3 circuit breaker.
5. For wires 4 terminals see 1270625 P6/97