LANDING GEAR AND BRAKE SYSTEM

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LANDING GEAR.

The landing gear is a fully-retractable tricycle landing gear consisting of a main gear located aft of each engine nacelle, and a nose gear located near the forward end of the fuselage. Each landing gear is mechanically connected to a single gear box, which is normally driven by an electric motor. In the event of landing gear electrical system failure, the landing gear can be extended by operating a hand crank, located at the right side of the pilot’s seat. Landing gear over-travel during operation is prevented by limit switches, which open the electrical circuit to the motor when the correct amount of travel has been attained. A safety switch prevents accidental retraction on the ground by opening the landing gear electrical circuit while the weight of the aircraft is on the gear.

Trouble Shooting the Landing Gear System:

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<th>PROBABLE CAUSE</th>
<th>CORRECTION</th>
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<td>LANDING GEAR FAILS TO RETRACT - GEAR MOTOR OPERATES</td>
<td>Manual extension crank improperly stowed.</td>
<td>Stow crank properly.</td>
</tr>
<tr>
<td></td>
<td>Defective landing gear actuator.</td>
<td>Replace actuator.</td>
</tr>
<tr>
<td></td>
<td>Defective reduction unit.</td>
<td>Replace reduction unit.</td>
</tr>
<tr>
<td></td>
<td>Pin sheared on gear motor shaft.</td>
<td>Replace pin.</td>
</tr>
<tr>
<td></td>
<td>Broken bolts or retracting linkage, or disconnected retracting linkage.</td>
<td>Replace broken parts. Connect linkage if disconnected.</td>
</tr>
<tr>
<td></td>
<td>Circuit breaker out.</td>
<td>Reset circuit breaker.</td>
</tr>
<tr>
<td>LANDING GEAR FAILS TO RETRACT - GEAR MOTOR DOES NOT OPERATE</td>
<td>Defective circuit breaker.</td>
<td>Replace circuit breaker.</td>
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<tr>
<td></td>
<td>Insufficient electrical power.</td>
<td>Recharge batteries. Check voltage regulators.</td>
</tr>
<tr>
<td></td>
<td>Defective UP limit switch.</td>
<td>Replace switch. Adjust in accordance with rigging procedure.</td>
</tr>
<tr>
<td></td>
<td>Defective landing gear safety switch.</td>
<td>Replace switch.</td>
</tr>
<tr>
<td></td>
<td>Incorrectly adjusted landing gear safety switch.</td>
<td>Adjust safety switch.</td>
</tr>
<tr>
<td></td>
<td>Defective landing gear relay.</td>
<td>Replace relay.</td>
</tr>
<tr>
<td></td>
<td>Defective landing gear switch.</td>
<td>Replace switch.</td>
</tr>
<tr>
<td></td>
<td>Defective landing gear motor.</td>
<td>Replace motor.</td>
</tr>
<tr>
<td></td>
<td>Defective UP electrical circuit.</td>
<td>Repair circuit.</td>
</tr>
<tr>
<td></td>
<td>Landing gear incorrectly rigged for retracted position.</td>
<td>Rig in accordance with rigging procedure.</td>
</tr>
<tr>
<td></td>
<td>Circuit breaker out, due to overload caused by incorrect landing gear rigging.</td>
<td>Reset circuit breaker and rig in accordance with rigging procedure.</td>
</tr>
<tr>
<td></td>
<td>Circuit breaker out, due to overload caused by defective retracting linkage.</td>
<td>Reset circuit breaker, replace defective linkage, rig in accordance with rigging procedure.</td>
</tr>
<tr>
<td></td>
<td>UP limit switch incorrectly adjusted.</td>
<td>Adjust in accordance with rigging procedure.</td>
</tr>
<tr>
<td>ONE LANDING GEAR FAILS TO RETRACT</td>
<td>Retracting linkage to affected gear broken or disconnected.</td>
<td>Replace broken parts. Connect linkage if disconnected. Rig in accordance with rigging procedure.</td>
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<tr>
<td>ONE LANDING GEAR FAILS TO RETRACT</td>
<td>Affected landing gear incorrectly rigged for retracted position.</td>
<td>Rig in accordance with rigging procedure.</td>
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<td>LANDING GEAR FAILS TO EXTEND - GEAR MOTOR OPERATES</td>
<td>Defective retracting linkage to affected landing gear.</td>
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<td>Defective landing gear actuator.</td>
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<td>Pin sheared on gear motor shaft.</td>
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<td>Broken bolts or retracting linkage, or disconnected retracting linkage.</td>
<td>Replace broken parts. Connect linkage if disconnected.</td>
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<td>Circuit breaker out.</td>
<td>Reset circuit breaker.</td>
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<tr>
<td></td>
<td>Defective circuit breaker.</td>
<td>Replace circuit breaker.</td>
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<td></td>
<td>Insufficient electrical power.</td>
<td>Recharge batteries. Check voltage regulators.</td>
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<td>Defective DOWN limit switch.</td>
<td>Replace switch. Adjust in accordance with rigging procedure.</td>
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<td>Defective landing gear switch.</td>
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<td>Defective landing gear motor.</td>
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<td></td>
<td>Defective DOWN electrical circuit.</td>
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<td></td>
<td>DOWN limit switch incorrectly adjusted.</td>
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<td></td>
<td>Landing gear incorrectly rigged for the DOWN position.</td>
<td>Rig in accordance with rigging procedure.</td>
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<tr>
<td></td>
<td>Circuit breaker out, due to overload caused by incorrect rigging.</td>
<td>Reset circuit breaker and rig in accordance with rigging procedure.</td>
</tr>
<tr>
<td></td>
<td>Circuit breaker out, due to overload caused by defective retracting linkage.</td>
<td>Reset circuit breaker, replace defective linkage, and rig in accordance with rigging procedure.</td>
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<tr>
<td>ONE LANDING GEAR FAILS TO EXTEND</td>
<td>Retracting linkage to affected gear broken or disconnected.</td>
<td>Replace broken parts. Connect linkage if disconnected. Rig in accordance with rigging procedure.</td>
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<tr>
<td>ONE LANDING GEAR FAILS TO EXTEND COMPLETELY</td>
<td>Affected landing gear incorrectly rigged for the DOWN position.</td>
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<td>Incorrect adjustment of manual extension linkage.</td>
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<td>Replace defective linkage or actuator.</td>
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<td>Landing gear improperly rigged.</td>
<td>Rig landing gear in accordance with rigging procedure.</td>
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<td>Circuit breaker out.</td>
<td>Reset circuit breaker.</td>
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<td>Defective circuit breaker.</td>
<td>Replace circuit breaker.</td>
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<td></td>
<td>Lamp burned out.</td>
<td>Replace lamp.</td>
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<td>Lamp loose.</td>
<td>Repair or replace receptacle.</td>
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<td></td>
<td>Defective electrical circuit.</td>
<td>Repair circuit.</td>
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<td></td>
<td>Landing gear not fully retracted.</td>
<td>Retract fully.</td>
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<td></td>
<td>Defective or incorrectly adjusted UP limit switch.</td>
<td>Replace and/or adjust switch in accordance with rigging procedure.</td>
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<td>GEAR UP (RED) LIGHT REMAINS ON WHEN GEAR IS DOWN</td>
<td>Defective UP limit switch.</td>
<td>Replace switch and adjust in accordance with rigging procedure.</td>
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<td>Circuit shorted to another system.</td>
<td>Locate and repair.</td>
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<td>GEAR DOWN (GREEN) LIGHT FAILS TO LIGHT</td>
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<td>GEAR DOWN (GREEN) LIGHT REMAINS ON WHEN GEAR IS UP</td>
<td>Defective circuit breaker or electrical circuit.</td>
<td>Replace circuit breaker.</td>
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<td>Lamp burned out.</td>
<td>Repair defective electrical circuit.</td>
</tr>
<tr>
<td></td>
<td>Lamp loose.</td>
<td>Replace lamp.</td>
</tr>
<tr>
<td></td>
<td>Landing gear not fully extended.</td>
<td>Repair or replace receptacle.</td>
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<td></td>
<td>One or more DOWN indicator switches defective or incorrectly adjusted.</td>
<td>Extend fully.</td>
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<td>GEAR DOWN (GREEN) LIGHT FLICKERS WHEN GEAR IS DOWN</td>
<td>Circuit shorted to another system.</td>
<td>Replace defective switches and/or adjust in accordance with rigging procedures.</td>
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<td></td>
<td>One or more DOWN indicator switches defective or incorrectly adjusted.</td>
<td>Locate and repair.</td>
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<td></td>
<td>Loose lamp.</td>
<td>Replace defective switches and/or adjust in accordance with rigging procedure.</td>
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<td>GEAR WARNING HORN SOUNDS IN FLIGHT WHEN LANDING GEAR IS DOWN AND THER-</td>
<td>Defective gear DOWN indicator switch.</td>
<td>Repair or replace receptacle.</td>
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<tr>
<td>TLES ARE RETARDED</td>
<td></td>
<td>Replace defective switch and adjust in accordance with rigging procedure.</td>
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<td>GEAR WARNING HORN SOUNDS IN FLIGHT WHEN LANDING GEAR IS UP AND THER-</td>
<td>Defective throttle microswitch.</td>
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<td>TLES ARE NOT RETARDED</td>
<td>Incorrectly adjusted throttle micro-switch.</td>
<td>Adjust in accordance with rigging procedure.</td>
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<td>Incorrectly adjusted gear DOWN indicator switches.</td>
<td>Replace switch and adjust in accordance with rigging procedure.</td>
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<tr>
<td></td>
<td>Defective gear DOWN indicator switches.</td>
<td>Replace switch and adjust in accordance with rigging procedure.</td>
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<tr>
<td></td>
<td>Circuit shorted to another system, incorrectly adjusted gear DOWN indicator switches.</td>
<td>Locate and repair.</td>
</tr>
<tr>
<td></td>
<td>Defective gear DOWN indicator switches.</td>
<td>Adjust switch in accordance with rigging procedure.</td>
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<td></td>
<td>Circuit breaker out.</td>
<td>Replace switch and adjust in accordance with rigging procedure.</td>
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<td></td>
<td>Defective circuit breaker.</td>
<td>Repair circuit.</td>
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<td></td>
<td>Landing gear safety switch incorrectly adjusted.</td>
<td>Replace horn or flasher unit.</td>
</tr>
<tr>
<td></td>
<td>Defective landing gear safety switch.</td>
<td>Reset circuit breaker.</td>
</tr>
<tr>
<td></td>
<td>Defective electrical circuit.</td>
<td>Replace circuit breaker.</td>
</tr>
<tr>
<td></td>
<td>Defective warning horn or flasher unit.</td>
<td>Replace switch and adjust in accordance with rigging procedure.</td>
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<td></td>
<td>Circuit breaker out.</td>
<td>Repair circuit.</td>
</tr>
<tr>
<td></td>
<td>Defective circuit breaker.</td>
<td>Replace horn.</td>
</tr>
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<td></td>
<td>Defective gear DOWN indicator switches.</td>
<td>Adjust in accordance with rigging procedure.</td>
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<td></td>
<td>Defective electrical circuit.</td>
<td>Repair circuit.</td>
</tr>
<tr>
<td></td>
<td>Defective warning horn.</td>
<td>Replace switch and adjust in accordance with rigging procedure.</td>
</tr>
<tr>
<td></td>
<td>Throttle microswitch incorrectly adjusted.</td>
<td>Repair switch and adjust in accordance with rigging procedure.</td>
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<td></td>
<td>Defective throttle microswitch.</td>
<td>Repair circuit.</td>
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<td></td>
<td>Doors incorrectly rigged.</td>
<td>Replace switch and adjust in accordance with rigging procedure.</td>
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<td>Defective door operating linkage.</td>
<td>Rig doors in accordance with rigging procedure.</td>
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<td>Insufficient fluid in shimmy dampener.</td>
<td>Replace defective linkage.</td>
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<td>Internal leakage in shimmy dampener.</td>
<td>Service shimmy dampener in accordance with Section 2.</td>
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<td>Roll pin attaching piston to piston rod sheared.</td>
<td>Replace defective seals and/or piston.</td>
</tr>
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<td>Shimmy dampener loose at mounting.</td>
<td>Replace roll pin.</td>
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<td>Tires out of balance.</td>
<td>Replace worn housing and/or attaching bolt.</td>
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<td></td>
<td>Replace tires when tread is worn unevenly or has flat spots.</td>
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<tr>
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</tr>
<tr>
<td>LANDING GEAR SHIMMIES DURING FAST TAXI, TAKEOFF, OR LANDING (CONTINUED)</td>
<td>Worn or loose wheel bearings.</td>
<td>Replace and/or adjust bearings.</td>
</tr>
<tr>
<td></td>
<td>Excessive clearance between upper and lower torque links.</td>
<td>Adjust clearance in accordance with alignment procedure.</td>
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<tr>
<td></td>
<td>Worn torque link bushings.</td>
<td>Replace bushings.</td>
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<td></td>
<td>Incorrect operating pressure.</td>
<td>Inflate to correct pressure.</td>
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<td></td>
<td>Incorrect wheel alignment.</td>
<td>Align in accordance with alignment procedure.</td>
</tr>
<tr>
<td>EXCESSIVE OR UN-EVEN WEAR ON TIRES</td>
<td>Wear resulting from shimmy.</td>
<td>See the preceding corrections for shimmy.</td>
</tr>
<tr>
<td></td>
<td>Incorrect rigging of nose gear steering system.</td>
<td>Rig in accordance with nose gear steering procedure.</td>
</tr>
<tr>
<td></td>
<td>One brake dragging.</td>
<td>Determine cause and correct.</td>
</tr>
<tr>
<td></td>
<td>Defective nose gear steering springs.</td>
<td>Replace springs.</td>
</tr>
<tr>
<td></td>
<td>Gimbal broken or damaged at the top of the nose strut.</td>
<td>Replace defective gimbal.</td>
</tr>
<tr>
<td></td>
<td>Incorrect rigging of nose gear steering system.</td>
<td>Rig in accordance with nose gear steering procedure.</td>
</tr>
<tr>
<td></td>
<td>Gimbal broken or damaged on top of the nose strut.</td>
<td>Replace defective gimbal.</td>
</tr>
<tr>
<td>NOSE GEAR FAILS TO STRAIGHTEN WHEN LANDING GEAR EXTENDS</td>
<td>Landing gear struts incorrectly inflated.</td>
<td>Inflate struts correctly.</td>
</tr>
<tr>
<td>NOSE GEAR FAILS TO STRAIGHTEN WHEN LANDING GEAR RETRACTS</td>
<td>Insufficient air and/or fluid in strut.</td>
<td>Service strut with proper amount of fluid and air.</td>
</tr>
<tr>
<td></td>
<td>Defective internal parts in strut.</td>
<td>Replace defective parts.</td>
</tr>
<tr>
<td></td>
<td>Defective O-rings.</td>
<td>Determine which O-rings are defective and replace.</td>
</tr>
<tr>
<td>ATTITUDE OF AIRCRAFT ON GROUND IS INCORRECT</td>
<td></td>
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<tr>
<td>STRUT BOTTOMS ON NORMAL LANDING OR TAXING ON ROUGH GROUND</td>
<td></td>
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</tr>
<tr>
<td>STRUT DEFLATED WITH EVIDENCE OF FLUID LEAKAGE</td>
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Landing Gear Actuator.

The landing gear actuator consists of an electric motor, a reduction unit, and a worm-and-sector assembly. The actuator is normally operated by the electric motor; however linkage is provided to disengage the motor-driven reduction unit and engage the manual extension system, which is linked directly to the actuator worm gear. The bellcrank that operates the main landing gear drive tubes is attached to the upper end of the sector shaft, which extends vertically through the actuator assembly, and the bellcrank that operates the nose gear drive tube is attached to the lower end of the sector shaft. Adjustable limit switches are provided so that correct landing gear travel can be obtained.

Removal of Landing Gear Actuator. (See figure 4-1.)

a. Jack the aircraft in accordance with Section 2.
b. Remove the rear seats and carpet.
c. Remove cabin floor above landing gear actuator and access hole cover from underside of fuselage beneath landing gear actuator.
d. Release tension on retracting linkage by engaging manual extension crank and operating a few turns toward the UP position.
e. Disconnect nose gear forward push-pull tube (see figure 4-1) from fork bolt.
f. Disconnect both main landing gear drive tubes from idler bellcranks.
g. Remove the nose gear drive tube attached to lower bellcrank.
h. Remove nut, washer, caps, and bolt attaching upper and lower bellcranks to the sector shaft.
i. Lift upper bellcrank enough to allow main gear drive tubes to be disconnected. Remove nuts, washers, and bolts attaching main gear drive tubes to
upper bellcrank and slide both tubes outboard so they
will not interfere with removal.
j. Disconnect manual extension disengage rod by
removing cotter pin and clevis pin.
k. Disconnect the manual extension drive tubes by
removing the three clevis pins, washers, and cotter
pins; then slide outer shaft aft and inner shaft for­
ward to disconnect.
l. Remove safetywire from bolts to be removed;
then remove the four bolts and washers attaching re­
duction unit and actuator assembly to the aft bulkhead.

NOTE
When removing the motor, disconnect and tag
all electrical wires at the quick-disconnects
provided.
m. Remove switch brackets from actuator assembly.
Do not disturb switch adjustments except to replace
switches or brackets.

NOTE
If switches are to be replaced, tag wires be­
fore disconnecting.

n. Remove the two bolts, washers, and nuts attach­
ing actuator assembly to forward bracket.
o. Lift actuator assembly vertically and remove
from aircraft.
p. Remove the lower bellcrank and spacer from end
of sector shaft.

Installation of Landing Gear Actuator. (See figure
4-1.)
a. Install lower bellcrank on lower end of sector
shaft.

NOTE
When installing lower bellcrank, align the index
punch mark on the bellcrank with the chamfered
spline on the sector shaft.
b. Position actuator assembly in position, aligning
manual extension outer and inner shaft so they will
mate.

NOTE
To facilitate installation, install all actuator
attaching bolts before any bolts are tightened.
c. Install the two bolts attaching the actuator to the
forward mounting bracket.

d. Install the four bolts and washers attaching actu­
or assembly and reduction unit to bulkhead.
e. If motor was removed, connect the electrical
wires at the quick-disconnect provided.
f. Install switch brackets with bolts, washers, and
nuts.

CAUTION
Check switches thoroughly for proper opera­
tion. A faulty switch may cause damage to
the landing gear actuator.
g. Tighten all nuts and bolts which were installed
but not tightened.
h. Safetywire bolts attaching actuator to the bulk­
head.
i. Connect manual extension drive tubes with clevis
pins and washers, and safety with cotter pins.
j. Connect the manual extension disengage rod with
clevis pin and safety with cotter pin.
k. Position upper bellcrank above actuator assembly,
slide main gear drive tubes inboard and attach to bell­
crank with bolts, washers, and nuts. Install bolts
with their threaded ends UP.

NOTE
Main gear drive tubes must be installed with
half-round side of end fitting upwards.
l. Place spacer and upper bellcrank on sector shaft.

NOTE
When installing upper bellcrank, align the index
punch mark on the bellcrank with the chamfered
spline on the sector shaft.
m. Insure that lower bellcrank and spacers are cor­
correctly in position and install bolt, caps, washer, and
nut.
n. Attach nose gear drive tube to lower bellcrank
with bolt, washer, and nut.
o. Connect main landing gear drive tubes to idler
bellcranks with bolts, spacers, and nuts.
p. Connect forward push-pull tube to fork bolt with
bolt and nut.
q. Perform an operational check of landing gear,
checking especially that limit switches are correctly
adjusted and landing gear is correctly rigged.
r. Install cabin floor panel and access hole cover on
underside of fuselage beneath landing gear actuator.
s. Install rear carpet and seats removed for remov­
a1 of actuator.
t. After making sure landing gear is DOWN and
locked, remove aircraft from jacks.
Figure 4-1. Landing Gear Actuator Installation

Change 3
### Manual Extension System.

The manual extension system consists of a hand crank, which is connected to the landing gear actuator by an arrangement of chain and sprockets, bellcranks, miter gears, and push-pull rods. The hand crank, located at the right of the pilot’s seat, is provided with a spring-loaded release button which unlocks the hand crank so that it can be folded into the stowed position. When the hand crank is folded, it disengages the manual extension system; when unfolded, into its operating position, the hand crank disengages the normal landing gear operating system.

### Removal of Manual Extension System. (See figure 4-2.)

1. Remove pilot’s seat.
2. Remove left rear seats and carpet to gain access to cover over extension system.
3. Remove access hole cover from cabin floor above the landing gear actuator.
4. Remove chain guards by removing the three attaching screws.
5. Remove chain by disconnecting at the master link.
6. Remove crank handle and shaft assembly as follows:
   1. Remove roll pin and washer from shaft.
   2. Remove cotter pin and clevis pin from spool.
   3. Pull crank handle and shaft from supports, removing spool as shaft is pulled through it.
   4. Remove upper rod assembly by removing cotter pins, washers, and clevis pins attaching rod assembly to the bellcranks.
   5. Remove upper bellcrank by removing nut, washer, and bolt; then remove bushing from bellcrank.

### Installation of Manual Extension System. (See figure 4-2.)

1. If the support bracket has been disassembled without removing the landing gear actuator, assemble as follows:
   1. Insert actuator drive tube thru the aft bushing; then install miter gear on shaft and insert roll pin.
   2. Holding sprocket and other miter gear in position, slide the shaft thru the gear and sprocket, then insert the two roll pins.

---

**Figure 4-1. Landing Gear Actuator Installation Callouts**

<table>
<thead>
<tr>
<th>Callout</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Landing Gear Motor</td>
</tr>
<tr>
<td>2.</td>
<td>Bolt</td>
</tr>
<tr>
<td>3.</td>
<td>Reduction Unit</td>
</tr>
<tr>
<td>4.</td>
<td>Bulkhead</td>
</tr>
<tr>
<td>5.</td>
<td>Nut</td>
</tr>
<tr>
<td>6.</td>
<td>Washer</td>
</tr>
<tr>
<td>7.</td>
<td>Cap</td>
</tr>
<tr>
<td>8.</td>
<td>Nut</td>
</tr>
<tr>
<td>9.</td>
<td>Washer</td>
</tr>
<tr>
<td>10.</td>
<td>Main Landing Gear Drive Tube</td>
</tr>
<tr>
<td>11.</td>
<td>Bolt</td>
</tr>
<tr>
<td>12.</td>
<td>Upper Bellcrank</td>
</tr>
<tr>
<td>13.</td>
<td>Spacer</td>
</tr>
<tr>
<td>14.</td>
<td>Bolt</td>
</tr>
<tr>
<td>15.</td>
<td>Washer</td>
</tr>
<tr>
<td>16.</td>
<td>Switch Bracket</td>
</tr>
<tr>
<td>17.</td>
<td>Up Limit Switch</td>
</tr>
<tr>
<td>18.</td>
<td>Bolt</td>
</tr>
<tr>
<td>19.</td>
<td>Washer</td>
</tr>
<tr>
<td>20.</td>
<td>Bolt</td>
</tr>
<tr>
<td>21.</td>
<td>Washer</td>
</tr>
<tr>
<td>22.</td>
<td>Switch Bracket</td>
</tr>
<tr>
<td>23.</td>
<td>Actuator Assembly</td>
</tr>
<tr>
<td>24.</td>
<td>Cap</td>
</tr>
<tr>
<td>25.</td>
<td>Nut</td>
</tr>
<tr>
<td>26.</td>
<td>Mounting Bracket</td>
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<tr>
<td>27.</td>
<td>Nut</td>
</tr>
<tr>
<td>28.</td>
<td>Gear Shaft</td>
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<tr>
<td>29.</td>
<td>Cotter Pin</td>
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<tr>
<td>30.</td>
<td>Pin</td>
</tr>
<tr>
<td>31.</td>
<td>Washer</td>
</tr>
<tr>
<td>32.</td>
<td>Outer Shaft</td>
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<tr>
<td>33.</td>
<td>Inner Shaft</td>
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<tr>
<td>34.</td>
<td>Cotter Pin</td>
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<tr>
<td>35.</td>
<td>Nut</td>
</tr>
<tr>
<td>36.</td>
<td>Washer</td>
</tr>
<tr>
<td>37.</td>
<td>Nose Gear Drive Tube</td>
</tr>
<tr>
<td>38.</td>
<td>Screw</td>
</tr>
<tr>
<td>39.</td>
<td>Bolt</td>
</tr>
<tr>
<td>40.</td>
<td>Cap</td>
</tr>
<tr>
<td>41.</td>
<td>Lower Bellcrank</td>
</tr>
<tr>
<td>42.</td>
<td>Spacer</td>
</tr>
<tr>
<td>43.</td>
<td>Manual Extension Disengage Rod</td>
</tr>
<tr>
<td>44.</td>
<td>Down Limit Switch</td>
</tr>
<tr>
<td>45.</td>
<td>Grease Fitting</td>
</tr>
<tr>
<td>46.</td>
<td>Bolt</td>
</tr>
<tr>
<td>47.</td>
<td>Washer</td>
</tr>
<tr>
<td>48.</td>
<td>Main Gear Drive Tube</td>
</tr>
<tr>
<td>49.</td>
<td>Spacer</td>
</tr>
<tr>
<td>50.</td>
<td>Washer</td>
</tr>
<tr>
<td>51.</td>
<td>Bolt</td>
</tr>
</tbody>
</table>
Figure 4-2. Manual Extension System Installation
Figure 4-2. Manual Extension System Installation Callouts

1. Clevis Pin 25. Cotter Pin
2. Spacer 26. Spacer
3. Spool 27. Clevis Pin
5. Spacer 29. Screw
7. Lug 31. Spacer
8. Cotter Pin 32. Sprocket
9. Spool 33. Spacer
10. Crank Assembly 34. Washer
11. Washer 35. Nut
12. Nut 36. Clevis Pin
13. Pin Lock 37. Spacer
15. Spring 39. Screw
16. Clevis Pin 40. Screw
17. Bolt 41. Chain Guard
18. Cotter Pin 42. Roll Pin
19. Link 43. Sprocket
20. Clevis Pin 44. Chain
21. Clevis Pin 45. Gear
22. Cotter Pin 46. Ring
23. Washer 47. Gear

b. Connect drive tubes from landing gear actuator.
c. Install chain tighteners with attaching screws and washers; then install adjusting screw, washers, and nut, but do not tighten at this time.
d. Install lower bellcrank with bolt, spacer, washer, and nut.
e. Insert bushing into upper bellcrank then install bellcrank with bolts, washers, and nuts.
f. If disassembled, reassemble crank handle and shaft with pins, cotter pins, nut and bolt.
g. Install crank handle and shaft assembly as follows:
   1. Insert crank handle and shaft through inboard support, spool, and the outboard support.
   2. Engage upper bellcrank with spool, align spool attaching holes, and install pin and cotter pin.
   3. Place washer and collar on the shaft and install roll pin and safety. This washer is to remove end play.
h. Install chain on sprockets and connect with master link. Adjust chain tighteners and tighten adjusting screw and nut.
i. Attach the lower rod assembly to the lower bellcrank and landing gear actuator with pins and washers and safety with cotter pins.
j. Attach upper rod assembly to bellcranks with pins, washers, and cotter pins.
k. If the length of the upper or lower rod has been changed, adjust as follows:
   1. Place crank in operating position.
   2. Adjust lower rod assembly to a length of approximately 18.10 inches, measured between the rod end bolt holes, and install.
   3. Pull lower rod assembly forward until internal gear, in landing gear actuator, reaches the end of its travel; adjust upper rod assembly so that rod and bolt holes align with holes in upper and lower bellcranks.
   4. Lengthen upper rod assembly one-half turn and install.

If the upper rod assembly adjustment cannot be obtained because an excessive amount of threads would be exposed, readjust the lower rod assembly to obtain the desired result, and repeat steps "3" and "4".

1. Perform an operational check to see that manual extension functions properly.

CAUTION

Do not use the manual extension system to fully retract the landing gear, except when manually pushing upward on all landing gears to relieve strain on manual extension system.

m. Install chain guards with attaching screws.
n. Install access hole cover on cabin floor above the landing gear actuator.
o. Install rear carpet and seats.

Main Landing Gear.

Each main landing gear consists of a wheel and tire assembly, brake assembly, lower piston assembly, cantilever axle, upper cylinder assembly, and torque links. The Air-oleo shock strut contains an orifice and tapered metering pin which vary the resistance to shock according to its severity. During extension and retraction, the landing gear pivots on heavy-duty needle bearings by means of trunnion shafts attached to the upper cylinder assembly.

Removal of Main Landing Gear. (See figure 4-3.)
a. Jack the aircraft in accordance with Section 2.
Figure 4-3. Main Landing Gear Installation
Figure 4-3. Main Landing Gear Installation Callouts

1. Landing Gear Safety Switch
2. Screw
3. Bracket
4. Screw
5. Washer
6. Nut
7. Nut
8. Landing Gear Support
9. Bearing
10. Washer
11. Attaching Shaft
12. Truss Assembly
13. Bolt
14. Bellcrank
15. Washer
16. Nut
17. Outboard Push-Pull Tube
18. Spacer
19. Down Indicator Switch
20. Spacer
21. Screw
22. Side Lock Link
23. Bracket
24. Nut

b. Drain brake system by loosening bleeder plug.
c. Disconnect brake hose at forward wheel well bulkhead union. Plug hose and cap fittings to prevent entry of foreign matter.

NOTE

Alternate to steps b. and c.
1. Remove 6 bolts thru brake cylinder assembly.
2. Remove brake cylinder assembly from disc.
3. Replace 6 bolts thru brake cylinder assembly using 3/8 or thicker board to hold linings in place.
4. Remove hose clamps and tie brake assembly out of way for further work.

d. Remove safety switch and down indicator switch by removing attaching screws and nuts.
e. Remove wire clamps and tie switches where they will not interfere with gear removal.
f. Release tension on retracting linkage by engaging manual extension crank and operating a few turns toward the UP position.
g. Disconnect the main landing gear doors.
h. Disconnect retracting linkage as follows:
1. Disconnect outboard push-pull tube from bellcrank by removing nuts, washers, and bolts.
2. Disconnect upper side link from lower side link by removing nuts, washers, and bolts.
i. Remove roll pins from attaching shafts, and insert AN6 bolt or puller tool.
j. Support gear and pull attaching shafts.

NOTE

Needle bearings, in which the attaching shafts pivot, are a press fit and should be removed only for replacement. Bearings must be removed by driving them toward the wheel well.

CAUTION

NOTE the amount of thickness of washers removed. These washers should be installed exactly as they were located before removal to insure proper alignment of side link assembly.

Disassembly of Main Landing Gear. (See figure 4-4.)
a. Completely deflate strut, and after all the air has been expelled, remove the valve body and drain fluid.
b. Remove lower strut assembly from upper truss assembly as follows:
1. Disconnect the torque link, brake hose clamps, bushings, and safety switch bracket by removing the cotter pins, nuts, washers, and bolts.
2. Disconnect brake hose from brake at elbow and remove hose.
3. Remove wheel and tire assembly and brake assembly from axle fitting.

CAUTION

Removal and handling of the lower strut should be done with care to prevent the possibility of damage to exposed parts.
c. (See figure 4-4) Disassemble upper cylinder assembly as follows:
1. Remove metering tube (4) from upper barrel assembly (38) by pulling straight out.

CAUTION

If the metering pin and seal support are to be reinstalled, use extreme caution during removal.

2. Disconnect torque links (14) by removing nut (20), washer (21), bushing (19), clamp (16), and bolt (15).
3. Remove lock ring (27), scraper ring (28), and internal lock ring (29).
4. Pull piston assembly (10) from upper cylinder
Figure 4-4. Main Landing Gear Strut

Change 3
### Figure 4-4. Main Landing Gear Strut Callouts

| 2. Packing | 21. Washer |
| 3. "O" Ring | 22. Nut |
| 4. Orifice Tube Assembly | 23. Cotter Pin |
| 5. Metering Pin | 24. Striker Plate |
| 6. "O" Ring | 25. Screw |
| 7. Seal Support | 26. Bushing |
| 8. "O" Ring | 27. Lock Ring |
| 10. Barrel Piston | 29. Internal Lock Ring |
| 11. Bolt | 30. "O" Ring |
| 12. Shaft | 31. Backup Ring |
| 13. Roll Pin | 32. "O" Ring |
| 14. Torque Link | 33. Backup Ring |
| 15. Bolt | 34. Ring Pack Support |
| 16. Clamp | 35. Spacer |
| 17. Bushing | 36. Inner Bearing |
| 18. Bushing | 37. External Lock Ring |
| 19. Spacer | 38. Barrel Assembly |
| | 39. Screw |
| | 40. Switch Bracket |
| | 41. Spacer |
| | 42. Clamp |
| | 43. Washer |
| | 44. Nut |
| | 45. Orifice |
| | 46. Trunnion |
| | 47. Washer |
| | 48. Bolt |
| | 49. Screw |
| | 50. Clamp |
| | 51. Clamp |
| | 52. Spacer |
| | 53. Nut |
| | 54. Nut |
| | 55. Bushing |
| | 56. Rivet |

#### Assembly (38).

**NOTE**

Lower piston barrel and axle fittings are a press fit and drilled on assembly. Disassembly is not recommended.

6. See Section 2 for cleaning and inspection of main landing gear.

#### Assembly of Main Landing Gear. (See figure 4-4.)

**NOTE**

Before each component of the main landing gear shock strut is assembled, assure that it is thoroughly clean, then lubricate with system hydraulic fluid.

a. Assemble landing gear as follows:
   1. Carefully work O-ring (6) over threads of metering pin (5) and install in seal support (7) with nut (9).
   2. Install O-ring (6) in groove on outside of seal support (7).
   3. Insert seal support (7), with metering pin assembled, into lower piston barrel (10).
   4. Slide lock ring (27), scraper ring (28), and internal lock ring (29) on piston barrel (10).
   5. Install backup ring (33), O-ring (32), and backup ring (31) inside ring pack support (34); then work O-ring (30) on the outside into groove on ring pack support (34) and slide onto piston barrel (10).
   6. Install spacer (35) on piston barrel (10).
   7. Install inner bearing (38) on piston barrel (10) and secure with external lock ring (37).

**NOTE**

Install inner bearing with chamfered end up in order to seat against external lock ring.

8. Carefully work piston barrel into cylinder assembly (38) and slide ring pack support (34), internal lock ring (29), scraper ring (28), and lock ring (27) into cylinder assembly (38) and secure.

**NOTE**

To prevent damage to piston barrel and ring pack support during installation, a ring pack support tool P/N 0880004-1 available from your Cessna Dealers' Organization should be used. (See figure 4-5A.)

9. Carefully work O-ring (3) into groove in orifice tube (4) and insert into cylinder assembly (38) taking care to align holes.

   a. Align holes and install two bolts (48), washers (47) and nuts (64).
   b. Assemble torque links (14), if removed, then connect with bolt (15), washers (21), spacer (19), and nut (20).
   c. Install switch striker plate and switch bracket assembly as shown in figure 4-4.
   d. Install brake assembly, wheel and tire assembly; then connect hoses and clamp.
   e. Service strut with hydraulic fluid in accordance with Section 2. Do not fill with air at this time.
   f. Install new O-ring (2) on valve body (1) and install in top of orifice tube (4).

#### Installation of Main Landing Gear.

a. If needle bearings were removed, install as follows:
   1. Press needle bearings into landing gear supports. Bearings must seat against shoulders provided in supports.
   b. Position gear in place; then install washers between supports and trunnion and align holes.
   c. Install attaching shafts into gear trunnion and
ADD OR REMOVE WASHERS BETWEEN TORQUE LINKS AS NECESSARY TO OBTAIN CORRECT WHEEL ALIGNMENT.

PLACE STRAIGHTEDGE AT AXLE HEIGHT.

MAXIMUM TOE-OUT .06 ± .05 MEASURED ON WHEEL RIM IN A HORIZONTAL PLANE THRU CENTER OF AXLE.

TAKE MEASUREMENTS AT EDGES OF WHEEL RIM.

FORWARD

Figure 4-5. Main Wheel Alignment
align gear trunnion, washer, and bearing in the landing gear supports, then work the shafts into position, using care to align holes in shaft and trunnion for the installation of roll pin.

**NOTE**

The attaching shafts are a slip fit and should be lubricated with light oil to aid in the installation of the shafts.

- Remove AN6 bolt used in removal and installation of attaching shafts and install roll pin.
- Connect side brace and push-pull tubes and gear door using bolts, washers, and nuts.

**BRAKE SYSTEM**

- Install safety switch and down indicator switch with screws and nuts and adjust in accordance with Rigging of Main Landing Gear.

**NOTE**

Make sure landing gear limit switches have all holes in switch housing plugged and packed with DC-4 Silicone Compound to prevent moisture entering limit switches.

- Remove plug and caps and connect brake hose to union at bulkhead at forward wheel well. Use suitable lubricant on threads.
- Install clamps securing switch wire bundle and brake hose.

---

**ALL DIMENSIONS ARE IN INCHES**

**MAIN LANDING GEAR**  
P/N 0880004-1

- 2.750
- 2.150
- 1.375
- 1.075
- 4.00
- 6.00
- 2.600
- 1.300

**NOSE LANDING GEAR**  
P/N 0880004-2

- 2.750
- 2.100
- 1.375
- 1.050
- 2.00
- 4.00
- 2.480
- 1.240

**NOTES**

1. Material to be 4130 Type I steel.
2. Finish inside bore to smooth finish.
3. Cut cylinder on center line to form two halves.
4. Wrap cylinder with mystic tape 5812 (Stock Code F840022) or equivalent. Cut tape on one side to permit halves to hinge open.
5. Coat tool with light oil to prevent rust.

---

*Figure 4-5A. Landing Gear Ring Pack Support Tool*
i. Service and bleed brake system in accordance with Servicing Instructions, Section 2.

j. Perform operational check on landing gear.

k. Remove jacks and inflate strut in accordance with Section 2.

l. Check landing gear alignment in accordance with Main Wheel Alignment and Figure 4-5.

Main Wheel Alignment. (See figure 4-5.)

Correct alignment of the main landing wheels is necessary to minimize tire wear. If the tires are wearing excessively or unevenly, the wheel alignment should be checked and corrected in accordance with the following procedure:

a. Position the aircraft with the main wheels resting on grease plates.

NOTE

For each set of grease plates, use two aluminum sheets approximately 18 inches square with sufficient grease spread between them to permit the top plates to slide freely on the bottom plates.

b. Set a straightedge in place against the main wheel tires at axle height as illustrated.

c. Place one leg of a carpenter’s framing square against the straightedge, with the other leg against the inboard side of the wheel being checked. Measure the distance from framing square leg adjacent to wheel, to wheel rim, at extreme aft circumference of wheel rim. The difference between the two measurements will be the toe in or toe-out for that wheel. Maximum permissible toe-out for either wheel is 0.06 ± 0.05 inch.

NOTE

The aircraft must be jacked to remove weight from main gear before removing washers from between torque links.

d. Remove washers from between torque links to correct for excessive toe-in. Wheel adjustment after adjustment must be within limits prescribed in step “c.”

NOTE

(See figure 4-5.) AN960-716 and AN960-716L washers are used as shims between the upper and lower torque links. Combinations of thick and thin washers can be used between the torque links to obtain the correct wheel alignment. For each washer that is added or removed from between the torque links, washers of the same thickness must be removed from or added to the outside of the torque links so that .004 to .020 inch sideplay is maintained. Insure that washers are centered on spacer while torquing bolt. (See figure 1-4. for torque values.)
Figure 4-6. Main Landing Gear Door Installation
### Main Landing Gear Doors

The main landing gear is equipped with wheel well doors and strut doors. Each strut door, pivoting on a continuous hinge located at its outboard end, is operated by a push-pull rod attached to the main landing gear strut. Each wheel well door, pivoting on forged aluminum hinges located at its inboard end, is operated by a bellcrank and push-pull tube, which is connected to the landing gear retracting linkage. The operating mechanism is so arranged that the wheel well door is closed when the main gear is either fully retracted or fully extended.

### Removal of Main Landing Gear Doors. (See figure 4-6.)

1. Remove strut door as follows:
   1. Disconnect door link rod from strut by removing nut and bolt.
   2. Remove cotter pins in the ends of hinge pin; then remove the hinge pin and outboard door.

2. Remove wheel well door as follows:
   1. Jack aircraft and engage manual extension, and operate toward the up position until the main gear door opens sufficiently to disconnect link from door.
   2. Disconnect the door link tube from main gear door.

3. Remove wheel well door by removing nuts, washers, and bolts attaching hinge arms to door.

   - If desired, remove hinge arms as follows:
     1. Remove lower wing root fillet and hinge covers by removing attaching screws.
     2. Remove hinge arms from brackets by removing nuts, washers, spacers, and bolts.

### Installation of Main Landing Gear Door. (See figure 4-6.)

1. If hinge arms were removed, attach to brackets with bolts, spacers, washers, and nuts. Install hinge covers and lower wing root fillet with attaching screws.

2. Install wheel well door as follows:
   1. Jack aircraft and engage manual extension to release tension on gear retraction system.

### NOTE

If length of door link tube has been changed, or new door components are being installed, rig in accordance with Rigging Procedures of Main Landing Gear Doors.

---

**Figure 4-6. Main Landing Gear Door Installation Callouts**

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>5. Screw</td>
<td>15. Door Link Tube</td>
<td>24. Cotter Pin</td>
</tr>
<tr>
<td>10. Main Wheel Well Door</td>
<td>29. Spacer</td>
<td>30. Cotter Pin</td>
</tr>
</tbody>
</table>

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If aircraft was placed on jacks, insure the gear is DOWN and locked and remove aircraft from jacks.

h. Inflate struts in accordance with Section 2.

i. Lubricate torque links in accordance with Lubrication Chart.

---

If length of door link rod has been changed or new door components are being installed, rig in accordance with Rigging Procedures of Main Landing Gear Doors.
Figure 4-7. Main Landing Gear Retracting Linkage - Inboard Components
NOTE
Make sure door link tube adjustment does not cause deformation of door.

1. Operate gear to the UP position.

CAUTION
When retracting gear while rigging door, be prepared to stop before damage can occur.

k. If necessary, readjust door link tube (15) so that door fits flush.

The door push-pull tube is to be 5 degrees over-center with the door actuator arm against its stop, as shown in figure 4-11, in both gear UP and gear DOWN position.

m. Install access hole cover on wheel well door.

NOTE
Door actuator arm (19) and bellcrank (33) are a matched set and should not be separated.

Main Landing Gear Retracting Linkage.

The main landing gear retracting linkage consists of push-pull tubes, bellcranks, torque tubes, braces, and links interconnected between the landing gear actuator and the main landing gear. A positive downlock is obtained by rigging the main side links to an over-center position. The link assemblies which hold the main side links in an over-center position are also rigged over-center. Downlock springs, which apply spring tension to the over-center position of the link assemblies, are provided as an added safety feature. Hook-type mechanical locks are provided to lock the landing gear in its retracted position. The main landing gear retracting linkage also operates the main landing gear door operating mechanism.

Removal of Main Landing Gear Retracting Linkage.
(See figures 4-7 and 4-8.)

a. Jack the aircraft in accordance with Section 2.
b. Disconnect main landing gear doors.
c. Release tension on retracting linkage by engaging hand crank and operating a few turns toward the UP position.
d. Remove access hole cover from underside of wing, forward of wheel well.
e. Remove rear seats, carpet, and floorboard to gain access to the landing gear actuator.
f. Remove the intermediate push-pull tube (4) as follows:
   1. Disconnect drive tube from landing gear actuator bellcrank.
   2. Disconnect drive tube from idler bellcrank (16) by removing nut (46), spacers (44), and bolt; then remove drive tube by pulling into the wheel well area.
g. Remove idler bellcrank (16) and door operating linkage as follows:
   1. Remove nut (35) and bolt (31) and four screws attaching bearing housing to web.
   2. Remove nut (27) and thrust bearing washer (29) then pull door actuator arm (19) thru web. Then remove thrust bearing washers (36).

NOTE
Door actuator arm (19) and bellcrank (33) are a matched set and should not be separated.

3. Remove nut (37), thrust bearing washers (40), and bolt (10) attaching idler bellcrank (16) to front spar and support web.
4. Remove nut (24), thrust bearing washers (20), and bolt (17) attaching bellcrank rocker arm (22) to front spar and support web.
5. Pull bellcranks and attached linkage from between front spar and support web.
6. Remove the spacers (23 and 41) from the idler bellcrank (16) and bellcrank rocker arm (22).

Figure 4-7. Main Landing Gear Retracting Linkage-Inboard Components Callouts

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Nut</td>
<td>20. Thrust Bearing Washer</td>
</tr>
<tr>
<td>2. Bolt</td>
<td>21. Roll Pin</td>
</tr>
<tr>
<td>3. Torque Tube</td>
<td>22. Bellcrank Rocker Arm</td>
</tr>
<tr>
<td>5. Washer</td>
<td>24. Nut</td>
</tr>
<tr>
<td>8. Washer</td>
<td>27. Nut</td>
</tr>
<tr>
<td>12. Door Link Tube</td>
<td>31. Bolt</td>
</tr>
<tr>
<td>13. Nut</td>
<td>32. Rocker Arm Lower Link</td>
</tr>
<tr>
<td>14. Washer</td>
<td>33. Bellcrank</td>
</tr>
<tr>
<td>15. Upper Connecting Link</td>
<td>34. Washer</td>
</tr>
<tr>
<td>16. Idler Bellcrank</td>
<td>35. Nut</td>
</tr>
<tr>
<td>17. Bolt</td>
<td>36. Washer</td>
</tr>
<tr>
<td>18. Spacer</td>
<td>37. Nut</td>
</tr>
<tr>
<td>19. Door Actuator Arm</td>
<td>38. Nut</td>
</tr>
<tr>
<td></td>
<td>39. Bolt</td>
</tr>
<tr>
<td></td>
<td>40. Thrust Bearing Washer</td>
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<tr>
<td></td>
<td>41. Spacer</td>
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<tr>
<td></td>
<td>42. Bolt</td>
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<tr>
<td></td>
<td>43. Bolt</td>
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<tr>
<td></td>
<td>44. Spacer</td>
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<tr>
<td></td>
<td>45. LH Main Drive Tube</td>
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<tr>
<td></td>
<td>46. Nut</td>
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<tr>
<td></td>
<td>47. Nut</td>
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<tr>
<td></td>
<td>48. Bearing</td>
</tr>
<tr>
<td></td>
<td>49. Inner Drive Tube</td>
</tr>
<tr>
<td></td>
<td>50. Bolt</td>
</tr>
<tr>
<td></td>
<td>51. Outer Drive Tube</td>
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<tr>
<td></td>
<td>52. Bolt</td>
</tr>
<tr>
<td></td>
<td>53. Bushing</td>
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<tr>
<td></td>
<td>54. Idler</td>
</tr>
<tr>
<td></td>
<td>55. Washer</td>
</tr>
<tr>
<td></td>
<td>56. Nut</td>
</tr>
</tbody>
</table>
Figure 4-8. Main Gear Retracting Linkage-Outboard Components Callouts

1. Outboard Push-Pull Tube
2. Bolt
3. Torque Tube
4. Bolt
5. Nut
6. Nut
7. Washer
8. Bolt
9. Nut
10. Uplock Push-Pull Tube
11. Washer
12. Mounting Bracket
13. Rib Assembly
14. Nut
15. Support
16. Bolt
17. Bolt
18. Upper Side Link
19. Uplock Assembly
20. Washer
21. Nut
22. Nut
23. Washer
24. Bolt
25. Screw
26. Spacer
27. Nut
28. Washer
29. Nut
30. Spacer
31. Nut
32. Washer
33. Bolt
34. Bolt
35. Bellcrank
36. Pin
37. Down Indicator Switch
38. Spacer
39. Nut
40. Screw
41. Setscrew
42. Side Brace Lock Link
43. Check Nut
44. End Fitting
45. Bolt
46. Nut
47. Spacer
48. Bolt
49. Nut
50. Door Link Rod
51. Nut
52. Washer
53. Spacer
54. Bolt
55. Nut
56. Bolt
57. Lower Side Link
58. Washer
59. Nut
60. Washer

7. Remove upper connecting links (15) by removing nuts (13), washers (14), and bolts (25).
8. Remove rocker arm lower link (32) by removing nuts (30 and 35), washers (28 and 34), and bolts (25 and 31).

NOTE
See figure 4-8 for the following steps.

h. Remove outboard push-pull tube (1) as follows:
   1. Disconnect the push-pull tube from the bellcrank (35) by removing nut (31), washer (32), and bolts (34).
   2. Disconnect push-pull tube from torque tube (3) by removing nut (5) and bolt (4).
   3. Disconnect bellcrank (35) and side brace lock link (42) as follows:
      1. Disconnect DOWN indicator switch (37) by removing nuts (39) and screws (40).
      2. Remove downlock spring.
      3. Disconnect side brace lock link from lower side link (57) by removing nut (55), washer (60), and bolt (45).
      4. Disconnect bellcrank (35) from the upper barrel by removing nut (29), spacer (30), and bolt (33).
      5. Remove the side brace lock link (42) from the bellcrank (35) by removing setscrew (41) and pin (36).
   j. Remove uplock assembly as follows:
      1. Disconnect uplock push-pull tube (10) from uplock assembly by removing nut (22), washer (23), and bolt (24).
      2. Remove screws (25) and spacer (26) attaching uplock assembly to side link (18).
   k. Remove side links (18 and 57) as follows:
      1. Disconnect lower side link (57) from upper barrel by removing nut (49), door link rod (50), nut (51), washers (52), spacers (53), and bolt (54).
      1. Remove torque tube (3) as follows:
         1. Disconnect uplock push-pull tube (10) from torque tube by removing nut (6), washer (7), and bolt (8).
         2. Remove nut (9), washer (11), and bolt (2) attaching torque tube to rib mounting bracket.
   3. (See figure 4-7) Remove nut (1), washer (8), and bolt (9) attaching torque tube to torque tube support (7).

Installation of Main Landing Gear Retracting Linkage. (See figure 4-8.)

NOTE
See figure 4-7 for the following steps.

f. Install idler bellcrank (16) and door operating linkage as follows:

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4-24 LANDING GEAR AND BRAKE SYSTEM

1. Attach rocker arm lower link (32) to bellcrank rocker arm (22) and bellcrank (33) with bolts (25 and 31), washers (28 and 34), and nuts (30 and 35).
2. Attach upper connecting links (15) to bellcrank rocker arm (22) and idler bellcrank (16) with bolts (29), washers (14), and nuts (13).
3. Install spacers (23 and 41) in idler bellcrank (16) and idler bellcrank rocker bell (22).
4. Place bellcranks and attached linkage in position between front spar and support web.
5. Install bellcrank rocker arm (22) with bolt (17), thrust bearing washers (20) and nut (24).
6. Install idler bellcrank (16) with bolt (10), thrust bearing washers (40), and nut (37).
7. Install door actuator arm (19) and shaft and arm assembly thru web; then install thrust bearing washer (29) and nut (27).
8. Install four screws attaching bearing housing to web and bolt (31) and nut (35). Safety with locktite sealant.

NOTE
Door actuator arm (19) and bellcrank (33) are a matched set.

i. Install landing gear drive tube (45) as follows:
1. Insert drive tube into position from the wheel well and attach to idler bellcrank (16) with bolt (42), spacer (44), and nut (46).
2. Attach drive tube to landing gear actuator bellcrank.
3. Install intermediate push-pull tube (4) as follows:
1. Attach push-pull tube to torque tube (3) with bolt (2), washer (5), and nut (6) then connect spring.
2. Attach push-pull tube to idler bellcrank (16) with bolt (43), spacers (18), and nut (47).
4. Install four screws attaching bearing housing to web and bolt (31) and nut (35). Safety with locktite sealant.

NOTE
Door actuator arm (19) and bellcrank (33) are a matched set.

j. Install landing gear drive tube (45) as follows:
1. Connect landing gear doors and rig per Main Landing Gear Door Rigging Procedure.
2. Connect landing gear doors and rig per Main Landing Gear Door Rigging Procedure.
3. Install intermediate push-pull tube (4) as follows:
1. Attach push-pull tube to torque tube (3) with bolt (2), washer (5), and nut (6) then connect spring.
2. Attach push-pull tube to idler bellcrank (16) with bolt (43), spacers (18), and nut (47).
4. Install access hole covers on underside of wing forward of wheel well.
5. Install floorboard and rear carpet.
6. Connect landing gear doors and rig per Main Landing Gear Door Rigging Procedure.
7. Install access hole covers on underside of wing forward of wheel well.
8. Install floorboard and rear carpet.
9. Connect landing gear doors and rig per Main Landing Gear Door Rigging Procedure.
10. Install four screws attaching bearing housing to web and bolt (31) and nut (35). Safety with locktite sealant.

Rigging of Main Landing Gear. (See figure 4-1.)

The following landing gear rigging procedure is designed specifically for the Model 411. A faithful following of this procedure will result in a properly rigged and efficient operating systems. Before starting the rigging the "toe-in" should be checked in accordance with main wheel alignment procedures and the tires inflated to proper pressure.

CAUTION
Assure shock struts are properly serviced with oil and air prior to retracting the landing gear.

a. Jack aircraft using the three provided jack points. One point is located on the underside of the fuselage, just aft of the nose wheel well, and one point is located on the lower surface of each wing on the wing rear spar, just aft of the main gear attach points. Position jacks to clear movement of main gear strut door.

CAUTION
Anytime the floorboards are removed a temporary protective cover should always be used to prevent damage and improper settings of the landing gear actuator limit switches.

b. Remove carpet and floorboards covering the gear box and idler in the fuselage.
c. Release compression on retracting linkage by engaging manual extension crank and operating a sufficient number of turns toward the up position to open the inboard main gear door 20°-30°.

NOTE
Prior to any operation of the landing gear by the manual extension crank, assure there is no electrical power on the aircraft, and the landing gear switch is in the neutral position.

d. (See figure 4-6) Remove main wheel well door actuating tube (15) by removing nut (14) and washer (11) from the door actuator bellcrank (16); and nut (12), washers (11), spacers (13), and bolt (17) from the door attachment.
e. (See figure 4-15) Disconnect nose gear retracting linkage in the nose gear wheel well by removing nut, washer, and bolt attaching forward push-pull tube (37) to fork bolt (39) on the torque tube.
f. Remove seats and carpet above landing gear actuator and remove floorboard and access hole covers from bottom of landing gear actuator.

g. (See figure 4-7) Disconnect the inboard end of both intermediate push-pull tubes (4) (wing root idler to torque tube) by removing nut (47), washers (18), and bolt (43). Disconnect RH center main drive tube (51), and reconnect inner drive tube (49) to idler (54).
h. (See figure 4-1) Disconnect nose gear drive tube (37) at gear actuator bellcrank by removing cotter pin (34), nut (35), washer (36), and bolt (38).

CAUTION
During operation of landing gear actuator be prepared to stop to prevent any possible damage.

CAUTION
(See figure 4-9) It is recommended that the LH main drive tube (21) be held during actuation to prevent damage to the structure. It may be necessary to install a length of safety-wire in the LH main drive tube end to help hold tube in position during operation.

j. (See figure 4-1) Adjust the UP and DOWN limit switches (17 and 44) on the main gear box and main drive tube as follows:
1. Adjust both limit switches to the end of their adjusting slots in a direction which will permit maximum bellcrank travel.

NOTE
When adjusting either limit switch, align switch so that roller is contacted squarely by the bellcrank or drive tube.
2. Engage manual extension crank and operate toward the up position until the internal stop in the actuator is reached. To prevent possible damage to the actuator, do not force against the internal stop.

3. (See figure 4-1) Note the angular position of the crank when internal stop is reached. Back crank off toward the down position 2-1/2 turns of the hand crank, then advance crank one turn toward the up position. Adjust the up limit switch so that it is just actuated at this point (17). Repeat 2-1/2 and 1 turn operations to insure setting is correct.

4. (See figure 4-1) Manually operate the gear box bellcrank (12) toward the down position until the internal stop in the actuator is reached. Do not force against the internal stop.

5. (See figure 4-1) Note the angular position of the crank when internal stop is reached. Back crank off toward the up position three turns of the hand crank, then advance the crank one turn toward the down position. Adjust the down limit switch (44) so that it is just actuated at this point. The down limit switch is actuated by the main gear drive tube (48) end fitting. Repeat three and one turn operations to insure setting is correct.

6. After these preliminary adjustments to the limit switches have been made, stow the manual extension crank and operate the actuator electrically to the up position until the up limit switch is actuated.

CAUTION

Caution must be observed during actuation to insure that no damage is incurred by the disconnected ends of the main and nose drive tubes.

NOTE

To facilitate rigging of the landing gear, a two-position momentary ON switch with suitable lengths of electrical wires can be connected to the landing gear electrical circuit in such a manner that the landing gear can be observed while being operated during rigging. The use of an external power source is also recommended.

7. Engage the manual extension crank and note the angular position of the crank. Operate crank toward the up position noting the number of turns required to reach the internal stop in the actuator. The minimum number of turns required in the down position is one and the maximum (and desired) number of turns is two. If necessary, adjust the down limit switch to meet this requirement.

10. (See figure 4-1) Connect LH main drive tube (10) and connect RH outer drive tube (51, figure 4-7) to idlers. Actuate gear box electrically to the down position. Manually place door actuator arm (19, figure 4-7) against its stop in gear down position. Adjust LH main drive tube (45, figure 4-7) to align with hole in bellcrank (16, figure 4-7). Lengthen rod end two turns. Actuate gear actuator electrically toward the up position as required to install bolts (42), washers (44), and nut (46).

CAUTION

Bolts (42 and 43, figure 4-7) must be installed with head of bolts forward.

11. (See figure 4-9) Operate actuator to the up position and check the pull force required to move the door actuator arms (6) from their stops (5), as illustrated (figure 4-10).

NOTE

The pull required to move door actuator arm from stop must be measured at a right angle to the arm. The tool illustrated in figure 4-10 can be made to facilitate this measurement.

12. (See figure 4-9) Adjust the length of both main drive tubes (19 and 21) as necessary to obtain an equal force in pounds required to move door actuator arms (19, figure 4-7) from stops in both the up position and the down position. The maximum difference between the forces required to move one door actuator arm from its stop, in both up and down positions, is ten pounds. The maximum force required to move the door actuator arm from its stop is 25 -10, -10 pounds in both up and down position.

k. (See figure 4-9) Adjust side brace lock links (9) as follows:

1. With landing gear in the down position, adjust end fitting (8) so that lower side link (11) and upper side link (12) are held firmly in overcenter position when side brace lock link (9) is firmly overcenter.

2. During retraction check for clearance between lower side links (11) and outboard push-pull tube (2). It may be necessary to add or subtract washers to provide clearance.

3. Manually “Break” the lock link from its overcenter position and move the landing gear to a position five to six inches inboard from the down and locked position, then release. The landing gear must free fall and lock when released from this position.

NOTE

Adjust the side brace lock link end fitting (8) to the longest length at which the free fall requirement can be obtained and maintained. The main drive tube (21) is disconnected at the idler bellcrank (16) when checking free fall.

Change 3
4. Adjust both main landing gear side brace lock links in this manner.

NOTE
After the preceding steps have been completed, the main landing gear retracting system is rigged from the limit switches through the idler bellcranks, and both side brace lock links are adjusted at the landing gear. The following procedure is to rig the retraction system from the idler bellcranks to the side brace lock links.

1. (See figure 4-9) Make the following preliminary preparations:
   1. Remove uplocks (3) and uplock push-pull tubes (13) by removing attaching bolts.
   2. Adjust the length of intermediate push-pull tubes (15) to 1/4 inch from as short as possible and install.
   3. (See figure 4-9A) Screw fork bolts (2) into torque tubes (1) as far as possible.
   4. Operate landing gear actuator to DOWN position.
   5. (See figure 4-9A) With landing gear DOWN, adjust length of outboard push-pull tubes (4) so that rod end holes align with the holes in fork bolts (2) and bellcranks (10, figure 4-9), then shorten one turn.
   6. Operate landing gear actuator toward the UP position far enough to permit installation and install outboard push-pull tubes (4). INSTALL WITH THE COLLAR-END OF THE HI-SHEAR RIVETS POINTING DOWN FOR CLEARANCE.

   The preceding preparations will result in incomplete retraction, thus eliminating the possibility of damage to the wing structure caused by retracting too far.

6. (See figure 4-8) Adjust outboard push-pull tubes (1) to a preliminary length of 5.15 inches and attach to torque tube with bolts (8), washers (7), and nuts (6).
7. (See figure 4-8) Connect uplock push-pull tubes (10) to uplock assemblies with bolts (24), washers (23), and nuts (22). DO NOT INSTALL UPLOCK HOOKS.

m. Operate landing gear to the UP position and observe the highest position reached by the gear during retraction and the amount of drop-off.

n. Adjust the highest position reached by the gear during retraction as follows:
   1. (See figure 4-9) Lengthen fork bolt (4) in half-turns to increase the highest position during retraction.

NOTE
Figure 4-9A illustrates this adjustment. Lengthening the fork bolt increases dimension "B," the longer dimension "B" is, the higher the gear will retract.

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**Figure 4-9. Schematic of Main Gear Retracting Linkage**

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1. Torque Tube 3. Rod End
2. Fork Bolt 4. Outboard Push-Pull Tube

Figure 4-9A. Fork Bolt Adjustment

2. The axle dust cover should make light contact with the corrugated reinforcement at the top of wheel well, then drop down a specified distance. Refer to step "a."

3. Adjust the fork bolts for both main landing gears in this manner.

4. (See figure 4-9) Adjust the amount of drop-off as follows:
   1. Determine whether drop-off is too little or too much. The minimum and desired amount of drop-off, measured at the center of the wheel, is 1/8 inch. The maximum is 1/4 inch.
   2. If drop-off is too much, lengthen intermediate push-pull tube (1) in half-turn increments until drop-off is correct.

Figure 4-9B. Drop-Off Adjustment

Figure 4-9C. Measuring Drop-Off

NOTE: DIMENSIONS ARE FOR ILLUSTRATING PRINCIPLE ONLY.

NOTE

Figure 4-9D. Principle Used for Obtaining Drop-Off

NOTE: DIMENSIONS ARE FOR ILLUSTRATING PRINCIPLE ONLY.
3. (See figure 4-9B) If drop-off is too little, shorten intermediate push-pull tube (1) in half-turn increments until drop-off is correct.

4. Adjust the amount of drop-off for both main landing gears in this manner.

NOTE

Whenever changes have been made in the main landing gear drop-off make sure uplock hook engages properly.

p. Adjust the down lock tension as follows:

1. (See figure 4-11) Operate the landing gear to the DOWN position. The main landing gear down lock tension should be 40 to 60 pounds. During rigging, the down lock tension should be maintained between 40 and 50 pounds. The 60 pound upper limit during routine maintenance is established in order to compensate for variances of aircraft loading and temperature. If at anytime, either main landing gear down lock tension checks under 40 or over 60 pounds, re-rig as necessary.

2. If down lock tension is too high, lengthen outboard push-pull tube (4, figure 4-9A) until the correct down lock tension is obtained.

NOTE

(See figure 4-9A) Since the highest position during retraction is controlled by the combined length of the outboard push-pull tube (4) and the fork bolt (2), this combined length must remain unchanged to maintain the correct highest position. When adjusting the outboard push-pull tube to obtain the specified down lock tension, the fork bolt must be readjusted a corresponding amount in the direction that will not change the combined length of the push-pull tube and fork bolt.

CAUTION

The bolt (4, figure 4-8) installing outboard push-pull tube (4, figure 4-9A) to the fork bolt (2, figure 4-9A) must be installed with the bolt head forward.

3. (See figure 4-9A) If down lock tension is too low, shorten outboard push-pull tube (4) until the correct down lock tension is obtained. Readjust the fork bolt (2) as required in the preceding "NOTE."

4. Adjust the down lock tension for both main landing gear in this manner.

NOTE

(See figure 4-9) In addition to the down lock tension requirement, the landing gear must also "free fall" and lock when released from a position which is not more than six inches inboard from the DOWN position, while intermediate push-pull tube (15) is DISCONNECTED from idler bellcrank (16). If necessary, readjust side brace lock link (9) to obtain this condition.

q. (See figure 4-8) Install and adjust uplocks as follows:

1. Insure that spacers (26) are in place, position uplock assemblies (19), and attach to upper side links with nuts. Do not tighten attachment.

2. Operate landing gear to the UP position.

CAUTION

Use caution when landing gear nears the UP position before adjustment of uplock push-pull tubes has been completed. If necessary, readjust the push-pull tube and/or uplock hooks to prevent damage.

3. Adjust uplock push-pull tubes so that uplock assemblies fully engage the spacers provided on the landing gear and tighten nuts.

NOTE

Elongated slots are provided in the uplock hooks so that each uplock hook can be adjusted vertically to contact the spacers.

4. Operate the landing gear several times, observing uplock assemblies. Uplock hooks must engage fully with the spacers provided on the gear, and must engage and disengage freely and smoothly with no indication of binding.

5. VISUALLY CHECK THE ALIGNMENT OF ALL ROD ENDS TO INSURE THAT THEY ALIGN WITH THEIR ATTACH FITTINGS.

r. (See figure 4-15) Connect nose gear retracting linkage by installing bolt (38) and nut (36) attaching forward push-pull tube (37) to fork bolt (39).

NOTE

If landing gear retraction system limit switch adjustment was changed while rigging the main landing gear, disregard step "q" and rig nose gear in accordance with Nose Gear Rigging Procedure.

s. (See figure 4-8) Install main wheel well door link tubes (15) with bolts (17), spacers (13), washers (11), and nuts (14 and 12). Rig doors in accordance with Main Gear Landing Gear Doors Rigging Procedure.

t. Reinstall floorboards, seats, carpet, and access covers.

u. Insure that landing gear is DOWN and locked, then remove jacks.

Adjustment of Landing Gear Safety Switch.

The landing gear safety switch is located on the aft side of the left main landing gear and is actuated by the upper torque link.

a. Jack aircraft in accordance with Section 2.

b. Place landing gear switch in the DOWN position.

c. Insure that battery switch is OFF.

d. With left main landing gear strut fully extended, adjust arm of landing gear safety switch so that switch is actuated when the arm is raised to a position which is approximately .30 inch from torque tube.
NOTE
The arm is adjusted by removing the cotter pin and nut which attach the arm to the switch, repositioning the arm, and reinstalling the nut and cotter pin.

e. Check the adjustment of the landing gear safety switch as follows:

WARNING
Since landing gear may retract if adjustment of safety switch is incorrect, insure that all wheel well areas are clear while performing the following checks.

1. If available, connect an external power source, if not available, turn battery switch ON.
2. Raise the switch arm to the position adjusted in step "d." While holding the switch arm in this position, have an assistant place the landing gear switch in the UP position. Landing gear should NOT retract.
3. Continue to raise the switch arm upward to the end of its travel. Landing gear should NOT retract.
4. Release the switch arm. Landing gear SHOULD retract.
5. Operate landing gear through several cycles, checking landing gear for proper operation.

f. Insure that landing gear switch and landing gear are DOWN and battery switch is OFF, then remove jacks.

Adjustment of Landing Gear Warning System.
a. Adjust the throttle microswitch as follows:

NOTE
To properly adjust the throttle microswitch, it is necessary to fly the aircraft. As a preliminary adjustment before flight, adjust microswitch to actuate when the aft edges of the throttle levers are approximately 3/16 inch aft of the word "THROTTLE" on the control quadrant.

1. Obtain a pressure altitude of 2500 feet.
2. Adjust propeller pitch levers to obtain 2300 rpm on both engines.
3. Place mixture levers in FULL RICH.
4. Retard throttle levers to obtain 12 inches of manifold pressure.

NOTE
If throttle levers are retarded below the specified manifold pressure, advance them and repeat the retarding procedure.

b. Adjust DOWN indicator switches as follows:
1. (See figure 4-6) Disconnect main wheel door link tubes (15) from main wheel well door (10).
2. (See figure 4-14) Disconnect nose gear door link tube (15) from nose gear door hinge (21).
3. Release tension on retracting linkage by engaging manual extension crank and operating a few turns toward the UP position.
4. (See figure 4-15) Disconnect nose gear forward push-pull tube (37) from fork bolt (39) by removing nut and bolt.
5. (See figure 4-7) Disconnect main gear intermediate push-pull tube (4) from idle bellcrank (16) by removing nut, spacers and bolt.
6. Adjust all three DOWN indicator switches so that they are not actuated until landing gear is DOWN and locked by the over-center linkage. Adjust the main landing gear switches by repositioning. Adjust the nose gear switch by adjusting the switch actuating bolt.
7. Attach the push-pull tubes disconnected in steps "4" and "5, "
8. Using the normal landing gear retraction system, operate landing gear to the UP position.
9. Place landing gear switch in a neutral position, engage the manual extension crank, and lower the landing gear. Stop cranking immediately when the green light illuminates, and note the exact angular position of the crank.
10. After microswitch adjustment is completed, place throttle levers in the CLOSED position and the mixture levers in IDLE CUT-OFF.

NOTE
The remainder of the adjusting procedure must be accomplished with the aircraft on the ground.

6. With engines not being operated, place mixture levers in FULL RICH.

WARNING
Insure that fuel selector valve handles and fuel boost pump switches are in the OFF position.

7. Jack aircraft in accordance with Section 2.
8. Fully advance throttle levers, then retard to the position marked on the control quadrant during flight.
9. Adjust the throttle microswitch to actuate at this position. Turn battery switch ON and check that warning horn sounds as throttle levers are retarded to this position, then turn battery switch OFF.

NOTE
Elongated slots are provided for vertical adjustment and an adjusting screw positions the microswitch horizontally.

10. After microswitch adjustment is completed, place throttle levers in the CLOSED position and the mixture levers in IDLE CUT-OFF.
11. Resume cranking toward the DOWN position, noting the number of turns required, until the internal stop in the landing gear actuator is reached. The number of turns required should not be less than four, nor more than eight.

12. If necessary, readjust DOWN indicator switches as required to meet the conditions of steps "6" and "11."

13. (See figure 4-16) Connect nose gear forward push-pull tube (7) to fork bolt (8).

14. (See figure 4-7) Connect main gear intermediate push-pull tube (4) to idler bellcrank (16).

15. Insure that landing gear is DOWN, then remove jacks.

**NOSE GEAR.**

The nose gear consists of a wheel and tire assembly, yoke, axle, lower strut, upper strut, trunnion assembly, torque links, and shimmy dampener. The Air-oleo shock strut contains an orifice and tapered metering pin which vary the resistance to shock according to its severity. During extension and re-

---

**Figure 4-10. Fabrication and Use of Tool for Measuring Door Actuator Arm Tension**
4-11 SERVICE MANUAL

LANDING GEAR AND BRAKE SYSTEM

SPRING SCALE
MODEL 140 HEAVY DUTY 0-200 LBS.
JOHN H. CHATILLION & SON
85 CLIFF STREET
NEW YORK CITY, NEW YORK

Figure 4-11. Main Landing Gear Down Lock Requirements and Torque Links

40-50 LBS. DURING RIGGING
40-60 LBS. FOR ROUTINE IN-SERVICE INSPECTION
NOTE
To facilitate installation, rub wax or paraffin on the wheel well bulkheads against which the retainers must slide; and move forward evenly.

c. Install eight bolts (14), washers (16), and nuts (17) attaching retainers to airframe. Torque heads of bolts to 85 ± 15 inch-pounds.

d. Align Gimbal fitting on nose gear steering unit and install spacers (27 and 28), washers (26 and 30), and bolts (25 and 29). Torque bolts to 50-70 inch-pounds.

Removal and Disassembly of Nose Gear Torque Link Assemblies.

a. Nose Gear (see figure 4-13).

WARNING
If the aircraft is on jacks, it is advisable to deflate struts before removing torque links to avoid possible damage.

1. Remove cotter pins (11, 37 and 42).
2. Remove nuts (10, 38 and 43).
3. Remove washers (7, 39 and 44).
4. Remove spacers (8, 48 and 57).
5. Remove bolts (6, 49 and 56) attaching links to strut and attaching the upper torque links to the lower torque links.

NOTE
Observe the number of washers (53) installed to facilitate reinstallation.

6. Remove nose gear torque links by pulling forward.

NOTE
The bushings and spacers in the torque links are a press fit and should be removed only for replacement.

b. Remove grease fittings from torque links.

Assembly and Installation of Nose Gear Torque Link Assemblies.

a. Nose Gear (see figure 4-13).
1. If removed, press in new bushings (40, 52 and 55).

NOTE
Bushings must be pressed in wet using MIL-P-8585 zinc chromate primer or equivalent, and lube fitting holes of bushings (52 and 55), aligned with torque brace lube fitting holes.

b. If aircraft was placed on jacks, insure the gear is DOWN and locked and remove aircraft from jacks.

c. Lubricate torque links in accordance with Lubrication Chart.

Nose Gear Doors.

Right and left main doors are used to enclose the nose gear in its retracted position. The doors are connected to the nose gear retracting linkage and hinged at their outboard ends, pivoting downward during nose gear extension and remaining down while the nose gear is down.

Removal of Nose Gear Doors. (See figure 4-14.)

a. Remove nut, washers, and bolt from door link tubes (3 and 15).

b. Remove the three nuts and bolts from four hinge brackets and doors; then remove doors.

c. Remove Nose gear door hinges as follows:
1. Remove necessary radio equipment and shelves to gain access to hinge bolts.
2. Remove nuts, spacers, washers, and bolts from hinge brackets and remove hinges.
Installation of Nose Gear Doors.

a. If nose gear door hinges were removed, install as follows:
   1. Install hinges in brackets using bolts, washers, spacers, and nuts.
   2. Replace radio shelves and equipment removed previously.
   b. Install nose gear doors at the four hinges with the three bolts and nuts.
   c. Connect door link tubes with bolt, washers, and nut.
   d. Rig nose gear doors in accordance with rigging procedure.

Rigging Nose Gear Door. (See figure 4-14.)

a. Jack aircraft in accordance with Section 2.

b. Disconnect main door link tubes (3 and 15) from center hinges (8 and 21) by removing cotter pins, nuts, washers, and bolts.

c. Using the normal landing gear retraction system, operate gear to the UP position.

NOTE

The use of an external power source is recommended for operation of electrical units while engines are not being operated.

CAUTION

When operating gear before door rigging is completed, be prepared to stop before damage can occur. On new doors, operation by hand is necessary to make sure of clearance between fuselage skin and door.
d. Connect and adjust main door link tubes (3 and 15) until main doors close snugly when gear is in the UP position.

e. Extend and retract gear, check for clearance between nose tire and doors, and readjust door link tubes (3 and 15) as necessary to obtain clearance.

f. Insure that landing gear is DOWN and locked, then remove jacks.

Nose Gear Retracting Linkage.

The nose gear retracting linkage consists of a drag brace, truss assembly, bellcranks, torque tubes, and push-pull tubes interconnected between the landing gear actuator and the nose gear. A positive down lock is obtained by rigging the drag brace to an over-center position. The connector link assembly which holds the drag brace in an over-center position is also rigged over-center. A hook-type mechanical lock is provided to lock the nose gear in its retracted position. The nose gear retracting linkage also operates the main nose gear doors.

Removal of Nose Gear Retracting Linkage. (See figure 4-15.)

a. Jack the aircraft in accordance with Section 2.

b. Remove pilot's seat and front carpet.

c. Remove covers from access holes from underside of fuselage and left front cabin floor.

![Diagram of Nose Gear Doors Installation](image-url)

**Figure 4-14. Nose Gear Doors Installation**
Figure 4-16. Schematic of Nose Gear Retracting Linkage

1. Nose Gear Strut
2. Adjusting Fork
3. Connector Link
4. Adjusting Rod End
5. Uplock Torque Tube
6. Spring
7. Forward Push-Pull Tube
8. Fork Bolt
9. Adjusting Bellcrank
10. Intermediate Push-Pull Tube
11. Idler Bellcrank
12. Nose Gear Drive Tube
13. Actuator Bellcrank
14. Landing Gear Actuator
15. Torque Tube Assembly
16. Outboard Bellcrank
17. Truss Assembly
18. Drag Brace
operation of electrical units while engines are not being operated.

3. Check the up lock tension at the nose gear door actuator arm, as illustrated in figure 4-17. The force required to move the connector link from its position against up lock torque tube must be 75 ±10-15 pounds.

4. Shorten forward push-pull tube (7) in half-turn increments to increase up lock tension; lengthen to decrease.

5. Operate landing gear to the DOWN position and check the down lock tension in the same manner. The force required to move the connector link from its position against the up lock torque tube must be 25 ±10 pounds.

6. Lengthen fork bolt (8) in half-turn increments to increase down lock tension; shorten to decrease. DO NOT adjust forward push-pull tube (7).

7. Operate landing gear to the UP position and re-check the up lock tension. If necessary, readjust forward push-pull tube (7) in accordance with step 4.

NOTE
Since the combined length of fork bolt (8) and forward push-pull tube (7) determines the down lock tension, this combined length must remain unchanged. When changing the length of the push-pull tube to obtain the correct up lock tension, change the length of the fork bolt to a corresponding amount in the direction that will not change their combined length.

1. Adjust the up lock hook as follows:
   1. With landing gear in the UP position, check the clearance between up lock hook and the spacer on the strut with which the hook engages.
   2. Adjust up lock hook to obtain a minimum clearance of .002 inch and a maximum clearance of .06 inch at the closest point, which should be at the underside of the spacer, near the fully engage position of the hook.

NOTE
For adjustment of up lock hook, elongated holes are provided in the supports to which the hook is attached.

3. Operate landing gear several times to observe the up lock hook. The hook must engage and disengage freely, with no indication of binding between the hook and the spacer.

NOTE
An access cover is provided in the top of the nose gear wheel well to check up lock hooks in the gear UP position with doors closed.

j. Connect down lock assist spring and cycle landing gear. The spring must cause no interference with gear operation.

k. (See figure 4-14) Install door link tubes (3 and 15) with bolts and nuts and rig nose gear doors in accordance with Nose Gear Door Rigging Procedures.

l. Insure that landing gear is DOWN and locked, then remove aircraft from jacks.

---

**Figure 4-17. Nose Gear Tension Requirements**

Nose Gear Shimmy Dampener.

The shimmy dampener provided for the nose gear offers resistance to shimmy by forcing hydraulic fluid through small orifices in the piston. The outer housing is attached to the upper nose strut and moves as the strut turns, while the piston and piston rod are attached to the trunnion assembly which does not turn, thus causing motion between the housing and the piston.

Removal of Nose Gear Shimmy Dampener. (See figure 4-18.)

a. Disconnect piston rod (23) from trunnion assembly by removing cotter pin (26), nut (25), washer (22), and bolt (21).

b. Remove shimmy dampener by removing cotter pin (12), nut (11), bushing (18), washer (19), and bolt (21).

Disassembly of Nose Gear Shimmy Dampener. (See figure 4-18.)

a. Push piston rod (23) into shimmy dampener, remove filler plug (9) and O-ring (10), and drain fluid.

b. Remove lock ring (1) from forward end of shimmy dampener and pull piston and rod assembly from barrel (8).

**CAUTION**

Remove bearing heads and piston assemblies with care to prevent damage to seals.
1. Lock Ring  
2. Internal Retaining Ring  
3. Wiper Ring  
4. Backup Ring  
5. O-Ring  
6. Bearing Head  
7. O-Ring  
8. Barrel  
9. Filler Plug  
10. O-Ring  
11. Nut  
12. Cotter Pin  
13. Backup Ring  
14. O-Ring  
15. Roll Pin  
16. Piston  
17. Bearing Head  
18. Bushing  
19. Washer  
20. Bolt  
21. Bolt  
22. Washer  
23. Piston Rod  
24. Spacer  
25. Nut  
26. Cotter Pin

Figure 4-18. Shimmy Dampener
c. Remove O-ring (14) and backup ring (13) from piston (16).
d. Remove piston (16) from piston rod (23) by removing roll pin (15).
e. Remove bearing head (17) from piston rod (23).
f. Remove lock ring (1) from aft end of shimmy dampener and pull bearing head (6) from barrel (8).
g. Remove outer O-rings (7) from bearing heads (6 and 17).
h. Remove internal retaining rings (2), wiper rings (3), O-rings (5), and backup rings (4) from bearing heads (6 and 17).

Assembly of Nose Gear Shimmy Dampener. (See figure 4-18.)

Before each component of the shimmy dampener is assembled, assure that it is thoroughly clean, then lubricate with system hydraulic fluid.
a. Install O-ring (5), backup ring (4), wiper rings (3), and internal retaining rings (2) inside bearing heads (6 and 17).
b. Install outer O-rings (7) on bearing heads (6 and 17).
c. Install bearing head (6) in barrel (8) and secure with aft lock ring (1).
d. Position bearing head (17) on piston rod (23), then assemble piston (16) to piston rod (23) with roll pin (15).
e. Install O-ring (14) and backup rings (13) on piston (16).
f. Insert piston and piston rod assembly into barrel (8), slide bearing head (17) into position, and secure with forward lock ring (1).

CAUTION
Insert piston and bearing heads with care to prevent damage to O-rings.

g. Completely fill shimmy dampener with hydraulic fluid, as specified in Section 2, and install filler plug (9) and O-ring (10).

NOTE
For proper operation, shimmy dampener must be completely full of hydraulic fluid, with no trapped air present. Push piston rod into the shimmy dampener to the limit of its travel, then fill with hydraulic fluid. If desired, shimmy dampener can be serviced after installation in accordance with Section 2.

Installation of Nose Gear Shimmy Dampener. (See figure 4-18.)
a. Place bushing (18) in barrel (8), align mounting holes, and install bolt (20), washer (19), nut (11), and cotter pin (12).

NOTE
Lubricate bushing (18) with light oil during installation.

b. Connect the piston rod (23) to the trunnion assembly with bolt (21), washer (22), spacer (24), nut (25), and cotter pin (26).
c. If not filled with hydraulic fluid during assembly, service shimmy dampener in accordance with Section 2.

Nose Gear Steering System.
The nose gear steering system permits nose gear steering with the rudder pedals, for angles up to 18 degrees, either right or left of center. Spring loaded nose gear steering cables permit continued resisted turning action of the nose gear for steering angles greater than 18 degrees, up to a maximum of 55 degrees. Steering arms, welded to the rudder torque tubes, are connected by the steering cables, to a steering gimbal, which pivots in a support mounted directly above the nose gear trunnion assembly. The gimbal allows nose gear steering when the gear is down. When gear is retracted, the gimbal serves as an idler, permitting free wheeling of the nose gear steering.

Removal of Nose Gear Steering System. (See figure 4-19.)
a. Remove pilot's and copilot's seats.
b. Remove scuff plates from front carpet by removing attaching screws, then remove carpet and access panels on pilot's and copilot's side of aircraft.
c. Remove cable access panel from underside of aircraft.
d. Disconnect the nose gear steering cables at the forward bellcrank in the nose wheel well by loosening the turnbuckles.

CAUTION
Do not remove clevis pin from nose gear steering bellcrank without first releasing tension on the nose gear steering cables.
e. Remove necessary radio shelving to gain access to nose gear steering cable pulleys and remove cable guard pins.
f. Disconnect nose gear steering cable from rudder torque tube by removing cotter pin, nut, and bolt.
g. Pull forward cable thru wheel well web into nose section then pull cable forward and remove from aircraft.
h. Disassemble cables from spring by removing cotter pins, nuts, and bolts.
i. If desired, remove nose gear steering bellcrank as follows:
  1. Remove the two bolts in the gimbal.
  2. Remove the nut, washer, and bolt in bellcrank and remove bellcrank.

Installation of Nose Gear Steering System. (See figure 4-19.)
a. If removed, install nose gear steering bellcrank as follows:
1. Position bellcrank in place and install the two washers and bolts in the gimbal.
2. Align outer hole in bellcrank with hole in structure and install bolt, washer, and nut.
b. Attach forward end of turnbuckles to bellcrank with screws, washers, and nuts.
c. Assemble forward and aft cables to spring with bolts, nuts, and safety with cotter pins.
d. Route the aft cable thru the spring housing to the rudder torque tube and connect with bolt and nut and safety with cotter pin.
e. Route the forward cable thru nose wheel well web.
f. Attach forward end of turnbuckles to bellcrank with screws, washers, and nuts.
g. Connect nose gear steering cables to turnbuckles and tighten. Rig cable tension in accordance with Rigging of Rudder Control System (Section 7). Resafety turnbuckles.
h. Install access cover plates on underside of fuselage and under pilot's and copilot's scuff plates.

NOTE
Nose steering springs are pre-set at the factory to 85 pounds.

Rigging the Nose Gear Steering System.

Rig nose gear steering system in accordance with Section 7.

Nose Wheel and Tire Assembly.

The nose wheel is a two-piece, magnesium alloy casting. Two halves of the wheel, which are bolted together, can be separated to install the tire. Each wheel half contains a tapered roller bearing, which seats in hardened steel cups. The nose wheel rotates around a tubular axle attached to the nose strut fork.

Removal of Nose Wheel and Tire Assembly. (See figure 4-20.)

a. Jack the aircraft in accordance with Section 2.
b. Remove cotter pin (2), nut (3) and bolt (7).
c. Remove axle bolt buckets (4). After removal of buckets, the wheel and tire assembly can be removed from fork (1).
d. Remove spacers (5) and axle tube (6) from wheel.

Disassembly and Assembly of Nose Wheel and Tire Assembly.

Instructions for the disassembly and reassembly of the main wheel and tire assembly also applies to the nose wheel and tire assembly.

Installation of Nose Wheel and Tire Assembly. (See figure 4-20.)
a. Insert axle tube (6) in wheel and place spacers (5) on ends of axle tube.

b. Place wheel and tire assembly in position, align with mounting holes in fork (1), and install axle bolt buckets (4).
c. Install bolt (7) and nut (2).

NOTE
Tighten nut (3) until a slight bearing drag is felt as wheel is rotated. Loosen nut to the nearest slot that will align cotter pin hole.
d. Install cotter pin (2).
e. Insure gear is DOWN and locked, then remove aircraft from jacks.

Main Wheel and Tire Assembly.

The main wheel is a two-piece, magnesium alloy casting, equipped with a single-disc type brake. The two halves of the wheel, which are bolted together, can be separated to install the tube and tire. Tapered roller bearings, seated in hardened steel cups, are provided in each wheel half. The brake side of the main wheel is equipped with a hardened-steel brake disc, bolted to the wheel half. The brake disc is a single unit.

Removal of Main Wheel and Tire Assembly. (See figure 4-21.)
a. Jack the aircraft in accordance with Section 2.
b. Remove snap ring (1), bearing cap (2), cotter pin (3), nut (4) and washer (5) from axle.
c. Remove brake unit from plate by removing six washers and bolts and secure in a position not to interfere with removal of wheel.
d. Remove wheel and tire assembly from axle using caution to prevent damage to axle threads and to keep bearings clean.
e. Remove outer bearing cone (6) from wheel to prevent it from dropping out of wheel after wheel removal.

Disassembly of Main Wheel and Tire Assembly. (See figure 4-21.)
a. Remove tire (11) as follows:

1. Deflate tire by removing valve core from tube.

WARNING
Always deflate tire before separating wheel halves.

2. Remove nuts (7), washers (6) and bolts(17) and separate wheel halves (9 and 14).

NOTE
Remove O-ring, if installed, between wheel halves and discard, they are not necessary.

3. Separate brake disc (15) from wheel half (14).
4. Remove each wheel half from tire and remove tire and tube.
Figure 4-21. Main Wheel, Tire and Brake Assembly
### Figure 4-21. Main Wheel, Tire and Brake Assembly Callouts

<table>
<thead>
<tr>
<th>Callout</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Snap Ring</td>
</tr>
<tr>
<td>2</td>
<td>Cap</td>
</tr>
<tr>
<td>3</td>
<td>Cotter Pin</td>
</tr>
<tr>
<td>4</td>
<td>Nut</td>
</tr>
<tr>
<td>5</td>
<td>Washer</td>
</tr>
<tr>
<td>6</td>
<td>Bearing</td>
</tr>
<tr>
<td>7</td>
<td>Nut</td>
</tr>
<tr>
<td>8</td>
<td>Washer</td>
</tr>
<tr>
<td>9</td>
<td>Wheel Half</td>
</tr>
<tr>
<td>10</td>
<td>Bearing Cup</td>
</tr>
<tr>
<td>11</td>
<td>Tire</td>
</tr>
<tr>
<td>12</td>
<td>Spacer</td>
</tr>
<tr>
<td>13</td>
<td>O-Ring</td>
</tr>
<tr>
<td>14</td>
<td>Wheel Half</td>
</tr>
<tr>
<td>15</td>
<td>Bearing Cup</td>
</tr>
<tr>
<td>16</td>
<td>Brake Disc</td>
</tr>
<tr>
<td>17</td>
<td>Bolt</td>
</tr>
<tr>
<td>18</td>
<td>Bearing</td>
</tr>
<tr>
<td>19</td>
<td>Grease Seal Ring</td>
</tr>
<tr>
<td>20</td>
<td>Grease Seal Felt</td>
</tr>
<tr>
<td>21</td>
<td>Snap Ring</td>
</tr>
<tr>
<td>22</td>
<td>Nut</td>
</tr>
<tr>
<td>23</td>
<td>Washer</td>
</tr>
<tr>
<td>24</td>
<td>Plate</td>
</tr>
<tr>
<td>25</td>
<td>Bolt</td>
</tr>
<tr>
<td>26</td>
<td>Lining</td>
</tr>
<tr>
<td>27</td>
<td>Plate</td>
</tr>
<tr>
<td>28</td>
<td>Anchor Bolt</td>
</tr>
<tr>
<td>29</td>
<td>Bleeder</td>
</tr>
<tr>
<td>30</td>
<td>Brake Cylinder</td>
</tr>
<tr>
<td>31</td>
<td>Washer</td>
</tr>
<tr>
<td>32</td>
<td>Nut</td>
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<td>33</td>
<td>Washer</td>
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<tr>
<td>34</td>
<td>Bolt</td>
</tr>
<tr>
<td>35</td>
<td>Piston</td>
</tr>
<tr>
<td>36</td>
<td>O-Ring</td>
</tr>
<tr>
<td>37</td>
<td>Insulator</td>
</tr>
<tr>
<td>38</td>
<td>Insulator Shim</td>
</tr>
<tr>
<td>39</td>
<td>Backup Plate</td>
</tr>
<tr>
<td>40</td>
<td>Lining</td>
</tr>
</tbody>
</table>

b. Remove snap ring (21), felt retainers (19), felt seal (20), and bearing cone (18) from wheel half (14).

c. Bearing cups (10 and 15) are a shrink fit, and should be removed only for replacement.

**NOTE**

If removal is necessary, place wheel half in boiling water for at least 30 minutes, then remove the bearing cup by tapping cup evenly from the inner side.

Assembly of Main Wheel and Tire Assembly. (See figure 4-21.)

a. If removed, replace bearing cups (10 and 15).

**NOTE**

Bearings are a shrink fit in the wheel. To install, place wheel in boiling water for at least 30 minutes, chill bearing cups with dry ice, and tap lightly into position to insure proper seating.

b. Install tube in tire and leave deflated.

c. Place wheel halves (9 and 14) and brake disc (16) in position on tire.

d. Install bolts (17), washers (8) and nut (7). Torque nut (7) to value marked on wheel half.

**CAUTION**

Tighten nuts evenly and torque correctly to lessen the possibility of bolt failure. Make sure at least one full thread is thru nut.

e. Inflate tire enough to seat the beads on the wheels, deflate completely, then reinflate to approximately one-half operating pressure.

f. Install bearing cone (18), felt seal (20), grease seal rings (19) and snap ring (21).

**BRAKE SYSTEM - MAIN AND PARKING.**

The aircraft has a hydraulically actuated braking system. A hydraulic master cylinder is attached to each pilot's rudder pedal, and hydraulic lines and hoses are routed from these cylinders through the cabin.
through the wings, and to the brake assemblies on each main landing gear. The brakes are single-disc, non-adjustable type, with three actuating cylinders in each brake assembly. No manual adjustment is necessary on these brakes. The brakes can be operated from either pilot’s or copilot’s pedals. The parking brake system consists of a manually operated handle assembly connected to the parking brake valves located in each main brake line. When pressure is applied to the brake system and the parking brake handle is pulled, the valve holds pressure on the brake assemblies until released. To release parking brakes, push parking brake handle in.

**NOTE**

Do not depress rudder pedals when releasing parking brakes.

Trouble Shooting the Brake System.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>CORRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRAKE PEDAL BOTTOMS</td>
<td>Insufficient brake fluid in system.</td>
<td>Bleed and fill system in accordance with Section 2.</td>
</tr>
<tr>
<td></td>
<td>Brake disc warped, causing excessive clearance.</td>
<td>Replace disc.</td>
</tr>
<tr>
<td></td>
<td>Loose bleeder screw, faulty bleeder screw washer, or adapter not tight.</td>
<td>Tighten bleeder screw. Replace washer. Tighten adapter.</td>
</tr>
<tr>
<td></td>
<td>Leaking connections or broken lines or hoses.</td>
<td>Tighten connections. Replace or repair lines or hoses.</td>
</tr>
<tr>
<td>&quot;SPONGY&quot; BRAKES</td>
<td>Rudder pedals not connected to master cylinders.</td>
<td>Connect pilot’s rudder pedals to master cylinders.</td>
</tr>
<tr>
<td></td>
<td>Damaged O-ring seal in master cylinder or in brake actuating cylinder.</td>
<td>Replace O-ring seal.</td>
</tr>
<tr>
<td></td>
<td>Damaged Lock-o-seal in master cylinder.</td>
<td>Replace Lock-o-seal.</td>
</tr>
<tr>
<td>BRAKES DRAG</td>
<td>Air trapped in system.</td>
<td>Bleed system.</td>
</tr>
<tr>
<td></td>
<td>Swollen hose.</td>
<td>Replace hose.</td>
</tr>
<tr>
<td></td>
<td>Binding brake pedal linkage.</td>
<td>Free linkage to prevent binding.</td>
</tr>
<tr>
<td></td>
<td>Brake disc badly dished or warped.</td>
<td>Replace brake disc.</td>
</tr>
<tr>
<td></td>
<td>Internally swollen hoses and/or swollen O-ring seals due to improper hydraulic fluid in system.</td>
<td>Replace hoses and/or O-ring seals. Flush system with denatured alcohol. Bleed and fill system in accordance with Section 2.</td>
</tr>
<tr>
<td>BRAKES FAIL TO HOLD</td>
<td>Brake linings worn out.</td>
<td>Replace linings in accordance with Section 4.</td>
</tr>
<tr>
<td></td>
<td>New linings just installed.</td>
<td>Taxi aircraft and apply brakes several times to condition linings.</td>
</tr>
<tr>
<td></td>
<td>Air in system.</td>
<td>Bleed and fill system in accordance with Section 4.</td>
</tr>
<tr>
<td></td>
<td>Oil, grease, or other foreign material on disc or brake linings.</td>
<td>Clean and flush with carbon tetrachloride, then taxi the aircraft slowly, apply the brakes several times to condition the linings.</td>
</tr>
<tr>
<td></td>
<td>Rudder pedals positioned so that brakes cannot be fully applied.</td>
<td>Reposition pedals.</td>
</tr>
<tr>
<td></td>
<td>Brakes too hot from extensive use.</td>
<td>Allow time for brakes to cool.</td>
</tr>
</tbody>
</table>
Figure 4-22. Brake System Plumbing Installation
Removal of Brake System. (See figure 4-22.)

a. Drain fluid from system by removing bleeder valve.
b. Remove pilot's and copilot's seats in accordance with Section 3.
c. Remove front carpet and scuff plates from front floorboards.
d. Remove the access panels in front floorboard area and on bottom of fuselage.
e. Remove covers from around rudder pedals.
f. Disconnect master cylinders (29) from rudder pedals and rudder torque tube by removing cotter pins and clevis pins.
g. Remove hoses (1 and 2) from master cylinders and parking brake valve.
h. Disconnect link (11), cable (31), and stop (10), and lines (12 and 13) from parking brake valves (5).
i. Remove parking brake valves (5) by removing nuts, washers, and screws attaching valves to bulkhead.
j. Remove clamps from lines (12 and 13) then disconnect lines from elbow (14) and union (15) and remove line.

NOTE
Removal of brake lines is not recommended except for replacement.

k. Remove access panels on lower side of inboard leading edge, wing gap covers, left and right wings.
l. Remove clamps from lines (16 and 17) then disconnect at wing gap from unions (15 and 19) and pull line from stub wing section.
m. Remove clamps from lines (18 and 20) then disconnect union (19) and elbow (22) and remove lines thru access holes in wing.

NOTE
If brake cylinders are to be disassembled, proceed as follows:

a. Remove the six washers and bolts in the brake units, then remove brake unit from disc.
b. Disconnect hydraulic hose from brake unit.
c. Disassemble brake unit as follows:
   1. Remove brake linings by sliding a thin screwdriver or knife behind the lining and prying out.
   2. Install stop (10) with screw and nut, and tighten only snug at this time.
   a. Remove pilot's and copilot's seats in accordance with Section 3.
   b. Disconnect hydraulic hose from brake unit.
   c. Disassemble brake unit as follows:
      1. Remove brake cylinders are to be disassembled, proceed as follows:

Main Wheel Brake Disassembly. (See figure 4-21.)
a. Remove the six washers and bolts in the brake units, then remove brake unit from disc.
b. Disconnect hydraulic hose from brake unit.
c. Disassemble brake unit as follows:
   1. Remove brake linings by sliding a thin screwdriver or knife behind the lining and prying out.
   d. If brake cylinders are to be disassembled, proceed as follows:
1. Use air pressure or other suitable pressure to remove pistons.
2. Remove O-rings.

Main Wheel Brake Lining Replacement.

The linings should be replaced at each overhaul, or when worn in excess. If the linings are worn between .125 and .100 inch, they should be replaced.

Assembly of Main Wheel Brake. (See figure 4-21.)

a. If removed, install O-rings in brake cylinders.
b. Install pistons in each cylinder.

NOTE

With a clean cloth, wipe all parts clean and lubricate O-rings and pistons with clean hydraulic oil before installation.

c. Install brake linings in place. Insure they snap into position.

Installation of Main Wheel Brake. (See figure 4-21.)

a. Install the brake units on main wheel assembly brake disc with six bolts and washers and safety with safetywire.
b. Install hydraulic hose fitting in brake unit, if removed, and connect the hydraulic hose. Then bleed brakes in accordance with bleeding procedure in Section 4.

c. Install brake linings in place. Insure they snap into position.

e. Pump slowly until fluid in master cylinder reservoir is within 1/2 inch of the top.
f. Close bleeder plug (29) and detach bleeder pump hose.
g. Check brake operation.

NOTE

If brakes are "spongy" and do not have a solid feel in the pedals, repeat the above procedure.

h. Replace filler plug in master cylinder.

Parking Brake Valves.

The removal and installation of the parking brake valves is included in the Removal and Installation of the Brake System.

Master Cylinder. (See figure 4-24.)

Each vertical mounting type master cylinder used on the aircraft incorporates a fluid reservoir and cylinder within the same body(11). A plastic filler plug (3) is used to close the filler opening in the cover (5), which is threaded into the body. The filler plug is vented, as sufficient ventilation is not provided by clearance between the piston rod (6) and piston rod passage through the cover (5). With the exception of the piston return spring (12), all internal operating parts are assembled onto the piston rod; piston (17), piston spring (15), lock-o-seal (19), and compensating sleeve (20). A seal between the piston (17) and the cylinder walls is provided by a packing O-ring (16) installed in a groove around the piston. As pressure is applied to advance the piston rod into the cylinder, the piston remains stationary until the lock-o-seal is seated on the piston (.030 to .040 inch movement). Proper operation of the master cylinder depends upon this seating action. When the lock-o-seal is seated, fluid cannot get past the piston and with continued movement of the piston rod forcing the piston farther into the cylinder, pressure in the cylinder is increased. At any time during the stroke that pressure on the piston is eased, the piston spring will tend to keep the piston seated against the lock-o-seal, maintaining pressure in advance of the piston. As the pressure is further eased, allowing the piston return spring to force the piston to retreat, the upper end of the compensating sleeve will contact the cover boss, forcing the piston to unseat itself from the lock-o-seal. This will allow additional fluid from the reservoir to enter the cylinder. This positive unseating also allows unrestricted passage of fluid from cylinder to reservoir while the piston is in the static position. This is to compensate for any excess fluid which may be present in the system due to pumping or from thermal expansion. The effective stroke of
the piston is 1.437 inches with maximum displacement of .5327 cubic inch. Reservoir capacity is approximately 3.391 cubic inches.

Removal of Master Cylinder. (See figure 4-24.)

Removal of either master cylinder can be accomplished as follows:

a. Remove pilot's seat in accordance with Section 2.
b. Remove carpet, left scuff plate, and left access hole cover.
c. Drain hydraulic fluid from master cylinder by removing the line at the main wheel, then connect the line after draining fluid to prevent entry of foreign material into brake.

d. Disconnect clevis (1) from rudder pedal (21) by removing cotter pin (25) and pin (26).
e. Disconnect lower end of master cylinder by removing cotter pin (24), pin (22), and spacers (23). 
f. Disconnect hose from fitting (7) in base of master cylinder body (11) by lifting master cylinder enough to allow removal of hose.
g. Remove master cylinder and cap hose to prevent entry of foreign material into system.

Disassembly of Master Cylinder. (See figure 4-24.)

Disassembly of either master cylinder can be accomplished as follows:

a. Remove filler plug (3) and drain residual hydraulic fluid from reservoir portion of master cylinder. Screw (4) serves no purpose in this assembly except as a plug for the threaded hole in the cover, and need not be removed.
b. Remove setscrew (10) and unscrew cover (5) to remove cover and piston rod (6) along with the other illustrated parts which are attached to the piston rod. The piston return spring (12) will remain inside the body (11); to remove, lift from position.
c. Remove nut (14) from piston rod (6), to remove piston spring (15), piston (17), lock-o-seal (19), and compensating sleeve (20).
d. Back off jamb nut (2) from its locking position against base of clevis (1) and remove both parts from piston rod (6).
e. Remove O-ring (16) from piston (17).
f. Remove elbow (7) from body (11), if required.

**NOTE**

Clean all metal parts with a suitable solvent. O-ring seals should be washed in clean system hydraulic fluid or denatured alcohol. Inspect metal parts for wear and thread damage. Inspect cylinder walls for corrosion, pitting and scores. Damaged cylinder walls require replacement of the body (11). Inspect O-ring seal (16) and O-ring (18) portion of lock-o-seal (19) for swelling, chipping, or other evidence of damage. Replace as necessary. Repairs to master cylinder components are not recommended. Damage or defective parts should be replaced.
Figure 4-24. Brake Master Cylinder Installation
Assembly of Master Cylinder. (See figure 4-24.)

Assemble either master cylinder as follows:

a. Install lock-o-seal (19) on shank of piston rod (6).

**CAUTION**

Lubricate O-ring portion of lock-o-seal with system hydraulic fluid and install carefully to prevent damage from the threaded portion of the piston rod shank.

O-ring (18) portion of lock-o-seal (19) should be installed first, then set retainer in place around O-ring and against piston rod shank base as illustrated.

b. Slip O-ring (16) into groove in piston (17) as illustrated, using clean system hydraulic fluid as a lubricant.

**CAUTION**

Install O-ring carefully to prevent chipping on sharp corner of piston.

c. Install piston (17), piston spring (15), and nut (14) on piston rod (6) as illustrated. Tighten nut (14) and with piston spring (15) compressed to seat piston (17) against nut. Adjust clearance between piston and lock-o-seal (19) to .040 inch as illustrated, using feeler gage or .040 wire to check measurement.

**CAUTION**

Be careful, when inserting feeler gage or wire, not to damage lock-o-seal.

NOTE

The .030 to .040 inch dimension between the lock-o-seal and the piston determines the relationship between piston rod travel and seating of the lock-o-seal to the piston. Proper master cylinder operation depends upon this dimension being set correctly.

d. Place piston return spring (12) into cylinder section of body (11), broad base down, as illustrated.

e. Lubricate cylinder walls and piston (17) with clean system hydraulic fluid and insert nut (14) against piston return spring.

f. Place compensating sleeve (20) notched end toward piston, over piston rod (6). Slide cover (5) over piston rod, and tighten into body. Install setscrew (10) and tighten to prevent movement of cover (5).

g. Screw jamb nut (2) and clevis (1) onto piston rod end.

h. Install filler plug (3), and elbow (7), if removed during disassembly.

**NOTE**

If elbow is being installed, use a suitable lubricant on packing (9) and threads before screwing into master cylinder.

Installation of Master Cylinder. (See figure 4-24.)

Install either master cylinder as follows:

a. Lift hose end and connect to lower elbow (7).

**NOTE**

Use only system hydraulic fluid for lubricant when making this connection.

b. Insert pin (22) through master cylinder mounting brackets and hole in body of master cylinder (11) with spacers (23) in place as illustrated. Secure pin (22) with cotter pin (24).

c. Connect clevis (1) to rudder pedal (21) with pin (26). Adjust clevis (1) to align tips of rudder pedals (21) with rudder pedals in a neutral position. Secure pin (26) with cotter pin (25), and secure clevis with jamb nut (2).

d. Install access hole cover, carpet, and scuff plates.

e. Fill master cylinder and bleed brakes in accordance with bleeding procedure in Section 4.

f. Install pilot’s seat.