TURBO DAKOTA

MAINTENANCE MANUAL

CARD 1 OF 2

PA-28-201T

PIPER AIRCRAFT CORPORATION

[PART NUMBER 761 702]

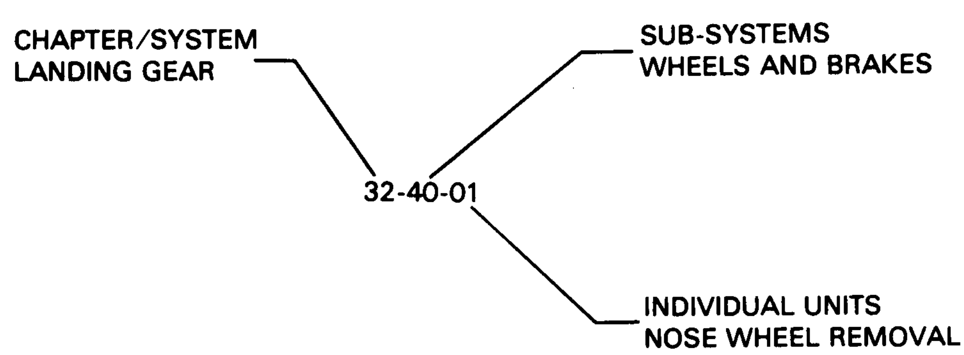
INTRODUCTION.

This PIPER AIRCRAFT Maintenance Manual is prepared in accordance with the GAMA (General Aviation Manufacturers Association) format. This maintenance manual is divided into various Groups which enable a broad separation of contents (Chapters) within each group.

The various Chapters are broken down into major systems such as Electrical Power, Flight Controls, Fuel, Landing Gear, etc. The System/Chapters are arranged more or less alphabetically rather than by precedence or importance. All System/Chapters are assigned a number, which becomes the first element of a standardized numbering system. Thus the element “32” of the number series 32-00-00 refers to the System/Chapter on “Landing Gear.” All information pertaining to the landing gear will be covered in this System/Chapter.

The major System/Chapters are then broken down into Sub-System/Sections. These sections are identified by the second element of the standardized numbering system. The number “40” of the basic number series 32-40-00 is for the “Wheels and Brakes” portion of the landing gear.

The individual units within a Sub-System/Section may be identified by a third element of the standardized numbering system, such as 32-40-01. This number could be assigned by the manufacturer to fit the coverage requirements of the publication.



This manual does not contain hardware callouts for installation. Hardware callouts are only indicated where a special application is required. To confirm the correct hardware used, refer to the PA-28-201T Parts Catalog P/N 761 701, and FAR 43 for proper utilization.

AEROFICHE EXPLANATION AND REVISION STATUS

Maintenance manual information incorporated in this set of Aerofiche cards is arranged in accordance with the general specifications of Aerofiche adopted by the General Aircraft Manufacturer's Association. The information compiled in this Aerofiche maintenance manual is kept current by revisions distributed periodically. These revisions supersede all previous revisions and are complete Aerofiche card replacements and shall supersede Aerofiche cards of the same number in the set.

Identification of revised material:

Revised text and illustrations are indicated by a black vertical line along the left-hand margin of the frame, opposite revised, and added material. Revision lines indicate only current revisions with changes and additions to existing text and illustrations. Changes in capitalization, spelling, punctuation, indexing, the physical location of the material or complete page additions are not identified by revision lines.

A reference and record of the material revised is included in each chapter's table of contents/effectivity. The codes used in the effectivity columns of each chapter are defined as follows:

TABLE OF CONTENTS/EFFECTIVITY CODES

Original Issue:	None
First Revision:	Revision Identification, (1R Month-Year)
Second Revision:	Revision Identification, (2R Month-Year)

All subsequent revisions will follow with consecutive revision numbers such as 3R, 4R, etc., along with the appropriate month-year.

Added Subject:	Revision Identification, (A Month-Year)

6. Revisions to maintenance manual 761 702 issued February 1, 1979 are as follows:

Effectivity	Publication Date	Aerofiche Card Effectivity
ORG790201	February 1, 1979	1 and 2
PR790320	March 20, 1979	1 and 2
PR800123	January 23, 1980	1 and 2
PR801103	November 3, 1980	1 and 2
PR810727	July 27, 1981	1 and 2
PR830218	February 18, 1983	1 and 2
PR840816	August 16, 1984	1 and 2
IR860730	July 30, 1986	1
IR860921	September 21, 1986	1
IR870506	July 12, 1987	1
IR950215*	February 15, 1995	1 and 2

* INTERIM CHANGE

Chapters 5, 6, and 27 of Card 1, and Chapter 51 of Card 2 have been revised. There are no other changes included in this interim change revision. Please discard your current cards 1 and 2, and replace them with the revised ones.

VENDOR PUBLICATIONS.

ENGINE:

Overhaul Manual = CONTINENTAL-OVERHAUL MANUAL
Form No. X-30030A
Teledyne Continental Motors
Aircraft Products Division
Mobile, Alabama 36601

Parts Catalog = CONTINENTAL-Form No. X-30031A
Teledyne Continental Motors
Aircraft Products Division
Mobile, Alabama 36601

Operators Handbook = CONTINENTAL-Form No. X-30512
Teledyne Continental Motors
Aircraft Products Division
Mobile, Alabama 36601

PROPELLER:

Overhaul Instructions = HARTZELL COMPACT CONSTANT SPEED
and FEATHERING PROPELLER-P/N 117-D
Hartzell Propeller Inc.
Piqua, Ohio 45356

MAGNETOS:

Installation, Operation
and Maintenance
Instructions = D-2000 and D-2200 SERIES MAGNETO
IGNITION SYSTEM-P/N L-928
Bendix Electrical Components Division
Sidney, New York 13838

PIPER PUBLICATIONS.

ELECTRONICS:

AutoFlight II Service
Manual= Piper P/N 761 481

Pitch Trim Service
Manual= Piper P/N 753 771

AutoControl III B and
Altimatic III B Service
Manual= Piper P/N 753 502

Altimatic III C Service
Manual= Piper P/N 761 602

79 Vero Beach Avionics
Wiring Diagrams
Manual= Piper P/N 761 713

AEROFICHE:

PA-28-201 T Parts
Catalog=Piper P/N F761 701

GAMA SYSTEM/CHAPTER INDEX GUIDE

GAMA SYSTEM/CHAPTER INDEX GUIDE (cont)

LIST OF ILLUSTRATIONS

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CHAPTER

4

AIRWORTHINESS LIMITATIONS

CHAPTER 4- AIRWORTHINESS LIMITATIONS

TABLE OF CONTENTS/EFFECTIVITY

AIRWORTHINESS LIMITATIONS.

GENERAL.

The airworthiness limitations is FAA approved and specifies inspections and maintenance required under Parts 43.13 and 91.163 of the Federal Aviation Regulations.

The following limitations related to fatigue life of the airplane and its components have been established with respect to the PA-28-201T airplane:

1. The safe life of the airframe structure will be released when the information becomes available.
2. The safe life limit of the propeller blades is unlimited.

—NOTE—

Refer to the LIMITATIONS in the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual for a detailed delineation of the flight limitations of the airplane. The mandatory replacement time and/or inspection intervals of life limited parts are contained in Chapter 5 of this manual

—END—

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CHAPTER

5

TIME LIMITS/MAINT CHECKS

CHAPTER 5-TIME LIMITS/MAINTENANCE CHECKS

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This chapter provides instructions for conducting inspections. Repair or replacement instructions for those components found to be unserviceable at inspection may be found in the chapters covering the applicable aircraft system.

—CAUTION—

When working on engines, ground the magneto primary circuit before performing any operation.

TIME LIMITS.

INSPECTION REQUIREMENTS.

Required inspection procedures are listed in Inspection Report. The inspection procedure is broken down into eight major groups which are Propeller, Engine, Cabin, Fuselage and Empennage, Wing, Landing Gear, Operational Inspection and General. The first column in each group lists the inspection or procedure to be performed. The second column is divided into four columns indicating the required inspection intervals of 50 hours, 100 hours, 500 hours, and 1000 hours. Each inspection or operation is required at each of the inspection intervals as indicated by a circle (O). If an item is not entirely accessible or must be removed, refer to the applicable section of this manual for instructions on how to gain access to remove the item. When performing inspections, use forms furnished by the Piper Factory Service Department, available through Piper Dealers or Distributors.

—NOTE—

In addition to inspection intervals required in Inspection Report, preflight inspections must be performed.

PREFLIGHT CHECKS.

This check is for the pilot and/or mechanic and should become part of the airplane operational routine and/or preflight check before each flight. Refer to Section IV of the Pilot's Operating Manual for a listing of items that must be checked.

OVERLIMITS INSPECTION.

If the airplane has been operated so that any of its components have exceeded their maximum operational limits, check with the appropriate manufacturer.

SCHEDULED MAINTENANCE CHECKS.

—*NOTE*—

Although most notes in the back of this section are referred to in the text, they also contain additional information not covered.

PERIODIC INSPECTIONS.

—*NOTE*—

Perform an inspections or operations at each of the inspection intervals as indicated by a circle (O).

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
A. PROPELLER GROUP				
1. Inspect spinner and back plate for cracks	O	O	O	O
2. Inspect blades for nicks and cracks	O	O	O	O
3. Check for grease and oil leaks	O	O	O	O
4. Lubricate propeller per lubrication chart (refer to maintenance manual, chapter 12)	O	O	O	O
5. Inspect complete spinner and spinner mounting bulkheads for security, chafing, cracks, deterioration, wear, and correct installation		O	O	O
6. Inspect propeller mounting bolts and safety (check torque if safety wire is broken)		O	O	O
7. Inspect hub parts for cracks and corrosion		O	O	O
8. Rotate blades of propeller and check for tightness in hub pilot tube		O	O	O
9. Remove propeller and clean sludge from propeller and crankshaft			O	O
10. Inspect complete propeller assembly for security, chafing, cracks deterioration, wear, and correct installation		O	O	O
11. Overhaul propeller (Refer to Hartzell Service Letter 61D)				O
B. ENGINE GROUP				
WARNING: Read latest Teledyne Continental Service Bulletin M86-11 before completing this inspection group.				
WARNING: Ground magneto primary circuit before working on engine.				
NOTE: Read notes 5 and 19 before completing this inspection group.				
1. Remove engine cowling	O	O	O	O
2. Clean and check cowling for cracks, distortion and loose or missing fasteners		O	O	O
3. Drain oil sump (drain while engine is warm)		O	O	O
4. Check full flow (spin on type) oil filter element (check element for foreign particles). Check oil level after installing new filter	O	O	O	O
5. Inspect oil temperature sender unit for leaks and security		O	O	O
6. Inspect oil lines and fittings for leaks, security, chafing, dents, and cracks (see note 7)	O	O	O	O

PERIODIC INSPECTIONS. (cont)

—NOTE—

Perform all inspections or operations at each of the inspection intervals as indicated by a circle (O).

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
B. ENGINE GROUP (cont)				
7. Clean and check oil radiator cooling fins.		O	O	O
8. Fill engine with oil per information on cowl or lubrication chart (Refer to Maintenance Manual, Chapter 12)		O	O	O
9. Clean engine	O	O	O	O
CAUTION: Use caution not to contaminate pressure pump with cleaning fluid.				
10. Inspect condition of spark plugs (Clean and adjust gap as required) (See Note 9)		O	O	O
11. Check cylinder compression (See Note 14)		O	O	O
12. Inspect ignition harness and insulators (high tension leakage and continuity) (See Note 6 and 18)	O	O	O	O
13. Inspect magneto points for proper clearance (Maintain clearance at .018 ±.006) (See Notes 5 and 6)		O	O	O
14. Inspect magneto for oil seal leakage		O	O	O
15. Inspect breaker felts for proper lubrication		O	O	O
16. Inspect distributor block for cracks, burned areas or corrosion, and height of contact springs			O	O
17. Inspect magnetos to engine timing (See Note 16)		O	O	O
18. Overhaul or replace magnetos (See Note 6)				O
19. Remove induction air filter and tap gently to remove dirt particles (Replace as required)	O	O	O	O
20. Clean injector nozzles as required (Clean with acetone only)	O	O	O	O
21. Inspect induction airbox valve and check for excessive wear or cracks, replace defective parts		O	O	O
22. Inspect fuel injector attachments for loose hardware		O	O	O
23. Inspect intake seals for leaks and clamps for tightness		O	O	O
24. Inspect all air inlet duct hoses (Replace as required)		O	O	O
25. Inspect condition of flexible fuel lines		O	O	O
26. Replace flexible fuel lines				O
27. Clean gascolator bowl and screen	O	O	O	O
28. Inspect fuel system for leaks		O	O	O
29. Check condition and operation of fuel pumps (engine driven and electric)		O	O	O
30. Overhaul or replace fuel pumps (engine driven and electric) (See Note 6)				O
31. Inspect condition of electric fuel pump (Replace as required)				O
32. Inspect pressure pump and lines		O	O	O

PERIODIC INSPECTIONS. (cont)

—NOTE—

Perform all inspections or operations at each of the inspection intervals as indicated by a circle (O).

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
B. ENGINE GROUP (cont)				
32. Overhaul or replace pressure pump (See Note 6).........................				O
33. Inspect throttle, alternate air, mixture and propeller governor controls for travel and operating condition		O	O	O
34. Inspect exhaust stacks, connections and gaskets (Replace gaskets as required, refer to Chapter 78).....................................	O	O	O	O
35. Inspect breather tubes for obstructions and security		O	O	O
36. Inspect crankcase for cracks, leaks and security of seam bolts....		O	O	O
37. Inspect engine mounts for cracks and loose mountings (See Note 10)...		O	O	O
38. Inspect rubber engine mount bushings for deterioration (Replace as required, refer to Chapter 71)..................................		O	O	O
39. Inspect all engine baffles and seals		O	O	O
40. Inspect fire wall seals		O	O	O
41. Inspect condition of alternator and starter...................................		O	O	O
42. Inspect all lines, air ducts, electrical leads and engine attachments for security, proper routing, chafing, deterioration and correct installation	O	O	O	O
43. Check air conditioning compressor oil level (See Note 15)				
44. Inspect condition and tension of compressor drive belt (Refer to Maintenance Manual, Chapter 21)..............................		O	O	O
45. Check security of compressor mounting.....................................		O	O	O
46. Check compressor clutch security and condition of wiring.........		O	O	O
47. Check fluid in brake reservoir (Fill as required).........................	O	O	O	O
48. Overhaul or replace propeller governor (Refer to Hartzell Service Letter No. 61D)				O
49. Complete overhaul of engine or replace with factory rebuilt (See Note 6)				
C. TURBOCHARGER GROUP				
1. Inspect all air inlet ducting and compressor discharge ducting for worn spots, loose clamps or leaks..	O	O	O	O
2. Inspect engine air inlet assembly for cracks, loose clamps and screws..	O	O	O	O
3. Inspect exhaust ducting and exhaust stacks for signs of leaks or cracks. Check all clamps for tightness	O	O	O	O
4. Inspect exhaust heat exchanger..		O	O	O
5. Carefully inspect all turbo support brackets, struts, etc., for breakage, sagging or wear...	O	O	O	O

PERIODIC INSPECTIONS. (cont)

—NOTE—

Perform all inspections or operations at each of the inspection intervals as indicated by a circle (O).

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
C. TURBOCHARGER GROUP (cont)				
6. Inspect all oil lines and fittings for wear, leakage, heat damage or fatigue	O	O	O	O
7. Inspect bypass valve for security and safety	O	O	O	O
8. Run up engines, check all instruments for smooth, steady response.	O	O	O	O
9. Remove all turbocharger components from the engine. Inspect and repair or replace as necessary. Check turbocharger rotor for excessive play, carbon and dirt deposits. (Refer to Troubleshooting Chart in Chapter 81 of the Maintenance Manual) Remove turbine and compressor housings. Inspect turbine wheel and impeller for physical damage and excessive buildup of deposits. If excessive, replace Turbocharger Assembly				O
D. CABIN GROUP				
1. Inspect cabin entrance, door and windows for damage, operation and security.	O	O	O	O
2. Inspect upholstery for tears		O	O	O
3. Inspect seats, seat belts, security brackets and bolts		O	O	O
4. Check trim operation		O	O	O
5. Inspect rudder pedals		O	O	O
6. Inspect parking brake and brake handle for operation and cylinder leaks		O	O	O
7. Inspect control wheels, column, pulleys and cables		O	O	O
8. Inspect flap control cable attachment bolt (See latest revision of Piper Service Bulletin 965.)		O	O	O
9. Inspect landing, navigation, cabin and instrument lights	O	O	O	O
10. Inspect instruments, lines and attachments		O	O	O
11. Inspect gyro operated instruments and electric turn and bank (Overhaul or replace as required)		O	O	O
12. Replace instrument air, central air filter.		O	O	O
13. Clean or replace vacuum regulator filter		O	O	O
14. Inspect altimeter (Calibrate altimeter system in accordance with FAR 91.170, if appropriate) (See Note 13)		O	O	O
15. Check operation of fuel selector valve		O	O	O
16. Inspect condition of heater controls and ducts		O	O	O
17. Inspect condition and operation of air vents		O	O	O
18. Inspect condition of air conditioning ducts if installed		O	O	O
19. Remove and clean air conditioning evaporator filter if installed		O	O	O

PERIODIC INSPECTIONS. (cont)

—NOTE—

Perform all inspections or operations at each of the inspection intervals as indicated by a circle (O).

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
E. FUSELAGE AND EMPENNAGE GROUP				
1. Remove inspection plates and panels (See Note 20)		O	O	O
2. Inspect baggage door, latch and hinges for condition, operation and security		O	O	O
3. Inspect battery, box and cables (Check at least every 30 days. Flush box as required and fill battery per instructions on box)	O	O	O	O
4. Inspect electronic installations		O	O	O
5. Inspect bulkheads and stringers for damage		O	O	O
6. Inspect antenna mounts and electrical wiring for security, and corrosion in plugs.		O	O	O
7. Inspect air conditioning system for freon leaks (See Note 15)		O	O	O
8. Check freon level in sight gauge of receiver-dehydrator (Refer to Maintenance Manual, Chapter 21)	O	O	O	O
9. Inspect air conditioner condenser air scoop rigging	O	O	O	O
10. Inspect fuel lines, valves, sender units, and gauges for damage and operation		O	O	O
11. Inspect security of all lines		O	O	O
12. Inspect vertical fin and rudder surfaces for damage		O	O	O
13. Inspect rudder hinges, horn and attachments for damage and operation		O	O	O
14. Inspect rudder control stops to insure stops have not loosened and locknuts are tight		O	O	O
15. Inspect vertical fin attachments		O	O	O
16. Inspect rudder hinge bolts for excess wear (Replace as required)		O	O	O
17. Inspect stabilator surfaces for damage		O	O	O
18. Inspect stabilator, tab hinges, horn and attachments for damage and operation		O	O	O
19. Inspect stabilator control stops to insure stops have not loosened and locknuts are tight		O	O	O
20. Inspect stabilator attachments (see latest Piper Service Bulletin 856)		O	O	O
21. Inspect stabilator and tab hinge bolts and bearings for excess wear (Replace as required)		O	O	O
21a. Inspect stabilator trim mechanism		O	O	O
22. Inspect fuselage wing attach fittings for corrosion, general condition and security (See latest revision of Piper Service Bulletin 977.)		O	O	O
23. Inspect cable tensions with tensiometer (See Note 11)		O	O	O
24. Inspect cables, aileron, rudder, stabilator, stabilator trim, turnbuckles, guides and pulleys for safety, damage and operation (See Note 21)		O	O	O
25. Clean and lubricate stabilator trim drum screw (Refer to lubrication chart in Maintenance Manual, Chapter 12)			O	O
26. Inspect stabilator balance weight attachments and arm for security and condition		O	O	O

PERIODIC INSPECTIONS. (cont)

—NOTE—

Perform all inspections or operations at each of the inspection intervals as indicated by a circle (O).

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
E. FUSELAGE AND EMPENNAGE GROUP (cont)				
27. Inspect emergency locator transmitter battery for replacement date per Maintenance Manual (See latest revision of Piper S/L No. 820)...		O	O	O
28. Clean and lubricate all exterior needle bearings				O
29. Lubricate per lubrication chart in Maintenance Manual, Chapter 12	O	O	O	O
30. Inspect rotating beacon for security and operation		O	O	O
31. Inspect security of Autopilot bridle cable clamps		O	O	O
32. Inspect all control cables, air ducts, electrical leads, lines, radio antenna leads and attaching parts for security, routing, chafing, deterioration, wear and correct installation		O	O	O
33. Reinstall inspection plates and panels		O	O	O
F. LANDING GEAR GROUP				
1. Inspect oleo struts for proper extension per Maintenance Manual (Check fluid level as required)	O	O	O	O
2. Inspect nose gear steering control and travel.		O	O	O
3. Inspect wheels for alignment		O	O	O
4. Put airplane on jacks.		O	O	O
5. Inspect tires for cuts, uneven or excessive wear and slippage		O	O	O
6. Remove wheels, clean, check and repack bearings		O	O	O
7. Inspect wheels for cracks, corrosion and broken bolts		O	O	O
8. Check tire pressure per Maintenance Manual	O	O	O	O
9. Inspect brake lining and disc for condition and wear		O	O	O
10. Inspect brake backing plates for condition and wear		O	O	O
11. Inspect brake lines		O	O	O
12. Inspect nose gear centering bungee		O	O	O
13. Inspect gear forks for damage		O	O	O
14. Inspect oleo struts for fluid leaks and scoring		O	O	O
15. Inspect gear struts, attachments, torque links, and bolts for condition and security		O	O	O
16. Inspect all brake lines, electrical leads, and attaching parts for security, routing, chafing, deterioration, wear, and correct installation		O	O	O
17. Lubricate per lubrication chart in Maintenance Manual	O	O	O	O
18. Remove airplane from jacks		O	O	O
19. Inspect gear fairings for condition and security	O	O	O	O

PERIODIC INSPECTIONS. (cont)

—NOTE—

Perform all inspections or operations at each of the inspection intervals as indicated by a circle (O).

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
G. WING GROUP				
1. Remove inspection plates and fairings		O	O	O
2. Inspect surfaces and tips for damage, loose rivets, and condition of walkway		O	O	O
3. Inspect aileron hinges and attachments		O	O	O
4. Inspect aileron control stops to insure stops have not loosened and locknuts are tight		O	O	O
5. Inspect aileron balance weight and arm for security and condition.		O	O	O
6. Inspect aileron cables, pulleys and bellcranks for damage and operation		O	O	O
7. Inspect flaps and attachments for damage and operation		O	O	O
8. Inspect condition of bolts used with hinges (Replace as required)				O
9. Lubricate per lubrication chart in Maintenance Manual, Chapter 12	O	O	O	O
10. Inspect forward and aft wing attach fittings for corrosion, general condition and security. (See latest revision of Piper Service Bulletin 977.)		O	O	O
11. Inspect wing attachment bolts and brackets		O	O	O
12. Inspect fuel tanks and lines for leaks and water		O	O	O
13. Fuel tanks marked for capacity		O	O	O
14. Fuel tanks marked for minimum octane rating		O	O	O
15. Inspect fuel cell vents		O	O	O
16. Inspect all control cables, air ducts, electrical leads, lines and attaching parts for security, routing, chafing, deterioration, wear, and correct installation		O	O	O
17. Reinstall inspection plates and fairings		O	O	O
H. OPERATIONAL INSPECTION				
1. Check fuel pump and fuel tank selector	O	O	O	O
2. Check fuel quantity, pressure and flow readings	O	O	O	O
3. Check oil pressure and temperature	O	O	O	O
4. Check alternator output	O	O	O	O
5. Check manifold pressure	O	O	O	O
6. Check alternate air	O	O	O	O
7. Check parking brake	O	O	O	O
8. Check vacuum gauge	O	O	O	O
9. Check gyros for noise and roughness	O	O	O	O
10. Check cabin heater operation.	O	O	O	O
11. Check magneto switch operation	O	O	O	O
12. Check magneto RPM variation	O	O	O	O
13. Check throttle and mixture operation	O	O	O	O

PERIODIC INSPECTIONS. (cont)

—NOTE—

Perform all inspections or operations at each of the inspection intervals as indicated by a circle (O).

Nature of Inspection	Inspection Time (hrs)			
	50	100	500	1000
H. OPERATIONAL INSPECTION (cont)				
14. Check propeller smoothness	O	O	O	O
15. Check propeller governor action	O	O	O	O
16. Check engine idle	O	O	O	O
17. Check electronic equipment operation	O	O	O	O
18. Check operation of Autopilot including automatic pitch trim, and manual electric trim. (See Note 17.)	O	O	O	O
19. Check air conditioner compressor clutch operation	O	O	O	O
20. Check air conditioner condenser scoop operation	O	O	O	O
I. GENERAL				
1. Aircraft conforms to FAA Specification	O	O	O	O
2. All FAA Airworthiness Directives complied with	O	O	O	O
3. All Manufacturer's Service Bulletins and Letters complied with		O	O	O
4. Check for proper Flight Manual	O	O	O	O
5. Aircraft papers in proper order	O	O	O	O

PERIODIC INSPECTIONS. (cont)

NOTES:

1. Refer to last card of the Piper Parts Price List Aerofiche for a check list of current revision dates to Piper inspection reports and manuals.
2. All inspections or operations are required at each inspection interval as indicated by a (O). Both the annual and 100 hour inspections are complete inspections of the airplane, identical in scope, while both the **500 and 1000** hour inspections are extensions of the annual or 100 hour inspections, which require a more detailed examination of the airplane, and overhaul or replacement of some major components. Inspections must be accomplished by persons authorized by the FAA.
3. Piper Service Bulletins are of special importance and Piper considers compliance mandatory.
4. Piper Service Letters are product improvements and service hints pertaining to servicing the airplane and should be given careful attention.
5. Inspections given for the Continental power plant are based on the engine manufacturer's operator's manual, (Continental Part No. X-30512) for this airplane, dated January 1978. Any changes issued to the engine manufacturer's operator's manual after this date shall supersede or supplement the inspection outlined in this report.
6. Replace or overhaul as required or at engine overhaul. For engine overhaul, refer to Continental Service Bulletin M74-20 for recommended engine overhaul period.
7. Replace flexible oil lines as required, but no later than 1000 hours of service.
8. Check throttle body attaching screws for tightness; the correct torque for these screws is 40 to 50 inch-pounds.
9. Rotate spark plugs from upper to lower positions and vice versa to lengthen plug life.
10. Check torque of mounting bolts.
11. Maintain cable tensions specified in chapter 27 of this manual.
12. Check cylinders for evidence of excessive heat indicated by burned paint on the cylinders. This condition is indicative of internal damage to the cylinder and, if found, its cause must be determined and corrected before the aircraft is returned to service.

    Heavy discoloration and appearance of seepage at the cylinder head barrel attachment area is usually due to emission of thread lubricant used during assembly of the barrel at the factory, or by slight gas leakage which stops after the cylinder has been in service for awhile. This condition is neither harmful nor detrimental to engine performance and operation. If it can be proven that leakage exceeds these conditions, the cylinder should be replaced.
13. If the altimeter is damaged, defective, or inaccurate, work must be done by an FAA approved instrument repair facility only, and a logbook entry made.
14. Refer to Continental Motors Service Bulletin M73-19.
15. The compressor oil level should not be checked unless a Freon leak has occurred, requiring an addition of Freon to the system.
16. For operation above 12,000 feet, more frequent ignition system maintenance is required.
17. Refer to flight manual supplement for preflight and flight check, for intended function in all modes.
18. Refer to latest Bendix Service Bulletin 612 for inspection of magnetos and ignition harnesses.
19. Refer to VSP 69.
20. If not already installed, add access panels per instructions in Chapter 51. See latest revision of Piper Service Bulletin 977.
21. Special care should be taken to inspect stabilator control cables beneath aft baggage compartment floor. Add access panels per instructions in Chapter 51 to ease this inspection.

PROGRAMMED INSPECTION.

The programmed inspection was designed to permit the best utilization of the aircraft, by scheduling inspections through the use of a planned inspection schedule. This programmed inspection schedule has been prepared in a manual form which is available from Piper Service Sales-under Piper Part Number 761 734.

UNSCHEDULED MAINTENANCE CHECKS.

SPECIAL INSPECTIONS AS REQUIRED UPON CONDITION.

The special inspections given, supplement the scheduled inspections as outlined in the Inspection Report to include inspections which are required at intervals not compatible with airframe operating time or inspection intervals. Typical of this type are:

1. Inspections required because of special conditions or incidents that arise, and because of these conditions or incidents, an immediate inspection would be required to insure further safe flight.
2. Hard or Overweight Landing. This inspection should be performed after a known rough landing is made or when a landing is made while the aircraft is known to exceed the design landing weight. Check the following areas and items:
   Wings for wrinkled skins, loose or missing rivets.
   Fuel leaks around the fuel tanks.
   Wing spar webs, bulkheads, wing and fuselage stringers and skins for any signs of overstress or damage.
   Landing gear and attachments for damage or fluid leakage.
   A possible alignment check to clarify any doubt of damage.
3. Severe Turbulence Inspection. The same items and locations should be checked as stated for Hard or Overweight Landings along with the following: Top and bottom fuselage skins for loose or missing rivets and wrinkled skins. Empennage skins and attachments.
4. Engine overspeed, sudden stoppage, loss of oil, overtemperature and lightning strike. Check with Engine Manufacturer for necessary corrective action.

—END—

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CHAPTER

6

DIMENSIONS AND AREAS

CHAPTER 6-DIMENSIONS AND AREAS

TABLE OF CONTENTS/EFFECTIVITY

DIMENSIONS.

The principal airplane dimensions are shown in Figure 6-1 and are listed in Chart 601.

CHART 601. LEADING PARTICULARS AND PRINCIPAL DIMENSIONS

MODEL	PA-28-201T
ENGINE	
Manufacturer	Continental
Model	TSIO-360-FB
Rated Horsepower at Propeller RPM	200
Oil, SAE Number	See Chart 1201
Oil Sump Capacity	8 U.S. quarts
Oil Consumption, Maximum	.009 lb/bhp/hr above 75% power
Fuel, Aviation Grade, Minimum and Specified Octane	100/130 or 100LL
Fuel Injector	Continental
Magnetos, Bendix:	
Left	10-79020-18L
Right	10-79020-19L
Magneto Drive, Rotation	Clockwise
Magneto Timing	20° BTC
Magneto Point Clearance	.018
Spark Plug Gap Setting	0.15 to 0.19
Firing Order	1-6-3-2-5-4
Starter-Prestolite (12-volt)	MCL-6501
Alternator:	
Prestolite (65 AMP)	ALX-9425
Alternator Voltage Regulator, WICO	X16300B
Alternator Overvoltage Relay, WICO	X16799B
PROPELLER-Constant Speed	
Manufacturer	Hartzell
Hub, Model	BHC-C2YF-1-( )F
Blade, Model	F8459A-8R
Diameter (in.)	76.0
Diameter, Minimum (in.)	75.0

CHART 601. LEADING PARTICULARS AND PRINCIPAL DIMENSIONS (cont)

MODEL	PA-28-201T
LANDING GEAR	
Type	Tricycle-Fixed
Tread (Width From Each Tire Center)	10.0 ft.
Turning Radius	30 ft.
Nose Gear Strut	Combination Air-Oil
Nose Tire Pressure	33/35 psi
Nose Gear Travel	30° ± 2° To Left or Right
Main Gear Strut	Combination Air-Oil
Visible Piston Extension for Struts	
Main Gear Strut	4.5 ± .5 in.
Nose Gear Strut	2.50 ± .25 in.
Main Tire Pressure	35/40 psi
Brakes	Cleveland 30-55 Cleveland 30-65 (Optional Heavy Duty Brake Assembly)
Tires:	
Main	6.00 x 6, 6 ply
Nose	5.00 x 5, 6 ply
FUEL SYSTEM	
Fuel Tanks:	
Capacity (each)	38.5 gal.
Unusable Fuel (each)	2.5 gal.
Total Capacity	77 gal.
Total Unusable Fuel (Refer to Owner’s Handbook, Pilot’s Information Manual or Flight Manual for Particular Airplane)	5 gal.

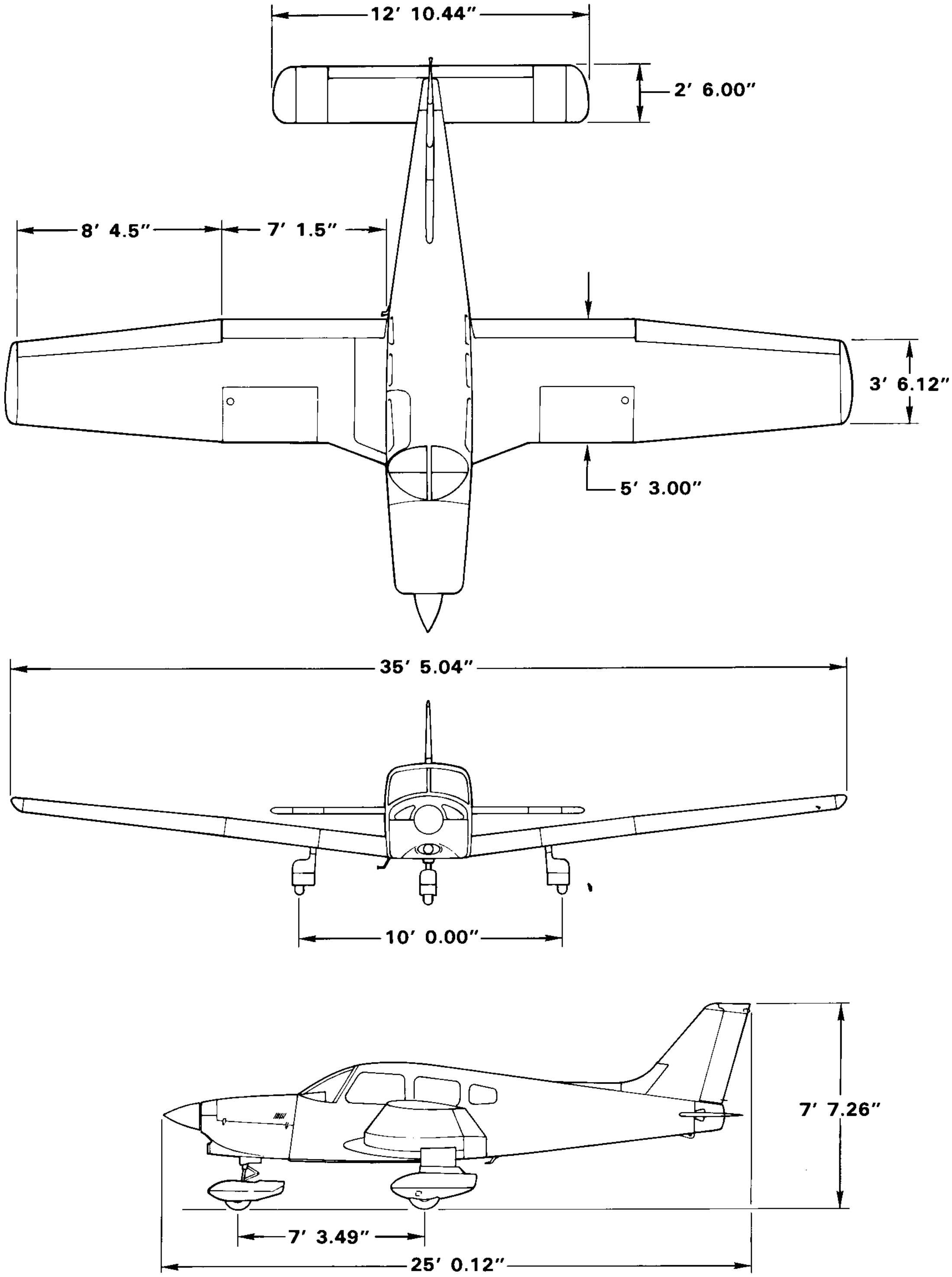

Figure 6-1. Three View

STATION REFERENCE LINES.

In order to facilitate the location of various components of the airplane which require maintenance and servicing, a method utilizing fuselage station (Sta.), wing station or buttock line (BL), and waterline (WL) designations is frequently employed in this manual. (Refer to Figure 6-2.) Fuselage stations, buttock lines, and waterlines are reference points measured by inches in the vertical or horizontal direction from a given reference line which indicates station locations of structural members of the airplane.

ACCESS PLATES AND INSPECTION PROVISIONS.

The access and inspection provisions for the airplane are shown in Figure 6-3. The component to be serviced or inspected through each opening is identified in the illustration. All access plates and panels are secured by either metal fasteners or screws. To enter the aft section of the fuselage, remove the rear trim panel.

WEIGHT AND BALANCE DATA.

When figuring various weight and balance computations, the empty, static and gross weight, and center of gravity of the airplane may be found in the Weight and Balance Form of the Airplane Flight Manual.

SERIAL NUMBER PLATE.

The serial number plate is located on the left side of the fuselage near the leading edge of the stabilator. The serial number should always be used when referring to the airplane on service or warranty matters.

—END—

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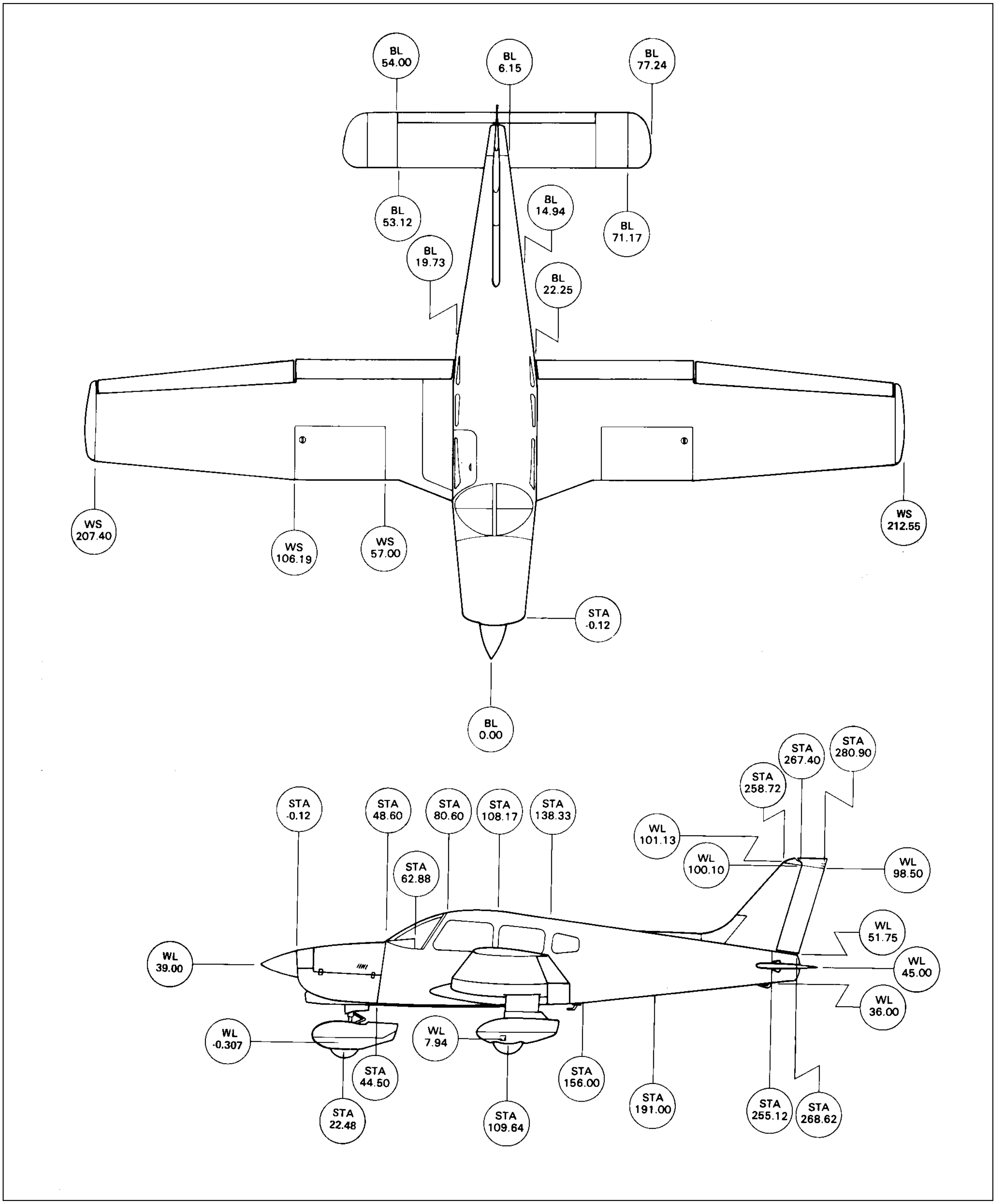
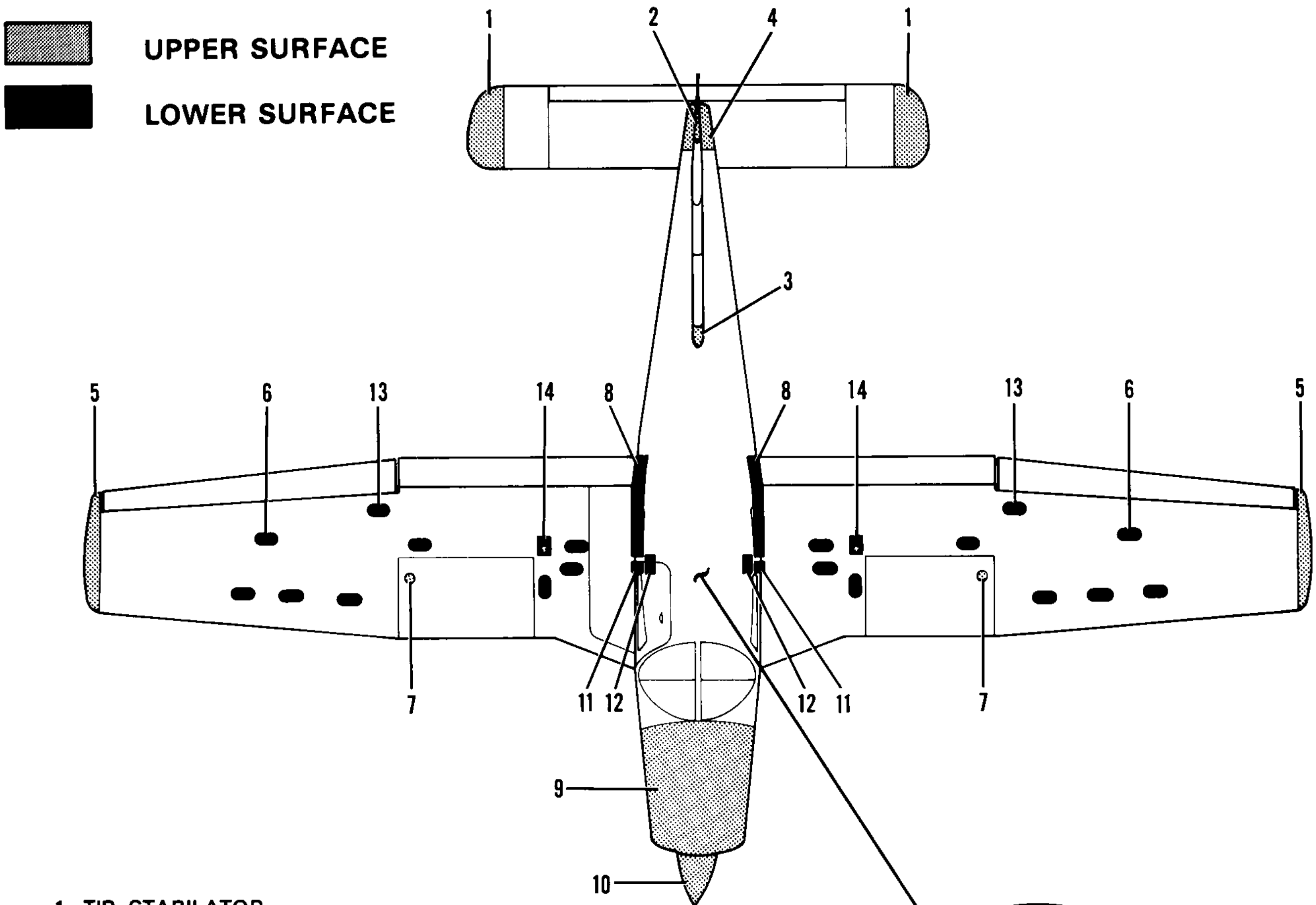
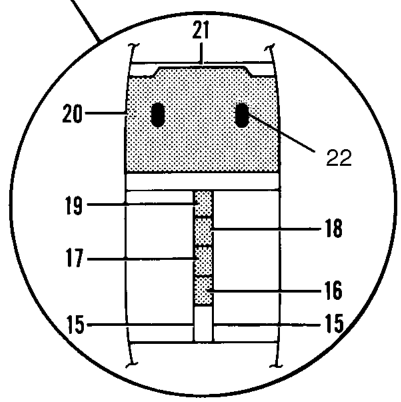


Figure 6-2. Station Reference Lines





1. TIP, STABILATOR
2. TIP, RUDDER
3. FAIRING, FIN
4. TAIL CONE, CONTROL CABLE AND TRIM SCREW
5. TIP, WING
6. COVER, BELLCRANK AND CONTROL CABLES
7. CAP, FUEL TANK FILLER
8. FAIRING, FLAP TORQUE TUBE AND AILERON CABLES
9. COWL ASSEMBLY, ENGINE
10. SPINNER, PROPELLER
11. FAIRING, FUEL LINES
12. COVER, FUEL LINES AND SPAR ATTACHMENT BOLTS
13. COVER, CONTROL CABLES
14. FAIRING, MAIN GEAR STRUT ASSEMBLY
15. COVERS, AILERON AND STABILATOR CONTROL CABLE
16. PLATE, AILERON AND STABILATOR CONTROL CABLE FORWARD
17. COVER, FLAP AND TRIM CONTROL
18. PLATE, CONTROL CABLES MIDDLE
19. PLATE, CONTROL CABLES AND PULLEYS REAR
20. SEAT, TORQUE TUBE CONTROL CABLES
21. PANEL, AFT AREA OF FUSELAGE, STROBE LIGHT POWER SUPPLY, BATTERY
22. **CONTROL CABLE INSPECTION PANELS (Airplanes manufactured before 1979 may not have these panels installed. Refer to Chapter 51 for procedures to install control cable inspection panels.)**

Figure 6-3. Access Plates and Panels

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CHAPTER

7

LIFTING AND SHORING

CHAPTER 7- LIFTING AND SHORING

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

JACKING.

Jacking the airplane is necessary to service the landing gear and to perform other service operations. Proceed as follows:

1. Place jacks under jack pads on the front wing spar. (Refer to Figure 7-1.)

—CAUTION—

Be sure to apply sufficient tail support ballast; otherwise the airplane will tip forward.

2. Attach the tail support to the tail skid. Place approximately 250 pounds of ballast on the base of the tail support to hold down the tail.
3. Raise the jacks until all three wheels are clear of the surface.

—END—

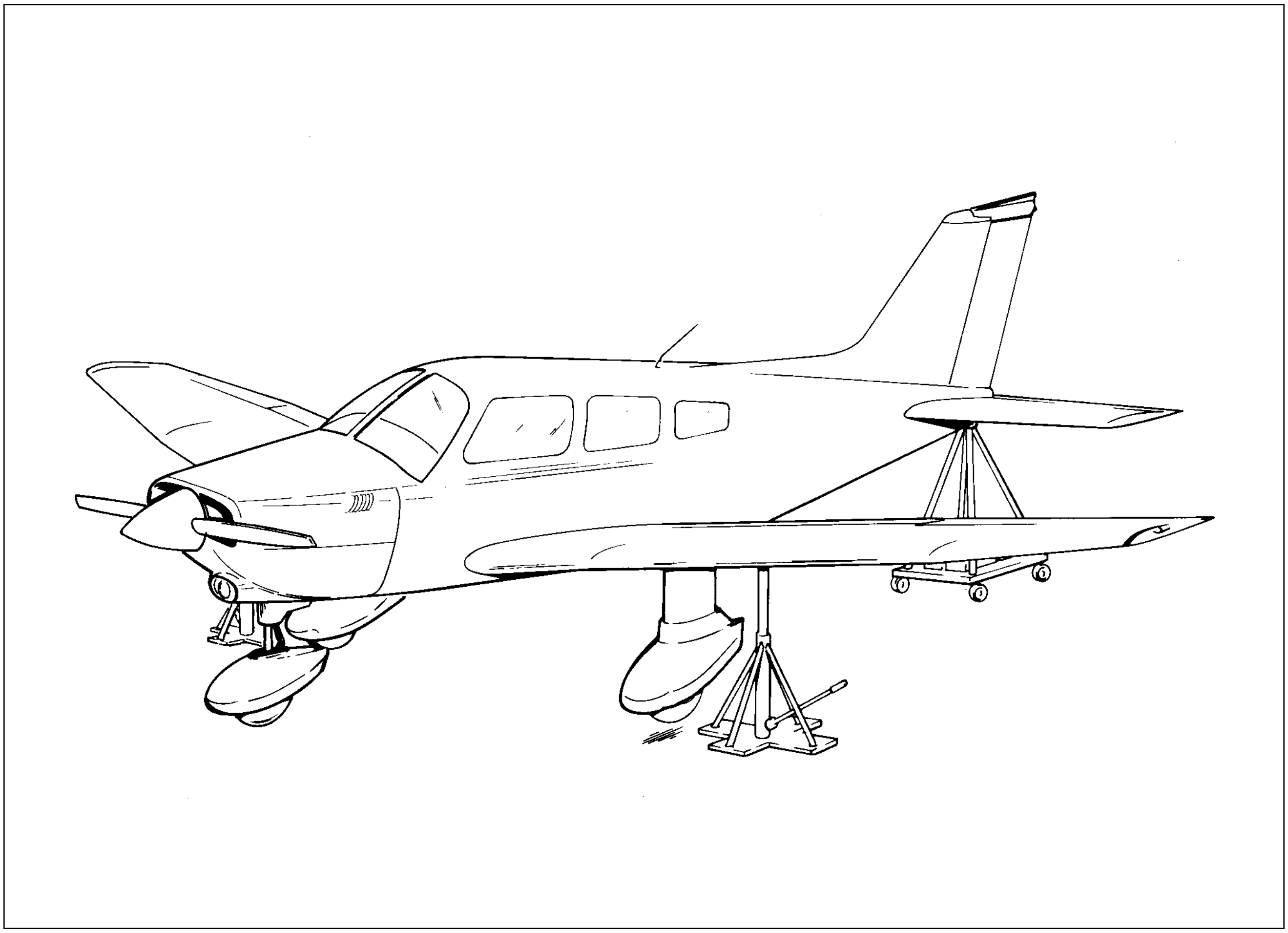

Figure 7-1. Jacking Arrangement

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CHAPTER

8

LEVELING AND WEIGHING

CHAPTER 8 - LEVELING AND WEIGHING

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LEVELING.

The airplanes are provided with a means for longitudinal and lateral leveling. The airplanes may be leveled while on jacks, during the weighing procedure while the wheels are on scales, or while the wheels are on the ground. To level the airplane for purposes of weighing or rigging, the following procedures may be used:

1. To longitudinally level the airplane, partially withdraw the two leveling screws located immediately below the left front side window. (Refer to Figure 8-2.) Place a level on these screws heads and adjust the jacks until the level is centered. Should the airplane be either on scales or on the floor, first block the main gear oleos to full extension; then deflate the nose wheel until the proper position is reached.
2. To laterally level the airplane, place a level across the spar box assembly located under the rear seats. (Refer to Figure 8-3.) Raise or lower one wing tip by deflating the appropriate tire on the high side of the airplane or adjust either jack until the bubble of the level is centered.

WEIGHING. (Refer to Figure 8-1.)

The airplane may be weighed by the following procedure:

1. Position a scale and ramp in front of each of the three wheels.
2. Secure the scales from rolling forward and tow the airplane up onto the scales.
3. Remove the ramp so as not to interfere with the scales.
4. If the airplane is to be weighed for weight and balance computations, level the airplane.

—END—

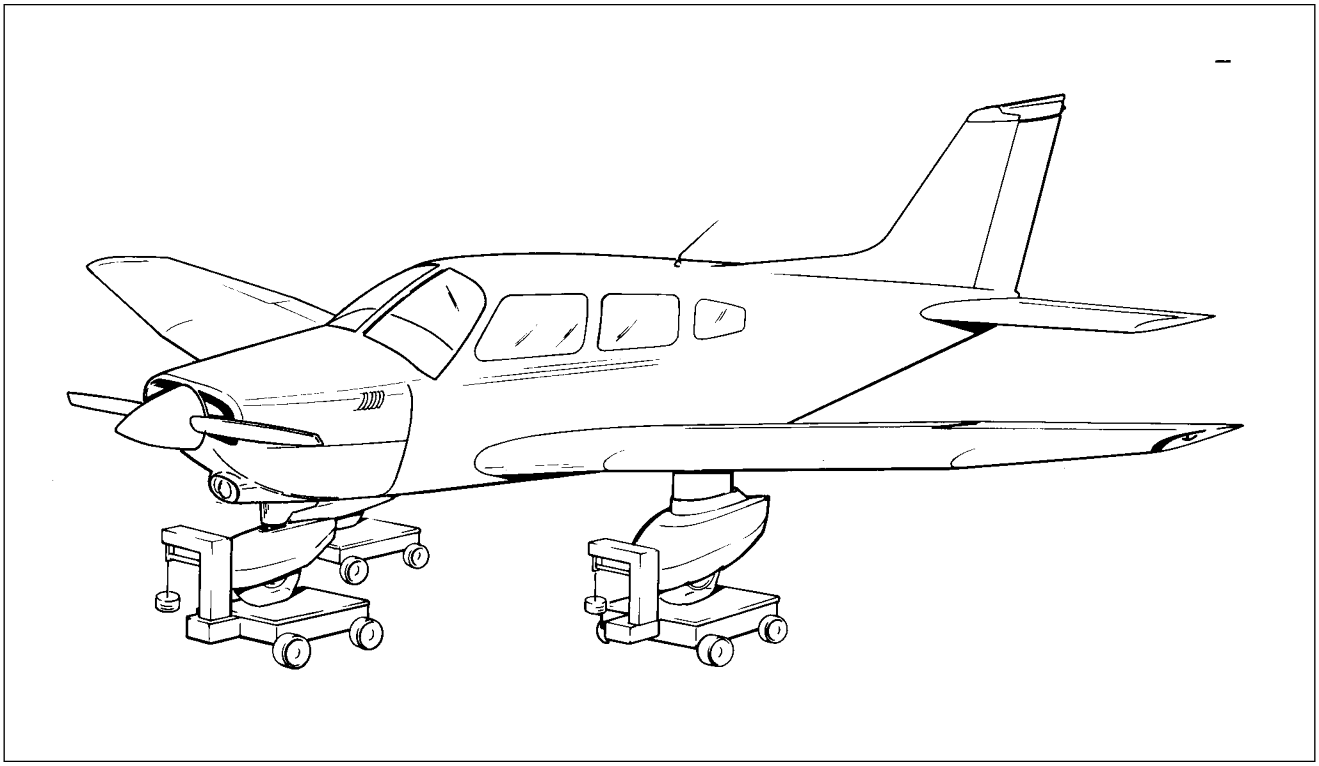

Figure 8-1. Weighing Airplane

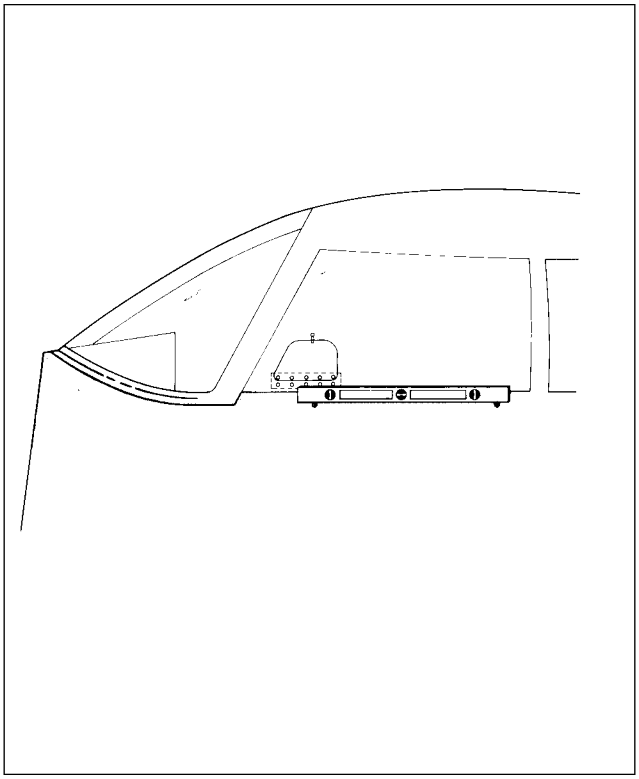

Figure 8-2. Leveling Longitudinally

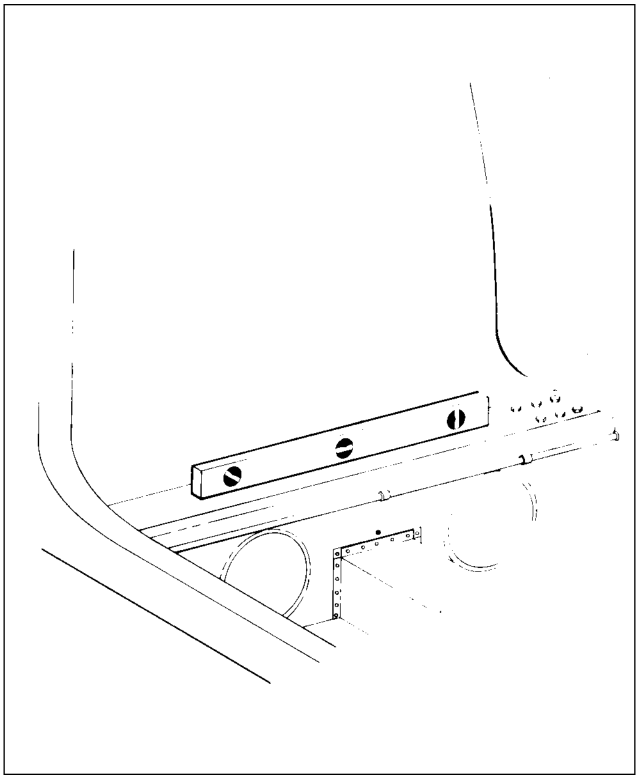

Figure 8-3. Leveling Laterally

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CHAPTER

9

TOWING AND TAXIING

CHAPTER 9- TOWING AND TAXIING

TABLE OF CONTENTS/EFFECTIVITY

TOWING.

—CAUTION—

When towing with power equipment, do not turn the nose gear in either direction beyond its steering radius limits as this will result in damage to the nose gear and steering mechanism. Do not tow the airplane with control locks installed.

The airplane may be moved by using the nose wheel steering bar that is stowed in the baggage area, or towing equipment that will not damage or cause excess strain to the nose gear steering assembly. Towing lugs are incorporated as part of the nose gear fork.

TAXIING.

Before attempting to taxi the airplane, ground personnel should be checked out by a qualified pilot or other responsible person. Engine starting and shutdown procedures should be covered as well. When it is ascertained that the propeller back blast and taxi area are clear, apply power to start the taxi roll and perform the following checks:

1. Taxi forward a few feet and apply brakes to determine their effectiveness.
2. While taxiing, make slight turns to determine the effectiveness of steering.
3. Observe wing clearances when taxiing near buildings or other stationary objects. If possible, station a guide outside the airplane to observe.
4. When taxiing on uneven ground, avoid holes and ruts.
5. Do not operate the engine at high RPM when running up or taxiing over ground containing loose stones, gravel, or any loose material that may cause damage to the propeller blades.

—END—

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CHAPTER

10

PARKING AND MOORING

CHAPTER 10 - PARKING AND MOORING

TABLE OF CONTENTS/EFFECTIVITY

PARKING.

When parking the airplane, insure that it is sufficiently protected against adverse weather conditions and presents no danger to other aircraft. When parking the airplane for any length of time or overnight, it is recommended that it be moored.

1. To park the airplane, head it into the wind, if possible.
2. Set the parking brake by pulling back the brake lever and depressing the knob attached to the left side of the handle; then release the handle. To release the parking brake, pull back on the brake lever to disengage the catch mechanism, and allow the handle to swing forward.

—NOTE—

Care should be taken when setting brakes that are overheated. During cold weather, accumulated moisture may freeze the discs and lining together if the aircraft is parked with the brakes set.

3. The aileron and elevator may be locked by using the seat belt.

MOORING.

The airplane is moored to insure its immovability, protection, and security under various weather conditions. The following procedure gives the instructions for proper mooring of the airplane:

1. Head the airplane into the wind, if possible.
2. Block the wheels.
3. Lock the aileron and elevator controls using the seat belt or control surface blocks.
4. Secure tie-down ropes to the wing tie-down rings and the tail skid at approximately 45 degree angle to the ground.

—NOTE—

Use square or bowline knots. Do not use slip knots. Additional preparations for high winds include using tie-down ropes from the landing gear legs, and securing the rudder.

—END—

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CHAPTER

11

REQUIRED PLACARDS

CHAPTER 11- REQUIRED PLACARDS

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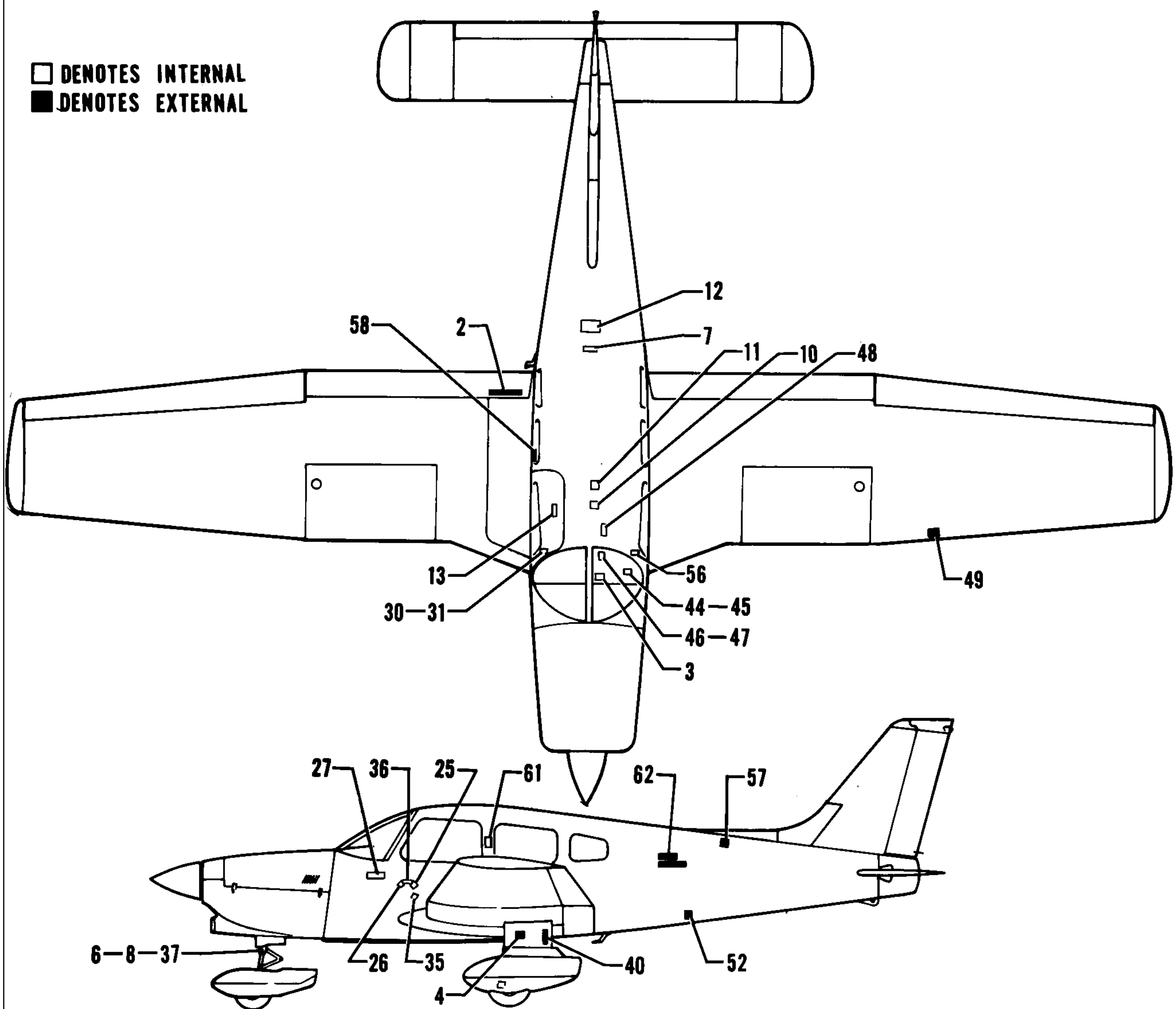
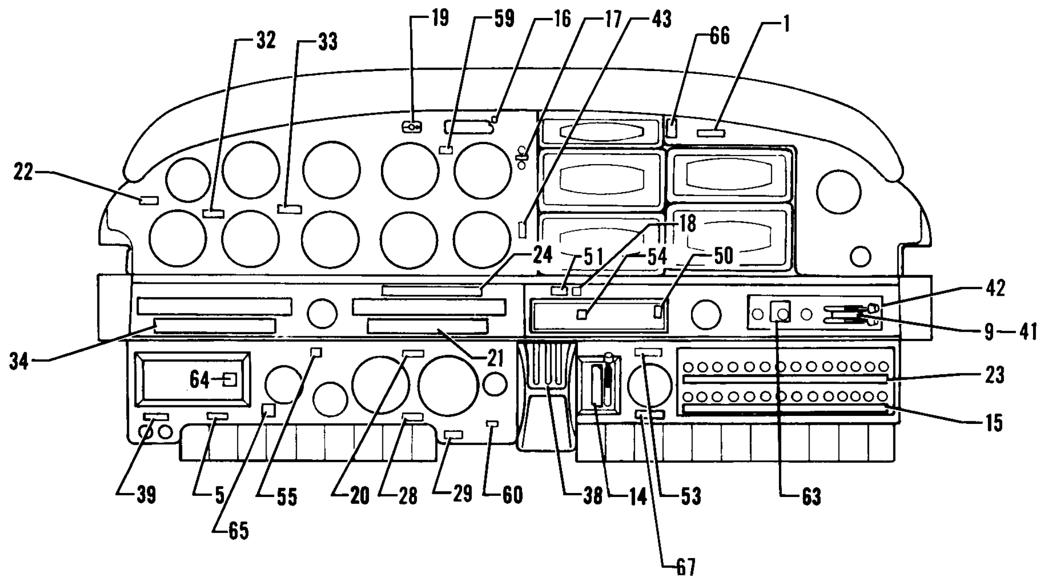


Figure 11-1. Placards and Decals



1. PLACARD - OIL COOLER WINTERIZATION
9. PLACARD - HEATER AND DEFROST
14. PLACARD - ALTERNATE AIR
15. PLACARD - CIRCUIT BREAKER, LOWER
16. PLACARD - EMERGENCY FUEL ON
17. PLACARD - PRIMER
18. PLACARD - AUXILIARY FUEL PUMP
19. PLACARD - PRESS TO TEST
20. PLACARD - CRUISE FUEL FLOWS
21. PLACARD - LANDING CHECKLIST
22. PLACARD - MANEUVERS LIMITATIONS
23. PLACARD - CIRCUIT BREAKER, UPPER
24. PLACARD - FUEL
28. PLACARD - CONTINUOUS GROUND R.P.M.
29. PLACARD - IN-FLIGHT R.P.M. - MP RESTRICTIONS
32. PLACARD - CROSSWIND COMPONENT
33. PLACARD - MANEUVERING SPEED
34. PLACARD - TAKE-OFF CHECKLIST
38. PLACARD - ENGINE CONTROL
39. PLACARD - MIKE AND HEADPHONE
41. PLACARD - HEATER AND DEFROST (LIFT TO ACTUATE)
42. PLACARD - CLIMATE CONTROL CENTER
43. PLACARD - AIR CONDITIONING DOOR LIGHT
50. PLACARD - INSTRUMENT LIGHTS PANEL
51. PLACARD - INSTRUMENT LIGHTS
53. PLACARD - WARNING
54. PLACARD - RED STROBE LIGHT
55. PLACARD - PITCH TRIM
59. PLACARD - ALTITUDE REPORTER INSTALLED
60. PLACARD - MIKE JACK (WITH CONSOLE MIKE JACK)
63. PLACARD - VENT FAN
64. PLACARD - AUTOFLITE II
65. PLACARD - OMNI COUPLER
66. PLACARD - RADIO POWER "ON-OFF"
67. PLACARD - EMERGENCY BUS SWITCH

Figure 11-1. Placards and Decals (cont)

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CHAPTER

12

SERVICING

CHAPTER 12 -SERVICING

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This chapter contains routine handling and servicing procedures that are most frequently encountered. Frequent reference to this section will aid the individual by providing information such as the location of various components, ground handling procedures, routine service procedures and lubrication. When any system or component requires service other than the routine procedures as outlined in this section, refer to the appropriate section for that component.

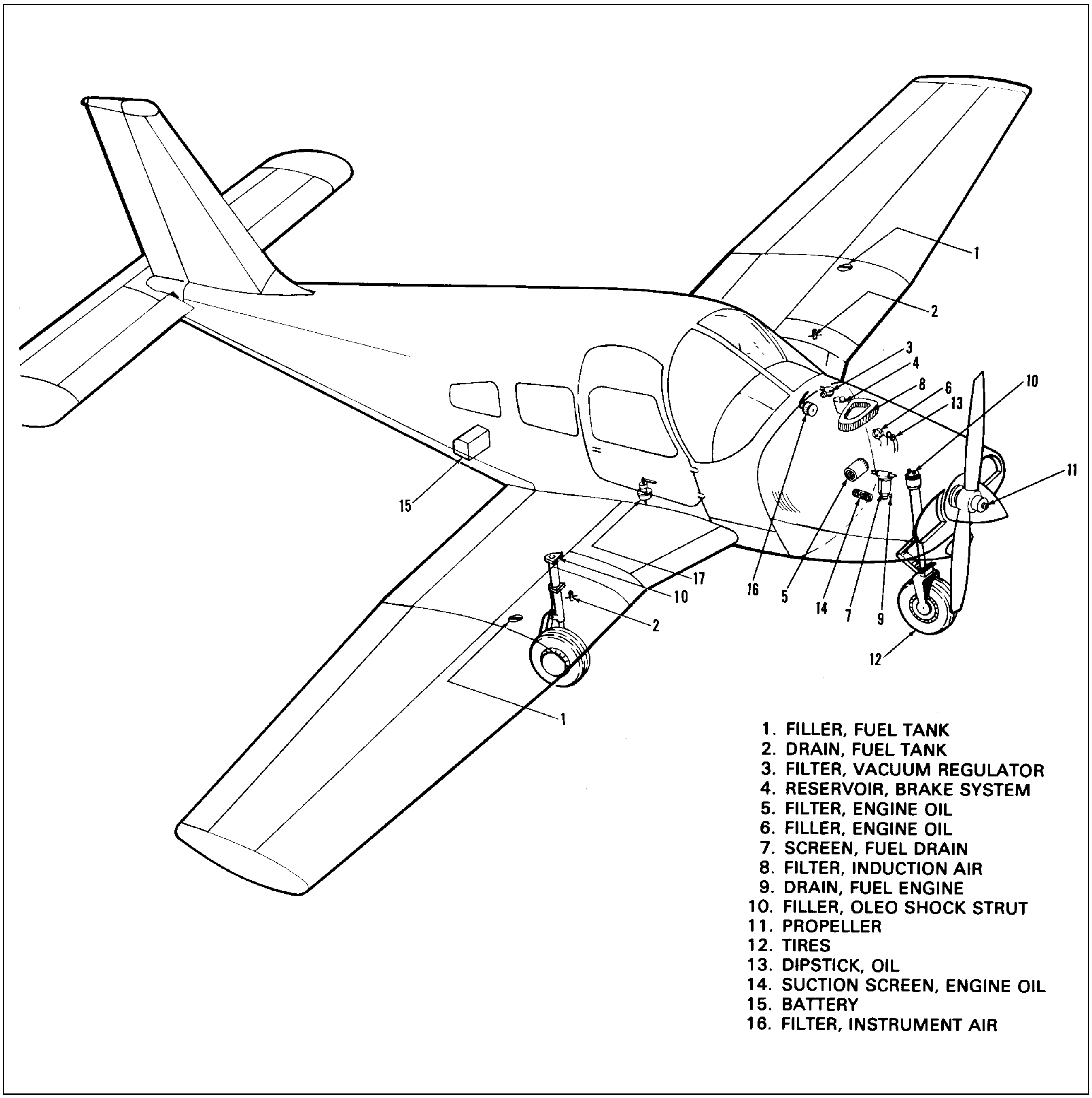


Figure 12-1. Service Points

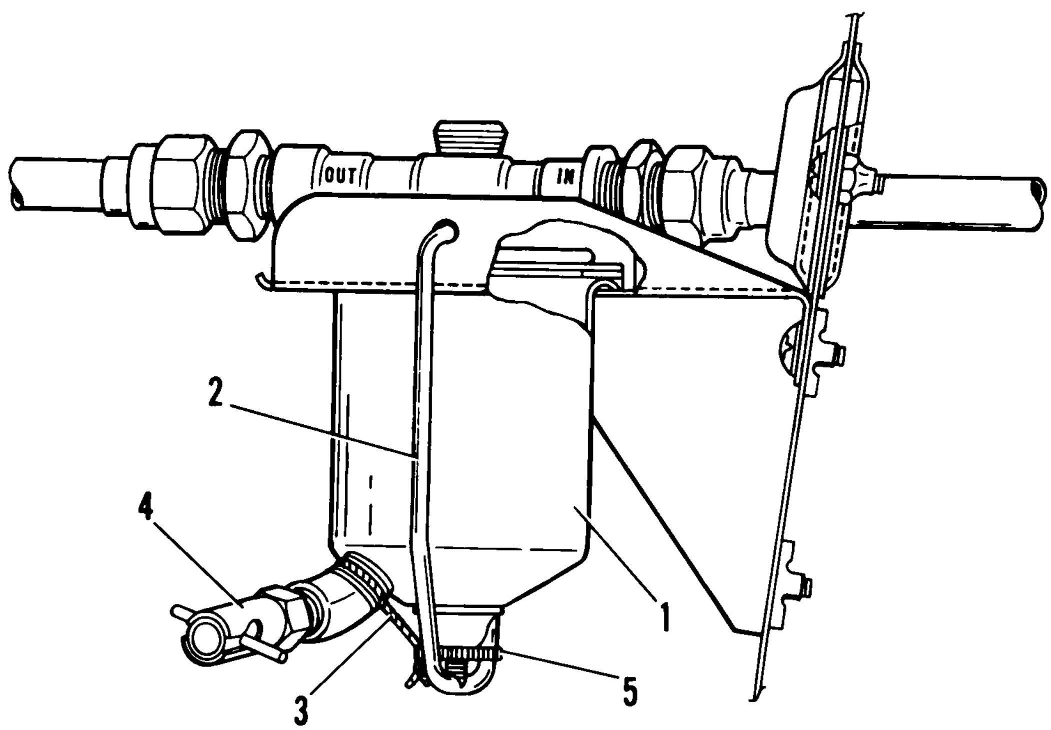
REPLENISHING.

FUEL SYSTEM.

SERVICING FUEL SYSTEM.

At intervals of 50 hours or 90 days, whichever comes first, clean the fuel strainer screen located in the gascolator assembly on the left side of the fire wall, and the screen in the inlet side of the injector. Instructions for the removal and cleaning of the screen, and additional fuel system service information may be found in Chapter 28.

Inspection intervals of the various fuel system components may be found in Chapter 5.



1. BOWL
2. BAIL
3. SAFETY WIRE
4. DRAIN
5. THUMB NUT

Figure 12-2. Fuel Strainer

FILLING FUEL TANKS.

Observe all required precautions for handling gasoline. Fill the fuel tanks with the fuel as specified on the placard adjacent to the filler neck or in Chart 601. Each wing tank has a capacity of 38 1/2 U.S. gallons, for a total capacity of 77 U.S. gallons. Five U.S. gallons are considered unusable fuel.

DRAINING MOISTURE FROM FUEL SYSTEM.

The fuel tanks and fuel strainer should be drained daily prior to first flight to avoid the accumulation of water or sediment. Each fuel tank is equipped with an individual quick drain located at the lower inboard rear corner of the tank. The fuel strainer with a quick drain valve (refer to Figure 12-2) is located on the lower left side of the fire wall. Drain fuel tanks and strainer per the following:

1. Drain each tank through its individual quick drain located at the lower inboard rear corner of the tank, making sure that enough fuel has been drained to insure that all water and sediment is removed.
2. Place a container under the fuel strainer drain. Drain the fuel strainer by opening the quick drain on the strainer.
3. Examine the contents of the container placed under the fuel strainer drain for water and sediment and dispose of the contents.

—CAUTION—

When draining any amount of fuel, care should be taken to insure that no fire hazard exists before starting engine.

DRAINING FUEL SYSTEM.

Fuel may be drained from the system by opening the valve at the inboard end of each fuel tank. The drain valve requires the drain cup pin to hold valve open. The remaining fuel in the system may be drained through the filter bowl. Any individual tank may be drained by closing the selector valve and then draining as desired.

ANTI-ICING FUEL ADDITIVE.

The PA-28-201T is approved for operation with an anti-icing fuel additive which meets the specification MIL-I-27686.

When using this additive, the following steps must be met:

1. It must be uniformly blended with the fuel while refueling.
2. It must not exceed .15% by volume of the refueled quantity.

—NOTE—

One and one half liquid ozs. per ten gallons of fuel would fall within this range.

3. It should be blended at not less than 10% by volume.
4. A blender supplied by the additive manufacturer should be used.

5. Except for the information contained herein, the manufacturer's mixing or blending information should be followed.

—CAUTIONS—

Assure that the additive is directed into the flowing fuel stream. The additive flow should start after and stop before the fuel flow. Do not permit the concentrated additive to come in contact with the aircraft painted surfaces or the interior surfaces of the fuel tanks. Some fuels have anti-icing additives pre-blended in the fuel at the refinery, so no further blending should be performed. Fuel additives cannot be used as a substitute for preflight draining of the fuel system drains.

OIL SYSTEM.

SERVICING OIL SYSTEM.

The engine oil level should be checked before each flight and changed after each 100 hours of engine operation. During oil change the oil screen(s) should be removed and cleaned, and the oil filter cartridge replaced. Replace oil filter at 50-hour intervals. Use a quality brand aviation grade oil of the proper season viscosity. Refer to Chart 1201 and Chart 9105 for proper oil grade and specification. Detergent oil that meets Continental Motor Corporation Specification MHS-24, is the only recommended lubricating oil for the PA-28-201T airplanes.

—CAUTION—

Do not introduce any trade additive to the basic lubricant unless recommended by the engine manufacturer.

DRAINING OIL SUMP AND OIL COOLER.

If the engine is cold, run it until the oil temperature reaches the green arc as indicated on the gauge on the instrument panel. Locate the oil drain hose that connects to the engine sump and oil cooler and runs back and out the opening in the bottom cowl. Place a suitable container, with a capacity of at least 12 quarts, under the drain hose. Open the drain valve by pushing in until it latches open and allow all oil to drain. Close valve by pulling out and re-safety with MS-20995-C41 safety wire.

RECOMMENDATIONS FOR CHANGING OIL. (Refer to Chart 1201.)

The engine manufacturer recommends that the oil supply be drained and the entire sump filled with fresh oil after each 100 hours of engine operation. Always start and warm the engine to operating temperature before performing an oil change. While draining the oil, the screens should be removed from the crankcase cover and cleaned thoroughly. If sludge deposits are heavy, subsequent oil changes should be made at shorter intervals.

1. Note the following for Continental engines:
   A. Detergent oil that meets Continental Motors Corporation Specification MHS-24, is the only recommended lubricating oil.

FILLING OIL SUMP.

The oil sump should normally be filled with oil to the mark on the engine dipstick. The quantity of oil required for the engines may be found in Chart 601. The specified grade of oil may be found in Chart 1201, the Lubrication Chart, or on the access door. To service the engine with oil, open the access door and remove the oil filler cap.

CHART 1201. RECOMMENDED ENGINE LUBRICATING OILS

Average Grade Oil	Average Ambient Air Temperature
SAE 50 SAE 30 or 10-W-30	Above 40°F Below 40°F

NOTE—

When the average ambient air temperature is approximately at the dividing line, use the lighter oil.

OIL FILTER. (Full Flow) (Refer to Figure 12-3.)

1. The oil filter should be replaced after each 50 hours of engine operation; this is accomplished by removing the lockwire from the bolthead at the end of the filter housing, loosening the cartridge, and removing it from the adapter.

—NOTE—

Ascertain that oil filter complies with specifications of the latest revision of Continental Aircraft Engine Service Bulletin M75-7.

2. Before discarding the throw away filter, remove the element for inspection by using a Burroughs or Champion cutter tool #5230 (Burroughs Tool and Equipment Corp., 2429 N. Burdick St., Kalamazoo, Mich. 49007). It will cut open any spin-on type oil filter for inspection. Examine the material trapped in the filter for evidence of internal engine damage, such as chips or particles from bearings. In new or newly overhauled engines, some small particles of metallic shavings might be found; these are generally of no consequence and should not be confused with particles produced by impacting, abrasion or pressure. Evidence of internal engine damage found in the oil filter justifies further examination to determine the cause.
3. After the filter has been replaced, tighten the new cartridge within 18 to 20 foot-pounds of torque. Lockwire the bolthead to the loops on the side of the housing to the drilled head of the thermostatic valve. Be sure the lockwire is replaced at both the attaching bolthead and the thermostatic oil cooler bypass. Use MS-20995-C41 safety wire.

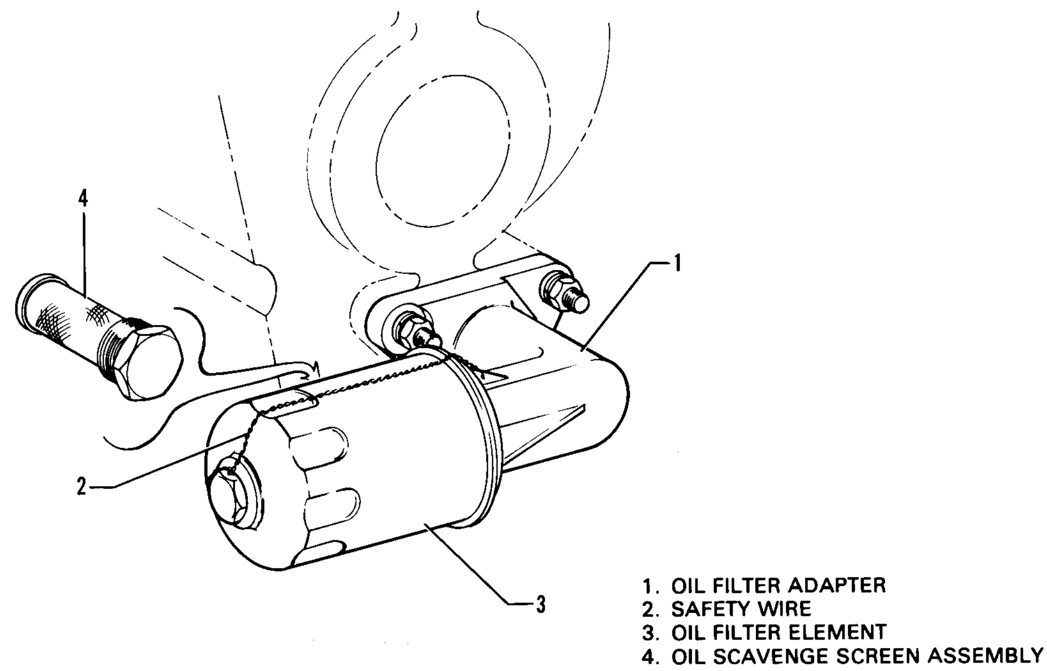


Figure 12-3. Oil Filter

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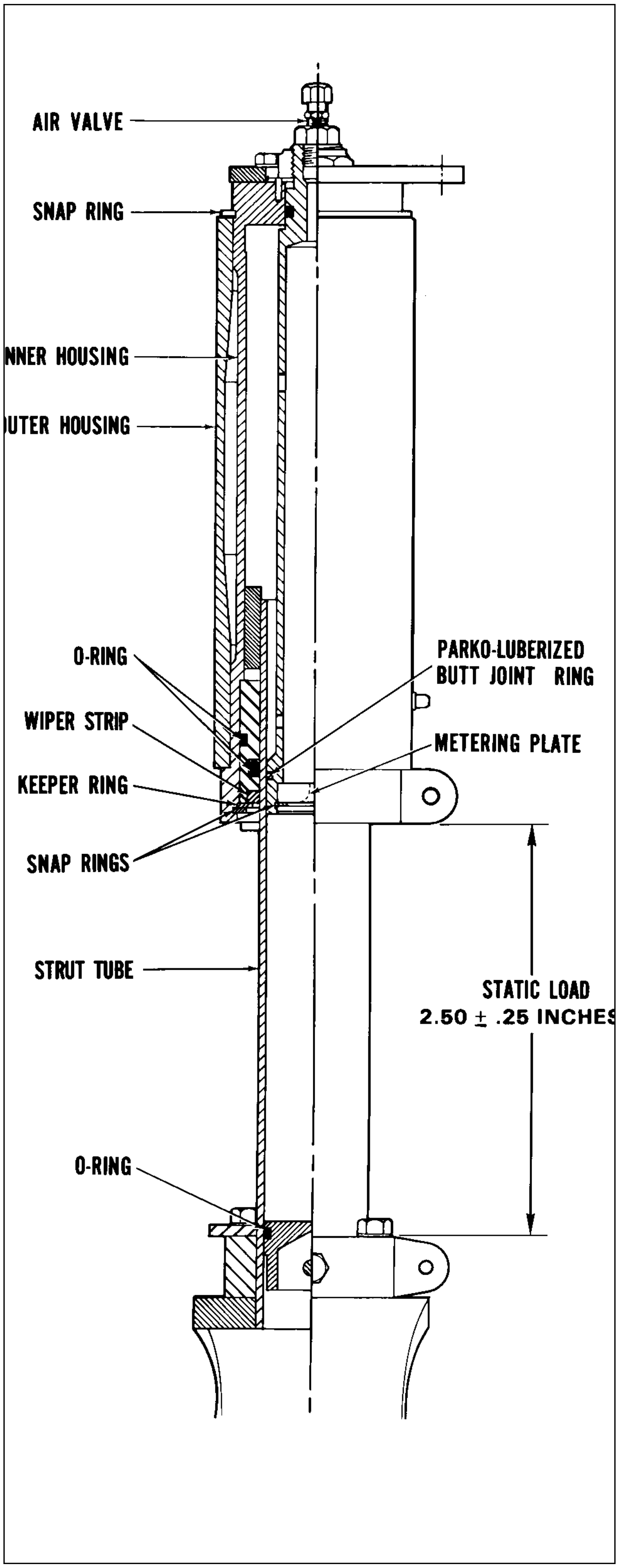


Figure 12-4. Nose Gear Oleo Strut
(Cut-away View)

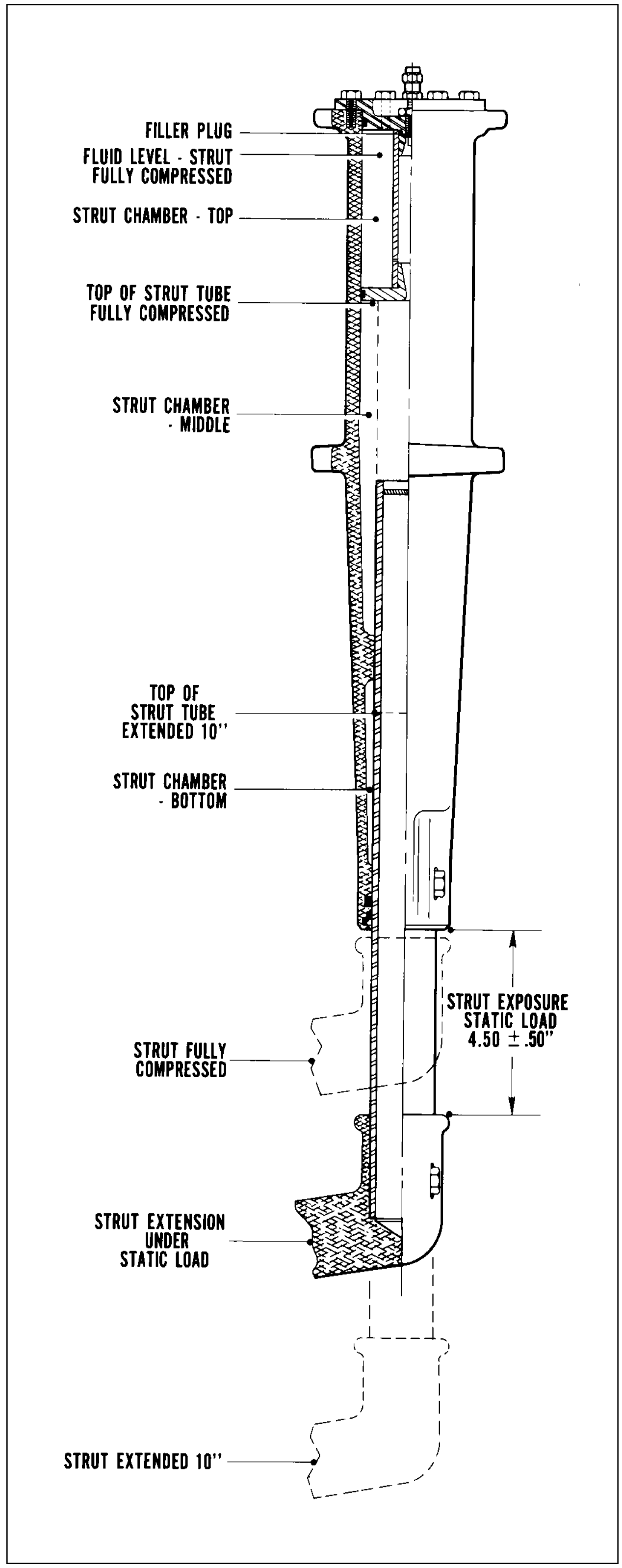


Figure 12-5. Main Gear Oleo Struts
(Cut-away View)

SCHEDULED SERVICING.

LANDING GEAR.

SERVICING OLEO STRUTS.

The air-oil type oleo strut should be maintained at proper strut piston tube exposures for best oleo action. The nose gear strut must have approximately 2.50 ± .25 inches of piston tube exposed, while the main gear strut requires approximately 4.5 ± .50 inches of tube exposure.

—CAUTION—

Do not exceed these tube exposures.

These measurements are taken with the airplane sitting on a level surface under normal static load.

—NOTE—

Normal static load is the empty weight of the airplane plus full fuel and oil.

—WARNING—

Do not release air by removing the strut valve core or filler plug. Depress the valve core pin until the strut chamber pressure has diminished.

—CAUTION—

Clean all dirt and foreign particles from around the filler plugs of the landing gear struts, therefore, before attempting to remove these plugs, the area around the filler plugs should be cleaned with compressed air and/or with a quick drying solvent.

If the strut has less tube exposure than prescribed, determine whether it needs air or oil by rocking the airplane. If the oleo strut oscillated with short strokes (approximately one inch) and the airplane settles to its normal position within one or two cycles after the rocking force is removed, the oleo strut requires inflating. Check the valve core and filler plug for air leaks, correct if required, and add air. If the oleo strut oscillates with long strokes (approximately three inches) and the airplane continues to oscillate after the rocking force is removed, the oleo struts require fluid. Check the oleo for indications of oil leaks, correct if required, and add fluid. For repair procedures of the landing gear and/or oleo struts, refer to Chapter 32 of this manual.

FILLING NOSE GEAR OLEO STRUT.

To fill the nose gear oleo strut with hydraulic fluid (MIL-H-5606), whether it be only the addition of a small amount or if the unit has been completely emptied and will require a large amount, it should be filled as follows:

1. Raise the airplane on jacks. (Refer to Chapter 7.)
2. Place a pan under the gear to catch spillage.
3. Relieve air pressure from the strut housing chamber by removing the cap from the air valve and depressing the valve core.
4. There are two methods by which the strut chamber may be filled and these are as follows:

Method I.

A. Remove the valve core from the filler plug at the top of the nose gear strut housing. Allow the filler plug to remain installed.
B. With the piston tube extended, fill the strut with approved type fluid.
C. Attach one end of a clean plastic hose to the valve stem of the filler plug and submerge the other end of the hose in a container of clean hydraulic fluid; make sure the end of the hose is below the surface of the fluid.

—NOTE—

An air tight connection is necessary between the plastic tube and the valve stem. Without such a connection, a small amount of air will be sucked into the oleo strut during each sequence, resulting in an inordinate amount of air bubbles and prolonged filling operations.

D. Fully compress and extend the piston tube, thus expelling any air trapped within the strut chamber. By watching the fluid pass through the plastic hose, it can be determined when the strut is full and no air is present in the chamber.
E. When air bubbles cease to flow through the hose, compress the piston fully and remove the hose from the valve stem. Remove the filler plug to determine that fluid level is visible up to the bottom of the filler plug hole.
F. Reinstall the core in the filler plug and the plug in the strut housing and torque plug to 45 foot-pounds.

Method II.

A. Remove the filler plug from the top of the nose gear strut housing.
B. Raise the strut piston tube until it is fully compressed.
C. Pour hydraulic fluid from a clean container through the filler opening until it reaches the bottom of the filler plug hole. (Air pressure type oil container may be helpful.)
D. Install the filler plug finger-tight and extend and compress the strut two or three times to remove air from the housing.
E. Remove the filler plug; raise the strut to full compression and fill with fluid if needed.
F. Reinstall filler plug and torque to 45 foot-pounds.

5. With the airplane still on jacks, compress and extend the gear piston tube several times to ascertain that the strut will operate freely. The weight of the gear, wheel, and fork should allow the piston tube to extend.
6. Clean off any overflow of fluid and inflate the strut till 2.50 ± .25 inches of piston tube is exposed.
7. Check that fluid is not leaking around the strut piston at the bottom of the housing.

FILLING MAIN GEAR OLEO STRUTS.

To fill the main gear oleo struts with hydraulic fluid (MIL-H-5606) one of the following methods should be used, depending on the type of service performed on the strut assembly:

Method I. Addition of small amount of fluid.

A. Raise the airplane on jacks until torque link assembly has almost reached its full travel. (Refer to Chapter 7.)
B. Place a pan under the gear to catch any spillage.
C. Relieve the air pressure from the strut housing chamber by removing the cap from the air valve and depressing the valve core. (Access to air valve is through cap on top of wing.)
D. Remove the valve core from the filler plug and allow the filler plug to remain installed.
E. Remove any one torque link bolt, allowing piston tube to extend (ten inches minimum, twelve inches maximum.)

—NOTE—

With the torque link disconnected the piston tube is free to slide from the strut housing.

F. With the piston tube extended, fill the strut with the approved type hydraulic fluid.
G. Attach one end of a clear plastic hose to the valve stem of the filler plug and submerge the other end of the hose in a container of clean hydraulic fluid; make sure the end of the hose is below the surface of the fluid.

—NOTE—

An air tight connection is necessary between the plastic tube and the valve stem. Without such a connection, a small amount of air will be sucked into the oleo strut during each sequence, resulting in an inordinate amount of air bubbles and prolonged filling operations.

H. Fully compress and extend the piston tube, thus expelling any air trapped within the strut chamber. By watching the fluid pass through the plastic hose, it can be determined when the strut is full and no air is present in the chamber.
I. When air bubbles cease to flow through the hose, fully compress the piston and remove the hose from the valve stem. Remove the filler plug to determine that fluid is visible up to the bottom of the filler plug hole.
J. Reinstall the air valve core in the filler plug and the plug in the strut housing and torque plug to 45 foot-pounds.
K. With the airplane still on jacks, compress and extend the gear piston tube several times to ascertain that the strut will operate freely. The weight of the gear, wheel, and fork should allow the piston tube to extend.

L. Clean off any fluid overflow and inflate strut to 4.5 ± .5 inches.
M. Remove aircraft from jacks and check strut exposure.

Method II. Filling completely empty struts.

A. Proceed with Steps A through E of Method I.
B. Remove the filler plug at the top inboard side of the main gear housing and fully extend the piston.
C. Pour one-half pint minimum of MIL-H-5606 hydraulic fluid through the plug hole using a syringe or pump oil can.
D. Allow fluid to drain into and fill the chamber below the top bearing hole.
E. Reconnect torque links.
F. Add more fluid until fluid level is even with bottom of air valve hole, with piston fully compressed and no entrapped air in assembly below valve hole.
G. Install air valve and torque plug 350-400 inch lbs.
H. Proceed with Steps K through M of Method I.

INFLATING OLEO STRUTS.

Prior to initial operation of the engine. The air or nitrogen pressure in each landing gear assembly shall be adjusted to the applicable pressure or visible piston extension by adding or releasing air or nitrogen through the air valve.

After making sure that an oleo strut has sufficient fluid and that the torque link assembly is properly connected. Attach a strut pump to the air valve and inflate the oleo strut. The strut should be inflated until the correct inches of piston is exposed with normal static load (empty weight of the airplane plus full fuel and oil) on the gears when servicing by the extension method. If the pressure servicing method is used, the pistons should be fully extended; the main gear should be inflated from 240 to 260 psi. The nose gear should be inflated from 120 to 140 psi. Pressure servicing is the preferred method. Rock the airplane service times to ascertain that the gear settles back to the correct strut position. (If a strut pump is not available, the airplane may be raised and line pressure from a high pressure air system used. Lower the airplane and while rocking it, let air from the valve to bring the strut down to the proper extension. Before capping the valve, check for valve core leakage.)

SERVICING STEERING BUNGEE.

At the specified frequency according to the Lubrication Chart, the steering bungee must be serviced as follows:

1. Remove the lower cowling.
2. Clamp the rudder pedals in the neutral position.
3. Remove the nut, washers, and bolt that secures the steering bungee and the steering arm.
4. Disconnect the bungee from the idler arm by removing the nut, washer and bolt.
5. Remove the steering bungee from the aircraft.
6. Cut the safety wire from the bungee retainer.
7. Carefully remove the retainer and release the spring.
8. Apply Aero Lubriplate to the spring and mounting hardware as specified in the Lubrication Chart.
9. Compress the spring into the bungee tube and install the retainer securing with MIL-W-6713 Type 316 safety wire.
10. With the nose gear in the neutral position, install the steering bungee into position. The primary web must be in the vertical position with the retaining clip facing down. Safety wire on bottom side.

11. Install the bolt, washers and nut that secures the bungee to the steering arm.
12. Install the bolt, washer, and nut that secures the bungee to the idler arm.
13. Align the nose gear per Alignment of Nose Landing Gear.
14. Remove the rudder pedal clamps and check the operation of the steering bungee.
15. Install the lower cowling.

BRAKE SYSTEM.

The brake system incorporates a hydraulic fluid reservoir through which the brake system is periodically serviced. Fluid is drawn from the reservoir by the brake cylinders to maintain the volume of fluid required for maximum braking efficiency. Spongy brake pedal action is often an indication that the brake fluid reservoir is running low on fluid. When found necessary to accomplish repairs to any of the brake system components, or to bleed the system, these instructions may be found in Chapter 32.

FILLING BRAKE CYLINDER RESERVOIR.

The brake cylinder reservoir should be filled to the level marked on reservoir with the fluid specified in Lubrication Chart. The reservoir, located on the upper right hand side of the bulkhead in the nose compartment, should be checked at every 50-hour inspection and replenished as necessary. No adjustment of the brakes is necessary, though they should be checked periodically per instructions given in Chapter 32.

DRAINING BRAKE SYSTEM.

To drain the brake system, connect a hose to the bleeder fitting on the bottom of the cylinder and place the other end of the line in a suitable container. Open the bleeder and slowly pump the hand brake lever and the desired brake pedal until fluid ceases to flow. To drain the wheel brake unit, disconnect the line at the bottom of the unit and allow fluid to flow into a suitable container. To clean the brake system, flush with denatured alcohol.

TIRES.

The tires should be maintained at the pressure specified in Chart 601. When checking tire pressure, examine the tires for wear, cuts, bruises and slippage. The tire, tube, and wheel should be balanced when installed. Align the index mark on the tire with the index mark on the tube.

TIRE BALANCE.

Proper balancing is critical for the life of aircraft tires. If a new tire is balanced upon installation it will usually remain balanced for the life of the tire without having any shimmy or flat spots, and an inexpensive balancer can be made that will balance almost any tire for light aircraft. Refer to Chapter 95 for balancer details. Balance the tire as follows

1. Mount the tire and tube (if one is used) on the wheel, but do not install the securing bolts. Install the wheel bearings in the wheel; then, using the -7 bushings, -6 spacers, and -5 nuts, install the wheel-tire assembly on the -8 pipe. Secure the -5 nuts finger-tight so that the wheel halves touch each other. Be sure the bolt holes are aligned. Insert the -4 axle through the -8 pipe and place the wheel in the center of the balancer. Make sure the axle is only on the chamfered edges of the balancer and that it is at 90° to the sides of the balancer.

2. Release the tire. If it is out of balance it will rotate, coming to rest with the heaviest point on the bottom. Tape a 1/2 ounce patch across top center of the tire. Rotate the tire 45° and release it again. If the tire returns to the same position, add a 1 ounce patch and again rotate the tire and release it. Continue this procedure until the tire is balanced.
3. When balance is attained, put a chalk mark on the sidewall directly below the patch. Use one mark for each half ounce of weight needed. Mark the valve stem location of the tire and the opposite wheel half to assure reassembly in the same position. Remove the wheel from the balance stand, break it down and clean the inside of the tire with toluol. Apply a coat of patch cement to both the patch and the inside center of the tire in line with the chalk marks. When the cement has dried, install the patches making certain they are on the center line of the tire and aligned with the chalk marks on the sidewall. Burnish the patches to remove trapped air, etc.
4. When reassembling the wheel, powder the inside of the tire. Mount the tire on the valve side of the wheel in the same position it was in when it was balanced. Install the other wheel half, aligning the chalk marks. Install the bolts and tighten to required torque, then air the tire and recheck the balance. The wheel should not be more than 1/2 ounce out of balance.

INDUCTION AIR FILTER.

REMOVAL OF AIR FILTER.

The filter is located just in front of the fire wall above the turbocharger. Remove filter by the following procedure:

1. Remove upper engine cowl.
2. Loosen studs and carefully move the cover assembly aside.
3. The filter is now free for removal. Clean or replace the filter as required.

CLEANING AND INSPECTION OF AIR FILTER.

1. The filter should be cleaned daily when operating in dusty conditions and if any holes or tears are noticed, the filter should be replaced immediately. For replacement filter, refer to Parts Catalog.
2. Remove the filter element and shake off loose dirt by tapping on a hard surface, being careful not to damage or crease the sealing ends.

—CAUTION—

Never wash the filter element in any liquid or soak in oil. Never attempt to blow off dirt with compressed air.

3. The filter housing can be cleaned by wiping with a clean cloth soaked in suitable quick drying type solvent. When the housing is dry, reinstall.

INSTALLATION OF AIR FILTER.

After cleaning and inspection, install the filter element and cover in reverse order of removal instructions.

PROPELLER.

The spinner, back plate and propeller surfaces should be cleaned and inspected frequently for nicks, scratches, corrosion and cracks. Minor nicks and scratches may be removed as found in Chapter 61. The face of each blade should be painted when necessary with a flat paint to retard glare. To prevent corrosion, wipe surfaces with a light oil or wax.

In addition, propellers should be inspected for grease or oil leakage and freedom of rotation on the hub pilot tube. To check freedom of rotation, rock the blade back and forth through the slight freedom allowed by the pitch change mechanism. Lubricate the propeller at 100-hour intervals in accordance with the Lubrication Chart.

Additional service information for the propeller may be found in Chapter 61.

ELECTRICAL SYSTEM.

Servicing the electrical system involves adding distilled water to the battery to maintain correct electrolyte level, checking cable connections, and checking for any spilled electrolyte that would lead to corrosion. The security of all electrical connections should be checked as well as the operation of all lights, general condition of the alternator and starter. All electrical wires should be inspected for chafing and bare wires. For detailed information on this system, refer to Chapter 39 of this manual.

BATTERY SERVICING.

BATTERY BOX CORROSION PREVENTION.

The battery should be checked for spilled electrolyte or corrosion at each 50-hour inspection or at least every 30 days, whichever comes first. Should corrosion be found in the box, on the terminals or around the battery, the battery should be removed and both the box and battery cleaned by the following procedure:

1. Remove the box drain cap from the underside of the fuselage and drain off any electrolyte that may have overflowed into the box.

—CAUTION—

Do not allow soda solution to enter battery.

2. Clean battery and the box. Corrosion effects may be neutralized by applying a solution of baking soda and water mixed to a consistency of thin cream. The application of this mixture should be applied until all bubbling action has ceased.
3. Rinse the battery and box with clean water and dry.
4. Place the cap over the battery box drain.
5. Reinstall battery. (Refer to Chapter 24 for additional service information.)

LUBRICATION INSTRUCTIONS.

Proper lubrication procedures are of immeasurable value both as a means of prolonging the service life of the airplane and as a means of reducing the frequency of extensive and expensive repairs. The periodic application of recommended lubricants to their relevant bearing surfaces, as detailed in the following paragraphs, together with the observance of cleanliness, will insure that maximum efficiency and utmost service of all moving parts. Lubrication instruction regarding the locations, time intervals, and type of lubricants used may be found in the Lubrication Charts 1201. To insure the best possible results from the application of lubricants, the following precautions should be observed:

1. Use recommended lubricants. Where general purpose lubricating oil is specified, but unavailable, clean engine oil may be used as a satisfactory substitute.
2. Check the components to be lubricated for evidence of excessive wear and replace them as necessary.
3. Remove all excess lubricants from components in order to prevent the collection of dirt and sand in abrasive quantities capable of causing excessive wear or damage to bearing surfaces.

APPLICATION OF OIL. (Refer to Chart 1201.)

Whenever specific instructions for lubrication of mechanisms requiring lubrication are not available, observe the following precautions:

1. Apply oil sparingly, never more than enough to coat the bearing surfaces.
2. Since the control cables are sufficiently coated by the manufacturer, additional protection for the prevention of corrosion is unnecessary.

APPLICATION OF GREASE.

Care must be taken when lubricating bearings and bearing surfaces with a grease gun, to insure that gun is filled with new, clean grease of the grade specified for the particular application before applying lubricant to the grease fittings.

1. Where a reservoir is not provided around a bearing, apply the lubricant sparingly and wipe off any excess.
2. Remove wheel bearings from the wheel hub and clean thoroughly with a suitable solvent. When repacking with grease, be sure the lubricant enters the space between the rollers in the retainer ring. Do not pack the grease into the wheel hub.

LUBRICATION CHARTS. (Refer to Figures 12-6 through 12-16.)

Each part of the airplane to be lubricated, as depicted on the Lubrication Charts, is indicated by a frequency symbol which shows the time intervals between lubrications. Application symbols with the frequency symbols show how the lubrication is applied. A parts nomenclature key, referred to by a number adjacent to the frequency symbol, identifies the part to be lubricated. Within the frequency symbol is a code letter which identifies the type of lubricant to be used and a special instructions number which gives instruction for lubricating a particular component. Refer to Chapter 91 for a list of Consumable Materials and suggested vendors.

CHART 1202. LUBRICATION CHART (LANDING GEAR AND POWER PLANT)

COMPONENT	LUBRICANT	FREQUENCY
1. MAIN AND NOSE WHEEL BEARINGS - SEE SPECIAL INSTRUCTION NO. 1	MIL-G-3545	100 HRS
2. FRESH AIR VENT SHAFT	MIL-G-23827	500 HRS
3. CABIN HEAT AND DEFROSTER MECHANISM	MIL-L-7870	100 HRS
14. CARB. AIR BOX SHAFT AND EXPOSED OLEO STRUT	FLUOROCARBON RELEASE AGENT DRY LUBRICANT #MS-122	100 HRS
5. AIR FILTER - SEE SPECIAL INSTRUCTION NO. 2	CLEAN AS OFTEN AS NEC-ESSARY, EVERYDAY UNDER SEVERE CONDITIONS	50 HRS
6. ENGINE CONTROL PIVOT POINTS	MIL-L-7870	100 HRS
7. OIL FILTER - SEE SPECIAL INSTRUCTION NO. 3		50 HRS
8. ENGINE SUMP - SEE SPECIAL INSTRUCTION NO. 3 AND CONTINENTAL SPECIFICATION MHS-24	MIL-L-22851	50 HRS
9. BRAKE RESERVOIR - SEE SPECIAL INSTRUCTION NO. 5	MIL-H-5606	AS REQUIRED
10. OLEO STRUT- SEE SPECIAL INSTRUCTION NO. 5	UNIVIS - 40	AS REQUIRED
11. NOSE WHEEL TORQUE LINKS	MIL-L-7870	l 00 HRS
12. OLEO HOUSING	MIL-G-23827	100 HRS
13. NOSE WHEEL STEERING	MIL-G-23827	100 HRS

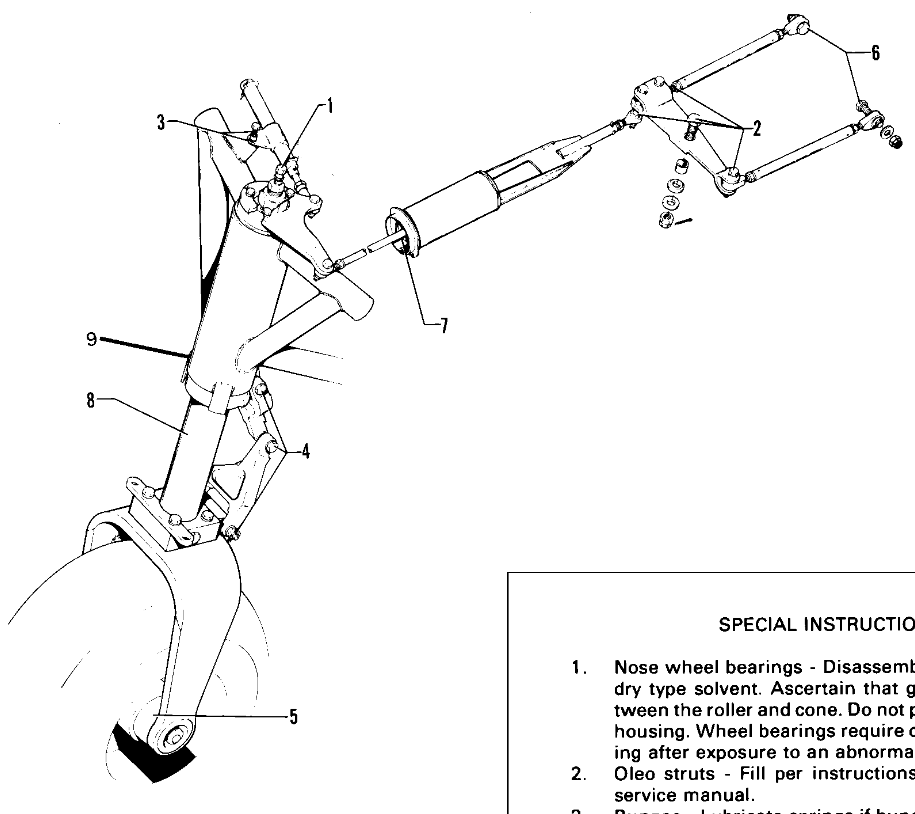
SPECIAL 11 INSTRUCTIONS

1. Wheel Bearings - Require cleaning and repacking after exposure to an abnormal quantity of water. Disassemble and clean with quick drying type solvent. Ascertain that grease is packed between the bearing roller and cone. Do not pack grease in wheel housing.
2. Air Filter - Inspect filter at least once every 50 hours. Under extremely adverse operating conditions, it must be inspected more frequently. The maximum filter life is 100 Hours; however, do not hesitate to replace the filter if inspection reveals an excessively dirty, punctured or ruptured filter.
3. Intervals between oil changes can be increased as much as 100% from the 50 hour cycle provided the full flow (cartridge type) oil filter element is changed each 50 hours of operation. See Continental Service Bulletin No. M75-2 for additional information.
5. Oleo Strut and Brake Reservoir - Fill per instructions on unit or container. Do not use hydraulic fluid with a castor oil or ester base.

NOTES

1. Lubrication Points - Wipe all lubrication points clean of old lubricants, dirt, etc., before applying fresh lubricants.
2. Bearings and Bushings - Clean exterior with quick drying type solvent before lubricating.

COMPONENT	LUBRICANT	FREQUENCY
1. OLEO STRUT FILLER POINT	MIL-H-5606	AS REQUIRED
2. STEERING BELLCRANK PIVOT POINT	MIL-L-7870	100 HRS
3. CENTERING SPRING ASSEMBLY PIVOT POINT	MIL-L-7870	100 HRS
4. TORQUE LINK ASSEMBLY	MIL-L-7870	100 HRS
5. NOSE WHEEL BEARING	TEXACO MARFAX ALL PURPOSE GREASE OR MOBIL GREASE 77 (OR MOBIL EP2 GREASE)	100 HRS
6. NOSE GEAR STEERING ROD END BEARINGS	MIL-L-7870	100 HRS
7. BUNGEE SEAL	PARKER O-RING	100 HRS
8 EXPOSED OLEO STRUT	FLUOROCARBON RELEASE AGENT DRY LUBRICANT #MS-122	100 HRS
9. NOSE LANDING GEAR GREASE FITTING	MIL-G-23827	100 HRS

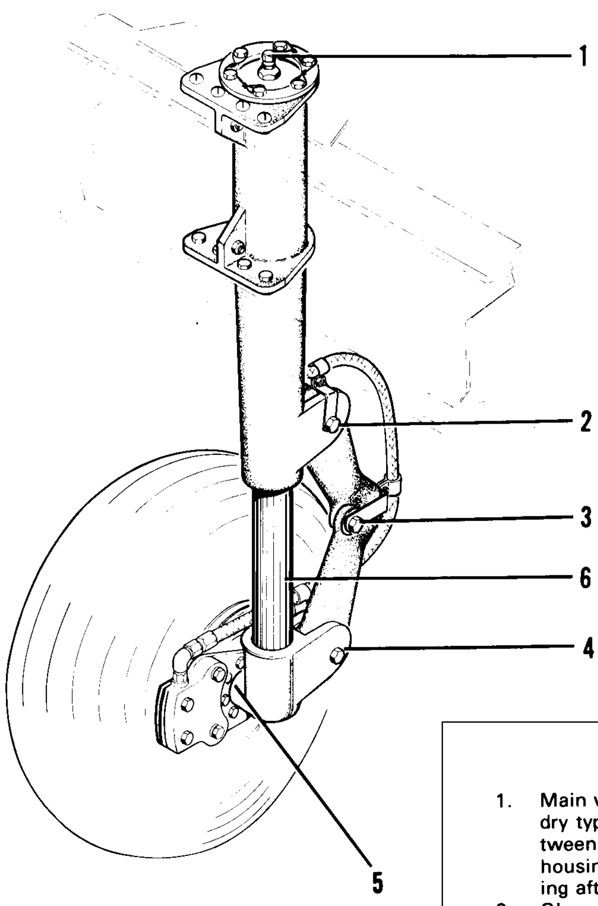


SPECIAL INSTRUCTIONS

1. Nose wheel bearings - Disassemble and clean with a dry type solvent. Ascertain that grease is packed between the roller and cone. Do not pack grease in wheel housing. Wheel bearings require cleaning and repacking after exposure to an abnormal quantity of water.
2. Oleo struts - Fill per instructions on unit or refer to service manual.
3. Bungee - Lubricate springs if bungee is disassembled.

Figure 12-6. Lubrication Chart (Landing Gear, Nose)

COMPONENT	LUBRICANT	FREQUENCY
1. OLEO STRUT FILLER POINT	MIL-H-5606	AS REQUIRED
2. UPPER TORQUE LINK BEARING	MIL-G-23827	100 HRS
3. TORQUE LINK BUSHING	MIL-L-7870	100 HRS
4. TORQUE LINK CONNECTING BUSHING	MIL-G-23827	100 HRS
5. MAIN WHEEL BEARING	TEXACO MARFAX ALL-PURPOSE GREASE OR MOBIL GREASE 77 (OR MOBIL EP2 GREASE)	100 HRS
6. EXPOSED OLEO STRUT	FLUOROCARBON RELEASE AGENT DRY LUBRICANT #MS- 122	100 HRS
7. BRAKE RESERVOIR	MIL-H-5606	100 HRS

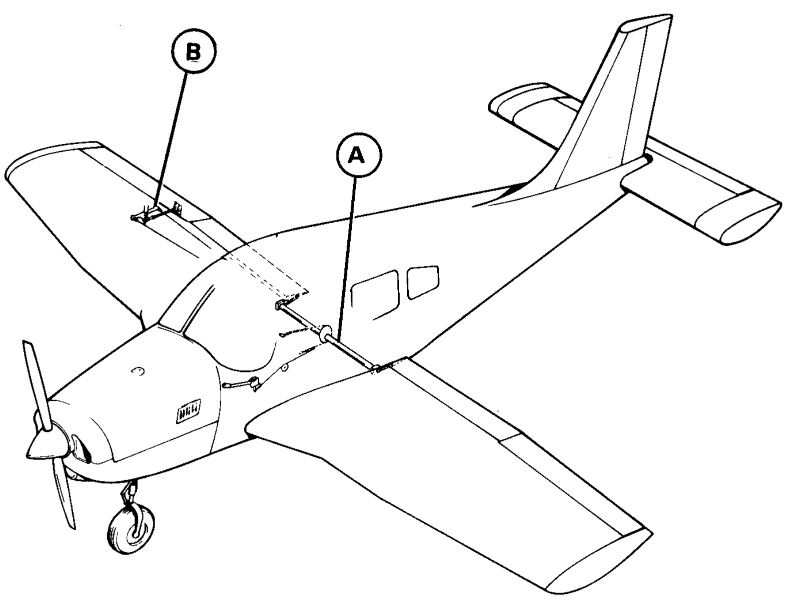


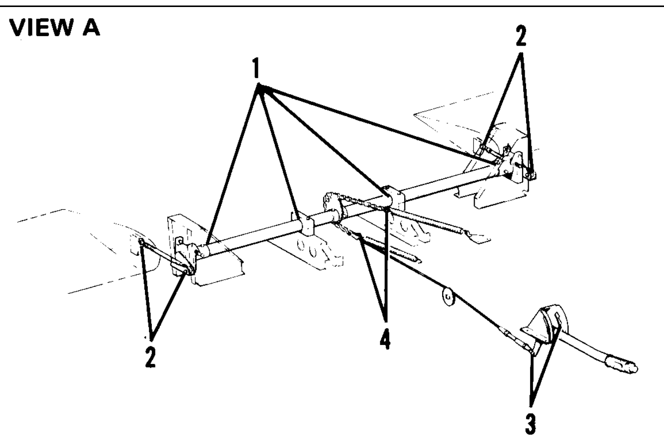
SPECIAL INSTRUCTIONS

1. Main wheel bearings - Disassemble and clean with a dry type solvent. Ascertain that grease is packed between the roller and cone. Do not pack grease in wheel housing. Wheel bearings require cleaning and repacking after exposure to an abnormal quantity of water.
2. Oleo struts and brake reservoir - Fill per instructions on unit or container or refer to service manual.

Figure 12-7. Lubrication Chart (Landing Gear, Main)

COMPONENT	LUBRICANT	FREQUENCY
1. FLAP TORQUE TUBE BEARING BLOCKS	MIL-L-7870	100 HRS
2. FLAP CONTROL ROD END BEARINGS	MIL-L-7870	100 HRS
3. FLAP HANDLE PIVOT POINT, LOCK MECHANISM AND TURNBUCKLE END	MIL-L-7870	100 HRS
4. FLAP RETURN AND TENSION CHAINS	MIL-L-7870	500 HRS
5. AILERON BELLCRANK PIVOT POINTS	MIL-L-7870	100 HRS
6. AILERON CONTROL ROD END BEARINGS	MIL-L-7870	100 HRS
7. AILERON BELLCRANK CABLE ENDS	MIL-L-7870	100 HRS





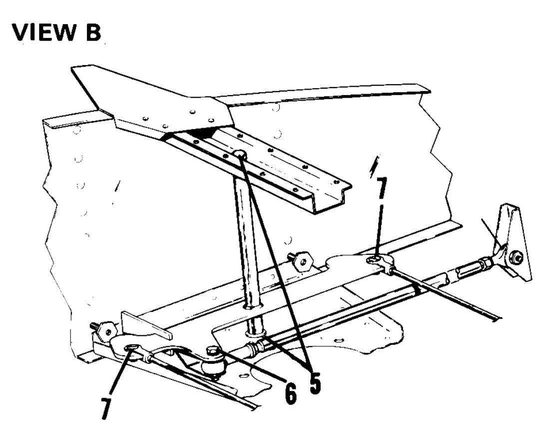


Figure 12-8. Lubrication Chart (Control System)

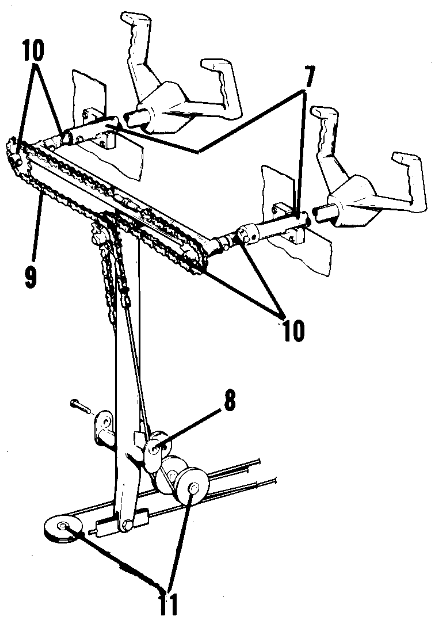
—CAUTION—

Do not lubricate control wheel shaft or bushings. Clean only using alcohol or other suitable solvent

COMPONENT	LUBRICANT	FREQUENCY
1. AILERON HINGE PINS	MIL-L-7870	100 HRS
2. FLAP HINGE BEARINGS	MIL-L-7870	100 HRS
3. STABILATOR HINGE PINS	MIL-L-7870	100 HRS
4. RUDDER HINGE BEARINGS	MIL-L-7870	100 HRS
5. CONTROL CABLE PULLEYS	MIL-L-7870	100 HRS
6. TRIM CONTROL WHEEL	MIL-L-7870	100 HRS.
7. O-RING, CONTROL SHAFT BUSHING	PARKER O-RING* LUBRICANT	AS REQUIRED
8. TEE BAR PIVOT POINT	MIL-L-7870	100 HRS.
9. CONTROL COLUMN CHAIN	MIL-L-7870	500 HRS
10. CONTROL COLUMN FLEX. JOINTS AND SPROCKET	MIL-L-7870	100 HRS
11. STABILATOR CONTROL	MIL-L-7870	100 HRS.

*SPECIAL INSTRUCTIONS

Disassemble O-ring retainer plates from instrument panel; lubricate O-ring and reassemble.



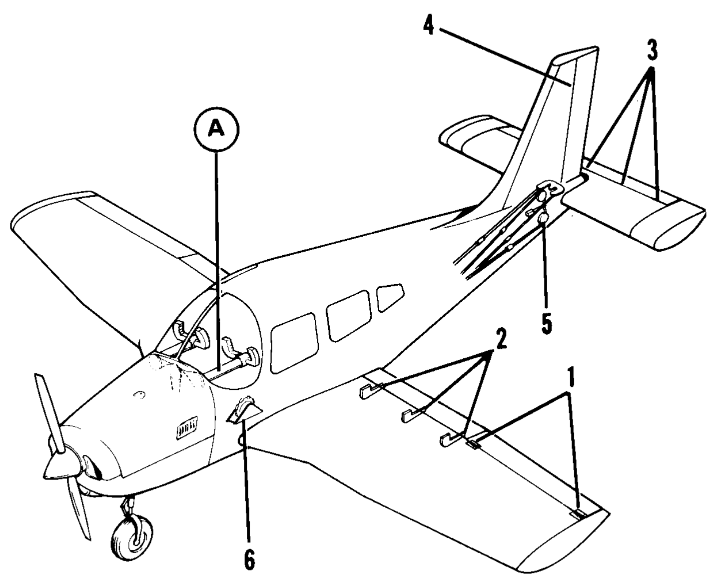
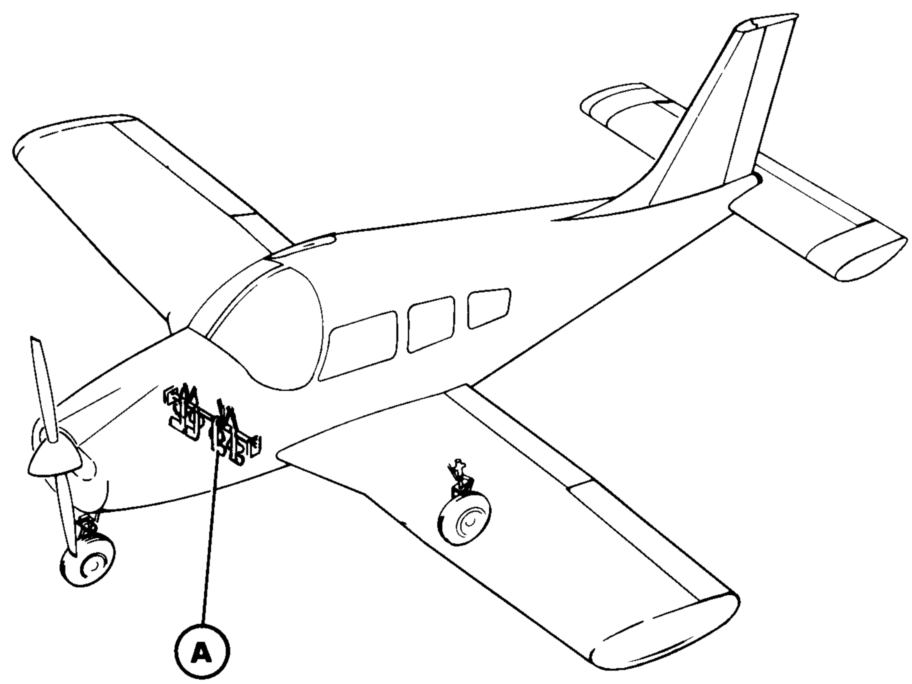


Figure 12-8. Lubrication Chart (Control System) (cont.)

COMPONENT	LUBRICANT	FREQUENCY
1. RUDDER TUBE BEARING BLOCKS	MIL-L-60326	100 HRS
2. TOE BRAKE CYLINDER ATTACHMENTS	MIL-L-7870	100 HRS
3. RUDDER TUBE CONNECTIONS	MIL-L-7870	100 HRS
4. BRAKE ROD ENDS	MIL-L-7870	100 HRS



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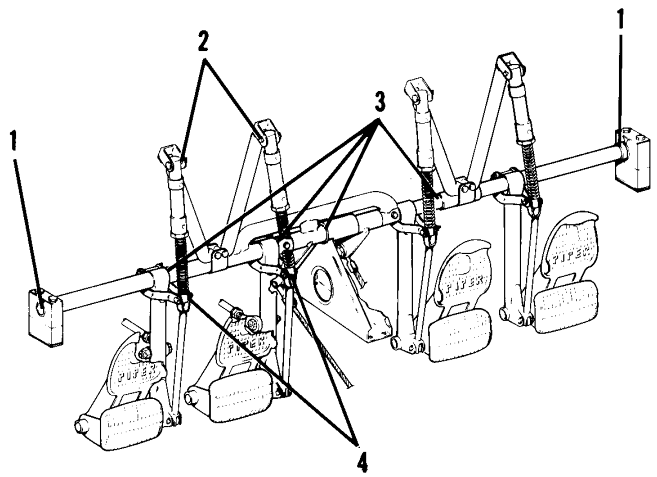


Figure 12-8. Lubrication Chart (Control System) (cont)

COMPONENT	LUBRICANT	FREQUENCY
1. RUDDER ARM CABLE ENDS	MIL-L-7870	100 HRS
2. STABILATOR TRIM SCREW	MAG-1 OR AERO LUBRIPLATE FISKE BROS. REFINING CO.	100 HRS
3. STABILATOR SCREW/TAB LINKS	MIL-L-7870	100 HRS
4. STABILATOR HINGE POINTS	MIL-L-7870	100 HRS.
5. RUDDER TRIM ASSEMBLY	MIL-L-7870	100 HRS.

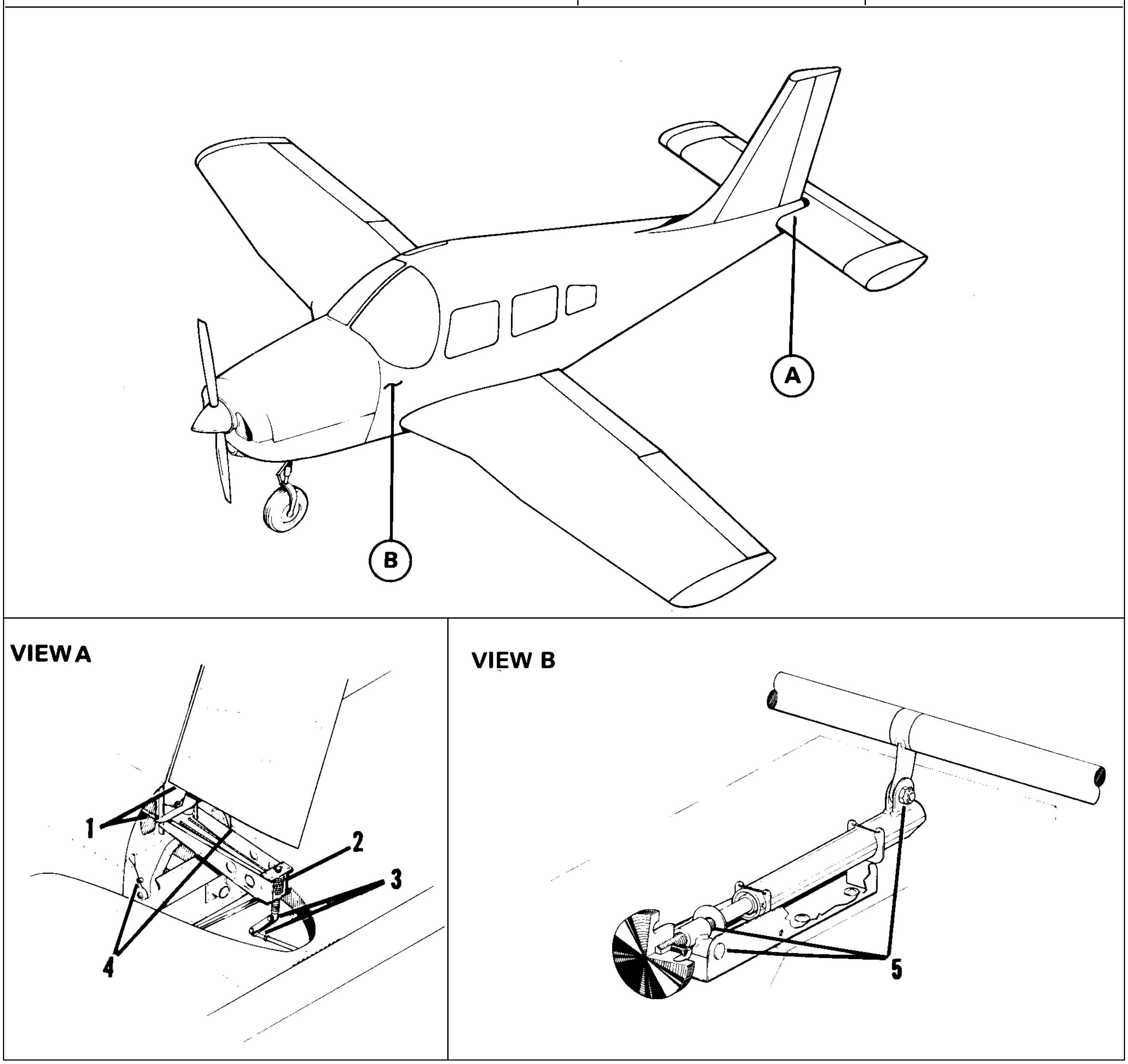
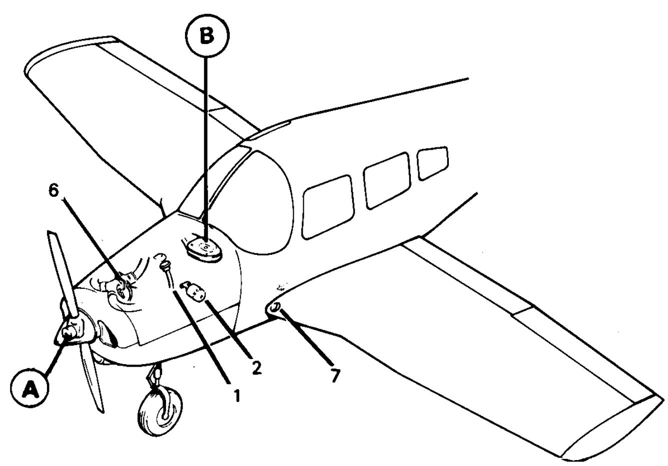
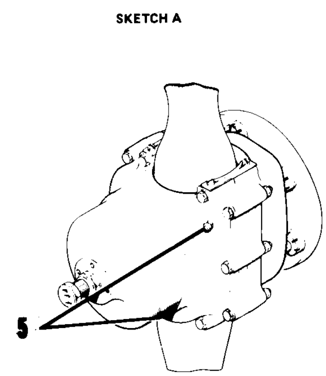


Figure 12-8. Lubrication Chart (Control System) (cont)

COMPONENT	LUBRICANT	FREQUENCY
1. ENGINE OIL SUMP	CONTINENTAL SPECIFICATION MHS-24A AND SERVICE BULLETIN M75-2	100 HRS
2. OIL FILTER	SEE SPECIAL INSTRUCTIONS NO. 2 AND NO. 3	50 HRS
3. INDUCTION AIR FILTERS	CLEAN AS OFTEN AS NECESSARY, EVERYDAY UNDER SEVERE CONDITIONS	
4. ALTERNATE AIR DOOR	MIL-L-7870	100 HRS
5. PROPELLER ASSEMBLY	MIL-G-23827	100 HRS
6. ENGINE CONTROL AND ENVIRONMENTAL CONTROL PIVOT POINTS	MIL-L-7870	100 HRS
7. FRESH AIR VENT SHAFTS	MIL-G-7711	500 HRS





SPECIAL INSTRUCTIONS

1. Air Filter - To clean filter, tap gently to remove dirt particles. Do not blow out with compressed air or use oil; replace filter if punctured or damaged.
2. See latest revision of TCM Service Bulletin M75-2 for recommended oil and filter change period. The engine lubricating oil system is serviced with MIL-C-6529. Type II for the initial fill and for the first 25 hours engine time per TCM Operator's Manual and MHS-184. Service engine thereafter with oil per MHS-24A and TCM Service Bulletin M75-2.
3. Ascertain that oil filter complies with specifications of latest revision of TCM Service Bulletin M75-7.
4. Propeller - Remove one of two grease fittings for each blade. Apply grease through fitting until fresh grease appears at hole of removed fitting.

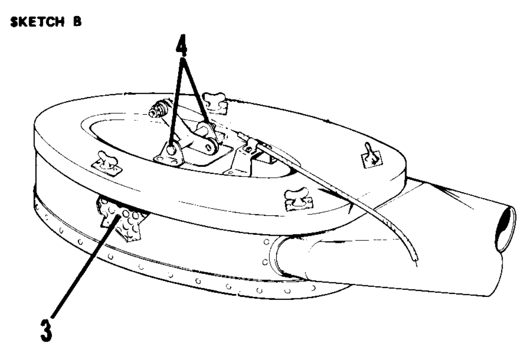


Figure l2-9. Lubrication Chart (Power Plant and Propeller)

COMPONENT	LUBRICANT	FREQUENCY
1. DOOR HINGES	MIL-L-7870	100 HRS
2. DOOR SEALS	MIL-L-60326	50 HRS
3. DOOR LATCH MECHANISMS	MAG-1 OR AERO LUBRIPLATE, FISKE BROS. REFINING CO.	500 HRS
4. SEAT TRACK ROLLERS, STOP PINS AND REAR SEAT LEG RETAINER (CLIP AND CAM)	MAG-1 OR AERO LUBRIPLATE, FISKE BROS. REFINING CO.	100 HRS
5. SEAT LATCH STOP PIVOT POINT (COPILOT)	MIL-L-7870	100 HRS

SPECIAL INSTRUCTIONS

Apply fluorocarbon dry lubricant to door seals at least once a month to prevent the seal from sticking, and improve sealing characteristics.

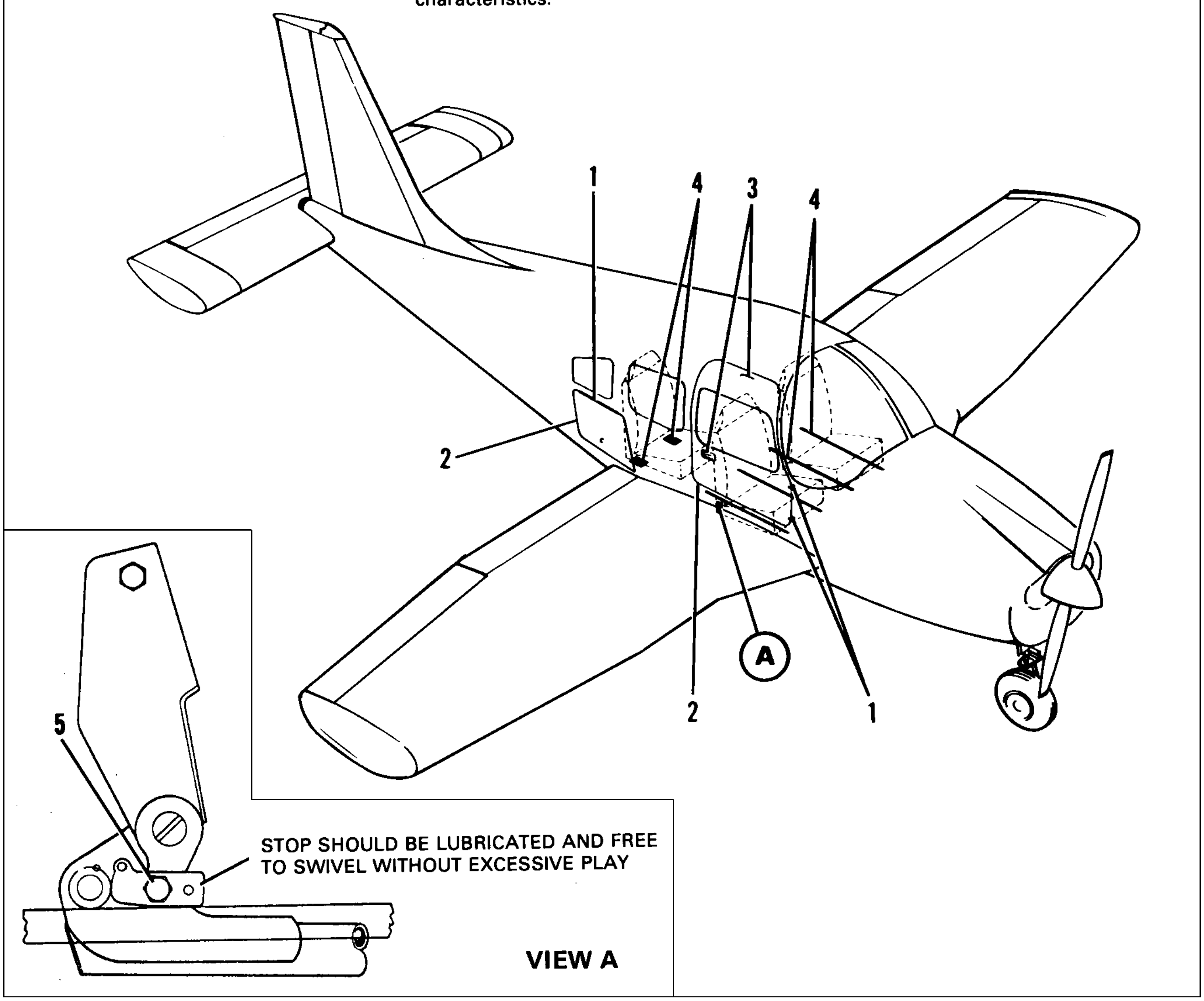


Figure 12-10. Lubrication Chart (Cabin Door, Baggage Door and Seat)

COMPONENT	LUBRICANT	FREQUENCY
1.. CONDENSER HINGE AND ACTUATORS	MIL-L-7870	100 HRS
2. CONDENSER DOOR ACTUATING TRANSMISSION	MIL-G-23827	500 HRS

SPECIAL INSTRUCTIONS

Transmission to be 1/2 full of grease. Apply grease during assembly and lubricate transmission ball nut and screw with MIL-G-23827 grease.

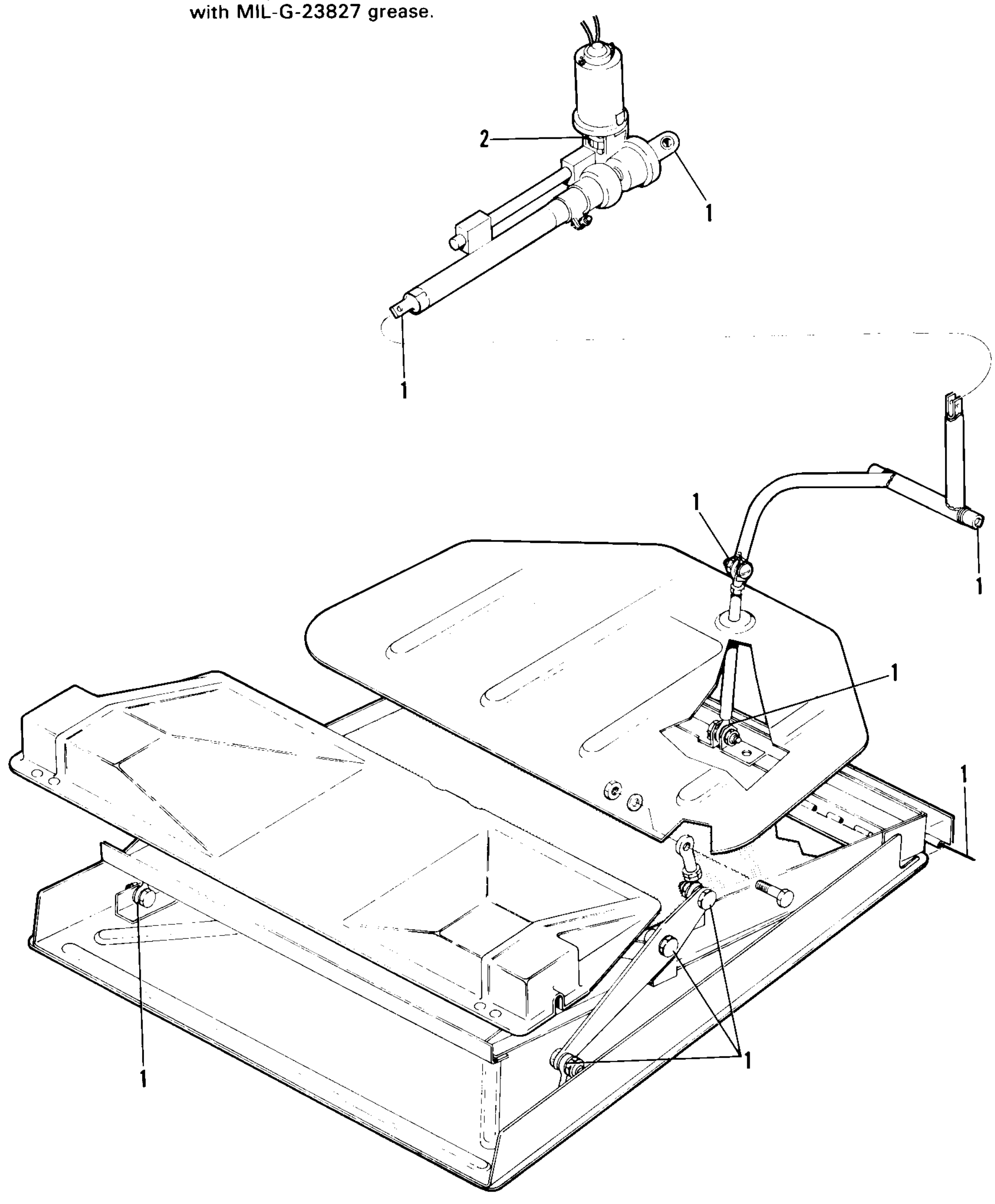


Figure 12-11. Lubrication Chart (Air Conditioning Condenser)

CHAPTER

20

STANDARD PRACTICES/ AIRFRAME

CHAPTER 20-STANDARD PRACTICES/AIRFRAME

TABLE OF CONTENTS/EFFECTIVITY

STANDARD PRACTICES-AIRFRAME.

TORQUE WRENCHES.

Torque wrenches should be checked daily and calibrated by means of weights and a measured lever arm to make sure that inaccuracies are not present. Checking one torque wrench against another is not sufficient and is not recommended. Some wrenches are quite sensitive as to the way they are supported during a tightening operation. Any instructions furnished by the manufacturer must be followed explicitly.

When it is necessary to use a special extension or adapter wrench together with a torque wrench, a simple mathematical equation must be worked out to arrive at the correct torque reading. Following is the formula to be used: (Refer to Figure 20-1.)

T = Torque desired at the part.
A = Basic lever length from center of wrench shank to center of handle or stamped on wrench or listed for that model wrench.
B = Length of adapter extension, center of bolt to center of shank.
C = Scale reading needed to obtain desired torque (T).

The formula: $C = \frac{A \times T}{A+B}$

EXAMPLE

A bolt requires 30 foot-pounds and a 3 inch adapter (one-quarter of a foot or .25’) is needed to get at it. You want to know what scale reading it will take on a one-foot lever arm wrench to obtain the 30 foot-pounds at the bolt.

$$C = \frac{1 \times 30}{1 + .25} \text{ or } C = \frac{30}{1.25} \text{ 24 ft.-lbs.}$$

Remember, the 3 inch adapter must be projecting 3 inches straight along the wrench axis. In general, avoid all complex assemblages or adapters and extensions of flex joints.

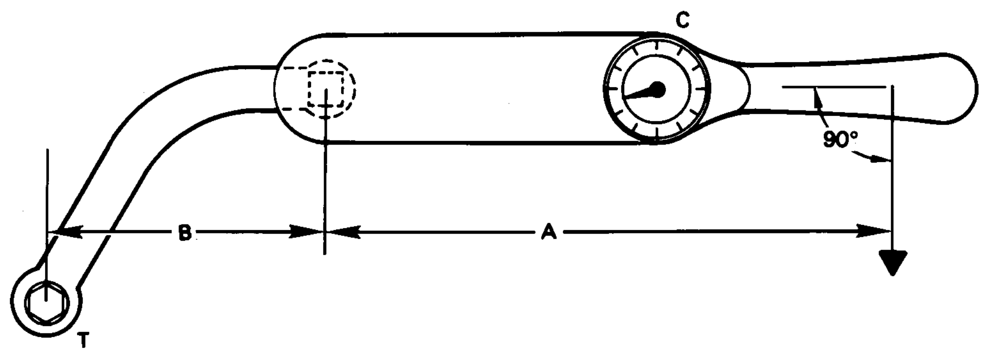


Figure 20-1. Torque Wrench Formula

METHOD OF INSTALLING ROD END BEARINGS.

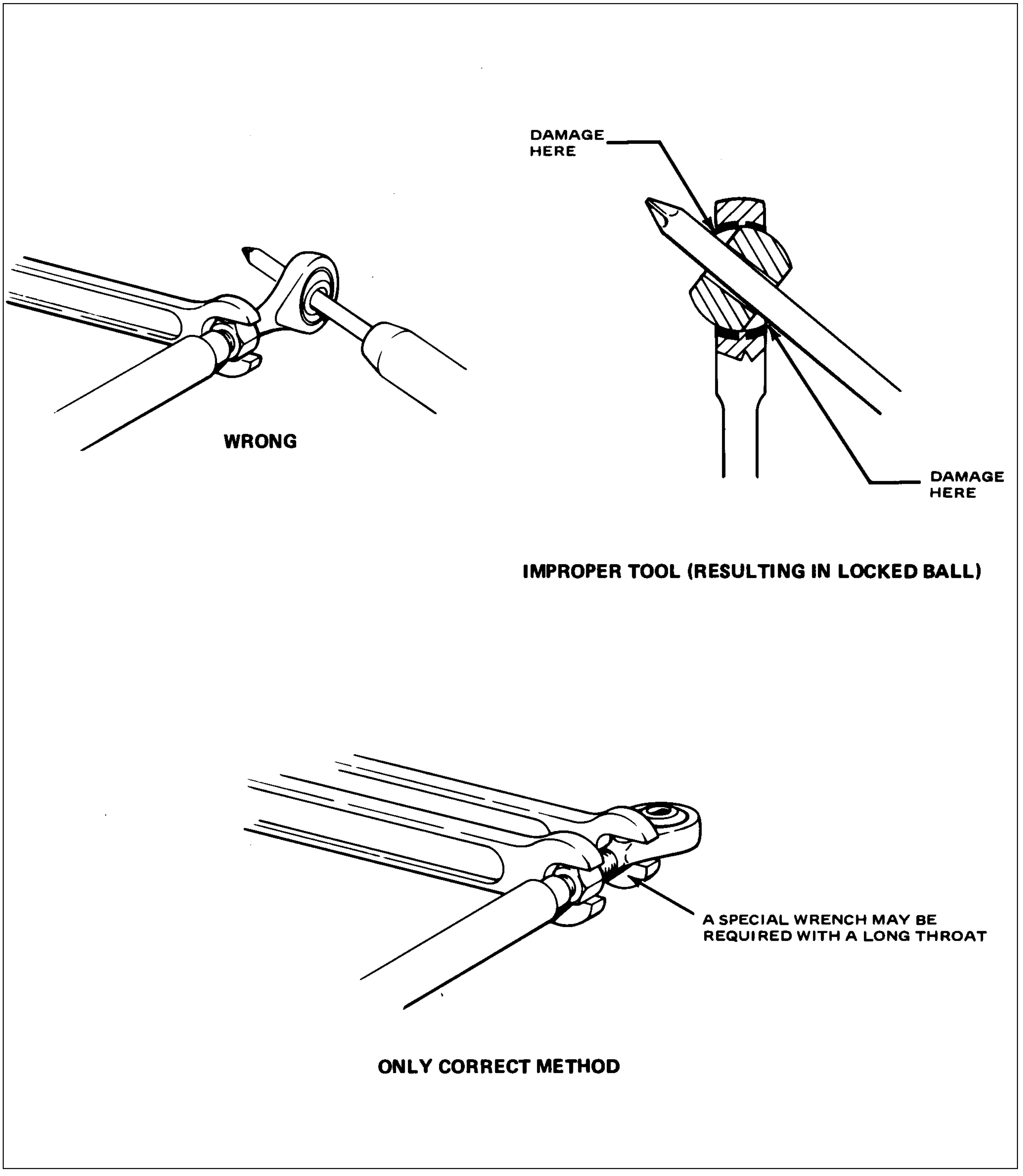


Figure 20-2. Method of Installing Rod End Bearings

IDENTIFICATION OF FLUID LINES. (Refer to Figure 20-3.)

Fluid lines in aircraft are often identified by markers made up of color codes, words, and geometric symbols. These markers identify each line's function, content, and primary hazard, as well as the direction of fluid flow.

In most instances, fluid lines are marked with 1-inch tape or decals. Paint is used on lines in engine compartments, where there is the possibility of tapes, decals or tags being drawn into the engine induction system.

In addition to the above-mentioned markings, certain lines may be further identified as to specific function within a system; for example, DRAIN, VENT, PRESSURE or RETURN.

Lines conveying fuel may be marked FLAM; lines containing toxic materials are marked TOXIC in place of FLAM. Lines containing physically dangerous materials, such as oxygen, nitrogen, or freon, are marked PHDAN.

The aircraft and engine manufacturers are responsible for their replacement when it becomes necessary.

Generally, tapes and decals are placed on both ends of a line and at least once in each compartment through which the lines runs. In addition, identification markers are placed immediately adjacent to each valve, regulator, filter or other accessory within a line. Where paint or tags are used, location requirements are the same as for tapes and decals.

FLARELESS TUBE ASSEMBLIES. (Refer to Figure 20-4.)

Although the use of flareless tube fittings eliminates all tube flaring, another operation, referred to as presetting, is necessary prior to installation of a new flareless tube assembly which is performed as follows:

1. Cut the tube to the correct length, with the ends perfectly square. Deburr the inside and outside of the tube. Slip the nut, then the sleeve, over the tube (Step 1).
2. Lubricate the threads of the fitting and nut. See Figure 20-4 for proper lubricant to use, depending on the type system the tubing assemblies are to be used on. Place the fitting in the vise (Step 4), and hold the tubing firmly and squarely on the seat in the fitting. (Tube must bottom firmly in the fitting.) Tighten the nut until the cutting edge of the sleeve grips the tube. This point is determined by slowly turning the tube back and forth while tightening the nut. When the tube no longer turns, the nut is ready for final tightening.
3. Final tightening depends upon the tubing. For aluminum alloy tubing up to and including 1/2 inch outside diameter, tighten the nut from one to one and one-sixth turns. For steel tubing and aluminum alloy tubing over 1/2 outside diameter, tighten from one and one-sixth to one and one-half turns.

After presetting the sleeve, disconnect the tubing from the fitting and check the following points (illustrated in Step 3):

1. The tube should extend 3/32 to 1/8 inch beyond the sleeve pilot; otherwise blowoff may occur.
2. The sleeve pilot should contact the tube or have a minimum clearance 0.005 inch for aluminum alloy tubing or 0.015 inch for steel tubing.
3. A slight collapse of the tube at the sleeve cut is permissible. No movement of the sleeve pilot, except rotation is permissible.

IDENTIFICATION OF AIRCRAFT FLUID LINES.

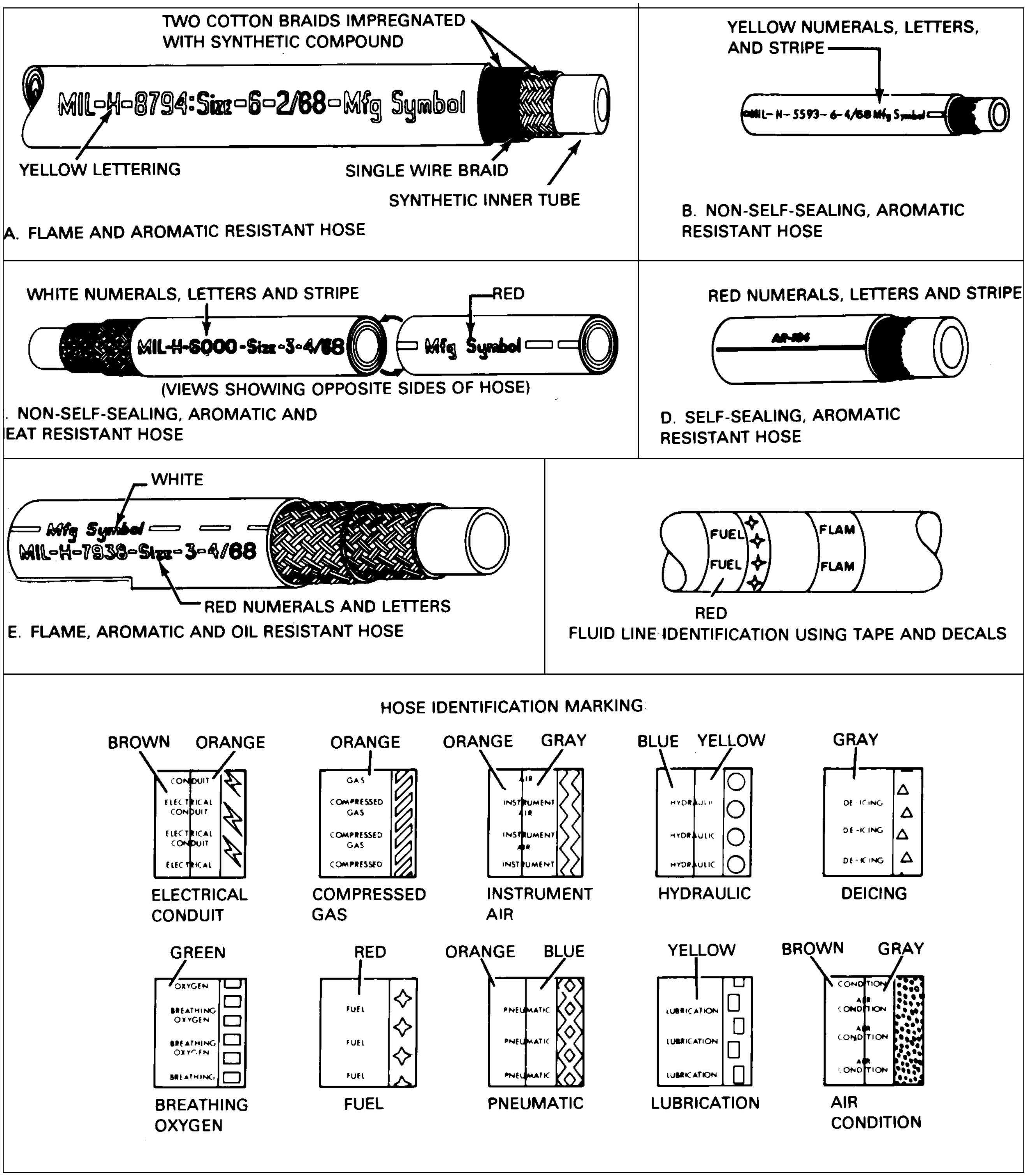
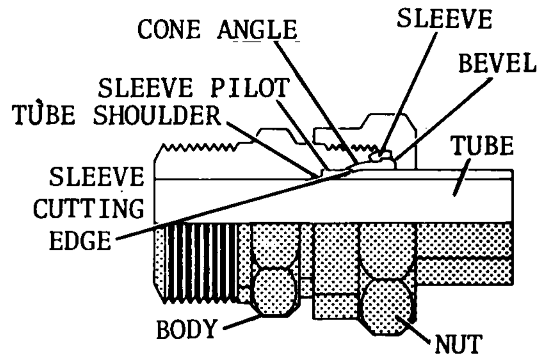


Figure 20-3. Identification of Aircraft Fluid Lines

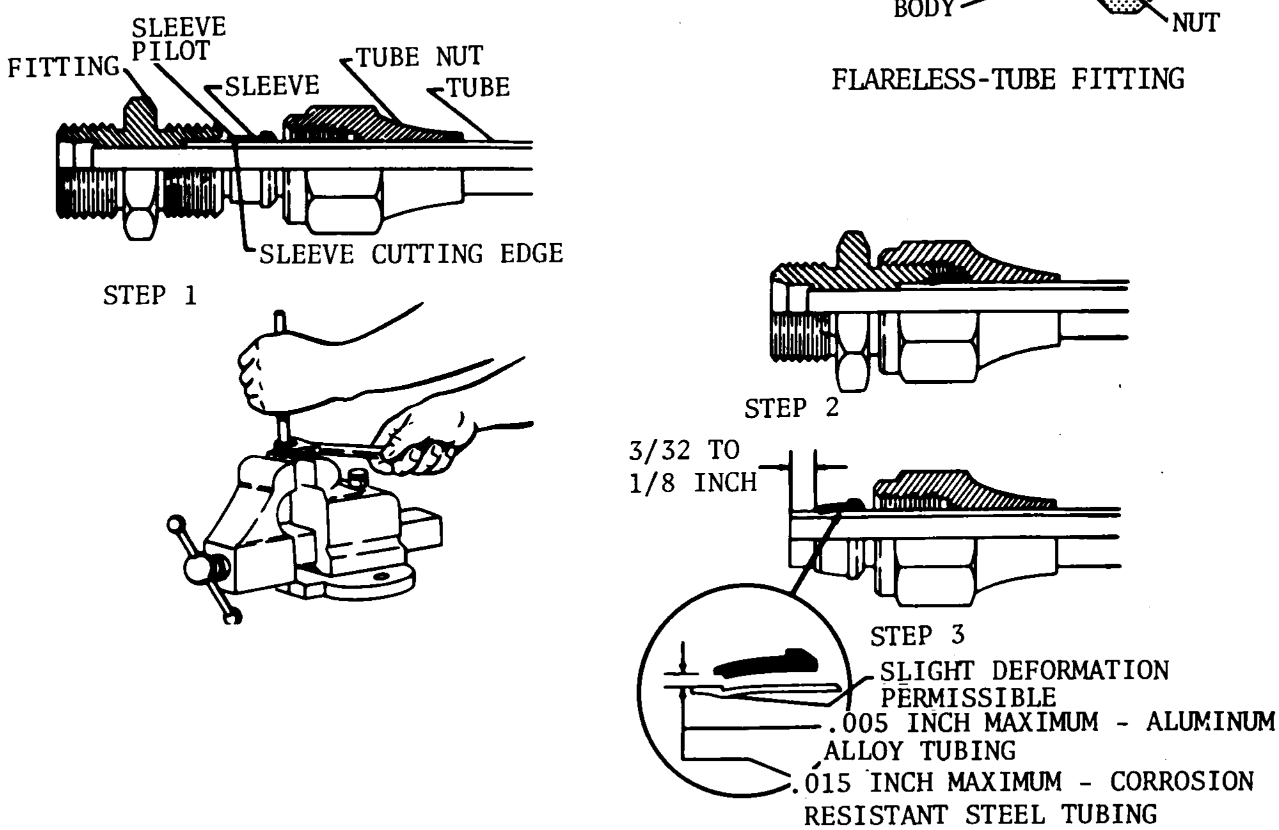
TUBING SYSTEM	LUBRICANT
HYDRAULIC	MIL-H-5606
FUEL	MIL-H-5606
OIL	System Oil
PNEUMATIC	MIL-L-4343
OXYGEN*	MIL-T-5542

*CAUTION-DO NOT USE OIL OR GREASE

TUBING AND HOSE LUBRICANTS



FLARELESS-TUBE FITTING



PRESETTING FLARELESS-TUBE ASSEMBLY

Figure 20-4. Flareless Tube Fittings

SUPPORT CLAMPS.

Support clamps are used to secure the various lines to the airframe or powerplant assemblies. Several types of support clamps are used for this purpose. The rubber-cushioned and plain are the most commonly used clamps. The rubber-cushioned clamp is used to secure lines subject to vibration; the cushioning prevents chafing of the tubing. The plain clamps is used to secure lines in areas not subject to vibration.

A teflon-cushioned clamp is used in areas where the deteriorating effect of Skydrol 500, hydraulic fluid (MIL-H-5606) or fuel is expected, however, because it is less resilient, it does not provide as good as vibration damping effect as other cushion materials.

Use bonded clamps to secure metal hydraulic, fuel and oil lines in place. Unbonded clamps should be used only for securing wiring. Remove any paint or anodizing from the portion of the tube at the bonding clamp location. Make certain that clamps are of the correct size. Clamps supporting clips smaller than the outside diameter of the hose may restrict the flow of fluid through the hose.

All plumbing lines must be secured at specified intervals. The maximum distance between supports for rigid fluid tubing is shown in Chart 2002.

CHART 2001. THREAD LUBRICANTS

TYPE OF LINE	TYPE OF LUBRICANT
Brakes	MIL-H-5606
Freon	TT-A-580 or MIL-T-5544, Anti-Seize Compound
Fuel	MIL-T-5544, Anti-Seize, Graphite Petrolatum
Landing Gear (Air Valve)	6PB Parker
Oil	MIL-G-6032, Lubricating Grease (Gasoline and Oil Resistant)
Pitot and Static	TT-A-580 (JAN-A-669), Anti-Seize Compound (White Lead Base)

—NOTE—

Lubricate engine fittings only with fluid contained in the particular lines.

CHART 2002. MAXIMUM DISTANCE BETWEEN SUPPORTS FOR FLUID TUBING

TUBE OD (IN.)	DISTANCE BETWEEN SUPPORTS (IN.) ALUMINUM ALLOY	STEEL
1/8	9-1/2	11-1/2
3/16	12	14
1/4	13-1/2	16
5/16	15	18
3/8	16-1/2	20
1/2	19	23
5/8	22	25-1/2
3/4	24	27-1/2
	26-1/2	30

CHART 2003. MAXIMUM ALLOWABLE RESISTANCE VALUES

ITEM TO BE ELECTRICALLY BONDED	MAXIMUM ALLOWABLE RESISTANCE VALUE IN OHMS
Engine Mount	.003
Generators	.003
Ailerons	.003
Elevators	.003
Rudder	.003
Motor(s)	.003
Flaps	.003
Trim Tabs	
Conventional Hinge	.003
Piano Wire Hinge	.01
Instrument Panel Inserts	.01
Interior Lights	.01
Exterior Lights Mounted on Non-Conductive Material	.003
Heaters	.003
Electrical Equipment	.003
Avionics “Black Boxes”	.003
Battery Ground Point to Generator Ground Point	.01
Refueling Ground Attachment to .032 Aluminum Plate under Tire (A/C on Ground)	10 Megohms

ELECTRICAL BONDING.

Aircraft electrical bonding should be accomplished or verified to establish a maximum allowable resistance value. See Chart 2003 for values.

All electrical, electronic equipment and components shall be installed in such a manner as to provide a continuous low-resistance path from the equipment enclosure to the airplane structure.

Parts shall be bonded directly to the primary structure rather than to the other bonded parts.

All parts shall be bonded with as short a lead as possible.

All bonding surfaces shall be cleaned prior to the installation of the bonded joint.

All nuts used in bonding shall be of the self-locking type. (Do Not use fiber-locking type.)

All electrical bonding shall be accomplished without affecting the structural integrity of the airframe.

Bond connections shall be secure and free from corrosion.

Self-Tapping Screws will not be used for bonding purposes.

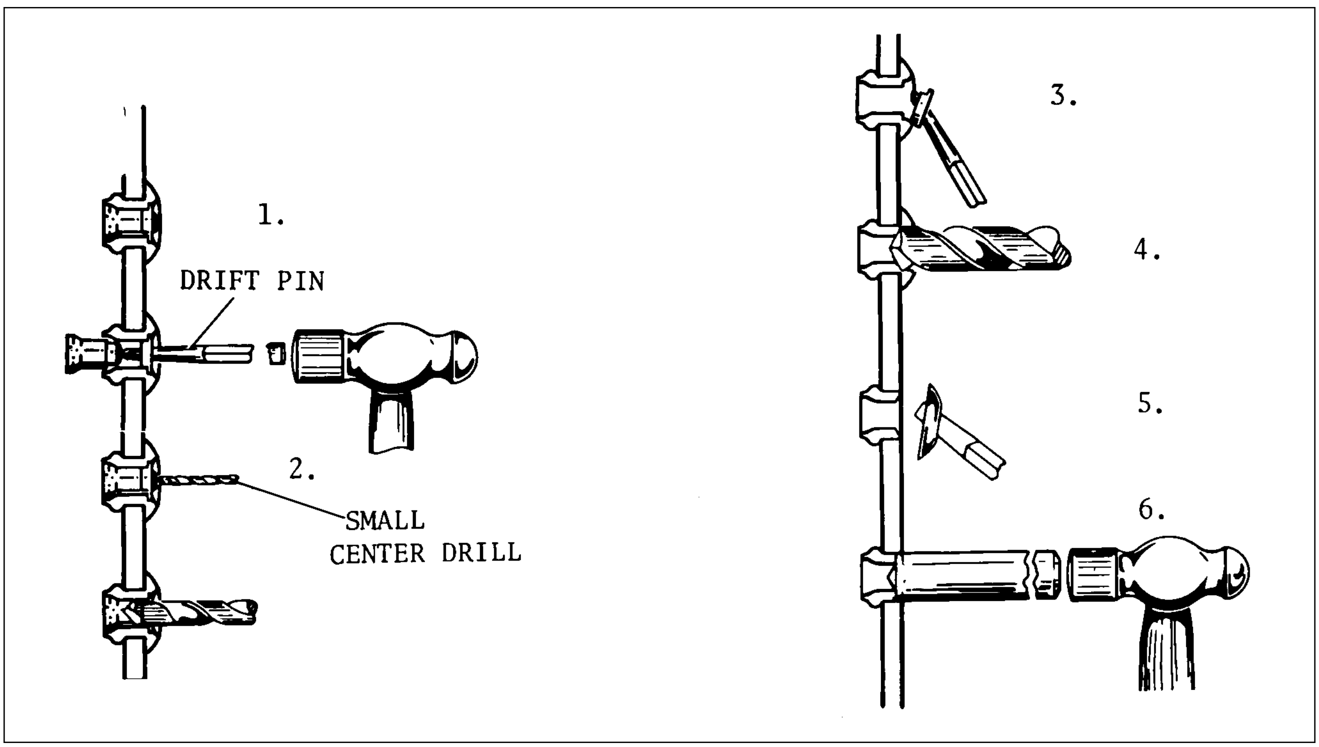


Figure 20-5. Removal of Cherrylock Rivets

REMOVAL OF CHERRYLOCK RIVETS.

To remove cherrylock rivet:

1. File head flat.
2. Centerpunch rivet head.
3. In thick material, remove the lock by driving out the rivet stem using, a tapered steel drift pin. (See View 1.)

—NOTE—

Do not drill completely through the rivet sleeve to remove a rivet, as this will tend to enlarge the hole.

4. In thin material, use a small center drill to provide a guide for a larger drill on top of the rivet stem, and the tapered position of the stem be drilled away to destroy the lock.
5. Remove the remainder of the locking collar out of the rivet head by prying it loose with the drift pin. (See View 3.)
6. Drill nearly through the head of the rivet, using a drill the same size as the rivet shank. (See View 4.)
7. Pry off the rivet head using the drift pin. (See View 5.)
8. Drive out the remaining shank with a pin having the same diameter as the rivet shank. (See View 6.)

CHART 2004. HOSE CLAMP TIGHTENING, (INITIAL INSTALLATION)

Types of hose	Types of clamps	
	Worm screw type	All other types
Self sealing	Finger-tight-plus 2 complete turns	Finger-tight-plus 2 1/2 complete turns
All other hose	Finger-tight-plus 1 1/4 complete turns	Finger-tight-plus 2 complete turns
If clamps do not seal at specified tightening, examine hose connection and replace parts as necessary.		

AIRCRAFT FINISH CARE. (Cleaning)

EXTERIOR SURFACES.

The airplane should be washed with a mild soap and water. Harsh abrasives or detergents used on painted or plastic surfaces could make scratches or cause corrosion of metal surfaces. Cover areas where cleaning solution could cause damage. To wash the airplane, the following procedure may be used:

1. Flush away loose dirt with water.
2. Apply cleaning solution with a rag, sponge or soft bristle brush.
3. To remove stubborn oil and grease, use a cloth dampened with naphtha.
4. Where exhaust stains exist, allow solution to remain on the surface longer.
5. Any good automotive wax may be used to preserve the painted surfaces. Soft cleaning cloths or a chamois should be used to prevent scratches when cleaning or polishing. A heavier coating of wax on the leading surfaces will reduce the abrasion problems in these areas.

WINDSHIELD AND WINDOWS.

1. Remove dirt, mud, etc., from exterior surfaces with clean water.
2. Wash with mild soap and warm water, or an aircraft plastic cleaner using a soft cloth or sponge and a straight rubbing motion. Do not rub surfaces harshly.
3. Remove oil and grease with a cloth moistened with kerosene.

—NOTE—

Do not use gasoline, alcohol, benzene, carbon tetrachloride, thinner, acetone or window cleaning sprays.

4. After cleaning plastic surfaces, apply a thin coat of hard polishing wax. Rub lightly with a soft cloth. Do not use a circular motion.
5. A severe scratch or mar in plastic can be removed by using a jeweler’s rouge to rub out the scratch. Smooth both sides and apply wax.
6. To improve visibility through windshield and windows during flight through rain, a rain repellent such as REPCON should be applied to the windshield and windows. The surfaces of the windshield and windows treated becomes so smooth that water beads up and readily flows off the surface. Apply this product in accordance with the manufacturer’s instructions. (Refer to Chart 9105. List of Consumable Materials for Specifications and Manufacturer’s address.)

HEADLINER, SIDE PANELS AND SEATS.

1. Clean headliner, side panels and seats with a stiff brush and vacuum where necessary.

—CAUTION—

Solvent cleaners required adequate ventilation.

2. Soiled upholstery, except leather, may be cleaned by using an approved air drying type cleaner or foam upholstery cleaner. Carefully follow the manufacturer’s instructions. Avoid soaking or harsh rubbing.
3. Leather material should be cleaned with saddle soap or mild soap and water.

CARPETS.

Use a small whisk broom or vacuum to remove dirt. For soiled spots, use a non-inflammable dry-cleaning fluid.

ENGINE COMPARTMENT.

Before cleaning the engine compartment, place strips of tape on the magneto vents to prevent any solvent from entering these units.

1. Place a pan under the engine to catch waste.

—CAUTION—

Do not spray solvent into the alternator, starter, pneumatic pump, air intake and alternate air inlets.

2. With the engine cowling removed, spray or brush the engine with solvent or a mixture of solvent and degreaser, as desired. It may be necessary to brush areas that were sprayed where heavy grease and dirt deposits have collected in order to clean them.
3. Allow the solvent to remain on the engine from five to ten minutes; then rinse the engine clean with additional solvent to allow to dry.

—CAUTION—

Do not operate engine until excess solvent has evaporated or otherwise been removed.

4. Remove the protective covers from the magnetos.
5. Lubricate controls, bearing surfaces, etc., per Lubrication Charts. (Refer to Chapter 12.)

FUEL SYSTEM.

1. To flush the fuel tanks and selector valve, disconnect the fuel line at the carburetor.
2. Select a fuel tank, turn on the electric pump and flush fuel through the system until it is determined there is no dirt and foreign matter in the fuel valve or tank. During this operation, agitation of the fuel within the tank will help pick up and remove any dirt.
3. Repeat this procedure for each tank.
4. When all tanks are flushed, clean all filters.

LANDING GEAR.

Before cleaning the landing gear, place a plastic cover or similar material over the wheel and brake assembly.

1. Place a pan under the gear to catch waste.
2. Spray or brush the gear area with solvent or a mixture of solvent and degreaser, as desired. It may be necessary to brush areas that were sprayed where heavy grease and dirt deposits have collected in order to clean them.
3. Allow the solvent to remain on the gear from five to ten minutes; then rinse the gear with additional solvent and allow to dry.
4. Remove the cover from the wheel and remove the catch pan.
5. Lubricate the gear per Lubrication Chart. (Refer to Chapter 12.)

—END—

CHAPTER

21

ENVIRONMENTAL SYSTEM

CHAPTER 21-ENVIRONMENTAL SYSTEM

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CHAPTER 21-ENVIRONMENTAL SYSTEM (cont)

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

Because of the simplicity of the heating and ventilating system installed on the PA-28-201T the operation and maintenance instructions of the components are combined. A pictorial description of these systems may be found in Figures 21-1 and 21-2. A pictorial installation of the air conditioning may be found in Figure 21-3.

DESCRIPTION AND OPERATION.

Cabin heat is provided by fresh air, which enters through the area surrounding the landing light, vented to a heat exchanger, installed on the exhaust tail pipe, through a hose aft of the landing light. The heated air is then vented to the cabin through a valve controlled from the instrument panel.

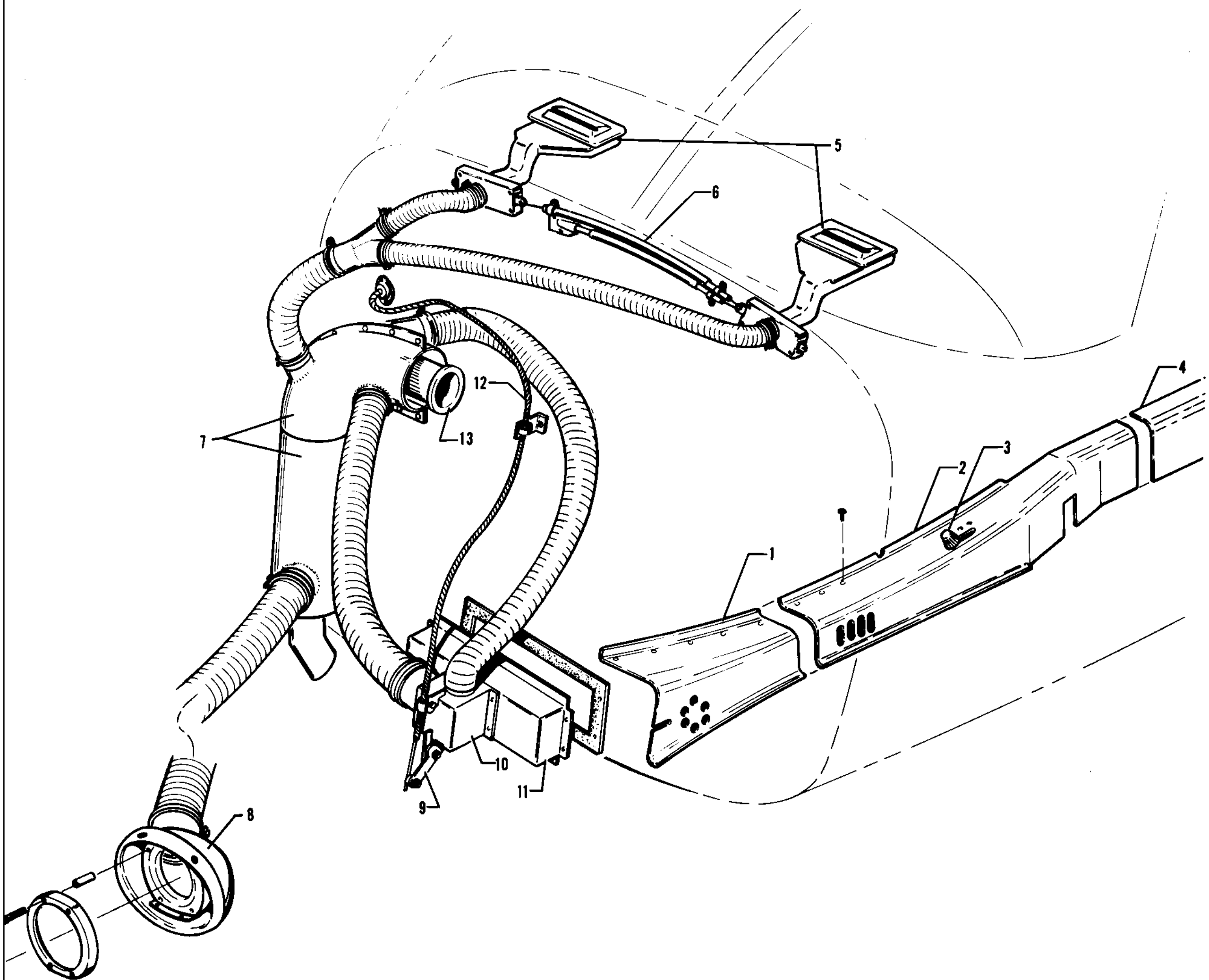
HEATING.

HEATER MAINTENANCE.

The heater exchanger must be removed in order to inspect the tail pipe. Check the operation of the push-pull controls to insure the valve doors function properly. When the controls are pulled out, the door should be completely open to permit full air flow. When the controls are pushed in, the valves should close off all air passage and vent the air into the engine compartment. Refer to Figure 21-1 for an illustration of the heater system.

OVERHEAD VENT SYSTEM. (Not Adaptable With Air Conditioning)

The overhead vent system utilizes the ducting noted in Figure 21-2. Air enters an inlet at the top of the fin and is ducted through the vent system. Small louvers control the flow of air into the cabin. This vent system may also be equipped with a blower (optional). This blower, mounted aft of the close-out panel underneath the top of the fuselage, will force air through the overhead vent system whenever desired.



1. HEAT DUCT - FRONT
2. HEAT DUCT - CENTER
3. REAR CONTROL
4. HEAT DUCT - REAR
5. DEFROSTER DUCT OUTLETS
6. DEFROSTER CONTROL CABLE ASSEMBLY
7. HEAT MUFF
8. INLET AIR DUCT AND LANDING LIGHT MOUNT
9. CABIN HEAT BOX CONTROL ARM
10. CABIN HEAT BOX MANIFOLD
11. CABIN HEAT BOX DISTRIBUTOR
12. CABIN HEAT CONTROL CABLE
13. EXHAUST PIPE

Figure 21-1. Cabin Heater and Defroster

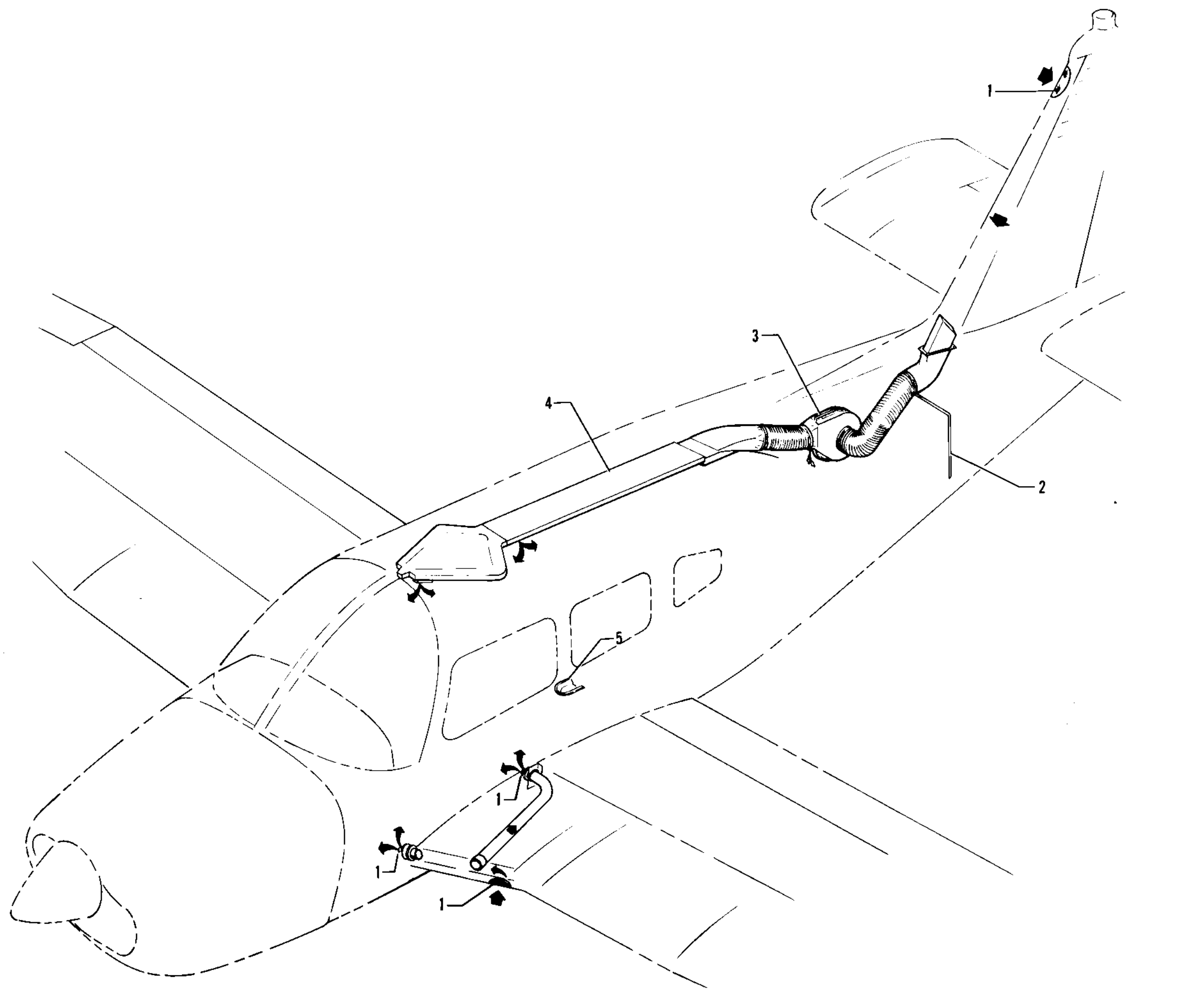


Figure 21-2. Overhead Vent System and Fresh Air System
(Not Available With Air Conditioning)

COOLING.

DESCRIPTION AND OPERATION. (Refer to Figure 21-3.)

This installation consists of a compressor with its special bracketry, an evaporator, a condenser, a receiver-dehydrator, circulating fan, thermal expansion valve, and related plumbing.

The evaporator filters, dehumidifies and cools the air. The evaporator is mounted in a fabricated housing along with the receiver-dehydrator, circulating fan, thermal expansion valve and related plumbing. This housing is located at the rear of the cabin, aft of the baggage area. The compressor is a two cylinder, piston type compressor which is supported by special bracketry at the rear of the engine. A V-belt connected to an extended gear box drives the compressor through a magnetic clutch. The condenser is installed on a hinge mounted door that is located on the bottom portion of the fuselage tail section. The condenser door is hinge mounted to allow extension into the airstream during system operation. The condenser door is electrically activated to provide the following positions, (system on-fully extended or system off-fully retracted).

The system is protected by a Ranco type pressure switch which automatically controls the condenser maximum head pressure by temporarily de-clutching the compressor in the event the pressure becomes exessively high. The controls are located on the aircraft instrument panel adjacent to the heater and defroster levers, and consist of an Air Conditioning control, a fan control to govern the cold air velocity, and a temperature control.

The system design is such that there is no increase in drag to the aircraft during its takeoff flight conditions. During maximum power demands the compressor is de-clutched and the condenser door is automatically retracted.

The air conditioning system in this aircraft is a recirculating, independent unit. It filters, dehumidifies and cools the air as it cycles through the evaporator. The unit is operated from controls mounted on the right side of the instrument panel. The air conditioning master switch has a two position ON-OFF switch. When the “AIR COND” position is selected the compressor clutch engages, the condenser scoop opens and the circulating fan is turned on. The temperature is controlled by a thermostat operated by the temperature control selector. A two position fan switch (LOW-HIGH) operates the blower. The fan may be operated to circulate air without using the air conditioning unit.

The air conditioning system uses Refrigerant 12 as the refrigerant. The refrigerant enters the comprasor as a vapor. The compressor pressurizes the heat-laden vapor until its pressure and heat reach a point much hotter than the outside air. The compressor then pumps the vapor to the condenser where it cools and changes to a liquid. The liquid then passes to the receiver-dehydrator. Its function is to filter, remove any moisture and insure a steady flow of liquid refrigerant into the evaporator through the expansion valve. The expansion valve is a temperature controlled metering valve which regulates the flow of the liquid refrigerant to the evaporator. The evaporator absorbs the heat from the air passing over the coils. From the evaporator the refrigerant vapor returns to the compressor where the cycle is repeated.

—NOTE—

The air conditioning system should be operated at least once a month to prevent sticking valves and keep the system lubricated.

CHART 2101. TROUBLESHOOTING (AIR CONDITIONER)

Gauge Indication	Probable Causes	Remedy
High discharge pressure.	Overcharge of refrigerant.	Purge excess refrigerant.
	Air in system.	Check for leaks. Bleed charge from system. Evacuate and recharge system.
	Overheated condenser due to blocking air passage.	Clean bugs and dirt from condenser fins. Straighten fins if bent.
	Flooded evaporator indicated by heavy frosting on suction line and compressor suction service valve.	Check that capillary bulb is securely clamped to suction line. If capillary bulb OK replace expansion valve.
	Restriction in liquid line from condenser.	Check for kinked hoses and stopped up filter.
Low discharge pressure.	Undercharge of refrigerant. Sight glass shows bubbles or foam.	Add refrigerant until bubbles disappear. Check system leak.
	Damaged compressor valves or dirt under valves.	Replace compressor.
	Damaged compressor. Worn or broken piston or piston rings.	Replace compressor.
Low suction pressure. (Accompanied by icing evaporator.)	Low air supply through evaporator.	Repair blower or blower motor. Clean stoppage in air ducts.
	Very dirty evaporator fins and coils.	Clean and flush with water.

CHART 2101. TROUBLESHOOTING (AIR CONDITIONER) (cont)

Gauge Indication	Probable Causes	Remedy
Low suction pressure. (Evaporator not cold enough) suction gauge may read a vacuum indicating evaporator lacks refrigerant.	Undercharge of refrigerant.	Add refrigerant. Install new dryer. Evacuate and recharge.
	Moisture freezing in expansion valve. Valve will show frost. Expansion valve inlet screen clogged. Inoperative expansion valve. Valve stuck closed or capillary bulb has lost its charge.	Remove screen. Clean with solvent and replace. Warm capillary by holding in hand. If suction pressure does not charge, replace expansion valve.
	Restriction anywhere in liquid line. Restriction will show frost.	Locate restriction and repair.
High suction pressure.	Capillary bulb clamp loose on suction line. Suction line shows frost.	Clean contact surfaces of suction line and cap bulb. Tighten clamp.
	Expansion valve not closing. Evaporator flooded. Suction line frosted to compressor.	Replace expansion valve.
	Compressor drive belt slipping.	Adjust belt tension.
	Magnetic clutch slipping.	Check electrical circuit for correct voltage to clutch coil. Clean clutch surfaces of oil.
	Leaking or broken compressor valves.	Replace compressor.

CHART 2102. TROUBLESHOOTING (AIR CONDITIONING SYSTEM)

Trouble	Cause	Remedy
Condenser door will not close when air conditioner switch is in the "OFF" position.	Faulty relay "K-2."	Replace relay.
System produces no cooling.	Electrical	
	Blown fuse in control head.	Replace fuse.
	Open circuit breaker.	Reset circuit breaker.
	Broken or disconnected electrical wire.	Check all terminals for loose connections; check wiring for hidden breaks.
	Broken or disconnected ground wire.	Check ground wire to see if loose, broken, or dis-connected.
	Clutch coil burned out or disconnected.	Check current flow to clutch, replace if inoperative.
	Thermostat sensing element defective.	Check thermostat and cabin comfort control panel.
	Blower motor disconnected or burned out.	Check current flow to blower motor. Repair or replace if inoperative.
	Mechanical	
	Loose or broken drive belt.	Replace drive belts and/or tighten to specifications.
	Compressor partially or completely frozen.	Remove compressor for service or replacement.
	Expansion valve stuck in open position.	Replace expansion valve.

CHART 2102. TROUBLESHOOTING (AIR CONDITIONING SYSTEM) (cont)

Trouble	Cause	Remedy
System produces no cooling. (cont)	Refrigeration	
	Broken refrigerant line.	Examine all lines for evidence of breakage by external stress or rubbing wear.
	Leak in system.	Evacuate system, apply static charge, leak test system, and repair leak as necessary.
	Compressor shaft seal leaking.	Replace compressor.
	Clogged screen or screens in receiver-dehydrator or expansion valve; plugged hose or coil.	Repair as necessary.
System will not produce sufficient cooling.	Electrical	
	Blower motor sluggish in operation.	Remove blower motor for service or replacement.
	Mechanical	
	Compressor clutch slipping.	Remove clutch assembly for service or replacement.
	Obstructed blower passage.	Examine entire passage for obstruction. Correct as necessary.
	Insufficient air circulation over condenser coils; fins clogged with dirt or bugs.	Clean condenser coils.
	Evaporator filter clogged.	Clean with cleaning solvent to remove cigarette tars.

CHART 2102. TROUBLESHOOTING (AIR CONDITIONING SYSTEM) (CONT)

Trouble	Cause	Remedy
System will not produce sufficient cooling. (cont)	Refrigeration	
	Insufficient refrigerant in system.	Recharge system until bubbles disappear in receiver-dehydrator and gauge readings stabilize to specifications.
	Clogged screen in expansion valve.	Purge system and replace expansion valve.
	Expansion valve thermal bulb has lost charge.	Purge system; replace expansion valve.
	Clogged screen in receiver-dehydrator.	Purge system; replace receiver-dehydrator.
	Excessive moisture in system.	Purge system; replace receiver-dehydrator.
	Air in system.	Purge, evacuate and charge system. (Replace receiver-dehydrator)
Exececessively noisy system.	Electrical	
	Defective winding or improper connection in compressor clutch coil.	Replace or repair as necessary.
	Mechanical	
	Loose or excessively worn drive belts.	Tighten or replace as required.
	Noisy clutch.	Remove clutch for service or replacement as necessary.

CHART 2102. TROUBLESHOOTING (AIR CONDITIONING SYSTEM) (cont)

Trouble	Cause	Remedy
Exececssively noisy system. (cont)	Electrical (cont)	
	Compressor noisy.	Check mountings and repair; remove compressor for service or replacement.
	Compressor oil level low.	Fill with correct amount of specified oil.
	Refrigeration	
	Excessive charge in system.	Discharge excess freon until high pressure gauge drops within specifications.
	Low charge in system.	Check system for leaks; charge system.
	Excessive moisture in system.	Replace dehydrator; purge, evacuate, and charge system.

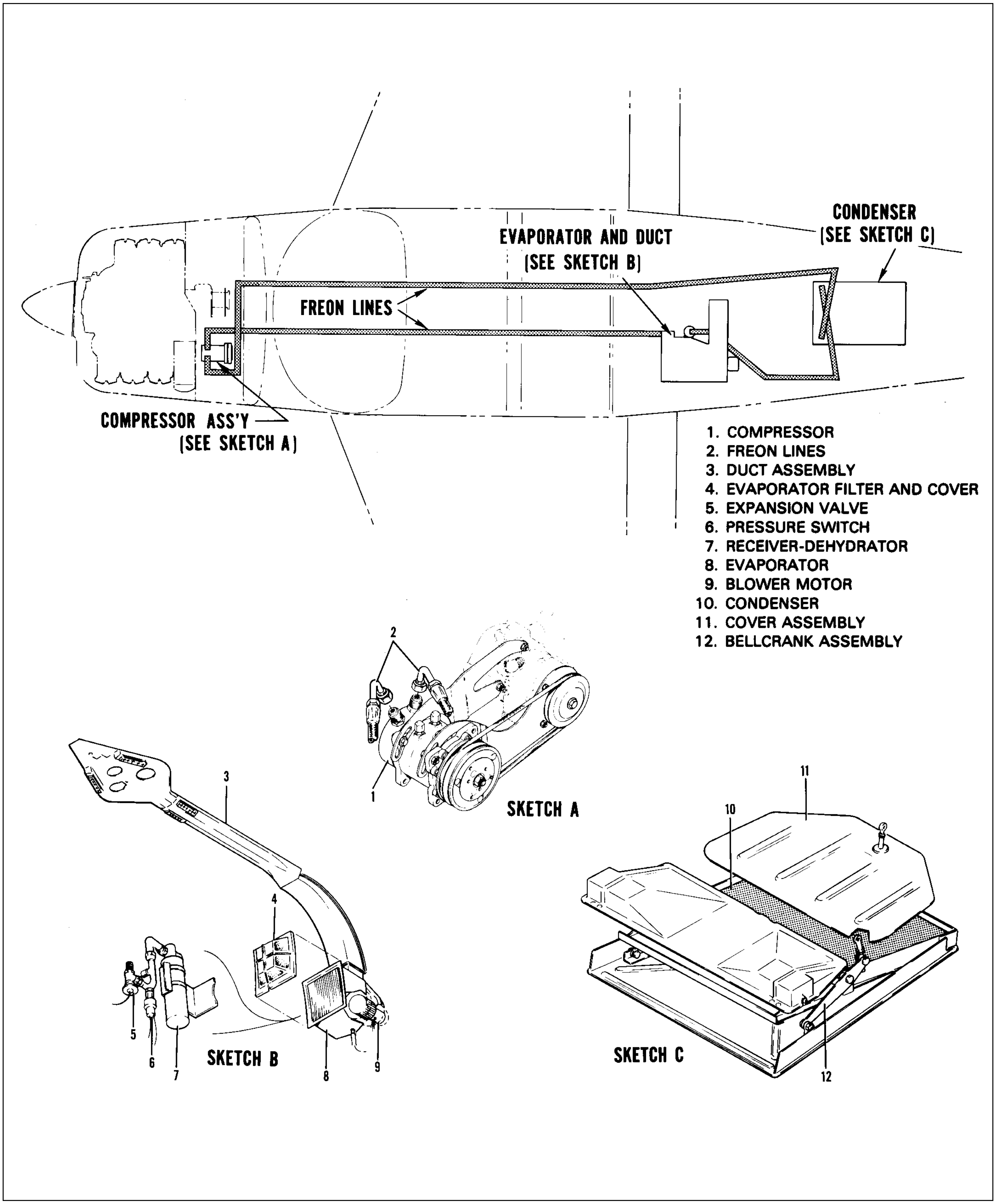


Figure 21-3. Air Conditioning System Installation (Typical)

MALFUNCTION DETECTION. (Refer to Charts 2101, 2102, and 2103.)

The detection of system malfunction largely depends on the mechanic's ability to interpret the gauge pressure readings into system problems. A system operating normally will have a low side gauge pressure reading that will correspond with the temperature of the refrigerant evaporating in the evaporator, allowing for a few degrees temperature rise due to loss in the tube walls and fins. The high side will have a gauge pressure that will correspond with the temperature of the refrigerant condensing in the condenser, allowing for a few degrees temperature drop due to loss in the tube walls and fins.

Any deviation from that which is normal indicates a malfunction within the system due to a faulty control device, obstruction, defective part, or improper installation.

Detection of system malfunction is made easier with the knowledge that the temperature and pressure of Refrigerant 12 is in close proximity between the pressures of twenty and eighty pounds per square inch (psi). A glance at the temperature-pressure chart will show that there is only a slight variation between the temperature and pressure of the refrigerant in the lower range.

It is correct to assume that for every pound of pressure added to the low side, a temperature increase of about one degree Fahrenheit takes place. For instance, a pressure of 23.8 on the chart indicates a temperature of 24°F. A change of pressure of almost one pound to 24.6 psi gives us a temperature increase to 25°F.

—NOTE—

For each 1,000 feet of elevation above sea level, the gauge readings will be about one inch of mercury or 1/2 psi higher than the chart indicates.

It must be pointed out that the actual temperature of the air passing over the coils of the evaporator will be several degrees warmer allowing for a temperature rise caused by the loss in the fins and tubing of the evaporator.

The importance of a seasonal checkup of the air conditioning system should be brought to the attention of the customer whenever possible. A thorough check of the system performed in a methodical manner will reveal trouble the customer is often not aware of. Locating and repairing the trouble early will usually result in savings to the customer both in time and additional troubles that too often result from neglect.

A Performance Test of the system is the only positive way in which the complete system can be checked for efficient operation. The air conditioning system should be given this test before work is begun on the system whenever possible, however, if the system is completely inoperative, repairs must be performed before the system can be properly tested. The test can uncover further work that must be performed before the system is brought to its full operating efficiency. The Performance Test should always be performed after repair workhas been done and before the aircraft is released to the customer. The serviceman performing this test carefully will insure that the repairs have been properly performed and that the system will operate satisfactorily.

The Performance Test when properly performed includes a thorough examination of the outside of the system as well as the inside. Many related parts are overlooked because it is felt they are of no bearing on theoperating efficiency of the unit. For this reason, a thorough visual inspection of the complete system should be performed, followed by an operating inspection of the system.

CHART 2103. TEMPERATURE PRESSURE

Evaporator Pressure Gauge Reading p.s.i.	Evaporator Temperature °F.	High Pressure Gauge Reading p.s.i.	Ambient Temperature °F.
0	-21	72	40
2.4	-15	86	50
4.5	-10	105	60
10.1	2	109	62
11.2	4	113	64
12.3	6	117	66
13.4	8	122	68
14.6	10	126	70
15.8	12	129	71
17.1	14	132	72
18.3	16	134	73
19.7	18	137	74
21	20	140	75
22.4	22	144	76
23.1	23	148	77
23.8	24	152	78
24.6	25	156	79
25.3	26	160	80
26.1	27	162	81
26.8	28	165	82
27.6	29	167	83
28.4	30	170	84
29.2	31	172	85
30	32	175	86
30.9	33	177	87
31.7	34	180	88
32.5	35	182	89
33.4	36	185	90
34.3	37	187	91
35.1	38	189	92
36	39	191	93
36.9	40	193	94
37.9	41	195	95
38.8	42	200	96
39.7	43	205	97
41.7	45	210	98
43.6	47	215	99
45.6	49	220	100
48.7	52	228	102
49.8	53	236	104
55.4	57	260	110
60	62	275	115
64.9	66	290	120

SPECIAL SERVICING PROCEDURES.

The air conditioning system should be serviced by a qualified shop with trained personnel. The following procedures and precautions should be observed.

The efficiency of this system depends upon the pressure-temperature relationship of pure refrigerant. As long as the system contains only pure refrigerant plus a specified amount of compressor oil (which is mixed with the refrigerant), it is considered to be chemically stable. Foreign materials within the system will affect the chemical stability, contaminate the system, and decrease its efficiency.

1. GENERAL REFRIGERATION SYSTEM PROCEDURES.
   A. REFRIGERANT SAFETY PRECAUTIONS.
      (1) Refrigerant 12 (commonly known as R-12 or “Freon” 12) is odorless and colorless in either the liquid or gaseous state. R-12 for charging refrigeration systems is supplied in pressurized containers (approx. 70 psi at 70°F) in liquid form. Since this material is essentially inert at room temperatures the dangers are primarily associated with the pressure and the refrigeration effects of the release and subsequent evaporation of this pressurized liquid.
      (2) Wear suitable eye protection when handling R-12 due to the possibility of freezing of the eye if contacted by escaping liquid refrigerant. If liquid R-12 does strike the eye, the following actions should be taken:
         (a) DO NOT RUB THE EYE.
         (b) Splash large quantities of cool water into the eye to raise the temperature.
         (c) Tape on an eye patch to avoid the possibility of dirt entering the eye.
         (d) Rush to a physician or hospital for immediate professional aid.
         (e) DO NOT ATTEMPT TO TREAT IT YOURSELF.
      (3) If liquid R-12 strikes the skin frostbite can occur. Treat with cool water and protect with petroleum jelly.
      (4) Do not discharge large quantities of R-12 into closed rooms. It may displace most of the air in thc room and this could cause oxygen starvation. Gaseous R-12 is heavier than air and flows to the bottom of a container.
      (5) Do not discharge R-12 into an open flame or onto a very hot surface (500°F+). Poisonous phosgene gas is generated by the action of the heat on the refrigerant.
      (6) Do not apply direct flame or other high heat source to a R-12 container due to the high pressures which will result. If any heating is done to R-12 containers the container pressure should be monitored and kept below 150 psi.
   B. SYSTEM SERVICING PRECAUTIONS.
      (1) Systems should be discharged slowly to prevent the escape of liquid refrigerant and the loss of the lubricating oil.
      (2) Systems should not be left open to the atmosphere when discharged. Moisture and other contamination may enter and damage open systems.
      (3) Never introduce anything but pure refrigerant and refrigerant oil into a system.
      (4) Keep refrigerant oil containers tightly sealed and clean to prevent absorption of moisture or other contamination.
      (5) Use only approved refrigeration oil in the compressor. If any doubt exists about the cleanliness of the compressor oil, replace it with new oil.
      (6) Never reuse oil removed from the system. Discard it.
      (7) When Loctite Refrigerant Sealant has been used on a joint it must be heated to 400°F prior to disassembly. Loctite must be used to seal any pipe threads in the system lines.

(8) Replace the receiver-dehydrator assembly on any system which has been operating with a leak allowing air to enter the system. If a receiver-dehydrator is left open to the atmosphere it should be replaced due to the loss of effectiveness of the drying compound it contains.

—NOTE—

A very strong acid (HCL) is formed when R-12 comes in contact with moisture.

A new receiver-dehydrator should be opened and connected to the system only when ready to charge the system with refrigerant.

(9) Recommended torque values must be used on all flare fitting and O-ring joints. See Chart 2104.

CHART 2104. ALUMINUM TUBING TORQUE

Metal Tube O.D.	Thread and Fitting Size	Alum. Tubing Torque
1/4	7/16	5-7 ft.-lbs.
3/8	5/8	11-13 ft.-lbs.
1/2	3/4	15-20 ft.-lbs.
5/8	7/8	21-27 ft.-lbs.
3/4	1-1/16	28-33 ft.-lbs.

SERVICE VALVES

The purpose of the service valve is to service the air conditioning system. (Testing, Bleeding, Evacuating and Charging.) This aircraft is equipped with service valves mounted in the suction and discharge line of theevaporator assembly. These valves are the “2” position type Schrader valves. All normal air conditioning service should be performed at the evaporator assembly mounted valves.

—NOTE—

Service valves are also located on thc compressor. However, usc of these valves in servicing is not recommended

If a Schrader service valve is not serviceable, thc core asscmbly must be replaced.

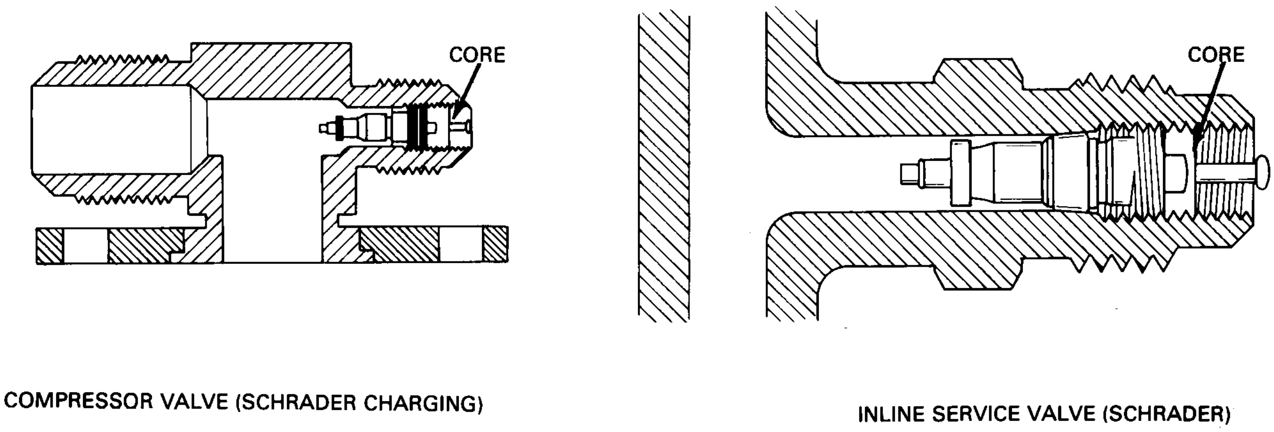


Figure 21-4. Service Valves

SERVICE VALVE REPLACEMENT.

The valves on the compressor are sealed with a gasket placed in the valve port boss. Lubricate the gasket with refrigerant oil of the type used in the compressor, place the valves with the tube fitting facing aft and secure with .312 bolts, torque to 15-23 inch-pounds.

—CAUTION—

Whenever the air conditioning refrigerant lines or system is opcned for any reason, the lines and fittings should be capped and sealed immediately to prevent dirt and other contaminants from entering the system. (It is not advisable to put a plug into the hoses or fittings.)

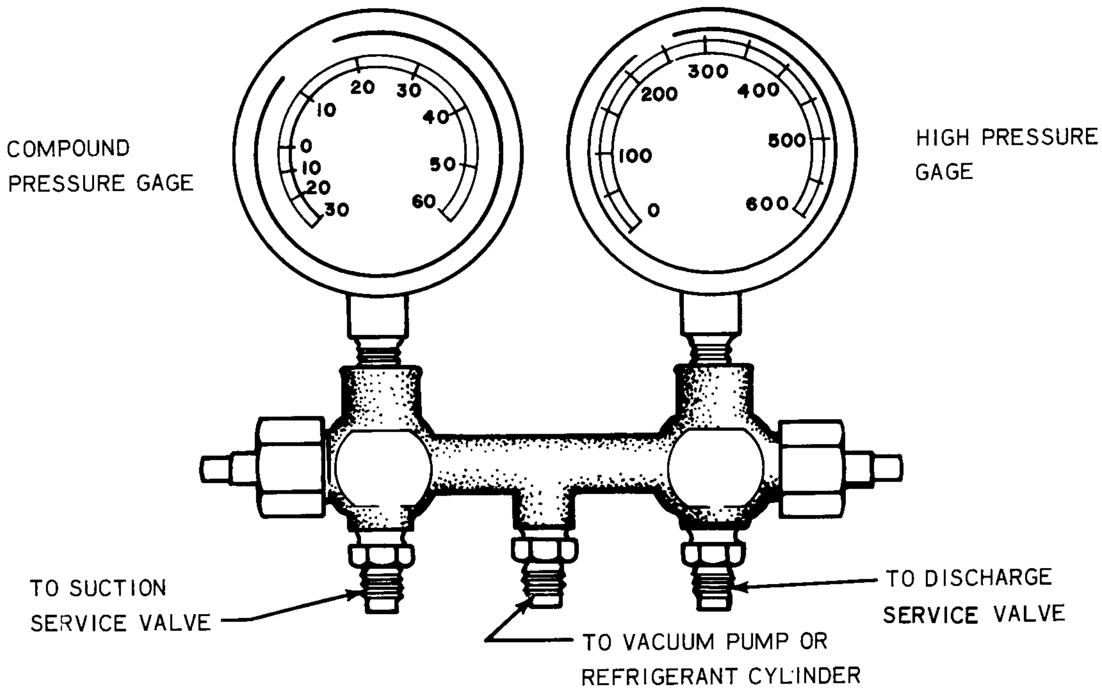


Figure 21-5. Test Gauge and Manifold Set

TEST GAUGE AND MANIFOLD SET.

The proper testing and diagnosis of the air conditioning system require that a manifold gauge set be attached into the system. This set consists of two gauges mounted to a manifold. One gauge is a high pressure gauge used in the discharge side of the system. The other is a low pressure gauge used in the suction side of the system. The manifold is a device having fittings for both gauges and connection hoses with provisions for controlling the flow of refrigerant through the manifold. See Figures 21-5 and 21-6.

The center port of the manifold set is used for charging or evacuation procedures, or any other servicc that may be necessary.

Both the high and low side of the manifold have hand shut-off valves. When the hand valve is turned all the way in, in a clockwise direction, the manifold is closed. The pressures on that side of the system will, however, be recorded on the gauge above the hose.

Cracking the hand valve, in the counterclockwise direction, opens the system to the middle service port of the manifold set. This is desirable only when it is necessary to let refrigerant out or into the system. Refer to Figures 21-5 and 21-6.

CHECKING SYSTEM FOR LEAKS.

There are several methods of doing this operation, depending on the type of equipment which is available. Two methods of performing this check will be covered in the following paragraphs.

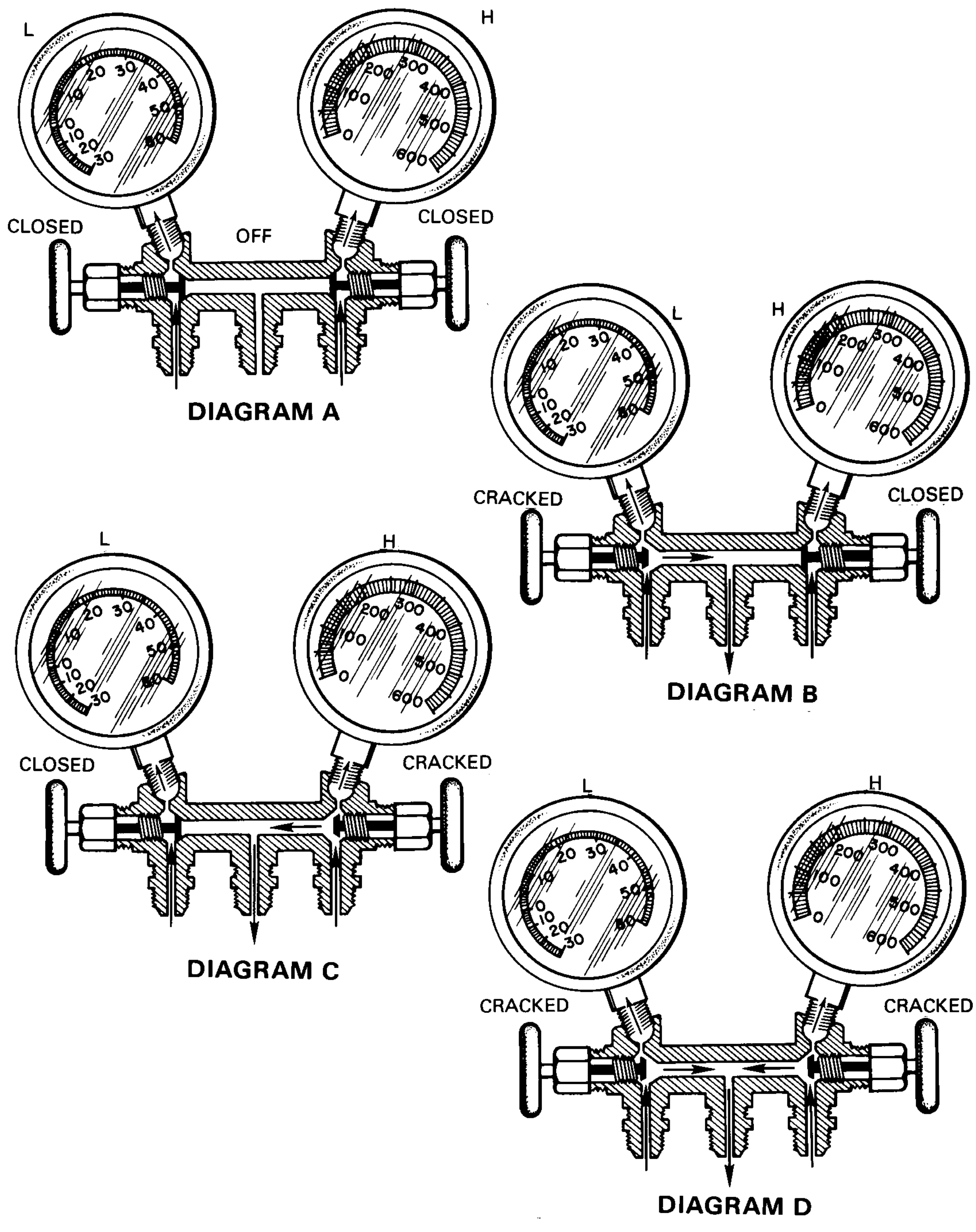


Figure 21-6. Manifold Set Operation

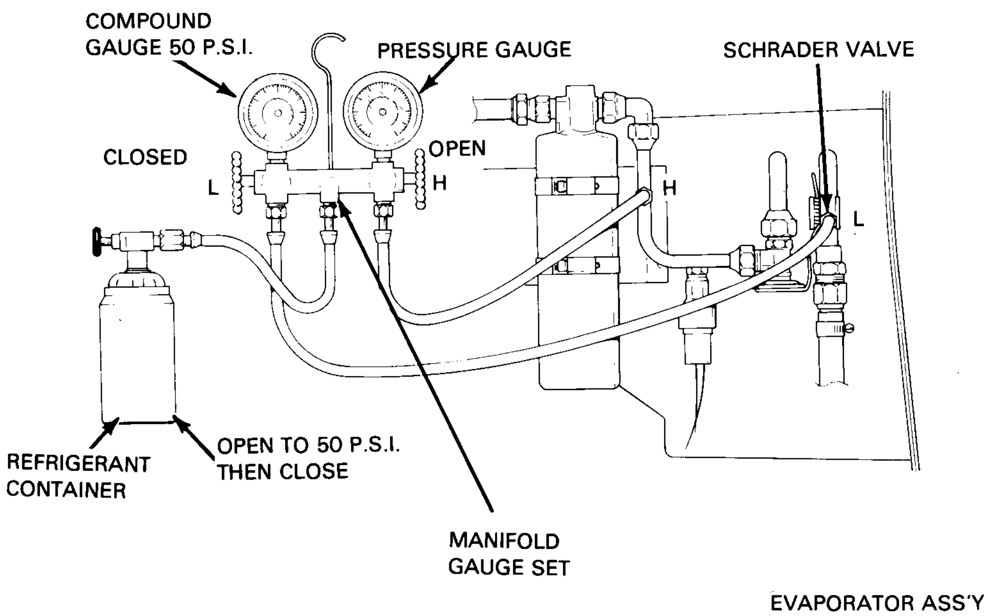


Figure 21-7. Leak Test Hookup

—NOTE—

Evacuate system prior to leak check.

LEAK CHECK - METHOD I.

1. Connect the manifold gauge set into the system and determine if there is any refrigerant in the system. A minimum of 50 psi refrigerant pressure in the system is needed for leak detection. (Refer to Figure 21-7.)
2. Purge the hoses of air by allowing some refrigerant to escape from the connections at the service valves. Then tighten connections at the service valve.
3. Close the low side manifold valve and open the high side manifold valve.
4. Open the refrigerant container service valve and allow the pressure at the low side gauge to reach 50 psi at which time close the high side manifold valve.
5. Close the refrigerant container service valve and remove the hose if no leaks are evident.
6. It is advisable to use an electronic leak detector to check this system instead of an open flame leak detector due to the possible presence of gasoline fumes in the engine area.
7. If any leaks are found, purge the system of refrigerant, make the necessary repairs and check the compressor oil.
8. Add oil, if required, (refer to Checking Compressor Oil) then repeat Steps 1 through 5.
9. If no further leaks are found, the system may be evacuated and charged. (Refer to Evacuating the System and Charging the System.)

LEAK CHECK - METHOD II.

1. Remove the access panel at the rear of the cabin to gain access to the service valves.
2. Remove the protective cap on the high pressure Schrader valve fitting and connect a charging hose with a shut-off valve arrangement to the fitting. The charging hose must have a Schrader fitting or adapter to fit the valve.
3. Connect the other end of the charging hose to a small cylinder of refrigerant and purge the hose by allowing a slight amount of refrigerant gas to escape from the Schrader valve fitting.
4. The cylinder of refrigerant should be placed upright in a container of warm (125° F max. water on a small scale).
5. Allow approximately 1/2 pound of refrigerant to enter the system by opening the valve on the charging hose and observing the weight change on the scale.
6. Using an electronic leak detector, check all joints and repair any leaks.
7. After completion of repair of any leaks, proceed to check the system in accordance with one of the methods outlined for any other leaks.
8. If no further repair is required on the system, it is now ready to evacuate in accordance with Evacuating the System.

DlSCHARGING. (Required only if system contains refrigerant.)

—NOTE—

Applies to Kent Moore J23500 or similar charging station. (Refer to Figure 21-9.)

1. Close all valves on charging station.
2. Connect red high pressure charging line to high pressure Schrader valve at the evaporator fitting.
3. Open valve (high pressure control) on charging station one turn.
4. Hold end of blue low pressure charging line in a shop rag and slowly open valve (low pressure control) on charging station allowing refrigerant to exhaust from system into shop rag.

—CAUTION—

Refrigerant can cause freezing of skin. Be particularly careful not to allow contact with the eyes.

Do not allow refrigerant to escape too rapidly, as excessive oil may be carried out of system. When hissing stops, system is empty and valve should be closed if no further work is planned.

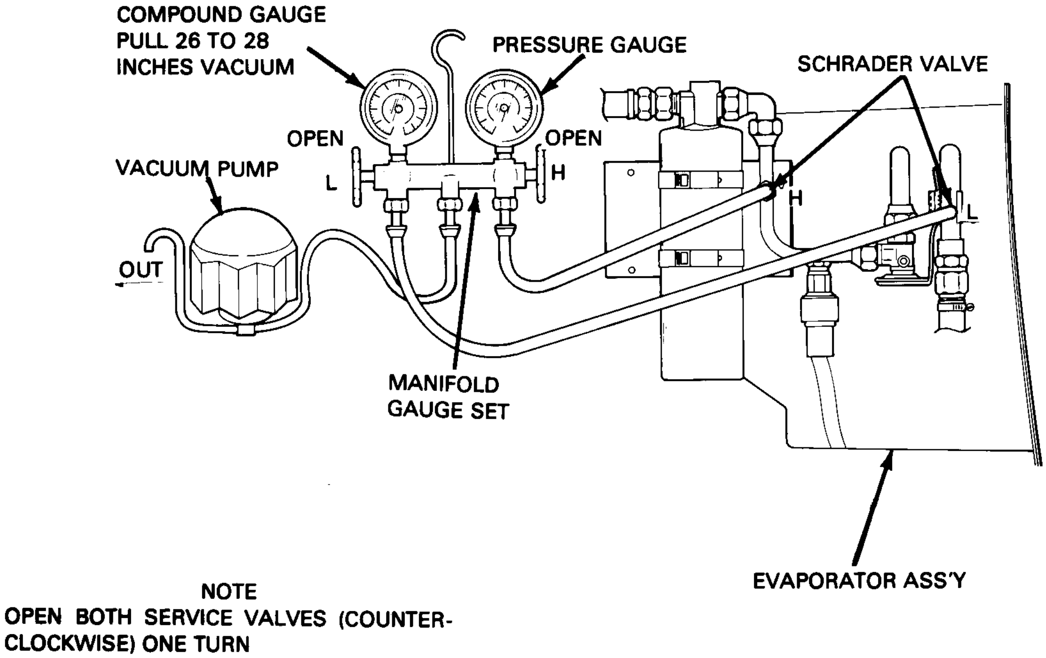


Figure 21-8. Evacuation Hookup

EVACUATING THE SYSTEM.

If the system has been operated in a discharged condition or anytime the system has been open to atmospheric pressure, the receiver-dehydrator must be replaced and the system evacuated to remove any trapped air and moisture which has entered it. A vacuum pump capable of pulling 29 inches of mercury or better should be used. As we lower the pressure in the air conditioning system, we lower the boiling temperature of the water (moisture) that may be present. Then we are able to pull this water, in the form of vapor, out of the system. The following table demonstrates the effectiveness of moisture removal under a given vacuum.

	System Vacuum	Temperature °F.
	27.99	100
COMPOUND GAUGE	28.89	80
READING IN INCHES	29.40	60
OF MERCURY VACUUM	29.71	40
	29.82	20
	29.88	0

—NOTE—

For each 1,000 feet of elevation above sea level, the compound gauge reading will be about one inch lower, numerically.

The following steps should be of help when performing this operation.

1. Remove access panel at the rear of the cabin to gain access to the Schrader service valves.

—CAUTION—

Ascertain that all system pressure is released before attempting the evacuation. (Refer to Special Servicing Procedures.)

2. Connect the manifold gauge set to the airplane service valves. (Refer to Service Valves.)
3. The high and low manifold hand valves should be in the closed position. (Refer to Figures 21-5 and 21-6.)
4. Connect the center manifold hose to the inlet of the vacuum pump.

—NOTE—

Make sure the exhaust port on the vacuum pump is open to avoid damage to the vacuum pump.

5. Start the vacuum pump and open the low side manifold hand valve. Observe the compound, low pressure gauge needle, it should show a slight vacuum.
6. Continue to operate the vacuum pump until 26 to 28 inches of vacuum is attained on the low pressure gauge, then extend the operation for another 25 minutes.
7. If the system cannot maintain 26 to 28 inches of vacuum, close both manifold hand valves and observe the compound gauge.
8. Should the compound gauge show a loss of vacuum, there is a leak in the system which must be repaired before continuing with evacuation.
9. If no leaks are evident, reopen both manifold hand valves and continue the evacuation for another 30 minutes.
10. Close both manifold hand valves, stop vacuum pump and disconnect center manifold hose from the vacuum pump.
11. Proceed to charge the system in accordance with Charging the System.

—NOTE—

The system should be charged as soon as it has been evacuated.

CHARGING THE SYSTEM.

When the system is completely evacuated in accordance with instructions given in Evacuating the System, one of the following procedures should be used to charge the system.

1. CYLINDER PRESSURE GAUGE
2. COMPOUND GAUGE
3. VALVE, LOW PRESSURE CONTROL
4. VALVE, VACUUM CONTROL
5. CHARGING CYLINDER
6. BRACKET
7. SIGHT GLASS
8. CYLINDER BASE VALVE
9. HIGH PRESSURE GAUGE
10. VALVE, HIGH PRESSURE CONTROL
11. VALVE, REFRIG. CONTROL
12. CHARGIN LINE HOSE HOLDER
13. BRACKET
14. LOW PRESSURE CHARGING LINE
15. HIGH PRESSURE CHARGING LINE
16. HEATING ELEMENT PLUG
17. VACUUM PUMP
18. OIL FILL LOCATION
19. NECK ASSEMBLY
20. REFRIGERANT DRUM SUPPORT
21. REFRIGERANT DRUM VALVE
22. VACUUM PUMP VALVE
23. VACUUM PUMP EXHAUST PORT
24. TOP CYLINDER VALVE
25. REFRIGERANT DRUM
26. WEB STRAP
27. REFRIGERANT DRUM REDUCER
28. CHARGING CYLINDER HOSE
29. VACUUM PUMP INTAKE HOSE
30. VACUUM PUMP SWITCH
31. VACUUM PUMP POWER CORD

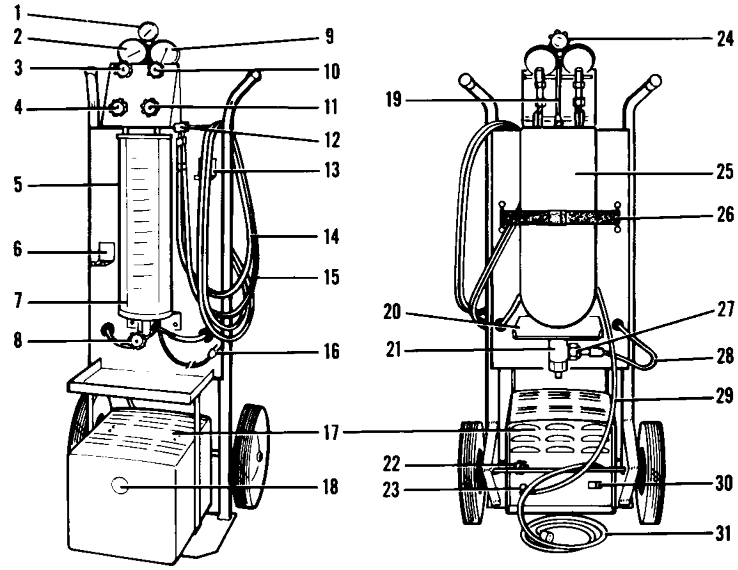


Figure 21-9. Charging Stand

CHARGING WITH A CHARGING STAND.

This is the preferred method of charging the system.

—NOTE—

The following instructions apply to Kent Moore, J23500 charging stand. (Refer to Figure 21-9.)

1. With the system discharged and evacuated, proceed to hook up the charging stand. (Refer to Figure 21-10.)
2. Fill the charging cylinder by opening the valve at the base of the charging cylinder and filling the sight glass with two pounds of liquid refrigerant.
3. If refrigerant stops filling the sight glass, open the valve at the top of the gauge neck assembly intermittently to relieve head pressure and allow refrigerant to continue filling the sight glass to the required amount.
4. When refrigerant reaches the required level in the sight glass, close both the valve at the base of the cylinder and the valve at the bottom of refrigerant tank. Be sure the top valve is fully closed.

—NOTE—

If bubbling occurs in sight glass, reopen the cylinder base valve momentarily to equalize drum and cylinder pressure.

5. Connect the heating element plug to a 110 volt outlet.
6. Turn cylinder sight glass to match pressure reading on cylinder pressure gauge, this scale should be used during entire charging operation.
7. Close valve (low pressure control), fully open valve (refrigerant control) and allow all the liquid refrigerant contained in the charging cylinder to enter high side of aircraft system.
8. When the full charge of refrigerant has entered the system, close valve (refrigerant control) and valve (high pressure control).
9. After completion of charging, close all valves on the charging stand. Disconnect the high and low pressure charging lines from the aircraft system. (A small amount of refrigerant remaining in the lines will escape.) Replace lines on holder of charging stand to keep air and dirt out of lines. Open the valve at the top of cylinder to relieve any remaining pressure, then reclose the valve.
10. Reinstall protective caps of Schrader valves and any access panels previously removed.

USING AIRPLANE COMPRESSOR TO CHARGE SYSTEM.

This method is the least desirable due to the requirement of operating the airplane's engine to run the compressor.

—CAUTION—

Ascertain that the area around the airplane is clear and a qualified person is at the controls of the airplane.

1. With the system evacuated as outlined in Evacuating the System, connect the refrigerant charging hose to the manifold (refer to Figure 21-10) and purge the charging hose of air.
2. Place the refrigerant container on a scale to observe the amount of refrigerant entering the system. Open the high pressure valve and add as much refrigerant as possible.
3. Close the high pressure valve, start the engine and operate it at 900 to l000 RPM.
4. Operate the air conditioner and set controls to maximum cooling.
5. Open the low pressure valve and complete charging the system.
6. Close the low pressure valve after two pounds of refrigerant has been added to the system.
7. With the system still operating, observe the sight glass in the top of the receiver-dehydrator by removing the plastic plug.
8. The sight glass should be clear of any bubbles or foam. lf bubbles or foam are seen passing through the sight glass, it is an indication of a low refrigerant charge in the system and more refrigerant is required. This check should be made with OAT of 70° F or higher and with the air conditioner operating.
9 If more refrigerant must be added to the system, open the low pressure valve and increase engine speed to 2000 RPM and observe the sight glass. After the sight glass has cleared, close the low pressure valve and observe the pressure gauges. At 1000 RPM the gauge pressure should be 15 to 20 psi on the low side and 150 to 200 on the high side

—NOTE—

Suspect leaks or an inaccurate scale if two pounds of refrigerant does not fill the system.

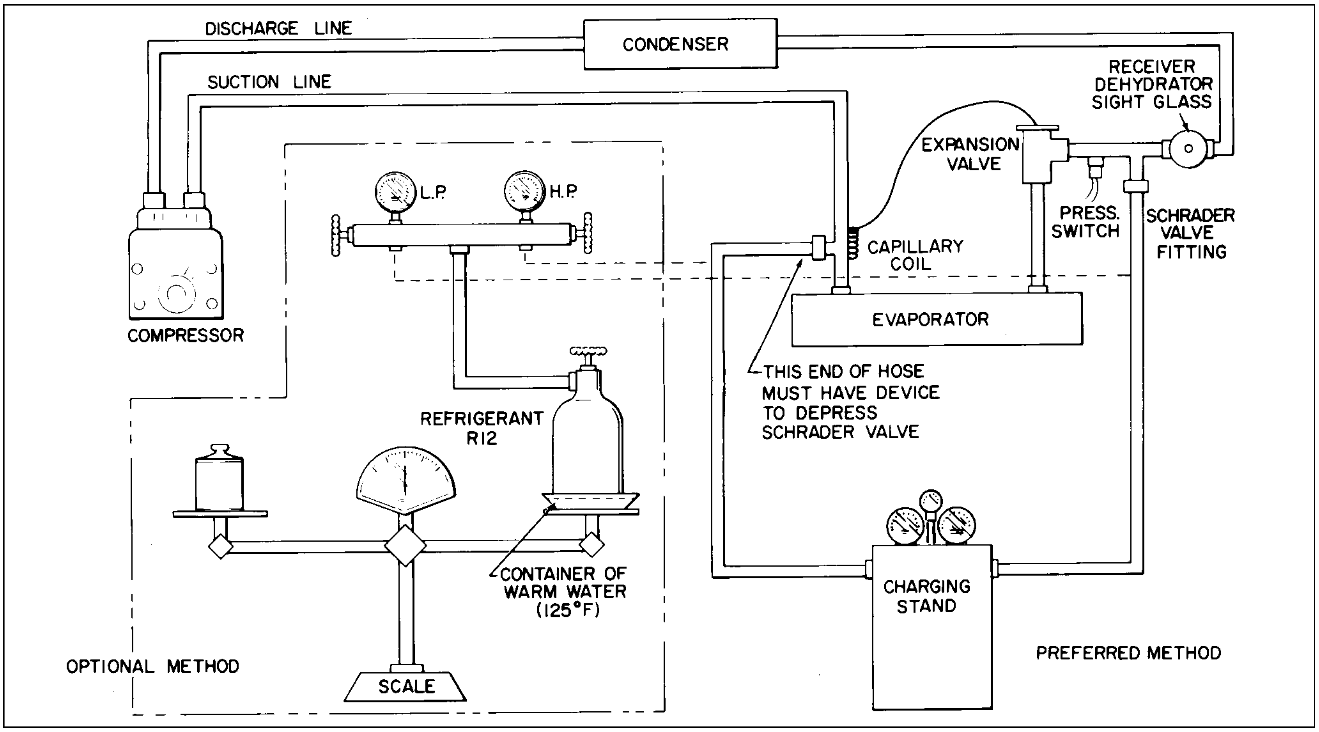


Figure 21-10. Charging Hookup

10. Shut off the air conditioning system and airplane engine. Then remove the charging lines from the Schrader valves with care due to the refrigerant remaining in the hose.

—NOTE—

A shop cloth should be used to divert escaping refrigerant when disconnecting the charging hose from the Schrader valve. Recap the valve.

ADDITIONAL OR PARTIAL CHARGE TO SYSTEM.

It is possible to top off this system with refrigerant by the following method:

1. Remove the access panel at the rear of the cabin.
2. Connect a charging hose to a refrigerant cylinder and also to the Schrader valve fitting on the suction line. (Refer to Figure 21-10.)
3. Purge the charging hose by allowing a small amount of refrigerant gas to escape at the Schrader valve fitting.
4. Start the engine and operate at 1000 RPM and turn the air conditioner on maximum cool.
5. Remove the plastic plug from the sight glass in the top of the receiver-dehydrator.
6. With a low refrigerant charge in the system, bubbles will be seen passing through the sight glass when the system is operating.
7. Open the valve on the refrigerant cylinder.

8. Allow refrigerant to flow into the system until the bubbles disappear from the sight glass.
9. Close the refrigerant valve and check to see that the sight glass remains clear during system operation.
10. When the sight glass stays clear of bubbles, add an additional 1/4 pound of refrigerant to the system. (Engine should be operating at 1000 RPM.)

—NOTE—

This should be done with OAT at 70°F, or higher, with the air conditioner operating.

11. Shut off the air conditioner and engine. Remove the charging hose from the Schrader valve with care due to refrigerant remaining in the line.
12. Replace the access panels.

COMPRESSOR SERVICE.

It is not advisable to service the compressor in the field. It should be done by a qualified shop which has the special equipment and trained personnel required to properly service the unit.

Maintenance to this unit and its related components is limited to the replacement of worn drive belt and magnetic clutch. Any other service requires removal of the compressor from the system. For any special tools and instructions contact Sankyo International Corp., 3529 Miller Park Drive, P.O. Box 2903, Garland, Texas 75042.

—NOTE—

An important factor in air conditioning servicing is cleanliness and care should be execised to prevent dirt or foreign material from entering the system. All hose and tubing ends should be capped immediately. Any lubrication required in the assembly of the components should be refrigerant oil of the type used in the compressor.

COMPRESSOR REMOVAL.

The removal of the compressor requires a complete system discharge. (Refer to Discharging.)

1. Ascertain that air conditioning circuit protector is in the off position.
2. Remove engine cowling.
3. Disconnect the electrical leads to the magnetic clutch on the compressor.
4. Depressurize the air conditioning system.
5. Remove the suction and discharge line from the service valves on the compressor.

—NOTE—

All open lines should be capped immediately to prevent dirt and moisture from entering the system.

6. Loosen the four bolts securing the compressor in the mounting brackets. Rotate the compressor in the bracket slots to disconnect drive belt.
7. Support compressor and remove the attachment bolts.

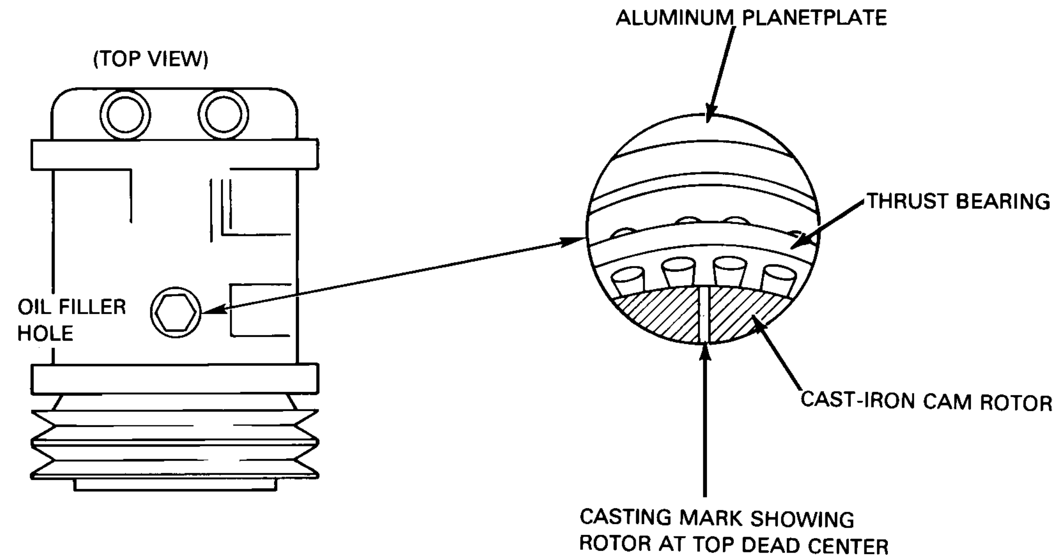


Figure 21-11. Top Dead Center Casting Mark (Sankyo Compressor)

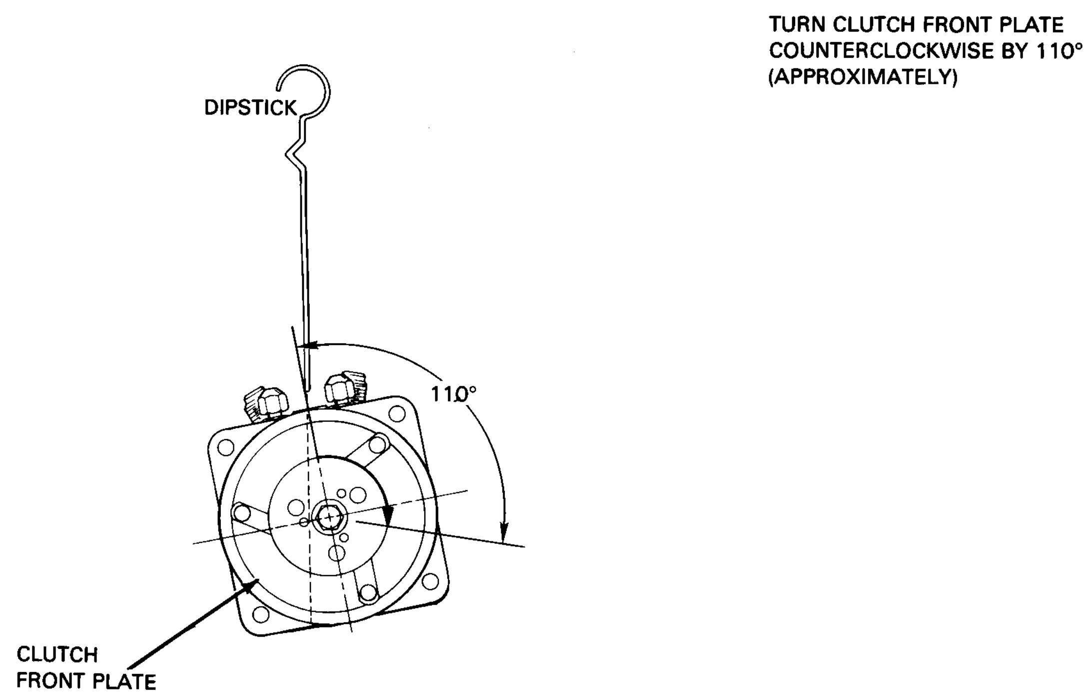


Figure 21-12. Rotation of Clutch Front Plate (Sankyo Compressor Oil Check)

COMPRESSOR INSTALLATION.

1. Place the compressor in the mounting brackets and install attachment bolts. Do not torque attachment bolts at this time.
2. Install compressor drive belt. Rotate compressor drive belt. Rotate compressor in mounting bracket slots to obtain a belt tension of 85 to 90 pounds. Torque the four attachment bolts 300 to 350 inch-pounds. Also refer to paragraph on Replacement of Compressor Drive Belt.
3. Check the oil level in the compressor in accordance with instructions given in the next paragraph.
4. Connect the discharge and suction lines to their respective fittings.
5. Evacuate and charge the system as explained in this section.

—WARNING—

If the air conditioner is to be operated on the ground for servicing, the test area should be clean and free of any loose objects lying on the ramp. Only the service valves located on the evaporator assembly should be used for testing.

CHECKING COMPRESSOR OIL.

The oil level should be checked any time the system is discharged. The following steps should be followed to perform this check:

1. Run the compressor for 10 minutes with engine at 1900 RPM.

—WARNING—

If the air conditioner is to be operated during ground servicing, the test area should be clean and free of any loose objects lying on the ramp. Only the service valve located on the evaporator assembly should be used for testing.

2. Discharge the system as previously explained; be careful not to loose any oil.
3. Remove the oil fill plug.
4. Position the rotor to top dead center (refer to Figure 21-11) by rotating the clutch front plate until the casting mark is visible in the center of the hole.
5. Rotate the clutch front plate clockwise by approximately 110. (Refer to Figure 21-12.)
6. Insert dipstick, No. 32447, purchased from Sankyo. (See Compressor Service paragraph for Sankyo address.)
7. Remove the dipstick and count the number of increments of oil. The acceptable oil level in increments is 7 to l0. This represents between 2.6 and 4.4 fluid ounces.
8. When oil is added, use Suniso No 5GS or Texaco Capella “E” grade or equialent 500 viscosity refrigerant oil.
9. When installing the oil filler plug, make sure the sealing O-ring is not twisted and that no dirt or particles are on the O-ring or seat. Torque the plug to 6-9 foot-pounds. Do not overtighten the plug to stop a leak; remove the plug and install a new O-ring.
10. Evacuate and charge the system as explained in this section.

—CAUTION—

The oil plug should not be removed with pressure in the system.

ADJUSTMENT OF DRIVE BELT TENSION.

1. Rotate the compressor to obtain tension of 100 pounds for new belt or 85 to 90 pounds for an old belt.

— WARNING—

If the air conditioner is to be operated during ground servicing, the test area should be clean and free of any loose objects lying on the ramp. Only the service valve located on the evaporator assembly should be used for testing.

2. Run the engine for a 15 minute period at 1900 RPM with the compressor engaged.
3. Shut down engine and recheck the belt tensions. New belt tension should fall back to desired tension of 85 to 90 pounds. Old belts reinstalled should retain the 85 to 90 pounds span tension.
4. This tension check should be made at every l00 hours or annual inspection, whichever occurs first.

REFRIGERANT LINES AND ROUTING.

The refrigerant lines in this aircraft are flexible high pressure hoses and should be handled accordingly. The hoses in the power plant area are routed so as to provide maximum protection from heat and abrasion. They couple at the fire wall to hoses routed through the two inboards, external hat section on the bottom of the fuselage, up through the floor to the condenser and evaporator in the tail cone. The discharge is in the right hand section and the suction in the left.

—NOTE—

Before any of the hose couplings are uncoupled, the system must be completely discharged. (See Discharging.)

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RECEIVER-DEHYDRATOR REMOVAL.

This unit is mounted on the inboard side of the evaporator assembly housing.

1. Discharge the system of all refrigerant. (See Discharging.)
2. Uncouple the refrigerant lines at the receiver-dehydrator. (See Special Servicing Procedures.)
3. Remove the clamp attaching the unit to the evaporator housing.

—NOTE—

This part is not serviceable, it must be replaced. The receiver-dehydrator should be replaced when the system has been operated without a charge or is left open.

RECEIVER-DEHYDRATOR INSTALLATION.

1. Slip the mounting bracket around the receiver and put it in place on the evaporator housing with the tube fitting on top. Align the fittings to the proper line before securing the mounting bracket.

—NOTE—

Torque the fittings. (See Chart 2104.)

2. Evacuate and recharge the system in accordance with Evacuating the System and Charging the System.

CONDENSER REMOVAL.

The condenser is mounted in a frame assembly located in the bottom of the fuselage between stations 156.00 and 191.00

1. Discharge the system. (See Special Servicing Procedures and Discharging.)
2. Remove access panel from the aft bulkhead of cabin.
3. Remove the forward cover panel.
4. Uncouple the suction and discharge hoses at the condenser fitting. (See Special Servicing Procedures.) Remove the hose clamps holding the hoses to the condenser frame.
5. Remove the AN-3 bolts from the upper ends of the side hinges and rod ends.
6. Support the condenser assembly and remove the bolt attaching the actuating rod to the condenser assembly.
7. Lower the aft end of the assembly on the piano hinge at the forward end of assembly.
8. Remove the eight screws attaching the piano hinge to the condenser frame assembly and remove from aircraft.
9. To remove condenser core from assembly, remove the screws in the side mounting frame.

CONDENSER INSTALLATION.

1. Install the condenser core to the frame assembly with the hose fittings forward and up.
2. Place the condenser and frame assembly to the fuselage frame mounting bracket and insert the (8) screws into the piano hinge.
3. Attach the side hinges and actuating rod and rig per Condenser Assembly Rigging Instructions.
4. Seal and couple the hose fittings (seal with Loctite refrigerant sealant applied to flanges only).
5. Adjust the condenser in accordance with Condenser Assembly Rigging Instructions.
6. Seal all around forward cover panel (and aft cover panel if removed) with Permagum Bead No. 576 purchased from Prestolite Engineering Company. (See Figure 21-14.)

—NOTE—

Whenever it is necessary to remove and replace the cabin rear panel, it should be replaced and sealed in the original manner. If it is not, because of the low pressure area in the cabin, exhaust gases may seep into the cabin.

—WARNING—

Make a carbon monoxide test on ground and in flight with and without the air conditioner operating. Presence of CO shall not exceed one part in 20,000.

CONDENSER DOOR ACTUATOR.

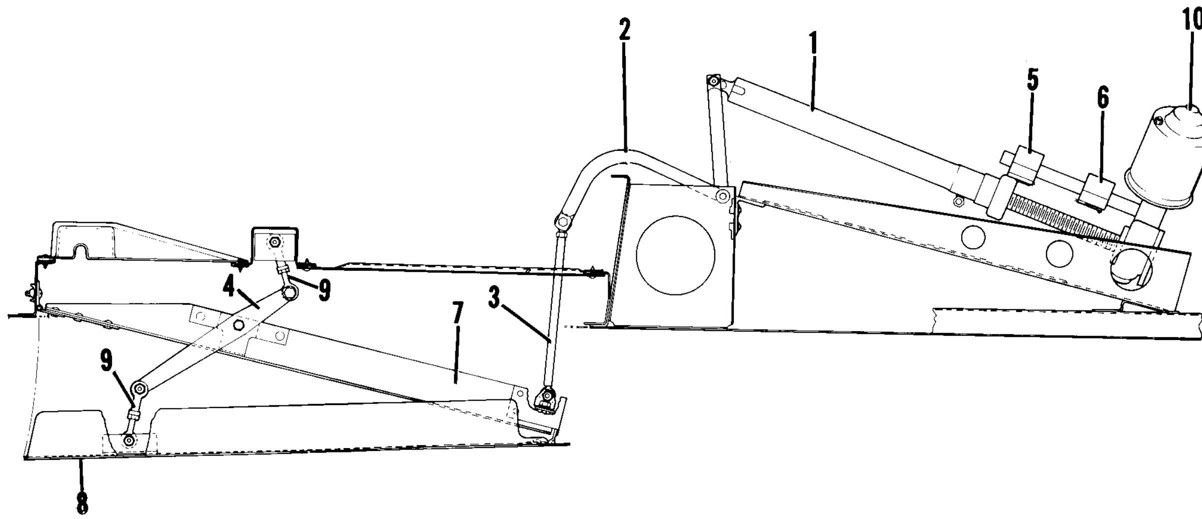
The actuator is on a bracket mounted between two bulkheads in the tail cone. It is coupled to the condenser assembly through a bellcrank mounted to a bracket on the bulkhead aft of the condenser. The actuator travel is controlled by two limit switches. Both the up and down switches are located on the actuator. Refer to Figure 21-14 for the switch locations.

CONDENSER ASSEMBLY RIGGING INSTRUCTIONS. (Refer to Figure 21-14.)

The condenser assembly is actuated by an electric motor through bellcranks, push rods and limit switches.

It is necessary for the condenser door to fit flush with the fuselage skin, and with increased force along the forward edge. The following steps will help accomplish this requirement:

1. Adjust open limit switch to open the condenser door 5.00 ±.50 inches when measured from the leading edge of the door to the fuselage skin.
2. Adjust side push rods so that a vertically measured gap of.16 of an inch exists along the trailing edge of the door at the instant the forward edge of the door becomes flush with the fuselage skin.
3. With the door fully closed adjust the “CLOSED” limit switch so that the actuator travels an additional .12 of an inch after the door is fully closed, this is necessary to preload the mechanism. (Refer to Figure 21-14, View A-A.)
4. Cycle the assembly several times to be certain it operates properly without binding.



1. ACTUATING TRANSMISSION ASSY.
2. BELLCRANK ASSY. (CONDENSER)
3. PUSH ROD ASSY.
4. BELLCRANK ASSY. (MECHANISM)
5. OPEN LIMIT SWITCH
6. CLOSED LIMIT SWITCH
7. CONDENSER
8. CONDENSER DOOR
9. PUSH ROD
10. TRANSMISSION MOTOR ASSY.

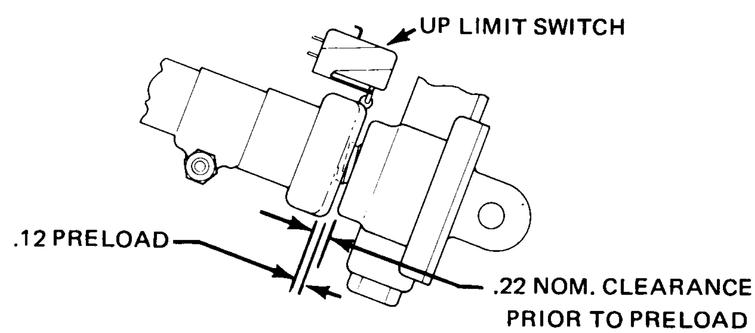


Figure 21-14. Condenser Air Scoop Installation

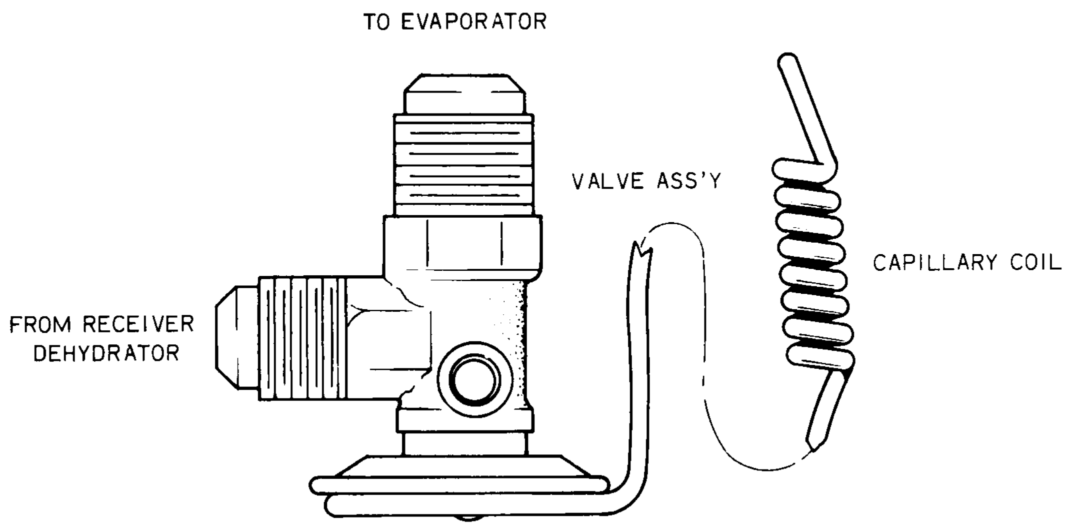


Figure 21-15. Expansion Valve

EXPANSION VALVE REMOVAL. (Refer to Figure 21-15.)

The expansion valve is located in the evaporator assembly between the receiver drier and the evaporator inlet. The capillary coil is attached to thc evaporator outlet line.

1. Remove the necessary access panels and discharge system.
2. Remove the capillary coil from the outlet line. (Do not kink the capillary tube.)
3. Uncouple all related tube fittings. (See Special Servicing Procedures.)

—NOTE—

If this part is not serviceable, it must be replaced with a new part.

EXPANSION VALVE INSTALLATION.

1. Install the expansion valve in the inlet line of the evaporator core by coupling the related fittings. (Seal all couplings with sealant applied to tube flanges only) Torque fittings per Chart 2104.
2. Secure the capillary coil to the evaporator outlet line.
3. Evacuate and charge the system. (See Evacuating the System and Charging the System.) Check for leaks. (See Checking the System for Leaks.)
4. Replace access panels.

EVAPORATOR REMOVAL.

The evaporator assembly consists of the evaporator core, receiver-dehydrator, expansion valve, circulating fan and pressure switch together with necessary housing and plumbing. The housing is fabricated of thermoplastic material. The condensed moisture is dumped overboard through a hose clamped to a fitting on the bottom of the evaporator housing.

The evaporator assembly is located behind the cabin rear panel, attached to the mounting panel with 12 screws and washers and a bracket securing the back to the mounting panel.

1. Remove air conditioning filter cover, filter and rear access panels.

—NOTE—

Discharge the system before disassembling any components for service.

2. Uncouple the liquid line from the inlet side of the receiver-dehydrator and the suction line from the evaporator core outlet. (See Special Servicing Procedures.)
3. Disconnect the related electrical wires.
4. Remove flexible air duct from housing outlet. Remove drain hose from housing.
5. Remove temperature probe from evaporator housing.
6. Remove the screws attaching the support bracket and evaporator housing to the mounting panel. Remove the assembly through the access hole in the bulkhead.

EVAPORATOR INSTALLATION.

1. Cement gasket in place on the flanges of the evaporator housing and attach the large end of the mounting gasket to the back of the housing.
2. Install the housing through the access hole with the air duct outlet on top. Mate the mounting flanges to the mating surface of the mounting panel and insert the screws. (Do not tighten at this time.)
3. Line up the mating bracket with mating holes in mounting panel, insert screws and tighten. Tighten screws in the flange at this time. Be certain gasket is in place. The flange must have an air tight seal.
4. Couple the suction and discharge lines to their respective fittings (apply Loctite refrigerant sealant to tube flanges only).
5. Evacuate and charge system. (See Evacuating the System and Charging the System.)
6. Check for leaks (see Checking the System for Leaks). If no leaks are detected seal and install access panel on evaporator housing.
7. Couple flexible air duct and drain tube.
8. Make and check electrical connections. (Refer to Figure 21-17.)
9. Check operation of blower and refrigerant systems.
10. Install rear bulkhead panels. Be certain to seal. (See WARNING.)

—WARNING _

Whenever it is necessary to remove and replace the rear cabin panel, it should be replaced and sealed in the original manner to prevent exhaust from entering the cabin. After removing and replacing the rear panel, conduct a carbon monoxide test on the ground and in flight with and without the air conditioner operating. Presence of CO shall not exceed one part in 20,000.

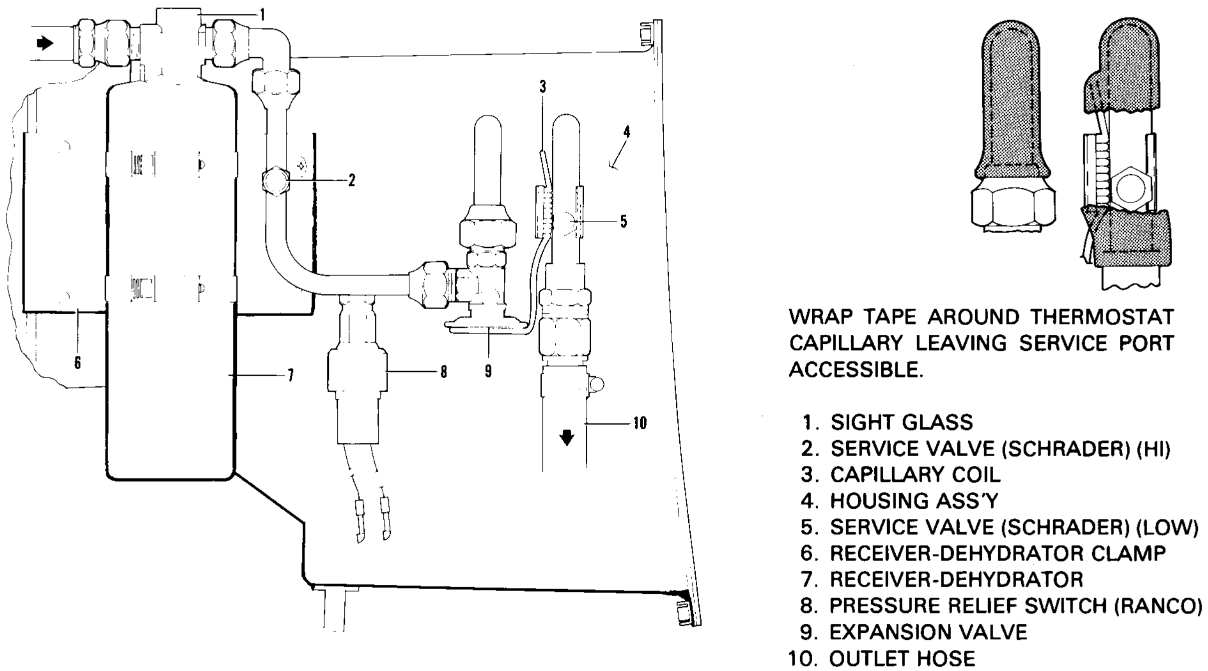


Figure 21-16. Components Installation

PRESSURE RELIEF SWITCH. (Ranco)

The pressure relief switch automatically prevents the system from over pressurization by breaking the electrical circuit to the magnetic clutch, stopping the compressor until pressure is reduced. The switch is located in the line between the reeeiver and expansion valve.

—NOTE—

Before the relief switch is removed, the air conditioning system must be discharged (See Discharging.)

ELECTRICAL INSTALLATION.

The electrical system, routing and component are installed and routed in the conventional aircraft manner. The wiring harness is connected to switches in the climate control center on the right side of the instrument panel. The harnesses cross the instrument panel to the left side where two (2) wires are taken off for the compressor clutch. The harness then passes aft along the left side of the fuselage where it connects to the blower motor, pressure relief switch and the condenser actuating motor.

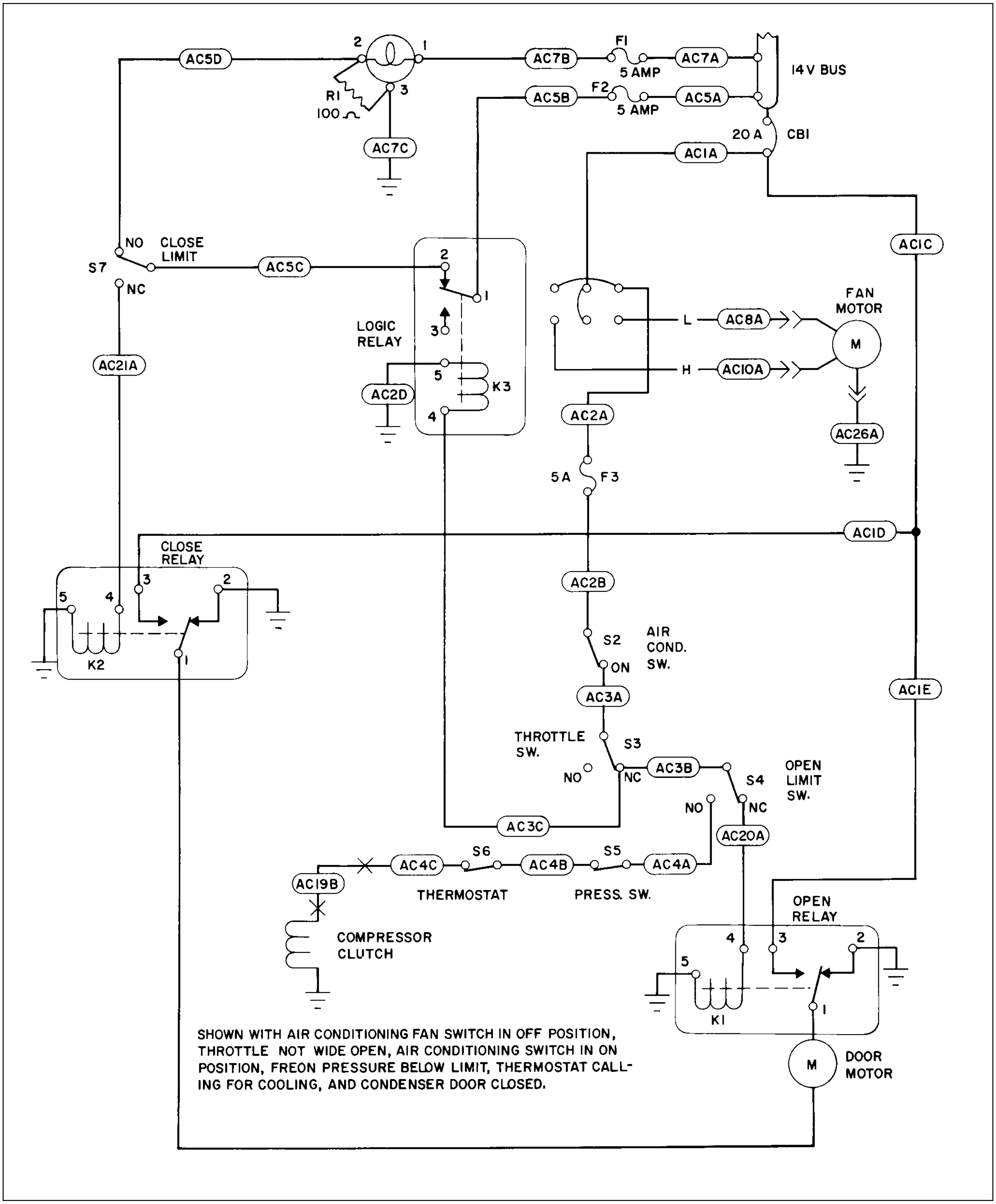


Figure 21-17. Air Conditioning Wiring Schematic

FUSE REPLACEMENT.

There are three fuses located behind the air conditioning system control panel. A 20 amp circuit breaker mounted in the circuit breaker panel protects the complete air conditioning electrical system.

CABIN VENT SYSTEM.

OVERHEAD VENT BLOWER DESCRIPTION.

The blower is mounted in the aft section of the fuselage and is connected to the overhead vent system. The blower draws air in from the dorsal fin and forces it through the ducting, whenever desired. The four position blower switch on the instrument panel controls the three speed blower.

REMOVAL OF BLOWER ASSEMBLY.

1. Remove the access door from the aft wall of the baggage area.
2. With the master switch off, disconnect the plug assemblies at the blower assembly.
3. Remove the inlet and outlet hoses from the blower assembly by removing the clamps.
4. Remove the screws, washers and nuts that secure the blower assembly to the hanger braces.
5. Remove the screws and washers which secure the blower assembly to the retainer and hangers.
6. Remove the blower assembly from the aircraft.

DISASSEMBLY OF BLOWER ASSEMBLY.

1. Remove the hose duct from the forward edge of the blower assembly by removing the nuts, washers and screws.
2. Remove the cover from the blower assembly by removing the nuts, washers and screws.
3. Remove the blower fan from the motor shaft by removing the set screw.
4. For removal of the motor, proceed as follows:
   A. Separate the plate from the motor cover by carefully drilling out the connecting rivets.
   B. Cut the motor wires at the edge of the receptacle and plug and remove the wire ends from the blocks.
   C. Remove the motor from the mounting plate by removing the nuts, washers and bolts.

REBUILDING OF BLOWER ASSEMBLY.

1. Mount the motor on the plate and secure it with the bolts, washers and nuts. Be sure that the motor nuts are snug and the shaft spins freely.
2. Position the cover over the motor plate with the motor wires protruding through the cover grommet.
3. With the holes in the cover matching the holes in the motor plate, secure the two parts together with rivets.
4. Apply PRC-5000 sealant to fill any opening left after the wires are brought through the grommet.
5. Install the wires in the plug and receptacle.
6. Position the blower fin on the motor shaft and secure with set screw.
7. Secure the cover to the blower assembly with screws, washers and nuts.
8. Position the hose duct on the blower assembly and secure it with screws, washers and nuts. The screws must be installed with their heads inside the duct.
9. After cleaning the surfaces of all old sealant, use white rubber chalk PRC-5000 sealant to seal where thc duct attaches to the blower assembly.

INSTALLATION OF BLOWER ASSEMBLY.

1. Position the blower assembly in the hangers and retainer and install the washers and screws.
2. Install the nuts, washers and screws securing the blower assembly to the hanger braces.
3. Seal all hose joints with Arno No. C-520 wrap tape; then install the inlet and outlet hoses securing them with the clamps.
4. With the master switch off, connect the plug and receptacles at the blower.
5. Check the blower for the proper operation.
6. Install the access door to the aft wall of the baggage area and secure with the attaching hardware.

—END—

CHAPTER

22

AUTO FLIGHT

CHAPTER 22 - AUTOFLIGHT

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

Due to the wide varity of A.F.C.S. (Automated Flight Control System) options, it is mandatory to follow the service literature published by the individual manufacturer of the A.F.C.S. equipment installed in any particular airplane. This includes mechanical service such as; adjusting bridle cable tension, servo removal and installation, servo clutch adjustments, etc.

NON-PIPER A.F.C.S. EQUIPMENT CONTACTS.

Refer to the following list of Autopilot/Flight Director manufacturers to obtain service direction, parts support, and service literature.

Bendix Avionics Division
2100 N.W. 62nd Street
Fort Lauderda1e, F1a. 33310
(305) 776-4100/TWX 5109559884

Collins General Aviation Division
Rockwell International
Cedar Rapids, Iowa 52406
(3l9) 395-3625 Telex: 464-42l

Edo Corporation - Avionics Division
Box 6l0
Municipal Airport
Mineral Wells, Texas 76067
(8l7) 325-25l7 Telex: 76067

King Radio Corporation
400 North Rodgers Road
Olathe, Kansas 6606l
(9l3) 782-0400 Telex: 4-2299-Kingrad

Sperry Flight Systems/Avionics Div.
8500 Balboa Blvrd.
P.O. Box 9028
VanNuys, CA. 9l409
(213) 894-8111 Telex: 65-1367

G1oba1 Navigation
2144 Michelson Drive
Irvine, CA. 92715
(714) 851-0119

PIPER A.F.C.S. EQUIPMENT.

In the case of early models, Piper AutoPilot equipment bears the Piper name, and the appropriate Piper Autopilot/ Flight Director Service Manual shall be used.

—NOTE—

If a Roll Axis-only Autopilot is installed, or if no Autopilot is installed, consult the Piper Pitch Trim Service Manual 753 771 for manual electric pitch trim service information.

The following is a complete listing of Piper A.F.C.S. equipment service literature. It is imperative to correctly identify the AutoPilot system by "faceplate" model name, in order to consult the appropriate service manual. Each manual identifies the revision level and revision status as called out on the Master Parts Price List - Aerofiche published monthly by Piper. Consult the aircrafts parts catalog for replacement parts.

NAME	PIPER PART NO.
AutoControl I/II & Altimatic I/II	753 798
AutoControl III and Altimatic III and IIIB	753 723
AutoControl IIIB and AltiMatic IIIB-I	761 502
AltiMatic IIIC	761 602
AltiMatic V and V-I	761 525
AltiMatic V F/D and V F/ D-I	761 526
AltiMatic X F.D./A.P./ & X A.P.	761 668
AutoFlite	753 720
AutoFlite II	761 481
Piper Pitch Trim (Manual-Electric)	757 771

—END—

CHAPTER

23

COMMUNICATIONS

23 - COMMUNICATIONS

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This chapter of the manual contains information necessary to perform operational checks of the Emergency Locator Transmitter (ELT), with and without a pilot's remote switch. Included are the appropriate removal and installation instructions to facilitate battery replacement.

EMERGENCY LOCATOR TRANSMITTER. (Communications Components Corp.)

DESCRIPTION.

The electrical power for the ELT transmissions is totally supplied by its own self-contained battery. However, aircraft power is required to shut off transmitter with the remote switch. For portable use, the ELT can be easily removed from its mounting in the aircraft. The battery should be replaced per the manufacturer's recommendations. The battery must be replaced if the transmitter has been used in an emergency situation or if accumulated test time exceeds one hour. The replacement date is marked on the transmitter label.

BATTERY REMOVAL AND INSTALLATION.

The ELT is located on the right side of the airplane tail section, ahead of the stabilator.

1. Remove the access plate on the right side of fuselage aft of sta. 228.30.
2. Rotate the ON/ARM/OFF switch to the OFF position.
3. Disconnect the antenna coax cable (twist left, then pull outwards).
4. Disconnect the harness to the pilot's remote switch.
5. Remove the forward mounting bracket by pulling the black plastic knob out. Remove the transmitter from the airplane.
6. Remove the six Phillips-head screws securing the transmitter cover. Remove the cover.
7. Lift out the old battery pack.
8. Copy the expiration date on the battery into the space provided on the external ELT name and date plate.
9. Disconnect and replace with a new battery pack. The nylon battery connector is a friction fit and is easily removed by pulling on the exposed end.
10. Insert transmitter into airplane and fit into place. Replace mounting bracket by pushing the black plastic knob into place.
11. Reconnect the pilot's remote switch harness and the antenna coax cable to the transmitter.
12. Set the ON/ARM/OFF switch to the ARM position.
13. Reinstall the access plate previously removed.

—NOTE—

It may be advisable to test the unit operation before installing the access plate. (See Testing Emergency Locator Transmitter paragraph.)

—NOTE—

Inspect the external whip antenna for any damage. Avoid bending the whip. Any sharply bent or kinked whip should be replaced. Antenna damage may cause structural failure of whip in flight.

PILOT'S REMOTE SWITCH.

A pilot's remote switch, located on the left side panel, is provided to allow the transmitter to be controlled from inside the cabin. The pilot's remote switch is placarded ON, AUTO/ARM and OFF/RESET. The switch is normally left in the AUTO/ARM position. To turn the transmitter off, move the switch momentarily to the OFF/RESET position. The aircraft master switch must be ON to turn the transmitter OFF. To actuate the transmitter for tests or in the event the automatic feature was not triggered by impact, move the switch upward to the ON position and leave it in that position as long as transmission is desired.

TESTING EMERGENCY LOCATOR TRANSMITTER.

The transmitter operates on the emergency frequencies of 121.5 and 243 MHz; both of these frequencies are monitored by the various FAA installations. Before performing any operational test of the ELT, the following precautions should be observed:

—CAUTION—

Testing of an ELT should be conducted in a screen room or metal enclosure to ensure that electromagnetic energy is not radiated during testing. If a shielded enclosure is not available, testing may be performed in accordance with the following procedures:

1. ***Test should be no longer than three audio sweeps.***
2. ***If the antenna is removed, a dummy load should be substituted during the test.***
3. ***Test should be conducted only within the time period made up of the first five minutes after any hour.***
4. ***If the operational tests must be made at a time not included within the first five minutes after the hour, the test should be coordinated with the closest FAA Tower or Flight Service Station.***

Consult FAA Advisory Circular AC 20-81 for detailed information concerning above caution.

1. Remove the access plate on the right side of the fuselage aft of sta. 228.30.
2. Tune the aircraft communications receiver to 121.5 MHz and switch the receiver ON; deactivate the squelch, and turn the receiver volume up until a slight background noise is heard.

—NOTE—

If the aircraft is not fitted with a communications receiver, request that the tower listen for your test.

3. On the transmitter, set the ON/ARM/OFF switch to the ON position. Keep the switch in this position for only a few seconds; then set to the OFF position. Return to the ARM position.

—NOTE—

The test transmission should have been picked up by the aircraft communications receiver and/or control tower. During cold weather, there may be a slight delay before transmission occurs.

4. A transmitter which is functioning properly should emit a characteristic downward swept tone.
5. When the test is completed, ascertain the transmitter ON/ARM/OFF switch is in the ARM position.
6. Place the access panel on the right side of the fuselage aft of sta. 228.30.

—WARNING—

Whenever the unit is checked by moving the transmitter ON/ARM/OFF switch from the ARM to the ON position, it must then be moved to the OFF position before reverting to the ARM position again.

—CAUTION—

Under normal conditions, the transmitter switch must be set to arm.

TESTING PILOT'S REMOTE SWITCH.

Before performing any operational test of the pilot's remote switch, the same precautions noted in the previous paragraph must be observed.

1. Tune the aircraft communications receiver to 121.5 MHz and switch the receiver ON, deactivate the squelch, and turn the receiver volume up until a slight background noise is heard.

—NOTE—

If the aircraft is not fitted with a communications receiver, request that the tower listen for your test.

2. Set the pilot's remote switeh to the ON position. Hold the switch in this position for only a few seconds.

—NOTE—

The test transmission should have been picked up by the aircraft communications receiver and/or control tower. During cold weather there may be a slight delay before transmission occurs

3. Set the pilot's remote switch to the momentary OFF/ RESET position. The switch is spring loaded to automatically return to the ARM position.

INADVERTENT ACTIVATION.

The remote switch allows the pilot to turn off the transmitter inadvertently activated by impact or improper switch selection. The pilot simply selects the momentary OFF/ RESET position. The transmitter shuts off and the spring loaded switch automatically returns to the ARM position. The aircraft master switch must be ON to turn transmitter OFF with the remote switch. Stopping inadvertent activation at the transmitter itself is accomplished in the following manner:

1. Improper switch selection is corrected by rotating the switch to the OFF position and then to the ARM position.
2. If the transmitter is inadvertently activated through impact, deactivate by pushing in on the ON/ARM/OFF switch.

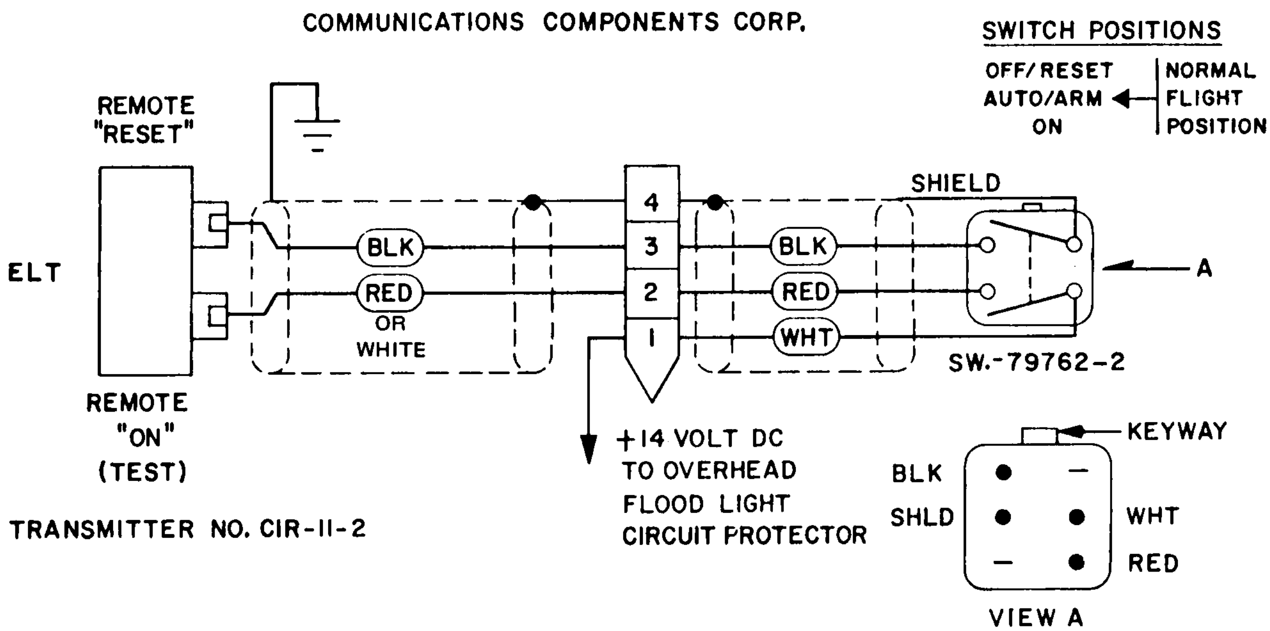
—NOTE—

As a routine precaution, it is recommended that the ELT battery be replaced at the earliest opportunity after inadvertent activation and a functional test be made in accordance with directions in this section. Note, however, that the problem may not be in the transmitter. Check the following:
1. Proper spacing of antennas so as to minimize antenna conducted RF.
2. Rigidity of the transmitter installation.

—CAUTION—

Under normal conditions, the pilot's remote switch must be set to ARM position.

—END—



NOTE: AIRCRAFT POWER USED TO SHUT OFF THE ELT WITH REMOTE SWITCH.

Figure 23-1. Communications Components ELT Schematic

CHAPTER

24

ELECTRICAL POWER

CHAPTER 24- ELECTRICAL POWER

TABLE OF CONTENTS/EFFECTIVITY

—NOTE—

Refer to Chapter 91 for all wiring diagrams (schematics)

GENERAL.

This chapter contains instructions for correcting difficulties which may arise in the operation of the electrical generating, storage and external power portions of the system.

Schematics for the individual systems are located in Chapter 91 of this manual. For information concerning electronic equipment refer to Chapters 22 and 23.

DESCRIPTION AND OPERATION.

Electrical power is supplied by a 14 volt, direct current, negative ground electrical system. A 12 volt battery is incorporated into the system to furnish power for starting and as a reserve power source in case of an alternator failure. Access to the battery is gained by opening the right engine cowling and removing the battery box cover from the battery box located on the upper right corner of the fire wall.

The electrical generating system consists of an engine driven 65 ampere alternator. A solid state voltage regulator maintains the system bus voltage at 14 volts. Also incorporated is an overvoltage relay, which prevents damage to electrical and avionics equipment in case of regulator malfunction. The loads from the electrical bus system are protected by manual reset type circuit breakers mounted on the lower right hand side of the instrument panel.

The master switch must be on before any electrical equipment will operate. The master switch controls the master contactor and field circuit to the alternator. The switch is a double pole, single throw type.

The lighting system for night time operation is optional equipment and consists of a landing light, anticollision lights, navigation lights and panel lights.

TROUBLESHOOTING.

—WARNING—

All checks and adjustments of the alternator and/or its components should be made with the engine stopped. Therefore, to complete certain checks or adjustments, the alternator or the specific components should be removed and checked on a test stand.

Probable troubles peculiar to the electrical system components covered in this chapter are listed in Chart 2401, along with their probable causes and suggested remedies. After the trouble has been corrected, check the entire system for security and operation of its components.

CHART 2401. TROUBLESHOOTING (ALTERNATOR)

Trouble	Cause	Remedy
Zero output indicated on ammeter regardless of RPM (refer to alternator system test procedure).	Open field circuit.	With master switch turned on check for battery voltage (12V) from ship's main bus through entire field circuit to alternator field terminal. Measure voltage from ground (-) to the following points (+) in sequence: bus bar, field circuit breaker (5A), field terminals of master switch, voltage regulator and alternator field terminal. Interruption of voltage through any of these points isolates the faulty component or wire which must be replaced.
	Open output circuit.	With master switch turned on check for battery voltage (12V) from ship's main bus through entire output circuit to alternator battery post. Measure voltage from ground (-) to the following points (+) in sequence: bus bar, ammeter, and alternator battery post. Interruption of voltage through any of these points isolates the faulty component or wire which must be replaced.

CHART 2401. TROUBLESHOOTING (ALTERNATOR) (cont)

Trouble	Cause	Remedy
Zero output indicated on ammeter regardless of RPM (refer to alternator system test procedure). (cont)	Open field winding in alternator.	Disconnect field terminal of alternator from field wiring and check for continuity from field terminal to ground with ohmmeter (20-100 ohms) depending on brush contact resistance. ***—CAUTION—*** ***Turn magneto switch to off before turning prop.*** ***If resistance is high check brushes for spring tension and excessive wear and replace if necessary. If brushes are okay and field reads open, replace alternator.*** (Pull propeller slowly by hand turning alternator rotor through 360° of travel.)
Output indicated on ammeter does not meet minimum values specified in alternator system test procedure.	Faulty voltage regulator.	Start engine, turn on load (ref. alternator test procedure), set throttle at 2300 RPM. Check voltage at bus bar. Voltage should be 13.5 volts minimum. If voltage is below this value replace regulator.

CHART 2401. TROUBLESHOOTING (ALTERNATOR) (cont)

Trouble	Cause	Remedy
Output indicated on ammeter does not meet minimum values specified in alternator system test procedure. (cont.)	High resistance connections in field or output circuit.	Check visually for loose binding posts at the various junction points in system, alternator battery post, lugs on ammeter, connections at voltage regulator, circuit breaker, etc. Examine crimped terminal ends for signs of deterioration at crimp or strands of broken wire at crimp. Tighten any loose binding posts or replace bad wire terminals.
	Open rectifier.	If any of the six rectifiers pressed into the rear bell housing of the alternator open up internally it will result in a definite limitation on the current that can be drawn from the alternator. After having checked the previous causes of low output it can be assumed that a faulty rectifier exists and replacement of the rectifier is recommended.
Field circuit breaker trips.	Short circuit in field circuit.	Disconnect field wiring at terminal of alternator. Turn on master switch. If breaker continues to trip, proceed to disconnect each leg of field circuit, working from the alternator towards the circuit breaker until breaker can be reset and will hold. Replace component or wire which was isolated as defective.

CHART 2401. TROUBLESHOOTING (ALTERNATOR) (cont.)

Trouble	Cause	Remedy
Field circuit breaker trips. ter(cont)	Short circuit in field winding of alternator.	Disconnect field wiring at minal of alternator. Turn on master switch. Reset breaker and if breaker fails to retrip, this isolates short circuit to field of alternator itself. Check brush holders for shorting against frame. If there are no obvious signs of a physical short circuit at field terminal or brush holder, replace alternator. (Note: In_ termittent short circuit.) Internal short circuiting of the field can occur at various positions of the rotor, therefore, reconnect field, reset breaker. *—CAUTION—* ***Turn magneto switch to off before turning propeller.*** pull propeller slowly by hand turning alternator rotor through 360° of travel. Observe circuit breaker for signs of tripping.
Alternator warning light illuminates.	Short circuit in output circuit.	Disconnect wiring at battery post of alternator. Turn on master switch. If warning light fails to extinguish proceed to disconnect each leg of output circuit, working from the alternator towards the circuit breaker until light extinguishes. Replace component or wire which was isolated as defective.
	Shorted alternator diode.	Disconnect wiring at battery post of alternator. Turn on master switch if warning light fails to illuminate, this isolates short circuit to alternator.

CHART 2401. TROUBLESHOOTING (ALTERNATOR) (cont)

Trouble	Cause	Remedy
Alternator warning light illuminates. (cont.)	Battery installed with reversed polarity.	Remove battery and reinstall with correct polarity.
	Battery charged backwards.	Remove battery. Connect load such as landing light lamp or similar load and discharge battery. Recharge with correct polarity and test each cell for signs of damage due to reversed charging. ***—NOTE—*** ***This type of condition can only occur in a case where a discharged battery has been removed from the airplane and put on a charger with the polarity reversed. This reversal in polarity cannot occur in the plane due to any fault in the alternator system.***
Excessive ammeter fluctuation.	Defective voltage regulator.	Replace voltage regulator.
	Excessive resistance in field circuit.	Check all connections and wire terminals in field circuit for deterioration such as loose binding posts, broken wire strands at terminals, etc. Tighten all connections and replace faulty terminals.

CHART 2402. TROUBLESHOOTING (BATTERY)

Trouble	Cause	Remed
Discharged battery.	Battery worn out.	Replace battery.
	Low electrical system voltage.	Check voltage regulator voltage.
	Standing too long.	Remove and recharge battery if left in unused airplane 3 weeks or more.
	Equipment left on accidentally.	Remove and recharge.
	Impurities in electrolyte.	Replace.
	Short circuit (ground) in wiring.	Check wiring.
	Broken cell partitions.	Replace.
Battery life is short.	Overcharge due to level of electrolyte being below top of plates.	Maintain electrolyte.
	Sulfation due to disuse.	Replace.
	Impurities in electrolyte.	Replace battery.
	Low charging rate.	Check voltage regulator voltage.
Cracked cell jars.	Hold-down bracket loose.	Replace battery and tighten
	Frozen battery.	Replace.
Compound on top of battery melts.	Charging rate too high.	Reduce charging rate. Check voltage regulator voltage.
Electrolyte runs out of vent plugs.	Too much water added to battery and charging rate too high.	Drain and keep at proper level and check voltage regulator voltage.

CHART 2402. TROUBLESHOOTING (BATTERY) (cont.)

Trouble	Cause	Remedy
Excessive corrosion inside container.	Spillage from overfilling.	Use care in adding water.
	Vent lines leaking or clogged.	Repair or clean.
	Charging rate too high.	Adjust voltage regulator.
Battery freezes.	Discharged battery.	Replace.
	Water added and battery not charged immediately.	Always recharge battery for 1/2 hour following addition of water in freezing weather.
Leaking battery jar.	Frozen.	Replace.
Battery polarity reversed.	Connected backwards on air-plane or charger.	Battery should be slowly dis-charged completely and then charged correctly and tested.
Battery consumes excessive water.	Charging rate too high (if in all cells).	Correct charging rate.
	Cracked jar (one cell only).	Replace battery.

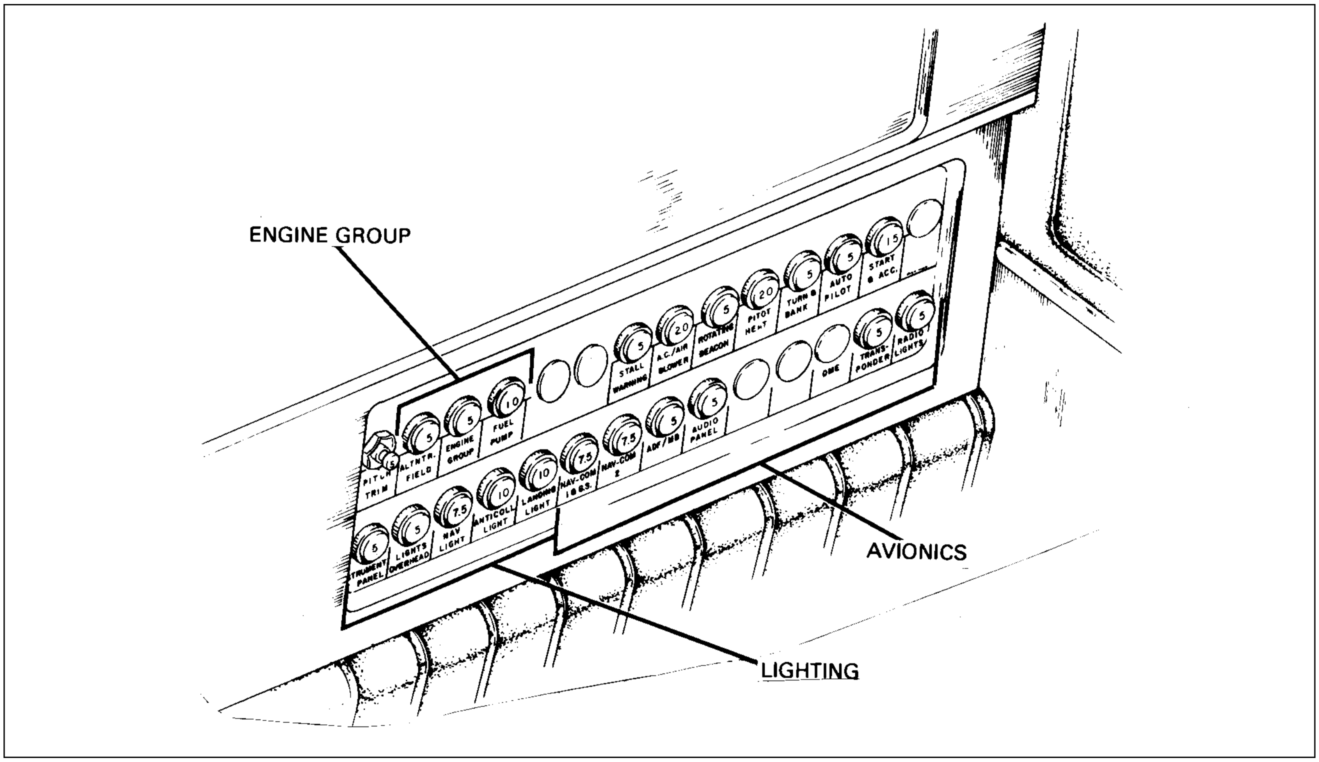


Figure 24-1. Instrument Panel- Circuit Breakers

D.C. GENERATION.

ALTERNATOR SYSTEM.

The alternator is mounted on the bottom of the accessory case at the rear of the engine. The alternating current is converted to direct current by diodes pressed into the end bell housing of the alternator. The diodes are highly reliable solid state devices, but are easily damaged if current flow is reversed through them.

There is one circuit breaker which controls the generating system. This circuit breaker, marked “Alternator Field,” is for the voltage regulator and alternator field. If this breaker trips, it will result in a complete shutdown of power from the generating system. After a one or two minute cool down period, the breaker can be reset manually. If tripping reoccurs, this indicates a short in the alternator circuit.

The ammeter does not indicate battery discharge, but displays the load in amperes placed on the generating system. With all electrical equipment off, except the master switch, the ammeter will indicate the amount of charging current demanded by the battery. This amount will vary depending on the percent of charge in the battery at the time. As the battery becomes charged the amount of current displayed on the ammeters will reduce to approximately two amperes. The amount of current shown on the ammeter will tell immediately whether or not the alternator system is operating normally, if the following principles are kept in mind.

—NOTE—

The amount of current shown on the ammeter is the load in amperes that is demanded by the electrical system from the alternator. As a check, take for example a condition where the battery is demanding 10 amperes charging current, then switch on the landing light. Note the value in amperes placarded on the circuit breaker panel for the landing light circuit breaker (10 amps) and multiply this by 80 percent. You will arrive at a current of 8 amperes. This is the approximate current drawn by the light. Therefore, when the light is switched on there will be an increase of current from 10 to 18 amperes displayed on the ammeter. As each unit of electrical equipment is switched on, the current will add up and the total, including the battery, will appear on the ammeter.

On airplanes without night flying equipment a simulated load can be made by connecting 8 landing lights wired in parallel from the main bus to airframe ground or fourteen 3 ohm, 100 watt resistors. (Refer to Figure 24-2.)

DESCRIPTION OF ALTERNATOR. (Refer to Figure 24-3.)

The principle components of the alternator are the brush holder assembly (1), the slip ring end head (2), the rectifiers (3), the stator (4), the rotor (5), and the drive end head (6).

1. The brush and holder assembly contains two brushes, two brush springs, a brush holder and insulator. The brush and holder assembly can easily be removed for inspection or brush replacement purposes.
2. The slip ring end head provides the mounting for the rectifiers and rectifier mounting plate, output and auxiliary terminal studs, and the brush and holder assembly. The slip ring end head contains roller bearing and outer race assembly and a grease seal.
3. The rectifiers used in these units are rated at 150 peak inverse voltage (PIV) minimum for transient voltage protection. Three positive rectifiers are mounted in the rectifier mounting plate while the three negative rectifiers are mounted in the slip ring end head.
4. The stator contains a special lead which is connected to the center of the three phase windings.
5. The rotor contains the slip ring, end bearing inner race and spacer on the slip ring end of the shaft.
6. The drive end head supports a sealed, prelubricated ball bearing in which the drive end of the rotor shaft rotates.

CHECKING ALTERNATOR SYSTEM.

An ammeter is used which enables an independent output check of the alternator, as well as the electrical output-input of the battery. Should the alternator show no output on the ammeter, check the circuit breakers of the alternator. If a further check of the ammeter shows no output from the alternator, check the alternator system. (Refer to the alternator and starter schematic in Chapter 91.)

1. Ascertain that the ammeter is operating properly.
2. Disconnect the battery lead (+) at the alternator.
3. Disconnect field leads at the alternator.
4. Ascertain that all electrical units are off and the battery is fully charged.
5. Turn on the master switch.

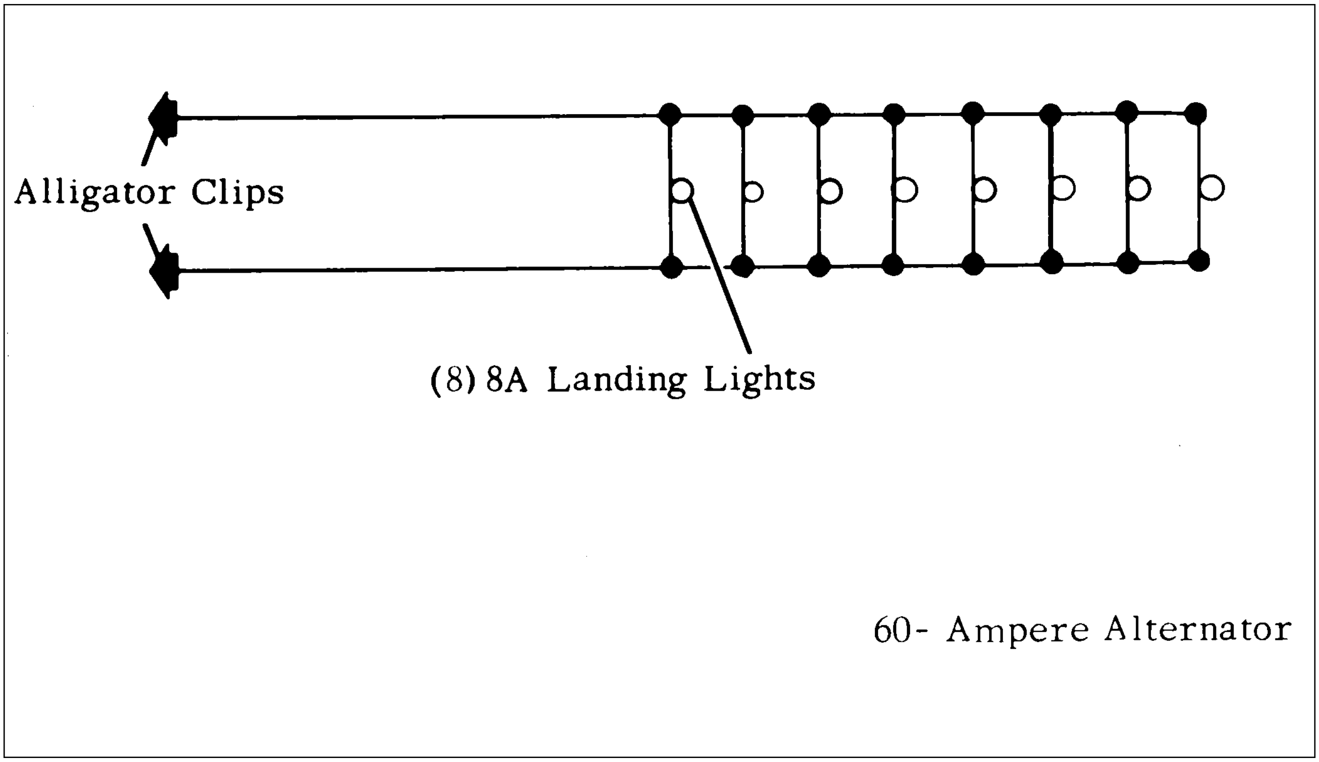


Figure 24-2. Lamp Bank Load

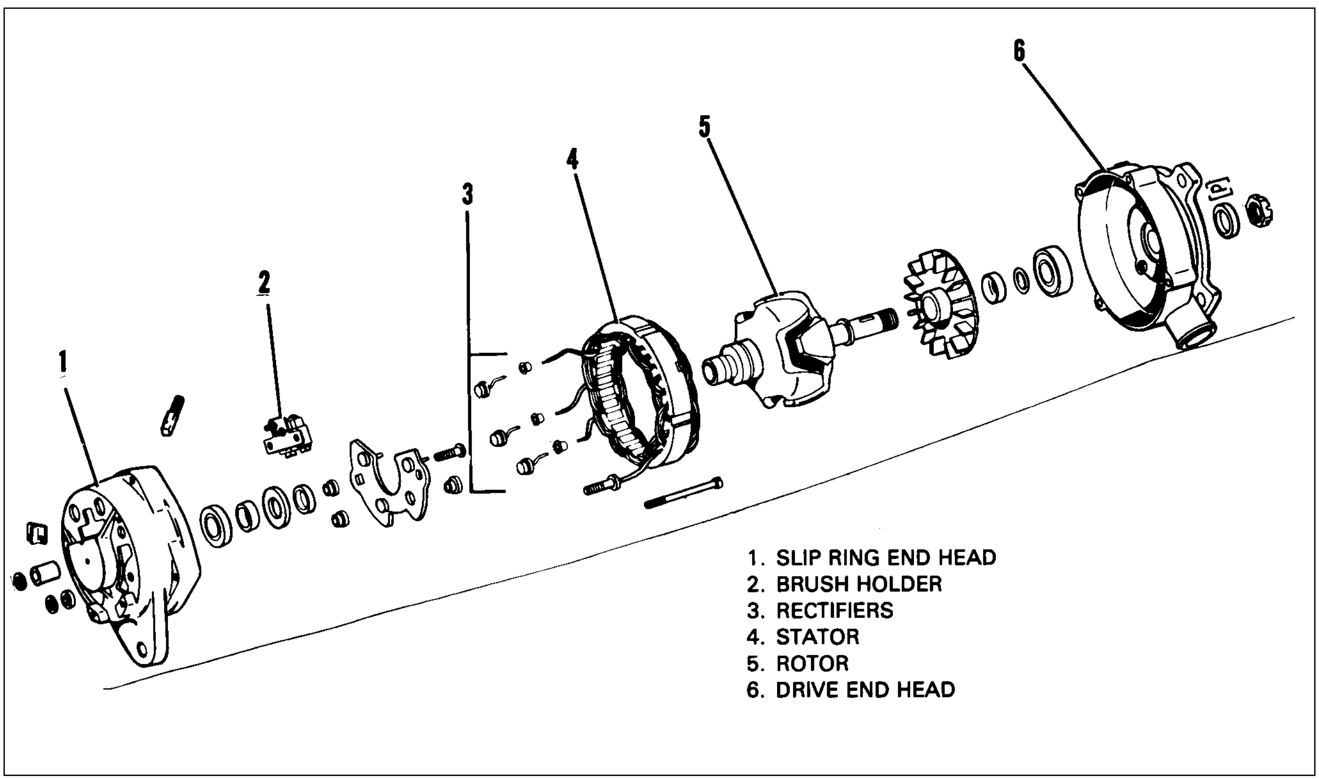


Figure 24-3. Exploded View of Alternator

6. To check the alternator output circuit, connect a voltmeter or 12 volt test light to the battery lead and to ground. If a reading of approximately 12 volts registers on the voltmeter or the test light lights, the battery circuit is operational.
7. Should there be no indication of voltage, trace back through the output circuit until voltage is indicated. (Refer to alternator and starter schematic in Chapter 91.) A component that allows no voltage to pass through it should be replaced.
8. Check the field circuit by the following procedure:
   A. On lead connected to (F1) terminal, connect a voltmeter to the field lead and to ground. If the voltmeter indicates any voltage, the circuit is operational.
9. If voltage is indicated at both the battery lead and field lead, the alternator should be checked for possible malfunction.

SERVICE PROCEDURES.

Since the alternator and regulator are designed for use on only one polarity system, the following procedures must be observed when working on the charging circuit. Failure to observe these service procedures will result in serious damage to the electrical equipment.

1. When installing a battery, always make sure the ground polarity of the battery and the ground polarity of the alternator are the same.
2. When connecting a booster battery, make certain to connect the negative battery terminals together and the positive battery terminals together.
3. When connecting a charger to the battery, connect the charger positive lead to the battery positive terminal and the charger negative lead to the battery negative terminal.
4. Never operate the alternator on an open circuit. Make absolutely certain all connections in the circuit are secure.
5. Do not short across or ground any of the terminals on the alternator or regulator.
6. Do not attempt to polarize the alternator.

OVERHAUL OF ALTERNATORS.

When repairing the alternator, complete disassembly may not be required. In some cases it will only be necessary to perform those operations which are required to effect the repair. However, in this section, the complete overhaul is covered step by step to provide detailed information on each operation. In actual service practice these operations may be used as required.

DISASSEMBLY OF ALTERNATORS.

1. Remove the two Number 10-24 screws holding the brush holder assembly in the slip ring end head. Remove the brush and holder assembly from the end head.
2. Remove the safety wire from the through bolts. Hold the pulley with a strap wrench and remove the pulley nut. The pulley must be removed with a Puller. Remove the fan, woodruff key and spacer from the shaft.
3. Remove the four through bolts and tap the drive end head lightly to separate the drive end head and rotor as a unit from the stator and slip ring end head.
4. Remove the nuts, lock washers, flat washers and insulators from the output and auxiliary terminal studs. Note carefully the correct assembly of the insulator washers and bushings. Using the special tools shown in Figure 24-4, support the end head and press out the three rectifiers. The end head can now be separated from the stator assembly.

5. To remove the slip ring end bearing and grease seal, it will be necessary to have a hook type or impact type bearing Puller as shown in Figure 24-5. Do not remove the bearing unless replacement is necessary.

—NOTE—

The inner race of the slip ring end bearing is pressed onto the rotor shaft. When bearing replacement is necessary, always replace the complete bearing assembly including the inner race.

6. To remove the drive end head from the rotor shaft, use a Puller that grips on the bearing retainer plate as shown in Figure 24-6. Do not attempt to remove by supporting the end head and pressing on the shaft, as this may result in distortion of the end head or stripping of the retainer plate screws. Remove the three retainer plate screws and press the bearing out of the end head. (Refer to Figure 24-7.)

INSPECTION AND TESTING OF COMPONENTS.

Upon completion of disassembly, all parts should be cleaned and visually inspected for cracks, wear or distortion and any signs of overheating or mechanical interference.

1. Rotor: The rotor should be tested for grounded or shorted windings. The ground test can be made with test probes, connected in series with a 110 volt test lamp, an ohmmeter or any type of continuity tester. (Refer to Figure 24-8.) There must not be any continuity between the slip rings and the rotor shaft or poles. To test for shorted turns in the rotor winding, connect a voltmeter, ammeter and rheostat as shown in Figure 24-9, or use an ohmmeter. Rotor current draw and resistance are listed in Chart 2403. Excessive current draw or a low ohmmeter reading indicates shorted windings. No current draw or an infinite ohmmeter reading would indicate an open winding.
2. Rectifiers: A diode rectifier tester will detect and pinpoint open or shorted rectifiers without going through the operation of disconnecting the stator leads. However, if a tester is not available, test probes and No. 57 bulb, connected in series with a 12 volt battery, can be used in the following manner. Touch one test probe to a rectifier heat sink and the other test probe to a lead from one of the rectifiers in the heat sink. Then reverse the position of the leads. The test bulb should light in one direction and not light in the other direction. If the test bulb lights in both directions, one or more of the rectifiers in that heat sink is shorted. To pinpoint the defective rectifier, the stator leads must be disconnected and the above test repeated on each rectifier. Open rectifiers can only be detected, when using the test bulb, by disconnecting the stator leads. The test bulb will fail to light in either direction if the rectifier is open.
3. Stator: The stator can be tested for open or grounded windings with a 12 volt test bulb, described in the rectifier section, or an ohmmeter in the following manner. Separate the stator from the slip ring end head just far enough to insert a fold of rags or blocks of wood. In other words, insulate the stator from the end head. To test for grounded windings, touch one test bulb or ohmmeter probe to the auxiliary terminal or any other stator lead, and the other test bulb or ohmmeter probe to the stator frame. If the test bulb lights, or ohmmeter indicates continuity, the stator is grounded. To test for open windings, connect one test probe to the auxiliary terminal or the stator winding center connection and touch each of the three stator leads. The test bulb must light, or the ohmmeter must show continuity. Due to the low resistance in the stator windings, shorted windings are almost impossible to locate. However, shorted stator windings will usually cause the alternator to “growl or be noisy during operation and will usually show some signs of overheating. If all other electrical checks are normal and alternator fails to supply its rated output, the stator should be replaced to determine whether or not it is the faulty component.
4. Bearings and Seals: Whenever the alternator is overhauled, new bearings and oil or grease seals are recommended, even though the bearings and seals appear to be in good condition. A faulty seal can cause an alternator to fail within a very short period of time.

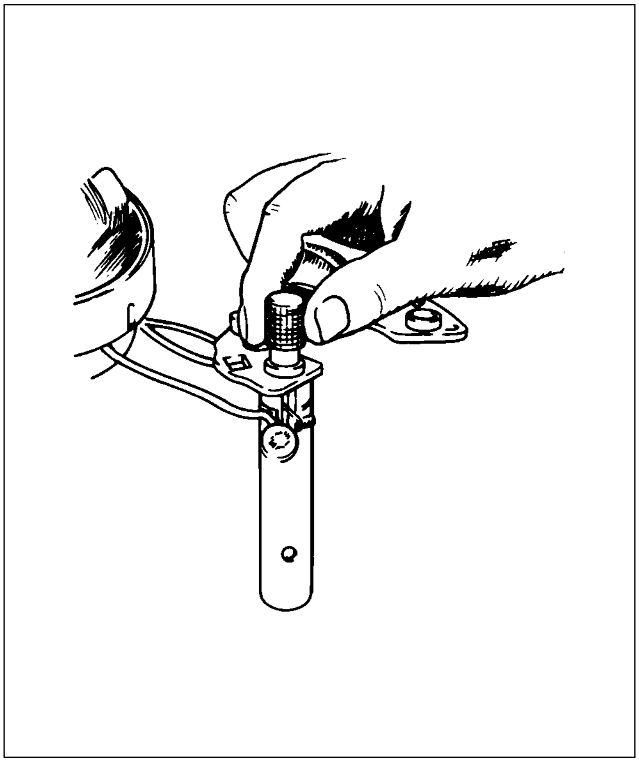


Figure 24-4. Removal of Rectifier

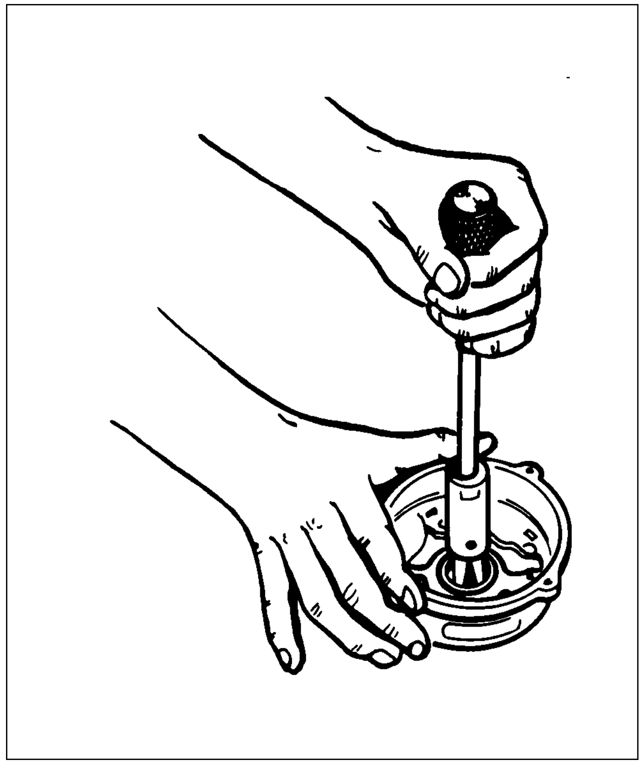


Figure 24-5. Removal of Slip Ring End Bearing

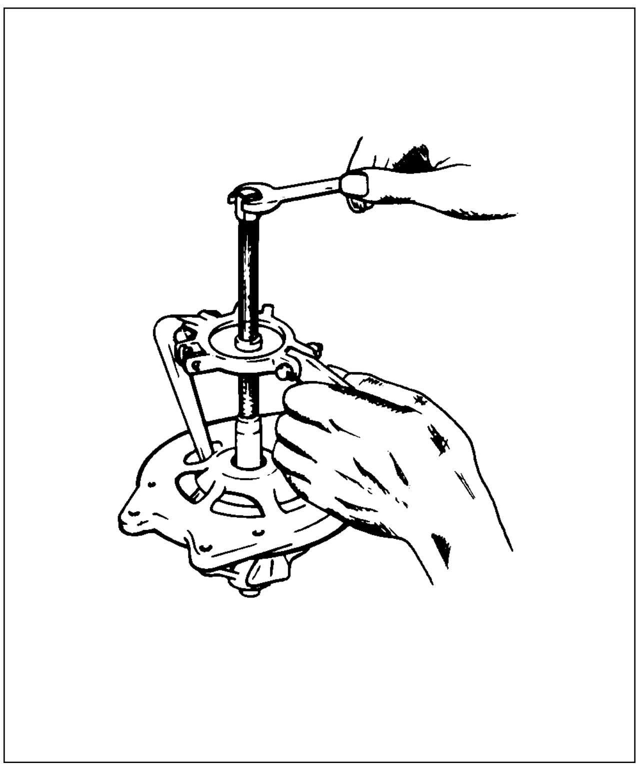


Figure 24-6. Removal of Drive End Head

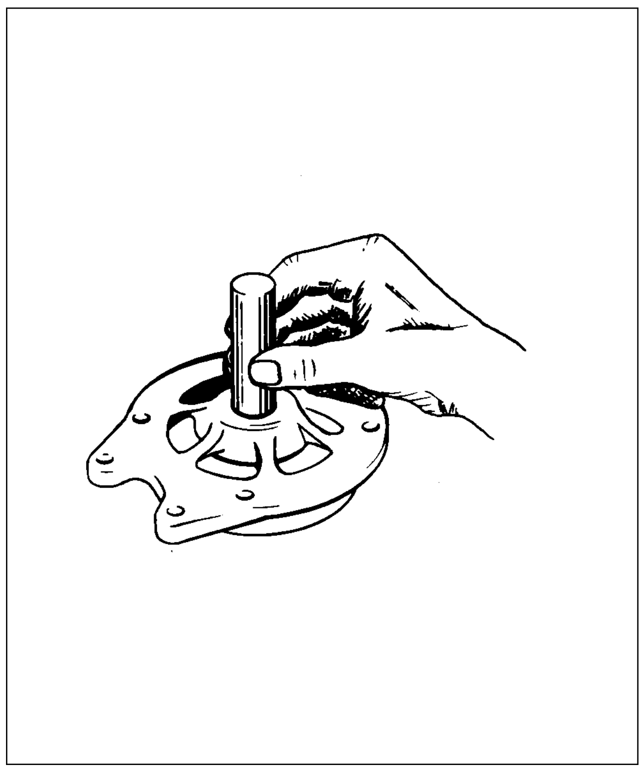


Figure 24-7. Removal of End Head Bearing

ASSEMBLY OF ALTERNATOR.

1. Press the ball bearing into the drive end head using a flat block approximately two inch square so that the pressure is exerted on the outer race of the bearing. Install the retainer plate. With the snap ring and retainer cup in place on the rotor shaft, use a tool that fits over the shaft and against the inner bearing race, and press until the inner bearing race is against the snap ring retainer cup. (Refer to Figure 24-10.)

—CAUTION—

Use an arbor press, do not hammer. Reconnect the stator leads to the rectifiers. When soldering these connections use pliers as a heat sink on the lead between the solder joint and the rectifier. Too much heat will damage the rectifiers.

2. Carefully install the rectifiers in the slip ring end head or rectifier mounting plate by supporting the unit and using the special tools illustrated in Figure 24-11.
3. Reassemble the rectifier mounting plate studs and insulators, making sure they are in the correct order. (Refer to Figure 24-15.)
4. After the slip ring end head is completely assembled, the stator and rectifier leads must be secured to the rectifier mounting plate with epoxy. Make sure the stator leads are positioned so that they do not interfere with the rotor.
5. Install the slip ring end bearing and oil seal. Make sure the lip of the oil seal is toward the bearing. Stake the seal in place. Correct assembly of bearing, seal, inner race and spacer as shown in Figure 24-12.
6. Assemble the alternator and install the through bolts. Spin the rotor to make sure there is no mechanical interference. Torque the through bolts to 30 to 35 inch-pounds. Safety wire should be installed after the unit has been bench tested for output. Install spacer, woodruff key, fan, pulley, lock washer and nut. Torque the nut to 3S foot-pounds, using a strap wrench to hold the pulley.
7. Install the brush and holder assembly and retaining screws. Spin the rotor and check for interference between the brush holder and rotor. Check between the field terminal and ground with an ohmmeter. The ohmmeter must indicate the amount of rotor resistance listed in Chart 2403.

TESTING ALTERNATORS.

1. Wiring connections for bench testing the alternator are shown in Figure 24-13. Refer to the Alternator Service Test Specification paragraph and Chart 2403 for output test figures. Adjust the carbon pile if necessary, to obtain the specified voltage.
2. After bench testing the alternator, install the safety wire and install the alternator on the engine.

—NOTE—

Always refer to the appropriate alternator and starter schematic wiring diagram when installing the alternator or testing the alternator.

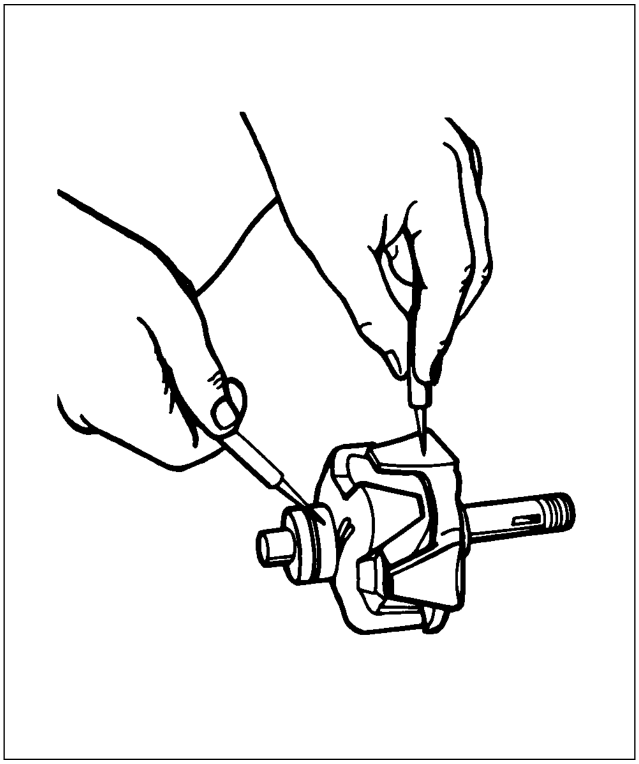


Figure 24-8. Testing Rotor for Grounds

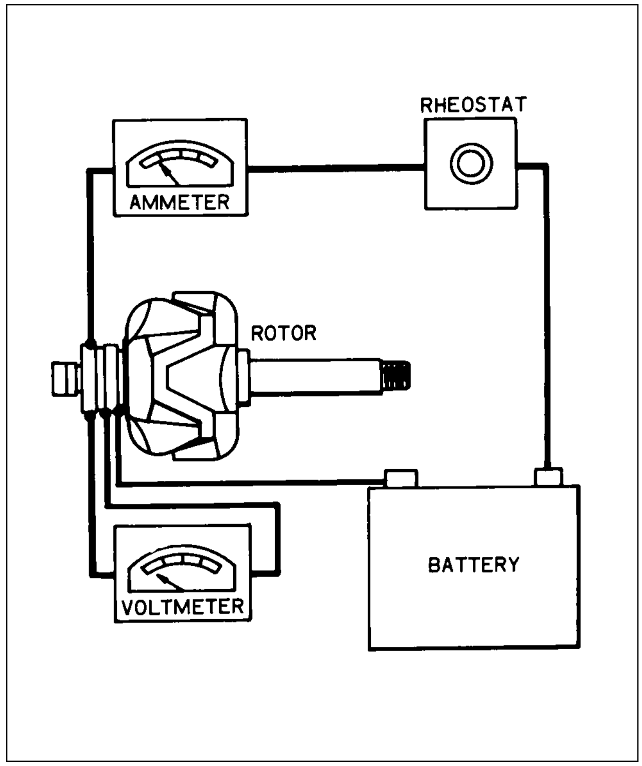


Figure 24-9. Testing Rotor for Shorts

Figure 24-10. Installation of Bearing

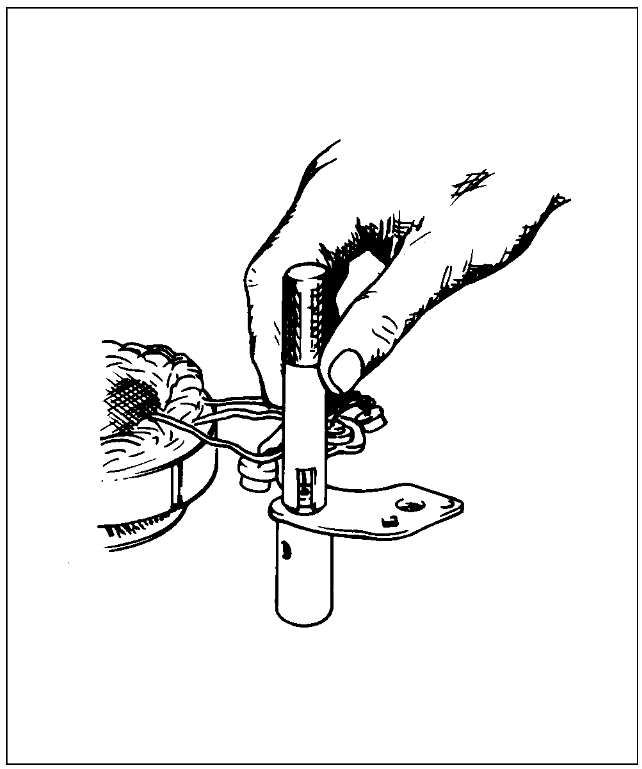


Figure 24-11. Installation of Rectifier

Figure 24-12. Slip Ring End Bearing Assembly

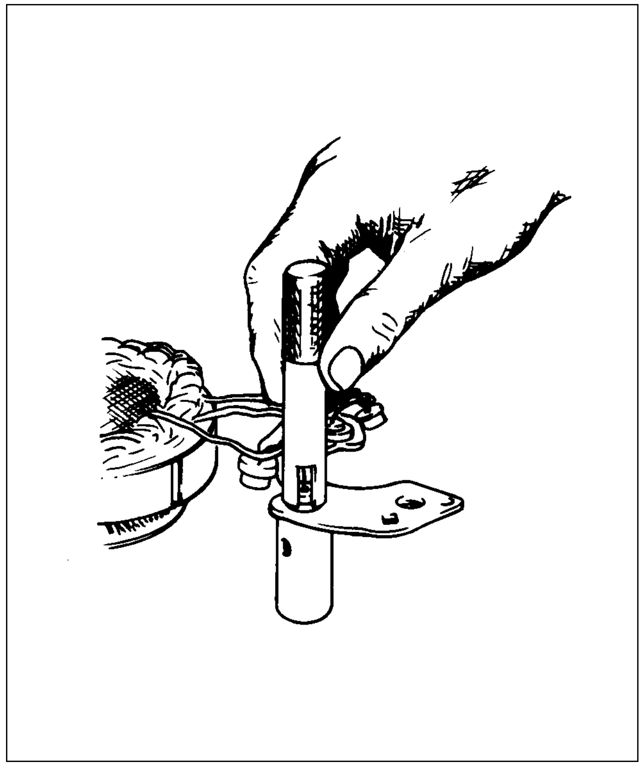


Figure 24-13. Testing Alternator

Figure 24-14. Brush Installation

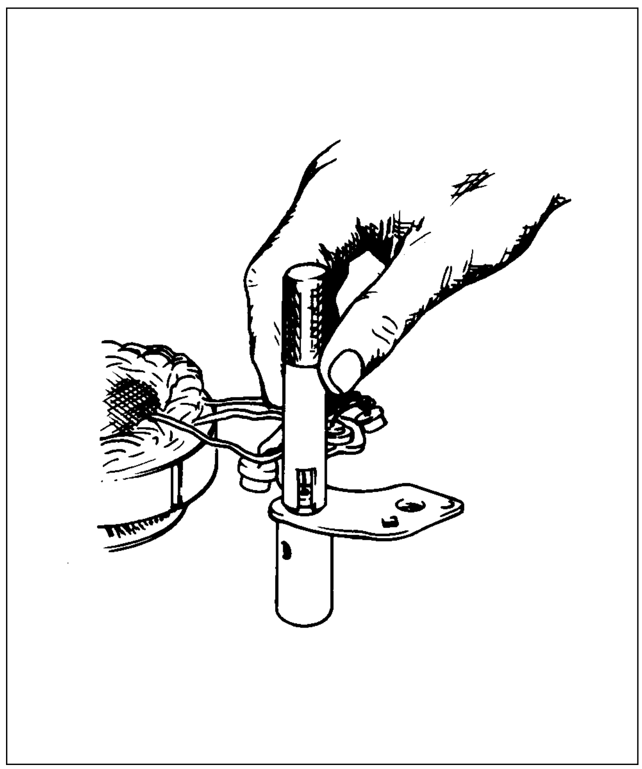


Figure 24-15. Internal Wiring Diagram

PRECAUTIONS.

The following precautions are to be observed when testing or servicing the electrical system.

1. Disconnect the battery before connecting or disconnecting test instruments, except voltmeter, or before removing or replacing any unit or wiring. Accidental grounding or shorting at the regulator, alternator, ammeter or accessories, will cause severe damage to the units and/or wiring.
2. The alternator must not be operated on an open circuit with the rotor winding energized.
3. Do not attempt to polarize the alternator. No polarization is required. Any attempt to do so may result in damage to the alternator, regulator or circuits.
4. Grounding of the alternator output terminal may damage the alternator and/or circuit and components.
5. Reversed battery connections may damage the rectifiers, wiring or other components of the charging system. Battery polarity should be checked with a voltmeter before connecting the battery. This aircraft is negative ground.
6. If a booster battery or fast charger is used, its polarity must be connected correctly to prevent damage to the electrical system components.

—NOTE—

If a solderless terminal on an aluminum cable is loose, corroded or otherwise unsatisfactory, it is recommended that the complete cable assembly be replaced instead of replacing or repairing the solderless terminal.

Should replacement of the complete assembly not be practical, it is permissable to replace the aluminum cable assembly with a copper cable assembly which is two sizes smaller (EX: AL-I1aluminum cable assembly is replaced with an AN-3 copper cable assembly). The new cable should be installed in accordance with AC-43-13-2A.

ALTERNATOR NOMENCLATURE.

1. Bearings: This unit has a sealed ball bearing at the drive end and a two piece roller bearing at the slip ring end. The inner race is pressed onto the rotor shaft and the rest of the bearing is in the slip ring end head. When the unit is assembled, the inner race aligns with the bearing. When the bearing is replaced, the new inner race must be installed on the rotor shaft.
2. Lubrication: The slip ring end bearing should be lubricated whenever the alternator is disassembled. The bearing should be thoroughly cleaned and repacked with Shell Alvania No. 2 (MIL-G-23827) or an equivalent bearing lubricant. The cavity behind the bearing should be packed one-third to one-half full with the same lubricant.
3. Brushes: These units have a separate brush holder assembly that is installed after the alternator has been assembled. The brush holder has a small hole that intersects the brush cavities. Use a pin or a piece of wire, as shown in Figure 24-14 to hold the brushes in the holder during assembly. Remove the pin after the brush holder retaining screws have been tightened. Make a continuity check to be sure the brushes are seated against the slip rings.
4. Drive Pulley: Torque the drive pulley retaining nut to 35 foot-pounds.

ALTERNATOR SERVICE TEST SPECIFICATIONS.

Prestolite specifications for the 14 volt alternators installed as standard equipment on PA-28-201T airplanes are as follows:

CHART 2403. ALTERNATOR SPECIFICATIONS

Alternator Model	ALY 9405	
Voltage	12 volts	
Rated Output	65 amperes	
Ground Polarity	Negative	
Rotation	Bi-Directional	
Rotor:		
Current Draw (77°F)	2.4 to 4.0 amps @ 12.0 volts	
Resistance (77°F)	3.0 to 5.0 ohms	
—NOTE—		
Do not test alternator on engine.		
Output test (77°F)		
Volts	14	14
Amperes Output	33	57
At Alternator RPM	3000 min.	6000 min.

BATTERY.

Access to the battery is through the aft side of the baggage compartment. It is enclosed in a thermoplastic box with a vent system and a drain. The vents allow fresh air to enter the box and draw off fumes that may accumulate due to the charging process of the battery. The drain is clamped off and should be opened occasionally to drain any accumulation of liquid or during cleaning of the box.

SERVICING BATTERY.

The battery should be checked for fluid level, but must not be filled above the baffle plates. A hydrometer check should be performed to determine the percent of charge in the battery. All connections must be clean and tight. (Refer to Chart 2404.)

CHART 2404. HYDROMETER READING AND BATTERY CHARGE PERCENT

Hydrometer Reading	Percent of Charge
1280	100
1250	75
1220	50
1190	25
1160	Very little useful capacity
1130 or below	discharged

REMOVAL OF BATTERY.

1. In the baggage compartment, remove the access panel to the aft section of the fuselage.
2. Disconnect the three cam locks from the battery box cover and remove the cover.
3. Disconnect the battery cables.

—NOTE—

Always remove the ground cable first and install it last to prevent accidental short circuiting or arcing.

4. Lift the battery from the box.

INSTALLATION OF BATTERY.

1. Ascertain that both the battery and battery box are clean and free from any acid.
2. Position the battery in the box with the positive terminal inboard.
3. Connect the positive lead (PIB) to the positive battery terminal and secure.
4. Connect the ground cable to the negative battery terminal and secure.
5. Reinstall the battery box cover and secure with three cam locks; then close cowling.

TESTING BATTERY.

The specific gravity check method is listed in Chart 2404. If the alternator output is known to be correct, the question of battery capability can be more accurately determined with a load type tester.

CHARGING BATTERY.

If the battery is not up to normal charge, remove it from the airplane and charge, starting with a charging rate of 4 amps and finishing with 2 amps. A fast charge is not recommended.

BATTERY BOX DESCRIPTION.

The box is made of thermoplastic with a vent and drain system. The vent allows fresh air to enter the box and draw off fumes that may accumulate due to the charging process of the battery. The drain is capped at the bottom of the fuselage and should be opened occasionally to drain any accumulation of liquid or during cleaning of the box.

REMOVAL OF BATTERY BOX. (Refer to Figure 24-16.)

1. Remove the battery from the box.
2. Remove the two mounting bolts and nuts securing the master contactor relay to the left side of the box. Note the location of components secured by these same bolts.
3. Remove the four mounting bolts securing the box and remove the box.

INSTALLATION OF BATTERY BOX. (Refer to Figure 24-16.)

1. Position the battery box in place and secure with four bolts previously removed.
2. Position the master contactor relay on the left side of the box and secure with the two bolts and nuts previously removed. Insure the proper connection of any components previously disconnected.
3. Install the battery and make the appropriate connections.

BATTERY BOX CORROSION PREVENTION.

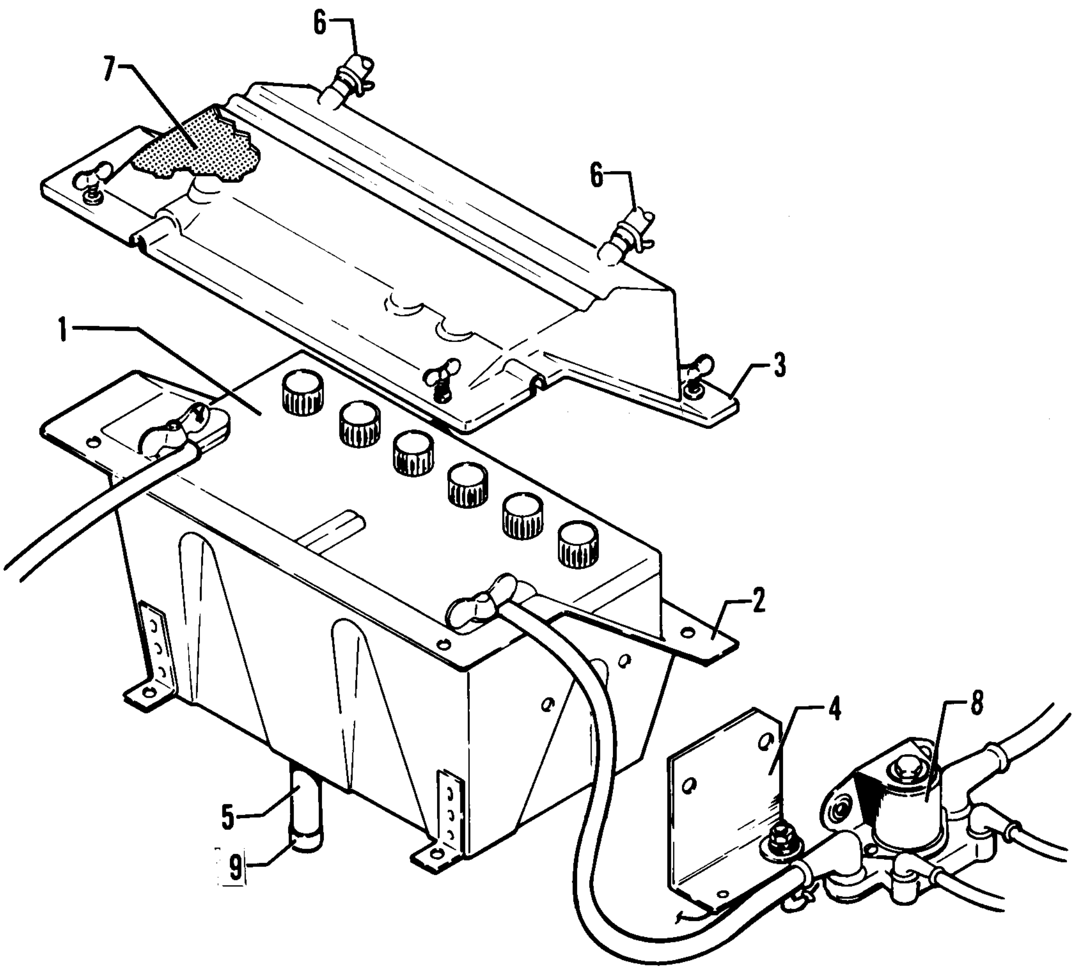
The battery should be checked for spilled electrolyte or corrosion at each 50-hour inspection or at least every 30 days, whichever comes first. Should residue be found in the box, or corrosion on the terminals or around the battery, the battery should be removed and both the box and battery cleaned by the following procedure:

1. Remove the box drain cap from the underside of the fuselage and drain off any electrolyte that may have overflowed into the box.

—CAUTION—

Do not allow baking soda to enter battery.

2. Clean the battery and the box. Corrosion effects may be neutralized by applying a solution of baking soda and water mixed to the consistency of thin cream. Continue application until bubbling action has ceased.
3. Rinse the battery and box with clean water and dry.
4. Place the cap over the battery box drain.
5. Reinstall battery. (Refer to battery installation.)



1. BATTERY - 25 AMP HOUR
2. BATTERY BOX - LOWER HALF
3. BATTERY BOX - UPPER HALF
4. DIODE AND MASTER RELAY ASSEMBLY PLATE
5. BATTERY BOX DRAIN
6. BATTERY BOX VENT HOSES
7. URETHANE BOX SPACER
8. POWER RELAY SOLENOID
9. DRAIN CAP

Figure 24-16. Battery Box

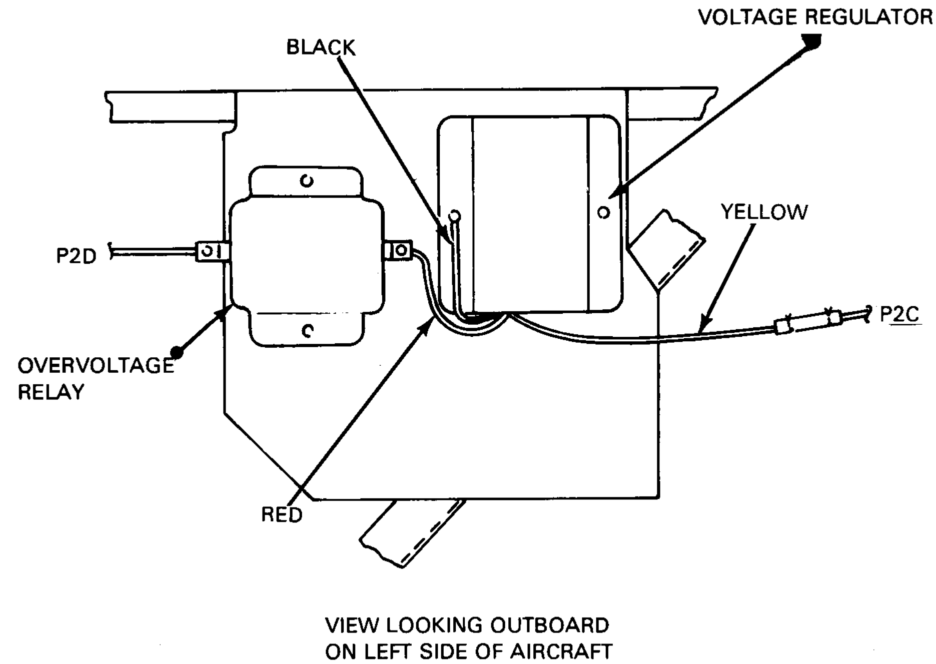


Figure 24-17. Voltage Regulator Location

VOLTAGE REGULATOR AND OVERVOLTAGE RELAY.

REMOVAL OF VOLTAGE REGULATOR AND/OR OVERVOLTAGE RELAY.

The voltage regulator and overvoltage relay are mounted on a plate which is fastened to the longerons at fuselage station 53.000 and waterline 44.000, underneath and forward of the instrument panel as shown in Figure 24-17.

1. Identify the voltage regulator or overvoltage relay to be tested.
2. Disconnect and label the wires, to ease reinstallation, from the unit to be tested.
3. Remove the screws mounting the unit to the plate, and remove the unit.

INSTALLATION OF VOLTAGE REGULATOR AND/OR OVERVOLTAGE RELAY.

1. Position the unit on the plate and secure it with the mounting screws.

—CAUTION—

Do not interchange regulator leads. This will destroy regulator and void warranty.

2. Reconnect the wires to the proper terminals.

CHECKING VOLTAGE REGULATOR.

The regulator is a fully transistorized unit in which all of the components are encapsulated in epoxy, which makes field repair of the unit impractical, and if it does not meet the specifications, it must be replaced. The regulator may be tested by the following procedure:

1. Be sure that the battery is fully charged and in good condition.
2. Check the alternator according to the manufacturer's instructions, to determine if it is functioning properly. This test must be done with the regulator out of the circuit. After completing this test, reconnect the regulator into the circuit.
3. Use a good quality accurate voltmeter with at least a 15 volt scale.
4. Connect the positive voltmeter lead to the red wire at the regulator harness connector, or terminal block. Connect the negative voltmeter lead to the regulator housing. Note: Do not connect the voltmeter across the battery, because the regulator is designed to compensate for resistance contained within the wiring harness.
5. With the alternator turning at sufficient RPM to produce a half load condition, or approximately 25 amperes output, the voltmeter should read between 13.6 and 14.3 volts. The ambient temperatures surrounding the voltage regulator should be between 50°F. to 100°F. while this test is being made.
6. The voltage regulator heat sink, or case, is the ground connection for the electronic circuit. Therefore, if this unit is tested on the bench it is most important that a wire, No. 14, be connected between the regulator case and the alternator. If the regulator does not regulate between 13.6 and 14.4 volts, one of the following conditions may exist:
   A. Regulates, but out of specification. The regulator is out of calibration and must be replaced.
   B. The voltmeter continues to read battery voltage.
      (1) Poor or open connections within the wiring harness.
      (2) The regulator is "open".
   C. Voltage continues to rise.
      (1) Regulator housing not grounded.
      (2) Regulator shorted, must be replaced.
7. These are some of the things to look for in case of failure:
   A. Poor or loose connections.
   B. Poor ground on the regulator housing.
   C. Shorted alternator windings.
   D. A grounded yellow wire. (This will cause instantaneous failure.)
   E. Disconnecting the regulator while the circuit energized.
   F. Open circuit operation of the alternator. (The battery disconnected.)

CHECKING OVERVOLTAGE RELAY. (Wico)

The relay may be tested with the use of a good quality, accurate voltmeter, with a scale of at least 20 volts and a suitable power supply, with an output of at least 20 volts, or sufficient batteries with a voltage divider to regulate voltage. The test equipment may be connected by the following procedure:

1. B+ is connected to "Bat" of the overvoltage control.
2. B- is connected to the frame of the overvoltage control.
3. Be sure both connections are secure, and connected to a clean, bright surface.
4. Connect the positive lead of the voltmeter to the "Bat" terminal of the overvoltage control.
5. Connect the negative lead of the voltmeter to the frame of the overvoltage control.
6. The overvoltage control is set to operate between 16.2 volts to 17.3 volts. By adjusting the voltage, an audible "click" may be heard when the relay operates.
7. If the overvoltage control does not operate between 16.2 and 17.3 volts it must be replaced.

CHART 2405. ELECTRICAL SYSTEM COMPONENT LOADS

Duty Cycle Cont.	Duty Cycle Inter.	Equipment	Circuit Breaker	Load (Amps)	Optional
X		Starter and Accessories	10		
X		Alternator Field	5		
X		Anti-Collision (Strobe)	10		X
X		Engine Group	5		
X	X	Landing Lights	10		X
X		Nav Lights	7.5		X
X		Panel Lights	5		X
X		Pitot Heat	20		X
X	X	Stall Warning	5		
		Turn Coord.	5		X
X	X	Alt. Warning Light	5		
X		ADF	5		X
X		Audio Marker	5		X
X		Comm 1	5		X
X		Comm 2	5		X
X		Nav 1	5		X
X		Nav 2	5		X
		Transponder	5		X

—NOTE—

Refer to Chapter 91 for electrical wiring schematics.

—END—

CHAPTER

25

EQUIPMENT/FURNISHINGS

CHAPTER 25- EQUIPMENT/FURNISHINGS

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

The PA-28-201T is equipped with four seats. The seats can be of the reclining or fixed back type. The following chapter deals with the removal, installation and repair of these seats.

PASSENGER COMPARTMENT.

REMOVAL AND INSTALLATION OF SEATS. (Refer to Figure 25-l.)

1. To remove the front seats the following procedure is suggested:
   A. Remove the fore and aft track stops.
   B. Move the seats forward to the track openings and remove the seat by lifting the seat brackets out of their respective openings.
2. To remove the rear seats, release the rear legs from the floor by depressing the pins in the floor fittings and sliding the seat back, rotate the seat slightly forward to free the rear legs and slide the seat back to free the front legs from their brackets.
3. Install the seats in the opposite manner of their removal.

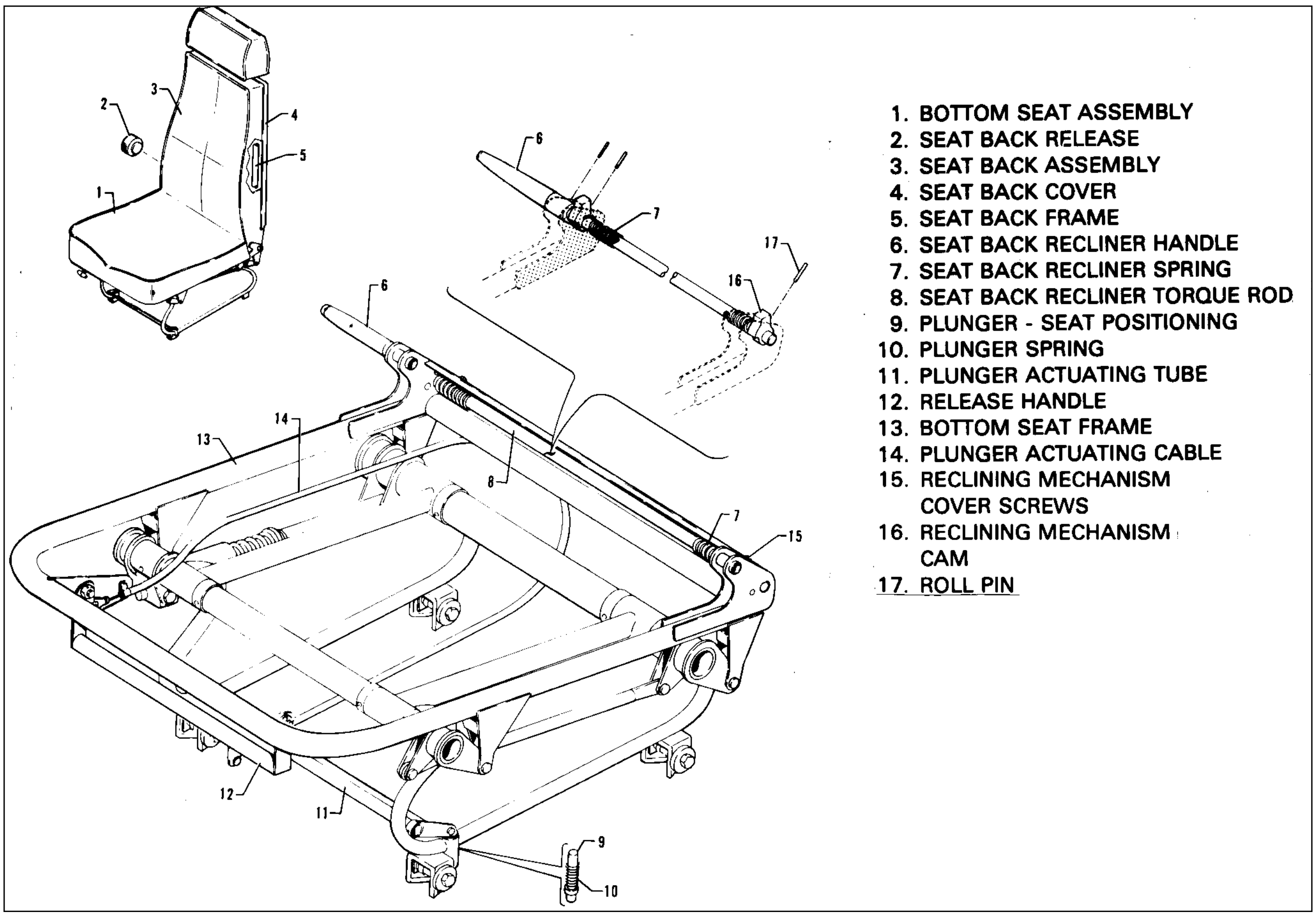


Figure 25-1. Seat Installation

REMOVAL AND INSTALLATION OF RECLINING MECHANISM. (Refer to Figure 25-1.)

1. Remove seat from aircraft, and if possible tilt back of seat forward.
2. Remove the cover running between the two seat brackets by removing the four retaining screws.
3. Carefully remove the cotter pins retaining the return springs.
4. Remove the roll pins positioning the cams on the torque tube.
5. By firmly gripping the handle pull the torque tube through the brackets and springs.
6. Install the mechanism in the opposite manner.

ADJUSTMENT OF SEAT BACK. (Refer to Figure 25-1.)

Should the back of the seat twist when leaning against it, check that the cams are attached to the torque tube properly, and if so make the proper adjustments with the stop bolts.

SHOULDER HARNESS INERTIA REEL ADJUSTMENT.

1. Allow the harness to wind up on the reel as much as possible.
2. On the end of the reel, pry off the plastic cap over the spring, making sure the spring does not come out of the plastic cap, and set cap aside.
3. Unwind the harness completely, then measure and mark the harness 24 inches from the reel center.
4. Wind the harness onto the reel until the 24 inch mark is reached, then hold reel and place cap with spring over reel shaft end.
5. Aligning slot in shaft with spring tang, wind spring 6 turns ± 1/ 2 turn and snap the plastic cover into holes in reel end shaft.
6. Release harness and allowing it to wind up, extend the harness a few times to check reel for smooth operation.
7. With reel fully wound, hold with inertia mechanism end up and pry off plastic cap over mechanism and set reel aside.
8. Install nut in plastic cap so that stud in cap is flush with nut surface, then reposition cap over reel end and orientating properly, snap in place. Extend harness a few times to make sure action is correct.

—END—

CHAPTER

27

FLIGHT CONTROLS

CHAPTER 27- FLIGHT CONTROLS

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 27 - FLIGHT CONTROLS (cont)

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This section contains the explanation for the removal, installation, rigging and adjustment procedures for the control assemblies of the various structural surfaces. For the removal and installation of the structural surfaces of the airplane, refer to Chapters 55 and 56. The assemblies need not be removed in order of paragraphs since each paragraph describes the individual removal and installation of the component.

DESCRIPTION AND OPERATION.

The airplane is controlled in flight by the use of three standard primary control surfaces, consisting of the ailerons, stabilator and rudder. Operation of these controls is through the movement of the dual control columns and dual rudder pedals. The individual surfaces are connected to their control components through the use of cables and push-pull tubes. Provision for directional and longitudinal trim control is provided by an adjustable trim mechanism for the rudder and stabilator. The flaps are mechanically operated and can be positioned in four locations of 0, 10, 25 and 40 degrees.

The aileron controls consist of two-control wheels connected by torque tubes to sprockets on each end of the horizontal control column. A chain is wrapped around the sprockets and around a double sprocket on the vertical post of the control column. The chain is connected to the primary aileron control cable which is routed through the center of the fuselage to the main spar and out through the wings to a bellcrank in each wing. A balance cable is also connected to the bellcrank. As the control wheels are moved, the control cables move the bellcranks and actuate push-pull rods to move the ailerons.

The stabilator controls are also connected to the control column. From the connecting point, cables are routed around a series of pulleys down under the floor and aft to the tail section of the airplane. The aft end of the cables connect to the stabilator balance arm which in turn is connected to the stabilator. When the control wheels are moved forward or aft, the cables move the balance arm up and down rotating the stabilator on its hinge points.

The rudder is controlled by the pilot’s and co-pilot’s rudder pedals. Cables are connected to both sides of the rudder pedal assembly and are routed aft through the bottom of the fuselage to the rudder horn. When one rudder pedal is pushed, the cables move in opposite directions turning the rudder horn and rudder. The wing flap system is operated by a lever located between the front seats.

For a visual description of the various control systems, refer to the illustrated figures throughout this section.

TROUBLESHOOTING.

Troubles peculiar to the flight controls are listed in Chart 2701, along with their probable causes and suggested remedies.

CHART 2701. TROUBLESHOOTING (SURFACE CONTROLS)

Trouble	Cause	Remedy
	AILERON CONTROL SYSTEM	
Lost motion between control wheel and aileron.	Cable tension too low.	Adjust cable tension. (Refer to Aileron Controls section in this chapter.)
	Linkage loose or worn.	Check linkage and tighten or replace.
	Broken pulley.	Replace pulley.
	Cables not in place on pulleys.	Install cables correctly. Check cable guards.
Resistance to control wheel rotation.	System not lubricated properly.	Lubricate system.
	Cable tension too high.	Adjust cable tension. (Refer to Aileron Controls section in this chapter.)
	Control column horizontal chain improperly adjusted.	Adjust chain tension. (Refer to Aileron Controls section in this chapter.)
	Pulleys binding or rubbing.	Replace binding pulleys and/or provide clearance between pulleys and brackets.
	Cables not in place on pulleys.	Install cables correctly. Check cable guards.
	Bent aileron and/or hinge.	Repair or replace aileron and/or hinge.
	Cables crossed or routed incorrectly.	Check routing of control cables.
Control wheels not synchronized.	Incorrect control column rigging.	Rig in accordance with this chapter.
Control wheels not horizontal when ailerons are neutral.	Incorrect rigging of aileron system.	Rig in accordance with this chapter.

CHART 2701. TROUBLESHOOTING (SURFACE CONTROLS) (cont.)

Trouble	Cause	Remedy
AILERON CONTROL SYSTEM (cont.)		
Incorrect aileron travel.	Aileron control rods not adjusted properly.	Adjust in accordance with this chapter.
	Aileron bellcrank stops not adjusted properly.	Adjust in accordance with this chapter.
Correct aileron travel cannot be obtained by adjusting bellcrank stops.	Incorrect rigging of aileron cables, control wheel and control rod.	Rig in accordance with this chapter.
Control wheel stops before control surfaces reach full travel.	Incorrect rigging between control wheel and control cables.	Rig in accordance with this chapter.
STABILATOR CONTROL SYSTEM		
Lost motion between control wheel and stabilator.	Cable tension too low.	Adjust cable tension as described in this chapter.
	Linkage loose or worn.	Check linkage and tighten or replace.
	Broken pulley.	Replace pulley.
	Cables not in place on pulleys.	Install cables correctly.
Resistance to stabilator control movement.	System not lubricated properly.	Lubricate system.
	Cable tension too high.	Adjust cable tension per Stabilator Controls section.
	Binding control column.	Adjust and lubricate per Stabilator Controls section.
	Pulleys binding or rubbing.	Replace binding pulleys and/or provide clearance between pulleys and brackets.
	Cables not in place on pulleys.	Install cables correctly.

CHART 2701. TROUBLESHOOTING (SURFACE CONTROLS) (cont.)

Trouble	Cause	Remedy
STABILATOR CONTROL SYSTEM (cont.)		
Resistance to stabilator control movement. (cont.)	Cables crossed or routed incorrectly.	Check routing of control cables.
	Bent stabilator hinge.	Repair or replace stabilator hinge.
Incorrect stabilator travel.	Stabilator stops incorrectly adjusted.	Adjust stop screws per Stabilator Controls section.
Correct stabilator travel cannot be obtained by adjusting stops.	Stabilator cables incorrectly rigged.	Rig cables in accordance with Stabilator Controls section.
STABILATOR TRIM CONTROL SYSTEM		
Lost motion between trim control wheel and trim tab.	Cable tension too low.	Adjust in accordance with Stabilator Controls section in this chapter.
	Cables not in place on pulleys.	Install cables as directed in Stabilator Controls section.
	Broken pulley.	Replace pulley.
	Linkage loose or worn.	Check linkage and tighten or replace.
Trim control wheel moves with excessive resistance.	System not lubricated properly.	Lubricate system.
	Cable tension too high.	Adjust in accordance with Stabilator Controls section.
	Pulleys binding or rubbing.	Replace binding pulleys. Provide clearance between pulleys and brackets.
	Cables not in place on pulleys.	Refer to Standard Procedures section in this chapter.
	Trim tab hinge binding.	Lubricate hinge. If necessary, replace.

CHART 2701. TROUBLESHOOTING (SURFACE CONTROLS) (cont.)

Trouble	Cause	Remedy
STABILATOR TRIM CONTROL SYSTEM (cont.)		
Trim control wheel moves with excessive resistance. (cont.)	Cables crossed or routed incorrectly.	Check routing of control cables.
Trim tab fails to reach full travel.	System incorrectly rigged.	Check and/or adjust rigging per Stabilator Controls section.
	Trim drum incorrectly wrapped.	Check and/or adjust rigging per Stabilator Controls section.
Trim indicator fails to indicate correct trim position.	Trim indicator unit not adjusted properly.	Adjust in accordance with Stabilator Controls section.
RUDDER CONTROL SYSTEM		
Lost motion between rudder pedals and rudder.	Cable tension too low.	Adjust cable tension per Rudder Controls section.
	Linkage loose or worn.	Check linkage and tighten or replace.
	Broken pulley.	Replace pulley.
	Bolts attaching rudder to bellcrank are loose.	Tighten bellcrank bolts.
Excessive resistance to rudder pedal movement.	System not lubricated properly.	Lubricate system.
	Rudder pedal torque tube bearing in need of lubrication.	Lubricate torque tube bearings.
	Cable tension too high.	Adjust cable tension per Rudder Controls section.
	Pulleys binding or rubbing.	Replace binding pulleys and/or provide clearance between pulleys and brackets.

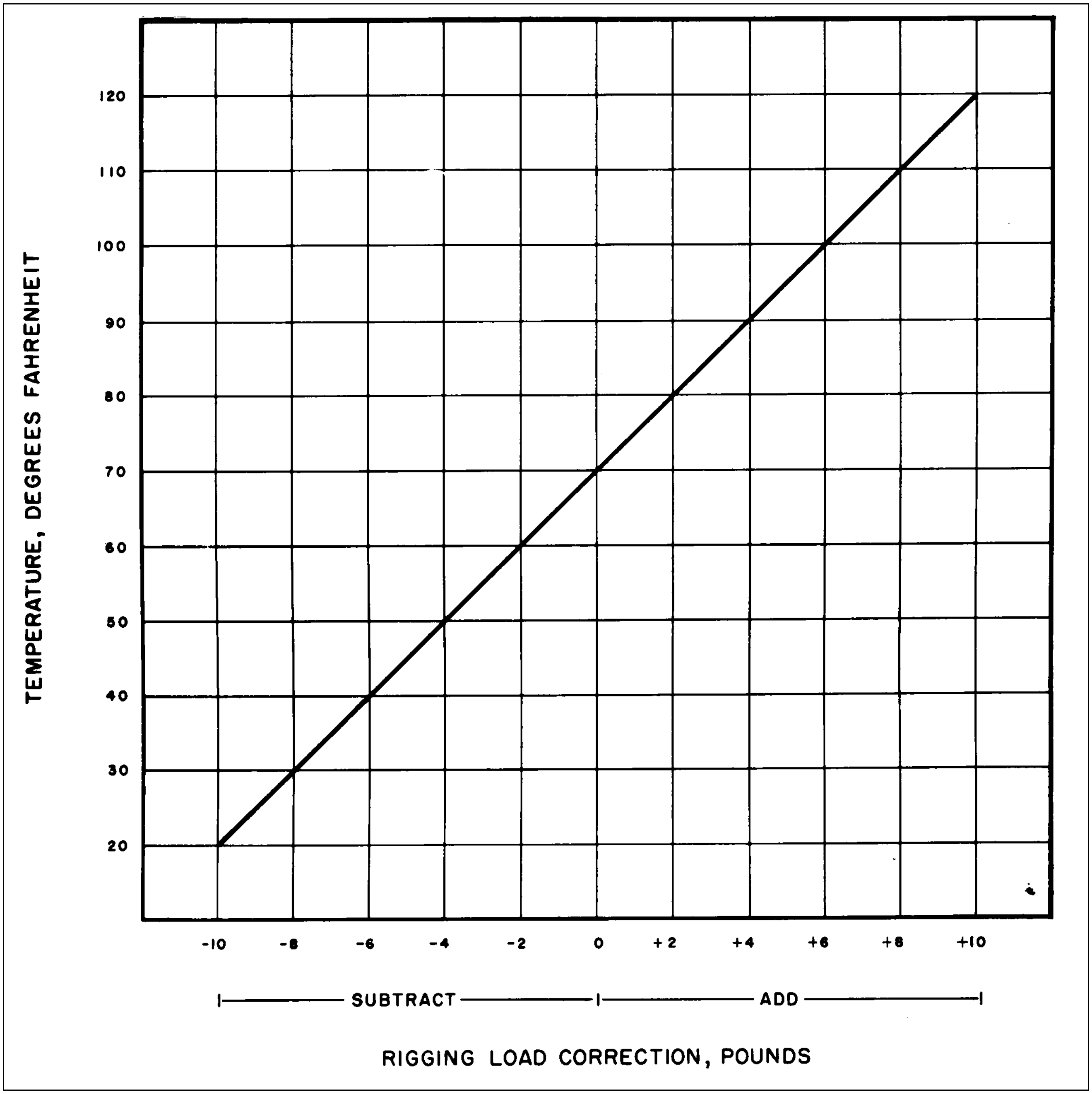
CHART 2701. TROUBLESHOOTING (SURFACE CONTROLS) (cont.)

Trouble	Cause	Remedy
RUDDER CONTROL SYSTEM (cont.)		
Excessive resistance to rudder pedal movement. (cont.)	Binding and/or damage of rudder bar.	Repair or replace.
	Binding and/or damage of rudder trim.	Repair, replace or lubricate.
	Binding and/or damage of steering bellcrank.	Repair, replace or check pivot.
	Binding and/or damage of steering rod, rod ends.	Replace.
	Binding and/or damage of bungee.	Repair, replace or lubricate.
	Binding and/or damage of nose centering spring assembly.	Repair, replace or lubricate.
	Binding and/or damage of strut assembly.	Repair, replace or lubricate.
	Cables not in place on pulleys.	Install cables correctly. Check cable guards.
	Cables crossed or routed incorrectly.	Check routing of control cables.
Rudder pedals not neutral when rudder is streamlined.	Rudder cables incorrectly rigged. Also rudder pedal, steering rods, bungee and rudder trim.	Rig in accordance with Rudder Controls section.
Incorrect rudder travel.	Rudder bellcrank stop incorrectly adjusted.	Rig in accordance with Rudder Controls section.
	Rudder pedals and rudder pedals stop incorrectly adjusted.	Rig in accordance with Rudder Controls section.

CHART 2701. TROUBLESHOOTING (SURFACE CONTROLS) (cont.)

Trouble	Cause	Remedy
RUDDER TRIM CONTROL SYSTEM		
Trim control knob moves with excessive resistance.	System not lubricated properly.	Lubricate system.
FLAP CONTROL SYSTEM		
Flaps fail to extend or retract.	Control cable broken or disconnected.	Replace or reconnect control cable. (Refer to Flaps section.)
Flaps not synchronized or fail to move evenly when retracted.	Incorrect rigging of system.	Adjust flaps as described in Flaps section.

CHART 2702. CABLE TENSION VS. AMBIENT TEMPERATURE



—NOTE—

Cable rigging tensions specified must be corrected to ambient temperature in the area where the tension is being checked, using Chart 2702.

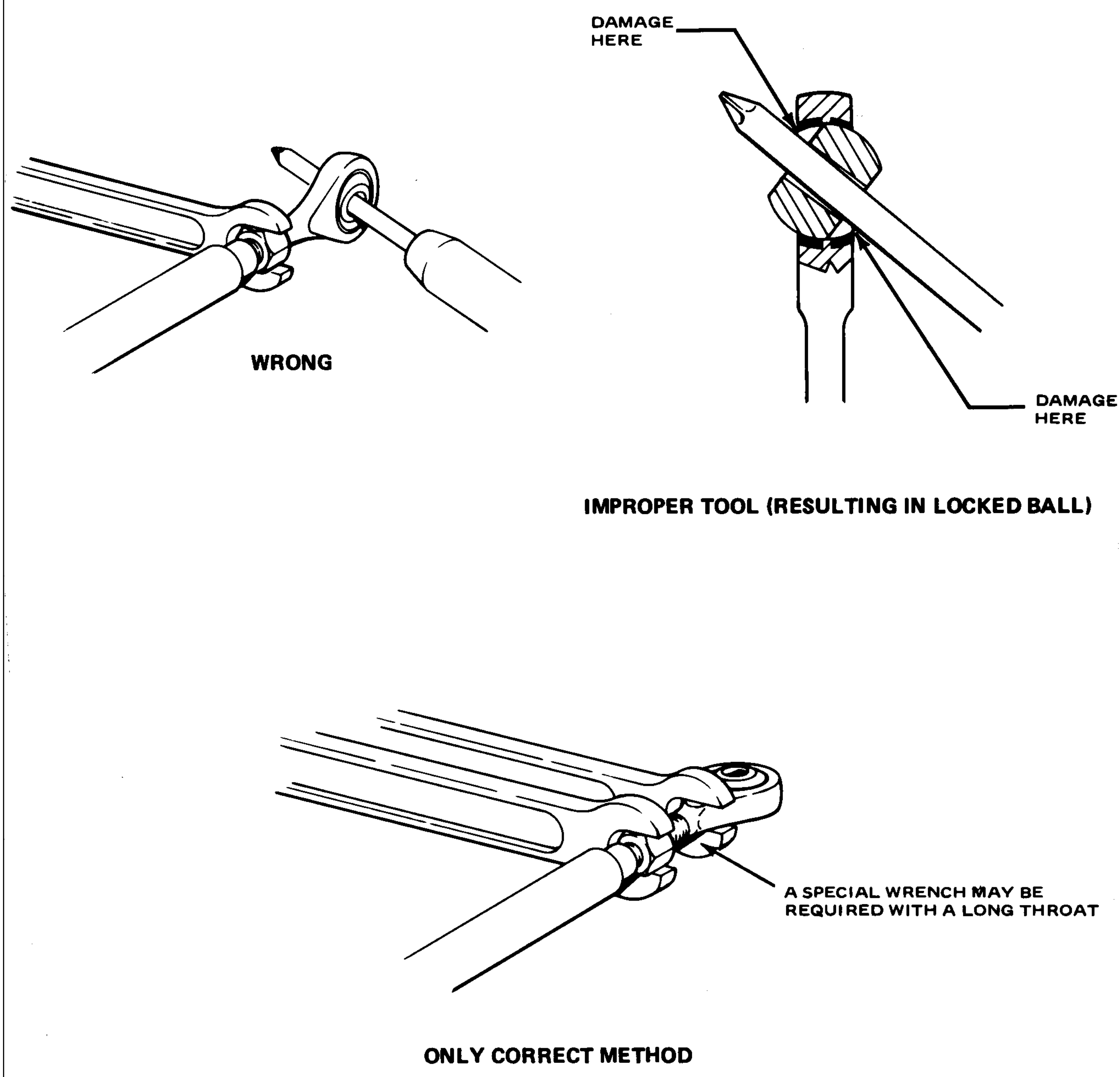


Figure 27-1. Correct Method of Installing Rod End Bearings

STANDARD PROCEDURES.

The following tips may be helpful in the removal, installation and rigging of the various assemblies:

1. It is recommended, though not always necessary to level and place the airplane on jacks during rigging and adjustment.
2. Remove turnbuckle barrels from cable ends before withdrawing the cables through the structures
3. Tie a cord to the cable end before withdrawing the cable through the structures to facilitate reinstallation of cable.
4. Turnbuckle stations are given at their neutral positions.
5. When referring to marking cable end, etc., before disconnecting a felt marking pen may be used.
6. Assemble and adjust the turnbuckles so that each terminal is screwed an approximately equal distance into the barrel. Do not turn the terminals in such a manner that will put a permanent “twist” into the cables.
7. Cable tensions should be taken with the appropriate control surface in its neutral position.
8. After completion of each adjustment, check the turnbuckles to be sure not more than three terminal threads are visible outside the barrel. Install the locking clips, and check for proper installation by turning to remove the clips using fingers only. Both locking clips may be installed in opposite holes. Locking clips which have been installed and removed must be scrapped and not reused.
9. When push rods or rod ends are provided with an inspection hole, the screw must be screwed in far enough to pass the inspection hole. This can be determined visually or by feel inserting a piece of wire into the inspection hole. If no hole is provided, there must be a minimum of .375 of an inch thread engagement.
10. After completion of adjustments, each jam nut must be tightened securely. Make sure they are installed as shown in Figure 27-1.

—NOTE—

Cable rigging tensions specified must be corrected to ambient temperature in the area where the tension is being checked, using Chart 2702. Cable tensions given apply only to airplanes without Autopilot bridle cables attached. Refer to appropriate Autopilot Service Manual for proper cable tensions when attaching bridle cables.

CONTROL COLUMN ASSEMBLY.

REMOVAL OF CONTROL COLUMN ASSEMBLY. (Refer to Figure 27-2.)

1. To remove either control wheel with tube, the following procedure may be used:
   A. Separate the control wheel tube from the flexible joint that is located on either side of the tee bar assembly by removing the nut, washer and bolt. Pull the tube from the flexible joint.
   B. If removing the left control tube, slide the stop from the tube.
   C. Should wires for the various Autopilot systems be installed in the control tube, disconnect them at the quick disconnect terminals behind the instrument panel. Draw the wires back into the tube and out through the forward end of the tube.
   D. Remove the control wheel assembly from the instrument panel.
2. The tee bar with assembled parts may be removed from the airplane by the following procedure:
   A. Remove the access panel to the aft section of the fuselage.
   B. Relieve cable tension from the stabilator control cables at one of the stabilator cable turnbuckles in the aft section of the fuselage.

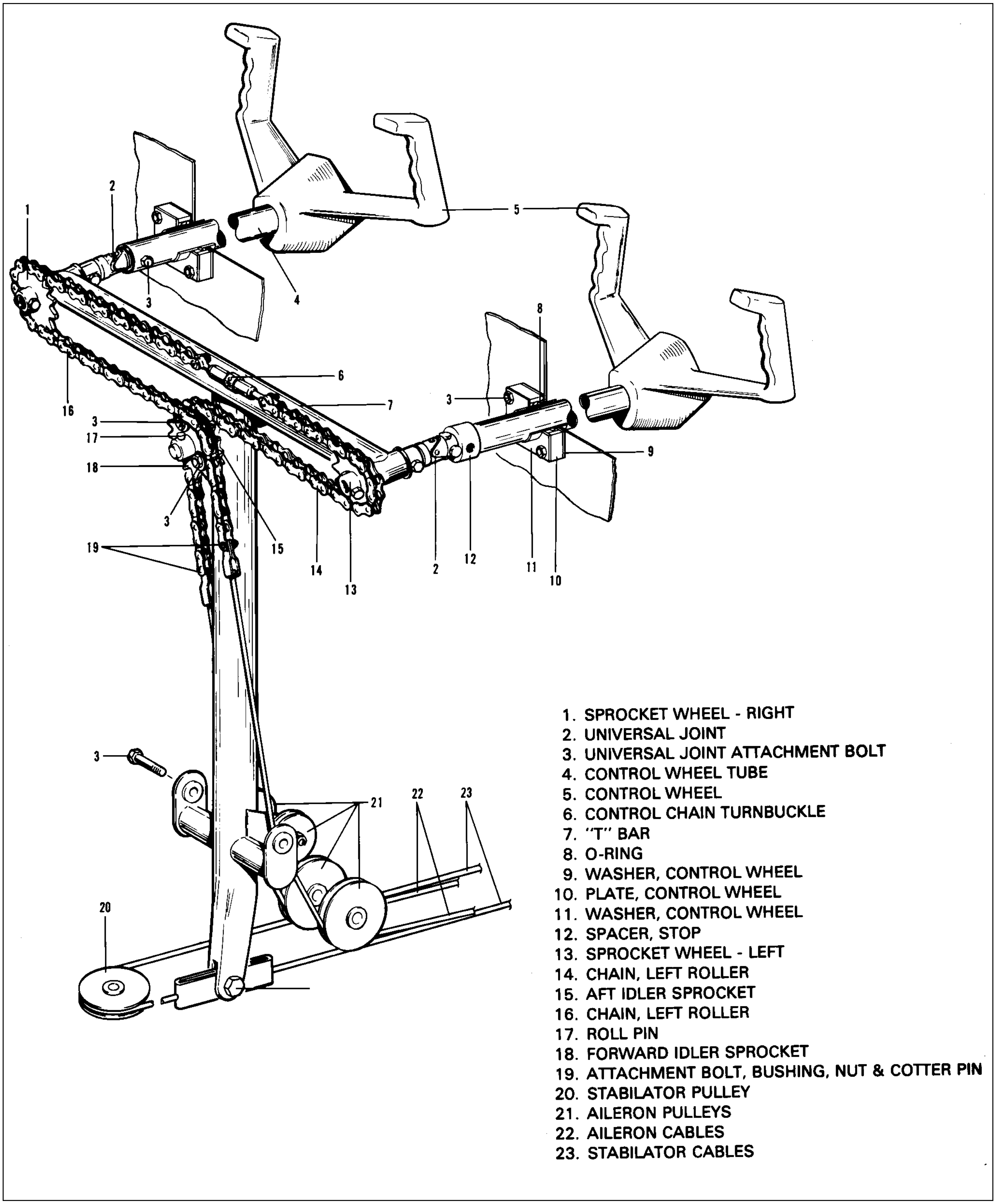


Figure 27-2. Control Column Assembly

C. Relieve tension from the aileron control cables and chains and at the turnbuckle that connects the chains at the top of the tee bar.
D. Disconnect the control chains from the control cables where the chains and cables join by removing the cotter pins, nuts, bolts and bushings.
E. Remove the tunnel cover by removing the rudder trim control knob and trim control knob and trim cover attaching screws. Roll back the carpet from the tunnel and remove the tunnel plate that is located just aft of the tee bar assembly, by removing the plate attaching screws.
F. Remove the two aileron control cable pulleys attached to the lower section of the tee bar by removing the pulley attaching bolt.
G. Disconnect the stabilator controls by removing nut, bolt, washers and cotter pin from the end of the tee bar assembly.
H. Disconnect the necessary controls, such as the mixture control, throttle control, etc., that will allow the tee bar assembly to be removed.
I. Remove the tee bar assembly by removing the attaching bolts with washers and nuts, which are through each side of the floor tunnel, and lifting it up and out through the right side of the cabin.

INSTALLATION OF CONTROL COLUMN ASSEMBLY. (Refer to Figure 27-2.)

1. The tee bar assembly may be installed in the airplane by the following procedure:
   A. Swing the tee bar assembly into place from the right side of the cabin and secure with attaching bolts, washers and nuts inserted in through each side of the floor tunnel.
   B. Place link assembly end into the lower end of the tee bar assembly and secure with bolts, washer, nut and cotter pin.
   C. Place the aileron control cables around the pulleys that attach to the lower section of the tee bar, position pulleys and secure with bolt, washers and nut.
   D. Install the control wheel per Step 2.
   E. Place the control wheels in neutral (centered) position and install the aileron control chains on the control wheel sprockets and idler cross-over sprockets. This turnbuckle must be centered between the two control wheel sprockets.
   F. Loosen the connecting bolts of the idler sprockets to allow the chain to fit snug around the control wheel sprockets and over the idler sprockets.
   G. Connect the aileron control cables to the ends of the chains with bolts, bushings, nuts and cotter pins.

—NOTE—

Cable tensions given apply only to airplanes without Autopilot bridle cables attached. Refer to appropriate Autopilot Service Manual for proper cable tensions when attaching bridle cables. Cable rigging tensions specified must be corrected to ambient temperature in the area where the tension is being checked using Chart 2702.

   H. Adjust the chain turnbuckle between the two control wheel sprockets to allow the control wheels to be neutral and obtain proper cable tensions as given in Figure 27-5. It may be necessary, in order to have both control wheels neutral, to set the chain turnbuckle to neutralize the wheels and then set cable tension with the turnbuckles located under the floor panel aft of the main spar as instructed in the Aileron Controls section. Before safetying the turnbuckle, check that when the ailerons are neutral, the control wheels will be neutral and the chain turnbuckle centered. Also, the aileron bellcranks should contact their stops before the control wheel hits its stop. Maintain .030 to .040 clearance between sprocket pin and adjustable stop bolts on tee bar.

I. Set stabilator cable tension with the turnbuckle in the aft section of the fuselage and instructions given in the Stabilator Controls section. Check safety of all turnbuckles upon completion of adjustments.

J. Tighten the connecting bolts of the idler sprockets.

K. Install the floor tunnel plate trim covers by placing the tunnel plate into position for installation and secure with the appropriate screws. Roll the carpet into place and install the rudder trim cover and knob.

2. Either control wheel assembly may be installed by the following procedure:
   A. Insert the control wheel tube through the instrument panel.
   B. Should wires for the various Autopilot systems need to be installed in the control tube, route them through the hole in the forward side of the tube and out of the small hole in the forward side. Position the rudder grommet in the hole in the side of the tube.
   C. On the left control tube install the stop.
   D. Connect the control wheel tube to the flexible joint of the tee bar assembly. If the control cables and/ or chains have not been removed or loosened, place the ailerons in neutral and install the control tube on the flexible joint to allow the control wheel to be neutral. Install bolt, washer and nut and tighten.

AILERON CONTROLS.

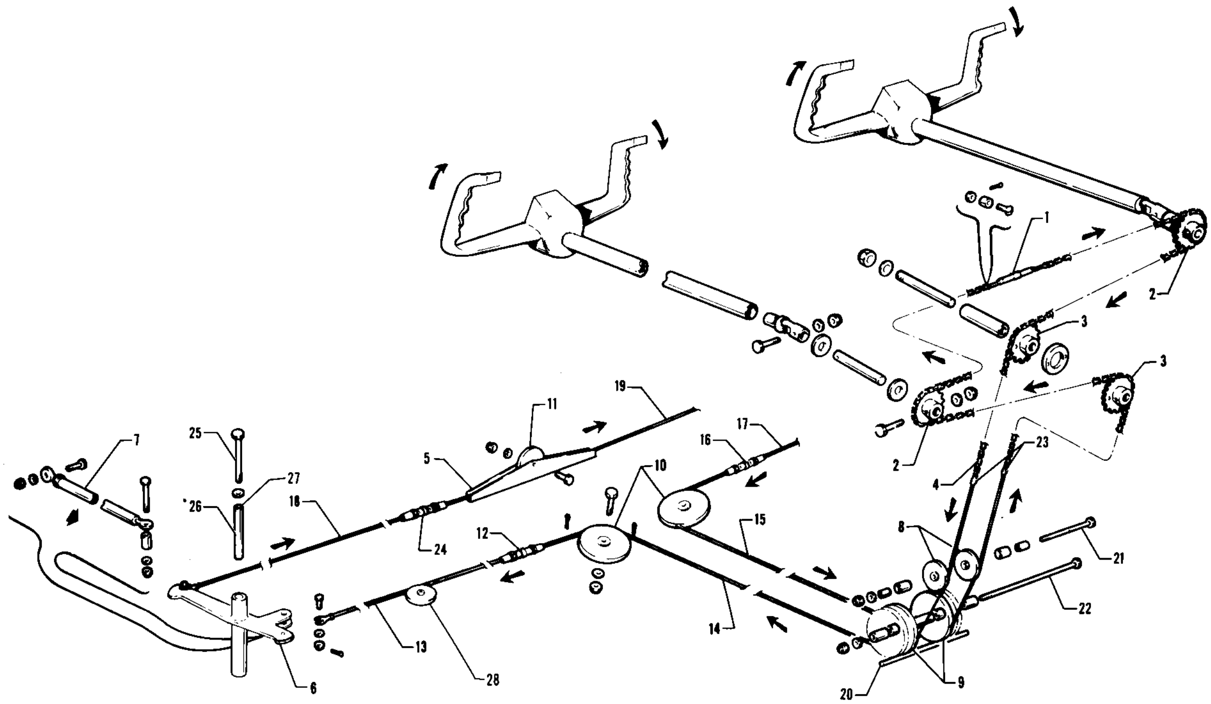
REMOVAL OF AILERON CONTROL CABLES. (Refer to Figure 27-3.)

l. For the removal of either the control cables in the fuselage or the wings, first remove the rear seat floor panel.
2. To remove either the right or left primary control cables that are located in the fuselage, the following procedure may be used:
   A. Remove the two front seats from the airplane.
   B. Remove the tunnel cover located aft of the tee bar assembly by removing the rudder trim control knob and trim cover attaching screws. Roll back the carpet from the tunnel and remove the tunnel plate that is located just aft of the tee bar assembly by removing the plate attaching screws.

—NOTE—

To help facilitate reinstallation of control cables, mark the cable ends and attach a line where applicable before drawing them through the fuselage or wing.

   C. Separate the primary control cable at the turnbuckle located under the rear seat or floor panel aft of the main spar.
   D. Remove the cable pulleys attached to the lower section of the control column tee bar assembly by removing the pulley attaching bolt.
   E. Move the cable guard under the pulley cluster located just aft of the lower portion of the tee bar by removing the cotter pin from the exposed end of the guard and sliding it to the left or right as required.
   F. Remove the cotter pins used as cable guards at the pulley in the forward area of the floor opening aft of the main spar.
   G. Disconnect the cable from the control chain at the control column tee bar assembly by removing the cotter pin, nut, bolt and bushing that connect the two together. Secure the chains in some manner to prevent them from unwrapping from around the sprockets.
   H. Draw the cable back through the floor tunnel.



1. TURNBUCKLE, CONTROL CHAINS
2. SPROCKET CONTROL WHEEL
3. SPROCKET, IDLER
4. CHAIN, AILERON CONTROL
5. BRACKET, PULLEY
6. BELLCRANK, AILERON
7. ROD, AILERON CONTROL
8. PULLEY, TEE BAR
9. PULLEY, FORWARD CLUSTER
10. PULLEY, PRIMARY CONTROL CABLE
11. PULLEY, BALANCE CABLE
12. TURNBUCKLE, RIGHT PRIMARY
13. CABLE, RIGHT WING PRIMARY
14. CABLE, RIGHT FUSELAGE PRIMARY
15. CABLE, LEFT FUSELAGE PRIMARY
16. TURNBUCKLE, LEFT PRIMARY
17. CABLE, LEFT WING PRIMARY
18. CABLE, RIGHT BALANCE
19. CABLE, LEFT BALANCE
20. ROD, CABLE GUARD
21. BOLT, WASHER & NUT
22. BOLT, WASHER & NUT
23. BOLT, NUT, BUSHING & COTTER PIN
24. TURNBUCKLE, BALANCE CABLE
25. BOLT, BELLCRANK PIVOT
26. BUSHING, BELLCRANK
27. TUBE, TEFLON
28. PULLEY, LEFT & RIGHT

Figure 27-3. Aileron Controls (Typical)

3. The primary control cable in either wing may be removed by the following procedure:
   A. Remove the access plate to the aileron bellcrank located on the underside of the wing forward of the center of the aileron.
   B. If not previously disconnected, separate the cable at the turnbuckle located in the area aft of the main spar.
   C. Disconnect the cable from the forward end of the aileron bellcrank by removing the cotter pin, nut, washer and bolt.
   D. Remove cable guard from pulley.
   E. Draw the cable from the wing.
4. Either balance cable may be removed by the following procedure:
   A. Separate the balance cable at the turnbuckle in the right side of the opening aft of the main spar.
   B. If the left balance cable is to be removed, remove the cotter pin used as a cable guard at the pulley in the center of the opening.
   C. Remove the access plate to the aileron bellcrank located on the underside of the wing forward of the center of the aileron.
   D. Disconnect the cable from the aft end of the aileron bellcrank by removing the cotter pin, nut, washer and bolt.
   E. Draw the cable from the wing.

INSTALLATION OF AILERON CONTROL CABLES. (Refer to Figure 27-3.)

—NOTE—

Cable tensions given apply only to airplanes without Autopilot bridle cables attached. Refer to appropriate Autopilot Service Manual for proper cable tensions when attaching bridle cables. Cable rigging tensions specified must be corrected to ambient temperature in the area where the tension is being checked using Chart 2702.

1. The installation of either the right or left primary control cable that is located in the fuselage may be accomplished as follows:
   A. Draw the cable through the fuselage floor tunnel.
   B. Connect the cable to the end of the control chain and secure using bushings, bolt, nut and cotter pin.
   C. Place the cable around the pulley that is located in the tunnel aft of the tee bar. Install the cable guard and secure with a cotter pin.
   D. Position cables and install the cable pulleys that attach to the lower section of the tee bar assembly. Secure with bolt, washer and nut.
   E. Place the cable around the pulley that is located within access opening just aft of the main spar and install cotter pin cable guards.
   F. If the primary control cable in the wing is installed, connect the control cable ends at the turnbuckle located within access opening just aft of the main spar.
   G. Check rigging and adjustment per instructions in this section.
   H. Install the floor tunnel plate trim covers by placing the tunnel plate into position for installation and secure with the attachment screws. Roll the carpet into place and install the rudder trim cover and knob.

2. The primary control cable in either wing may be installed by the following procedure:
   A. Draw the control cable into the wing.
   B. Connect the cable to the forward end of the aileron bellcrank using a bolt, washer, nut and cotter pin. Allow the cable end to rotate freely on the bellcrank.
   C. If the primary control cable in the fuselage is installed, connect the ends at the turnbuckle (12 or 16) located under the rear seat aft of the main spar.
   D. Install cable guard on pulley.
   E. Check rigging and adjustment per instructions in this section.
   F. Install the access plate on the underside of the wing.
3. Either balance cable may be installed by the following procedure:
   A. Draw the cable into the wing.
   B. Connect the cable to the aft end of the aileron bellcrank using a bolt, washer, nut and cotter pin. Allow the cable end to rotate freely on the bellcrank.
   C. Connect the balance cable ends at the turnbuckle that is located under the rear seat aft of the main spar.
   D. If the left cable was removed, install the cotter pin cable guard at the pulley located within the fuselage, aft of the main spar.
   E. Check rigging and adjustment per instructions in this section.
   F. Install the access plate on the underside of the wing.
4. Replace the rear seat floor panel and seats.

REMOVAL OF AILERON BELLCRANK ASSEMBLY. (Refer to Figure 27-3.)

1. Remove the rear seats and rear seats floor panel.
2. Remove the access plate to the aileron bellcrank located on the underside of the wing, forward of the center of the aileron.
3. Relieve tension from the aileron control cables by loosening the balance cable turnbuckle located in the opening aft of the main spar.
4. Disconnect the primary and balance control cables from the bellcrank assembly by removing cotter pins, nuts, washers and bolts.
5. Disconnect the aileron control rod at the aft or forward end, as desired, by removing the nut, washer and bolt.
6. Remove the nut, pivot bolt and washers that secure the bellcrank. The nut is visible from the underside of the wing.
7. Remove the bellcrank from within the wing.

INSTALLATION OF AILERON BELLCRANK ASSEMBLY. (Refer to Figure 27-4.)

1. Ascertain that the bellcrank pivot bushing and teflon tube are installed in the torque tube portion of the bellcrank.
2. Place the bellcrank in position in the wing with a washer located between each end of the torque tube and the mounting location.
3. Install the bellcrank pivot bolt with the head up. Install a washer and nut on the bolt, and torque nut within 20 to 25 inch-pounds. Check that the bellcrank rotates freely with little up-down play.
4. Install and adjust control rod and check aileron travel per Figure 27-5.
5. Connect the ends of the primary and balance control cables to the bellcrank using bolts, washers, nuts and cotter pins. Allow the cable ends to rotate freely on the bellcrank.
6. Tighten the control cables at the balance cable turnbuckle in the floor opening aft of the main spar. Check cable tension per Figure 27-5.
7. Install the access plate on the underside of the wing and replace the floor panel.

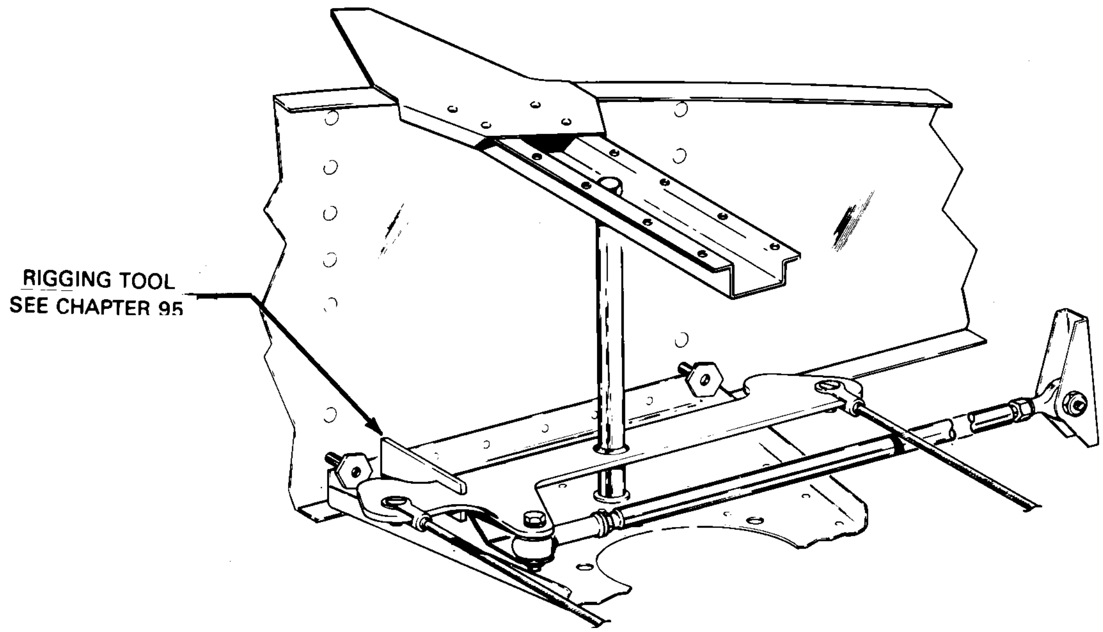


Figure 27-4. Bellcrank Rigging Tool Installed

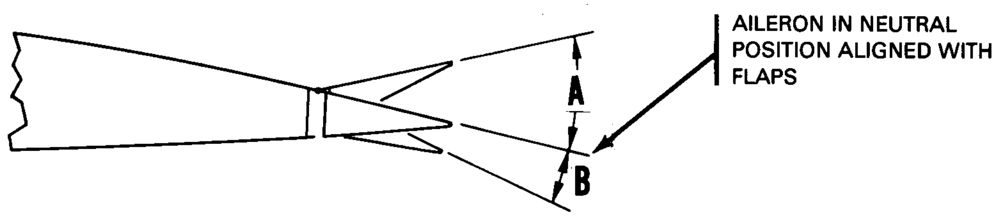
RIGGING AND ADJUSTMENT OF AILERON CONTROLS. (Refer to Figure 27-4.)

—NOTE—

Flap adjustment must be complete before starting aileron adjustment.

1. Move the tee bar to its full forward position and maintain this position throughout the rigging procedure, by use of a suitable tool or by placing weights on the aft side of the stabilator if stabilator control cable have been previously tensioned.
2. To check and adjust the rigging of the aileron controls, first set the right and left aileron bellcranks at neutral position. (Ascertain that the control chains have been rigged as described in the Installation of Control Column Assembly.) This may be accomplished by the following procedure:
   A. Remove the access plate to each aileron bellcrank located on the underside of the wing, forward of the center of the aileron by removing the plate attaching screws.
   B. Affix a bellcrank rigging tool, as shown in Figure 27-4, between the forward arm of each bellcrank and the adjacent rib. (This tool may be fabricated from dimensions given in Chapter 95.) The slotted end of the tool fits on the arm forward of and adjacent to the primary control cable end. The other end of the tool is positioned so that the side of the tool contacts the aft side of the bellcrank stop. The bellcrank must be moved to allow a snug fit of the tool between the bellcrank arm and rib. To do so, it may be necessary to loosen a primary control cable or the balance cable. Neutral position of the bellcranks is the position at which the forward and aft cable connection holes are an equal distance from the adjacent outboard wing rib.

3. With each bellcrank set at neutral, the ailerons may be checked and adjusted for neutral as follows:
   A. Ascertain that the bellcrank rigging tool fits snug between the bellcrank and the rib.
   B. Place an aileron rigging tool as shown in Figure 27-6 against the underside of the wing and aileron as close as possible to the inboard end of the aileron without contacting any rivets. The tool must be positioned paralleled with the wing ribs, with the aft end of the tool, even with the trailing edge of the aileron. (This tool may be fabricated from dimensions given in Chapter 95.)
   C. With the aileron control rod connected between the bellcrank and aileron, check that the surface of the wing contacts the tool at its forward surface and at the spacer, and the trailing edge of the flap contacts the aft end of the tool. The aileron is neutral at this position.
   D. Should the three points not contact, loosen the jam nut at the aft end of the control rod and rotate the rod until the three points contact. Apply a slight up pressure against the trailing edge of the aileron while making this adjustment. After adjustment, retighten the jam nut.
4. Adjust primary and balance cable tension as given in Figure 27-5 by the following procedure:
   A. Remove the rear seat floor panel to facilitate the necessary operation.
   B. Loosen the connecting bolts of the idler cross-over sprockets at the control tee bar to allow the chain to fit snug around the control wheel sprockets and over the idler sprockets.
   C. Ascertain that both bellcranks are at neutral position.
   D. Adjust the turnbuckles, located in the access opening just aft of the main spar, of the primary and balance cables to their proper cable tension and maintain neutral-center position of the control wheels. To obtain neutral position of both control wheels, it may also be necessary to adjust the roller chain turnbuckle located between the control wheel sprockets. During adjustment, obtain a little more tension on the primary control cables to hold the bellcranks in neutral against the rigging tools, finishing with even tension on all cables. Primary cable tension may be slightly more than balance cable tension, but should be within the specified tension.
   E. Check to insure that the left aileron up and right aileron down steps are contacted simultaneously and vice versa.
   F. Tighten the bolts to secure the idler cross-over sprockets.
   G. Remove the aileron bellcrank rigging tool from each wing.
5. Check the ailerons for correct travel from neutral per dimensions given in Figure 27-5, by the following procedure:
   A. Center the bubble of a protractor over the surface of an aileron at neutral position and note the reading.
   B. Move the aileron full up and down, and check the degree of travel for each direction. The degree of travel on the protractor is determined by taking the difference between the protractor reading at neutral and up, and neutral and down. The bubble must be centered at each reading. When measuring up travel, maintain a light down pressure (at up position only) on center of aft edge of the aileron. When measuring down travel, maintain a light up pressure on the center of the aft edge of the aileron. Use only enough pressure to remove any slack between the bellcrank and aileron.
   C. Should the travel not be correct, the travel may be set by rotating the bellcrank stops in or out. Stops are located in the wing attached to the rib that is adjacent to the aileron bellcrank.
   D. Repeat this procedure for the other aileron.
6. Check the bellcrank stops to assure that the bellcrank contact is made simultaneously, but still have cushion before contacting the control wheel stops. Maintain .030 to .040 clearance between sprocket pin and adjustable stop bolts on models having adjustable tee bar stops.
7. Check complete system for operation and safety of turnbuckles, bolts, etc.
8. Install access plates and panels.



AILERON

A: 25° ±2° UP

B: 12.5° ±2° DOWN

CABLE TENSION 40 ±5 LBS.

1. Flap Adjustment must be complete before starting aileron adjustment.
2. Maximum free play for aileron is 0.24 of an inch, measured at trailing edge.

Figure 27-5. Aileron Rigging

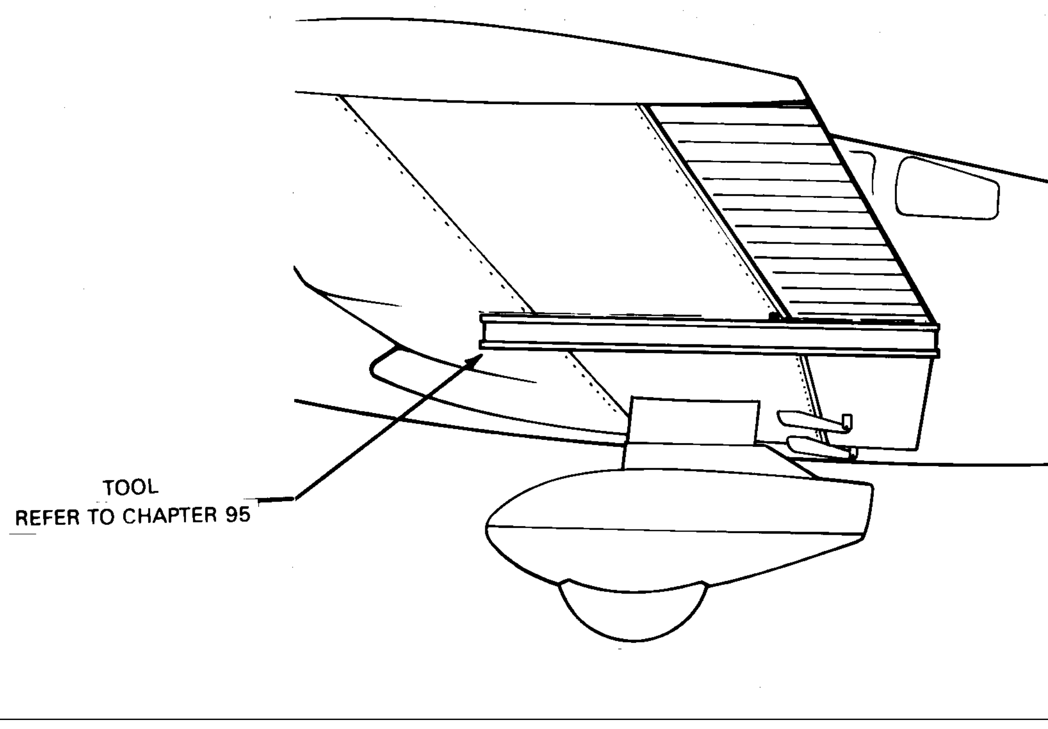
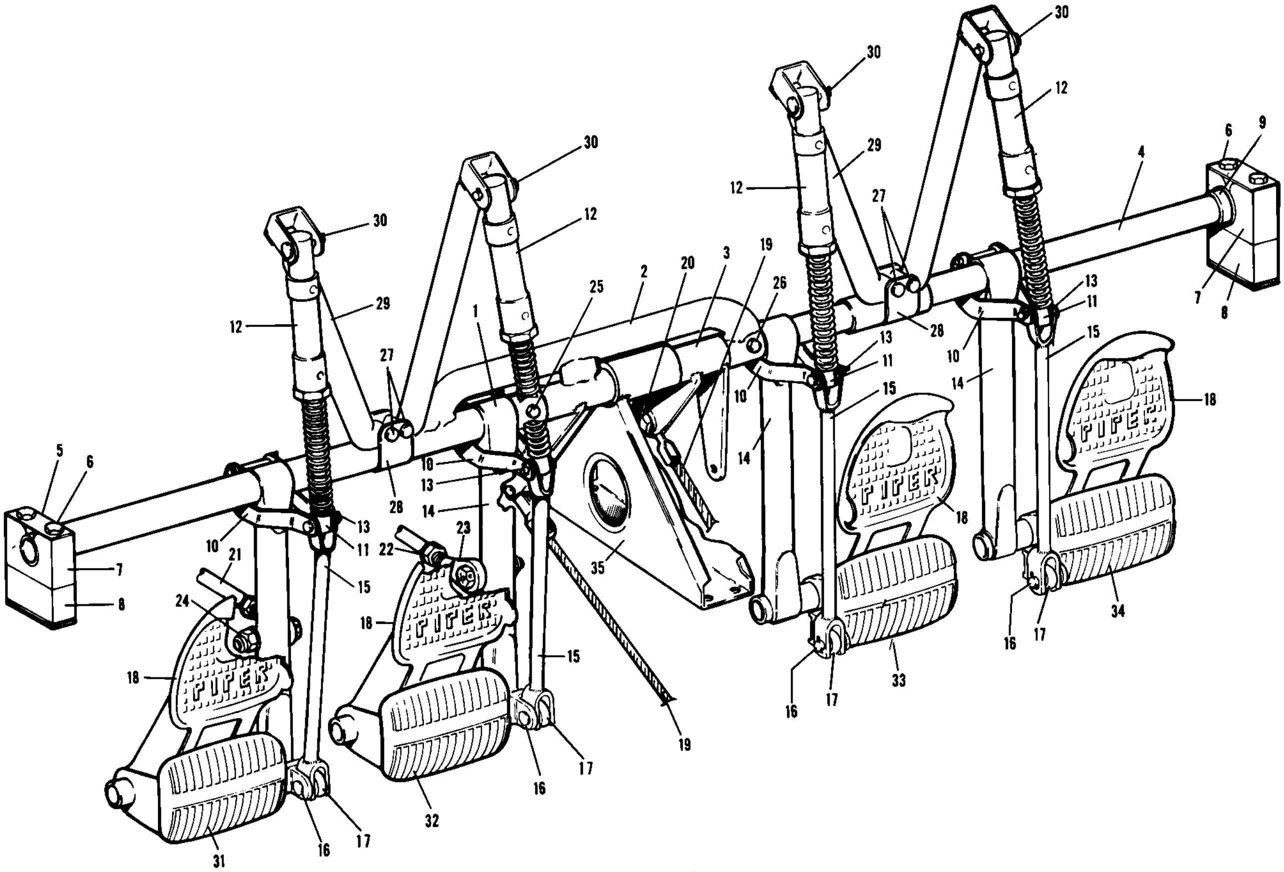


Figure 27-6. Aileron Rigging Tool (In Use)



1. TUBE, L. OUTER
2. TUBE, L. CENTER
3. TUBE, R. CENTER
4. TUBE, R. OUTER
5. PLATE
6. BOLT & NUT
7. SUPPORT BLOCK, UPPER
8. SUPPORT BLOCK, LOWER
9. WASHER, SPACER
10. ARM, IDLER
11. ROD, BRAKE CYLINDER
12. BRAKE CYLINDER
13. CLEVIS PIN & COTTER PIN
14. TUBE, RUDDER CONTROL
15. CLEVIS ROD
16. CLEVIS PIN & COTTER PIN
17. CLEVIS END
18. TOE BRAKE PEDAL
19. CONTROL CABLE, RUDDER
20. BOLT, WASHER, NUT & COTTER PIN
21. BUNGEE, NOSE WHEEL STEERING
22. JAM NUT
23. ROD END, BUNGEE
24. BOLT & NUT
25. BOLT, WASHER & NUT
26. BOLT, WASHER & NUT
27. BOLT, WASHER & NUT
28. BRACKET
29. VEE BRACE
30. CLEVIS PIN & COTTER PIN
31. RUDDER PEDAL, L. OUTER
32. RUDDER PEDAL, L. INNER
33. RUDDER PEDAL, R. INNER
34. RUDDER PEDAL, R. OUTER
35. BRACKET, TUBE SUPPORT

Figure 27-7. Rudder and Steering Pedal Assembly

RUDDER CONTROLS.

REMOVAL OF RUDDER PEDAL ASSEMBLY. (Refer to Figure 27-7.)

1. Remove the access panel to the aft section of the fuselage.
2. Relieve rudder and stabilator cable tension by loosening one of the rudder and stabilator cable turnbuckles in the aft section of the fuselage.
3. Remove the tunnel plate located just aft of the tee bar assembly by removing the rudder trim control knob, trim cover attaching screws and trim cover. Roll back the carpet from the tunnel and remove the tunnel plate that is located just aft of the tee bar assembly by removing the plate attaching screws.
4. Disconnect the stabilator control cable from the lower end of the tee bar assembly.
5. Remove the tee bar attaching bolts with their washers and nuts which are through each side of the floor tunnel. Pull the lower end of the bee bar aft.
6. Disconnect the control cable ends from the arms on the torque tube by removing the cotter pins, washers, nuts and bolts.
7. Disconnect the rudder trim from the torque tube assembly by removing the cotter pin, washers and bolt that connects the arm to the trim. Remove the cotter pin and clevis pin from the rudder trim mechanism and remove the mechanism from the mounting channel. Remove the screw from the engine control bracket assembly and swing it out of the way. Disconnect the alternate air cable and move aside.
8. Disconnect the steering rods at the rudder by removing nuts and bolts.
9. Disconnect the brake cylinders at the lower end of each cylinder rod by removing the cotter pins, washers, nut and bolts.
10. Disconnect the vee brace(s) (two braces are used with right hand brakes) from the torque tube by removing nuts, washers and bolts that secure the strap bracket to the vee brace.
11. Disconnect the torque tube support bracket where it attaches by removing the two bolts attached to the box located beneath, and the four bolts attached to the forward bulkhead.
12. Remove the two bolts that extend through the torque tube and are located at the center of the tube assembly over the floor tunnel. Compress the tubes. Remove the left and right toe brake pedal assembly.
13. Disconnect the torque tube support blocks from their support brackets on each side of the fuselage by removing the attaching nuts, washers and bolts.
14. Remove the trim side panels, if desired.
15. Rotate the rudder pedal bar assembly toward the cabin door far enough to pull the right pedal bar out. Rotate the remaining assembly to the left and remove the assembly from the aircraft. Note the spacers and washers on each end and between the support blocks.

INSTALLATION OF RUDDER PEDAL ASSEMBLY. (Refer to Figure 27-7.)

1. Assemble the torque tube assembly as shown in Figure 27-7. Do not at this time install the two bolts through the center of the tube assembly.
2. Place the upper support blocks on the ends of the torque tube assembly. Note that a washer is required on each end of the tube.
3. Position the support blocks on their mounting brackets at each side of the fuselage and secure with bolts, washers and nuts. Note that a bushing is required in the bolt holes of the upper support block, a plate on top of the upper- blocks between the upper and lower blocks and under the block mounting bracket.
4. Align the bolt holes in the center area of the torque tube assembly, install bolts, washers and nuts and tighten.

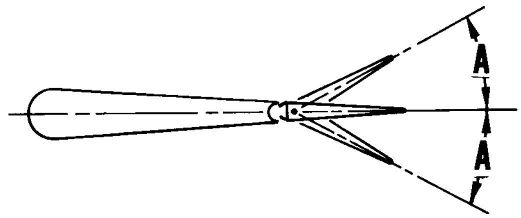
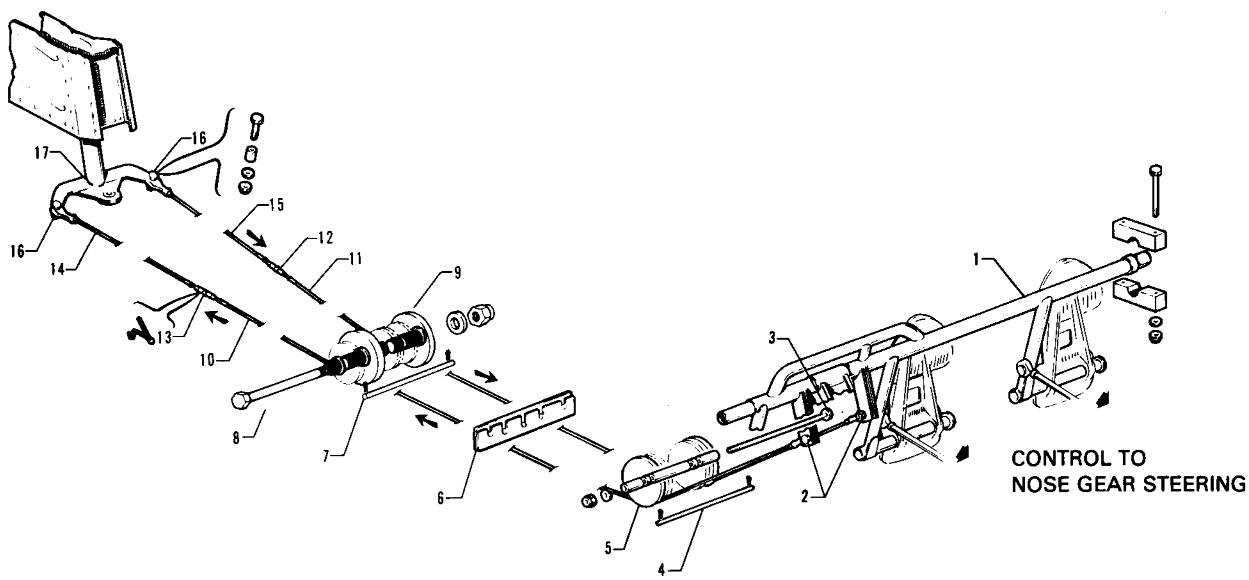


Figure 27-8. Rudder Rigging

5. Position the torque tube support bracket on the floor tunnel and secure with bolts.
6. Position the vee brace(s) on the torque tube, install the strap bracket around the torque tube and brace and secure with bolts, washers and nuts.
7. Check that the rod end on the clevis rod is adjusted to give a dimension of 7.94 inches between hole centers.
8. Connect the ends of the brake cylinder rods and clevis rods to the idler arms and secure with clevis and cotter pins.
9. Connect the steering rods to the rudder pedals and secure with bolts and nuts. Check steering rod adjustment per Alignment of Nose Gear, Chapter 32.
10. Connect the rudder trim to the arm of the torque tube and secure with bolt, washer, nut and cotter pin. A thin washer is installed under the nut which is tightened only finger tight.
11. Connect the ends of the rudder control cables to the arms provided on the torque tube and secure with bolts, washers, nuts and cotter pins. Allow the ends free to rotate.
12. Swing the tee bar into place and secure with attachment bolts, washers and nuts. Insert bolts through each side of the floor tunnel. (See Figure 27-2.)
13. Connect the stabilator control cables to the lower end of the tee bar with bolt, washer and nut, and secure with cotter pin. (See Figure 27-2.) Allow the cable ends to rotate freely.
14. Set rudder cable tension and check rigging and adjustment per Figure 27-8.
15. Set stabilator cable tension and check rigging and adjustment per Figure 27-14.
16. Check aileron cable tension.
17. Check safety of bolt and turnbuckles.
18. Install the floor tunnel plate and secure with screws. Fasten the tunnel carpet in place.
19. Install the rudder trim cover and control knob.
20. Install the access to the aft section of the fuselage.



1. RUDDER & STEERING PEDAL ASSY.
2. BOLT, WASHER, NUT & COTTER PIN
3. BOLT, BUSHINGS, WASHER & NUT
4. GUARD PIN, CABLE
5. PULLEY CLUSTER
6. RUB BLOCKS
7. GUARD PIN, CABLE
8. BOLT, BUSHINGS, WASHER & NUT
9. PULLEY CLUSTER
10. CABLE, RIGHT FORWARD
11. CABLE, LEFT FORWARD
12. TURNBUCKLE, LEFT
13. TURNBUCKLE, RIGHT
14. CABLE, RIGHT AFT
15. CABLE, LEFT AFT
16. BOLT, BUSHING, WASHER & NUT
17. HORN, RUDDER

Figure 27-9. Rudder Controls

REMOVAL OF RUDDER CABLES. (Refer to Figure 27-9.)

1. To remove either the forward or aft rudder cables, first remove the access panel to the aft section of the fuselage.
2. Disconnect the desired cable at the turnbuckle in the aft section of the fuselage.
3. Either forward rudder cable may be removed by the following procedure:
   A. Remove the rear seat floor panel and the front seats.
   B. Remove the cable guard pin from the underside of the pulley cluster that is located in the aft area of the flap torque tube.
   C. From within the area aft of the main spar, remove the cable rub blocks that are attached to the spar housing by removing the block attaching screws.
   D. Remove the rudder trim knob and the cover attaching screws.
   E. Remove the tunnel plate just aft of the tee bar by removing enough carpet from the tunnel to allow the plate attaching screws and the plate to be removed.
   F. Move the cable guard pin located under the pulley cluster just aft of the tee bar by removing the cotter pin from the exposed end and sliding it to the left or right, as required.
   G. Disconnect the end of the cable from the arm on the rudder pedal torque tube by removing the cotter pin, nut, washer and bolt.
   H. Draw the cable from the floor tunnel.
4. The aft rudder control cables may be removed by the following procedure:
   A. Remove the tail cone fairing by removing its attaching screws.
   B. Disconnect the cable from the rudder horn by removing cotter pin, nut, washer and bolt.
   C. Draw the cable through the fuselage.

INSTALLATION OF RUDDER CABLES. (Refer to Figure 27-9.)

1. The forward rudder control cables may be installed by the following procedure:
   A. Draw the control cable through the floor tunnel.
   B. Connect the end of the cable to the arm on the rudder pedal torque tube by installing bolt, washer, nut and cotter pin. Allow the cable end free to rotate on the arm.
   C. Connect the cable to the aft control cable at the turnbuckle in the aft section of the fuselage. If the aft control cables are not installed, install at this time per Step 2. Ascertain that each cable is in the groove of its pulley.
   D. Move the cable guard into position, that is located in the forward area of the tunnel, under the pulley cluster and secure with cotter pin.
   E. Within the area aft of the main spar, install the cable guard blocks onto the spar housing and secure with screws.
   E. Install the cable guard under the pulley cluster located just aft of the flap torque tube.
   G. Set cable tension and check rigging and adjustment as described in the next paragraph.
   H. Install the forward tunnel plate aft of the tee bar and secure with screws.
   1. Put the floor carpet in place and secure.
   J. Install the lower and upper selector covers and secure with screws.
   K. Install the rear seat or floor panel and install the seats.

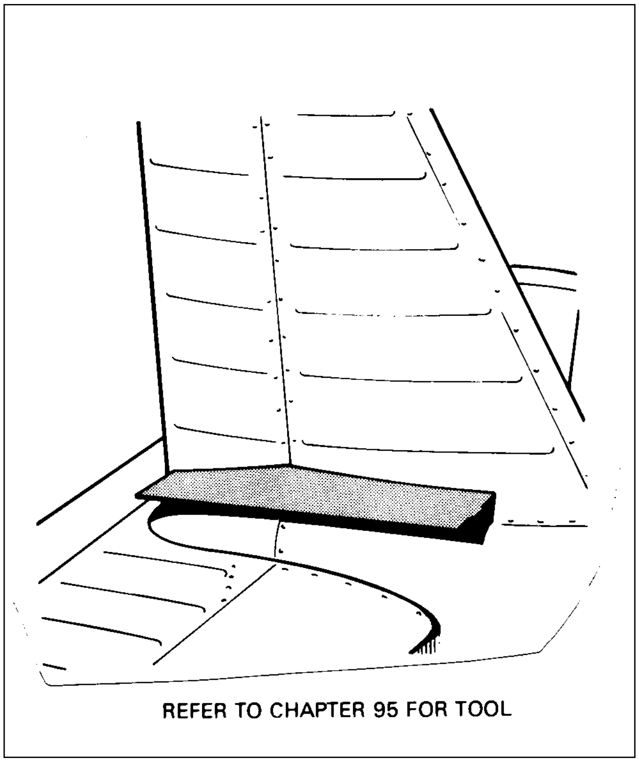


Figure 27-10. Utilization of Rudder Rigging Tool

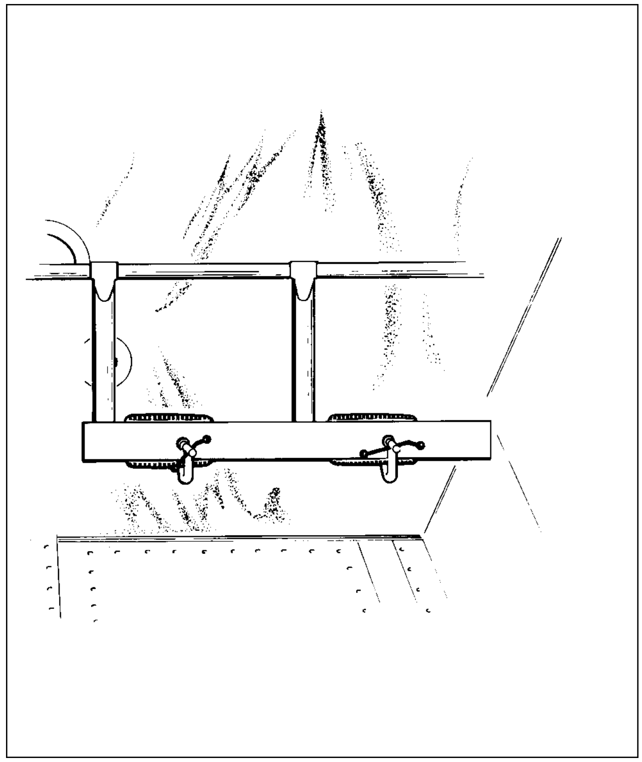


Figure 27-11. Clamping Rudder Pedals

2. The aft rudder control cables may be installed by the following procedure:
   A. Position the control cable in the fuselage.
   B. Connect the end of the cable to the rudder horn with bolt, washer, nut and cotter pin. Allow the cable end free to rotate.
   C. Connect the other cable end to forward control cable at the turnbuckle in the aft section of the fuselage.
   D. Set cable tension and check rigging and adjustment as described in the next paragraph.
   E. Install tail cone fairing and secure with screws.
3. Install the access panel to the aft section of the fuselage.

RIGGING AND ADJUSTMENT OF RUDDER CONTROLS.

1. To check and set the correct degree of rudder travel, the following procedure may be used:
   A. Check the rudder travel by swinging the rudder until it contacts its stop. If the control cables are connected, use the rudder pedals to swing the rudder.
   B. With the rudder against its stop, place a rigging tool against the side of the rudder and vertical stabilizer as shown in Figure 27-10. (Ascertain that the tool is not contacting any rivets.) If no gap exists between the rigging tool and the surface of the rudder and vertical stabilizer, the rudder stop for one direction of travel is correct as required in Figure 27-8 . (This tool may be fabricated from dimensions given in Chapter 95.)
   C. Swing the rudder in the other direction and check travel as directed in Step B.
   D. Should the rudder travel be incorrect showing a gap between the tool and any part of the control surfaces, the tail cone fairing should be removed and the stops reset to obtain correct rudder travel. (Refer to Figure 27-12.)

2. To set cable tension and alignment of the rudder, the following procedure may be used:
   A. Remove the access panel to the aft section of the fuselage.
   B. Ascertain that the nose gear steering has been aligned and rudder pedals set fore and aft according to Alignment of Nose Landing Gear, Chapter 32, Figure 32-7.
   C. Clamp the rudder pedals to align in a lateral position as shown in Figure 27-11.
   D. Adjust the turnbuckles in the aft section of the fuselage to obtain proper cable tension as given in Figure 27-8 and to allow the rudder to align at neutral position. Adjust the cables evenly to avoid uneven strain on aircraft components. Neutral position can be determined by standing behind the airplane and sighting the rudder with the vertical stabilizer or the center of the trim screw.
   E. Check safety of turnbuckles.
3. Install the tail cone fairing and the access panel to the aft section of the fuselage.

RUDDER TRIM CONTROLS.

REMOVAL OF RUDDER TRIM CONTROLS. (Refer to Figure 27-13.)

1. Remove the cover from over the trim control assembly by removing attaching screws.
2. Remove the rudder trim knob and the cover attaching screws.
3. Rotate the trim knob to the extreme left (counterclockwise) trim position.
4. Disconnect the housing lug from the arm on the rudder pedal torque tube by removing cotter pin, nut, washer and bolt.
5. Remove the threaded bushing from the aft end of the mounting channel by removing cotter pin and clevis pin. Some mounting channels have two holes in the aft end, note from which hole in the clevis pin was removed.
6. The mounting channel may be removed by removing the channel attaching screws at the inside of the channel.

INSTALLATION OF RUDDER TRIM CONTROLS. (Refer to Figure 27-13.)

Install the rudder trim mechanism and set it at the neutral (no load on spring) position. Perform the procedure only after all other rudder and nose wheel rigging is complete.

1. Install the trim control mounting channel on the upper side of the floor tunnel. A spacer plate on some models is installed between the channel and the tunnel. Install the attaching screws which are secured with anchor nuts.
2. Before attaching the assembly to the mounting channel, ascertain that the clips are installed so the safety wire will be on top. Also, that the threaded bushing is installed on the assembly shaft with the welded attachment bushing forward or toward the housing.
3. Attach the housing lug to the arm provided on the rudder pedal torque tube and secure with bolt, washer and nut. Tighten the nut only finger tight and safety with cotter pin.
4. Clamp the rudder pedals in neutral and position the threaded bushing in the mounting channel. Turn the control shaft until the holes in the bushing and channel align and then install the clevis pin and cotter pin. Should two thru holes be located in the aft end of the mounting channel, the pin must be installed through the hole that will give equal travel and hit rudder stops before bottoming out of the trim assembly.
5. With the rudder pedals neutral and no pressure fore or aft on the clevis pin, install the assembly cover so that the indicator washer and the neutral mark on the cover align.
6. Install the trim cover, secure with screws, and install the trim control knob.

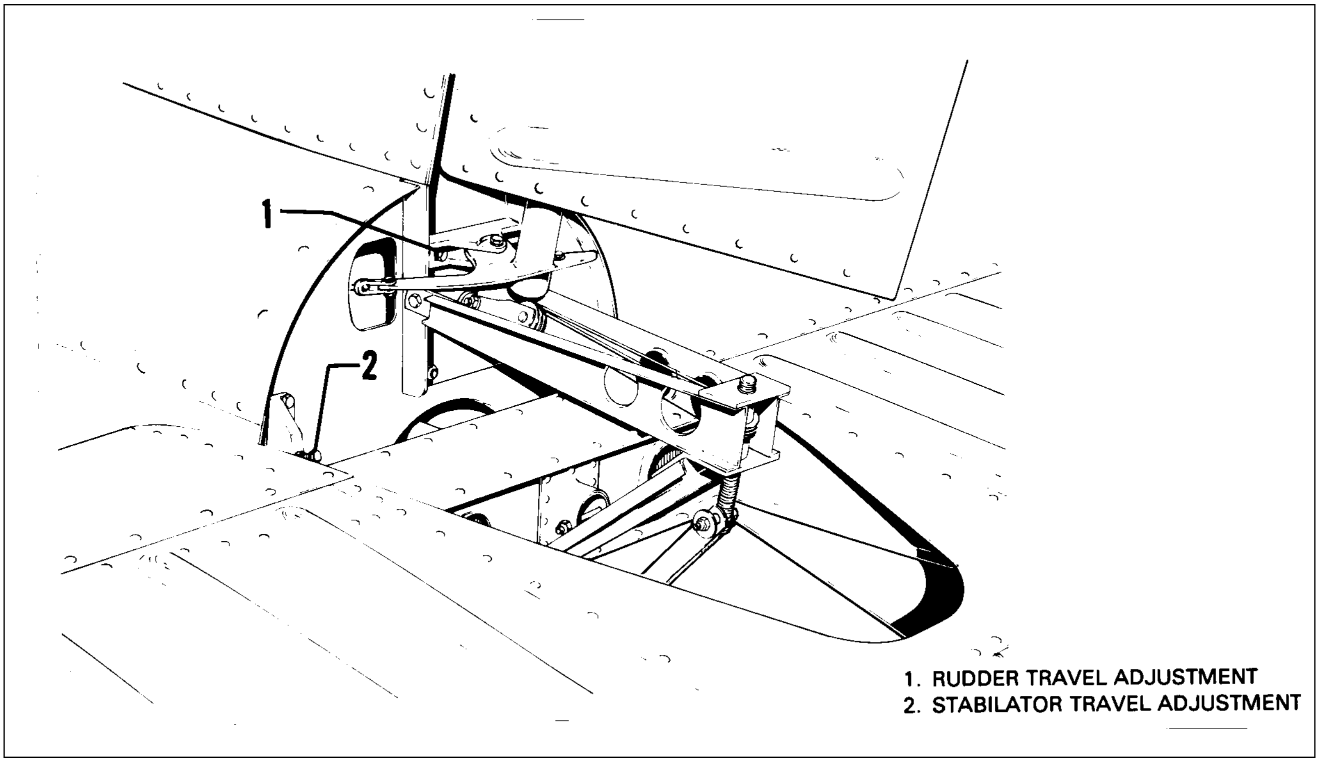


Figure 27-12. Rudder and Stabilator Travel Adjustments

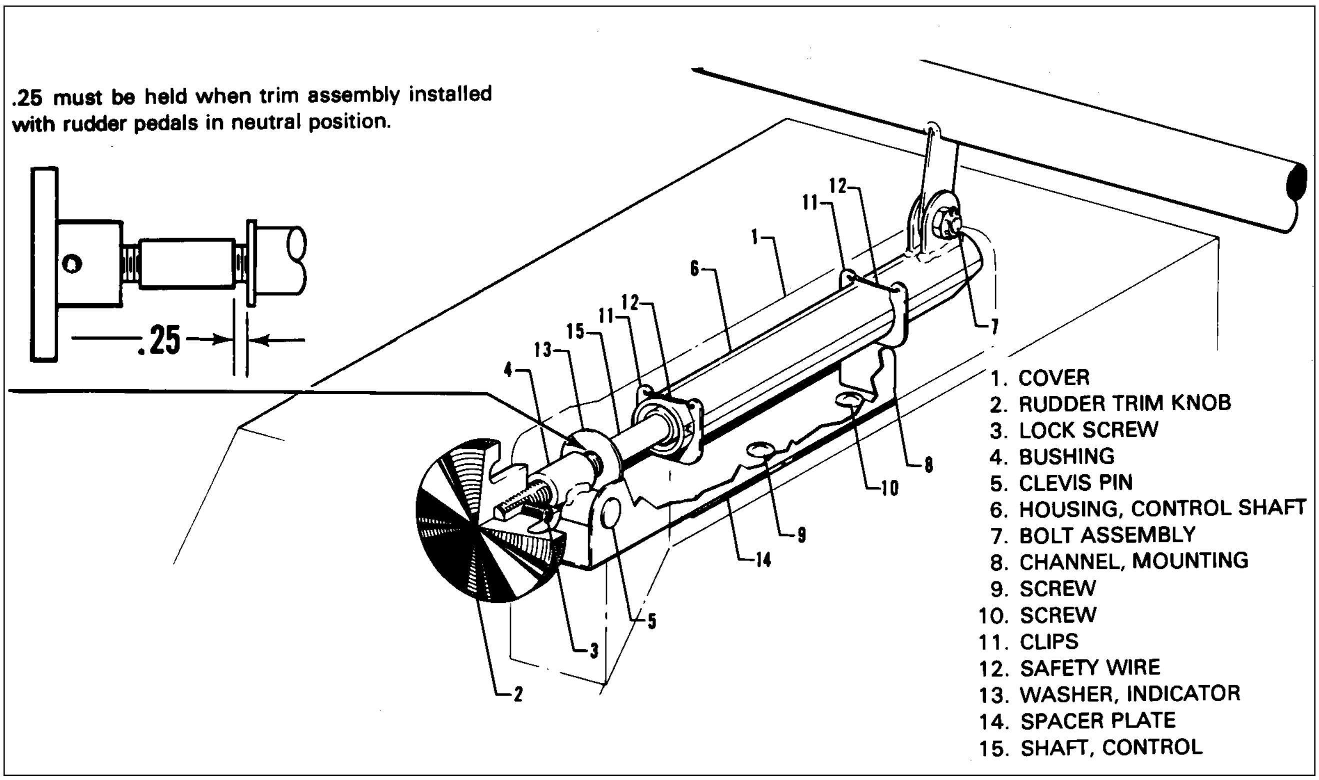


Figure 27-13. Rudder Trim Control

RIGGING AND ADJUSTMENT OF RUDDER TRIM CONTROLS.

Perform these procedures only after all other rudder and nose wheel rigging is complete. No adjustments are necessary other than those required during installation of the assembly in the airplane as given in the previous paragraph.

STABILATOR CONTROLS.

REMOVAL OF STABILATOR CONTROL CABLES. (Refer to Figure 27-15.)

1. To remove either the forward or aft stabilator cables, first remove the access panel to the aft section of the fuselage located in the baggage compartment, the two front seats, and the rear seats floor panel.
2. Disconnect the desired control cable at the turnbuckle in the aft section of the fuselage.
3. Either forward stabilator cable may be removed by the following procedure:
   A. Remove the tunnel carpet and cover plate by removing the rudder trim control knob and trim cover attaching screws. Roll back the carpet from the tunnel and remove the tunnel plate that is located just aft of the tee bar assembly by removing the plate attaching screws.
   B. Remove stabilator control cables by first removing the cotter pin guards at the pulleys located in the forward area of the tunnel.
   C. Disconnect the cables from the arm assembly by removing the cotter pin, nut, washer and bolt.
   D. Within the access opening aft of the main spar, remove the cable rub blocks that are attached to the spar housing by removing the block attaching screws.
   E. Remove the cotter pin cable guard at the pulley cluster located in the aft area the access opening aft of the main spar.

—NOTE—

To facilitate in the installation of control cables, a line may be attached to the cable end prior to removal.

   F. Draw the cables aft through the floor tunnel.
4. Either aft stabilator control cable may be removed by the following procedure:
   A. Disconnect the cable end at the balance arm of the stabilator by removing the cotter pin, nut, washer and bolt.
   B. Remove the cotter pin cable guard at the pulley located either above or below the balance arm.
   C. Remove the cable from the airplane.

INSTALLATION OF STABILATOR CONTROL CABLES. (Refer to Figure 27-15.)

—NOTE—

Cable tensions given apply only to airplanes without Autopilot bridle cables attached. Refer to appropriate Autopilot Service Manual for proper cable tensions when attaching bridle cables. Cable rigging tensions specified must be corrected to ambient temperature in the area where the tension is being checked using Chart 2702.

STABILATOR

A - STABILATOR TRAILING EDGE UP TRAVEL FROM NEUTRAL 16° ± 1°

B - STABILATOR TRAILING EDGE DOWN TRAVEL FROM NEUTRAL 2° ± 1°

CABLE TENSION 40 ± 5 LBS.

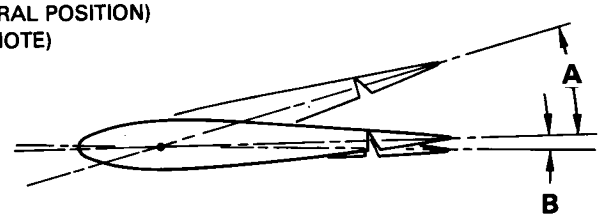
STABILATOR TRIM TAB

A - STABILATOR TAB TRAILING EDGE UP TRAVEL FROM NEUTRAL 3° ± 1°

B - STABILATOR TAB TRAILING EDGE DOWN TRAVEL FROM NEUTRAL 12° ± 1°

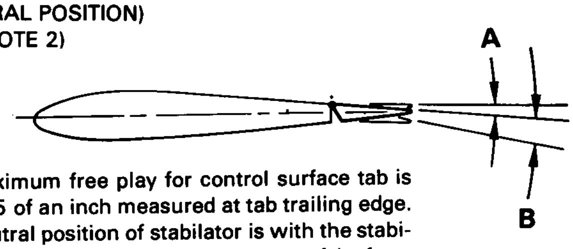
CABLE TENSION 10 ± 1 LBS.

STABILATOR CHORD LINE
(NEUTRAL POSITION)
(SEE NOTE)



Neutral position of stabilator is with the stabilator chord line parallel with the top of the front seat tracks.

STABILATOR CHORD LINE
(NEUTRAL POSITION)
(SEE NOTE 2)



1. Maximum free play for control surface tab is 0.15 of an inch measured at tab trailing edge.
2. Neutral position of stabilator is with the stabilator chord line parallel with the top of the front seat tracks.

Figure 27-14 Stabilator and Tab Rigging

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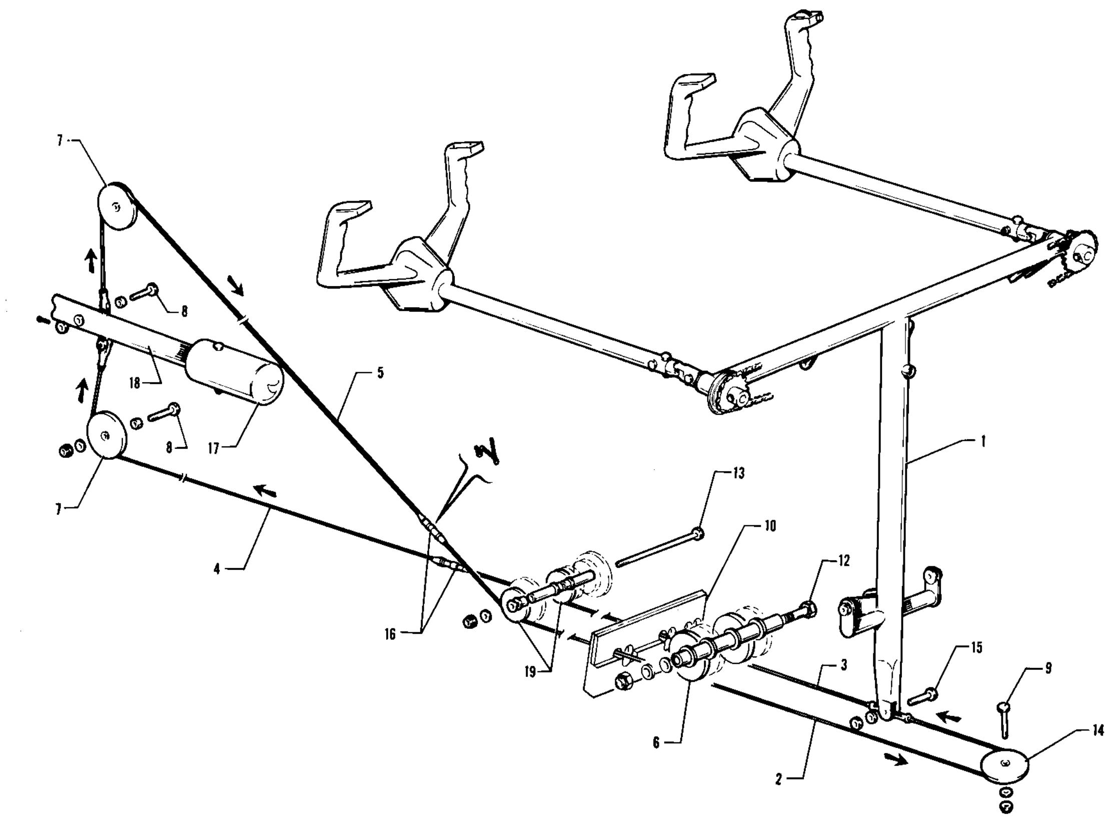


1. TEE BAR, CONTROL COLUMN
2. CABLE, RIGHT FORWARD
3. CABLE, LEFT FORWARD
4. CABLE, LEFT-LOWER AFT
5. CABLE, RIGHT-UPPER AFT
6. PULLEY, FORWARD CLUSTER
7. PULLEY, AFT
8. BOLT, WASHER, NUT & COTTER PIN
9. BOLT, WASHER & NUT
10. BLOCK, CABLE RUB
11. GUARD, CABLE
12. BOLT, WASHER & NUT
13. BOLT, WASHER & NUT
14. PULLEYS, FORWARD
15. BOLT, WASHER, NUT & COTTER PIN
16. TURNBUCKLE
17. WEIGHT, BALANCE ARM
18. BALANCE ARM, STABILATOR
19. PULLEYS

Figure 27- 15. Stabilator Controls

1. The forward stabilator cables may be installed by the following procedure:
   A. Draw the control cable through the floor tunnel. Ascertain that the right (upper) cable is routed around the pulleys in the forward area of the floor tunnel.
   B. Position the stabilator cables into the arm assembly along with the link assembly. (Refer to Figure 27-15, View A for correct positioning of components.) Secure the complete installation with bolt, washers, nut and cotter pin. Ascertain that no binding or excessive end play is evident in the hookup.
   C. If the aft control cable is not installed, install per Step 2.
   D. Connect the control cable to the aft cable at the turnbuckle in the aft section of the fuselage.
   E. For the right control cable, install the cotter pin cable guards at the pulley(s) in the forward area of the tunnel.
   F. Within the access opening aft of the main spar, install the cable rub blocks to the spar housing and secure with screws.
   G. In the access opening, install the cotter pin cable guard at the pulley cluster.
   H. Set cable tension and check rigging and adjustment as described in the next paragraph.
   I. Install the floor tunnel plate and trim covers by placing the tunnel plate into position for installation and secure with the attaching screws. Roll the carpet into place and install the rudder trim cover and knob.
   J. Install the front seats and rear seat floor panel.
2. Either aft stabilator control cable may be installed by the following procedure:
   A. Route the cable around its pulley located either over or under the balance arm of the stabilator.
   B. Connect the cable to the stabilator balance arm and secure with bolt, washer, nut and cotter pin. (Insure bushing is installed with bolt.)
   C. Connect the cable to the forward cable at the turnbuckle in the aft section of the fuselage. The upper aft cable connect to the right forward cable and the lower cable to the left cable.
   D. Install the cotter pin cable guard at the pulley, where required.
   E. Set cable tension and check rigging and adjustment as described in the following paragraphs.
   F. Install the seats and access panels.

RIGGING AND ADJUSTMENT OF STABILATOR CONTROLS.

1. Level the airplane. (Refer to Leveling, Chapter 8.)
2. To check and set the correct degree of stabilator travel, the following procedure may be used:
   A. Check the stabilator travel by placing a rigging tool on the upper surface of the stabilator as shown in Figure 27-18. (This tool may be fabricated from dimensions given in Chapter 95.)
   B. Set on a bubble protractor the number of degree up travel as given in Figure 27- 14 and place it on the rigging tool. Raise the trailing edge of the stabilator and determine that when the stabilator contacts its stops, the bubble of the protractor is centered.

—NOTE—

The stabilator should contact both of its stops before the control wheel contacts its stops.

   C. Set on the protractor the number of degrees down travel as given in Figure 27-14 and again place it on the rigging tool. Lower the trailing edge of the stabilator and determine that when it contacts its stops, the bubble of the protractor is centered.
   D. Should the stabilator travel be incorrect in either the up or down position, remove the tail cone fairing by removing the attaching screws and with the use of the rigging tool and bubble protractor turn the stops located at each stabilator hinge in or out. (Refer to Figure 27-12) to obtain the correct degree of travel.
   E. Ascertain that the lock nuts of the stop screws are secure and reinstall the tail cone fairing.

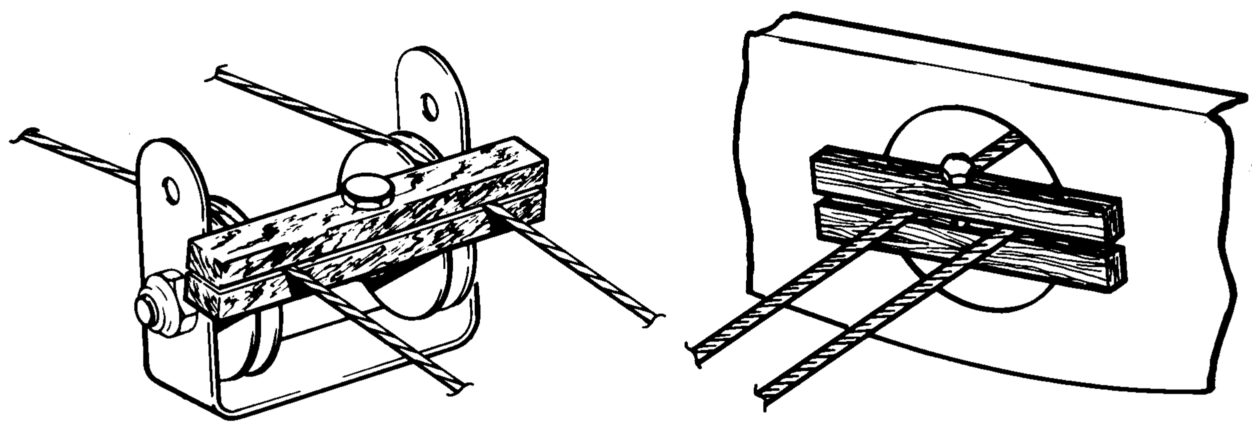


Figure 27-16. Methods of Securing Trim Cables

3. To check and set stabilator control cable tension, the following procedure may be used:
   A. Ascertain that the stabilator travel is correct.
   B. Remove the access panel to the aft section of the fuselage.
   C. Secure the control column in the near forward position. Allow 0.25 + 0.12 - 0.03 inch between the column and the stop bumper.
   D. Check each control cable for the correct tension as given in Figure 27-14.
   E. Should tension be incorrect, loosen the turnbuckle of the lower cable in the aft section of the fuselage and adjust the turnbuckle of the upper cable to obtain correct tension. Cable tension should be obtained with the control wheel at the 0.25 + 0.12 - 0.03 inch dimension from the stop and the stabilator contacting its stop.
   F. Check safety of all turnbuckles and bolts.
   G. With the tension of the upper cable correct and the control wheel still forward, adjust the turnbuckle of the lower cable to obtain correct tension.
   H. Check the full travel of the control wheel with relation to the full travel of the stabilator to determine that the stabilator contacts its stops before the control wheel contacts its stops. With the control wheel in the fore and aft positions. the travel distance from the point where the stabilator contacts its stops and the control wheel contacts its stops should be approximately equal. Readjust turnbuckles if incorrect.
   I. Reinstall access panels.
4. Remove the airplane from jacks.

STABILATOR TRIM CONTROLS.

REMOVAL OF STABILATOR TRIM ASSEMBLY. (Forward) (Refer to Figure 27-17.)

1. To remove the trim control wheel assembly and/or the trim control cables, first remove the panel to the aft section of the airplane.
2. If the aft trim cable is not to be removed, block the cables at the pulleys in the upper aft section of the fuselage to prevent them from unwrapping from the trim drum. (Refer to Figure 27-16.)
3. Loosen the cables if the trim control wheel is to be removed or disconnect if the cables are also to be removed. Do this at the trim cable turnbuckles in the aft section of the fuselage.
4. The control wheel with drum may be removed by the following procedure:
   A. Remove the control wheel cover by removing the cover attaching screws.
   B. The wheel assembly may be removed from its mounting brackets by removing nut, washer and bolt that secures the wheel between the brackets. Draw the wheel from the brackets. Use caution not to damage trim indicator wire.
   C. Unwrap the left cable from the drum.
   D. The wheel and drum are joined by a push fit, separate these two items with their center bushing and unwrap the right cable.
   E. Tie the cables forward to prevent them from slipping back into the floor tunnel.
5. The trim control cables may be removed by the following procedure:
   A. Remove the rear seat and the front seats, if desired.
   B. Unfasten the carpet from the aft portion of the floor tunnel and lay it forward.
   C. Remove the tunnel cover located between the trim control wheel and the spar cover by removing attaching screws.
   D. Remove the cable pulleys located in the tunnel by removing the cotter pin, washer and clevis pin.
   E. Remove the cable rub blocks located on the aft side of the main spar by removing the block attaching screws.
   F. Remove the cable guard pin at the pulley cluster located just aft of the wing flap torque tube at station 127.25.
   G. If installed, remove the cable pulleys within the aft section of the fuselage at station 156.5 by removing nut. washer, bushing and bolt.
   H. With the cables disconnected from the trim control wheel, draw the cable(s) through the floor tunnel.

INSTALLATION OF STABILATOR TRIM ASSEMBLY. (Forward) (Refer to Figure 27-17.)

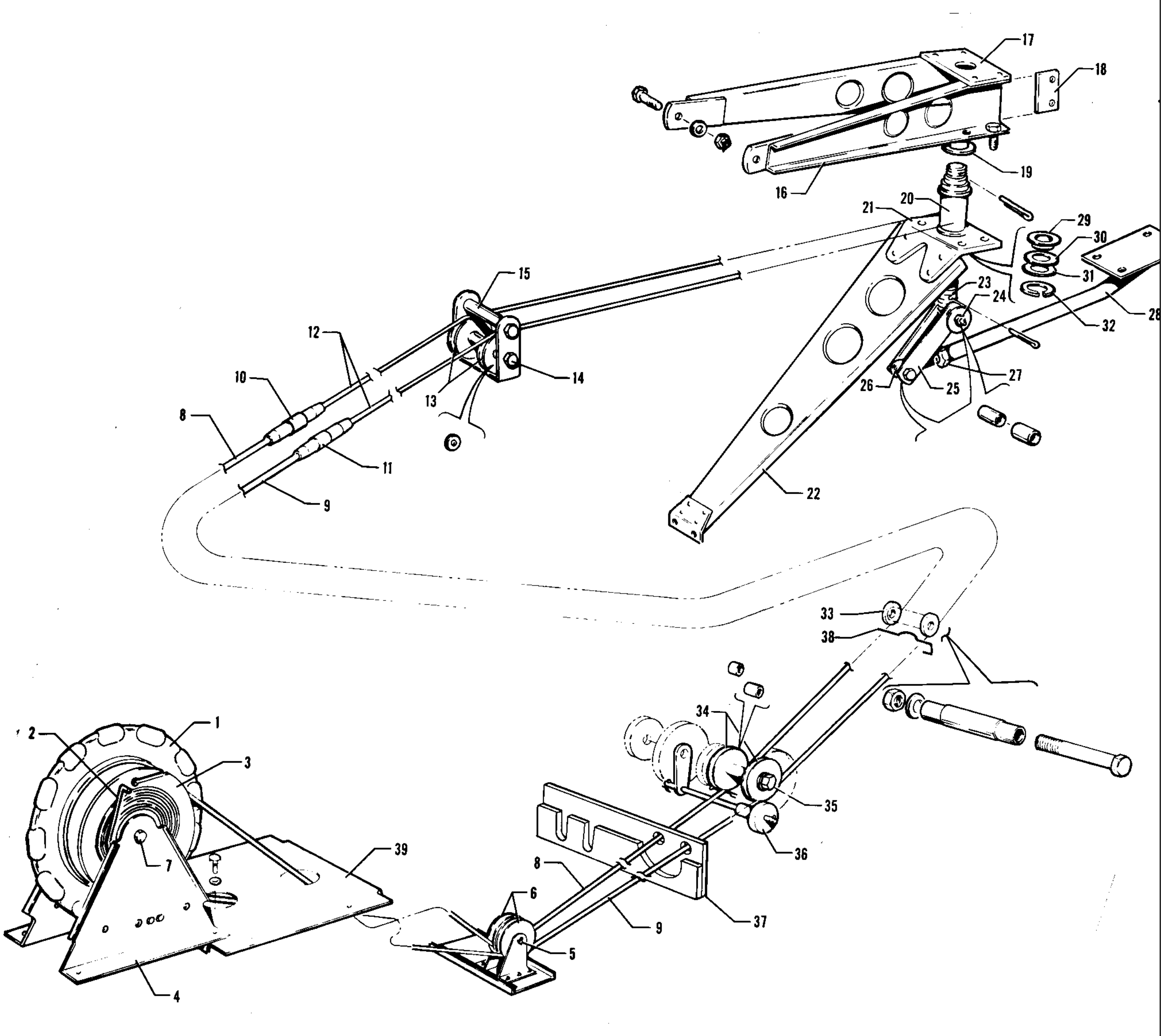
1. The trim control wheel with drum may be installed by the following procedure:
   A. Wrap the right trim cable on the trim drum by inserting the swaged ball of the cable in the slot provided in the side (right side) of the drum that mates with the control wheel, and looking at this side, wrap the drum with three wraps of the cable in a clockwise direction.
   B. Attach the control wheel to the cable drum by aligning the long lug of the drum with the long slot of the wheel and pushing the two pieces together.
   C. Wrap the left trim cable on the drum by inserting the swaged ball of the cable in the slot provided in the flanged side (left side) of the drum and looking at this side, wrap the drum with three wraps of the cable in a clockwise direction.
   D. Lubricate and install the bushing in the control wheel and drum.

E. Align the control cables and position the control wheel assembly between its mounting brackets. Ascertain that the end of the trim indicator wire is positioned in the spiraled slot of the drum with no bind on the end. Install the retainer bolt from the left side and install washer and nut.
F. Install the cover over the control wheel and secure with screws, unless the control cables have yet to be installed.

2. The trim control cables may be installed by the following procedure:
   A. Draw the cable(s) through the floor tunnel.
   B. Wrap the cable drum and install the trim control wheel as given in Step l.
   C. Position the cable pulleys on their mounting bracket within the floor tunnel and install the clevis pin, washer and cotter pin.
   D. Connect the cable to the aft cable at the turnbuckle in the aft section of the fuselage. Install aft cable if not installed.
   E. If previously installed, install the pulleys in the aft lower section of the fuselage at station 156.5 forward of the cable turnbuckles.
   F. Install the cable guard at the underside of the pulleys located just aft of the flap torque tube at station 127.25 and secure.
   G. Install the cable rub blocks located on the aft side of the main spar housing and secure with screws.
   H. Remove the blocks that secure the aft trim cable and check that the cables are seated on their pulleys.
3. Set cable tension and check rigging and adjustment as described in this section. Check safety of all turnbuckles.
4. Install the tunnel cover on the tunnel and secure with screws.
5. Install the carpet over the floor tunnel.
6. Install the cover over the trim control wheel and secure with screws and special washers.
7. Install the floor panel and seat belt attachments aft of the main-spar and secure panel with screws.
8. Install the panel to the aft section of the airplane and the seats.

REMOVAL OF STABILATOR TRIM ASSEMBLY. (Aft) (Refer to Figure 27-17.)

1. Remove the access panel to the aft section of the fuselage.
2. Block the trim cables at the first set of pulleys forward of the cable turnbuckles in the aft section of the fuselage by a method shown in Figure 27-16.
3. Disconnect the cable at the turnbuckles in the aft section of the fuselage.
4. Remove the tail cone by removing its attaching screws.
5. Disconnect the link between the trim screw and the trim control arm by removing the nut, washer and bolt that connects the link to the screw.
6. Remove the cotter pin from the top of the screw, and turn the screw down and out of the barrel.
7. Remove the snap ring, washer and thrust washer from the bottom of the barrel.
8. Disconnect the diagonal rib from the horizontal rib that supports the trim assembly by removing the four attaching nuts, washers and bolts.
9. Draw the trim cable from the fuselage.



1. CONTROL WHEEL, TRIM
2. INDICATOR, TRIM POSITION
3. DRUM, TRIM CABLE
4. MOUNTING BRACKET
5. CLEVIS PIN, WASHER & COTTER PIN
6. PULLEY CLUSTER
7. BOLT, BUSHING, WASHER & NUT
8. CABLE, RIGHT FORWARD
9. CABLE, LEFT FORWARD
10. TURNBUCKLE, RIGHT
11. TURNBUCKLE, LEFT
12. CABLE, AFT
13. PULLEY CLUSTER
14. BOLT, BUSHING, WASHER (3) & NUT
15. GUARD - BOLT, BUSHING, WASHER & NUT
16. RIB, HORIZONTAL SUPPORT
17. PLATE, RIB
18. GUARD
19. BUSHING, BARREL
20. BARREL, TRIM
21. CLIP, DIAGONAL RIB
22. RIB, DIAGONAL SUPPORT
23. SCREW, TRIM
24. BOLT, WASHER (2) & NUT
25. LINK
26. ROD END
27. JAM NUT
28. ARM, TRIM CONTROL
29. BUSHING BARREL
30. WASHER, THRUST
31. WASHER, SPACER
32. SNAP RING
33. PULLEY CLUSTER
34. PULLEY CLUSTER
35. BOLT, WASHER & NUT
36. GUARD, CABLE
37. RUB BLOCK

Figure 27-17. Stabilator Trim Control

INSTALLATION OF STABILATOR TRIM ASSEMBLY. (Aft) (Refer to Figure 27-17.)

1. Wrap the trim barrel by first laying the center (as measured equally from each end to the center of the cable) of the trim cable in the slot of the barrel. Bring the upper cable through the diagonal slot in the flange at the upper end of the barrel and wrap down in a counterclockwise direction. Bring the lower cable through the diagonal slot in the lower end of the barrel and wrap in a clockwise direction. Wrap the cable as evenly as possible to obtain 23 wraps on the barrel as viewed from the side opposite the slot and with the cables extending out from the slotted side.
2. Block both cables by clamping them between two pieces of wood laid next to the wraps to prevent them from unwrapping.
3. Ascertain that the barrel bushings are installed in the rib plate and clip.
4. Lubricate the bushings and install the trim barrel in the bushings between the two support ribs. Attach the bottom diagonal rib to horizontal rib and secure with bolt, washers and nuts.
5. Install the thrust washer, washer and snap ring on the lower end of the barrel.
6. Install the trim screw in the barrel and secure each end with a cotter pin through the screw.
7. Route the cables into the fuselage and attach the ends to the forward trim cables.
8. Remove the blocks that are holding the forward cables tight and aft cables at the barrel.
9. Set cable tension and check rigging and adjustment as described in “Rigging and Adjustment of Stabilator Trim.” Check safety of all turnbuckles.
10. Install the tail cone and secure with screws.
11. Install the access panel to the aft section of the fuselage.

RIGGING AND ADJUSTMENT OF STABILATOR TRIM. (Refer to Figure 27-17.)

1. Level the airplane. (Refer to Leveling, Chapter 8.)
2. Check for proper stabilator trim cable tension as given to Figure 27- 14. If cables were disconnected, rotate control wheel several times to allow the cables to seat and recheck tension.
3. Secure the stabilator in neutral position. To find neutral, place a rigging tool on the upper surface of the stabilator as shown in figure 27-18. (This tool may be fabricated from dimensions given in Chapter 95.) Zero a bubble protractor, set it on the rigging tool and tilt the stabilator until the bubble is centered.
4. With the stabilator centered, turn the trim wheel until the aft end of the turnbuckle of the right trim cable is approximately two inches forward of the double pulleys at the top of the rear bulkhead at station 228.3.
5. Check that the trim screw is turned down until the cotter pin stop in the top of the screw is contacting the plate on the horizontal support rib of the trim assembly. If the stop is not contacting the plate, the links between the screw and the trim control arm are not disconnected, disconnect the two by removing the connecting nut, washers and bolt. With the turnbuckle still at the two inch dimension from the pulley, turn the screw down until the pin contacts the plate.
6. Check the rod end on the tab actuating arm for approximately six threads forward of the jam nut.
7. Connect the links to the trim screw and secure with bolt, washers and nut.
8. Turn the trim control wheel until the trim tab streamlines with the neutral stabilator.
9. Check the bubble of the protractor over the neutral tab and then check tab travels as given in Figure 27-14. The degree of travel on the protractor is determined by taking the difference between the protractor reading at neutral and up, and neutral and down. The bubble must be centered at each reading with the airplane level.
10. To obtain correct travels, if incorrect, adjust by disconnecting the links at the actuating arm rod end and turning the end in or out as required. Reconnect links to rod end.
11. Secure the jam nut on the actuating arm rod end.
12. Turn the trim wheel to full travel and check for turnbuckle clearance and location of tab indicator.

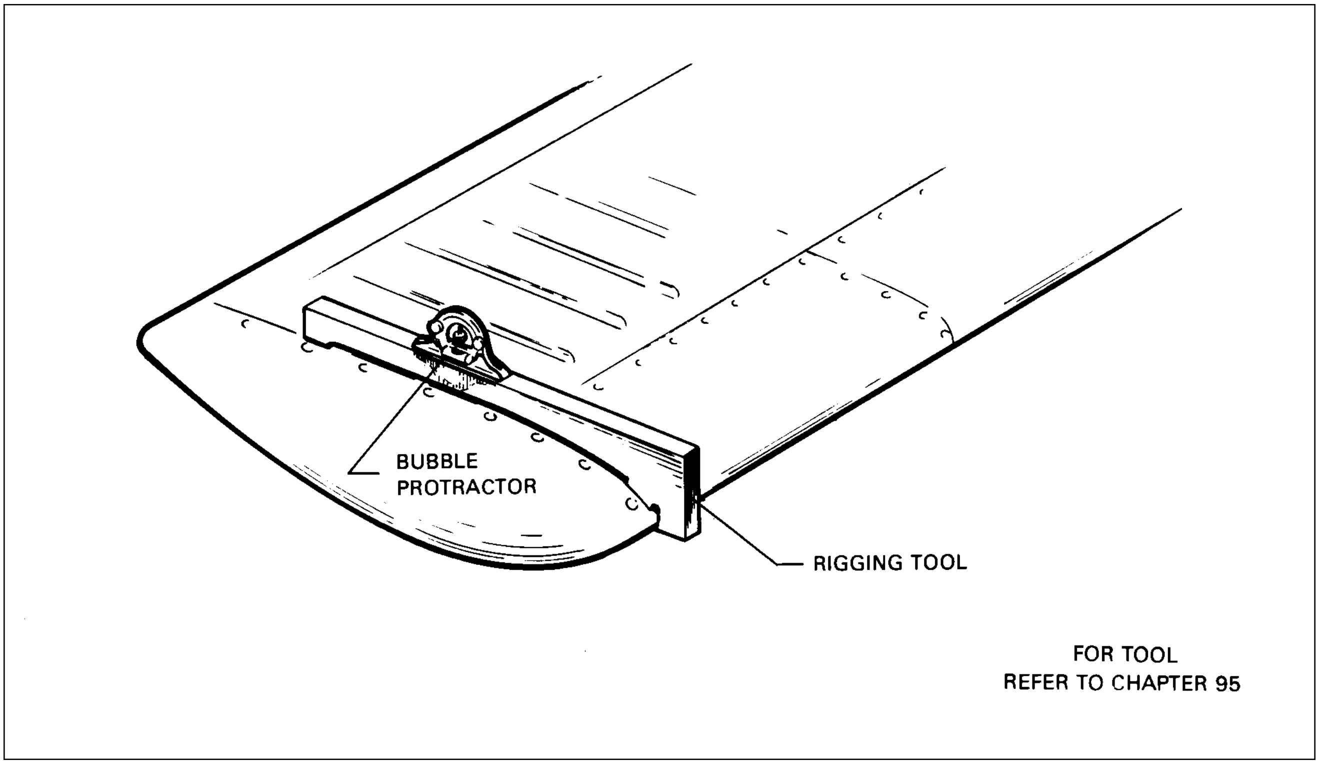


Figure 27-18. Utilization of Stabilator Rigging Tool

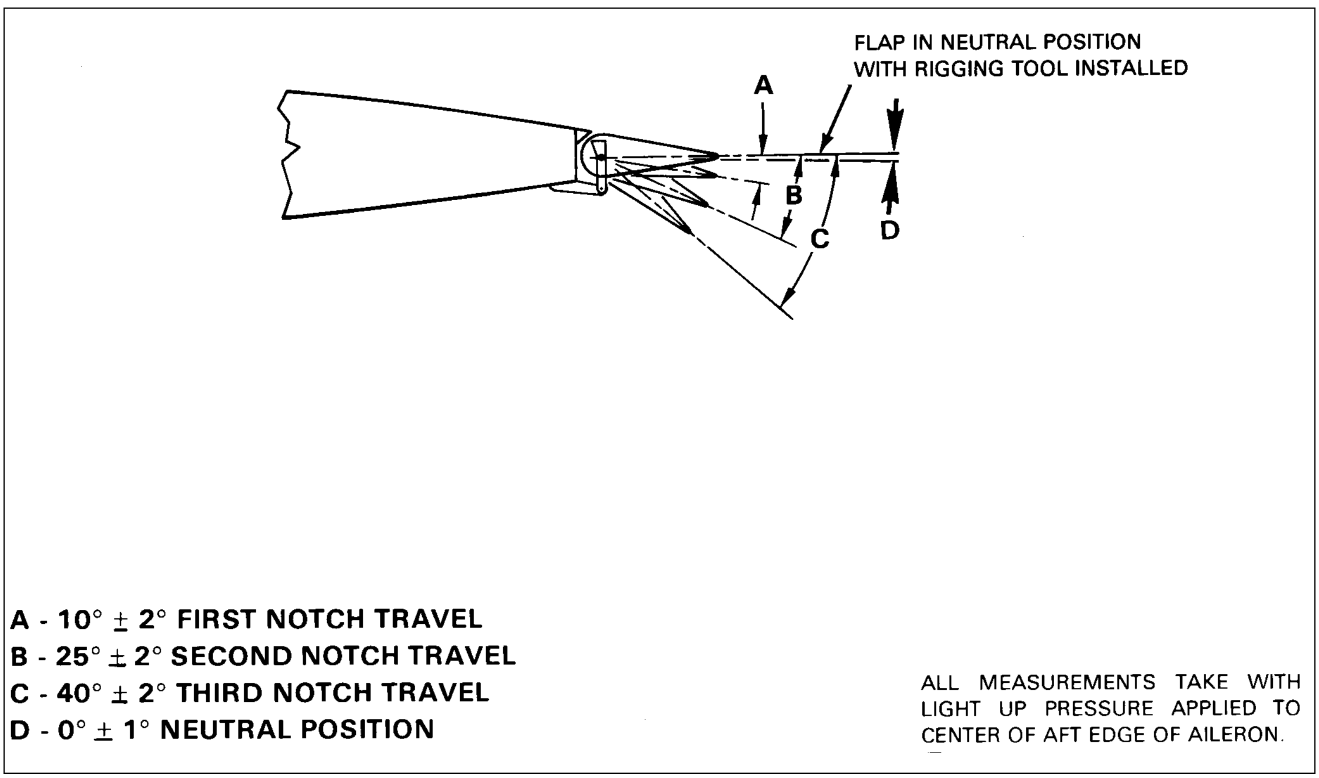
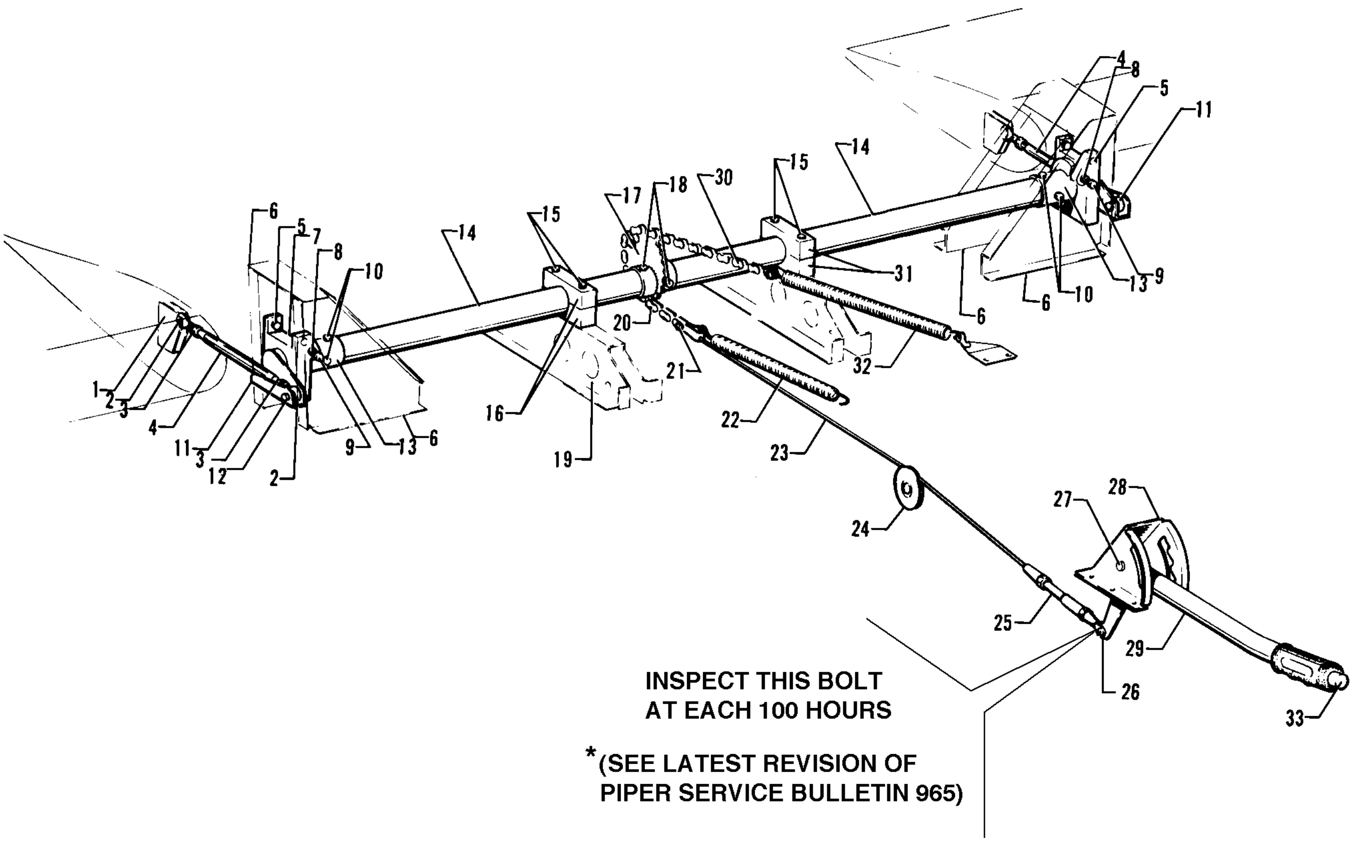


Figure 27-19. Flap Rigging

WING FLAP CONTROLS.

REMOVAL OF WING FLAP CONTROLS. (Refer to Figure 27-20.)

1. The flap torque tube assembly may be removed by the following procedure:
   A. Remove the access plate located between the underside of the aft section of each wing and the fuselage by removing the attaching screws.
   B. Remove the two front seats and the rear seat floor panel.
   C. Disconnect the left and right flap control tubes (rods) at the flaps by removing the nuts, washers and bolts or at the torque tube cranks (arms) by removing the bolts and washers from the inner side of each crank. It will be necessary to remove bolt through a hole in the side skin of the fuselage located over the torque tube with the flap handle moved to its 40 degree position.
   D. With the flap handle fully extend the flaps and disconnect the flap tension spring at the spar or the aft end of the control cable, as desired.
   E. Grasp the flap handle, release the plunger and allow the flap to return to the retracted position. Use caution as forward pressure will be on the handle with the tension spring disconnected.
   F. Disconnect the flap return spring at the spar or return chain, as desired.
   G. Disconnect the control cable from the chain by removing cotter pin, nut and clevis bolt.
   H. Remove the tube support blocks by removing the block attaching bolts.
   1. Remove the nuts, washers and bolts securing the right and left cranks and stop fittings on the torque tube.
   J. From between each wing and the fuselage, remove the cranks from the torque tube.
   K. Disconnect one bearing block from its mounting brackets by removing nuts, washers and bolts.
   L. Slide the tube from the bearing block still attached to its brackets; raise the end and lift it from the floor opening.
2. The flap control cable may be removed by the following procedure:
   A. If the front seats and rear seat floor panel have not been removed, remove the seats and floor panel.
   B. Disconnect the flap tension spring from the cable, if not previously disconnected, by extending the flaps to relieve spring tension.
   C. Retract the flap. Use caution as forward pressure will be on the handle with the spring disconnected.
   D. Disconnect the cable from the chain by removing cotter pin, nut, clevis pin and bushing.
   E. Remove the flap handle bracket and cover.
   F. Lift the aft section of the tunnel carpet far enough to remove the screws securing the tunnel cover that is between the flap handle and the spar cover. Remove the cover.
   G. Remove the cotter pin cable guard from the flap cable pulley located inside the floor tunnel just ahead of the spar housing.
   H. Remove the cable rub blocks located in the floor opening on the aft side of the spar housing by removing the attaching screws.
   I. Disconnect the cable turnbuckle at the flap handle by removing cotter pin, nut, washer, bushing* and bolt. Check clevis bolt for wear. Replace bolt if any wear is evident. *(See latest revision of Piper Service Bulletin 965.)
3. Remove the flap handle and bracket by disconnecting the cable turnbuckle from the handle and removing the bolts securing the bracket to the floor tunnel.



1. BRACKET, ROD ATTACHMENT
2. BOLT, WASHER & NUT
3. JAM NUT
4. ROD, FLAP CONTROL
5. BOLT, BEARING BLOCK ATTACHMENT
6. BRACKET, BEARING BLOCK
7. BLOCK, BEARING
8. NUT, LOCK
9. SCREW, FLAP ADJUSTMENT
10. BOLT, WASHER & NUT
11. CRANK (ARM), TORQUE TUBE
12. BOLT, WASHER & BUSHING
13. FITTING, TORQUE TUBE STOP
14. TUBE, TORQUE
15. BOLT, WASHER & NUT
16. BLOCK, BEARING
17. SPROCKET, TENSION SPRING
18. BOLT, WASHER & NUT
19. BRACKET, BEARING BLOCK
20. CHAIN, TENSION SPRING
21. CLEVIS BOLT, BUSHING NUT & COTTER PIN
22. SPRING, TENSION
23. CABLE, FLAP CONTROL
24. PULLEY
25. TURNBUCKLE
26. CLEVIS BOLT, BUSHING,* WASHER, NUT AND COTTER PIN
27. BOLT, BUSHING, WASHER & NUT
28. BRACKET, FLAP HANDLE
29. HANDLE, FLAP
30. CHAIN, RETURN SPRING
31. BLOCK, BEARING
32. SPRING, RETURN
33. BUTTON, FLAP RELEASE

Figure 27-20. Flap Controls

INSTALLATION OF WING FLAP CONTROLS. (Refer to Figure 27-20.)

1. The flap torque tube assembly may be installed by the following procedure:
   A. Install the chain sprocket with chain on the torque tube and secure with bolts, washers and nuts.
   B. Slide the tube stop fittings on their respective ends of the torque tube.
   C. Ascertain that one bearing block fitting is installed between its attachment brackets.
   D. Slide the other bearing block over its respective end of the torque tube.
   E. Position the torque tube by placing the end with the bearing block on it between the mounting bracket and sliding the other end into the previously attached bearing block.
   F. Position the remaining bearing block and secure with bolts, washers and nuts.
   G. Push the torque tube cranks (arms) on each end of the torque tube and slide the stop fitting in place. Align the bolt hole of the crank and stop fitting with the holes in the torque tube and install bolts. The holes in the stop fitting are longated to allow the stop fitting to be pushed against the bearing blocks thus allowing no side play of the assembly. Tighten the bolt assemblies on the stop fittings.
   H. Install the tube support blocks on their support brackets and secure with bolts.
   I. Connect the flap return spring to the return chain and/or at the spar housing.
   J. Connect the control cable end to the tension chain and secure with bushing, clevis bolt, nut and cotter pin.
   K. Pull the flap handle full back and connect the tension spring. Release the flap handle to the forward position.
   L. Connect the flap control tube to the flap and/or torque tube crank and secure. The bolt and bushing that connects the control tube to the crank is installed through a hole in the side of the fuselage located over the torque tube.
2. To install the flap handle with bracket, place the assembly on the floor tunnel and secure with bolts.
3. The flap control cable may be installed by the following procedure:
   A. Attach the cable and turnbuckle to the flap handle arm and secure with clevis bolt, bushing*, washer, nut and cotter pin. Ascertain that the turnbuckle end is free to rotate on the arm. *(See latest revision of Piper Service Bulletin 965.)
   B. Route the cable through the tunnel and spar housing.
   C. Install the cable rub blocks on the aft side of the spar housing and secure with screws.
   D. Install cotter pin cable guard over pulley located just ahead of the spar housing in the floor tunnel.
   E. Attach the cable end to the tension chain and secure with bushings, clevis bolt, nut and cotter pin. If the chain is not installed because of the torque tube assembly being removed. install the assembly as given in Step 3.
   F. Pull the flap handle full back and connect the tension spring to the cable end.
4. Install the tunnel cover and secure with screws. Also, the tunnel carpet and bracket cover.
5. Install and secure the seats.

RIGGING AND ADJUSTMENT OF WING FLAPS.

1. Place the flap handle in the full forward position.
2. If not previously removed, remove the rear seats floor panel.
3. To adjust the flap up stop and step lock, loosen the jam nut of the right torque tube stop screw, located in the floor opening along the outer end of the flap torque tube, and turn the stop screw to obtain approximately .60 of an inch between the stop fitting and the bearing block as measured along the top side of the screw. (Refer to Figure 27-21.) It may be necessary to loosen the adjustment screw of the left stop.

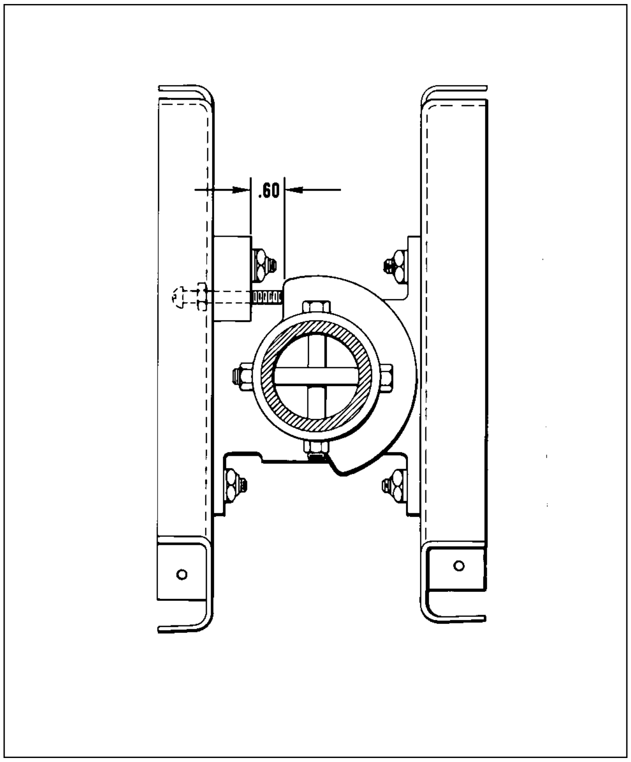


Figure 27-21. Flap Step Adjustment

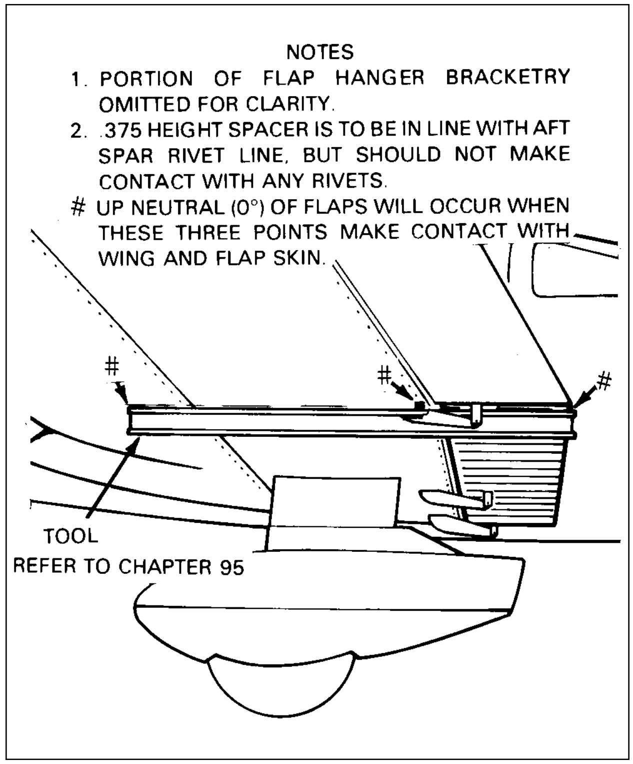


Figure 27-22. Utilization of Flap Rigging Tool

4. Place a .125 spacer between the stop fitting and the end of the screw. Determine that when pressure is applied down on the flap, it will remain in the up-lock position. If it extends, turn the adjustment screw out a few threads at a time until the flap remains in the up-lock position with the spacer inserted. Tighten the jam nut.
5. Rotate the left stop adjustment screw until it contacts the stop fitting. Tighten the jam nut.
6. Set the flap control cable tension (handle next to floor, 0 degrees) as given in Figure 27-19 at the turnbuckle that is attached to the lower end of the flap handle in the floor tunnel. To do this and if not previously removed, remove the flap handle cover and enough tunnel carpet to remove the tunnel cover just aft of the handle. Adjust and resafety the turnbuckle.

—NOTE—

Do not rotate the torque tube while retensioning the cable or tighten tight enough to allow tube to be pulled away from its stops.

7. To check up-neutral position of the flaps, place a flap rigging tool as shown in Figure 27-22 against the underside of the wing and flap as close as possible to the outboard end of the flap without contacting any rivets. The tool must be positioned parallel with the wing ribs with the aft end of the tool even with the trailing edge of the flap. (This tool maybe fabricated from dimensions given in Chapter 95.)
8. With the flap control rod connected between the torque tube crank arm and the flap, check that the surface of the wing contacts the tool at its forward surface and at the spacer, and the aft end of the flap contacts the aft end of the tool. The flap is neutral at this position.

9. Should the three points not contact, loosen the jam nuts on each end of the control rod and rotate the rod until the three points contact. Apply a slight up pressure against the trailing edge of the flap while making this adjustment. After adjustment retighten the jam nuts.
10. Check and adjust the other flap in alike manner.

—NOTE—

In the event of wing heaviness during flight, the flap on the side of the heavy wing can be adjusted down from neutral to remedy this condition by lengthening the control rod. Check the inspection hole in each rod end to ascertain that there are sufficient threads remaining and a wire cannot be inserted through these holes. Rod ends without check holes, maintain a minimum of .375 of an inch thread engagement. Do not raise the flap of the other wing above neutral.

11. Check the flap for full down travel to the degrees required in Figure 27-19. Should the travel not be as that required, readjust the torque tube sto screw in or out as required. After readjusting the screw, it wil be necessary to review Steps 4 thru 10.
12. Check operation of the flap and flap handle ratchet mechanism.
13. Install access plates and panels.

—END—

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CHAPTER

28

FUEL

CHAPTER 28- FUEL

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

The fuel system components covered in this section consist of the fuel tanks, selector valves, filter screens, fuel pumps and quantity transmitter units. Instructions are given for remedying difficulties which may arise in the normal operation of the fuel system . The instructions are organized so the mechanic can refer to: Removal, Repair, Installation and Adjustment of each part of the system.

Maintenance for fuel injection may be found under Power Plant, Chapter 73.

DESCRIPTION AND OPERATION. (Refer to Figure 28-1.)

The fuel system was designed with simplicity in mind. It incorporates two fuel tanks, one in each wing containing 38.5 U.S. Gallons, giving a total capacity of 77 gallons, of which 72 gallons are useable. The minimum fuel grade is 100/130 octane (green) or 100LL (blue). The tanks are attached to the leading edge of the wing with screws and are an integral part of the wing structure. This allows for removal for service. The tanks are vented individually by a vent tube which protrudes below the bottom of the wing at the rear inboard corner of each tank. The vents should be checked periodically to ascertain that the vent is not obstructed and will allow free passage of air.

Each fuel tank has an individual quick drain located at the bottom inboard rear corner. The fuel strainer also incorporates a quick drain, which is located on the left lower portion of the firewall. The quick drain protrudes thru the cowling to allow easy draining of the fuel strainer.

A fuel tank selector allows the pilot to control the flow of fuel to the engine, and is located on the left side wall below the instrument panel. It has three positions: OFF, LEFT TANK and RIGHT TANK. The arrow on the handle of the selector points to the tank which is supplying fuel to the engine. The vapor return from the engine is also routed back to the tank selected. When the selector valve is in the OFF position, vapor return is routed back to the right fuel tank. The valve also incorporates a safety latch which prevents inadvertently selecting the “OFF” position.

The engine fuel injection system is a “continuous flow” type, which utilizes a vapor return line leading back to the fuel tanks. This line provides a route back to the tanks for vapor laden fuel that has been separated in the injector pump swirl chamber. The engine has an engine driven fuel pump that is a part of the fuel injection system. The purpose of the electrically powered auxiliary fuel system is to supply fuel to the engine in case of engine driven fuel pump shaft failure or malfunction, for ground and inflight engine starting, and for vapor suppression. The auxiliary fuel pump switch is located on the instrument panel above the engine control quadrant, and is a three position rocker switch; LO, HI and OFF. The LO auxiliary fuel pressure is selected by pushing the top of the switch. The HI auxiliary fuel pressure is selected by pushing the bottom of the switch, but this can be done only after unlatching the adjacent guard. When the HI auxiliary fuel pump is activated, an amber light near the annunciation panel is illuminated. This light dims whenever the pump pressure reduces automatically and manifold pressure is below approximately 21 inches.

In case of a failed engine driven fuel pump, the auxiliary electric fuel pump should be set on HI. Adequate pressure and fuel flow will be supplied for up to approximately 75% power. Manual leaning to the correct fuel flow will be required at altitudes above 15,000 feet and for engine speeds less than 2300 RPM. An absolute pressure switch automatically selects a lower fuel pressure when the throttle is reduced below 21” Hg manifold pressure and the HI auxiliary fuel pump is on.

—NOTE—

Excessive fuel pressure and very rich fuel/air mixtures will occur if the HI position is energized when the engine fuel injection system is functioning normally.

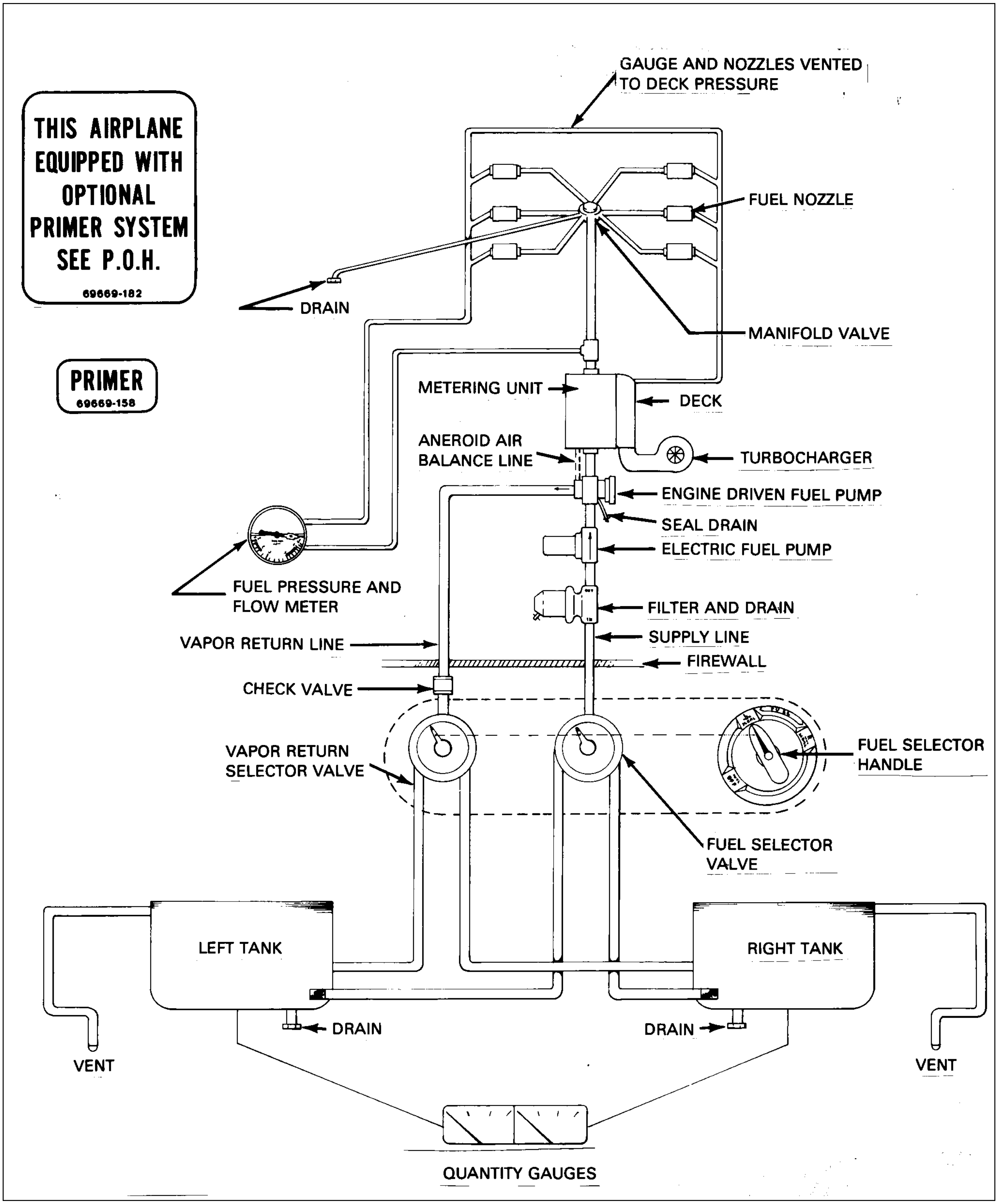

Figure 28-1. Fuel System Diagram

Low auxiliary fuel pressure is available and may be used during normal engine operation both on the ground and inflight for vapor suppression should it be necessary as evidenced by unstable engine operation or fluctuating fuel flow indications during idle or at high altitudes.

A spring loaded OFF primer button switch, located on the instrument panel and is used to select HI auxiliary fuel pump operation for priming, irrespective of other switch positions. The primer button may be used for both hot or cold engine starts.

On airplanes equipped with an optional engine primer system (identified by Placard below primer button shown in Figure 28-1), the primer switch location and actuation is the same as the basic airplane. However, this system does provide a separate primer system as an integral part of the engine fuel system. An electrically operated diverter valve is located in the metered fuel supply line between the air throttle valve and the manifold valve. Other components are two primer nozzles, located in the intake manifold on each side of the engine, the interconnecting fuel lines, and fine wire spark plugs. Actuation of the engine primer switch operates the auxiliary electric fuel pump on HI and energizes the diverter valve which supplies fuel to each primer nozzle. The diverter valve does not shut off all fuel flow to the manifold valve, therefore some quantity of fuel is also supplied to each cylinder nozzles during priming. Operation of the auxiliary fuel pump on HI and LO is unchanged .

TROUBLESHOOTING.

Troubles peculiar to the fuel system are listed in Chart 2801 along with their probable causes and suggested remedies. When troubleshooting, check from the power supply to the items affected. If no trouble is found by this method, the trouble probably exists inside individual pieces of equipment; they may be removed from the airplane and an identical unit or units, tested and known to be good, installed in their place.

CHART 2801. TROUBLESHOOTING (FUEL SYSTEM)

Trouble	Cause	Remedy
Failure of fuel to flow.	Fuel line blocked.	Flush fuel system.
	Fuel vent cap blocked.	Check and clean vent hole in cap.
	Mechanical or electrical fuel pump failure.	Check and replace if necessary.
	Fuel selector valve in improper position.	Reposition as required.
	Damaged fuel selector valve.	Replace fuel selector valve.

CHART 2801. TROUBLESHOOTING (FUEL SYSTEM) (cont.)

Trouble	Cause	Remedy
Fuel quantity gauge fails to operate.	Broken wire.	Check and repair.
	Gauge inoperative.	Replace gauge.
	Fuel sender float partially or completely filled with fuel.	Replace sender.
	Circuit breaker open.	Check and reset.
	Float and arm assembly of fuel sender sticking.	Check.
	Bad ground.	Check for good contact at ground lip or rear of gauge.
No fuel pressure indication.	Fuel selector valve stuck.	Check fuel selector valve.
	Fuel tanks empty.	Check fuel tanks and fill.
	Defective gauge.	Replace gauge.
	Fuel selector valve in improper position.	Reposition fuel selector valve lever.
Low pressure or pressure surges.	Obstruction in inlet side of pump.	Trace lines and locate obstruction.
	Air in line to pressure gauge.	Bleed line.

—NOTE—

Refer to Chapter 73 for additional Fuel Troubleshooting Information.

STORAGE.

FUEL TANK.

REMOVAL OF FUEL TANKS.

1. Drain the fuel from the fuel tank. (Refer to Draining Fuel System, Chapter 12.)
2. Remove the screws from around the perimeter of the tank assembly.
3. Disconnect fuel and vapor return line.
4. Pull the tank away from the wing assembly far enough to gain access for removal of the sender wire.
5. The tank is now free to be removed.

INSPECTION AND REPAIR OF FUEL TANK.

The entire interior of the tanks should be inspected for peeling of small areas of the sloshing compound. Indications are that in the majority of cases the peeling is started just inside the filler neck as a result of the metal nozzle of the gas filler hose nicking the compound. The following items are recommended:

1. The entire interior of the main tanks should be inspected with the tanks drained. This is accomplished with a mirror and inspection light through the filler neck. Small scrapes in the film adjacent to the filler neck may be disregarded provided there is no indication of peeling.
2. If peeling has occurred and separated material is found, the fuel tank should be removed and resloshed in accordance with the instructions included in each can of Randolph Sloshing Sealer, 802, Piper part number 757 572V. (Approved under Mil. Spec. MIL-L-G0478.) One gallon of sloshing compound is required per tank. After sloshing the tank, apply 1.5 lbs. air pressure and using a soap and water solution, check for leaks.
3. After resloshing, reinspect as above at intervals of 100 hours. These inspections may be discontinued after the second inspection if no peeling is discovered.

—NOTE—

The fuel tank should be replaced if the tank is damaged to the extent it cannot be repaired by the above method.

INSTALLATION OF FUEL TANK.

1. Slide the tank partly into position and connect the sender wire, fuel line and vapor return line.
2. Slide the tank completely into place and secure with screws around its perimeter.
3. Fill the fuel tank ad check for leaks, unrestricted fuel flow and proper sender indications no the quantity gauge as described in the Indicating section.

LOCKING FUEL CAP.

DISASSEMBLY OF LOCKING FUEL CAP. (Refer to Figure 28-2.)

1. Remove two screws on the back of the fuel cap.
2. Remove screw which secures the pawl to the back of key lock assembly.
3. Remove the pawl from the back of the key lock assembly.
4. Remove the nut which secures the key lock to the cover.
5. Slide the lock, gasket and spring over the back of the key lock.
6. The key lock may be removed by pushing the key lock through the cover.

ASSEMBLY OF LOCKING FUEL CAP.

1. Insert the key lock through the cover, making sure that the O-ring is installed under the head of the key lock.
2. Slide the spring, gasket and lock over the back of the key lock.
3. Reinstall the nut which secures the key lock to the cover.
4. Attach the pawl to the back of the lock assembly with the screw previously removed.
5. Reinstall the two screws on the back of the fuel cap. Use Locktite 271 on the threads.

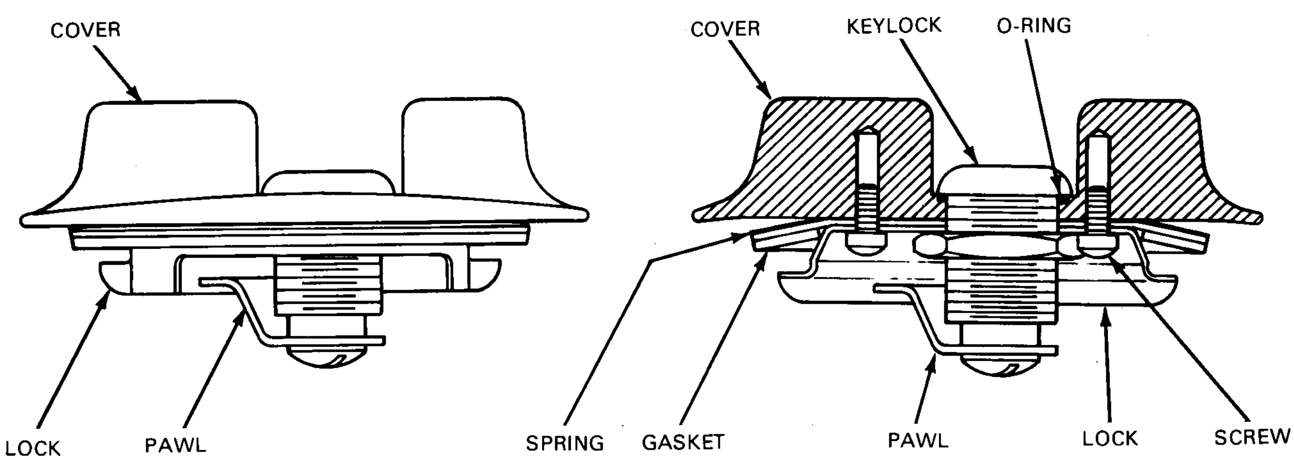

Figure 28-2. Locking Fuel Cap Assembly

DISTRIBUTION.

FUEL SELECTOR VALVE.

REMOVAL OF FUEL SELECTOR VALVE.

1. Remove three screws holding selector cover and the screw holding the handle. It will be necessary to remove side panel to gain access to the selector valve.
2. Remove selector handle and cover.
3. Disconnect fuel lines from the selector valve.
4. Remove fuel valve assembly by removing attaching screws.

INSTALLATION OF FUEL SELECTOR VALVE.

1. Secure the valve to the bulkhead attachment location with attaching screws.
2. Connect the fuel lines to the valve.
3. Install side panel.
4. Install the selector cover with attaching screws.
5. Install the valve control handle with attaching screws.

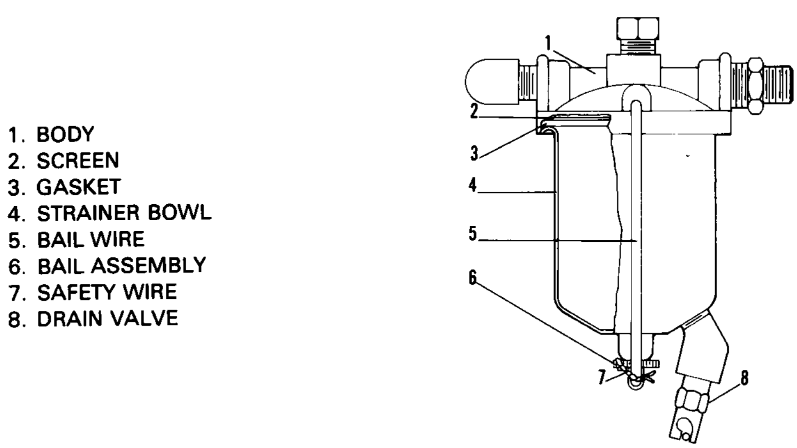

Figure 28-3. Fuel Filter Bowl and Screen

FUEL FILTER BOWL AND SCREEN. (Refer to Figure 28-3.)

REMOVAL OF FUEL FILTER BOWL AND SCREEN.

1. Ascertain that the fuel shutoff is in the off position.
2. Remove the engine cowlings by releasing the cowl fasteners or the attaching screws, depending on the type installed. Be certain that all electrical leads are disconnected prior to removal of the cowl.
3. Disconnect the fuel lines from the filter bowl housing.
4. Cut the safety wire, loosen the bail nut, move the bail wire to the side and remove the bowl.
5. Remove the housing of the filter bowl by spreading the ends of the bail wire allowing the housing to be lifted from the bracket.

INSTALLATION OF FUEL FILTER BOWL AND SCREEN.

1. Position the top of the filter bowl to the bracket and connect the fuel lines.
2. Spread the bail wire ends and insert them through the holes in the side of the mounting bracket and the top of the filter bowl.
3. Position the bowl and bail wire, and tighten the bail nut.
4. Safety the bail nut and the bail wire assembly.
5. Install the engine cowling.

CLEANING AND INSPECTION OF FILTER BOWL SCREEN.

1. Follow Steps 1, 2 and 3 under Removal of Fuel Filter Bowl and Housing for removal of the filter bowl.
2. Remove the gasket and screen from the filter housing.
3. Clean the screen and bowl with acetone or a suitable dry type solvent. If damaged, replace screen.
4. Replace the screen followed by a new gasket.
5. Position the bowl and bail wire, and tighten the bail nut.
6. Safety the bail nut and the bail wire assembly.

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ELECTRIC FUEL PUMP. (Airborne)

REMOVAL OF ELECTRIC FUEL PUMP.

The electric rotary vane type fuel pump is mounted in a bracket on the forward side of the fire wall. To remove pump, proceed as follows:

1. Remove engine cowl to gain access to the pump.
2. Remove fuel lines from the pump and disconnect the electrical leads.
3. Remove straps holding pump in position.
4. Do not attempt to disassemble or repair the fuel pump. If fuel pump proves to be defective, it should be replaced.

BENCH ADJUSTMENT OF ELECTRIC FUEL PUMP.

1. Ascertain that the pump is sufficiently lubricated to prevent damage if run dry for a period greater than five minutes.
2. Connect the electric leads to a 14-volt DC power source.
3. Using a suitable container with the proper octane fuel, connect a fuel line from a container to the inlet side of the pump.
4. Connect another line from the outlet side of the pump to a pressure gauge and bypass valve and back to the container.
5. Run the pump with the bypass valve open until a steady flow of fuel is obtained. Then close the bypass valve and check the pressure gauge for a proper reading of 26 to 29 psi, no flow. Do not keep the bypass valve closed for more than one minute during pump operation and adjustment.
6. Loosen the locknut and turn the adjusting screw until there is a reading of 29 psi maximum, no flow, on the gauge. Repeat Steps 5 and 6 until the proper pressure is obtained.
7. Disconnect the power source from the pump and lock the adjustment screw with the locknut. Remove the fuel lines from the pump.

IN AIRCRAFT ADJUSTMENT OF ELECTRIC FUEL PUMP.

1. With the access panel removed and the fuel selector in the OFF position, remove the fuel line from the outlet end of the pump.
2. Connect a test line with a bypass valve and pressure gauge to the outlet end of the pump.
3. Place a container below the pump to catch any fuel from the test line during the adjustment of the pump.
4. Turn the fuel selector on, open the bypass valve on the test line and start the pump.
5. When a steady flow of fuel is obtained, close the bypass valve and check the reading on the pressure gauge. It should read 26 to 29 psi, no flow. Do not keep bypass valve closed for more than one minute during pump operation and adjustment.
6. Loosen locknut on adjusting screw and turn screw to obtain the proper pressure of 29 psi maximum, no flow. Repeat Steps 7 and 8 until adjustment is complete. Lock adjusting screw with locknut.
7. Turn off fuel pump and close fuel selector. Remove the test line from the pump.
8. Reconnect the original fuel line to the pump. Open fuel selector and run the pump to check for any fuel leaks.
9. Shut off the pump, close the fuel selector and replace and secure the access panel.

INSTALLATION OF ELECTRIC FUEL PUMP.

1. Position the fuel pump inside the cover assembly and secure with cap screws, washers and plate.
2. Connect the fuel lines to the fuel pump.
3. Connect the electrical leads to the pump.
4. Turn the fuel selector on and operate the fuel pump. Check the line fittings for leakage.
5. Install the cowling.

CLEANING FUEL SYSTEM.

1. To flush the fuel tanks and selector valve, disconnect the fuel line at the injector.
2. Select a fuel tank, turn on the electric fuel pump and flush fuel through the system until it is determined there is no dirt and foreign matter in the fuel valve or tank. During this operation, agitation of the fuel within the tank will help pick up and remove any dirt.
3. Repeat this procedure for each tank.
4. When tanks are flushed, clean all filters.

AUXILIARY FUEL PUMP.

AUXILIARY FUEL PUMP ADJUSTMENT. (Refer to Figure 28-4.)

1. Install a calibrated pressure gauge in the fuel line between the electric fuel pump and engine.
2. Remove the aft access panel in the baggage compartment. The slider resistor is located at station 165.5 attached to the plate containing the voltage and overvoltage relays.
3. Disconnect the wire from the auxiliary pump circuit breaker.
4. From an external power source containing a voltmeter, connect the negative lead to the ground and the positive lead to the slide resistor high terminal.
5. Connect a calibrated voltmeter across the auxiliary fuel pump, and adjust the external power source until 12.0 to 12.5 volts direct current is indicated. Record the voltage reading from the external power source.
6. Check the calibrated pressure gauge. At least 31 to 37 psi should be indicated.
7. Connect the positive lead to the “LOW” power terminal of the slide resistor.
8. Adjust the power supply voltage level to obtain that recorded in step 5.
9. Slide the “LOW” terminal on the resistor to obtain a pump pressure of 8 to l0 psi.
10. Readjust power supply and “LOW” terminal to insure a pump pressure of 8 to 10 psi at a power supply voltage of that previously recorded in step 5.
11. Secure the “LOW” terminal slider.
12. Connect the positive lead to the “MEDIUM” power terminal of the slide resistor and adjust the power supply voltage level to the recorded in step 5.
13. Position the “MEDIUM” terminal on the resistor to obtain a pump pressure of 23.5 to 24.5 psi, and readjust the power supply and terminal to insure that pressure at a power supply voltage recorded in step 5.
14. Secure the “MEDIUM” power terminal and attach disconnected wires.
15. If the aircraft is equipped with a fuel diverter valve, operate the primer switch and insure the valve is being energized. Release the primer switch and operate the fuel pump switch in the HI-BOOST position and insure that the pump operates and that the diverter valve does not.

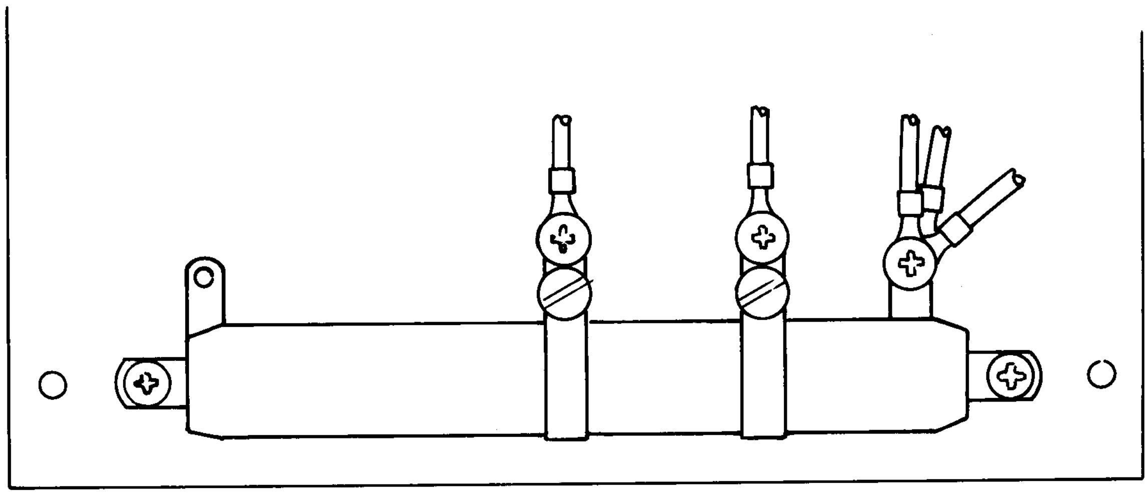

Figure 28-4. Aux. Fuel Pump Variable Resistor

AUXILIARY FUEL PUMP OPERATIONAL CHECK.

1. Install a calibrated fuel pressure gauge in the fuel line between the electric fuel pump and the engine, and disconnect the electrical leads to the manifold pressure switch located on the firewall.
2. Turn all cockpit controllable switches off.

—WARNING—

Due to possible fuel overflow conduct this operation in a no smoking, well ventilated area.

3. With the master switch in the on position, place electric fuel pump switch in the "LOW" position. The calibrated fuel pressure gauge should indicate a pressure increase, indicating pump operation. The pressure should not exceed 10 psi.
4. Set electric fuel pump switch in the "HIGH" position. Record the pressure indicated on the calibrated pressure gauge. The pressure on the gauge should be higher then that recorded in step 3 but not more than 24.5 psi.
5. Switch off Master Switch, and reconnect leads to the Manifold Pressure Switch.
6. Ascertain that the fuel pump switch is still in the "HIGH" position, and return the master switch to the on position. Record the pressure registered on the calibrated pressure gauge. The pressure attained in this step should be higher than that recorded in step 4, but not in excess of 37 psi.
7. Place the fuel pump switch in the off position and depress the prime switch. Record the pressure indicated and check against that recorded in step 4. The pressure attained in this step should be higher then that recorded in step 4 but not in excess of 37 psi.

LINES AND FITTINGS.

INSPECTION AND TIGHTENING OF FUEL LINE UNION FITTINGS.

1. Remove the aft inboard inspection panel from the lower surface of the right and left wing.
2. Remove the pilots seat and left cabin side panel. Fold back the carpeting that covers the forward side of the spar box and remove the cover from the fuel line(s).
3. Inspect all union fittings used in the fuel system for signs of leakage. Note any leaking fittings for later re-check.
4. Using a torque wrench and a tubing crow’s foot, carefully tighten each union fitting to the torques listed below:

Tube Size	Applied Torque	
1/4 in. OD	75-95 inch-pounds	Using a Tubing
3/8 in. OD	175-195 inch-pounds	Crow’s Foot

—CAUTION—

Using a crow’s foot adapter other than a tubing type will result in deformation or severe damage to the union nut and will probably cause a leak which will require replacement of the union and tubing.

—NOTE—

If during the torque check a galled nut and union are suspected, back off the nut and inspect the threads. If the union is serviceable, apply a thread lube such as Slip Spray Lubricant (Dupont) or Ferrulube (Parker-Hannif in), and torque the nut to the proper values as listed in Step 4. If the union is unserviceable, it must be replaced per instructions given in paragraph titled “Replacement of Fittings” following this paragraph.

When applying thread lubricant insure its application to the male connector threads only. Care should be taken that no lubricant enters the throat of the connector seat or contacts the ferrule seat face.

5. After torquing each fitting, measure the distance between the face of the union nut and face of tubing nut. Refer to Figure 28-5 for tolerance.
6. Any fitting found out of tolerance must be replaced in accordance with instructions given in paragraph titled “Replacement of Fittings.”
7. After all unions have been checked for proper tightness and all repairs (if any) have been made, insure that the airplane is full of fuel and run the engine for three to five minutes on each tank. Insure engine operation in a safe manner and location.
8. After engine shut down, wiggle all unions. If any fittings are found leaking, repairs must be accomplished in accordance with paragraph titled “Replacement of Fittings.”
9. When system is found leak free, replace the side panel, carpet, access plates and seat.
10. Make an appropriate logbook entry.

REPLACEMENT OF FITTINGS.

—*NOTE*—

Defueling of airplane may be required for union and/or tubing replacement.

1. If fittings show evidence of galling, or does not meet the dimensional requirements of Figure 28-5, or continues to leak after being tightened it must be repaired.
2. The recommended repair is to remove the leaking union and replace it using a standard AN fitting as outlined in "AC 43.13- 1 A paragraph 392." This will require cutting off the swaged ferrule and adding a short length of tubing.
3. If a replacement tube and union purchased from Piper is being used the ferrule is pre-swaged onto the tube. Install the pre-fabricated tube as follows:
   A. Apply a thread lube as recommended in Step 4 of paragraph titled "Inspection and Tightening of Fuel Line Union Fittings," to the threads of the union.
   B. Carefully align the tube into the union and snug up the nut using a wrench.
   C. Then using the wrench, tighten the nut one to two flats (1/6 to 1/3 of a turn).
4. If a repair is being made using Parker-Hannifin unions and tubes without pre-swaged ferrules they should be installed as follows:
   A. Cut off the tubing at a convenient location back from the fitting.
   B. De-burr the end of the tube and prepare a short length of tube, to splice into the line.
   C. Screw the nut and ferrule onto the union until solidly finger tight.
   D. Insert the tubes into the unions, being careful to insure proper straight alignment of the tubing and union.
   E. Using a tubing wrench tighten the nut one and one-quarter (1-1/4) turns.
5. After corrective action has been completed perform leak test as outlined in Steps 7 and 8 of paragraph titled "Inspection and Tightening of Fuel Line Union Fittings."

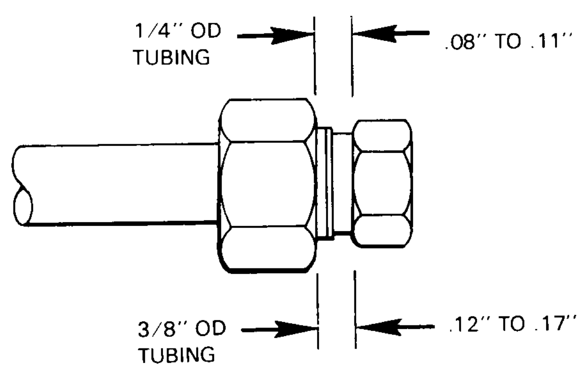

Figure 28-5. Tolerances, Union Nut and Tubing Nut

INDICATING.

FUEL QUANTITY.

REMOVAL OF FUEL QUANTITY TRANSMITTER UNIT.

1. Remove the fuel tank. (Refer to Removal of Fuel Tanks.)
2. Disconnect the transmitter wire from the connection post.
3. Cut the safety wire which secures the five attaching screws.
4. Remove the five screws and remove the unit.

CHART 2802. TRANSMITTER/FUEL GAUGE TOLERANCES

Actual Fuel in Tank (U.S. Gal.)	Gauge Reading (U.S. Gal.)	Tolerance (Plus or Minus) (Needle-Widths)
Full	F	2
32.5	30	2
22.5	20	2
12.5	10	
2.5	Zero	Plus 0 - Minus
0 Empty	Empty Dot	1/2

INSTALLATION OF FUEL QUANTITY TRANSMITTER UNIT.

1. Position the transmitter and gasket to the fuel tank and secure with machine screws and washers.
2. Safety the machine screws with MS20995-C32 wire.
3. Install the fuel tank. (Refer to paragraph on Installation of Fuel Tank.)

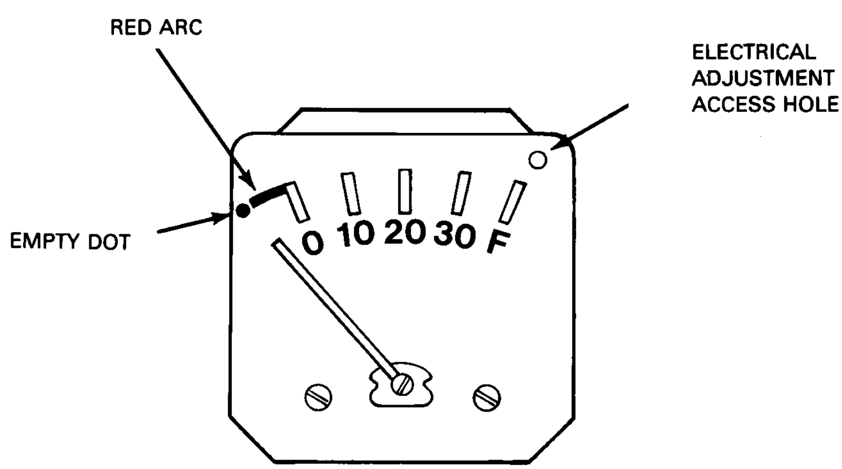

Figure 28-6. Fuel Gauge

FUEL QUANTITY SENDER/GAUGE CHECK INSTALLED.

Fuel quantity sender units and fuel quantity gauges can be checked while mounted in the airplane by using the following procedure:

1. Put the fuel selector levers in the “OFF” position. Completely drain dual tanks that relate to the fuel quantity senders and gauge to be checked. (Refer to Draining Fuel System, Chapter 12.)
2. Level airplane laterally (refer to Leveling, Chapter 8) and position the aircraft with a 1° nose up attitude.

—NOTE—

The electrical system should supply 12 to 14 volts to the gauge.

3. With the master switch in the “OFF” position, the gauge needle should be centered on the white dot to the left of the “O” radial mark, with a maximum deviation of 1/2 needle width. If not within this tolerance, the gauge should be replaced.
4. With the master switch in the “ON” position and no fuel in the tanks the gauge needle should be centered on the white dot to the left of the “O” radial mark with a maximum deviation of 1/2 needle width. If not within this tolerance, the gauge should be replaced.
5. Place 2 1/2 gallons of fuel in the wing fuel tank that relates to the gauge and sender unit being checked.
6. With 12 to 14-volts DC supplied to the electrical system and the master switch in the “ON” position, the needle should be centered on the “O” radial mark; plus 0, minus 1 needle width.
7. If the needle does not read within the above tolerance, remove the sender wire from the rear of the gauge and check the resistance to ground through the sender circuit. If the resistance is not within 6.5 ± 0.5 ohms, replace the sender. Then, recheck as specified above.
8. Add fuel to the tanks in accordance with the information given in Chart 2802 until tanks are full. Observe the gauge reading at each increment.
9. With the tanks full and master switch “ON”, the needle should be centered on the “F” radial mark within ±2 needle widths. If not within this tolerance, adjust the electrical adjustment (refer to Figure 28-6) just sufficiently to bring it within tolerance; do not center the needle.

—END—

CHAPTER

32

LANDING GEAR

CHAPTER 32 - LANDING GEAR

TABLE OF CONTENTS/EFFECTIVITY

CHAPTER 32 - LANDING GEAR (cont)

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

In this chapter are instructions for the removal, disassembly, inspection, overhaul, and installation of the various landing gear and brake system components used on the alignment of the nose gear, and the repair and service of the brake system.

DESCRIPTION AND OPERATION.

The PA-28-201T has incorporated a fixed tricycle landing gear utilizing a 5.00 x 5, 6 ply nose tire; and two 6.00 x 6, 6 ply main tires.

All three gear struts are of the air-oleo type. As shown in Figure 32-3, the nose gear is welded into the engine mount assembly and through using a single bungee-spring unit to aid in ground handling, is steerable through a 60 ± 2° arc.

The main wheels are equipped with single disc hydraulic brakes. The brakes can be actuated by either a hand lever (parking brake) which utilizes a push button to operate the locking mechanism, or by individual cylinders attached to each rudder pedal. The parking brake is operated by pulling back on the handle while simultaneously pushing on the button on the handle. To release the hand brake, pull aft on the handle and allow it to swing forward. A brake fluid reservoir is installed on the left forward face of the engine fire wall.

TROUBLESHOOTING.

Troubles peculiar to the landing gear are listed in Chart 3201, along with their probable causes and suggested remedies. When troubleshooting the landing gear it is recommended the airplane be put on jacks. (Refer to Chapter 7.)

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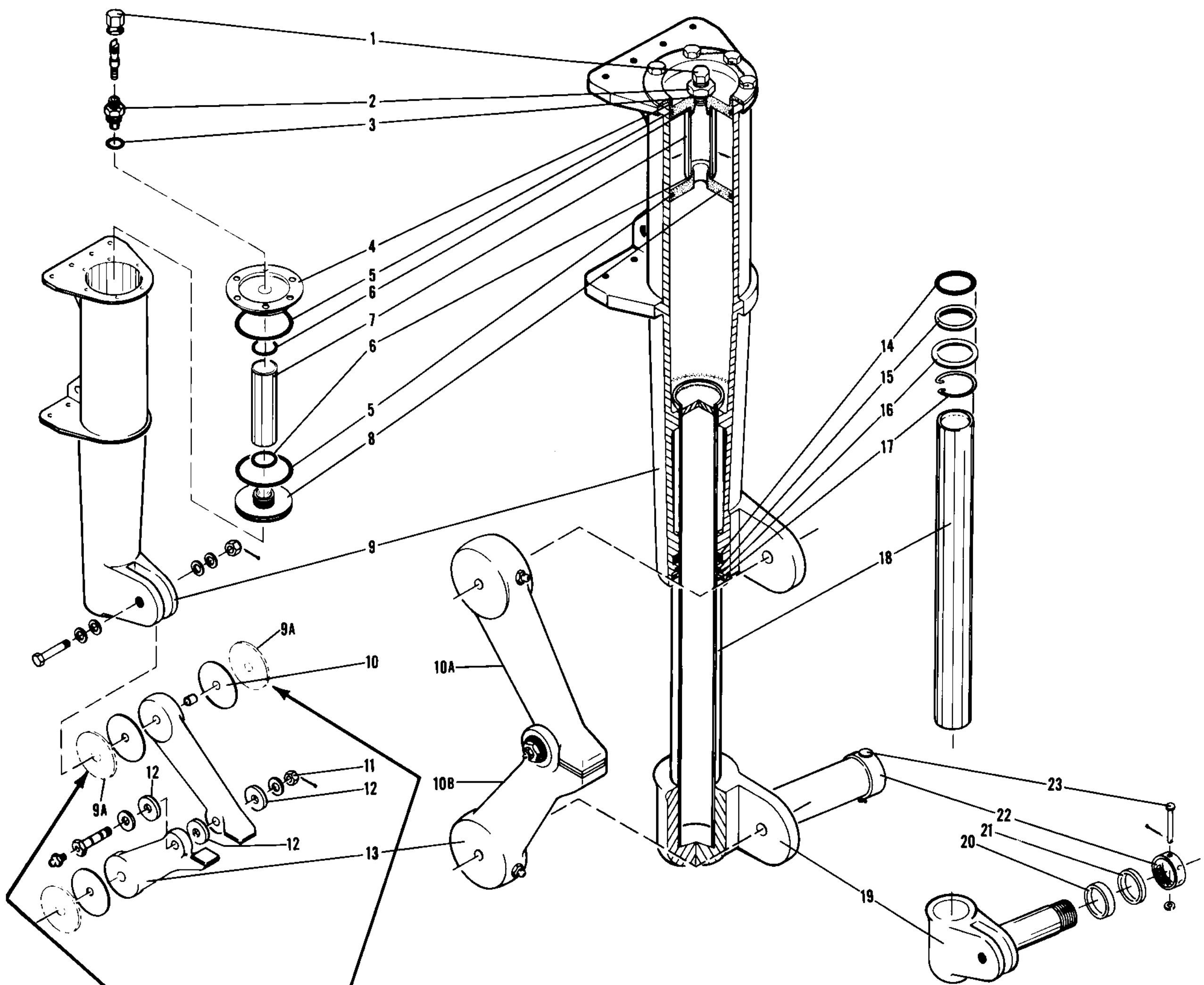
CHART 3201. TROUBLESHOOTING (LANDING GEAR)

Trouble	Cause	Remedy
Nose landing gear shimmies during fast taxi, takeoff, or landing.	Nose gear centering spring assembly or bracket loose at mounting.	Replace necessary parts and bolts.
	Tire out of balance.	Check balance and replace tire if necessary.
	Worn or loose wheel bearings.	Replace and/or adjust wheel bearings.
	Worn torque link bolts and/or bushings.	Replace bolts and/or bushings.
Excessive or uneven wear on nose tire.	Incorrect operating pressure.	Inflate tire to correct pressure.
	Wear resulting from shimmy.	Refer to proceedings for correction.
Nose gear fails to steer properly.	Oleo cylinder binding in strut housing.	Lubricate strut housing (refer to Lubrication Chart).
		Cylinder and/or strut housing bushings damaged.
	One brake dragging.	Determine cause and correct.
	Steering bellcrank loose on attachment plate.	Readjust and tighten.
	Steering bellcrank bearing and/or bolt worn.	Replace bearing and/or bolt.
	Centering spring assembly binding.	Repair or replace.
Main landing shimmies during fast taxi, takeoff, or landing.	Tire out of balance.	Check balance and replace tire if necessary.
	Worn or loose wheel bearings.	Replace and/or adjust wheel bearings.
	Worn torque link bolts and/or bushings.	Replace bolts and/or bushings.

CHART 3201. TROUBLESHOOTING (LANDING GEAR) (cont)

Trouble	Cause	Remedy
Excessive or uneven wear on main tires.	Incorrect operating pressure.	Inflate tire to correct pressure.
	Wheel out of alignment (toe-in or toe-out).	Check wheel alignment.
Strut bottoms on normal landing or taxiing on rough ground.	Insufficient air and/or fluid in strut.	Service strut with air and/or fluid.
	Defective internal parts in strut.	Replace defective parts.



NOTE

LINKS SHOULD BE LOOSE ENOUGH TO ALLOW FREE ACTION OF THE GEAR, BUT ALSO RESIST SIDE PLAY. TO ELIMINATE SIDE PLAY SHIM WASHERS (63311-03 - .005) MAY BE USED IF REQUIRED. IF BOTH LINKS REQUIRE SHIMS, MAKE SURE TO INSTALL THEM ON THE SAME SIDE OF EACH HINGE. MAXIMUM SIDE PLAY .005/.007. THIS APPLYS TO BOTH LINKS.

1. CAP, VALVE
2. PLUG FILLER
3. O-RING, CYLINDER HEAD
4. HEAD, CYLINDER
5. O-RING, CYLINDER HEAD
6. O-RING
7. TUBE, ORIFICE
8. PLATE, ORIFICE
9. STRUT HOUSING
9A. SHIM (AS REQ.)
10. WASHER (BEARING)
10A. LINK (UPPER)
10B. LINK (LOWER)
11. NUT
12. WASHER
13. TORQUE LINKS
14. O-RING
15. RING, SCRAPER
16. RING, SPACER
17. RING, RETAINER
18. TUBE, PISTON
19. AXLE STUB
20. SPACER
21. SPACER
22. NUT, WHEEL RETAINER
23. PIN, CLEVIS

Figure 32-l. Main Gear Oleo Strut Assembly

MAIN GEAR.

DISASSEMBLY OF MAIN GEAR OLEO. (Refer to Figure 32-1.)

The main gear axle and piston tube assembly may be removed from the cylinder housing with the gear removed from or installed on the airplane. On some airplanes the metering components of the gear that are located in the top of the housing may be removed, but only with the gear removed from the airplane. (Refer to paragraph on Removal of Gear.)

1. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
2. Place a drip pan under the main gear to catch spillage.
3. The gear axle and piston tube assembly may be removed by the following procedure:
   A. Remove the air from the oleo chamber by depressing the air valve core pin found in the inspection hole on top of the wing. After the pressure in the oleo chamber has diminished, remove the valve core pin, attach a small hose to the air valve, and drain the fluid by slowly compressing the piston tube. If it is desirable to extract more fluid from the chamber, remove the filler plug, insert a siphon hose and drain fluid from the upper area of the housing.
   B. Disconnect the flexible brake line at the elbow on the brake assembly.
   C. Disconnect the torque link assembly by removing any one of the three cotter pins, nuts, washers and bolts. Note arrangement of the components for reinstallation. Carefully slide the piston tube from the cylinder housing.
   D. The scraper ring, located inside the lower end of the cylinder housing, may be removed by first removing the retainer ring, spacer ring, and then the scraper ring.
   E. The O-ring seal, located just before the scraper ring, may be removed by using a curved wire or spoon shaped tool and inserting it under the ring.
4. The cylinder head, and in some airplanes the orifice assembly, may be removed by the following procedure:
   A. Cut safety wire and remove the bolts that secure the cylinder head in the top of the housing. Remove the assembly from the housing.
   B. If O-ring was used with cylinder head, remove and discard. If O-ring was not used with cylinder head, remove all traces of sealant from around the cylinder head and top of housing.
   C. The orifice assembly may be removed from within the housing by rotating it counterclockwise out of the housing with the use of a 50 x l 25 stud type spanner wrench (refer to Chapter 95 for Fabricated Orifice Replacement Tool). Do not remove orifice unless it necessitates replacement.

CLEANING, INSPECTION AND REPAIR OF MAIN GEAR OLEO.

1. Clean all parts with a suitable dry type cleaning solvent.
2. Inspect the landing gear oleo components for the following:
   A. Bearing surfaces of housing for excess wear, corrosion, scratches and overall damage.
   B. Retaining ring for cracks, burrs, etc.
   C. Cylinder tube for corrosion, scratches, nicks, excessive wear and misalignment.
   D. Air valve for operation and general condition.
   E. Orifice plate for hole restriction.
3. Repair of the oleo is limited to smoothing out minor scratches, nicks and dents, and replacement of parts.

ASSEMBLY OF MAIN GEAR OLEO. (Refer to Figure 32-l.)

1. Install the orifice assembly, if removed, by the following procedure:
   A. Lubricate with hydraulic fluid (MIL-H-5606) and install an O-ring in the annular slot in the metering orifice.
   B. Insert the orifice through the opening in the top of the gear housing and turn it into the threaded hole web. Tighten the orifice with the use of a stud type spanner wrench.
   C. Apply a thin layer of Permatex Forma-Gasket No. 6 Sealant directly underneath the flange of the cylinder head.

—CAUTION—

Do not cut or dislodge the O-ring in the slot of the orifice.

   D. Insert the tube of the metering assembly through the opening in the top of the housing and into the orifice.
   E. Secure the metering tube assembly with bolts and safety with MS20995-C32 wire.
2. Assemble the components of the piston tube on the tube by placing, in order, the retainer ring, spacer ring and scraper ring. Insert an O-ring into the annular slot in the bottom of the housing.
3. Lubricate the wall of the piston and carefully insert it into the housing being careful not to damage or dislocate the O-ring in the housing.
4. Ascertain that the bushings are installed in the upper and lower torque links. Install the links into their respective ends of the oleo strut and piston tube axle stub, using the appropriate combination of bearing washers and shim washers to allow free action of the links, yet resist side play. Position the brake line bracket and secure the complete assembly with bolt, washers, nut and cotter pins. Insure proper washers are under the head of the bolt and nut. At the connecting point of both upper and lower links, install the spacer washers and brake line bracket, then secure complete assembly with bolt, washers, nut and cotter pin. Insure proper washers are under head of bolt and nut.
5. Slide the scraper and spacer rings into place and secure with the retainer ring in the annular slot in the bottom of the housing.
6. Install the hydraulic brake line.
7. If removed, install the landing gear as described in this section.
8. Service the oleo strut as given in Servicing Oleo Struts, Chapter l2.
9. Actuate the gear several times by hand to be certain it operates freely.

—NOTE—

Links should be loose enough to allow free action of the gear, but also resist side play. To eliminate side play shim washers 63311-03 (.005) may be used as required. Maximum side play .005/.007 of an inch.

10. Remove the drip pan and slowly lower the airplane from the jacks.
11. If necessary, bleed brakes by instructions given in Wheels and Brakes section.

REMOVAL OF MAIN LANDING GEAR. (Refer to Figure 32-2.)

1. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
2. Place a drip pan under the main gear to catch spillage.
3. If desired, remove the air from the oleo chamber by depressing the air valve core pin found in the inspection hole on top of the wing. After the pressure in the oleo chamber has diminished, remove the valve core pin and attach a small hose to the air valve and drain the fluid by slowly compressing the piston tube. If it is desirable to extract more fluid from the chamber, remove the filler plug, insert the siphon hose and drain fluid from the upper area of the housing.
4. Remove the fairing from around the cylinder housing and the access plate located on the bottom of the wing and to the rear of the housing by removing attaching screws.
5. Unhook the hydraulic brake line inside the wing assembly. This is accessible through the access plate. Cap the line by use of a threaded cap or wrapping with plastic.
6. Remove the top four bolts by holding them with a slotted screwdriver and turning the nut with the appropriate wrench. Remove the remaining six by use of a wrench. Carefully remove the gear assembly from the wing.

CLEANING, INSPECTION AND REPAIR OF MAIN LANDING GEAR.

1. Clean all parts with a suitable dry type cleaning solvent.
2. Inspect the gear components for excessive wear, corrosion and damage. Check the cylinder housing and torque links for cracks, nicks and misalignment.
3. Repair of the landing gear is limited to reconditioning of parts, replacement of parts, smoothing out minor nicks and scratches and repainting areas where paint has chipped or peeled.

INSTALLATION OF MAIN LANDING GEAR. (Refer to Figure 32-2.)

1. The main landing gear assembly may be installed on the wing by the following procedure:
   A. Position the gear up in the wing through the access opening and secure with bolts, washers and nuts.
   B. Reconnect the brake line at the point of disconnection.
2. Service the oleo strut as described in Chapter 12.
3. Service the brake system. (Refer to Brake System, Chapter 12.)
4. Install the access plate to the bottom of the wing and the oleo housing fairing to the gear.
5. Slide the drip pan from under the gear and remove the airplane from the jacks.

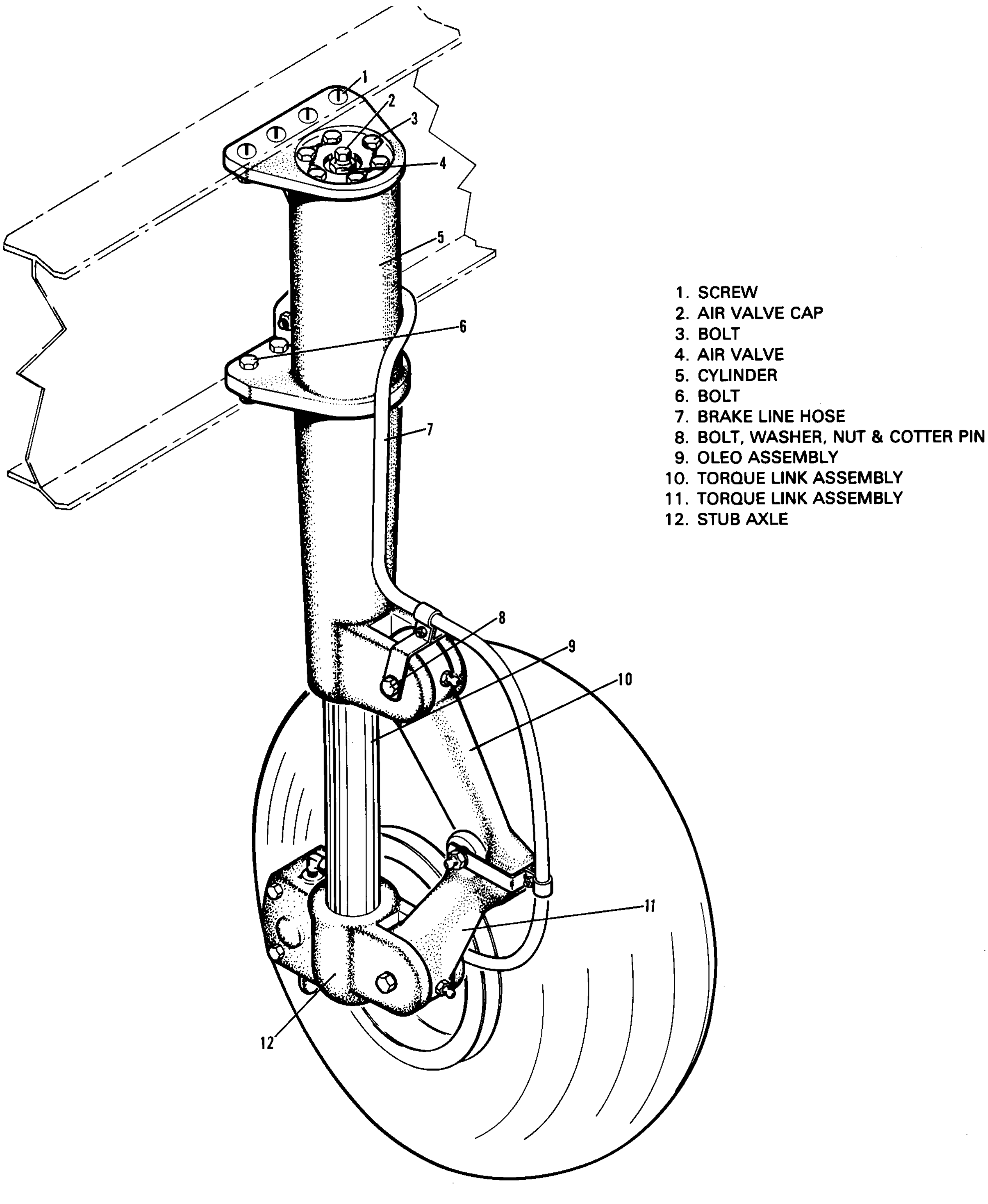


Figure 32-2. Main Gear Installation

NOSE GEAR.

The nose gear housing is an integral part of the engine mount and can not be removed without removing the engine and mount assembly. To service the air-oleo section of the strut, the following procedures should be followed.

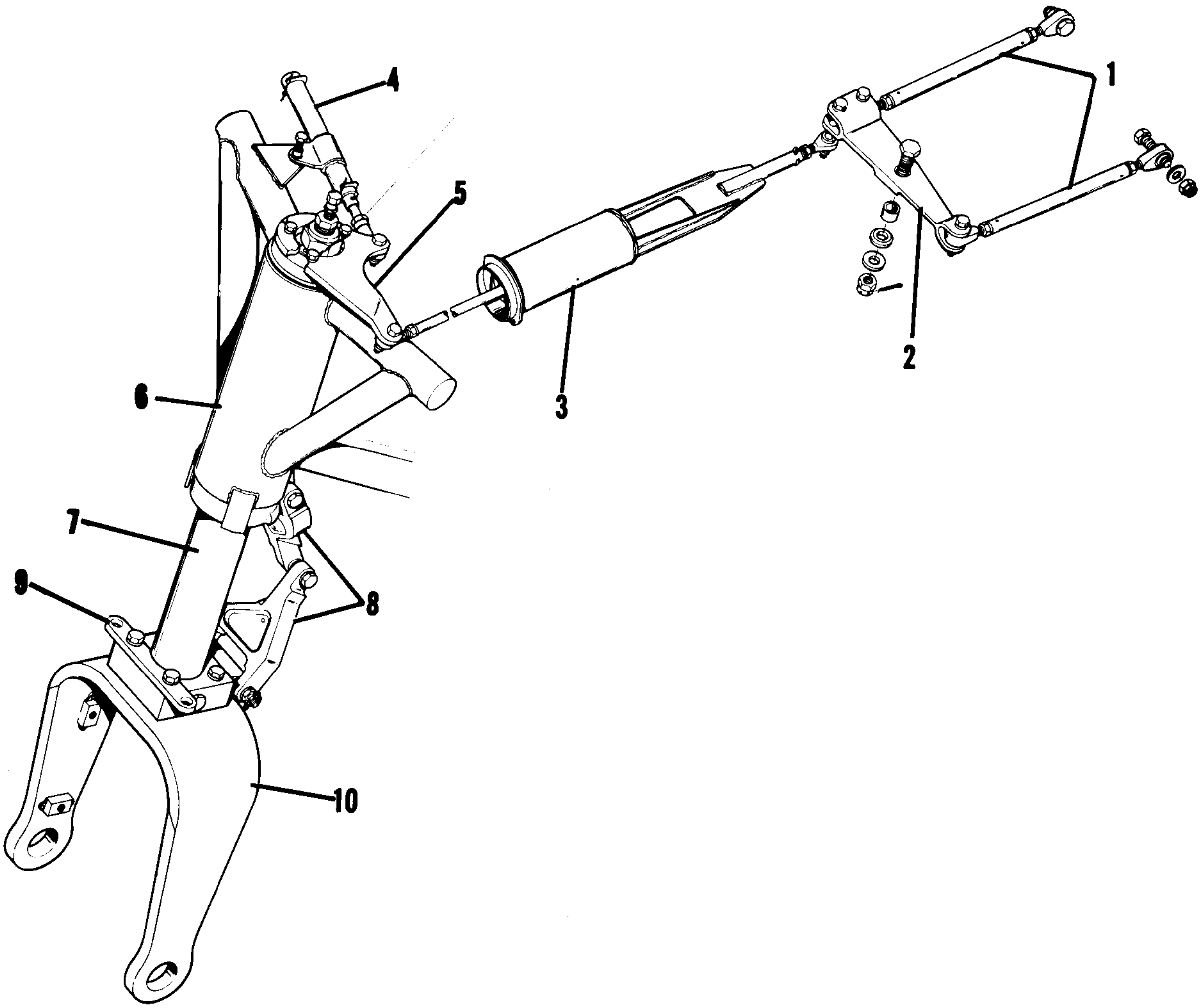
REMOVAL AND DISASSEMBLY OF NOSE GEAR OLEO. (Refer to Figure 32-3.)

1. Remove the engine cowling as described in Chapter 71.
2. Place airplane on jacks as described in Chapter 7.
3. Place a drip pan under the nose gear to catch hydraulic fluid spillage.

—WARNING—

Do not release air pressure in the strut by removing the valve core.

4. Release the air pressure in the strut by depressing the valve core pin until chamber pressure has diminished.
5. Remove the air valve and, with a small hose, siphon as much fluid from the strut as possible. Compressing the piston tube will aid in extracting the fluid.
6. Cut and remove safety wire on the three cap bolts located at the top of the strut and remove the bolts to disconnect the steering arm.
7. With support on the lower strut assembly, release and remove the snap ring and fork assembly from the bottom of the housing. The upper and lower bushings should remain pressed in the housing.
8. To remove the piston tube and fork from the cylinder, first separate the upper and lower torque links by removing the link connecting bolt assembly and separating the two links. Note spacer washer between the two links.
9. Compress the piston tube, reach up along the tube and release the snap ring from the annular slot at the bottom of the oleo housing.
10. Pull the piston tube with components parts from the cylinder.
11. The piston tube components may be removed by reaching in the tube and pushing out the upper bearing retainer pins. Slide from the tube, the upper bearing, lower bearing with outer and inner O-rings, wiper strip, washer and snap ring.



1. NOSE GEAR CONTROL RODS
2. BELLCRANK ASSEMBLY
3. BUNGEE ASSEMBLY
4. NOSE GEAR CENTERING SPRING ASSEMBLY
5. STEERING ARM
6. OUTER GEAR SUPPORT HOUSING
7. PISTON TUBE
8. TORQUE LINKS
9. TOW BAR LINK
10. NOSE WHEEL FORK

Figure 32-3. Nose Gear Installation

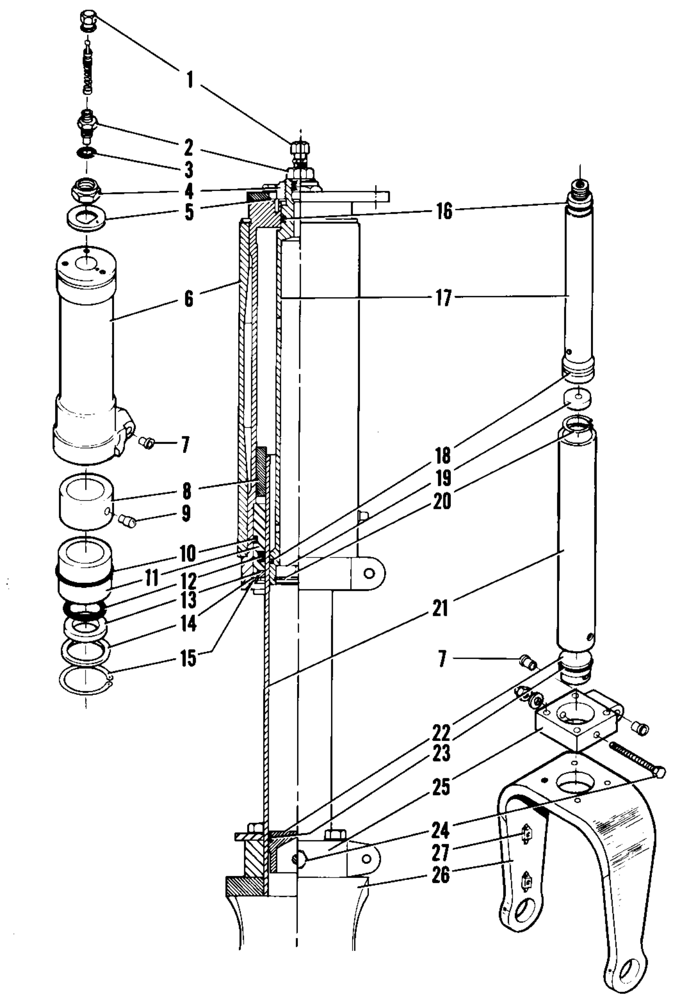
12. To remove the orifice tube, remove the large lock nut and lock washer from the top of the cylinder. Pull the tube from the cylinder.
13. The orifice plate is removed from the bottom of the orifice tube by releasing the snap ring that holds the plate in position.
14. To remove the piston tube plug with O-ring located in the lower end of the tube, remove the bolt assembly and insert a rod up through the hole in the body of the fork. Push the plug out through the top of the tube.

CLEANING, INSPECTION AND REPAIR OF NOSE GEAR OLEO.

1. Clean all parts with suitable dry type cleaning solvent.
2. Inspect the landing gear oleo assembly component for the following: A. Bearings and bushings for excess wear, corrosion, scratches and overall damage. B. Retaining pins for wear and damage. C. Lock rings for cracks, burrs, etc. D. Cylinder and orifice tube for corrosion, scratches, nicks and excess wear. E. Upper and lower cylinder bushings loose or turning in cylinder. F. Orifice plate for hole restriction. G. Fork tube for corrosion, scratches, nicks, dents and misalignment. H. Air valve general condition.
3. Repair of the oleo is limited to smoothing out minor scratches, nicks and dents and replacement of parts.

ASSEMBLY OF NOSE GEAR OLEO. (Refer to Figures 32-3 and 32-4.)

1. Ascertain that parts are cleaned and inspected.
2. To install the piston tube plug, first lubricate the tube plug and O-ring with hydraulic fluid (MIL-H-5606) and install the O-ring on the plug. Lubricate the inside wall of the tube, insert the plug into the top of the tube and push it to the fork end. Align the bolt holes of the fork, tube and plug, and install bolt assembly.
3. If desired, cement a cork in the hole in the bottom of the fork body to prevent dirt from entering between the fork and tube.
4. To assemble the components of the orifice tube, insert the orifice plate into the bottom of the tube, with the countersunk side of the orifice hole exposed. Secure the plate with the snap ring, lubricate and install the O-ring on the upper end of the tube.
5. Insert the orifice tube up through the bottom of the cylinder. With the tube exposed through the top of the cylinder, install the lock washer and insert roll pin through the lock washer into the piston. Install the tube lock nut finger tight at this time.
6. The fork and tube assembly may be assembled by installing the tube components on the tube. In order slide onto the tube, the snap ring, washer, lower bearing with outer and inner O-rings and upper bearing. Align the lock pin holes in the upper bearing with the pin holes in the piston tube and install pins.
7. Lubricate the inner wall of the cylinder with hydraulic fluid. Carefully insert the piston tube assembly into the bottom of the cylinder, allowing the orifice tube to guide itself into the fork tube, until the snap ring can be installed in the annular slot at the bottom of the cylinder. Install wiper strip, slide washer into position and secure assembly with snap ring.



1. AIR VALVE CAP
2. AIR VALVE
3. GASKET
4. FILLER PLUG NUT
5. WASHER
6. TUBE ASSEMBLY - OUTER
7. BEARING
8. BEARING
9. PIN - BEARING RETAINING
10. O-RING
11. BEARING
12. O-RING
13. WIPER RING
14. WASHER
15. SNAP RING
16. O-RING - (MS28775-210)
17. TUBE - OUTER
18. RING - BUTT JOINT
19. PLATE - ORIFICE
20. RING - SNAP
21. TUBE - LOWER
22. PLUG - PISTON TUBE
23. O-RING - (MS28775-218)
24. BOLT, WASHER AND NUT
25. BLOCK ASSEMBLY
26. FORK ASSEMBLY
27. NUT - PLATE
28. NOSE GEAR TORQUE LINKS

Figure 32-4. Nose Gear Oleo Strut Assembly

8. At the top of the cylinder, tighten (torque) the orifice tube lock nut to 500 (min.) 600 (max.) inch-pounds.
9. Ascertain that bushings are installed in the upper and lower torque links and then install both links. The torque link bolt assemblies should be lubricated and installed with the flat of the bolt head hex adjacent to the milled stop on the wide end of the link. Tighten the bolts only tight enough to allow no side play in the link, yet be free enough to rotate.
10. Ascertain that the upper and lower oleo housing bushings are installed. Install the cylinder into the oleo housing, position spacer washer(s) over the top of the cylinder and secure with snap ring. Install spacer washers under lock washer as required to allow only .0 to .015 of an inch play of the cylinder within the housing.
11. At the top of the oleo housing, install on the cylinder the steering arm. Install cap bolts, tighten 20 to 25 inch-pounds torque and safety with MS20995-C40 wire.
12. Lubricate the gear assembly. (Refer to Lubrication Chart, Chapter 12.)
13. Compress and extend the strut several times to ascertain that the strut will operate freely.

—NOTE—

Weight of gear, wheel and fork should allow the strut to extend.

14. Service the oleo strut with fluid and air. (Refer to Chapter 12.)
15. Check nose gear for alignment and gear operation.

ALIGNMENT OF NOSE GEAR. (Refer to Figure 32-5.)

1. Place the airplane on a smooth level floor that will accommodate the striking of a chalk line.
2. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
3. Level the airplane laterally and longitudinally. (Refer to Leveling, Chapter 8.)
4. From the center of the tail skid, extend a plumb bob and mark the contact point on the floor.
5. Extend a chalk line from the mark on the floor below the tail skid to a point approximately three feet forward of the nose wheel. Allow the line to pass under the wheel at the centerline of the tire. Snap the chalk line.
6. Ascertain that the rudder is properly rigged and the rudder cable tension is correct. (Refer to Rigging of Rudder, Chapter 27.)
7. Clamp the rudder pedals to align in a lateral position. (Refer to Figure 32-6.)
8. Ascertain that the nose wheel is in alignment with the longitudinal axis of the airplane or chalk line.
9. Install the steering bungee assembly between the gear steering horn and steering arm without any load on the bungee. Adjust the rod ends to obtain this no load condition, and connect the bungee to the steering horn.

—NOTE—

Check that the rod ends have sufficient thread engagement, by use of the check holes in the rods or a minimum of three-eights of an inch thread engagement.

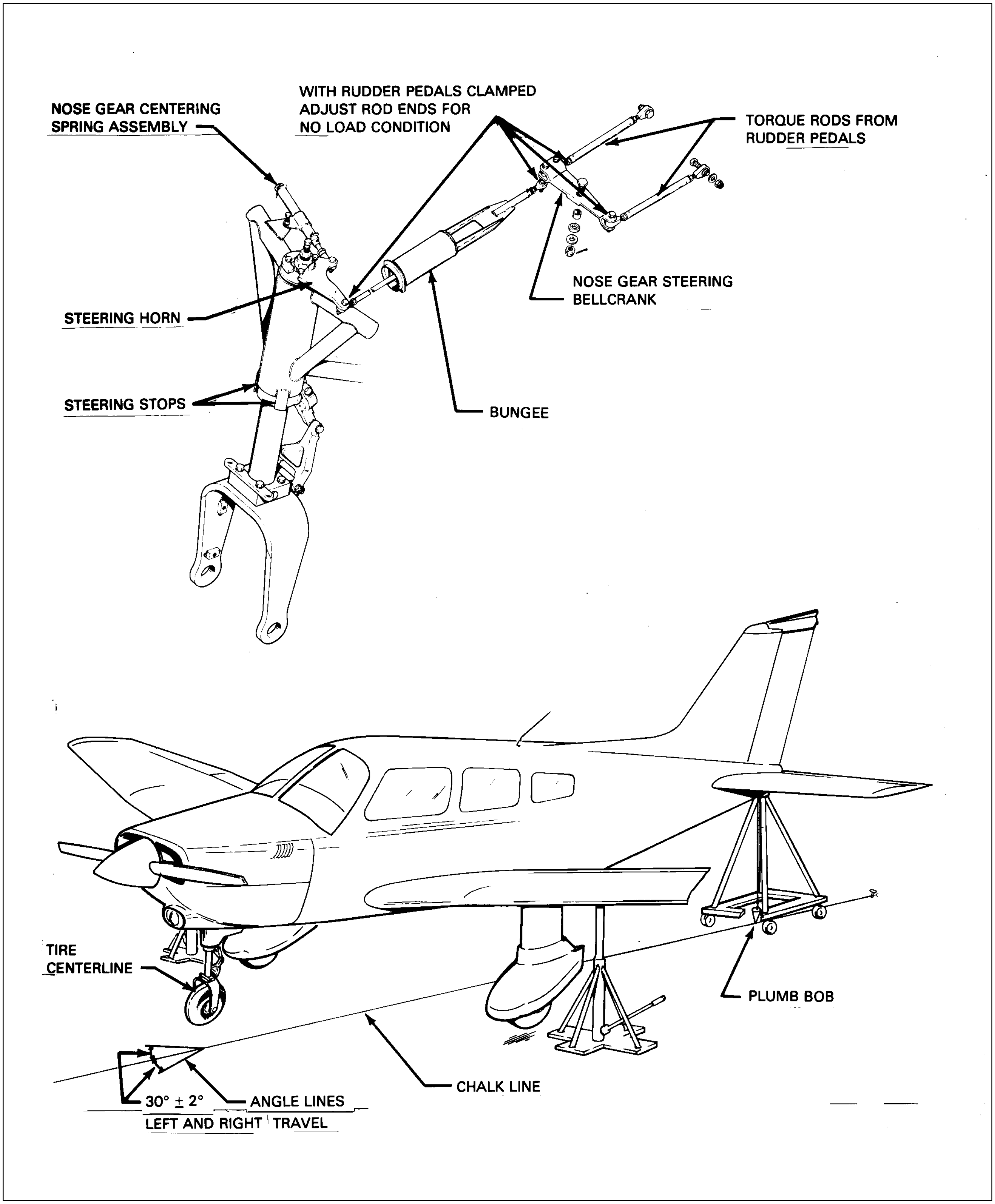


Figure 32-5. Nose Gear Alignment

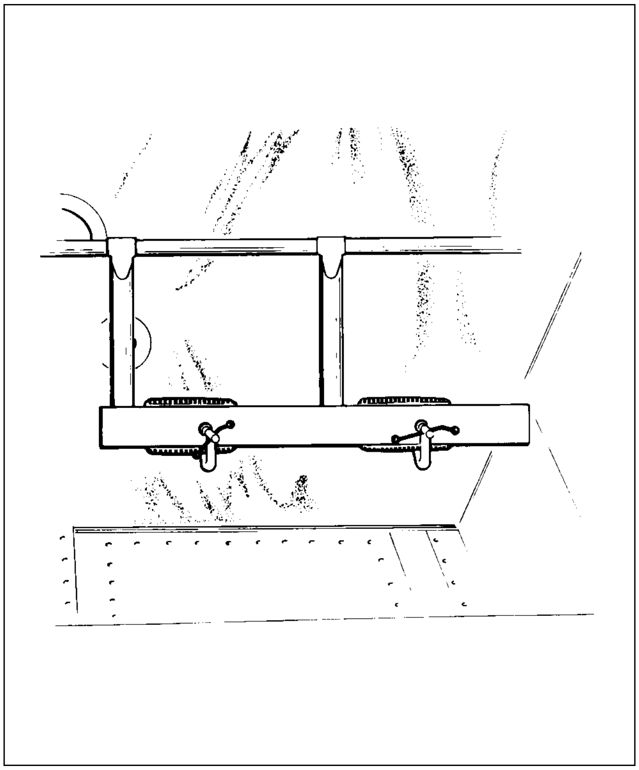


Figure 32-6. Clamping Rudder Pedals in Neutral Position

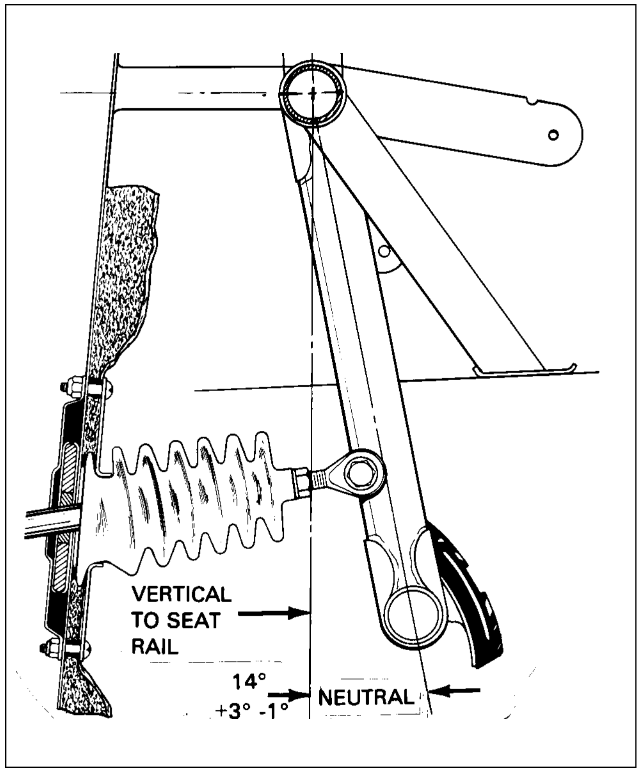


Figure 32-7. Rudder Pedals at Neutral Angle

—NOTE—

Prior to checking and/or making the following adjustment, ascertain that the rudder travel is correct per Rigging and Adjustment of Rudder, Chapter 27.

10. To check the nose gear steering, push pilot's left pedal to its stop for left turn and copilot's right pedal to its stop for right turn. If a gap exists between the fixed stop in the nose gear housing and the strut (whether or not the pedals have reached their stop or the end of their travels and the wheel has turned at least 20° left or right) the steering is correct. If there is no gap at the wheel stops check to see if the rudder stops are contacted prior to the wheel stops, if not, re-rig rudder system per above note before continuing with the nose wheel. If the wheel does not turn at least 20° left or right look for possible damage to rudder bar, steering rods, steering bellcrank, bungee, nose gear centering spring assembly, steering arm, torque links, gear fork or improper rigging of the system.
11. To check nose wheel for its maximum 30° ± 1° left and right travel, turn wheel with the tow bar. Mark on each side of the nose wheel an angle line from the center line and wheel pivot point. Turn the wheel in both directions to check for its maximum travel. Should travel exceed its maximum in one direction check for damaged nose gear housing stop and/ or strut assembly stop and nose gear centering spring assembly. If it does not reach maximum, check for possible damage to bungee and/or nose gear centering spring assembly. If maximum is reached requiring a lot of effort, look for a binding oleo, strut assembly, bungee, steering bellcrank, steering rod, rod end bearings and rudder bar.

12. Install the nose gear centering spring assembly between engine mount pivot point and the steering arm (with the wheel in the forward and aft neutral position) without any load on the spring. Adjust the rod end to obtain this no load condition.
l3. Remove the aircraft from jacks.

WHEELS AND BRAKES.

REMOVAL AND DISASSEMBLY OF MAIN WHEEL. (Refer to Figure 32-8)

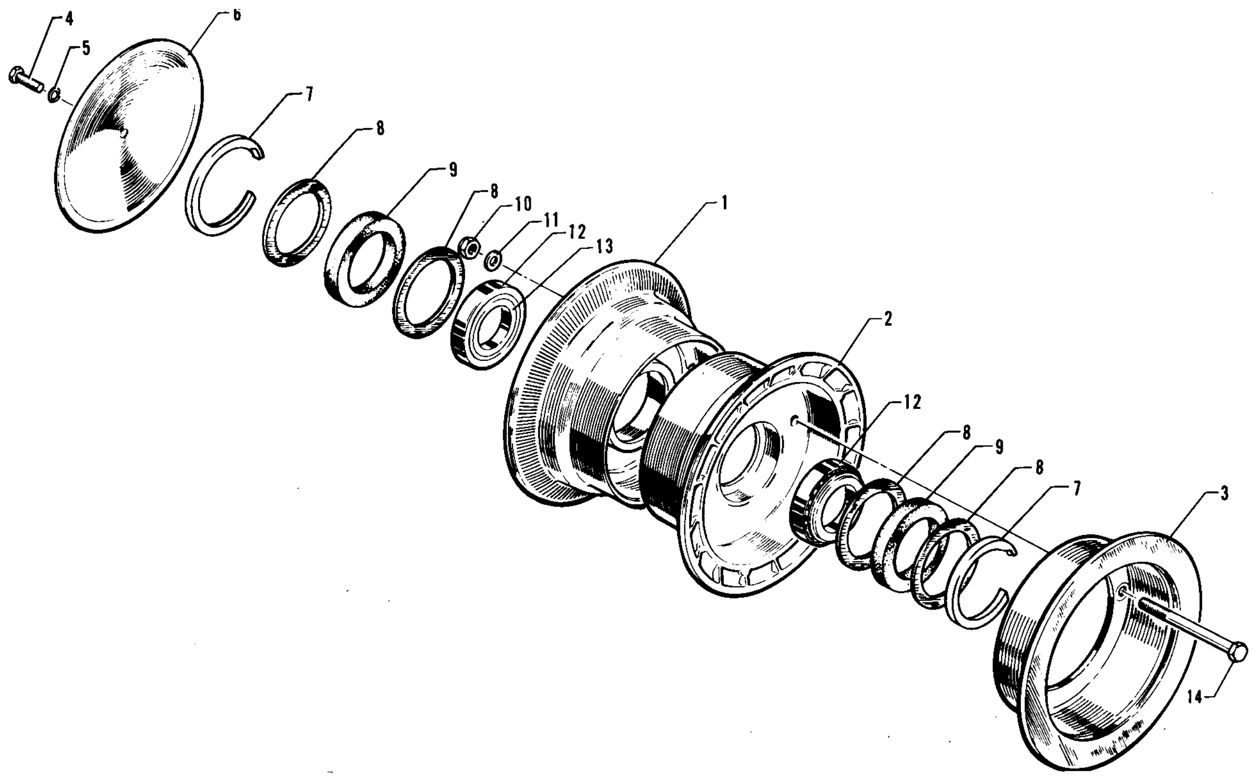
1. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)
2. If the wheel fairing is installed, remove the two fairing attachment bolts on each side of the fairing, and the small plate on top of the fairing; and, slide the fairing up the gear till access can be made to the wheel.
3. To remove the main wheel, remove the wheel fairings if applicable, the two cap bolts that join the brake cylinder housing, and the lining back plate assemblies. Remove the back plate from between brake disc and wheel.
3. Remove the dust cover and wheel nut by removing the cotter pin and flat head pin that safeties the wheel nut. Slide the wheel from the axle.
4. The wheel halves may be separated by first deflating the tire. With the tire sufficiently deflated, remove the wheel through bolts. Pull the wheel halves from the tire by removing the inner half from the tire first, and then the outer half.
5. The wheel bearing assemblies may be removed from each wheel half by first removing the retainer rings or snap rings that secure the grease seal retainers, and then the retainers, grease seals and bearing cone. The bearing cups should not be removed only for replacement and may be removed by tapping out evenly from the inside.

INSPECTION OF MAIN WHEEL ASSEMBLY.

1. Visually check all parts for cracks, distortion, defects and excess wear.
2. Check tie bolts for looseness or failure.
3. Check internal diameter of felt grease seals. Replace the felt grease seal if surface is hard or gritty.
4. Check tire for cuts, internal bruises, and deterioration.
5. Check bearing cones and cups for wear and pitting and relubricate.
6. Replace any wheel casting having visible cracks.

ASSEMBLY AND INSTALLATION OF MAIN WHEEL. (Refer to Figure 32-8.)

1. Ascertain that the bearing cup for each wheel is properly installed. Install the tire with tube on the outer wheel half and then join the two wheel halves. Position the brake disc in the inner wheel half and install the through bolts with the nuts on the valve stem side. Torque wheel nuts to 150 inch-pounds and inflate tire. (Refer to Chart 60l, Chapter 6.)
2. Lubricate the bearing cones and install the cones, grease seals and seal retainer rings. Secure with retainer rings or snap ring. Slide the wheel on the axle and secure with retainer nut. Tighten the nut to allow no side play, yet allow the wheel to rotate freely. Safety the nut with a flat head pin, washer and cotter pin. Reinstall the dust cover.



1. WHEEL HALF
2. WHEEL HALF
3. BRAKE DISC
4. SCREW
5. LOCK WASHER
6. DUST SHIELD
7. RETAINER SNAP RINGS
8. GREASE SEAL RETAINERS
9. GREASE SEAL
10. NUT
11. WASHER
12. BEARING CUP
13. BEARING CONE
14. WHEEL THROUGH BOLT

Figure 32-8. Main Wheel Assembly

4. Position the brake lining back plates between the wheel and brake disc and the brake cylinder on the torque plate. Insert the spacer blocks between the back plates and cylinder, and install the four bolts to secure the assembly. If the brake line was disconnected, reconnect the line and bleed the brakes.

REMOVAL AND DISASSEMBLY OF NOSE WHEEL. (Refer to Figure 32-9.)

1. Jack the airplane enough to raise the nose wheel clear of the ground. (Refer to Jacking, Chapter 7.)
2. If wheel fairing is installed, remove four bolts, two on each side, and the top covers held by metal screws. Slide fairing up on the gear until the wheel is removed.
3. Remove wheel by the following procedure:
   A. Remove the nut and washer from one end of the axle rod and slide out the rod and axle plugs.
   B. Lightly tap the axle tube out from the center of the wheel assembly by use of an object of near equal diameter, and of a soft metal such as brass, copper, or aluminum.

   —NOTE—

   Be certain not to damage the axle tube end in any way. This will make removal and installation extremely difficult.

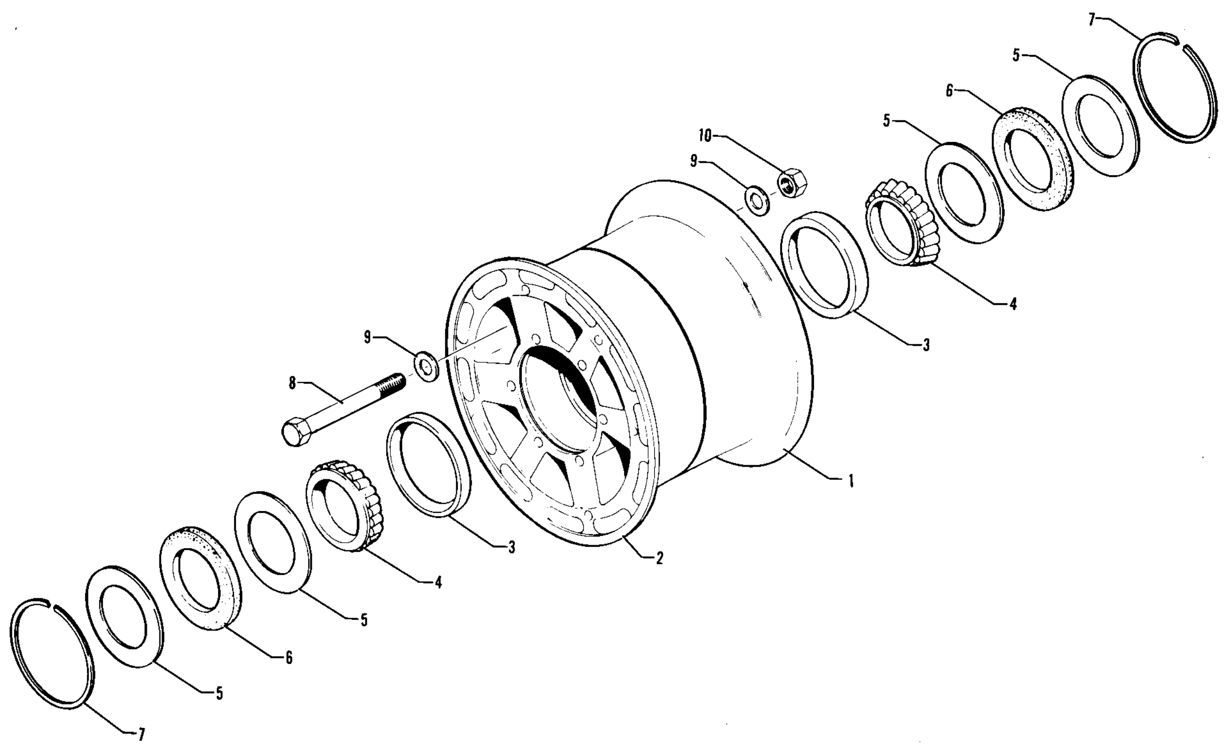
   C. Remove the spacer tubes and the wheel assembly.
   D. Slide down wheel fairing and remove by turning it sideways.
4. The wheel halves may be separated by first deflating the tire. With the tire sufficiently deflated, remove the wheel through bolts. Pull the wheel halves from the tire by removing the wheel half opposite the valve stem first and then the outer half.
5. The wheel bearing assemblies may be removed from each wheel half by first removing the three screws or snap ring which hold in the grease seal and seal retainers, and then the bearing cones. The bearing cup should be removed by tapping out evenly from the inside.

INSPECTION OF NOSE WHEEL ASSEMBLY.

1. Visually check all parts for cracks, distortion, defects and excess wear.
2. Check tie bolts for looseness or failure.
3. Check internal diameter of felt grease seals. Replace the felt grease seal if surface is hard or gritty.
4. Check tire for cuts, internal bruises and deterioration.
5. Check bearing cones and cups for wear and pitting; then relubricate.
6. Replace any wheel casting having visible cracks.

ASSEMBLY AND INSTALLATION OF NOSE WHEEL. (Refer to Figure 32-9.)

1. Ascertain that the bearing cup for each wheel half is properly installed. Install the tire with tube on the wheel half with the valve stem hole and then join the two wheel halves. Install the through bolts with the washers and nuts to the valve stem side, torque nuts to 90 inch-pounds and inflate tire. (Refer to Chart 60l , Chapter 6.)
2. Lubricate the bearing cones and install the cones and grease seal assembly. Secure with the same three screws or snap ring.
3. Replace the wheel fairing by turning sideways and slipping it up over the fork assembly.



1. WHEEL HALF
2. WHEEL HALF
3. BEARING CUP
4. BEARING CONE
5. GREASE SEAL RETAINER
6. GREASE SEAL
7. RETAINER SNAP RING
8. THROUGH BOLT
9. WASHER FOR THROUGH BOLT
10. NUT FOR THROUGH BOLT

Figure 32-9. Nose Wheel Assembly

4. Place the spacer tubes one on each side of the wheel and install unit in fork. Align and slide the axle tube through the spacer tubes and wheel assembly. Reinstall the axle plugs and rod with washer and nut. Tighten the nuts until no side play is felt, yet allowing the wheel to rotate freely.
5. Turn fairing so it will fall into place and reinstall it with four bolts and screws in the top covers.

WHEEL BRAKE ASSEMBLY.

BRAKE ADJUSTMENT AND LINING TOLERANCE.

No adjustment of the brake lining clearance is necessary as they are self-adjusting. Inspection of the lining is necessary, and it may be inspected visually while installed on the airplane. The linings are of the riveted type and should be replaced if the thickness of any one segment becomes worn below 0.100 of an inch or unevenly worn.

REMOVAL AND DISASSEMBLY OF WHEEL BRAKE ASSEMBLY. (Refer to Figure 32-10.)

1. To remove the brake assembly, first disconnect the brake line from the brake cylinder at the tube fitting.
2. Remove the two cap bolts that join the brake cylinder housing and the lining back plate assembly. Remove the back plate from between the brake disc and wheel.
3. Slide the brake cylinder housing from the torque plate.
4. Remove the pressure plate by sliding it off the anchor bolts of the housing.
5. The piston may be removed by injecting low air pressure in the cylinder fluid inlet and forcing the piston from the housing.
6. Check anchor bolt for wear.
7. Remove anchor bolt by the following procedure:
   A. Position cylinder assembly on a holding fixture. (Refer to Figure 32-l1, Step A.)
   B. Use a suitable arbor press to remove the anchor bolt from the cylinder body.
8. Install anchor bolt by the following procedure:
   A. Support anchor bolt in a holding fixture. (Refer to Figure 32-11, Step B.)
   B. Align cylinder body over anchor bolt. (Refer to Figure 32-11, Step C.)
   C. Use a suitable arbor press and apply pressure on the spot face directly over the anchor bolt hole. (Refer to Figure 32-11 Step D.)

CLEANING, INSPECTION AND REPAIR OF WHEEL BRAKE ASSEMBLIES.

1. Clean the assembly with a suitable solvent and dry thoroughly.
2. Check the wall of the cylinder housing and piston for scratches, burrs, corrosion, etc., that may damage O-rings.
3. Check the general condition of the brake bleeder screw and lines.
4. Check the brake disc for wear grooves, scratches, pits or coning beyond .015 in either direction would be cause for replacement. A single groove or isolated grooves up to 0.031 of an inch deep would not necessitate replacement, but a grooving of the entire surface would reduce lining life and should be replaced. Disc minimum thickness is .205 inch. If a powdery rust appears, one or two taxi-braking applications should clear it up. Heavier rust may require removal of the disc so that it may be wire brushed and then sanded with 220 grit sandpaper.

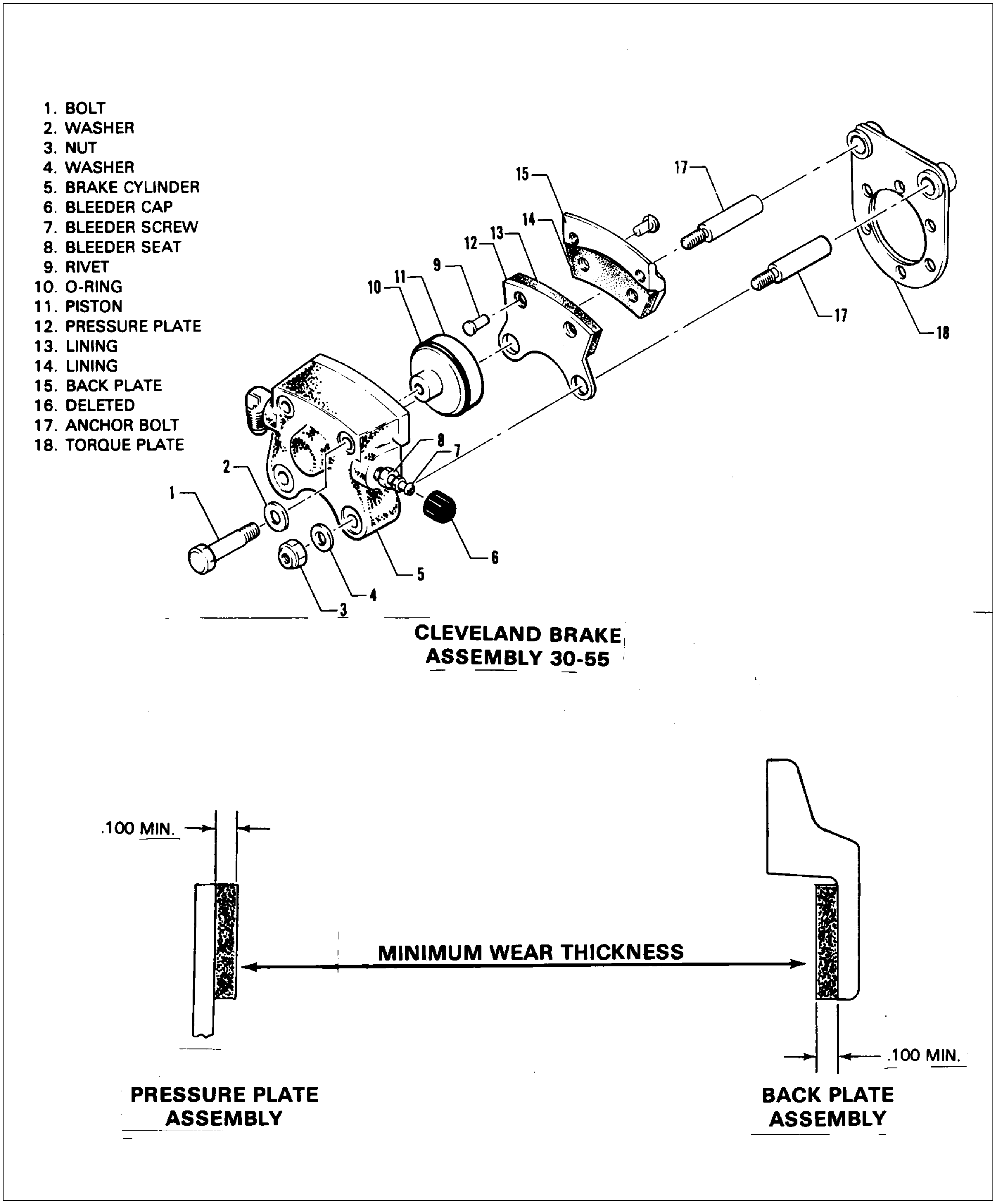


Figure 32-l0. Wheel Brake Assembly (30-55)

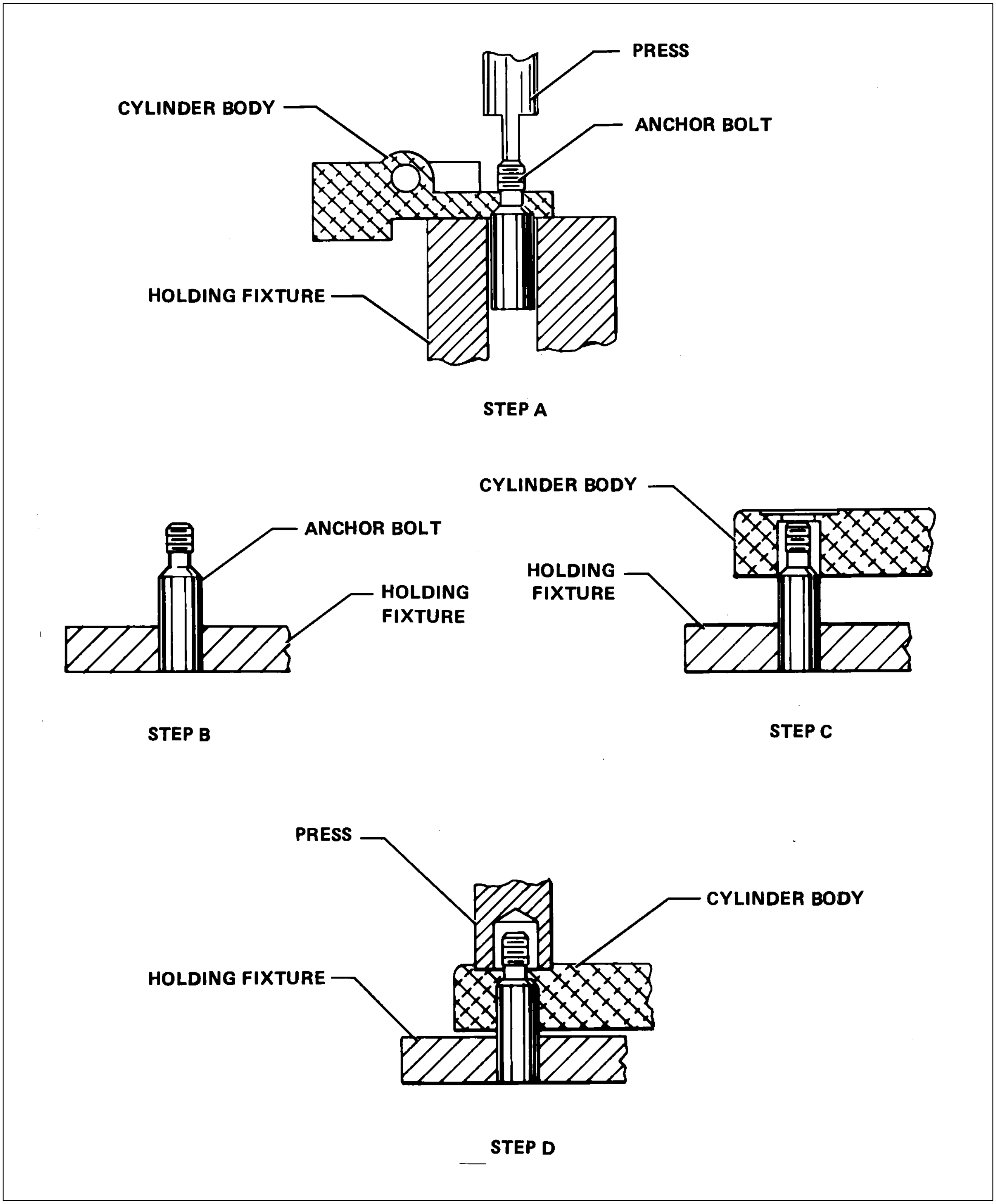


Figure 32-11. Removal and Installation of Anchor Bolts

5. Lining may be removed from backing plates by drilling or punching out the old rivets, and installing a new set using the proper rivets and a rivet set that will properly stake the lining and form a correct flare of the rivet. (A rivet setting kit is available through the Piper Dealers under part number 754 165.)
6. After installing new linings, they should be conditioned by performing a minimum of six light pedal effort braking applications from 25 to 40 MPH, allowing the discs to partially cool between stops.

CHART 3203. TROUBLESHOOTING (BRAKE SYSTEM)

Trouble	Cause	Remedy
Unable to obtain sufficient hydraulic brake pressure; excessive lever and/or pedal travel.	Air in system.	Bleed the system.
	Fluid leak in system.	Locate and repair.
	Defective master or toe brake cylinder.	Repair cylinder.
Brakes do not hold.	Oil or grease on lining.	Replace brake lining.
Brakes drag.	Piston cocked in cylinder.	Repair the piston and cylinder.
	Foreign matter wedged in brakes.	Inspect brake and remove any foreign matter.
	Back pressure due to malfunction of master cylinder.	Repair master cylinder.
	Water or ice in system - (wintertime only).	Flush the system.

ASSEMBLY AND INSTALLATION OF WHEEL BRAKE ASSEMBLY. (Refer to Figure 32-10.)

1. Lubricate the piston O-ring with fluid (MIL-H-5606) and install on piston. Slide the piston in cylinder housing until flush with surface of housing.
2. Slide the lining pressure plate onto the anchor bolts of the housing.
3. Slide the cylinder housing assembly on the torque plate of the gear.
4. Position the lining back plate between the wheel and brake disc. Install the two bolts to secure the assembly.
5. Connect the brake line to the brake cylinder housing.
6. Bleed the brake system.

BRAKE MASTER CYLINDER. (Hand/Parking Brake)

REMOVAL OF BRAKE MASTER CYLINDER. (Hand Brake) (Refer to Figure 32-12.)

1. To remove the brake master cylinder, first disconnect the inlet supply line from the fitting at the top of the cylinder and allow fluid to drain from the reservoir and line into a suitable container.
2. Disconnect the pressure line from the fitting on the cylinder and allow fluid to drain from the cylinder line.
3. Disconnect the end of the cylinder rod from the brake handle by removing the cotter pin that safeties the connecting clevis pin. Remove the clevis pin and spacer washers.
4. Disconnect the base of the cylinder from its mounting bracket by removing the attaching bolt assembly.
5. The handle assembly may be removed by removing the attaching bolt assembly that secures the handle' to its mounting bracket.

DISASSEMBLY OF BRAKE MASTER CYLINDER. (Refer to Figure 32-13.)

1. Remove the cylinder from its mounting bracket.
2. To disassemble the cylinder, first remove the piston rod assembly by removing the snap ring from the annular slot at the rod end of the cylinder. Draw the piston rod assembly from the cylinder.
3. The piston rod assembly may be disassembled by first removing the small snap ring securing the retainer bushing, spring, piston, seal, gland and, if desired, the large retainer spring.
4. Remove the O-rings from the piston and gland.

CLEANING, INSPECTION AND REPAIR OF BRAKE MASTER CYLINDER.

1. Clean the cylinder parts with a suitable solvent and dry thoroughly.
2. Inspect the interior walls of the cylinder for scratches, burrs, corrosion, etc.
3. Inspect the general condition of the fitting threads of the cylinder.
4. Check the piston for scratches, burrs, corrosion, etc.
5. Repairs to the cylinder are limited to polishing out small scratches, burrs, etc. and O-rings.

ASSEMBLY OF BRAKE MASTER CYLINDER. (Refer to Figure 32-13.)

—NOTE—

Use a small amount of hydraulic fluid (MIL-H-5606) on the O-ring and component parts to prevent damage and ease of handling during reassembly.

1. Install new O-ring on the inside and outside of the packing gland and on the outside of the piston. (When installing teflon O-ring on piston, it is recommended that it be installed with the use of a cone placed against the piston. The cone may be constructed of plastic or metal with dimensions shown in Figure 32-13.)

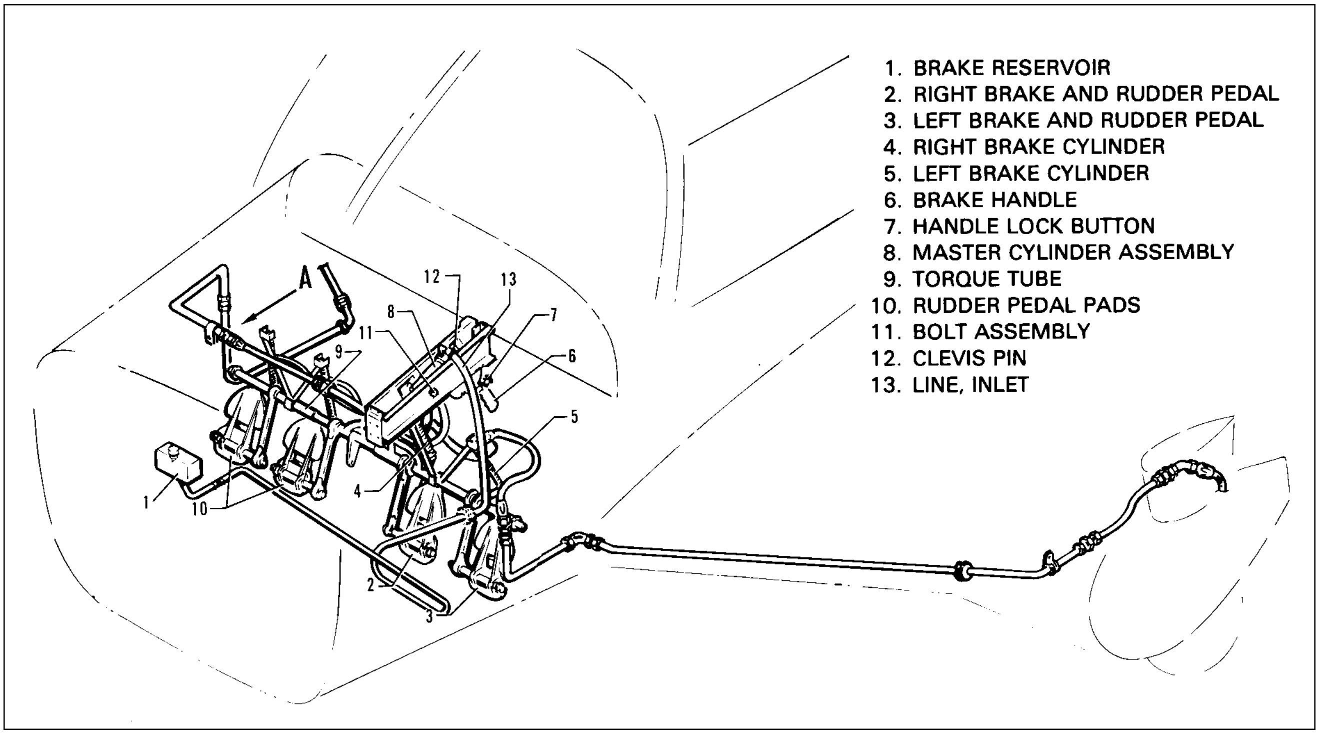


Figure 32-12. Brake System Installation

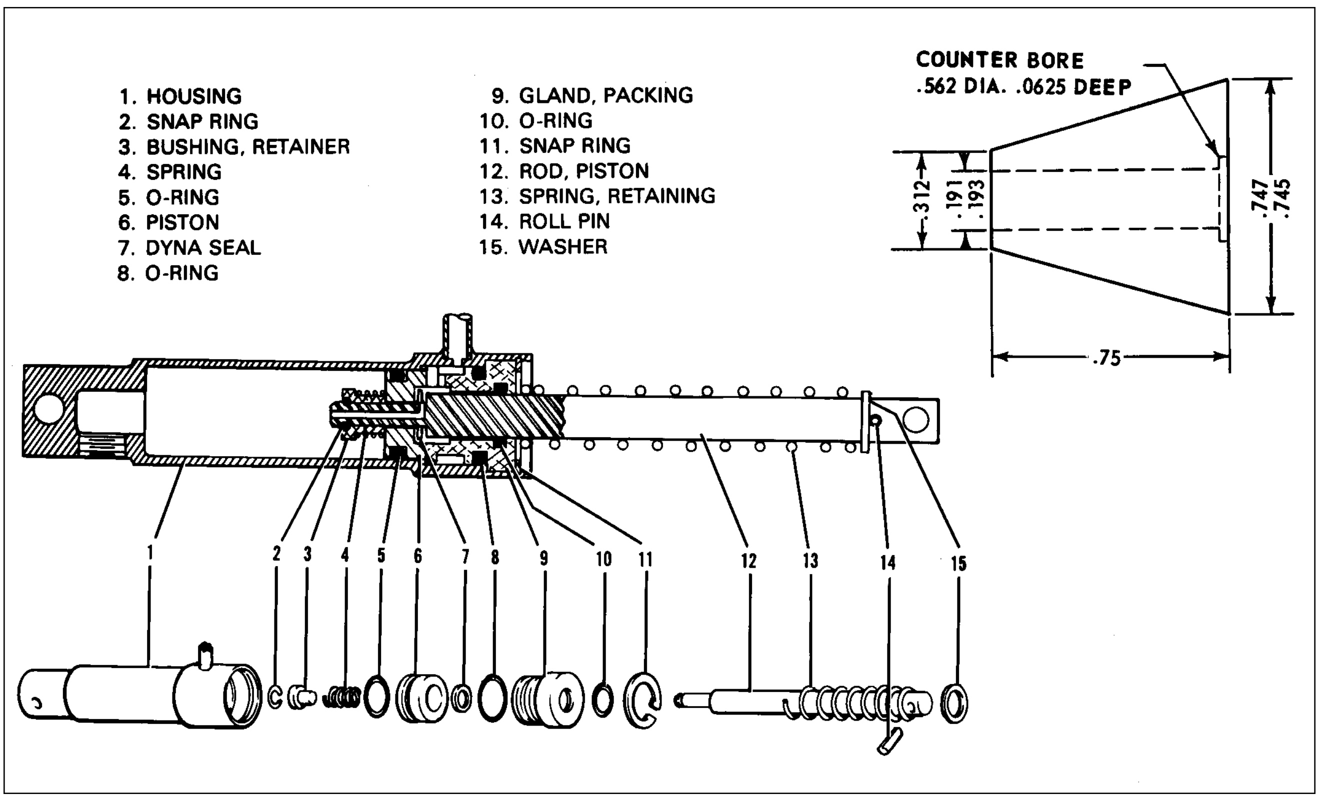


Figure 32-13. Brake Master Cylinder (Hand/Parking Brake)

2. To assemble the piston rod assembly, install on the rod, in order, the roll pins, return spring retainer washer, retaining spring, packing gland with O-rings, seal, piston with O-ring, spring and retainer bushing. Secure these pieces with snap ring on the end of the rod.
3. Insert the piston rod assembly in the housing and secure packing gland with snap ring.
4. Install the cylinder.

INSTALLATION OF BRAKE MASTER CYLINDER. (Hand/Brake) (Refer to Figure 32-12.)

1. Install the brake handle assembly between its mounting bracket and secure with bolt, washers, nut and cotter pin. Washers should be placed on each side of the handle, between the bracket, and under the nut.
2. Place the cylinder between the mounting bracket and secure the base end with bolt, washers, nut and cotter pin. This, too, should have washers placed on each side of the cylinder and under the nut.
3. Connect the rod end of the cylinder to the brake handle with a clevis pin and thin washers. Safety the clevis with a cotter pin.
4. Connect the pressure line to the fitting at the bottom of the cylinder.
5. Connect the inlet supply line to the fitting at the top of the cylinder and secure with spring clamp.
6. Bleed the brake system.

TOE BRAKE CYLINDER(S).

REMOVAL OF BRAKE CYLINDER. (Refer to Figure 32-14.)

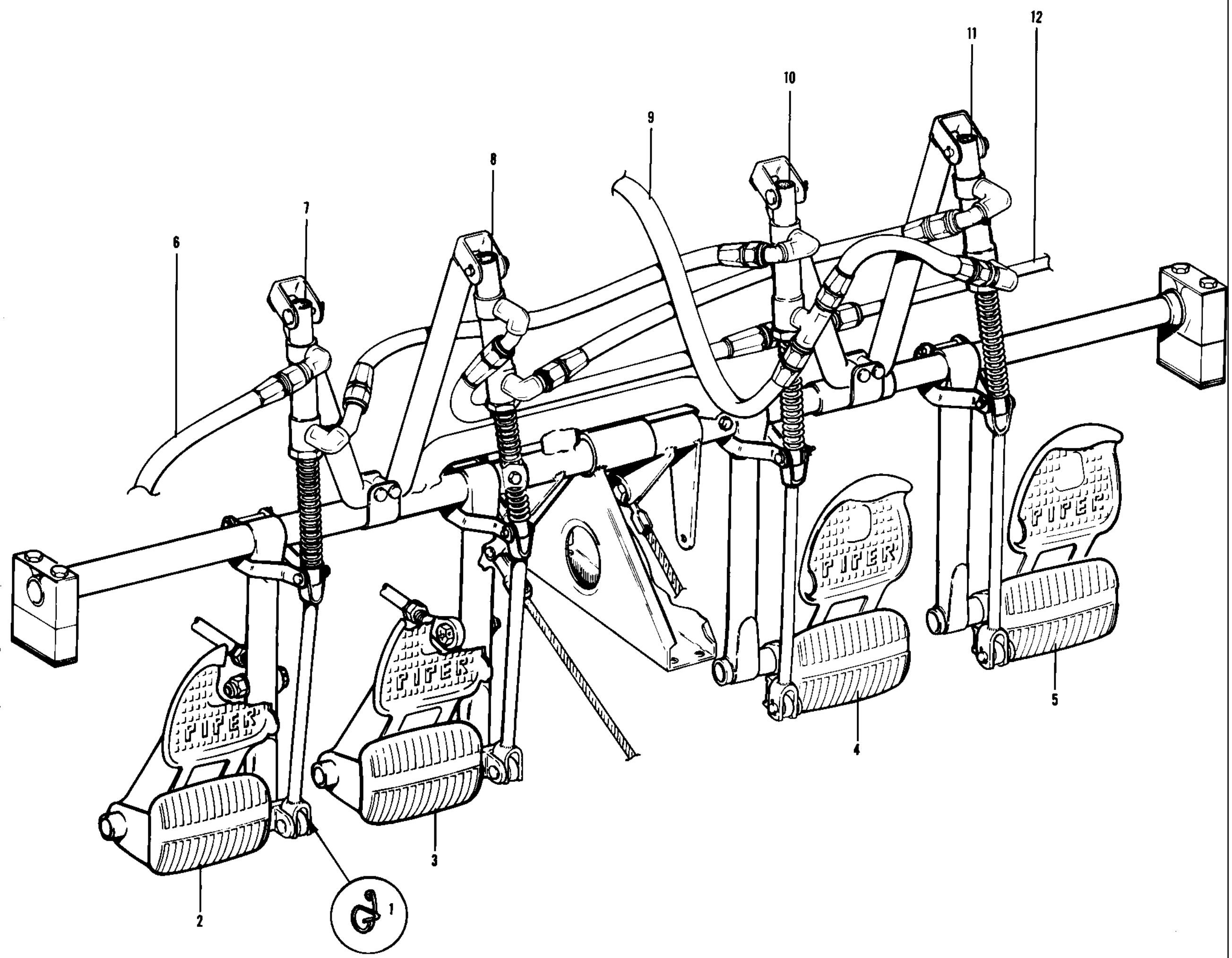
1. Disconnect the upper and lower lines from the cylinder to be removed and cap the lines to prevent fluid leakage or drain the fluid from the brake reservoir and master cylinder.
2. Remove the cylinder from its attachment fittings by first removing cotter pins that safety the cylinder attaching pins and then removing the pins.

DISASSEMBLY OF BRAKE CYLINDER. (Refer to Figure 32-15.)

1. Remove the cylinder from its mounting bracket.
2. To disassemble the cylinder, first remove the piston rod assembly by unscrewing the fitting from the cylinder.
3. The piston rod assembly may be disassembled by first removing the retaining ring securing the sleeve and then removing the spring, piston, seal, fitting and, if desired, the large return spring.
4. Remove the O-rings from the piston and fitting.

CLEANING, INSPECTION AND REPAIR OF BRAKE CYLINDER.

1. Clean the cylinder parts with a suitable solvent and dry thoroughly.
2. Inspect the interior walls of the cylinder for scratches, burrs, corrosion, etc.
3. Inspect the general condition of the fitting threads of the cylinder.
4. Check the piston and valve for scratches, burrs, corrosion, etc.
5. Repairs to the cylinder are limited to polishing out small scratches, burrs, etc. and replacing valve, washer, seal, and O-rings.



1. PEDAL RETURN SPRING
2. RUDDER PEDAL (PILOT)
3. RUDDER PEDAL (PILOT)
4. RUDDER PEDAL (COPILOT)
5. RUDDER PEDAL (COPILOT)
6. LINE TO LEFT WHEEL BRAKE
7. LEFT PILOT'S BRAKE CYLINDER
8. RIGHT PILOT'S BRAKE CYLINDER
9. LINE TO HAND BRAKE
10. LEFT COPILOT'S BRAKE CYLINDER
11. RIGHT COPILOT'S BRAKE CYLINDER
12. LINE TO RIGHT WHEEL BRAKE

Figure 32-14. Toe Brake Installation

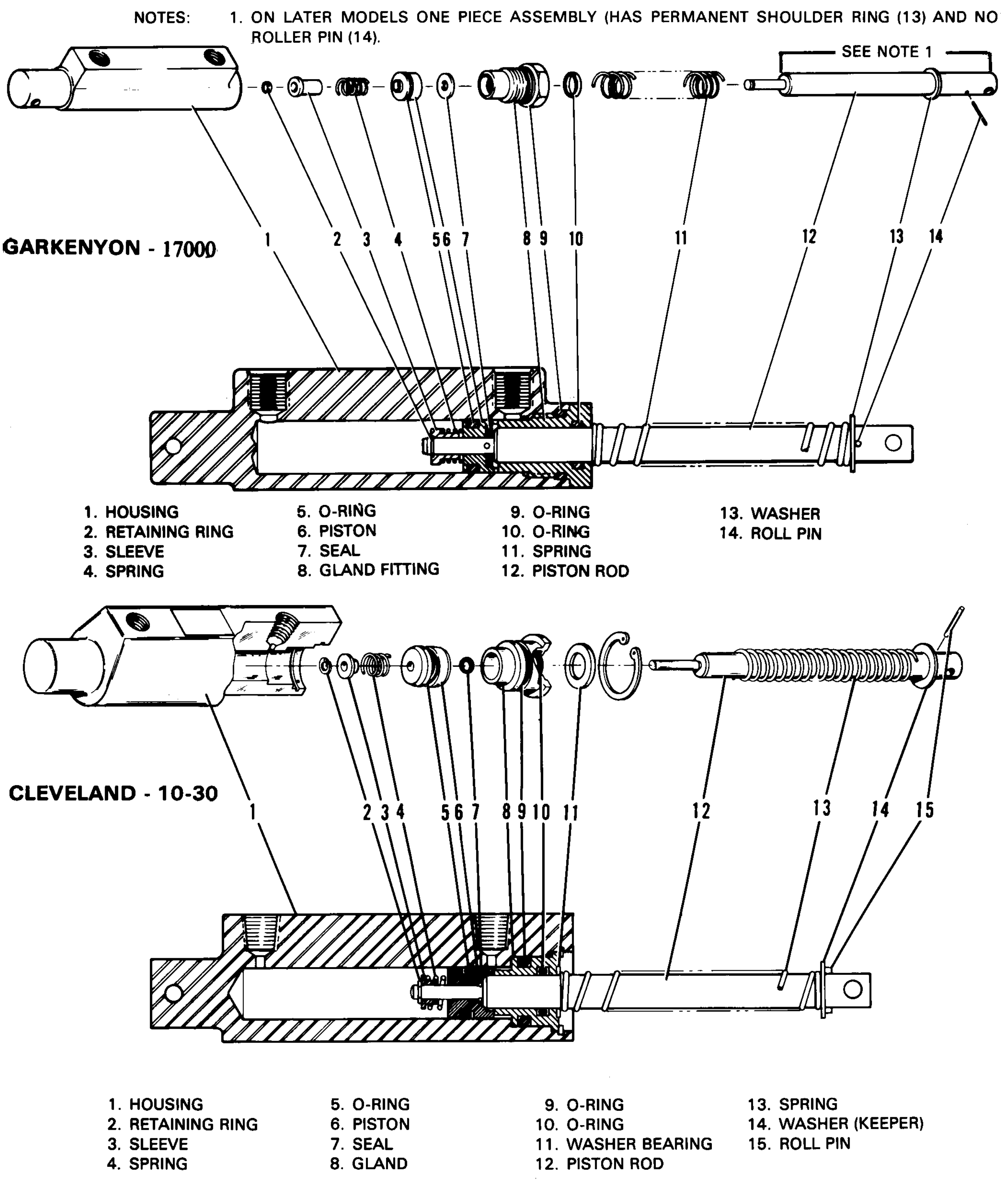


Figure 32-15. Toe Brake Cylinders

ASSEMBLY OF BRAKE CYLINDER. (Refer to Figure 32-l5.)

l. Cleveland cylinder number 10-30.

—NOTE—

Use a small amount of hydraulic fluid (MIL-H-5606) on the O-ring and component parts to prevent damage and ease of handling during reassembly.

A. Install new O-rings on the inside and outside of the packing gland and on the outside of the piston.
B. To assemble the piston rod assembly, install on the rod, in order, the roll pin, washer, spring, washer, packing gland, seal, piston assembly and spring.
C. Insert the piston rod assembly in the cylinder and secure with the snap ring.
D. Install the cylinder.

2. Gar-Kenyon cylinder number 17000.
A. Install new O-rings on the inside and outside of the fitting and on the outside of the piston. (Refer to above note.)
B. To assemble the piston rod assembly, install on the rod, in order, the roll pin and return spring washer on older models. Then, install on all models the return spring, fitting with O-rings, seal, piston with O-ring, spring and sleeve. Secure these pieces with the retaining ring on the end of the rod.
C. Insert the piston rod assembly in the cylinder and secure fitting.
D. Install the cylinder.

INSTALLATION OF BRAKE CYLINDER. (Refer to Figure 32-14.)

1. Position the cylinder at its mounting points and attach with clevis pins. Safety the pins with cotter pins.
2. Connect the brake lines to the cylinder fittings.
3. Bleed the brakes.

BLEEDING BRAKES.

BLEEDING PROCEDURE. (Gravity) (Refer to Figure 32-l6.)

1. Attach a clean, clear plastic tube to the brake bleeder of the right landing gear. Extend the free end of the tube to a container partially filled with hydraulic fluid (MIL-H-5606). Determine that the end of the tube is submerged in the fluid. Open the bleeder l /2 to 1 turn.
2. Fill the brake fluid reservoir located on the fire wall with hydraulic fluid.
3. Check to determine the right hand toe brake pedal(s) in the cockpit have been pulled full aft.
4. Pull the hand brake handle and slowly pump the master cylinder approximately 50 times or until hydraulic fluid is observed passing through the plastic tube at the brake bleeder.

—NOTE—

Fluid level in the reservoir must be maintained to prevent air from entering the system.

5. Pump right brake cylinder very slowly approximately 12 times. This will purge air from the toe brake cylinder system. Watch for any air forced through the clear plastic tube during this operation to insure air has been forced from the toe brake system.
6. Pump the hand brake an additional 25 times or until no air is observed through the clear plastic tube.
7. Tighten brake bleeder and remove the plastic tube.
8. Repeat steps a through f to the left main landing gear.

BLEEDING PROCEDURE. (Pressure) (Refer to Figure 32-17.)

l Place a clean, clear plastic tube on the vent fitting on top of the brake fluid reservoir. Extend the free end of the tube to a container partially filled with hydraulic fluid (MIL-H-5606). Be certain the end of the tube is submerged in the fluid.
2. Attach another clear plastic tube to the brake bleeder of the right landing gear. Connect the free end of this tube to the pressure source. Open the bleeder I to 2 turns and pressure fill the system with fluid.
3. With fluid continually flowing through the system, SLOWLY and simultaneously actuate the hand brake and toe brake pedal, of the side being bled, several times to purge the cylinders of air. On dual brake installations, both pedals for the brake being bled must be actuated.

—NOTE—

By watching the fluid pass through the plastic hose at the fluid reservoir and the bleeder fitting on the gear being bled, it can be determined whether any air is left in the system. If air bubbles are evident, filling of the system shall be continued until all the air is out of the system and a steady flow of fluid is obtained. Should the brake handle remain spongy, it may be necessary to disconnect the bottom of the toe brake cylinders (next to the pedal) and rotating the cylinder horizontally or even above horizontal and by use of the hand brake alone, purge the air from the system.

4. Close the open bleeder fitting to which the pressure hose is attached. Do not remove the tube from the fluid reservoir until both brakes have been bled. Check the brakes on the side being bled for proper pedal pressure. Replace cap on bleeder fitting.

—NOTE—

It may be necessary to remove any trapped air in the top of the wheel brake unit by applying pressure to the system with the brake hand lever and slowly opening the bleeder and release the hand lever

5. Repeat steps 2 through 4 to the left main landing gear.
6. Drain excess fluid from the reservoir to fluid level with a syringe.

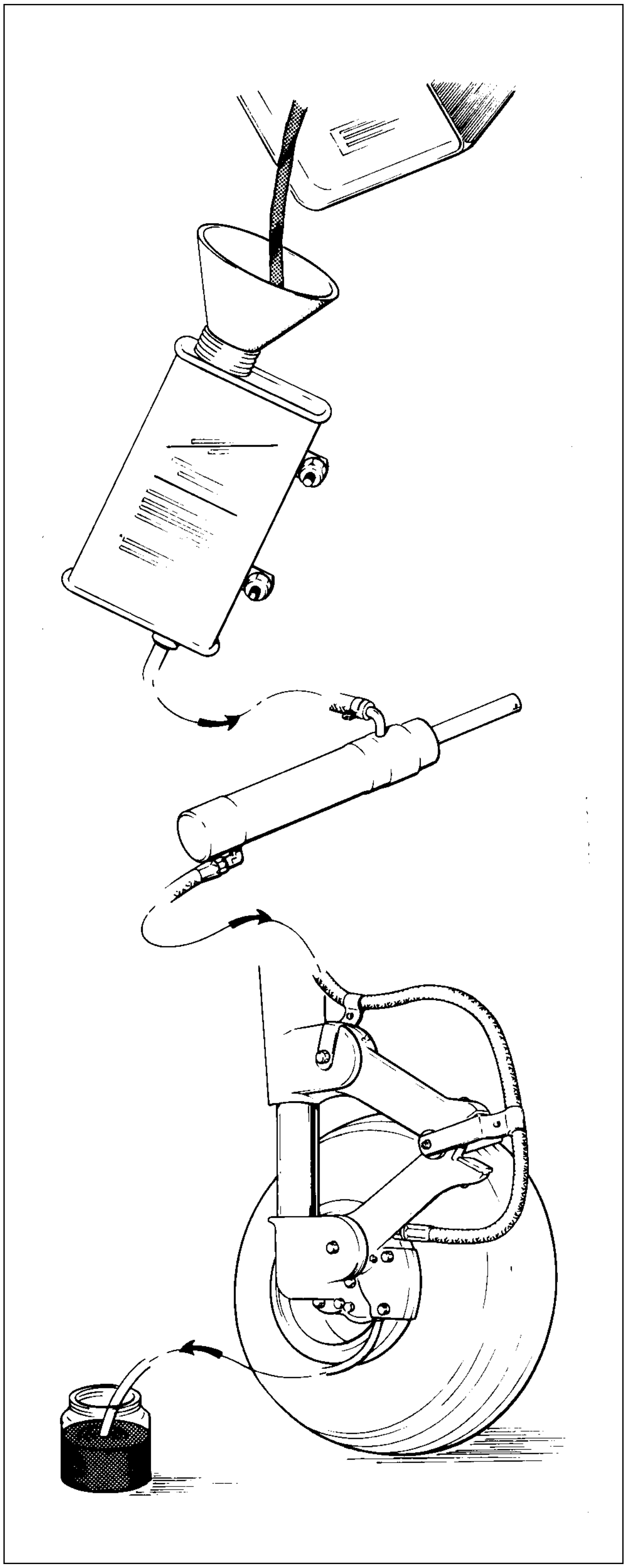


Figure 32-16. Bleeding Brakes (Gravity)

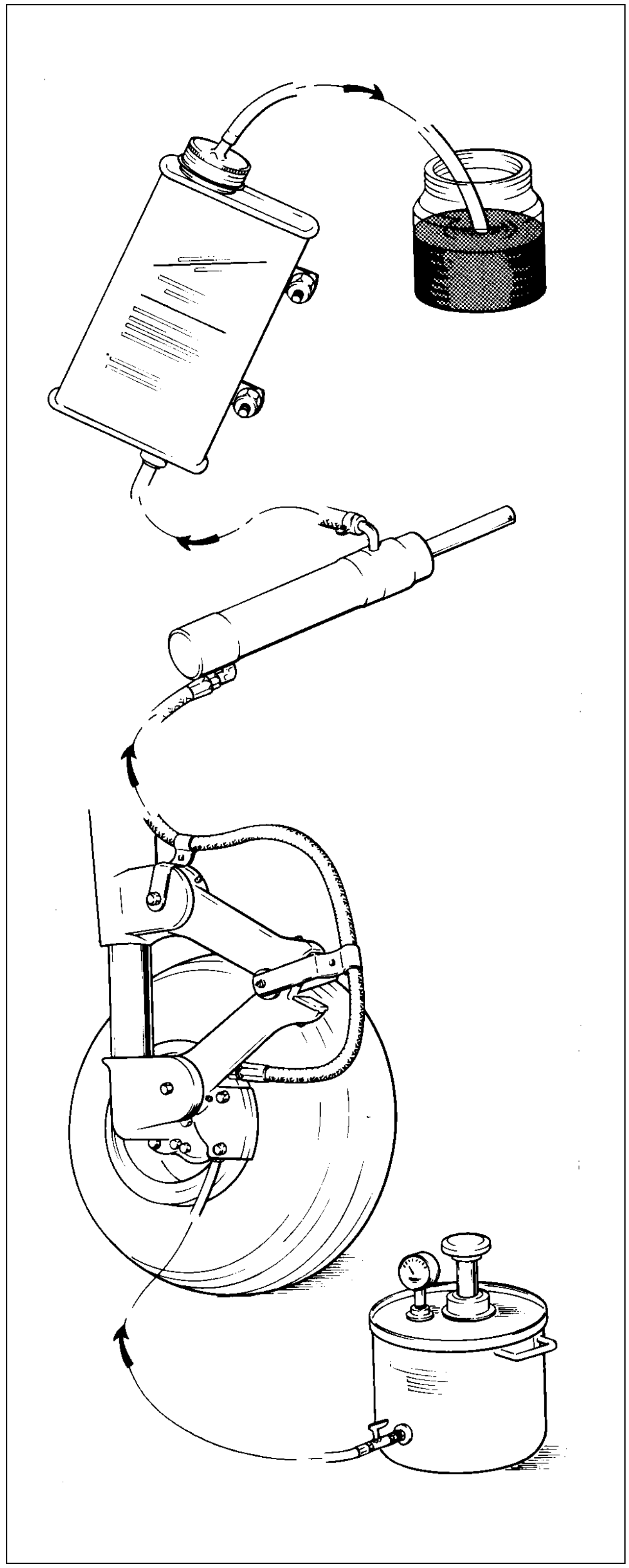


Figure 32-17.Bleeding Brakes (Pressure)

BRAKE SYSTEM LEAK CHECK.

Pull for a good, firm hand brake and lock parking brake mechanism. Allow system to stand for approximately 10 minutes, then by gripping the park brake handle it should not be able to be pulled aft further than the original set. Should the handle be able to be pulled towards the panel and feel spongy, a leak is present at some point in the system. This leak may appear at any one of the connections throughout the system or internally in the master brake cylinder of wheel brake assemblies.

BLEEDING BRAKES AFTER UNIT IS CHANGED.

1. Actuate the hand brake handle until some pressure builds up in the system. At this time, crack the attaching B nuts at any of the hose connections of the replaced unit. Most of the handle sponge feeling should be displaced by this action.
2. Actuate the master cylinder and the toe brake cylinder of the side unit was changed and bleed fluid through the brake assembly on the wheel by pumping pressure and cracking bleeder until pressure drops.

—CAUTION—

Do not allow pressure to bleed off before closing bleeders, for this will allow air to enter the system. Repeat the pumping and bleeding approximately 10 or more times or until all the air is released from the system. During all bleeding, fluid level of the reservoir must be maintained

—END—

TURBO DAKOTA

MAINTENANCE MANUAL

CARD 2 OF 2

PA-28-201T

PIPER AIRCRAFT CORPORATION

(PART NUMBER 761 702)

INTRODUCTION.

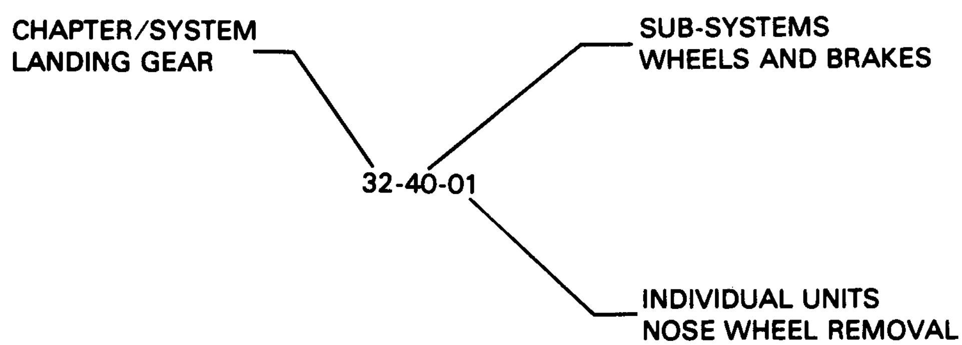
This PIPER AIRCRAFT Maintenance Manual is prepared in accordance with the GAMA (General Aviation Manufacturers Association) format. This maintenance manual is divided into various Groups which enable a broad separation of contents (Chapters) within each group.

The various Chapters are broken down into major systems such as Electrical Power, Flight Controls, Fuel, Landing Gear, etc. The System/Chapters are arranged more or less alphabetically rather than by precedence or importance. All System/Chapters are assigned a number, which becomes the first element of a standardized numbering system. Thus the element "32" of the number series 32-00-00 refers to the System/Chapter on "Landing Gear." All information pertaining to the landing gear will be covered in this System/Chapter.

The major System/Chapters are then broken down into Sub-System/Sections. These sections are identified by the second element of the standardized numbering system. The number "40" of the basic number series 32-40-00 is for the "Wheels and Brakes" portion of the landing gear.

The individual units within a Sub-System/Section may be identified by a third element of the standardized numbering system, such as 32-40-01. This number could be assigned by the manufacturer to fit the coverage requirements of the publication.

Example:



This manual does not contain hardware callouts for installation. Hardware callouts are only indicated where a special application is required. To confirm the correct hardware used, refer to the PA-28-201T Parts Catalog P/N 761 701, and FAR 43 for proper utilization.

AEROFICHE EXPLANATION AND REVISION STATUS

The Maintenance Manual information incorporated in this set of Aerofiche cards has been arranged in accordance with the general specifications of Aerofiche adopted by the General Aircraft Manufacturer's Association, (GAMA). The information compiled in this Aerofiche Maintenance Manual will be kept current by revisions distributed periodically. These revisions will supersede all previous revisions and will be complete Aerofiche card replacements and shall supersede Aerofiche cards of the same number in the set.

Conversion of Aerofiche alpha/numeric code numbers:
First number is the Aerofiche card number.
Letter is the horizontal line reference per card.
Second number is the vertical line reference per card.
Example: 2J16 = Aerofiche card number two of given set, Grid location J16.

To aid in locating the various chapters and related service information desired, the following is provided:

1. A complete manual System/Chapter Index Guide is for all fiche in this set.
2. A complete list of Illustrations is for all fiche in this set following System/Chapter Index.
3. A complete list of Charts is for all fiche in this set following list of Illustrations.
4. A complete list of paragraph titles and appropriate Grid location numbers is given at the beginning of each Chapter relating to the information within that Chapter.
5. Identification of Revised Material:

   Revised text and illustrations are indicated by a black vertical line along the left-hand margin of the frame, opposite revised, added or deleted material. Revision lines indicate only current revisions with changes and additions to or deletions of existing text and illustrations. Changes in capitalization, spelling, punctuation, indexing, the physical location of the material or complete page additions are not identified by revision lines.

   A reference and record of the material revised is included in each chapter's Table of Contents/ Effectivity. The codes used in the effectivity columns of each chapter are defined as follows:

TABLE OF CONTENTS/EFFECTIVITY CODES

Original Issue: None
First Revision: Revision Identification, (1R Month-Year) Second
Second Revision: Revision Identification, (2R Month-Year)
All subsequent revisions will follow with consecutive revision numbers such as 3R, 4R, etc., along with the appropriate month-year.
Added Subject: Revision Identification, (A Month-Year)
Deleted Subject: Revision Identification, (D Month-Year)

6. Revisions to maintenance manual 761 702 issued February 1, 1979 are as follows:

Effectivity	Publication Date	Aerofiche Card Effectivity
ORG790201	February 1, 1979	1 and 2
PR790320	March 20, 1979	1 and 2
PR800123	January 23, 1980	l and 2
PR801103	November 3, 1980	1 and 2
PR810727	July 27, 1981	1 and 2
PR830218	February 18, 1983	1 and 2
PR840816	August 16, 1984	1 and 2
IR860730	July 30, 1986	1
IR860921	September 21, 1986	1
IR870506	July 12, 1987	1
IR950215*	February 15, 1995	1 and 2

* INTERIM CHANGE

Chapters 5, 6, and 27 of Card 1, and Chapter 51 of Card 2 have been revised. There are no other changes included in this interim change revision. Please discard your current cards 1 and 2, and replace them with the revised ones.

GAMA SYSTEM/CHAPTER INDEX GUIDE

GAMA SYSTEM/CHAPTER INDEX GUIDE (cont)

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LIST OF ILLUSTRATIONS

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CHAPTER

33

LIGHTS

CHAPTER 33 LIGHTS

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

The optional lighting systems on the PA-28-201T render the aircraft operational at night, thus greatly extending the capability and flight time for the aircraft in any given period.

DESCRIPTION AND OPERATION.

Interior lighting is comprised of instrument panel back lighting, an overhead dome light and map lights. External lights consist of white wing tip strobe lights, navigation lights (including two tail lights) and a landing/taxi light located in the front of the aircraft intake scoop.

TROUBLESHOOTING.

When checking the lighting system, the master switch must be on in order for the lights to operate. Insure that the circuit breaker, which protects the light circuit, is pushed "ON". If light still fails to operate, replace bulb.

FLIGHT COMPARTMENT.

INSTRUMENT AND PANEL LIGHTS.

The instrument and panel lights are broken up into three groups: Lower Panel Light, Upper Panel Lights and Compass Light. The instrument lights are controlled by a 5 amp circuit breaker through a transistorized dimmer. A second dimmer control is connected to a variable resistor which controls the light intensity for all the avionics equipment. The dimmer controls are located in the middle of the instrument panel just above the pedestal. It may be necessary to gain access to the Dimmer Control Assembly, if so, follow the instructions given below.

REMOVAL OF DIMMER CONTROL ASSEMBLY.

1. Access to the Dimmer Control Assembly is from beneath the instrument panel.
2. Disconnect the electrical connection from the assembly.
3. Remove the two screws securing the assembly to the instrument panel.
4. Remove assembly from the airplane.

INSTALLATION OF DIMMER CONTROL ASSEMBLY.

1. Position the assembly in the instrument panel with the control knobs inserted into their appropriate slots.
2. Secure the assembly to the instrument panel with the two screws previously removed.
3. Connect the electrical connection to the assembly.
4. Check operation of Dimmer Control Assembly.

ANNUNCIATOR PANEL.

The annunciator panel is a small cluster of lights which warn of malfunctions in the various circuits or systems. A malfunction is identified by the illumination of an individual warning light. There are four warning lights on the PA-28-201T model. There is also a smaller light which indicates when the auxiliary fuel pump is on. Power is supplied from the bus bar through a 5 amp fuse located behind the switch panel.

The VAC warning light is controlled by a vacuum sensor switch located at the fire wall and is attached to the vacuum regulator. The sensor switch will activate when the differential pressure is below 3.5 in Hg.

The OIL warning light is controlled by an oil pressure sensor switch incorporated in the oil line to the oil pressure gauge and is located at the fire wall. The sensor switch will activate when the oil pressure is below 30 psi.

The ALT warning light is illuminated by current flowing from the bus bar to the alternator circuit. This condition exists when the alternator is not operating properly and the output is zero. During normal operation, the alternator warning circuit is also supplied with power from the top diode terminal. This current flows through a 5 amp fuse, located near the diode heat sink, to the resistor and diode creating a no-flow condition which does not allow the warning light to light.

The OVER BST warning light is activated whenever the engine manifold pressure exceeds 40.75 ± .15 inches of mercury. The manifold pressure sensor is incorporated in the manifold pressure gauge.

A press-to-test button is used to check the operation of the lights when the engine is running. The lights will work when the engine is not running with the master switch turned on. The auxiliary fuel on light is not tested with the press-to-test button.

EXTERIOR.

The optional exterior lighting on the PA-28-201T is comprised of wing tip and tail strobe and navigation lights. The landing and taxi light consists of one light bulb. It is 100 watts and located in the nose cowl.

REMOVAL OF LANDING/TAXI LIGHT.

1. Remove the retaining bracket from the lamp.
2. Pull lamp out and remove the two electrical leads from the back of the lamp. Lamp is now free.

—NOTE—

Make note of the placement of the wires to facilitate reinstallation.

INSTALLATION OF LANDING/TAXI LIGHT.

1. Replace electrical leads and secure with appropriate screws.
2. Insert lamp into position, fit retaining bracket and secure with appropriate hardware.

REMOVAL OF WING NAVIGATION LIGHTS.

1. Remove screw securing the lens retainer.
2. Remove the lens and bulb.

—NOTE—

To remove the complete lamp assembly, the wing tip must be removed.

INSTALLATION OF WING NAVIGATION LIGHTS.

1. Install bulb, lens and lens retainer.
2. Secure with the appropriate screw.

REMOVAL OF TAIL NAVIGATION LIGHT.

1. Remove the two screws securing the lens and lens retainer.
2. Remove the bulb.

—NOTE—

To remove the complete tail light assembly, unsolder the electrical lead from the base of the light assembly and disconnect the remaining electrical lead at the connector.

INSTALLATION OF TAIL NAVIGATION LIGHT.

1. Install bulb and lens in light assembly.
2. Place light assembly in position on tail and secure with screws previously removed.

ANTI-COLLISION (STROBE) LIGHTS.

The lights are located on each wing tip in the same assembly with navigation lights on the fin tip. They are rated to flash at approximately 50 times a minute.

REMOVAL OF WING TIP STROBE LIGHT.

1. Remove the screw securing the navigation light cover and remove cover.
2. Remove the three screws securing navigation light bracket assembly and pull out.
3. Remove the strobe lamp by cutting the wires on the lamp beneath the mounting bracket.
4. Remove the defective lamp.
5. Remove and discard the plug with the cut wires from its electrical socket.

INSTALLATION OF WING TIP STROBE LIGHT.

1. Route the wires from the new lamp down through the hole in the navigation light bracket.
2. Insert the wire terminals in the plastic plug supplied with the new lamp. Wire according to the schematic diagram located in Chapter 91 and also see Figure 33-1.
3. Position strobe lamp on navigation light bracket.
4. Secure navigation light assembly and bracket with appropriate screws.
5. Install navigation light cover and secure with appropriate screw.

REMOVAL OF STROBE POWER SUPPLY.

The strobe power supply is in the aft section of the fuselage.

1. Remove access panel to the aft section of the fuselage in the rear baggage compartment to gain access to power supply.
2. To remove power supply disconnect the two electrical plugs.
3. Disconnect the two other electrical leads.
4. Remove the four screws securing power supply to the fuselage. Power supply can now be removed.

INSTALLATION OF STROBE POWER SUPPLY. (Refer to Figure 33-1.)

1. Position the power supply in place and secure with the four screws previously removed.
2. Reconnect the electrical leads in their proper place.
3. Reconnect the electrical plugs previously removed in their proper place.
4. Replace access panel in rear baggage compartment.

STROBE TROUBLESHOOTING PROCEDURE.

The strobe light functions as a condenser discharge system. A condenser in the power supply is charged to approximately 450 volts DC discharged across the Xenon flash tube at intervals of approximately 50 flashes per minute. The condenser is parallel across the Xenon flash tube which is designated to hold off the 450 volts DC applied until the flash tube is triggered by an external pulse. This pulse is generated by a solid state timing circuit in the power supply.

When troubleshooting the strobe light system, it must first be determined if the trouble is in the flash tube or the power supply. Replacement of the flash tube will confirm if the tube is defective. A normally operating power supply will emit an audible tone of 1 to 1.5 KHZ. If there is no sound emitted, check the system according to the following instructions. When troubleshooting the system, utilize the appropriate schematic at the back of this section.

1. Ascertain the input voltage at the power supply is 14 volts.

—CAUTION—

When disconnecting and connecting the power supply input connections, do not get the connections reversed. Reversed polarity of the input voltage for just an instant will permanently damage the power supply. The reversed polarity destroys a protective diode in the power supply, causing self-destruction from overheating of the power supply. This damage is sometimes not immediately apparent, but will cause failure of the system in time.

2. Check for malfunction in interconnecting cables. (Refer to Figure 33-1.)
   A. Ascertain Pins 1 and 3 of interconnecting cable are not reversed.
   B. Using an ohmmeter, check continuity between Pins 1 and 3 of interconnecting cable. If a reading is obtained on the meter, the cable is shorted and should be replaced.

—NOTE—

A short of the type described in Steps A and B will not cause permanent damage to the power supply, but the system will be inoperative if such a short exists. A void any connection between Pins I and 3 of the interconnecting cable as this will discharge the condenser in the power supply and destroy the trigger circuits.

—CAUTION—

When disconnecting the power supply, allow five minutes of bleed down time prior to handing the unit.

3. Check interconnecting cables for shorts.
   A. Disconnect the output cables from the power supply outlets.
   B. The following continuity checks can be made with an ohmmeter.
   C. Check for continuity between the connectors of each interconnecting cable by checking from Pin 1to Pin 1, Pin 2 to Pin 2, and Pin 3 to Pin 3. When making these checks if no continuity exists, the cable is broken and should be replaced.
   D. Check continuity between Pins 1 and 2, 1 and 3, 2 and 3 of the interconnecting cable. If continuity exists between any of these connections, the cable is shorted and should be replaced.

—END—

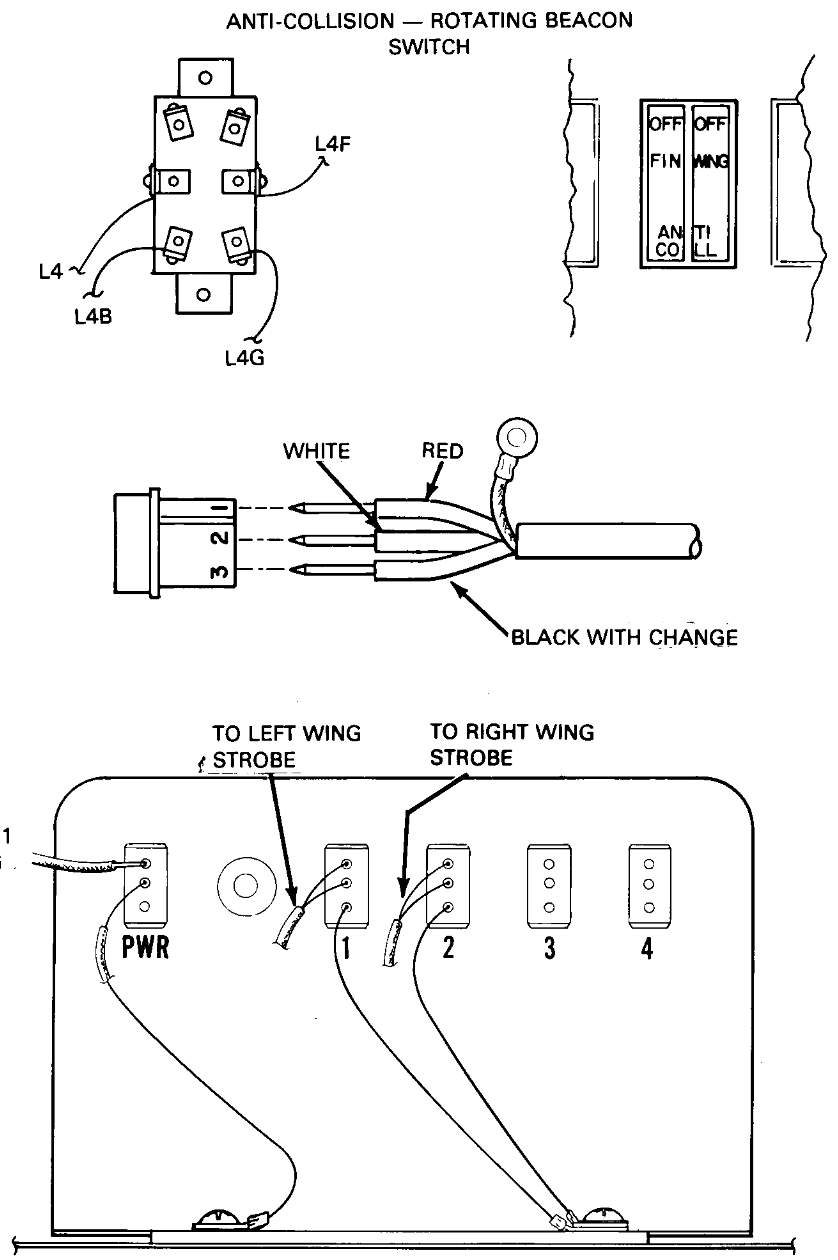

Figure 33-1. Strobe Light Connections

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CHAPTER

34

NAVIGATION AND PITOT/ STATIC

CHAPTER 34-NAVIGATION AND PITOT/STATIC

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

The instrument air system consists of pitot air and static air sources. The system supplies both pitot and static air pressure for the airspeed indicator, altimeter and vertical speed indicator. These instruments are face mounted.

DESCRIPTION AND OPERATION.

The pitot air system consists of a pitot mast located on the underside of the left wing, with its related plumbing. Impact air pressure entering the pitot is transmitted from the pitot inlet through hose and tubing routed through the wing to the airspeed indicator on the instrument panel. A partially or completely blocked pitot head will give erratic or zero reading on the instruments.

Static air system consists of a static port located on the bottom of the pitot mast. The static port is directly connected to the airspeed indicator, altimeter and rate of climb indicator on the instrument panel by means of hose and tubing routed through the wing along with the pitot line. An alternate static air source is located below the instrument panel in front of the pilot. The alternate static source is part of the standard system and has a shutoff valve which closes the port when it is not needed. A placard giving instructions for use is located on the instrument panel. Pitot and static lines can be drained through separate drain valves located on the left lower side of the fuselage interior.

REMOVAL AND REPLACEMENT OF FACE MOUNTED INSTRUMENTS.

Since all instruments are mounted in a similar manner, a description of a typical removal and installation is provided as a guide. Special care should be taken when any operation pertaining to the instruments is performed.

1. Remove the face panel.
2. With the face panel removed, the mounting screws for the individual instruments will be exposed. Remove the connections to the instrument prior to removing the mounting screws of the instrument to be removed.

—NOTE—

Tag instrument connections for ease of installation.

3. Installation of the instruments will be in the reverse of removal. After the installation is completed and before replacing the instrument face panel, check all components for security and clearance of the control column.

GYRO FITTING INSTALLATION PROCEDURE (EDO-AIRE).

The use of teflon tape on the fitting threads is recommended and should be installed as follows:

—CAUTION—

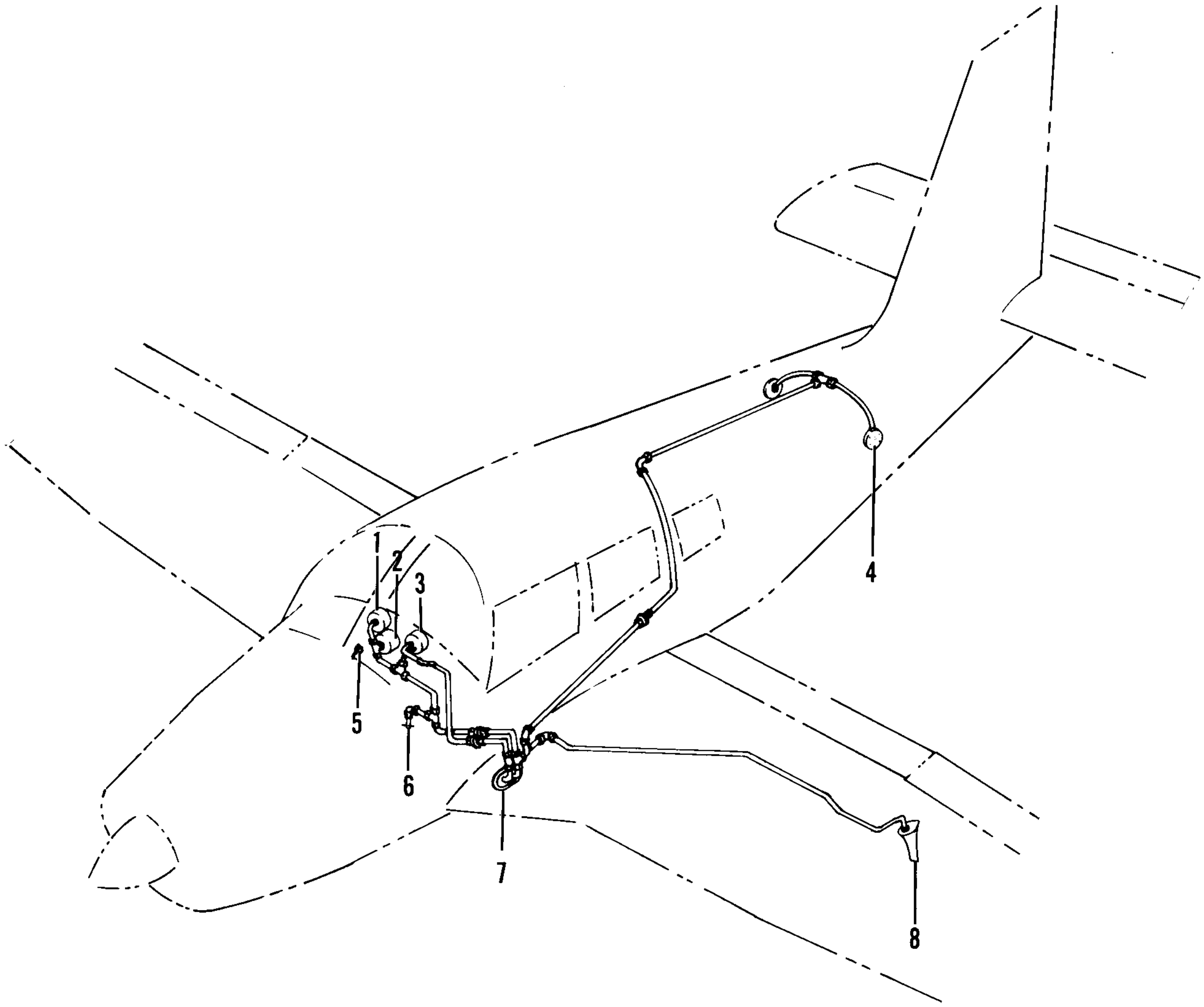
Permit no oil, grease, pipe compound or any foreign material to enter parts prior to installation of fittings. Make sure that all air lines are clean and free of foreign particles and/or residue before connecting lines to gyro. DO NOT USE THREAD LUBE ON FITTINGS OR IN PORTS. The use of thread lube can cause contamination shortening the life of the gyro and can cause premature failure. Any evidence of the use of thread lube will create a WARRANTY VOID CONDITION.

1. Carefully lay teflon tape on the fitting threads allowing one thread to be visible from the end of the fitting. Hold in place and wrap in the direction of the threads so tape will remain tight when the fitting is installed.
2. Apply sufficient tension while winding to assure that tape forms into thread grooves (one full wrap plus 1/2 inch overlap is sufficient).
3. After wrap is complete, maintain tension and tear tape by pulling in direction of wrap. The resulting ragged end is the key to the tape staying in place.
4. Press tape well into threads.
5. Screw fitting into port, being careful not to exceed torque requirements as noted on decal located on cover of gyro. (Refer to Chart 9105 for specifications and manufacturer’s address.)

FLIGHT

RATE OF CLIMB INDICATOR.

The rate of climb indicator measures the rate of change in static pressure when the airplane is climbing or descending. By means of a pointer and dial, this instrument will indicate the rate of ascent or descent of the airplane in feet per minute. Due to the lag of the instrument, the aircraft will be climbing or descending before the instrument gives the correct rate. The instrument will continue to read after the aircraft has assumed level flight. In rough air this should not be considered a malfunction.



1. ALTIMETER
2. VERTICAL SPEED INDICATOR
3. AIRSPEED INDICATOR
4. STATIC SOURCE PICKUP
5. HEATED PITOT SWITCH (OPTIONAL)
6. ALTERNATE STATIC SOURCE VALVE
7. PITOT AND STATIC DRAINS
8. PITOT HEAD

Figure 34-1. Pitot-Static System

CHART 3401. TROUBLESHOOTING (RATE OF CLIMB INDICATOR)

Trouble	Cause	Remedy
Pointer does not set on zero.	Aging of diaphragm.	Reset pointer to zero by means of setting screw. Tap instrument while resetting.
Pointer fails to respond.	Obstruction in static line.	Disconnect all instruments connected to the static line. Clear line.
	Pitot-static head frozen over.	
	Water in static line.	Check individual instruments for obstruction in lines.
	Obstruction in pitot head.	Clean lines and head.
Pointer oscillates.	Leaks in static lines.	Disconnect all instruments connected to the static line. Check individual instruments for leaks. Reconnect instruments to static line and test installation for leaks.
	Defective mechanism.	Replace instrument.
Rate of climb indicates when aircraft is banked.	Water in static line.	Disconnect static lines and blow out lines from cockpit out to pitot head.
Pointer has to be set before every flight.	Temperature compensator inoperative.	Replace instrument.
Pointer cannot be reset to zero.	Diaphragm distorted.	Replace instrument.
Instrument reads very low during climb or descent.	Case of instrument or line broken or leaking.	Replace instrument.

ALTIMETER.

The altimeter indicates altitude in feet above sea level. The indicator has three pointers and a dial scale, the long pointer is read in hundreds of feet, the middle pointer in thousandths of feet and the short pointer in ten thousandths of feet. A barometric pressure window is located on the right side of the indicator dial and is set by the knob located on the lower left corner of the instrument. The altimeter consists of a sealed diaphragm that is connected to the pointers through a mechanical linkage. The instrument case is vented to the static air system and as static air pressure decreases, the diaphragm expands, causing the pointers to move through the mechanical linkage to indicate a higher altitude.

CHART 3402. TROUBLESHOOTING (ALTIMETER)

Trouble	Cause	Remedy
Excessive scale error.	Improper calibration adjustment.	Replace instrument.
Excessive pointer oscillation.	Defective mechanism.	Replace instrument.
High or low reading.	Improper venting.	Eliminate leak in static pressure system and check alignment of sensor.
Setting knob is hard to turn.	Wrong lubrication or lack of lubrication.	Replace instrument.
Inner reference marker fails to move when setting knob is rotated.	Out of engagement.	Replace instrument.
Setting knob set screw loose or missing.	Not tight when altimeter was reset.	Tighten instrument screw, if loose. Replace screw, if missing.
Cracked or loose cover glass.	Case gasket hardened.	Replace or repair instrument.
Dull or discolored markings.	Age.	Replace or repair instrument.
Barometric scale and reference markers out of synchronism with pointers.	Drift in mechanism.	Reset pointers, refer to the latest revision of AC 43.13-1.
Altimeter sticks at altitude or does not change with change of altitude.	Water or restriction in static line.	Remove static lines from all instruments, blow line clear from cockpit to sensor.

CHART 3402. TROUBLESHOOTING (ALTIMETER) ()

Trouble	Cause	Remedy
Altimeter changes reading as aircraft is banked.	Water in static line.	Remove static lines from all instruments, and blow line clear from cockpit to sensor.
Altimeter requires resetting frequently.	Temperature compensator inoperative.	Change instrument.

—NOTE—

When any connections in the static system are opened for check, system must be rechecked per Part FAR 23.1325.

AIRSPEED INDICATOR.

The airspeed indicator provides a means of indicating the speed of the airplane passing through the air. The airspeed indication depends on the differential pressure between pitot air pressure and static air pressure. This instrument has the diaphragm vented to the pitot air source and the case is vented to the static air system. As the airplane increases speed, the pitot air pressure increases, causing the diaphragm to expand. A mechanical linkage picks up this motion and moves the instrument pointer to the indicated speed. The instrument dial is calibrated in knots and miles per hour, and also has the necessary operating range markings for safe operation of the airplane.

CHART 3403. TROUBLESHOOTING (AIRSPEED TUBES AND INDICATOR)

Trouble	Cause	Remedy
Pointers of static instruments do not indicate properly.	Leak in instrument case or in static lines.	Check for leak and seal.
Pointer of instrument oscillates.	Defective mechanism.	Replace instrument.
Instrument reads high.	Pointer not on zero.	Replace instrument.
	Leaking static system.	Find leak and correct.
Instrument reads low.	Pointer not on zero.	Replace instrument.
	Leaking static system.	Find leak and correct.
	Pitot-static head not aligned correctly.	Realign pitot-static head.

CHART 3403. TROUBLESHOOTING (AIRSPEED TUBES AND INDICATOR) (cont)

Trouble	Cause	Remedy
Airspeed changes as aircraft is banked.	Water in static line.	Remove lines from static instruments and blow out lines from cockpit to pitot-static head.

—NOTE—

When any connections in static system are opened for checking, system must be checked per FAR 23.1325.

MAGNETIC COMPASS.

The magnetic compass is a self-contained instrument. This instrument has an individual light which is connected to the instrument lighting circuit. The compass correction card is located in the card holder mounted on the instrument. The compass should be swung whenever instruments or radios are changed and at least once a year.

ADJUSTMENT OF COMPASS.

Before attempting to compensate compass, every effort should be made to place the aircraft in simulated flight conditions; check to see that the doors are closed, flaps in retreated position, engines running, throttles set at cruise position and aircraft in level flight attitude. Aircraft master switch, alternators, radios (except for combustion heater) should be on. All other cockpit controlled electrical switches should be in the off position.

1. Set adjustment screws of compensator on zero. Zero position of adjusting screws is when the dot of the screw is lined up with the dot of the frame.
2. Head aircraft on a magnetic North heading. Adjust N-S adjustment screw until compass reads exactly North.
3. Head aircraft on a magnetic East heading and do the same as Step 2, adjusting E-W adjusting screw.
4. Head aircraft on magnetic South heading and note resulting South error. Adjust N-S adjusting screw until one-half of this error has been compensated. No compensation adjustment shall be made with the combustion heater operating.
5. Head aircraft on magnetic West and do same as Step 4, adjusting E-W adjustment screw.
6. Head aircraft in successive magnetic 30 degree headings and record compass readings on appropriate deviation card. Deviations must not exceed +10° on any heading. An additional deviation card will have to made out for the combustion heater. This second deviation card shall be accomplished under the above conditions, except the combustion heater shall be operating.

CHART 3404. TROUBLESHOOTING (MAGNETIC COMPASS)

Trouble	Cause	Remedy
Excessive card error.	Compass not properly compensated.	Compensate instrument. (Refer to AC 43.13-lA Chapter 16, Section V.)
	External magnetic interference.	Locate magnetic interference and eliminate if possible.
Excessive card oscillation.	Insufficient liquid.	Replace or repair instrument.
Card sluggish.	Weak card magnet.	Replace or repair instrument.
	Excessive pivot friction or broken jewel.	Replace or repair instrument.
Liquid leakage.	Loose bezel screws.	Replace or repair instrument.
	Broken cover glass.	Replace or repair instrument.
	Defective sealing gaskets.	Replace or repair instrument.
Discolored markings.	Age.	Replace or repair instrument.
Defective light.	Burned out lamp or broken circuit.	Check lamp or continuity of wiring.
Card sticks.	Altitude compensating diaphragm collapsed.	Replace or repair instrument.
Card does not move when compensating screws are turned.	The gears that turn compensating magnets may be stripped.	Replace or repair instrument.
Compass swings erratically when radio transmitter is keyed.	Normal.	

DIRECTIONAL GYRO.

The directional gyro is a flight instrument incorporating an air driven gyro stabilized in the vertical plane. The gyro is rotated at high speed by lowering the pressure in the air tight case and simultaneously allowing atmospheric air pressure to enter the instrument against the gyro buckets. Due to gyroscopic inertia, the spin axis continues to point in the same direction even though the aircraft yaws to the right or left. This relative motion between the gyro and the instrument case is shown on the instrument dial which is similar to a compass card. The dial, when set to agree with the airplane magnetic compass provides a positive indication free from swing and turning error. However, the directional gyro has no sense of direction and must be set to the magnetic compass. Since the magnetic compass is subject to errors due to magnetic fields, electric instruments, etc., the directional gyro is only accurate for the heading it has been set for. If the gyro is set on 270°, for instance, and the aircraft is turned to some other heading, there can be a large error between the gyro and the magnetic compass due to the error in compass compensation, this will appear as gyro precession. The gyro should only be checked on the heading on which it was first set, also due to internal friction, spin axis error, air turbulence and airflow, the gyro should be set at least every 15 minutes for accurate operation, whether it has drifted or not.

—NOTE—

Refer to Removal and Replacement section of this chapter for special methods used in reinstallation of air driven gyros.

CHART 3405. TROUBLESHOOTING (DIRECTIONAL GYRO INDICATOR)

Trouble	Cause	Remedy
Excess drift in either direction.	Setting error.	Reset properly.
	Defective instrument.	Replace instrument.
	High or low vacuum. If vacuum is not correct, check for the following:	
	1. Relief valve improperly adjusted.	1. Adjust.
	2. Incorrect gauge reading.	2. Replace gauge.
	3. Pump failure.	3. Repair or replace.
	4. Vacuum line kinked or leaking.	4. Check and repair. Check for collapsed inner wall of hose.
Dial spins during turn.	Limits (55° bank) of gimbal	Reset gyro in level flight.
Dial spins continuously.	Defectlve instrument.	Replace instrument.

GYRO HORIZON.

The gyro horizon is essentially an air driven gyroscope rotating in a horizontal plane and is operated by the same principal as the directional gyro. Due to the gyroscopic inertia, the spin axis continues to point in the vertical direction, providing a constant visual reference to the attitude of the airplane relative to pitch and roll axis. A bar across the face of the indicator represents the horizon and aligning the miniature airplane to the horizon bar simulates the alignment of the airplane to the actual horizon. Any deviation simulates the deviation of the airplane from the true horizon. The gyro horizon is marked for different degrees of bank.

—NOTE—

Refer to Removal and Replacement section of this chapter for special methods used in reinstallation of air driven gyros.

CHART 3406. TROUBLESHOOTING (GYRO HORIZON INDICATOR)

Trouble	Cause	Remedy
Bar fails to respond.	Insufficient vacuum.	Check pump and tubing.
	Filter dirty.	Clean or replace filter.
Bar does not settle.	Insufficient vacuum.	Check line and pump. Adjust valve.
	Incorrect instrument.	Check part number.
	Defective instrument.	Replace.
Bar oscillates or shimmies continuously.	Instrument loose in panel.	Tighten mounting screws.
	Vacuum too high.	Adjust valve.
	Defective instrument.	Replace instrument.
Instrument does not indicate level flight.	Instrument not set properly.	
	Instrument not level in panel.	Loosen screws and level instrument.
	Aircraft out of trim.	Trim aircraft.
Bar high after 180° turn.	Normal, if it does not exceed 1/16 inch.	
Instrument tumbles in flight.	Low vacuum.	Reset regulator.
	Dirty filter.	Clean or replace filter.

CHART 3406. TROUBLESHOOTING (GYRO HORIZON INDICATOR) (cont)

Trouble	Cause	Remedy
Instrument tumbles in flight. (cont)	Line to filter restricted.	Replace line.
	Plug missing or loose in instrument.	Replace or tighten plug.
	Bank or pitch limits exceeded.	

TURN AND BANK INDICATOR.

The turn and bank indicator is an electrical instrument. The turn portion of the indicator is driven by a permanent magnet D.C. governor controlled gyro motor. Damping action is provided by a precision air dashpot. The pointer is designed to deflect in the direction of turn at a rate proportional to the rate of aircraft turn. The bank portion of the indicator is a ball sealed in a curved glass tube filled with damping fluid. In an improperly coordinated turn the ball is forced from the center of the tube thus indicating attitude error.

CHART 3407. TROUBLESHOOTING (TURN AND BANK INDICATOR)

Trouble	Cause	Remedy
Instrument will not operate.	No power to instrument.	Reset circuit breaker.
		Check circuit and repair.
	Instrument malfunction.	Repair instrument.
	Foreign matter lodged in instrument.	Replace instrument.
Incorrect sensitivity.	Out of calibration.	Replace instrument.
Incorrect turn rate.	Out of calibration.	Replace instrument.
Ball sticky.	Flat spot on ball.	Replace instrument.
Ball not in center when air-craft is correctly trimmed.	Instrument not level in panel.	Level instrument.

CHAPTER

35

OXYGEN SYSTEM

CHAPTER 35-OXYGEN

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

DESCRIPTION AND OPERATION.

The optional oxygen system available in the PA-28-201T renders the aircraft capable of cruising at higher altitudes.

The oxygen system is a portable unit consisting of a 22 cu. ft. capacity cylinder contained in a carrying case which utilizes a dual manifold, which allows either a single or double quick disconnect to be fitted to the manifold.

—CAUTION—

Use only aviation breathing oxygen when having the oxygen bottle charged. MIL-O-27210C specifies that the moisture content of aviation breathing oxygen must not exceed 0.005 milligrams of water vapor per liter of gas at a temperature of 70°F. and a pressure of 760 millimeters of mercury.

PASSENGER

TROUBLESHOOTING. (Refer to Chart 3501.)

CHART 3501. TROUBLESHOOTING (OXYGEN SYSTEM)

Trouble	Cause	Remedy
No indication of pressure on pressure gauge.	Cylinder empty or leak in system has exhausted pressure.	Charge system and check for leaks.
	Pressure gauge or regulator defective.	Return unit to manufacturer or take to approved shop.
Pressure indication normal, but no oxygen flowing.	Oxygen cylinder regulator assembly defective.	Return unit to manufacturer or take to approved shop.
Offensive odors in oxygen.	Cylinder pressure below 50 psi. Foreign matter has entered the system during previous servicing.	Purge the oxygen system. See directions in this chapter.

REMOVAL OF OXYGEN UNIT. (Refer to Figure 35-1.)

—WARNING—

Do not use grease or any grease type fittings on any hardware that connects to the oxygen bottle or system hardware. When working with the system make sure hands, clothing, and tools are free of oil, grease, and dirt when working with the oxygen system.

The oxygen unit can be released from its cradle by pulling down on the ring under the cradle, sliding the unit forward, and lifting it out of the cradle.

INSPECTION AND OVERHAUL TIME.

Due to the nature of the process used to test compressed gas tanks, it is recommended that overhaul, service, or hydrostatic tests be conducted by an FAA or manufacturer (Scott Aviation) approved shop. The following checks and charts give recommended inspection and overhaul times for the various parts of the oxygen system.

—NOTE—

Oxygen cylinders are identified by the ICC or DOT identification stamped on the cylinder. The standard weight cylinder (ICC or DOT3AA1800) must be hydrostatic tested at the end of each 5 year period. Lightweight cylinders (ICC or DOT 3HT1850) must be tested every 3 years and replaced after 4,380 refills, or 15 years, whichever comes first. The month and year of the last test is stamped on the cylinder beneath the ICC/DOT identification.

1. Inspect outlets, and using directions described in the next paragraph, check leaks both in the non-use and use condition.
2. Check the pressure gauge for accuracy by removing the back section of the unit and connecting a gauge of known accuracy to the fill port.
3. Inspect tank for dents, bulges, major strap chafing marks, or corrosion. Should any of these conditions exist, the tank should be hydrostatically tested.

CHART 3502. OXYGEN SYSTEM COMPONENT LIMITS

PARTS	INSPECTION	OVERHAUL
Regulator	300 Flight Hrs.	3 Yrs.
Pressure Gauge	300 Flight Hrs.	3 Yrs.
Outlets	300 Flight Hrs.	3 Yrs.
Recharge Valve	Each Use	Replace Every 3 Yrs.
Masks	Each Use	Replace as Necessary

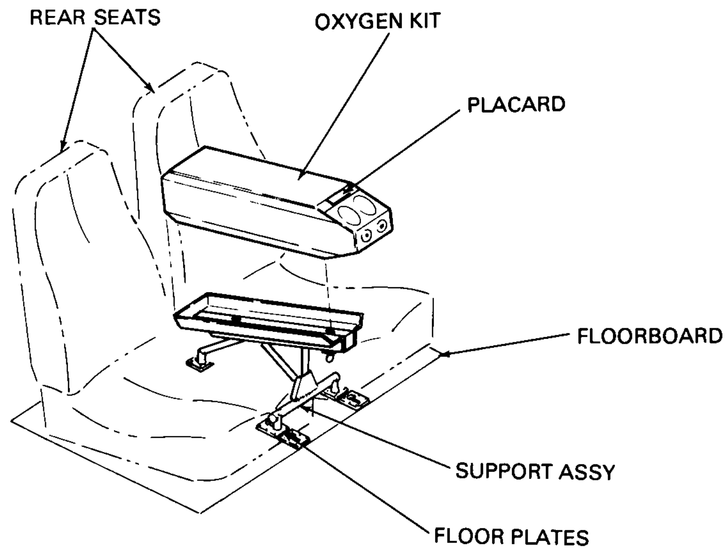


Figure 35-1. Oxygen Installation

TESTING FOR LEAKS.

Apply leak detector fluid (MIL-L-25567). The solution should be shaken to obtain suds or foam. The suds or foam should be applied sparingly to the joints of a closed system. Look for traces of bubbles. No visible leakage should be found. Repair or replace any defective parts and retest system. With the system pressurized to service pressure, further tests can be made. The rate of any leak should not exceed one percent of the total supply per 24 hour period. All traces of the detector fluid should be wiped off at the conclusion of the examination.

MAINTENANCE.

1. Check the cylinder to be sure it is securely mounted.
2. Check the cylinder for the ICC identification number and for the date of the last FAA inspection and test.
3. If cylinder is completely empty it must be completely disassembled and inspected in an FAA or manufacturer approved facility before recharging.
4. Refer to FAA Manual AC 43.13-lA for more details.

REMOVAL OF OUTLETS.

1. Make sure control valve is in full OFF position.
2. Connect a mask or connector to the valve to release any pressure.
3. Using a suitable spanner wrench, remove the outlet.
4. The outlet can now be removed from the low pressure line.

INSTALLATION OF OUTLETS.

1. Apply sealant (Permacel 412) to the male end of the fitting.
2. Install the outlet to the regulator extension with a suitable spanner wrench.
3. Torque the fittings into the outlets approximately 30 inch-pounds. Do not overtorque as this could damage the outlet.

PURGING OXYGEN SYSTEM.

The system should be purged whenever the cylinder pressure falls below 50 psi or if any lines are left open for any length of time. Also, if the bottle is left at below 200 psi it may develop odors from bacterial growth. This will make it necessary to purge the system. Use the following procedures:

—CAUTION—

When performing this operation, make sure the area is a NO SMOKING area, and it is as clean as possible of oil and dirt.

1. Keep all doors and windows open.
2. Connect the oxygen recharging unit to the filler valve.
3. Plug the oxygen masks into the outlet valves and turn on the system.
4. Set the recharging unit pressure regulator to deliver 50 psi and let the system purge for one hour. If any odor is still present repeat the procedure for one or more hours. If the odor persists after the second purging, send unit to its manufacturer, or an approved shop.

CLEANING OF FACE MASKS.

The disposable masks are designed for one-time use and require no maintenance. The pilot's and copilot's masks can be cleaned as follows:

1. Remove the microphone from the mask.
2. Remove the sponge rubber discs from the mask turrents. Do not use soap to clean sponge rubber discs, as this would deteriorate the rubber and give off unpleasant odors. Clean in clear water and squeeze dry.
3. Wash the rest of the mask with a very mild solution of soap and water.
4. Rinse the mask thoroughly to remove all traces of soap.
5. Make sure the sides of the breathing bag do not stick together while drying, as this may decrease the life of the rubber in the bag. The mask can be sterilized with a solution of 70 percent ethyl alcohol.

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CHAPTER

37

VACUUM

CHAPTER 37-VACUUM

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

The instrumentation in the PA-28-201T is designed to give a quick and actual indication of the attitude, performance and condition of the airplane. Maintenance, other than described in this chapter shall be done by the instrument manufacturer or an authorized repair station.

DESCRIPTION AND OPERATION.

The vacuum system employed to operate the gyro instruments is comprised of an engine driven dry vacuum pump, and a vacuum regulator valve containing a filter. A vacuum gauge is used to constantly monitor the system. An air filter is incorporated in the system to increase the life of the gyros. The filter is mounted behind the instrument panel in the upper left-hand corner and should be replaced at each 100 hours of operation. The instruments in this system are face mounted located on the instrument panel.

TROUBLESHOOTING.

A Troubleshooting Chart is provided to assist in locating and correcting possible malfunctions in the system.

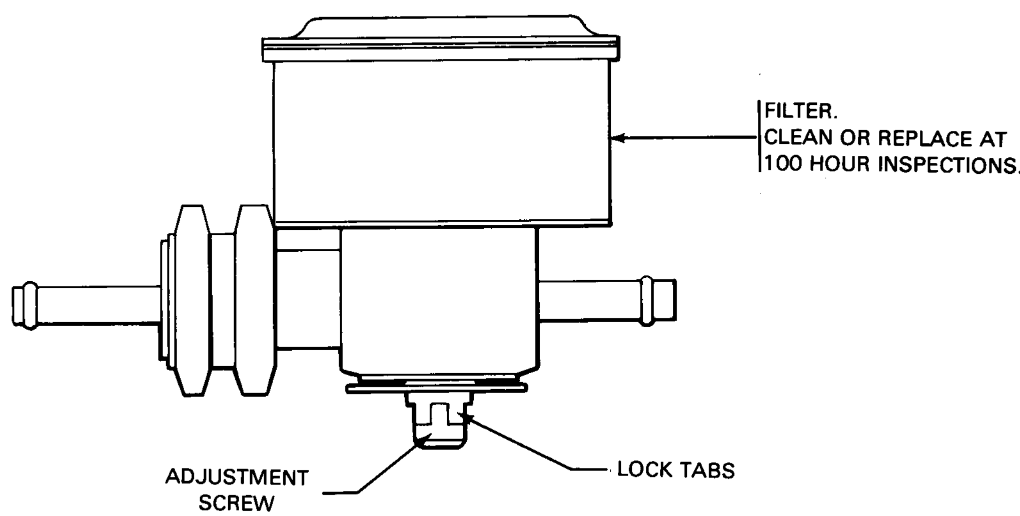

Figure 37-1. Vacuum Regulator

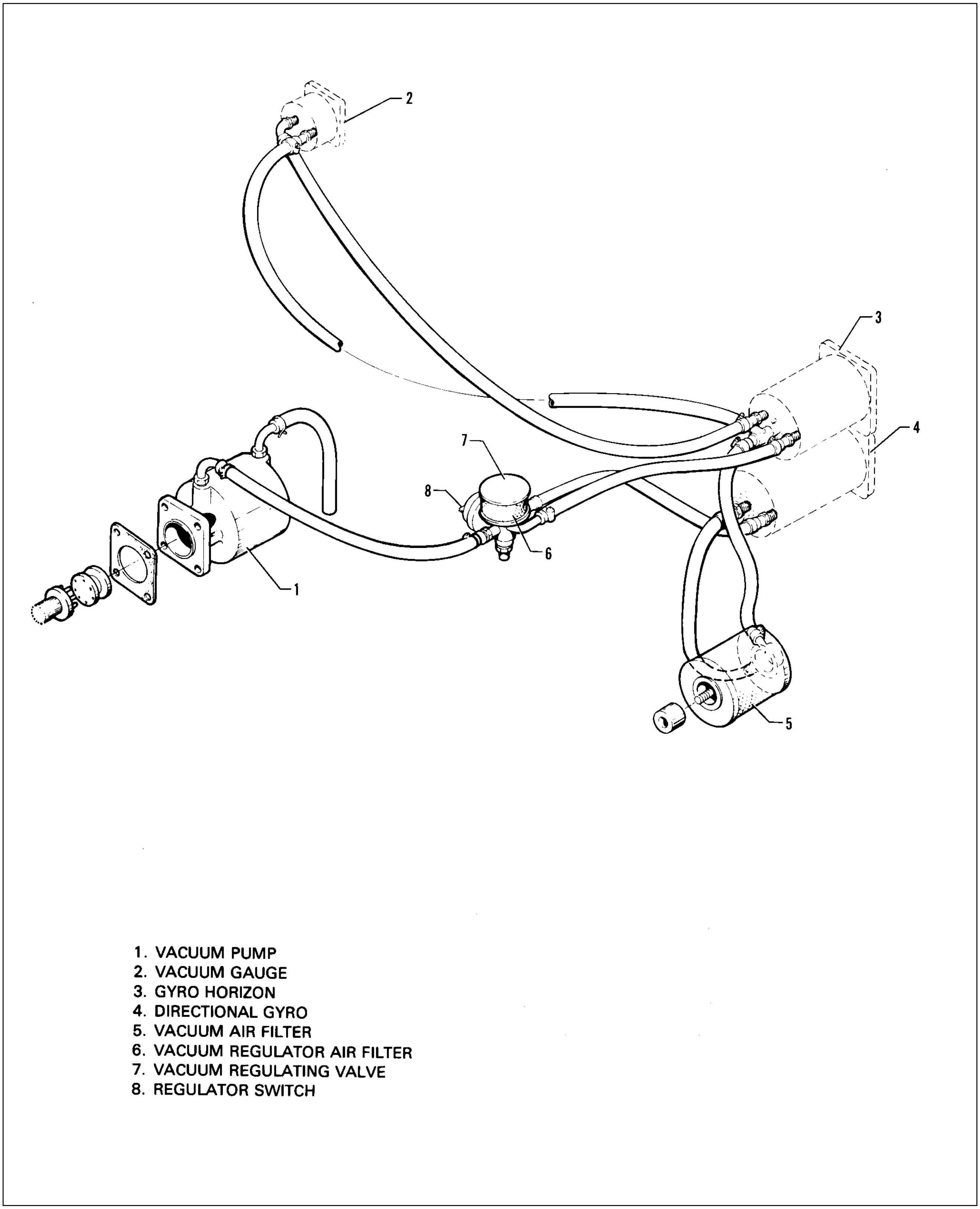

Figure 37-2. Vacuum System Installation

CHART 3701. TROUBLESHOOTING (VACUUM SYSTEM)

Trouble	Cause	Remedy
No vacuum gauge indication at instrument.	Filter clogged or dirty. Line from gyro to filter restricted.	Clean or replace filter. Check line.
No vacuum gauge indication at instrument or source.	Faulty gauge malfunctioning pump.	Replace gauge. Replace pump.
Low vacuum system pressure.	Filter dirty. Vacuum regulator valve incorrectly adjusted. Line from gyros to filter restricted. Line from pump to gyros leaking.	Clean or replace filter. Adjust regulator valve in ac cordance with adjustments in this section. Repair line. Check all lines and fittings.
Normal pressure indication but sluggish operation of instruments.	Faulty instrument.	Replace instrument.
High system pressure.	Vacuum regulator incorrectly adjusted. Vacuum regulator sticking or dirty screen.	Adjust regulator. Clean and check operation of regulator.
Regulator cannot be adjusted to produce correct pressure.	Lines leaking. Vacuum pump malfunctioning.	Check lines and fittings. Replace pump.
Vacuum correct on ground but will not maintain pressure at altitude.	Vacuum pump malfunctioning. Regulator sticky.	Replace pump. Clean regulator.

CHART 3701. TROUBLESHOOTING (VACUUM SYSTEM) (cont)

Trouble	Cause	Remedy
Vacuum correct but pilot reports pressure erratic or shows complete loss in flight.	Regulator sticky.	Clean regulator.
	Oil in pump due to leaky engine seal or cleaning fluid blown into pump while cleaning engine.	Replace pump.
Pressure can only be maintained at full throttle on ground.	Leak in system.	Repair or replace lines.
	Worn pump.	Replace pump.
	Stuck regulator.	Clean or replace regulator.

DISTRIBUTION.

VACUUM SYSTEM AND GYRO PRESSURE SERVICE TIPS.

The following information is intended to acquaint field service personnel with a means to diagnose vacuum system service symptoms on those components which are serviced by removal and replacement, along with recommended service practices. These items include hoses, clamps, gyro filters, vacuum regulating valves, vacuum gauges and vacuum pumps.

1. Hoses and Clamps:
   A. These items should be examined periodically and inspected carefully whenever engine maintenance activities cause hose disconnections to be made at the pump, regulating valve, gyros and/or vacuum gauge.
   B. The ends of the hoses should be examined for rubber separation and slivers of rubber on the inside diameter of the hoses. These slivers can and do become detached. If this happens, the vacuum pump sucks these loose particles and eventually ingest them. This can cause premature pump service.
   C. Hose, clamps and fittings should be replaced when broken, damaged or corroded.

—CAUTION—

When replacing any of the threaded fittings, DO NOT USE PIPE DOPE or any other anti-seize tape or compound. The AIRBORNE fittings are all cadmium plated to avoid the need for any other anti-seize materials. The reason for this caution is to protect the pump from ingesting any foreign materials that could cause premature service. If a thread lubricant is required, use a powdered molysulfide or graphite in dry form or in an evaporating vehicle; or employ a silicone spray. Apply sparingly to external threads of fittings only.

2. Vacuum Gauges:
   A. Vacuum gauges seldom require service and usually are replaced when malfunctions occur.

—NOTE—

Vacuum gauge failure in a properly operating vacuum system does not impair safety of flight.

B. If the vacuum gauge malfunctions in a manner to cause an incorrect reading in normal cruise conditions, the gauge must be checked by comparing the reading with a gauge of known accuracy. If the gauge is indicating correct values and the system vacuum level is not in accordance with the specified vacuum; then and only then should the regulator be reset.

   C. Visual examination of the gauge performance should cover the following steps:
      (1) With engine stopped and no vacuum applied to the gauge, its pointer should rest against the internal stop in the 9 o'clock position. Any other displacement from this position suggests need for replacement.
      (2) A slight overshoot during engine start-up, not to exceed half an inch (1/2") of mercury, is normal and is not cause to replace gauge.
      (3) With engine operating at normal cruise RPM, the gauge should read from 4.8 inches to 5.2 inches of mercury (vacuum.)
      (4) At 1200 RPM, the vacuum gauge reading should be more than four inches of mercury.
3. Gyro Filters:
   A. Gyro filters must be serviced on a scheduled basis, not to exceed 100 hours, or sooner as condition indicates.

—NOTE—

This system employs a central filter in combination with a differential vacuum gauge which will indicate a decline in panel gauge reading when the filter becomes clogged and vacuum declines below the recommended value. The filter should be replaced when gauge reading declines below the recommended value; do not adjust regulator.

4. Vacuum Regulator:
   A. The vacuum regulating valve seldom needs replacement. Symptoms that suggest replacement are:
      (1) Rapid fluctuation of the vacuum gauge needle.
      (2) Non-repeatability of the vacuum gauge reading when the panel gauge is not suspect or has been checked against a known test gauge (cruise RPM only).
   B. All modes of regulator malfunction tend to increase the vacuum power applied to the gyros. Thus, although excess vacuum is applied, a loss of vacuum does not occur.
   C. The gyros themselves act as a limiting device to keep the vacuum power applied from exceeding safe levels.

—NOTE—

If the panel gauge has been checked and found OK and the vacuum gauge reading does not repeat within the range of 4.8 to 5.2 inches of mercury, then the regulating valve should be changed. Observe the usual precautions for maintaining system cleanliness to avoid premature pump service.

5. Vacuum Pump:
   A. Before installation of fittings on pump, check for external damage. A pump that has been damaged or dropped should not be installed.
   B. When a vise is used to secure the pump while installing fittings, caution must be exercised to avoid pump damage. The square mounting flange must be held between soft wood blocks and only at right angles to the vise jaws. Use only enough vise pressure to hold the pump firmly. Do not apply vise pressure to the outside diameter or overall length of the pump.

—NOTE—

Refer to CAUTION under Step 1.

   C. With the pump properly secured in the vise, insert fittings into the ports and hand tighten firmly; then using a wrench, tighten each fitting from one-half to two additional turns.

VACUUM GAUGE.

The vacuum gauge is mounted in the right side of the instrument panel to the left and up from the cigar lighter. This gauge is calibrated in inches of mercury and has a direct pressure line and vent line. Therefore, the gauge indicates the differential pressure or actual pressure being applied to the gyro instruments. As the system filter becomes clogged or lines obstructed, the gauge will show a decrease in pressure. Do not reset the regulator until the filter and lines have been checked. For troubleshooting of this instrument, refer to Chart 3701 of this section.

REMOVAL AND INSTALLATION OF FACE MOUNTED INSTRUMENTS.

Since all instruments are mounted in a similar manner, a description of a typical removal and installation is provided as a guide. Special care should be taken when any operation pertaining to the instruments is performed.

1. Remove face panel.
2. Remove electrical or mechanical connections from the instrument.

—NOTE—

Tag instrument connections for ease of installation.

3. Remove the mounting screws of the instrument to be removed.
4. Install the instruments in the reverse of removal. After installation is completed and before replacing the instrument face panel, check all components for security and clearance of the control column.

VACUUM REGULATOR VALVE.

A vacuum regulator valve that contains a filter is incorporated in the system to control vacuum pressure to the gyro instruments.

ADJUSTMENTS OF VACUUM REGULATOR VALVE.

1. Bend locking tabs up to rotate adjustment screw

—NOTE—

Do not attempt adjustment of this valve with the engine in operation.

2. Start the engine, after allowing time for warm-up, run the engine at medium RPM.
3. With the engine running at medium RPM, the suction gauge should indicate 5.0 inches of mercury ± .1 inches of mercury. If the pressure reading fails to fall within this range, shut down the engine and adjust the regulator valve by moving the valve adjustment screw clockwise to increase the pressure, and counterclockwise to decrease the pressure. Start the engine and repeat the check. With engine running at medium RPM, the suction gauge should indicate 5.0 inches of mercury ± .1 inches of mercury. If the airplane is not equipped with a suction gauge, it will be necessary to connect a gauge by removing the plug from the back of the artificial horizon, and attaching a temporary gauge.
4. Restart the engine and repeat the check.
5. After the system pressure has been adjusted to these recommended settings, remove the gauge and install the plug, bend locking tabs down to lock adjustment screw in place.

VACUUM PUMP.

The vacuum pump is of the rotary vane, positive displacement type. This unit consists essentially of an aluminum housing, carbon rotor and moving carbon blades. This assembly is driven by means of a coupling mated to the engine driven gear assembly. The pump is mounted on the accessory section of the engine. For troubleshooting of the pumps, refer to Chart 3701 of this section.

REMOVAL AND REPLACEMENT.

The vacuum pump can be removed by the following procedure.

1. Remove the top portion of the engine cowling.
2. Loosen the hose clamp and remove the hose from the vacuum pump fitting.
3. Remove the vacuum pump by removal of the four retaining nuts, lock washer and plain washers.
4. Reinstall pump in reverse order of removal, noting alignment of spline on the pump drive with the spline on the engine drive assembly.

—END—

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CHAPTER

39

ELECTRICAL

CHAPTER 39-ELECTRICAL PANELS, PARTS AND INSTRUMENTS

TABLE OF CONTENTS/EFFECTIVITY

—NOTE—

Refer to Chapter 91 for all wiring diagrams (schematics)

INSTRUMENT AND CONTROL PANELS.

REMOVAL AND REPLACEMENT OF FACE MOUNTED INSTRUMENTS.

Since all instruments are mounted in a similar manner, a description of a typical removal and installation is provided as a guide for the removal and installation of the instruments. Special care should be taken when any operation pertaining to the instruments is performed.

1. Remove the face panel by removing the screws from around the perimeter of the panel.
2. With the face panel removed, the mounting screws for the individual instruments will be exposed. Remove the connections to the instrument prior to removing the mounting screws of the instrument to be removed.

—NOTE—

Tag instrument connections for ease of installation.

3. Installation of the instruments will be in the reverse given for removal. After the installation is completed and before replacing the instrument face panel, check all components for security and clearance of the control column.

REMOVAL AND REPLACEMENT OF CLUSTER MOUNTED INSTRUMENTS.

A cluster, located on the instrument panel, contains five individual instruments. Removal of these instruments can be accomplished by the following procedure:

1. Remove the face panel by removing the screws from around the perimeter of the panel.
2. With the face panel removed, the clear plastic cover on the cluster assembly will be exposed. Remove the cover and cluster by removing the six mounting screws.
3. Remove the connection to the individual instrument to be removed and remove the instrument from the cluster assembly.
4. Replace instrument in the reverse order of removal. Check all mountings and connections for security.

ANNUNCIATOR PANEL.

The annunciator panel for the PA-28-201T consists of three amber lights and a push button test switch located on the upper left center portion of the instrument panel. The panel monitors alternator output, oil pressure and the vacuum system. The ALT warning light will illuminate when alternator output is zero; the VAC light when the pressure difference is below 3.5 in. Hg; OIL light when the oil pressure is below 30 psi and the OVER BST light when the engine manifold pressure exceeds 40.75 ± .15 in. Hg. A smaller light indicates when the auxiliary fuel pump is on. A test button is included to check the operation of all the lights except for the auxiliary fuel pump light.

MULTIPURPOSE ELECTRICAL PARTS.

STALL WARNING HORN AND LIFT DETECTOR.

This system consists of a detector which is electrically connected to a stall warning horn. The following ground check can be performed to determine that the lift detector is functioning properly.

The lift detector is located on the left wing, with a tab extending beyond the leading edge. With the master switch ON gently lift the tab on the detector, the stall warning horn should activate.

REMOVAL OF LIFT DETECTOR.

—NOTE—

The master switch must be off prior to performing any work on the lift detector. Place reference marks on holding plate and wing skin for use when reinstalling.

1. Remove four screws holding the plate around the tab. The lift detector is fastened to this plate; remove the unit from wing.
2. Mark the electrical wires and terminals to facilitate reinstallation. Remove electrical wires from lift detector; remove lift detector from aircraft.

INSTALLATION OF LIFT DETECTOR.

1. Attach the electrical leads to the appropriate terminals of the lift detector.
2. Position the lift detector with its mounting plate on the wing, determining that the sensor blade of the unit drops down freely, and secure in position with the four screws previously removed.

ADJUSTMENT OF LIFT DETECTOR.

The lift detector switch is adjusted at the factory when the airplane is test flown, and should not require any further adjustment during the normal service life of the airplane. Should some type of service on the wing require removing the switch, the following instructions will help in positioning the switch at the proper position.

Loosen the two Philips head screws; one on either side of the vane. If the stall warning comes on too late, move the switch up. If the stall warning comes on too early, move the switch down. Retighten the screws after making any adjustments.

—CAUTION—

Never try to adjust the switch by bending the vane.

The only way to test the accuracy of the setting is to fly the airplane into a stall condition and NOTE the speed at which the stall warning comes on. The stall should be made with the flaps up and power off. It may be necessary to make several test flights and alternate adjustments before the desired setting is obtained. The stall warning should come on not less than five or more than ten miles per hour before the actual stall occurs.

ELECTRICAL SWITCHES AND CIRCUIT BREAKERS.

The switches are of the rocker type. The switches are mounted on the left side panel. The circuit breakers are single hole mounting, push button type with manual reset; they must be reset by the pilot whenever tripped. They are on a circuit breaker panel on the lower right hand corner of the instrument panel.

REMOVAL OF ELECTRICAL SWITCHES.

1. For a particular switch removal, remove the screws on the front of the panel.
2. From behind the panel remove the switch, and disconnect the electrical connections.

—NOTE—

Make none of the placement of the electrical leads to facilitate reinstallation.

INSTALLATION OF ELECTRICAL SWITCHES.

1. Reconnect electrical leads with mounting screws in their proper place.
2. Insert switch into its designated slot on the panel and secure with the screws previously removed.

REMOVAL OF CIRCUIT BREAKERS.

1. Remove knurl nut from circuit breaker face plate, front of instrument panel.
2. From behind instrument panel remove circuit protector from instrument panel.
3. Disconnect electrical connections fastened with screws to the circuit breaker.

—NOTE—

Make note of the placement of the electrical leads to facilitate reinstallation.

INSTALLATION OF CIRCUIT BREAKERS.

1. Connect the electrical leads to their proper screw and secure.
2. Insert circuit protector into its proper hole on the instrument panel.
3. Fasten and tighten knurl nut to circuit breaker face plate, front of instrument panel.

—END—

CHAPTER

51

STRUCTURES

CHAPTER 51-STRUCTURES

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

DESCRIPTION.

The PA-28-201T is an all metal semi-monocoque structure. The fuselage is constructed of bulkheads, stringers and stiffeners, to which all of the outer skin is riveted. The cabin entrance door is located on the right side of the fuselage above the wing. The wings and empennage are all metal, full cantilever semi-monocoque type construction with removable tips.

STRUCTURAL REPAIRS.

Structural repair methods used must be made in accordance with the regulations set forth in FAA Advisory Circular 43-13-1A. To assist in making repairs and/or replacements, Figure 51-1 identifies the type and thickness of various skin material used.

—WARNING—

No access holes are permitted in any control surfaces. The use of patch plates for repairs of all movable control surfaces is prohibited. The use of any filler material normally used for repair of minor dents and/or materials used for filling the inside of surfaces is also prohibited on all movable control surfaces.

Never make a skin replacement or patch plate from material other than the type of the original skin, or of a different thickness than the original skin. The repair must be as strong as the original skin. However, flexibility must be retained so the surrounding areas will not receive extra stress.

BAGGAGE COMPARTMENT INSPECTION HOLE AND COVER PLATE.

(See latest revision of Piper Service Bulletin 977.)

a. General.

Airplanes manufactured before 1979 may not have had control cable inspection access holes in the baggage compartment floor. The following is a method of fabricating inspection access holes in the floor of the baggage compartment, if desired.

b. Baggage Compartment Inspection Holes Fabrication Procedure. (Refer to Figure 51-1a.)

While Figure 51-1a shows the hole in the left side of the baggage compartment, a similar hole is also cut out in the right side baggage compartment floor. Installation will require two each inspection access covers, Piper P/N 62109-00.

1. Layout cut lines
   - (a) Gain access to baggage compartment.
   - (b) ***Carefully*** remove:
     - (1) Right side baggage compartment Royalite plastic close out panel.
     - (2) Rear close out panel.
     - (3) Carpeting from baggage compartment floor.
   - (c) Determine and mark a reference center line running through baggage compartment. Refer to Figure 51-1a for measurements.
   - (d) Measure two points 14.99 inches each side of the reference centerline. Joining these two points will form the centerlines of each inspection hole.

(e) Measure two points on each side of each centerline of both holes at distances of 8.48 inches and 10.98 inches from the aft edge of the baggage compartment floor.
(f) Connect the two 8.48” points and the two 10.98” points so that the resulting lines cross the centerline of each hole.
(g) Using the intersection of the lines constructed in step (f) with each hole’s centerline as the center, scribe an arc having a radius of 2.00”
(h) Draw a line (four lines total) tangent to each side of the arcs constructed on step (g).
(i) There should now be two ovals, like the one in Figure 51-1a, laid out on each side of the baggage compartment floor.

2. Cutting the holes.

— CAUTION —

Baggage compartment flooring is made of 0.025 inch thick aluminum. Use care when cutting through flooring so as not to damage cables and wiring routed below the floor.

(a) Drill a 1/4 inch hole inside of, and adjacent to, one of the scribed lines layed out for each hole.
(b) Using a 1/8 inch router bit, cut out the two inspection holes by following the lines layed out on each side of the baggage compartment floor.
(c) Deburr each cut edge using a file or emery wheel.

3. Installing covers.

(a) Lay one of the 62109-00 covers over one of the inspection holes. Using the screw holes in the cover, scribe the position for the screw holes on the baggage compartment floor.
(b) Drill a 0.120 inch hole in baggage compartment floor at each position layed out in step (a).
(c) Attach cover to flooring with No.8 X 0.38 corrosion resistant steel sheet metal screws.
(d) Repeat steps (a) through (c) on remaining hole.

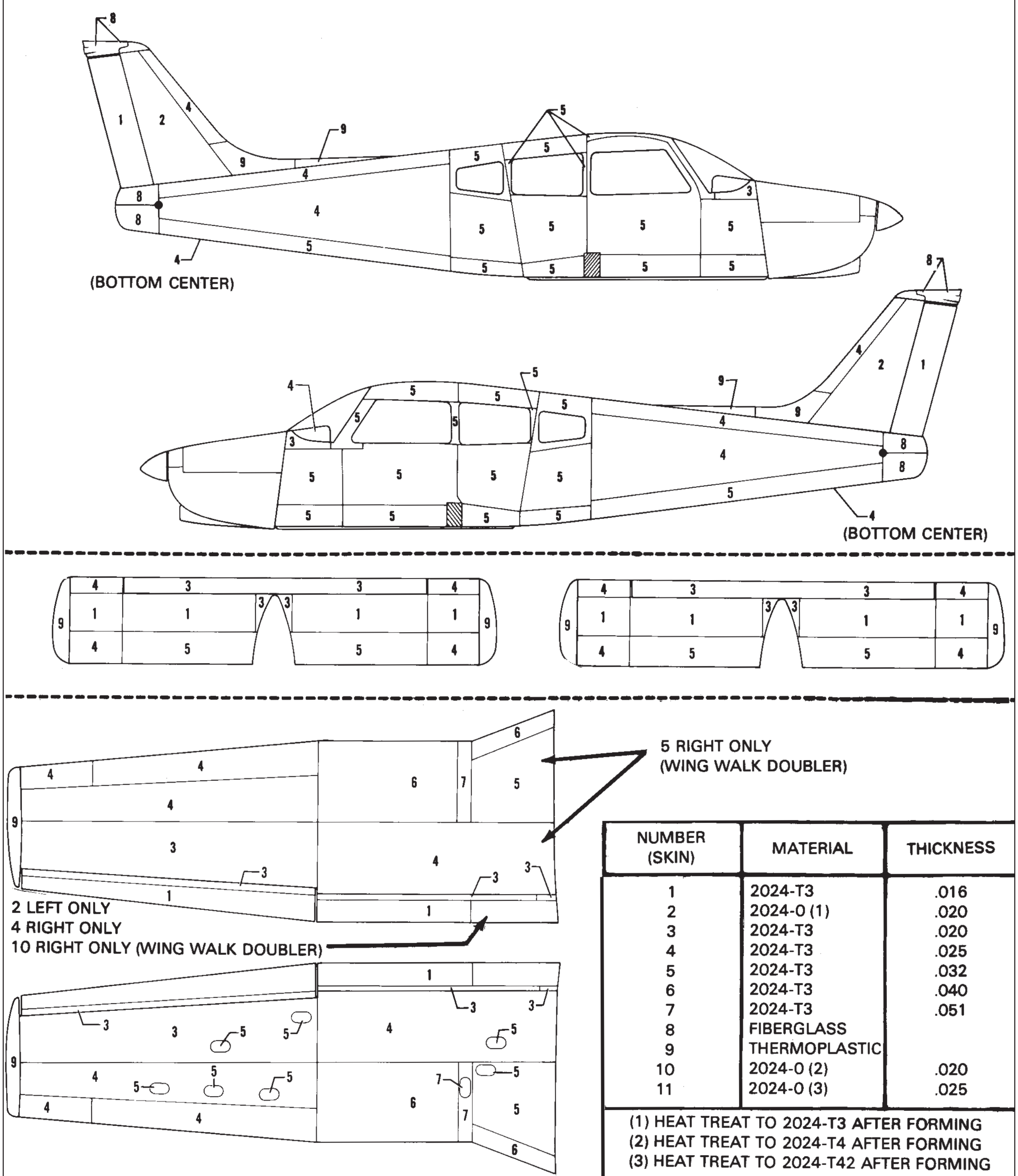
4. Install baggage compartment rear and side close out panels.
5. Install baggage compartment floor carpet.

FIBERGLASS REPAIRS.

The repair procedure in this manual will describe the methods for repair of Fiberglass Reinforced Structures, Fiberglass Touch-Up and Surface Repairs such as blisters, open seams, delamination, cavities, small holes and minor damages that have not harmed the fiberglass cloth material, Fiberglas Fracture and Patch Repairs such as puncture, breaks and holes that have penetrated through the structure and damaged the fiberglass cloth. A repair kit, part number 756 729 will furnish necessary material for such repairs, and is available through Piper Aircraft Dealers.

—NOTE—

Very carefully follow resin and catalyst mixing instructions furnished with repair kit.



NUMBER (SKIN)	MATERIAL	THICKNESS
1	2024-T3	.016
2	2024-0 (1)	.020
3	2024-T3	.020
4	2024-T3	.025
5	2024-T3	.032
6	2024-T3	.040
7	2024-T3	.051
8	FIBERGLASS	
9	THERMOPLASTIC	
10	2024-0 (2)	.020
11	2024-0 (3)	.025

(1) HEAT TREAT TO 2024-T3 AFTER FORMING
(2) HEAT TREAT TO 2024-T4 AFTER FORMING
(3) HEAT TREAT TO 2024-T42 AFTER FORMING

Figure 51-1. Skin Materials and Thickness

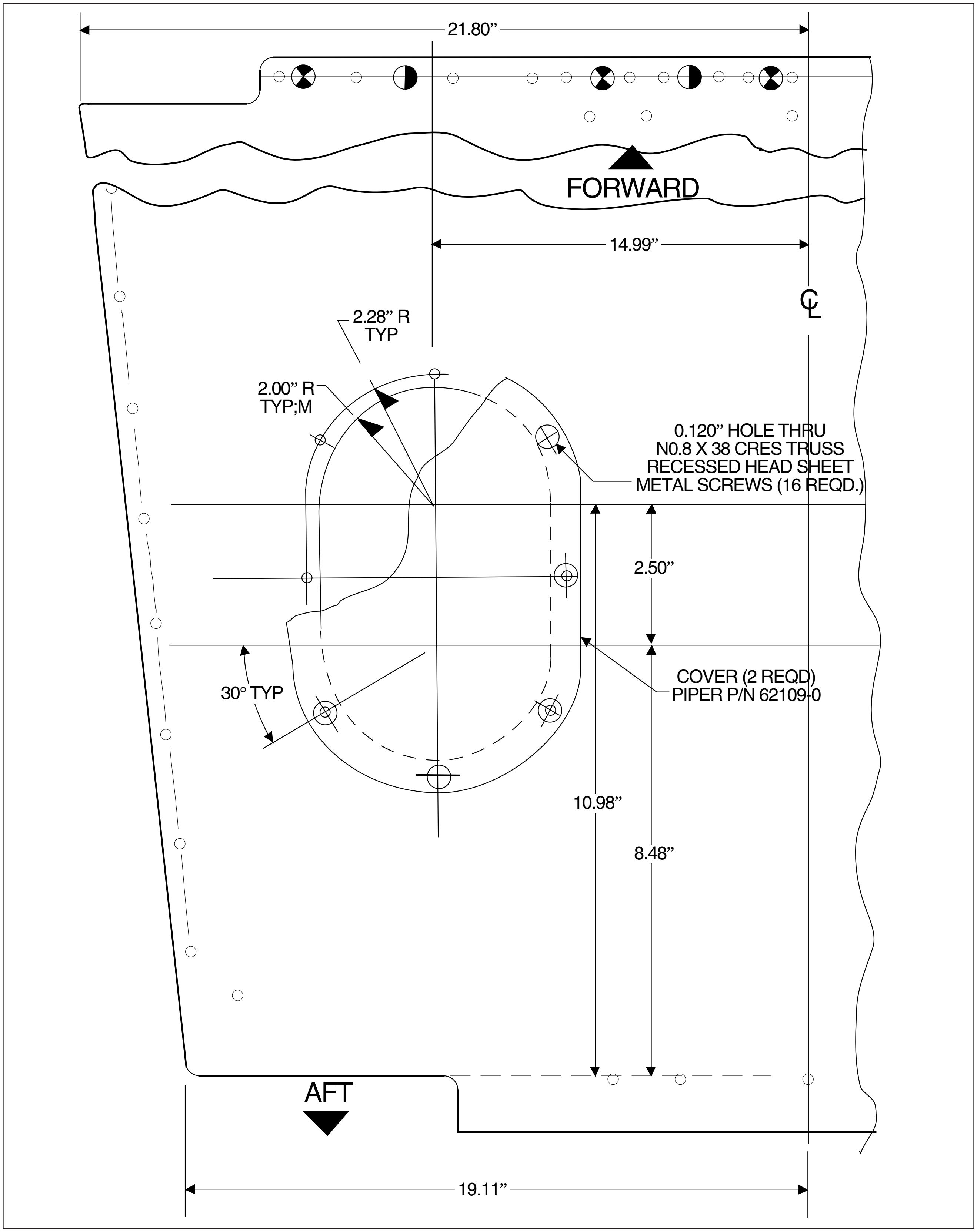


Figure 51-1a. Baggage Compartment Inspection Holes Cutout Details

FIBERGLASS TOUCH-UP AND SURFACE REPAIRS.

1. Remove wax, oil and dirt from around the damaged area with acetone, methylethylketone or equivalent and remove paint to gel coat.
2. The damaged area may be scraped with a fine blade knife or a power drill with a burr attachment to roughen the bottom and sides of the damaged area. Feather the edge surrounding the scratch or cavity. Do not undercut the edge. (If the scratch or cavity is shallow and penetrates only the surface coat, continue to Step 8.)
3. Pour a small amount of resin into a jar lid or on a piece of cardboard, just enough to fill the area being worked on. Mix an equal amount of milled fiberglass with the resin, using a putty knife or stick. Add catalyst, according to kit instruction, to the resin and mix thoroughly. A hypodermic needle may be used to inject gel into small cavities not requiring fiberglass millings mixed with the gel.
4. Work the mixture of resin, fibers and catalyst into the damaged area, using the sharp point of a putty knife or stick to press it into the bottom of the hole and to puncture any air bubbles which may be present. Fill the scratch or hole above the surrounding undamaged area about 1/16 inch.
5. Lay a piece of cellophane or waxed paper over the repair to cut off air and start the cure of gel mixture.
6. Allow the gel to cure 10 to 15 minutes until it feels rubbery to the touch. Remove the cellophane and trim flush with the surface, using a sharp razor blade or knife. Replace the cellophane and allow to cure completely for 30 minutes to an hour. The patch will shrink slightly below the structure surface as it cures. (If wax paper is used, ascertain wax is removed from surface.)
7. Rough up the bottom and edges of the hole with the electric burr attachment or rough sandpaper. Feather hole into surrounding gel coat, do not undercut.
8. Pour out a small amount of resin, add catalyst and mix thoroughly, using a cutting motion rather than stirring. Use no fibers.
9. Using the tip of a putty knife or fingertips, fill the hole to about 1/16 inch above the surrounding surface with the gel coat mixture.
10. Lay a piece of cellophane over the patch to start the curing process. Repeat Step 6, trimming patch when partially cured.
11. After trimming the patch, immediately place another small amount of gel coat on cut edge of the patch and cover with cellophane. Then, using a squeegee or the back of a razor blade, squeegee level with area surrounding the patch, leave the cellophane on patch for one or two hours or overnight, for complete cure.
12. After repair has cured for 24 hours, sand the patched area using a sanding block with fine wet sandpaper. Finish by priming, again sanding and applying color coat.

FIBERGLASS FRACTURE AND PATCH REPAIRS.

1. Remove wax, oil and dirt from around damaged area with acetone, methylethylketone or equivalent.
2. Using a key hole saw, electric saber saw, or sharp knife cut away ragged edges. Cut back to sound material.
3. Remove paint three inches back from around damaged area.
4. Working inside the structure, bevel the edges to approximately a 30 degree angle and rough-sand the hole and the area around it, using 80-grit dry paper. Feather back for about two inches all around the hole. This roughens the surface for strong bond with patch.

5. Cover a piece of cardboard or metal with cellophane. Tape it to the outside of the structure covering the hole completely. The cellophane should face toward the inside of the structure. If the repair is on a sharp contour or shaped area, a sheet of aluminum formed to a similar contour may be placed over the area. The aluminum should also be covered with cellophane.

6. Prepare a patch of fiberglass mat and cloth to cover an area two inches larger than the hole.

7. Mix a small amount of resin and catalyst, enough to be used for one step at a time, according to kit instructions.

8. Thoroughly wet mat and cloth with catalyzed resin. Daub resin on mat first, and then on cloth. Mat should be applied against structures surface with cloth on top. Both pieces may be wet out on cellophane and applied as a sandwich. Enough fiberglass cloth and mat reinforcements should be used to at least replace the amount of reinforcements removed in order to maintain the original strength. If damage occurred as a stress crack, an extra layer or two of cloth may be used to strengthen area.

9. Lay patch over hole on inside of structure, cover with cellophane, and squeegee from center to edges to remove all air bubbles and assure adhesion around edge of hole. Air bubbles will show white in the patch and they should all be worked out to the edge. Remove excess resin before it gels on the part. Allow patch to cure completely.

10. Remove cardboard or aluminum sheet from outside of hole and rough-sand the patch and edge of hole. Feather edge of hole about two inches into undamaged area.

11. Mask area around hole with tape and paper to protect surface. Cut a piece of fiberglass mat about one inch larger than the hole and one or more pieces of fiberglass cloth two inches larger than the hole. Brush catalyzed resin over hole, lay mat over hole and wet out with catalyzed resin. Use a daubing action with brush. Then apply additional layer or layers of fiberglass cloth to build up patch to the surface of structure. Wet out each layer thoroughly with resin.

12. With a squeegee or broad knife, work out all air bubbles in the patch. Work from center to edge, pressing patch firmly against the structure. Allow patch to cure for 15 to 20 minutes.

13. As soon as the patch begins to set up, but while still rubbery, take a sharp knife and cut away extra cloth and mat. Cut an outside edge of feathering. Strip cut edges of structure. Do this before cure is complete to save extra sanding. Allow patch to cure overnight.

14. Using dry 80-grit sandpaper on a power sander or sanding block, smooth patch and blend with surrounding surface. Should air pockets appear while sanding, puncture and fill with catalyzed resin. A hypodermic needle may be used to fill cavities. Let cure and resand.

15. Mix catalyzed resin and work into patch with fingers. Smooth carefully and work into any crevices.

16. Cover with cellophane and squeegee smooth. Allow to cure completely before removing cellophane. Let cure and resand.

17. Brush or spray a coat of catalyzed resin to seal patch. Sand patch, finish by priming, again sanding and applying color coat.

—NOTE—

Brush and hands may be cleaned in solvents such as acetone or methylethylketone. If solvents are not available, a strong solution of detergent and water may be used.

THERMOPLASTIC REPAIRS.

The following procedure will assist in making field repairs to items made of thermoplastic which are used throughout the airplane. A list of material needed to perform these repairs is given along with suggested suppliers of the material. Common safety precautions should be observed when handling some of the materials and tools used while making these repairs.

CHART 5101. LIST OF MATERIALS (THERMOPLASTIC REPAIR)

ITEMS	DESCRIPTIONS	SUPPLIERS
Buffing and Rubbing Compounds	Automotive Type-DuPont #7 Ram Chemical #69 x 1 Mirror Glaze #1	DuPont Company Wilmington, Del. l9898 Ram Chemicals Gardena, Cal. 90248 Mirror Bright Polish Co., Inc. Irvin, Cal. 92713
Cleaners	Fantastic Spray Perchlorethylene VM&P Naphtha (Lighter Fluid)	Obtain From Local Suppliers
ABS-Solvent Cements	Solarite #11 Series	Solar Compounds Corp. Linden, N.J. 07036
Solvents	Methylethylketone Methylene Chloride Acetone	Obtain From Local Suppliers
Epoxy Patching Compound	Solarite #400	Solar Compounds Corp. Linden, N.J. 07036
Hot Melt Adhesives Polyamids and Hot Melt Gun	Stick Form 1/2 in. dia. 3 in. long	Sears Roebuck & Co. or Most Hardware Stores
Hot Air Gun	Temp. Range 300° to 400° F	Local Suppliers

1. Surface Preparation:
   A. Surface dirt and paint if applied must be removed from the item being repaired. Household cleaners have proven most effective in removing surface dirt.
   B. Preliminary cleaning of the damaged area with perchlorethylene or VM&P Naptha will generally insure a good bond between epoxy compounds and thermoplastic.

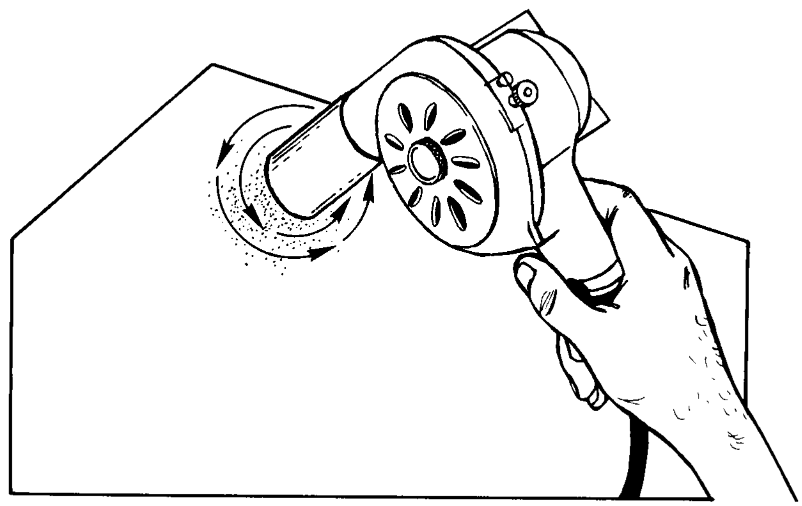


Figure 51-2. Surface Scratches, Abrasions or Ground-in-Dirt

2. Surface Scratches, Abrasion or Ground-in-Dirt: (Refer to Figure 51-2.)
   A. Shallow scratches and abraded surfaces are usually repaired by following directions on containers of conventional automotive buffing and rubbing compounds.
   B. If large dirt particles are embedded in thermoplastic parts, they can be removed with a hot air gun capable of supplying heat in the temperature range of 300° to 400°F. Use care not to overheat the material. Hold the nozzle of the gun about 1/4 of an inch away from the surface and apply heat with a circular motion until the area is sufficiently soft to remove the dirt particles.
   C. The thermoplastic will return to its original shape upon cooling.
3. Deep Scratches, Shallow Nicks and Small Holes: (Less than 1 inch in diameter.) (Refer to Figure 51-3.)
   A. Solvent cements will fit virtually any of these applications. If the area to be repaired is very small, it may be quicker to make a satisfactory cement by dissolving thermoplastic material of the same type being repaired in solvent until the desired paste-like consistency is achieved.
   B. This mixture is then applied to the damaged area. Upon solvent evaporation, the hard durable solids remaining can easily be shaped to the desired contour by filing or sanding.
   C. Solvent adhesives are not recommended for highly stressed areas, on thin walled parts or for patching holes greater than 1/4 inch in diameter.

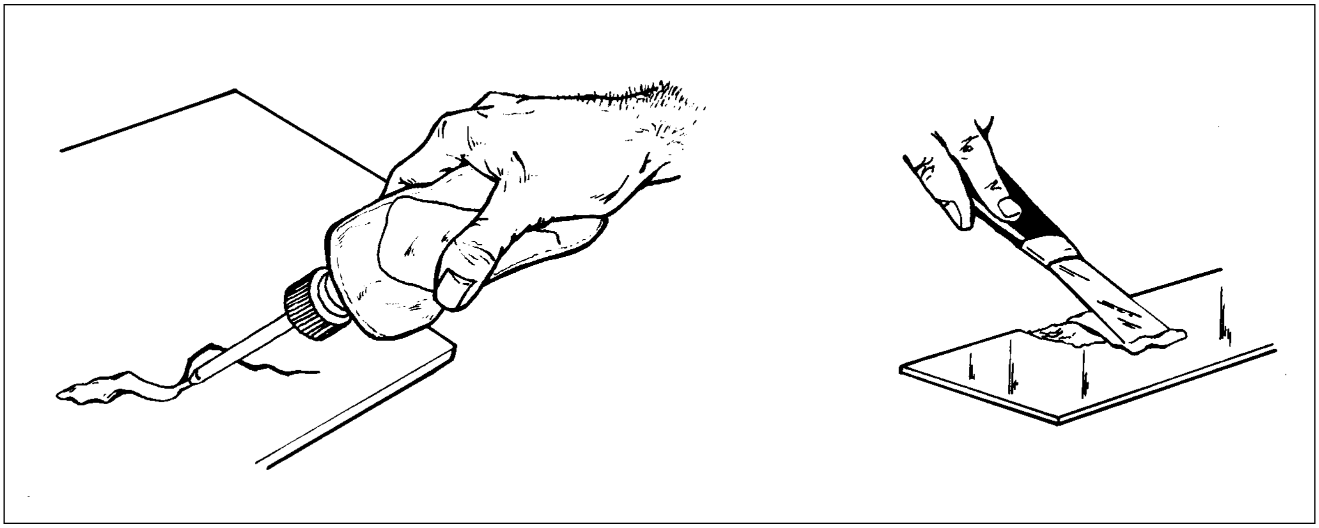


Figure 51-3. Deep Scratches, Shallow Nicks and Small Holes Repair

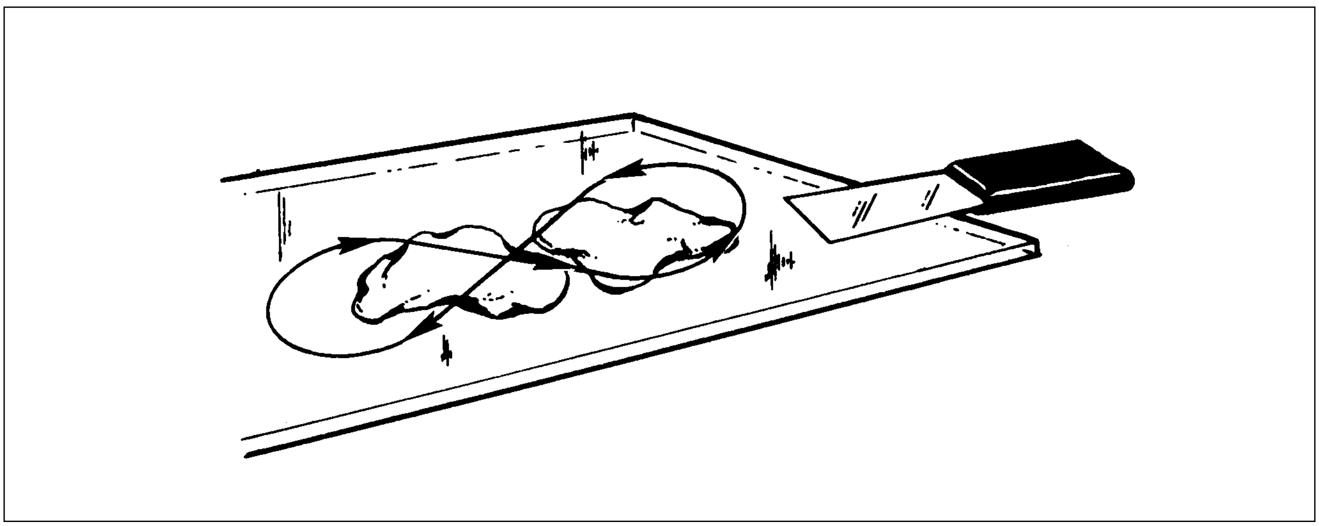


Figure 51-4. Mixing of Epoxy Patching Compound

D. For larger damages an epoxy patching compound is recommended. This type material is a two part, fast curing, easy sanding commercially available compound.
E. Adhesion can be increased by roughing the bonding surface with sandpaper and by utilizing as much surface area for the bond as possible.
F. The patching compound is mixed in equal portions on a hard flat surface using a figure eight motion. The damaged area is cleaned with perchlorethylene or VM&P Naptha prior to applying the compound. (Refer to Figure 51-4.)
G. A mechanical sander can be used after the compound is cured, providing the sander is kept in constant motion to prevent heat buildup.

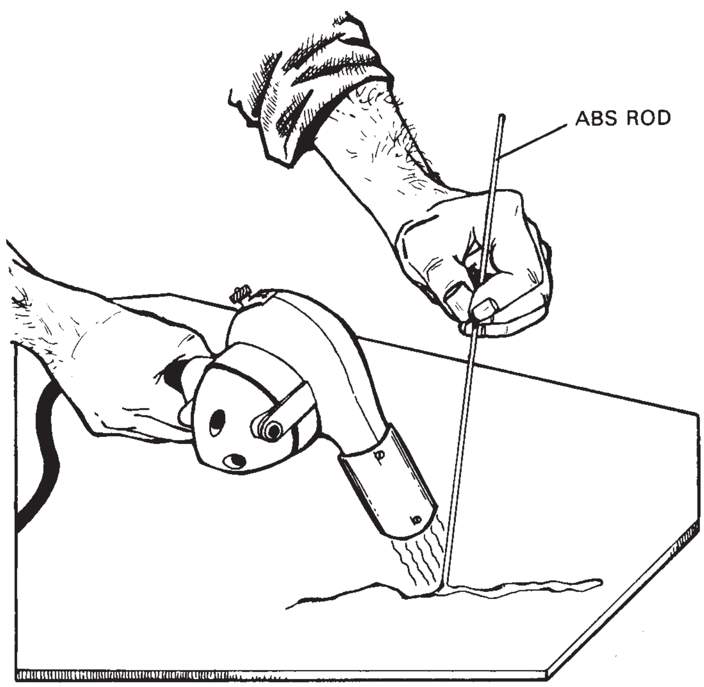


Figure 51-5. Welding Repair Method

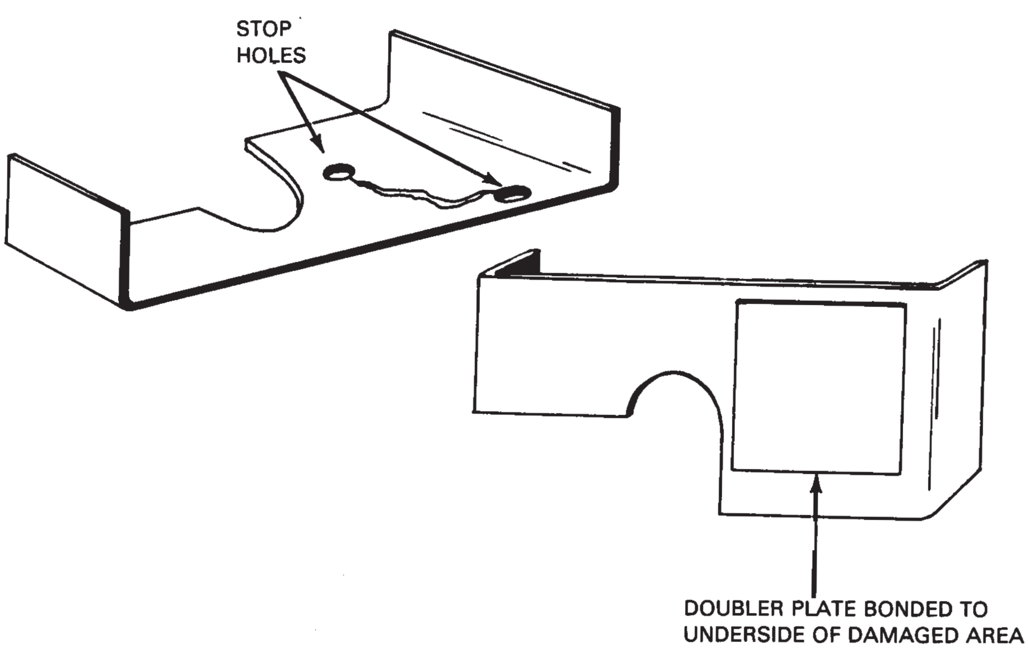


Figure 51-6. Repairing of Cracks

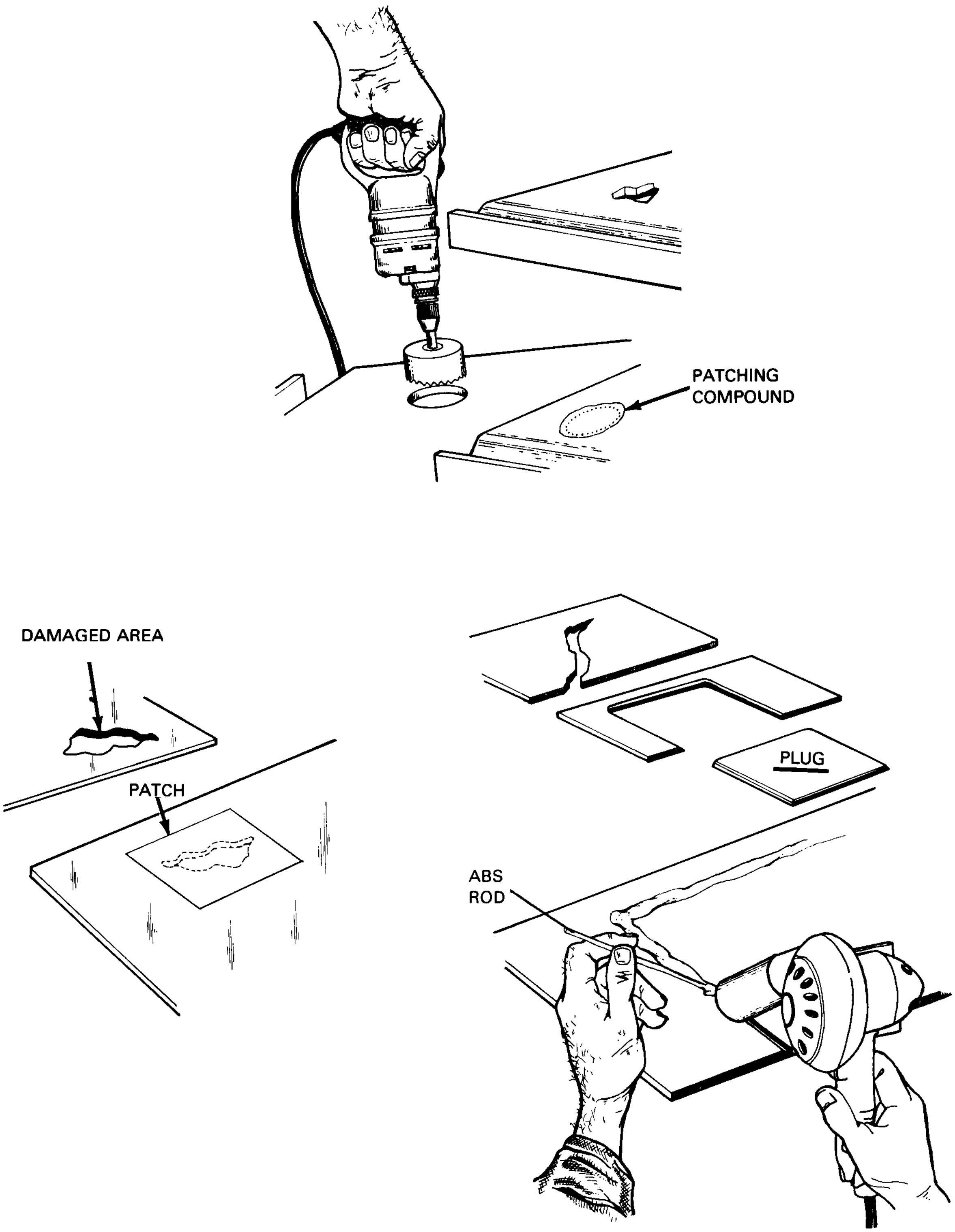


Figure 51-7. Various Repairs

H. For repairs in areas involving little or no shear stress, the hot melt adhesives, polyamids which are supplied in stick form may be used. This type of repair has a low cohesive strength factor.
I. For repairs in areas involving small holes, indentations or cracks in the material where high stress is apparent or thin walled sections are used, the welding method is suggested.
J. This welding method requires a hot air gun and ABS rods. To weld, the gun should be held to direct the flow of hot air into the fusion (repair) zone, heating the damaged area and rod simultaneously. The gun should be moved continuously in a fanning motion to prevent discoloration of the material. Pressure must be maintained on the rod to insure good adhesion. (Refer to Figure 51-5.)
K. After the repair is completed, sanding is allowed to obtain a surface finish of acceptable appearance.

4. Cracks: (Refer to Figure 51-6.)
   A. Before repairing a crack in the thermoplastic part, first determine what caused the crack and alleviate that condition to prevent it recurring after the repair is made.
   B. Drill small stop holes at each end of the crack.
   C. If possible, a double plate should be bonded to the reverse side of the crack to provide extra strength to the part.
   D. The crack should be “V” grooved and filled with repair material, such as solvent cement, hot melt adhesive, epoxy patching compound or of air welded, whichever is preferred.
   E. After the repair has cured, it may be sanded to match the surrounding finish.
5. Repairing Major Damage: (Larger than 1 inch in diameter.) (Refer to Figure 51-7.)
   A. If possible a patch should be made of the same material and cut slightly larger than the section being repaired.
   B. When appearances are important, large holes, cracks, tears, etc., should be repaired by cutting out the damaged area and replacing it with a piece of similar material.
   C. When cutting away the damaged area, under cut the perimeter and maintain a smooth edge. The patch and/or plug should also have a smooth edge to insure a good fit.
   D. Coat the patch with solvent adhesive and firmly attach it over the damaged area.
   E. Let the patch dry for approximately one hour before any additional work is performed.
   F. The hole, etc., is then filled with the repair material. A slight overfilling of the repair material is suggested to allow for sanding and finishing after the repair has cured. If patching compound is used the repair should be made in layers, not exceeding a 1/2 inch thickness at a time, thus allowing the compound to cure and insuring a good solid buildup of successive layers as required.
6. Stress Lines: (Refer to Figure 51-8.)
   A. Stress lines produce a whitened appearance in a localized area and generally emanate from the severe bending or impacting of the material. (Refer to Figure, 51-9.)
   B. To restore the material to its original condition and color, use a-hot air gun or similar heating device and carefully apply heat to the affected area. Do not overheat the material.
7. Painting the Repair:
   A. An important factor in obtaining a quality paint finish is the proper preparation of the repair and surrounding area before applying any paint.
   B. It is recommended that parts be cleaned prior to painting with a commercial cleaner or a solution made from one-fourth cup detergent mixed with one gallon of water.
   C. The paint used for coating thermoplastic can be either lacquers or enamels depending on which is preferred by the repair facility or customer. (See NOTE.)

—NOTE—

It is extremely important that solvent formulations be considered when selecting a paint, because not all lacquers or enamels can be used satisfactorily on thermoplastics. Some solvents used in the paints can significantly affect and degrade the plastic properties.

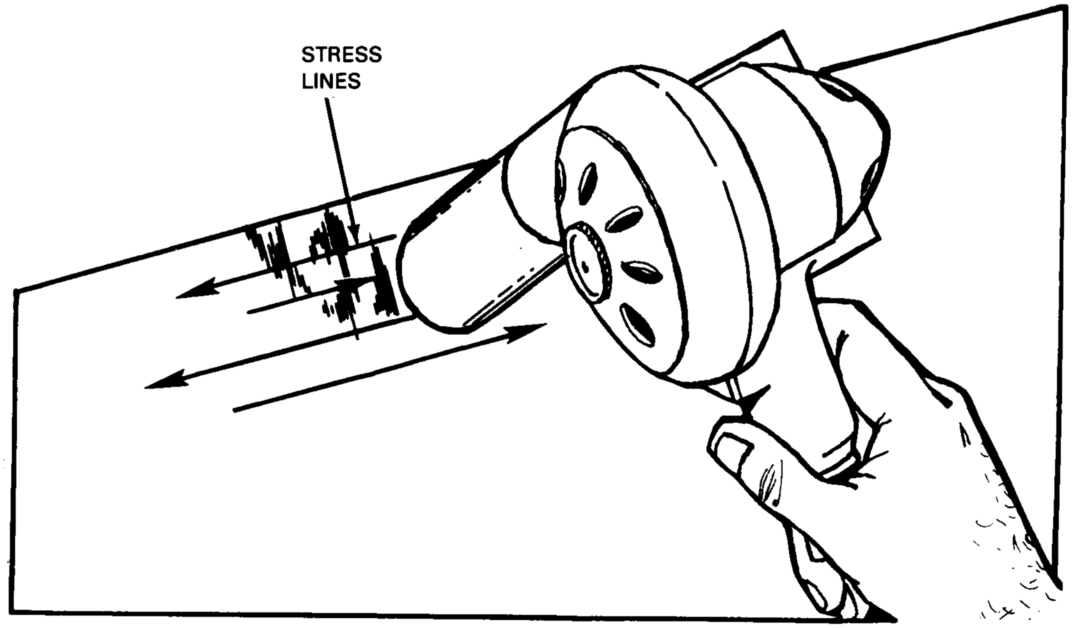


Figure 51-8. Repair of Stress Lines

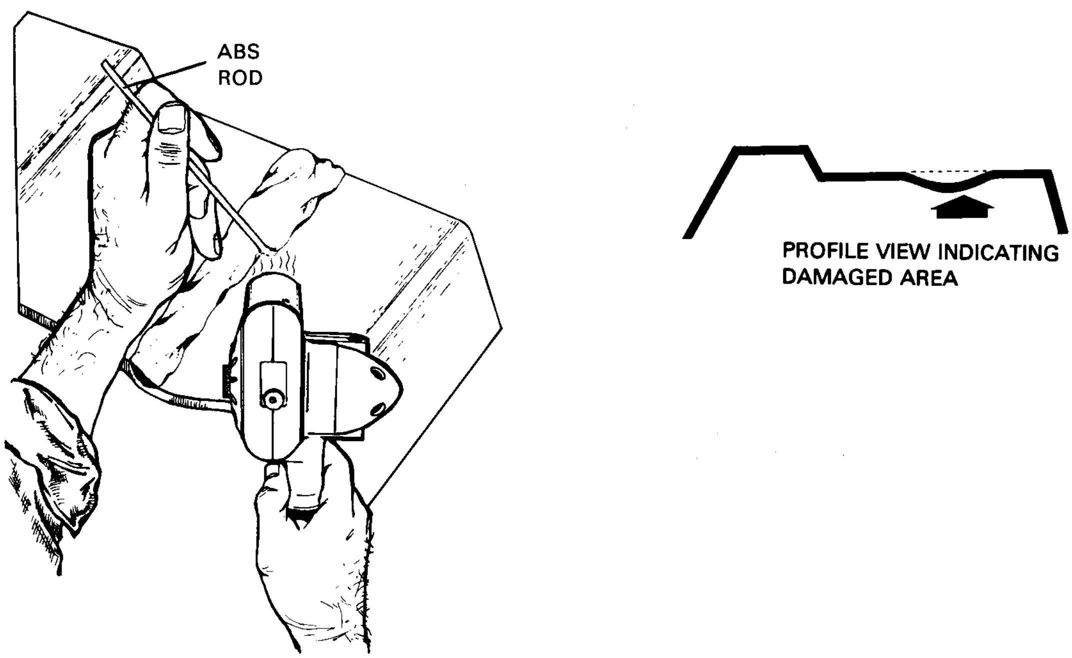


Figure 51-9. Repair of Impacted Damage

D. Another important matter to consider is that hard, brittle coatings that are usually best for abrasion resistance should not be used in areas which incur high stress, flexing or impact. Such coating may crack, thus creating a weak area.

SAFETY WALK REPAIR.

SURFACE PREPARATION.

1. Clean all surfaces with a suitable cleaning solvent to remove dirt, grease and oils. Solvents may be applied by dipping, spraying or mopping.
2. Insure that no moisture remains on the surface by wiping with a clean dry cloth.
3. Outline the area to which the liquid safety walk compound is to be applied, and mask adjacent surfaces.

—NOTE—

Newly painted surfaces shall be allowed to dry for 2.5 hours minimum prior to the application of the safety walk.

PRODUCT LISTING FOR LIQUID SAFETY WALK COMPOUND.

1. Suggested Solvents:
   Safety Solvent per MIL-S-18718
   Sherwin Williams Lacquer Thinner R7KC120
   Glidden Thinner No. 207
2. Safety Walk Material:
   Walkway Compound and Matting Nonslip (included in Piper Part No. 179872)

APPLICATION OF LIQUID SAFETY WALK COMPOUND.

Liquid safety walk compound shall be applied in an area, free of moisture for a period of 24 hours minimum after application. Do not apply when surface to be coated is below 50°F. Apply liquid safety walk compound as follows:

1. Mix and thin the liquid safety walk compound in accordance with the manufacturer's instructions on the container.
2. Coat the specified surfaces with a smooth, unbroken film of the liquid safety walk compound. A nap type roller or a stiff bristle brush is recommended, using fore and aft strokes.
3. Allow the coating to dry for 15 minutes to one hour before recoating or touch-up; if required after application of the initial coating.
4. After recoating or touch-up, if done, allow the coating to dry for 15 minutes to one hour before removing masking.

—NOTE—

The coated surface shall not be walked on for six hours minimum after application of final coating.

SURFACE PREPARATION FOR PRESSURE SENSITIVE SAFETY WALK.

The areas to which the pressure sensitive safety walk is to be installed must be free from all contaminates and no moisture present. If liquid safety walk is installed the area must be prepared as follows:

1. Area must be masked off to protect painted surfaces.
2. Apply suitable stripper MEK Federal Spec. TT-M-261, U.S. Rubber No. 3339 to wingwalk compound. As compound softens remove by using putty knife or other suitable tool.
3. Area must be clean and dry prior to painting.
4. Prime and paint area.

—NOTE—

Newly painted surfaces shall be allowed to dry for 2.5 hours minimum prior to the application of the safety walk.

APPLICATION OF PRESSURE SENSITIVE SAFETY WALK.

Wipe area with a clean dry cloth to insure that no moisture remains on surface. Do not apply when surface temperature is below 50°F. Apply pressure sensitive safety walk as follows:

1. Peel back the full width of the protective liner approximately 2 inches from the leading edge of the safety walk.
2. Apply the safety walk to the wing area, begin at the leading edge, insure proper alignment and position from wing lap.
3. Remove the remaining protective liner as the safety walk is being applied from front to back of wing area.
4. Roll firmly with a long handled cylindrical brush in both lengthwise directions. Make sure all edges adhere to the wing skin.
5. Install and rivet leading edge retainer.

—END—

CHAPTER

52

DOORS

CHAPTER 52-DOORS

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This airplane has one entrance door located on the right side of the fuselage and a baggage door also on the right side aft of the entrance door.

REMOVAL AND INSTALLATION OF DOOR SNUBBER.

1. If the existing door scal is torn or has deteriorated it should be replaced. If rebonding is required use:
   A. 3M EC 1300L (preferred)
   B. Proco Adhesive 6205-1
   C. Scotch Grip 2210
2. Remove windlace retainers. Expose the door jamb by rolling back and taping the windlace.
3. Disconnect the door-holder attached to the lower door jamb and remove scuff plate.
4. Remove the striker plate. (Refer to Figure 52-1.)
5. Remove the snubber as follows:
   A. Apply mineral spirits to the snubber to loosen the adhesive.
   B. Using a plastic scraper (or other appropriate instrument), scrape off the snubber while applying mineral spirits as necessary.
   C. With the snubber removed, use a clean cloth and mineral spirits to remove excess adhesive.
6. Installation of the door seal snubber is as follows:
   A. If the doorjamb paint is flaking or is excessively scuffed, rub down with wet and dry emery cloth. Clean the surface with Prep-Sol or equivalent cleaner which will not leave an oily residue.

—NOTE—

The normal "tack time" for 3M EC 1300L is 30 to 45 minutes at 75°F. However, adhesive which has "set" may be reactivated by a clean rag moistened with Toluol or Methylethylketone.

   B. To effect a clean installation it is recommended that the door jamb is masked off with tape as shown in Figure 52-1, View B.
   C. Apply adhesive to the door jamb with a small brush on the area indicated in Figure 52-1, View B.
   D. Apply adhesive to the inside surface of the snubber.
   E. Position the snubber with the protruding leg facing outboard beginning at-the lower center (±2 inches) of the door jamb. Work progressively around the door jamb applying pressure to the snubber to remove any trapped air and to ensure the edges are effectively bonded to the jamb.

—NOTE—

Do not stretch the rubber, especially in the corner areas, as this can cause cracks.

F. It takes approximately one day for the bond to cure. It is recommended that the door be kept open as long as possible during this time to effect maximum curing.
G. Remove masking tape if used, and clean off excessive adhesive using a clean cloth and mineral spirits or Toluol.
H. Install the striker plate.
I. Reposition the windlace and secure with retainers previously removed.
J. Install the scuff plate and door holder previously removed.
K. Adjust the door latch to compensate for the snubber, ensuring a good door to fuselage contour fit with no increase in latching effort.
L. After all adjustments and curing have been accomplished, coat the snubber with silicone-wipe off any excess.

PASSENGER/CREW.

REMOVAL OF DOOR.

1. Remove the clevis bolt, washer and bushing from the door holder assembly.
2. Remove cotter pins and clevis pins from the door hinges.
3. Remove the door from the airplane.

INSTALLATION OF DOOR.

1. Insert the door into position and install the hardware previously removed.
2. Make appropriate adjustments to the door.
3. Install the door holder assembly with the hardware previously removed.

ADJUSTMENT OF DOOR.

1. To acquire proper adjustment of the door insert the necessary washers to eyebolts between the fuselage and flange on the eyebolts.
2. Additional adjustments may be made by loosening the hinges on the door.
3. To insure longer life of the door seals and improve sealing characteristics, it is recommended they be lubricated with a fluorocarbon or similar dry lubricant in a spray can.

REMOVAL OF DOOR LATCH MECHANISM.

1. Remove the door latch mechanism by removing the door trim upholstery and the screws that attach the latch plate and latch mechanism to the door.
2. Disconnect the latch pull rod from the inside door handle.
3. Remove the complete latch mechanism.

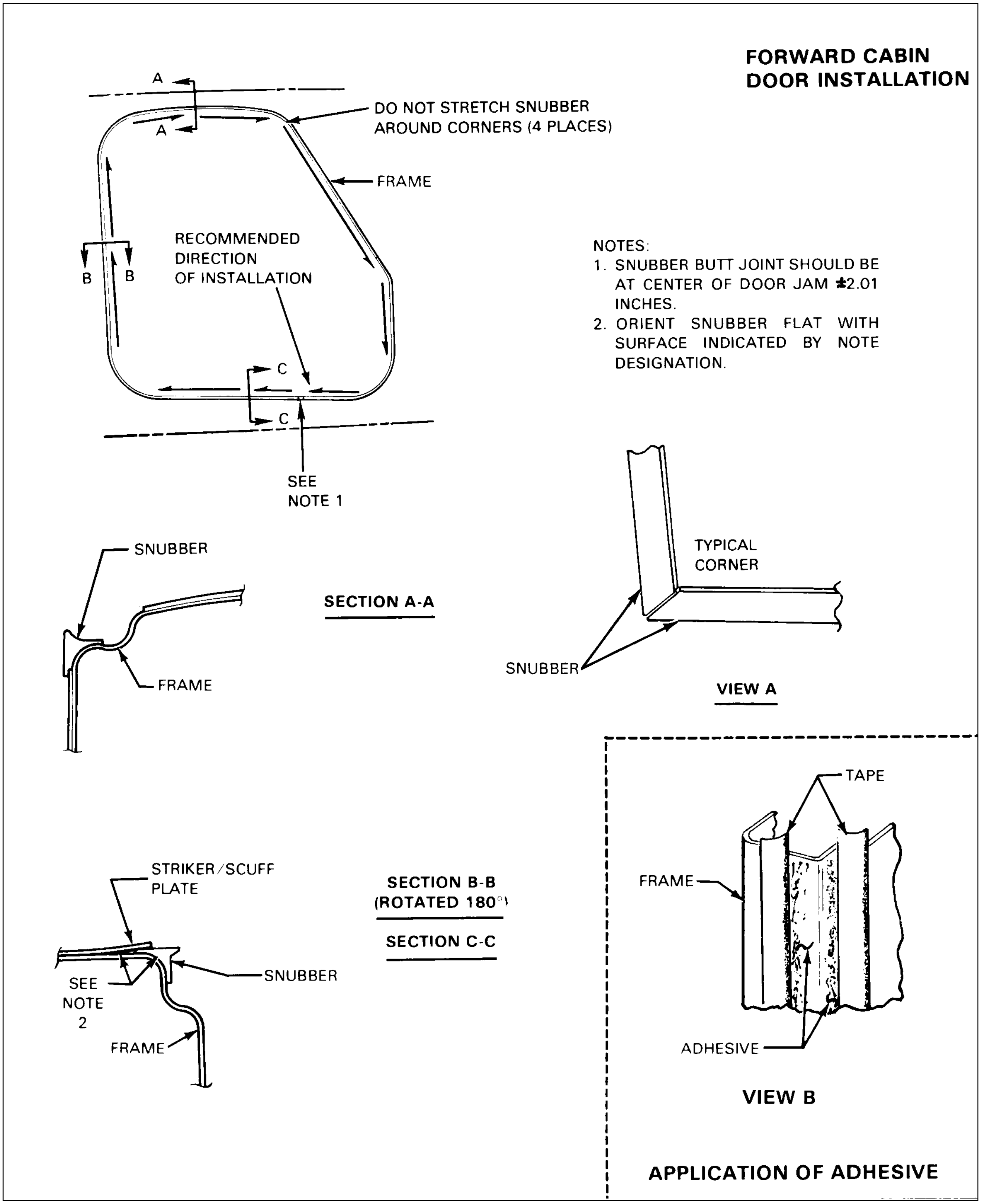


Figure 52-1. Snubber Installation

INSTALLATION OF DOOR LATCH MECHANISM.

1. Place the latch assembly into position on the door handle.
2. Connect the latch pull rod to the inside door handle.
3. Replace the screws that attach the latch plate and mechanism to the door. Install the door trim upholstery and secure with screws.

ADJUSTMENT OF DOOR LATCH MECHANISM.

To adjust the door latch, loosen the screws on the striker plate, make necessary adjustment, and retighten the screws.

REMOVAL OF DOOR LOCK ASSEMBLY.

1. Remove the door trim upholstery by removing the attachment screws.
2. Loosen the nut on the lock assembly and remove the lock by turning it sideways.

INSTALLATION OF DOOR LOCK ASSEMBLY.

1. Install the lock in the door by turning it sideways and placing it through the opening provided.
2. Replace the nut on the back of the lock assembly and tighten.
3. Replace the door trim upholstery and secure with the attachment screws.

REMOVAL OF DOOR AUXILIARY LATCH.

1. Remove the latch assembly by removing the two handles.
2. Remove six screws holding the pan on the inside of the door.
3. Remove the pan and pull the latch assembly through the opening on the door.

INSTALLATION OF DOOR AUXILIARY LATCH.

1. Place the latch assembly into position for installation.
2. Replace the pan and install the six screws and handles.
3. Check the latch assembly for operation and be certain that it is free of rubbing on the trim panels.

ADJUSTMENT OF AUXILIARY LATCH.

1. To adjust the door auxiliary latch remove the two screws from the latch plate found at the top of the door opening.
2. Remove the plate and turn the loop assembly in or out to make necessary adjustments.
3. Replace the latch plate and secure with the two attachment screws.

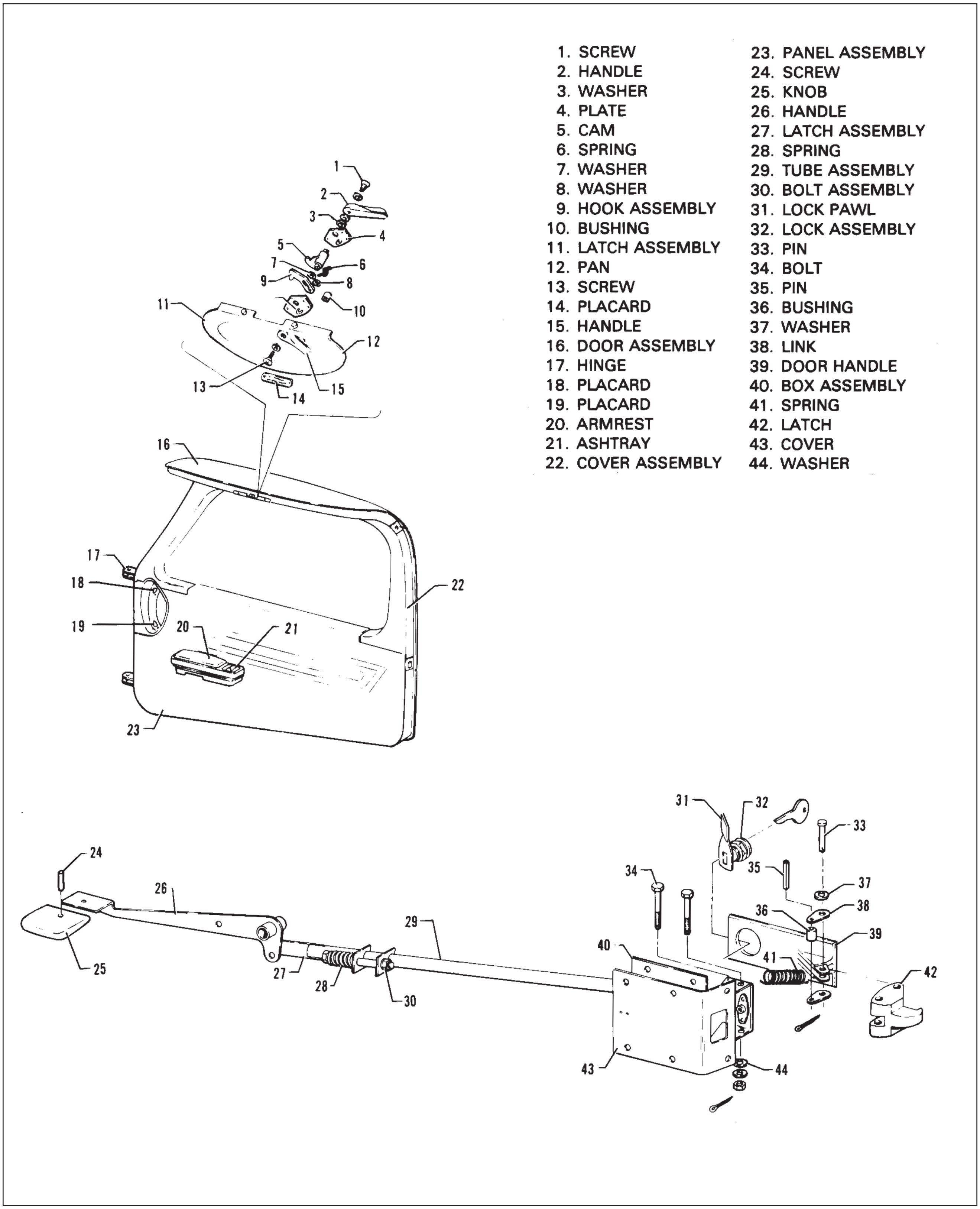


Figure 52-2. Door Installation

CARGO DOOR.

REMOVAL OF BAGGAGE DOOR.

With the door open remove the hinge pin from the hinge and remove the door.

INSTALLATION OF BAGGAGE DOOR.

Place the door in position so that the hinge halves are properly matched and install the hinge pin. It will not be necessary to replace the hinge pin with a new pin if it is free of bends and wear.

REMOVAL OF BAGGAGE DOOR LOCK ASSEMBLY.

1. With the door open remove two screws securing the access plate, remove the access plate.
2. Remove the nut from the back of the lock assembly with the use of a special wrench. (This tool may be fabricated from the dimensions given in Chapter 95.)
3. Remove the lock assembly through the front of the door.

INSTALLATION OF BAGGAGE DOOR LOCK ASSEMBLY.

1. Place the lock into position for installation.
2. Install the nut on the lock assembly and tighten with the use of a special wrench.
3. Install access plate and secure with two screws.

—END—

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CHAPTER

55

STABILIZERS

CHAPTER 55-STABILIZERS

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

STABILATOR.

REMOVAL OF STABILATOR. (Refer to Figure 55-2.)

—NOTE—

Before entering the aft portion of the fuselage, attach a stand to the tail skid for support; and with the use of a heavy pad, protect the inside of the fuselage. Be certain to distribute weight on top of the bulkheads so as not to damage the fuselage skin.

Should it be necessary to move the rudder to its extreme left or right for clearance, do so with the use of the rudder pedals or tow bar.

1. Remove the screws from around the upper and lower tail cone fairing assembly and remove the fairing separately.
2. Block the trim cable at the barrel of the trim screw assembly to prevent the cable from unwrapping.
3. Remove the access panel to the aft section of the fuselage located at the back wall of the baggage compartment.
4. Install cable blocks, as illustrated in Figure 55-1, on the stabilator trim control cable at the first set of pulleys forward of the cable turnbuckles to prevent the forward cable from unwrapping.
5. Disconnect the trim cables at the turnbuckles within the aft section of the fuselage.
6. Relieve tension from the stabilator control cables by loosening one of the cable turnbuckles in the aft section of the fuselage.
7. Disconnect the stabilator control cables from the stabilator balance arm by removing cotter pins, nuts, washers, bushings and clevis bolts.
8. Disconnect the trim indicator cable (overhead trim only) and the tab control arm connecting links from the trim screw by removing nut, washers, bushings and bolts.
9. Disconnect the trim assembly from the aft bulkhead of the fuselage by removing the attaching nuts, washers and bolts of the horizontal and diagonal support brackets.
10. Move the trim assembly up through the tail cone fairing cutout in the stabilator and remove, with cable, from the airplane.
11. Remove the stabilator by disconnecting the stabilator at its hinge points by removing attaching nuts, washers and bolts.

INSTALLATION OF STABILATOR. (Refer to Figure 55-2.)

—NOTE—

A clearance of .25 ± .06 of an inch between the stabilator and the side of the fuselage and .18 of an inch minimum between all parts of the stabilator and the tail cone assembly must be maintained throughout the stabilator travel. Use a proper washer combination on the stabilator hinges to attain the necessary tolerances.

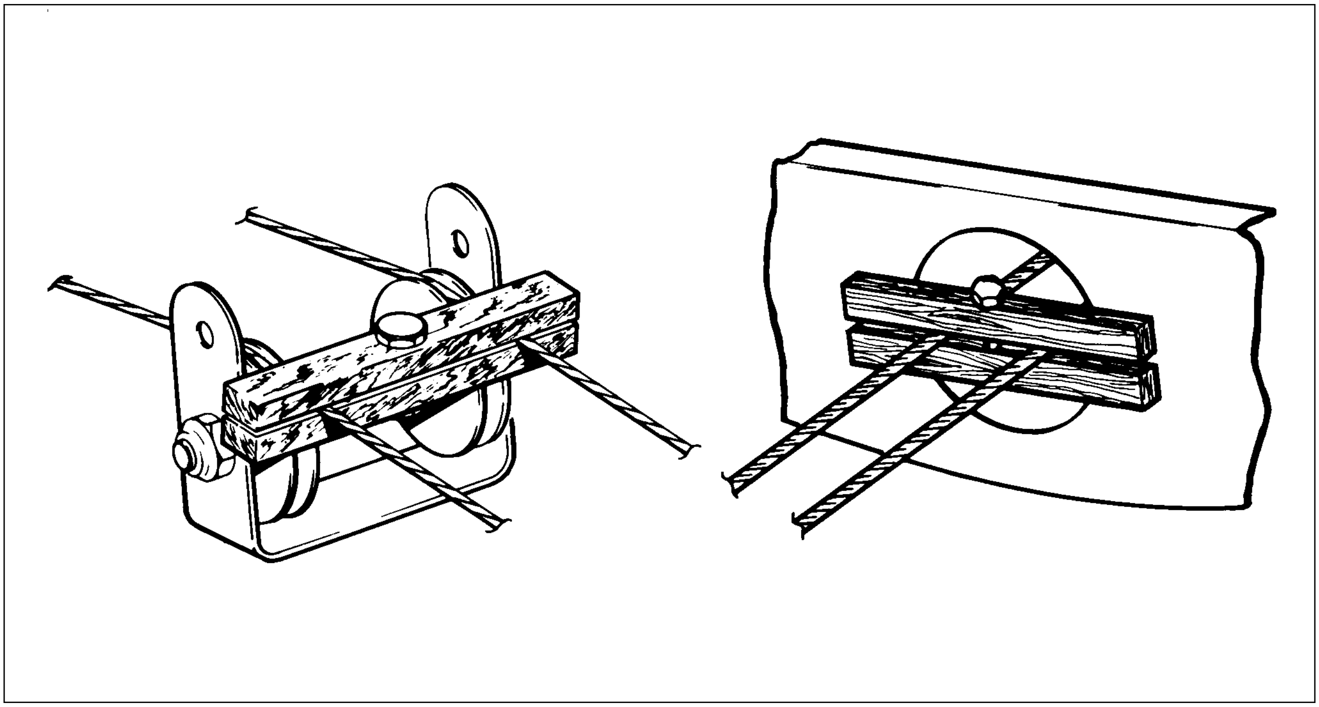


Figure 55-1. Methods of Securing Control Cables

1. Insert the stabilator in position and install attaching hinge bolts, washers and nuts.
2. Move the trim assembly through the cutout in the stabilator and attach the brackets of the assembly to the aft bulkhead with bolts, washers and nuts. Insert the trim cable ends into the fuselage.
3. Attach the stabilator control cables to the stabilator balance arm with clevis bolts, bushings, washers, nuts and cotter pins.
4. Connect the ends of the fore and aft trim cables at the turnbuckles within the aft section of the fuselage.
5. Remove the cable block from the trim control cable within the fuselage.
6. Set stabilator control cable tension and check rigging and adjustment according to Rigging and Adjustment of Stabilator, Chapter 27.
7. Remove the cable blocks from the trim cable at the barrel of the trim screw assembly.
8. Set stabilator trim control cable tension and check rigging and adjustment according to instructions Chapter 27. During this procedure, connect the trim indicator cable (overhead trim only) and the tab control arm to the trim screw, with the connecting links of the control arm, with bolt, bushings, washers and nut. Insure that the tab attachment bolt head is on the side next to the trim indicator cable to insure no interference with indicator cable.
9. Remove the pad from the aft section of the fuselage and replace the access panel.
10. Install the tail cone fairing and remove tail stand.

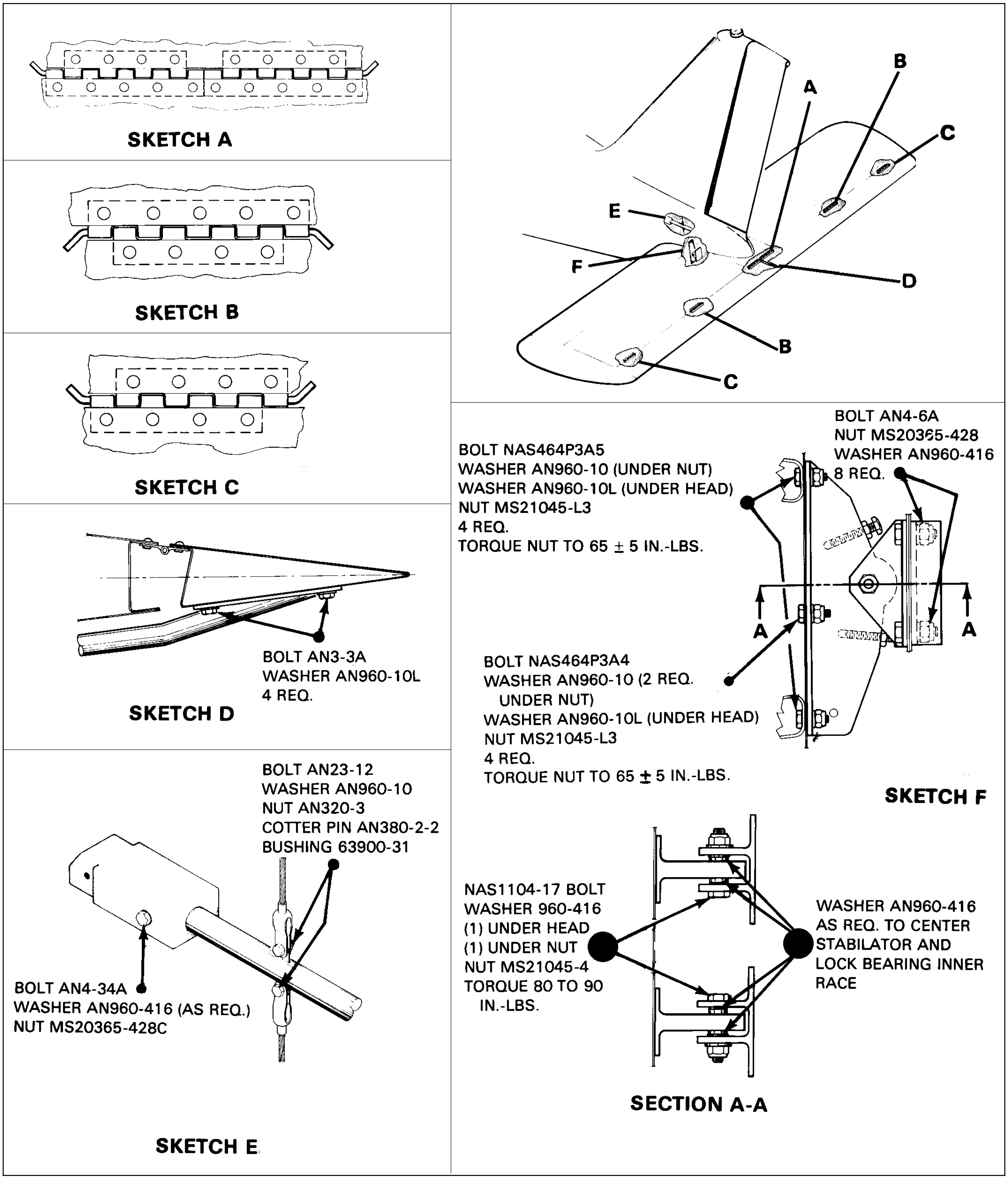


Figure 55-2. Stabilator Installation

BALANCING EQUIPMENT. (Refer to Figure 55-3.)

The balancing must be done using a suitable tool capable of measuring unbalance in inch-pounds from the center line of the control surface hinge line. A suggested configuration is shown in Chapter 95.

To use this tool:

1. Insure that the control surface is in its final flight configuration, static wicks, trim tabs, trim tab push pull rod and control surface tip (as applicable) should be installed. The surface should be painted and trim/servo tabs should be in the neutral position.

—NOTE—

Because paint is a considerable balance factor, it is recommended that existing paint be removed prior to repainting a control surface.

2. Place hinge bolts through control surfaces and place control surface on a holding fixture.
3. Avoiding rivets, place balancing tool on the control surface with the tool's hinge centerline directly over the hinge line of the control surface.
4. Adjust the movable trailing edge support to fit the width of the control surface. Tighten the set screw on the trailing edge support.
5. Adjust the trailing edge support vertically until the beam is parallel with the control surface chord line.
6. Remove the tool from the control surface and balance the tool itself by adding or removing nuts or washers from the beam balancing bolt. When balancing the tool, the movable weight must be at the bar's hinge centerline.
7. After balancing the tool, reattach it to the control surface. Keep the beam positioned 90° from the control surface hinge line.
8. Determine balance of control surface by sliding movable weight along the balance beam.
9. Read the scale when the bubble in the level has been centered. Since the movable weight weighs three pounds, every inch it is moved from the center of the beam equals three inch-pounds of force.

BALANCING STABILATOR. (Refer to Figure 55-3.)

To balance the stabilator, the assembly must be complete including the trim tab, the tab push rod and end bearing, stabilator tips and all attaching screws. Before balancing, tape the trim tab in neutral position with a small piece of tape. Place the complete assembly on the knife edge supports in a draft free area in a manner that allows unrestricted movement. Place the tool on the stabilator with the beam perpendicular to the hinge center line. Do not place the tool on the trim tab. Calibrate the tool as described in previous paragraph. Read the scale when the bubble level has been centered by adjustment of the movable weight and determine the static balance limit. If the static balance is not within the limits given, proceed as follows:

1. If the stabilator is out of limits on the leading edge heavy side, remove balance plates from the mass balance weight until the static balance is within limits. Do not attempt to adjust the stabilator tip balance weight.
2. If the stabilator is out of limits on the trailing edge heavy side, add balance plates to the mass balance weight until the static balance is within limits.

STABILATOR TRIM TAB.

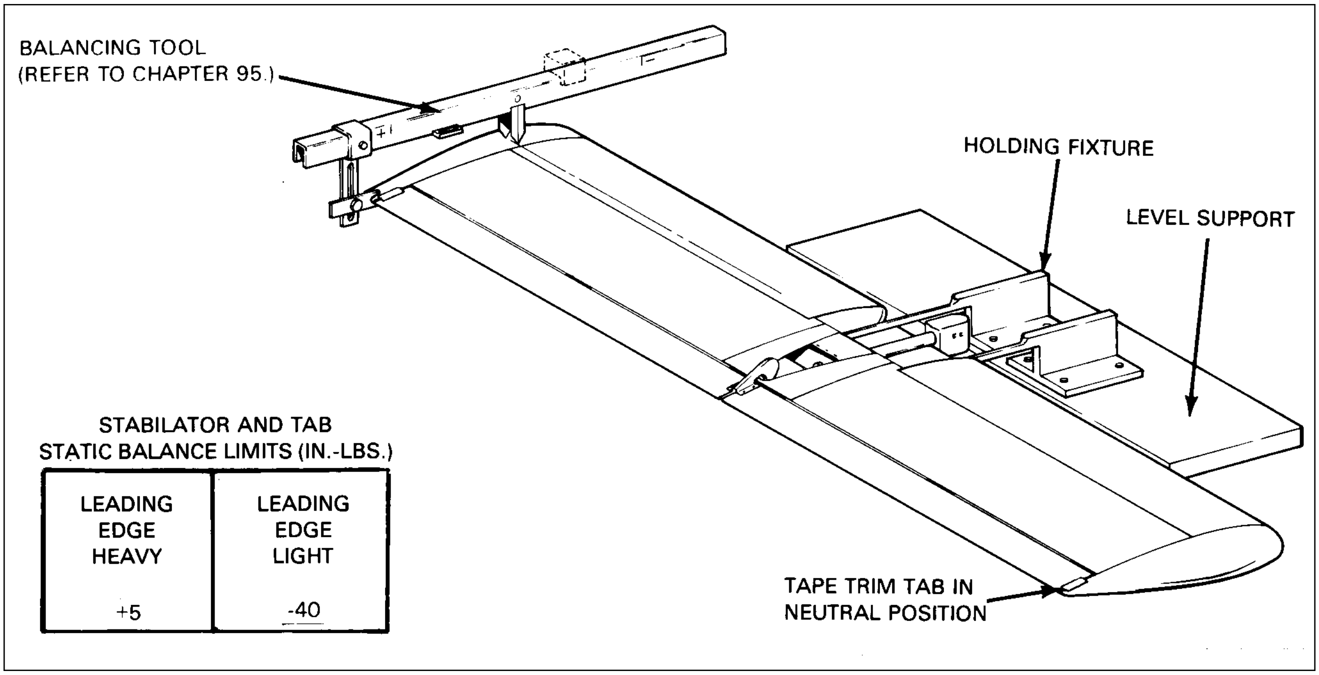


Figure 55-3. Stabilator Balance Configuration

REMOVAL OF TRIM TAB. (Refer to Figure 55-2.)

1. Disconnect the stabilator trim control rod by removing the bolts that attach the control rod to the stabilator trim tab.
2. Remove the stabilator trim hinge pins by cutting one end of the wire pins and removing.
3. The stabilator trim tab can now be removed.

INSTALLATION OF TRIM TAB. (Refer to Figure 55-2.)

1. Place the trim tab in position on the aft end of the stabilator.
2. Insert new pins and secure by bending the end to a 45 degree angle.
3. Install the control rod and attach with the four bolts and washers.

VERTICAL STABILIZER.

REMOVAL OF VERTICAL STABILIZER.

1. Remove the screws from the upper and lower tail cone fairing, the fin tip cover and the fairing at the forward base of the fin.
2. Remove the rudder per instructions given in this section.
3. Disconnect the leads from the antenna terminals (optional) and attach a line to the leads to assist in reinstallation.

4. Disconnect the wire antenna (optional) that attaches to the leading edge of the fin.
5. Disconnect the positive lead to the rotating beacon (optional) and attach a line prior to removal. Disconnect the ground level by removing the attachment screw.
6. Remove the stabilator trim assembly and aft trim cable in accordance with Removal of Stabilator Trim Assembly.
7. Remove the bolt and washer that attaches the leading edge of the fin to the fuselage.
8. Remove the nuts, washers and bolts that secure the fin spar to the aft bulkhead and remove the vertical fin.

INSTALLATION OF VERTICAL STABILIZER.

1. Insert the vertical fin into position and install the bolts, washers and nuts that secure the fin spar to the aft bulkhead.
2. Install the bolt and washer that attaches the leading edge of the fin to the fuselage.
3. Install the stabilator trim assembly and aft trim cable per instructions given in Installation of Stabilator Trim Assembly.
4. Install the rudder as explained in this section.
5. Pull the electrical and antenna leads through the vertical fin with the line that was attached.
6. Connect the antenna leads to the proper terminals and secure with washers and nuts.
7. Connect the electrical leads at the disconnects and insulate.
8. Rig and adjust the rudder and trim control cables as given in Chapter 27.
9. Check the operation of the radios and electrical lights.
10. Replace all fairings and access plates, and secure with attaching screws.

RUDDER.

REMOVAL OF RUDDER. (Refer to Figure 55-4.)

1. Remove the screws from around the upper tail cone fairing assembly and remove the fairing.
2. Remove the rudder tip by removing the attaching screws and disconnect the tail position light wire at the quick disconnect located at the tip of the rudder. Open the access panel in the rear of the baggage compartment to gain access to the aft section of the fuselage.
3. Relieve the cable tension from the rudder control system by loosening one of the cable turnbuckles in the aft section of the fuselage.
4. Disconnect the two control cables from the rudder horn by removing the cotter pins, nuts, washers, bushings and bolts.
5. Remove the cotter pins, nuts, washers and bolts from the upper and lower rudder hinge pivot points.
6. Pull the rudder up and aft from the vertical fin.

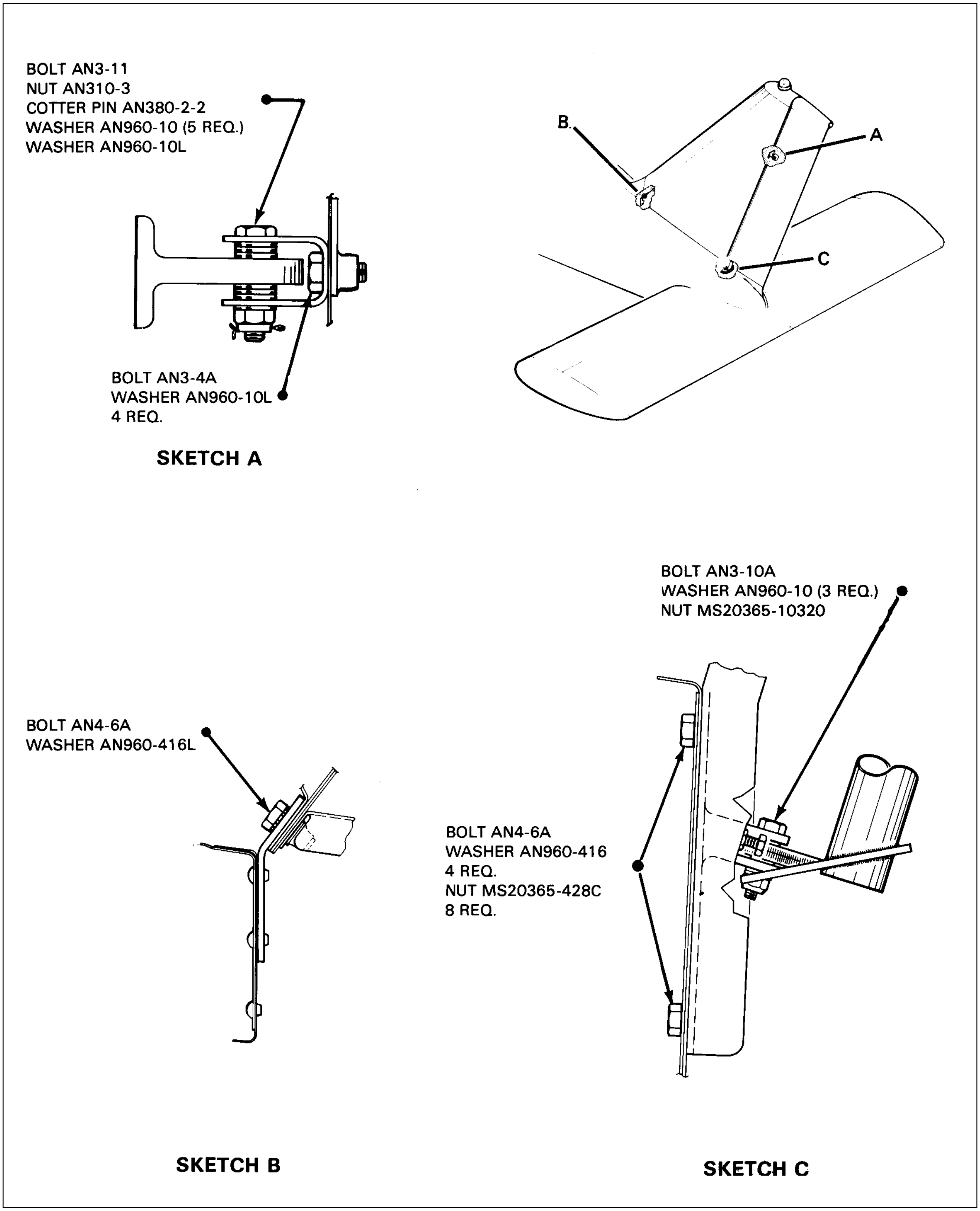


Figure 55-4. Vertical Stabilizer Installation

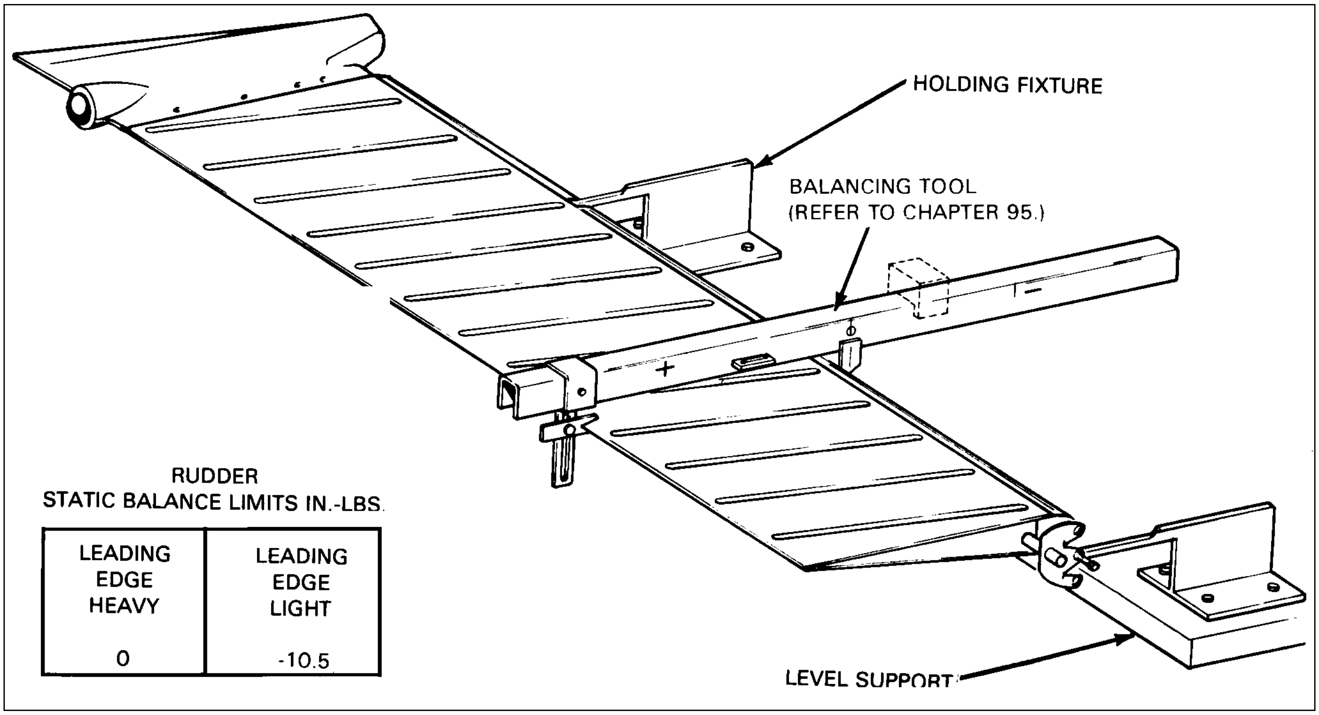


Figure 55-5. Rudder Balancing

INSTALLATION OF RUDDER. (Refer to Figure 55-4.)

1. Place the rudder in position and install the hinge bolts, washers, nuts and cotter pins.

—NOTE—

Use any washer combination of the hinge assembly to suit best, the centering and operation of the rudder.

2. Connect the tail position light electrical lead at the quick disconnect and cover the connector with an insulating sleeve. Tie both ends of the sleeve with number six electrical lacing twine.
3. Connect the control cables to the rudder horn with bolts, washers, nuts and cotter pins.
4. Check the rudder in accordance with Rigging and Adjustment of Rudder Chapter 27.
5. Install the upper tail cone fairing and rudder tip and secure with the attachment screws. Secure the access panel to the aft section of fuselage.

BALANCING RUDDER. (Refer to Figure 55-5.)

To balance the rudder, the assembly must be complete including the tip assembly and all attaching screws, the position light and wiring must be included. Place the complete assembly horizontally on knife edge supports in a draft free area in a manner that allows unrestricted movement. Place the tool on the rudder with the beam perpendicular to the hinge center line. Calibrate the tool as described in Paragraph 55-20-03, Balancing Equipment. Read the scale when the bubble lever has been centered by adjustment of the movable weight and determine the static balance limit. If the static balance is not within the limits given, proceed as follows:

1. Nose Heavy: This condition is highly improbable; recheck calculations and measurements.
2. Nose Light: In this case, the mass balance weight is too light or the rudder is too heavy because of painting; it will be necessary to strip the paint and repaint. If the rudder is too heavy as a result of repairs, the repair must be removed and the damaged parts replaced.

—END—

CHAPTER

56

WINDOWS

CHAPTER 56 - WINDOWS

TABLE OF CONTENTS/EFFECTIVITY

FLIGHT COMPARTMENT.

REMOVAL OF WINDSHIELD. (Refer to Figure 56)

1. Remove the collar molding from around the bottom of the windshield and the trim strip from between the windshield halves by removing the attaching screws.
2. Remove the windshield by raising the lower portion of the windshield and carefully pulling it out and downward to release the top and side edges.

—NOTE—

A damaged windshield should be saved since it can be used as a pattern for drilling required holes in the new windshield.

3. Clean the old tape and sealer from the windshield channels, strips and divider post.

INSTALLATION OF WINDSHIELD. (Refer to Figure 56-1.)

1. Be certain that the new windshield outside contours are the same as that of the old windshield. It may be found that it is necessary to cut or grind the new windshield to acquire the proper dimensions.
2. Apply black vinyl plastic tape around the outer edges of the entire windshield.
3. Apply Behr-Manning vinyl foam tape number 560 or equivalent over the plastic tape, completely around the edges of the windshield.
4. Apply Behr-Manning sealant number PRC 5000 or equivalent under the edge of the moldings and trim strips.
5. Place the windshield in position for installation and slide the windshield aft and up into place, using caution not to dislocate the tape around the edges. Allow clearance between the two windshields at the divider post for expansion.
6. Lay sealant at the bottom and center (inboard) of the windshield in the hollow between the outside edge and channel.
7. Lay a small amount of sealant under the center trim strip, install and secure.
8. Lay black vinyl tape on the underside of the collar molding, install and secure.
9. Seal with sealant any areas around windshield that may allow water to penetrate past the windshield.
10. Remove excess exposed sealer to tape.

CABIN.

REMOVAL OF SIDE WINDOWS.

The PA-28-201T airplane is equipped with single pane side windows. For removal of these windows, the following instructions may be used:

1. Remove the retainer molding from around the window by removing the attachment screws.

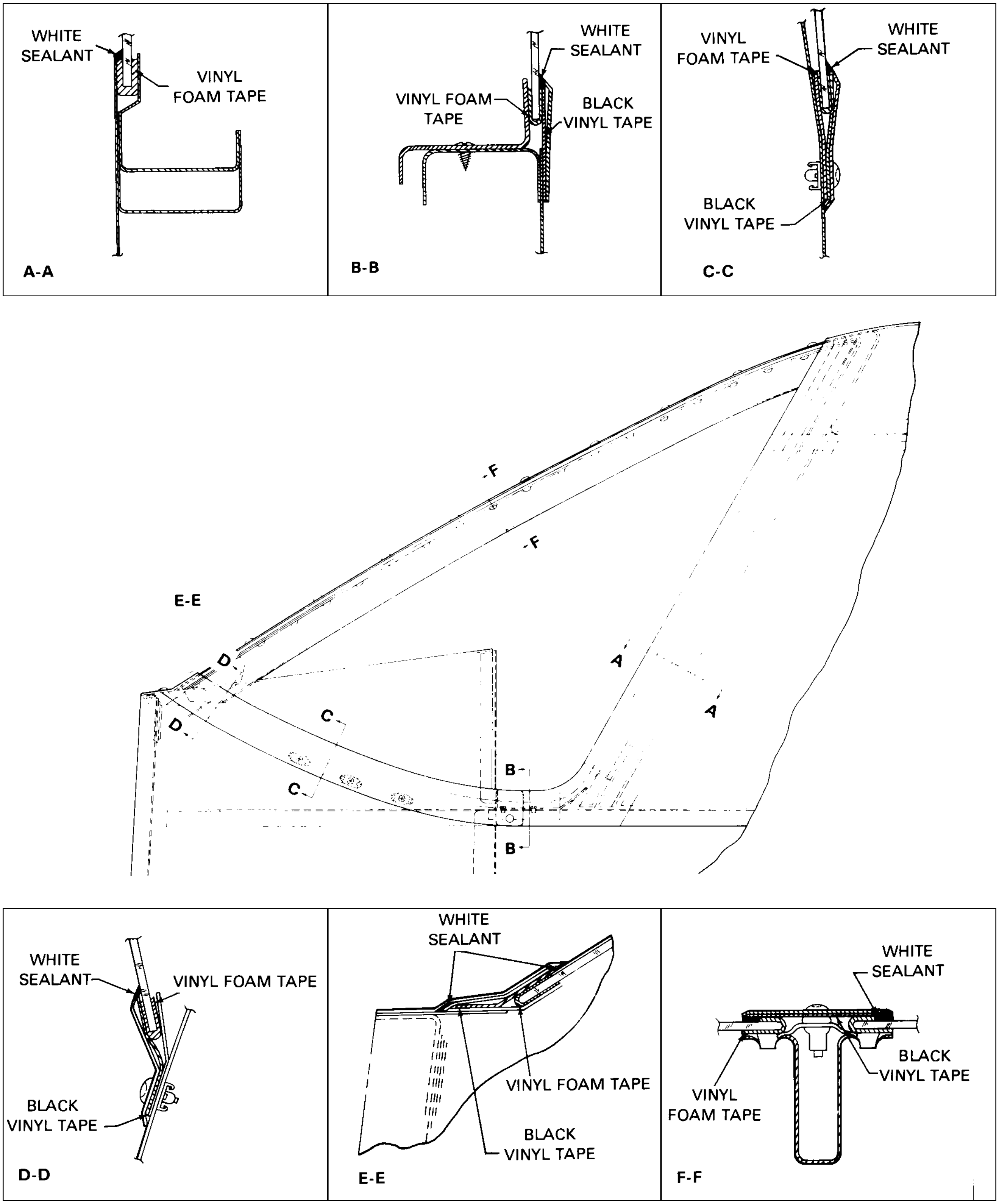


Figure 56-1. Windshield Installation (Typical)

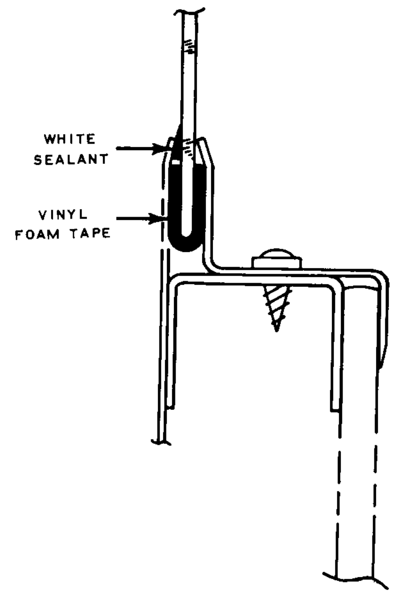


Figure 56-2. Side Window Installation, Single Pane (Typical)

2. Carefully remove the window from the frame.

—NOTE—

A damaged window should be saved to provide a pattern for shaping the new window.

3. Remove excess tape and sealer from the window frame and molding.

INSTALLATION OF SIDE WINDOWS. (Refer to Figure 55-2.)

1. Cut or grind the new window to the same dimension as the window removed.
2. Apply Behr-Manning vinyl foam tape number 560 or equivalent, on both sides of the window around the outer edges.
3. Apply Behr-Manning sealant number PRC 5000 or equivalent, completely around the outer surface of the windows at all attachment flanges.
4. Insert the window in the frame and install the retainer moldings.
5. Secure the molding with attachment screws and tighten until the vinyl foam tape is 25% compressed by the retainers.
6. Remove the excess exposed sealer and tape.

—END—

CHAPTER

57

WINGS

CHAPTER 57-WINGS

TABLE OF CONTENTS/EFFECTIVITY

GENERAL

This chapter deals with the removal and installation procedures for the wings and related components from the aircraft.

DESCRIPTION

Each wing panel is an all metal, full cantilever semi-monocoque type construction with a removable wing tip. Installed in each wing ahead of the main spar is a metal fuel tank with a capacity of 38.5 U. S. gallons each or 77 U. S. gallons total. Attached to each wing is an aileron, flap and main landing gear. The wings are attached to each side of the fuselage by inserting the butt ends of the main spars into a spar box carry-through. The spar box is an integral part of the fuselage structure which provides, in effect, a continuous main spar with splices at each side of the fuselage. There are also fore and aft attachments at the front and rear spars.

—NOTE—

The major subassemblies of the wing may be removed individually or the wing may be removed as a unit. To remove a wing, a fuselage supporting cradle is required.

AUXILIARY STRUCTURE

REMOVAL OF WING TIP

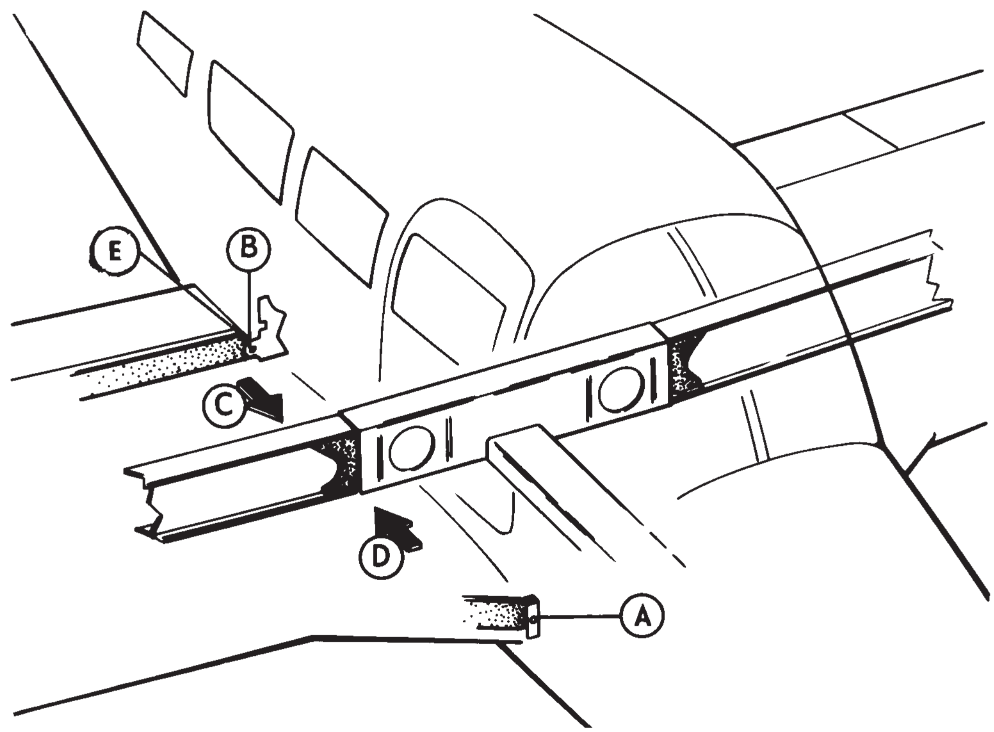
1. Remove the screws holding the wing tip to the wing, being careful not to damage the wing or wing tip.
2. Pull off the wing tip far enough to disconnect the position and strobe light wire assembly. The ground lead may be disconnected at the point of connection on the wing rib, and the positive lead may be disconnected at the wire terminal or unscrewed from the light assembly.
3. Inspect the wing tip to ascertain that it is free of cracks, severe nicks and minor damage.

REPAIR OF WING TIP

Fiberglass tips should be repaired in accordance with the procedures as described in the structural repairs portion of Chapter 51. Badly damaged thermoplastic tips should be replaced.

INSTALLATION OF WING TIP.

1. Place the wing tip in a position that the navigation and strobe light leads may be connected. Connect the ground lead to the wing rib by use of a screw and nut, and the positive lead to the position light by connecting the wire terminals or screwing the connectors together. Insulate the wire terminals and be certain that the ground lead is free of dirt and film to insure a good connection.
2. Insert the wing tip into position and install the screws around the tip. Use caution to refrain from damaging the wing tip or wing. Check operation of the lights.



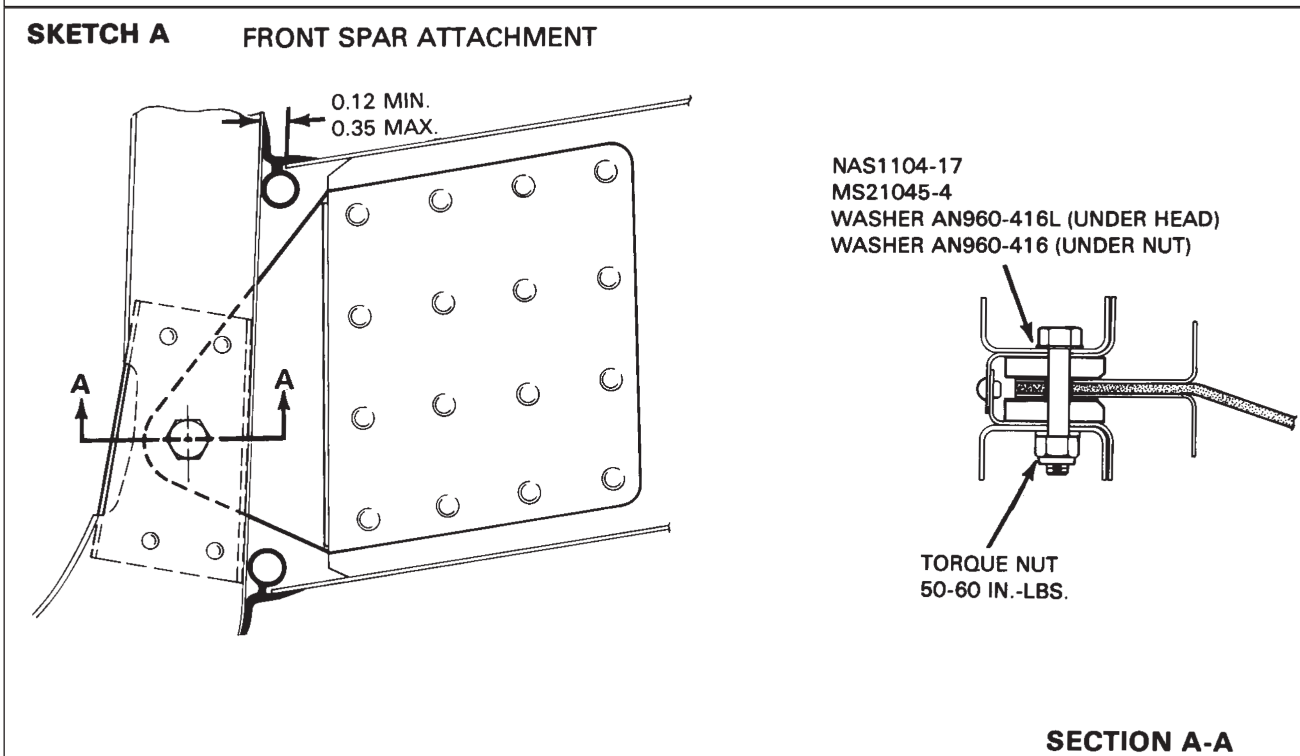
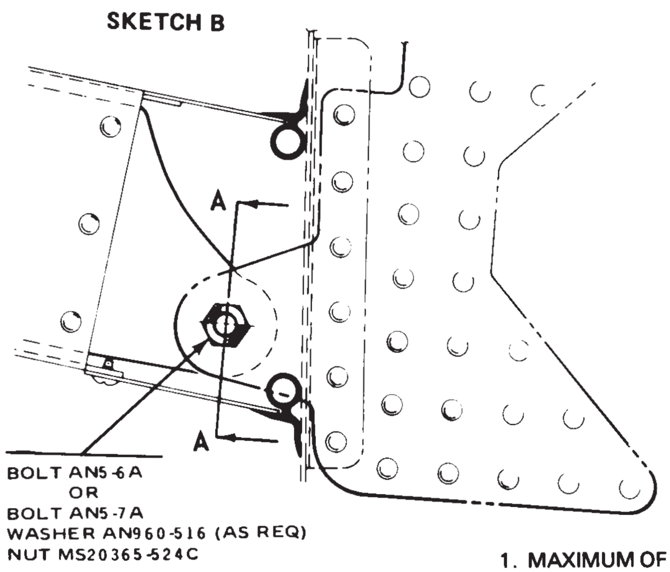
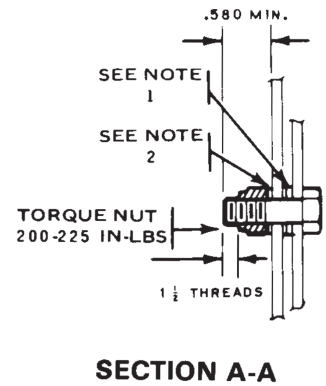


Figure 57-1. Wing Installation

SKETCH B REAR SPAR ATTACHMENT (SEE SKETCH E IF SERVICE WING IS BEING INSTALLED)





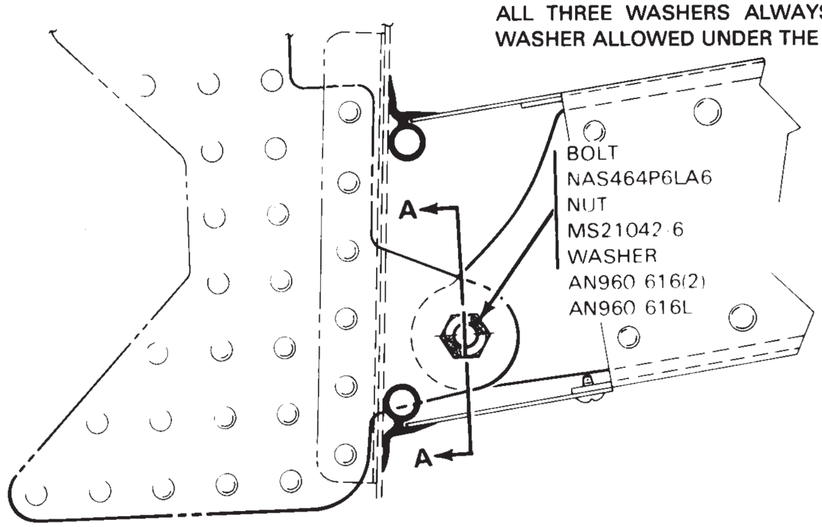
SECTION A-A

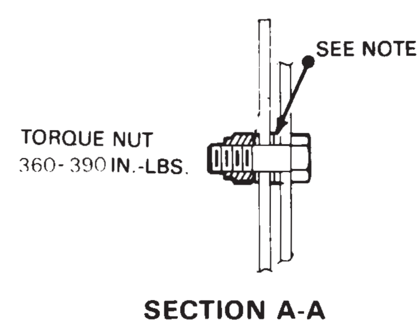
NOTES

1. MAXIMUM OF (2) AN960-516 WASHERS BETWEEN FORWARD FACE OF WING FITTING AND AFT FACE OF FUSELAGE FITTING. FACES OF FITTING MAY BE AGAINST EACH OTHER.
2. AFTER REQUIRED WASHERS ARE INSERTED BETWEEN FITTINGS, INSTALL BOLT AND CHECK TO INSURE THAT NO THREADS ARE BEARING ON THE FORWARD FITTING PRIOR TO INSTALLING THE NUT. USE SHORTEST BOLT WHICH WILL LEAVE 0.580 MINIMUM FROM FITTING TO END OF BOLT, ADD AN960-516 WASHERS AS REQUIRED (MINIMUM OF 1), TO LEAVE A MAXIMUM OF 1½ VISIBLE THREADS OR MINIMUM OF THE BOLT CHAMFER EXPOSED AFTER NUT IS TORQUED TO 200-225 INCH-POUNDS.

SKETCH E REAR SPAR ATTACHMENT (ON NEW SERVICE WING)

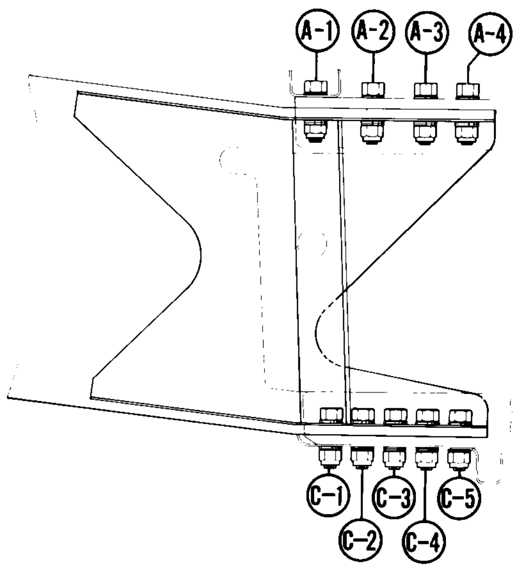
MAXIMUM NO. OF WASHERS ALLOWED BEWTEEN FWD FACE OF WING FITTING AND AFT FACE OF FUSELAGE FITTING IS ONE AN960-616L AND ONE AN960-616 ALL THREE WASHERS ALWAYS REQUIRED WITH ONLY THE AN860-616L WASHER ALLOWED UNDER THE HEAD.



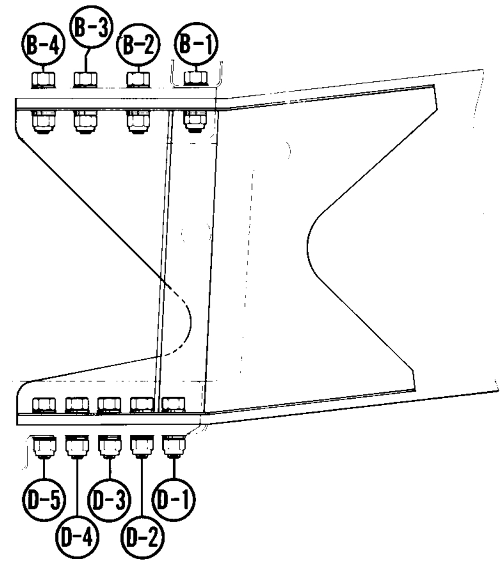


SECTION A-A

Figure 57-1. Wing Installation (cont.)



SKETCH C



SKETCH D

BOLT LEGEND | **WASHER**

POSITION	BOLT*	NUT*	UNDER HEAD	UNDER NUT
A-1	AN176-15A	MS20365-624C	(1) AN960-616	(1) AN960-616 & (1) 96352-3
A-2	AN176-15A	MS20365-624C	(1) AN960-616	(2) AN960-616 & (1) 96352-3
A-3	AN176-15A	MS20365-624C	(1) AN960-616	(2) AN960-616 & (1) 96352-3
A-4	AN176-15A	MS20365-624C	(1) AN960-616	(2) AN960-616 & (1) 96352-3
B-1	AN176-14A	MS20365-624C	(1) AN960-616	(1) AN960-616
B-2	AN176-14A	MS20365-624C	(1) AN960-616	(2) AN960-616
B-3	AN176-14A	MS20365-624C	(1) AN960-616	(2) AN960-616
B-4	AN176-14A	MS20365-624C	(1) AN960-616	(2) AN960-616
C-1	AN176-14A	MS20365-624C	(1) 96352-3	(1) AN960-616
C-2	AN176-14A	MS20365-624C	(1) 96352-3	(2) AN960-616
C-3	AN176-14A	MS20365-624C	(1) 96352-3	(2) AN960-616
C-4	AN176-14A	MS20365-624C	(1) 96352-3	(2) AN960-616
C-5	AN176-14A	MS20365-624C	(1) 96352-3	(1) 96352-3
D-1	AN176-14A	MS20365-624C	(1) 96352-3	(1) AN960-616
D-2	AN176-14A	MS20365-624C	(1) 96352-3	(2) AN960-616
D-3	AN176-14A	MS20365-624C	(1) 96352-3	(2) AN960-616
D-4	AN176-14A	MS20365-624C	(1) 96352-3	(2) AN960-616
D-5	AN176-14A	MS20365-624C	(1) 96352-3	(1) 96352-3

*Torque Boltheads on Upper Spar Cap and Nuts on Lower Spar Cap 360-390 inch-pounds

Figure 57-1. Wing Installation (cont.)

ATTACH FITTINGS

REMOVAL OF WING (Refer to Figure 57-1.)

1. Close the fuel valve and drain the fuel from the wing to be removed. (Refer to Draining Fuel System, Chapter 12.)
2. Drain the brake lines and reservoir. (Refer to Draining Brake System, Chapter 12.)
3. Remove the access plate at the wing butt rib and wing inspection panels.
4. Remove the front and back seats from the airplane.
5. Expose the spar box and remove the side trim cockpit panel assembly that corresponds with the wing being removed.
6. Place the airplane on jacks. (Refer to Jacking, Chapter 7.)

—NOTE—

To help facilitate reinstallation of control cables, and fuel and hydraulic lines, mark cable and line ends in some identifying manner and attach a line where applicable to cables before drawing them through the fuselage or wing.

7. Disconnect the aileron balance and control cables at the turnbuckles that are located within the fuselage aft of the spar.
8. If the left wing is being removed, remove the cotter pin from the pulley bracket assembly to allow the left aileron balance cable end to pass between the pulley and bracket.
9. Disconnect the flap from the torque tube by extending the flap to its fullest degree, and removing the bolt and bushing from the bearing at the aft end of the control rod.
10. Disconnect the fuel line at the fitting located inside of the wing, by removing the access panel on the forward inboard portion of the wheel well and reaching through to the fuel line coupling.

—CAUTION—

To prevent damage or contamination of fuel, hydraulic and miscellaneous lines, place a protective cover over the line fittings and ends.

11. Remove the clamps that are necessary to release the electrical harness assembly. Disconnect the leads from the terminal strip by removing the cover, and appropriate nuts and washers.
12. With the appropriate trim panel removed, disconnect the hydraulic brake line at the fitting located within the cockpit at the leading edge of the wing.
13. If the left wing is being removed, it will be necessary to disconnect pitot tube at the elbow located within the cockpit at the wing butt line.
14. Arrange a suitable fuselage cradle and supports for both wings.
15. Remove the wing jacks.
16. Remove the front and rear spar nuts, washers and bolts.
17. Remove the eighteen main spar bolts.
18. Slowly remove the wing being certain that all electrical leads, cables and lines are disconnected.

INSTALLATION OF WING. (Refer to Figure 57-1.)

—NOTE—

If wing being installed is new service wing, the rear spar must be drilled to .375/376.

1. Ascertain that the fuselage is positioned solidly on a support cradle.
2. Place the wing in position for installation, with the spar end a few inches from the side of the fuselage and set on trestles.
3. Prepare the various lines, control cables, etc., for inserting into the wing or fuselage when the wing is eased into place.
4. Slide the wing into position of the fuselage.
5. Install the eighteen main spar bolts in accordance with the bolt legend.
6. Install the bolt, washers, and nut that attaches the front spar and fuselage fitting. A minimum of one washer is required under the nut and head of bolt, then add washers as needed to leave a maximum of one and one-half threads visible or a minimum of the bolt chamfer exposed.
7. Insert the number of washers required (if any) at the rear spar between the forward face of the wing fitting and aft face of the fuselage fitting. Refer to Sketch B or E of Figure 57-1.
8. Torque the bolt heads on the upper spar cap and the nuts on the lower spar cap 360 to 390 inch pounds. Be certain that the bolts, nuts and washers are installed in accordance with the bolt legend. (Figure 57-1.)
9. Torque the forward spar attachment nut from 50 to 60 inch pounds. Torque the rear spar attachment nut as shown in Sketch B or E of Figure 57-1.
10. Install the wing jacks and the tail support to the tail skid with approximately 250 pounds of ballast on the base of the tail support. Remove the fuselage cradle and wing supports.
11. If the left wing was removed, it is necessary that the pitot tube be connected at the elbow located within the cockpit at the wing butt line. Replace or install clamps where found necessary.
12. Connect the hydraulic brake line onto the fitting located within the cockpit at the leading edge of the wing.
13. Connect the leads to the appropriate posts on the terminal strip and install the washers and nuts. (For assistance in connecting the electrical leads, refer to the electrical schematics in Chapter 91.) Place the clamps along the electrical harness to secure it in position and install the terminal strip dust cover.
14. Connect the fuel line at the fitting located inside of the wing, by reaching through the access panel on the forward inboard inspection panel.
15. Connect the aileron balance and control cables at the turnbuckles that are located within the fuselage aft of the spar. After the left balance cable has been inserted through the bracket assembly and connected, install a cotter pin cable guard into the hole that is provided in the bracket assembly.
16. Connect the flap by placing the flap handle in the full flap position, place the bushing on the outside of the rod end bearing, and insert and tighten bolt.
17. Check the rigging and control cable tension of the ailerons and flaps. (Refer to Rigging and Adjustment of Ailerons, and Rigging and Adjustment of Flaps, Chapter 27.)
18. Service and refill the brake system with hydraulic fluid in accordance with Servicing Brake System, Chapter 12. Bleed the system as described in the same chapter and check for fluid leaks.
19. Service and fill the fuel system in accordance with Servicing Fuel System in Chapter 12. Open the fuel valve and check for leaks and flow
20. Check the operation of all electrical equipment and pitot systems.
21. Remove the airplane from jacks.
22. Install the cockpit trim panel assembly, spar box carpet, the front and back seats and wing root rubber.
23. Replace all the access plates and panels on the wing involved.

FLIGHT SURFACES.

REMOVAL OF AILERON. (Refer to Figure 57-2.)

1. Disconnect the aileron control rod at the aileron attachment point by removing the nut, washers and bolt from the rod end bearing. To simplify installation note location of washers removed.
2. Remove the attaching screws, with nuts, from the hinges at the leading edge of the aileron, and remove the aileron by lowering the inboard end and swinging it forward to allow the balance arm to clear the opening in the outboard rib.

INSTALLATION OF AILERON. (Refer to Figure 57-2.)

1. Install the balance arm into the opening in the outboard rib by moving the inboard end of the aileron forward to allow the arm to be inserted through the opening. Move the aileron into place and install attaching screws and nuts. Ascertain that the aileron is free to move with no interference.
2. Attach the aileron control rod with bolts, washers and nut, dividing the washers so that the aileron is free to rotate from stop to stop without the control rod binding or rubbing on the opening in the aft spar. Be certain that the rod end bearing has no side play when tightening the bolt and that the rod does not contact the side of the bracket.
3. Actuate the aileron controls to insure freedom of movement.

CHECKING AILERON BALANCE. (Refer to Figure 57-3.)

The aileron control surfaces have been statically balanced at the time of installation at the factory and normally should not require rebalancing. The complete control surface including paint should be within the limits given in Figure 57-3. Any control surface that has been repainted or repaired should be rebalanced.

BALANCING EQUIPMENT AND PROCEDURE. (Refer to Figure 57-3.)

Balancing must be done using a suitable tool capable of measuring unbalance in inch-pounds from the hinge pin center line of the control switch, A suggested tool configuration is shown in Chapter 95.

To balance the control surface, proceed as follows:

1. Insure that the control surface is in its final flight configuration, static wicks, trim tabs, trim tab push pull rod and control surface tip (as applicable) should be installed. The surface should be painted and trim/ servo tabs should be in the neutral position.

—NOTE—

Because paint is a considerable balance factor, it is recommended that existing paint be removed prior to repainting a control surface.

2. Place hinge bolts through control surfaces and place control surface on a holding fixture.
3. Avoiding rivets, place the balancing tool on the control surface with the tool's hinge centerline directly over the hinge line of the control surface.
4. Adjust the movable trailing edge support to fit the width of the control surface. Tighten the set screw on the trailing edge support.
5. Adjust the trailing edge support vertically until the beam is parallel with the control surface chord line.

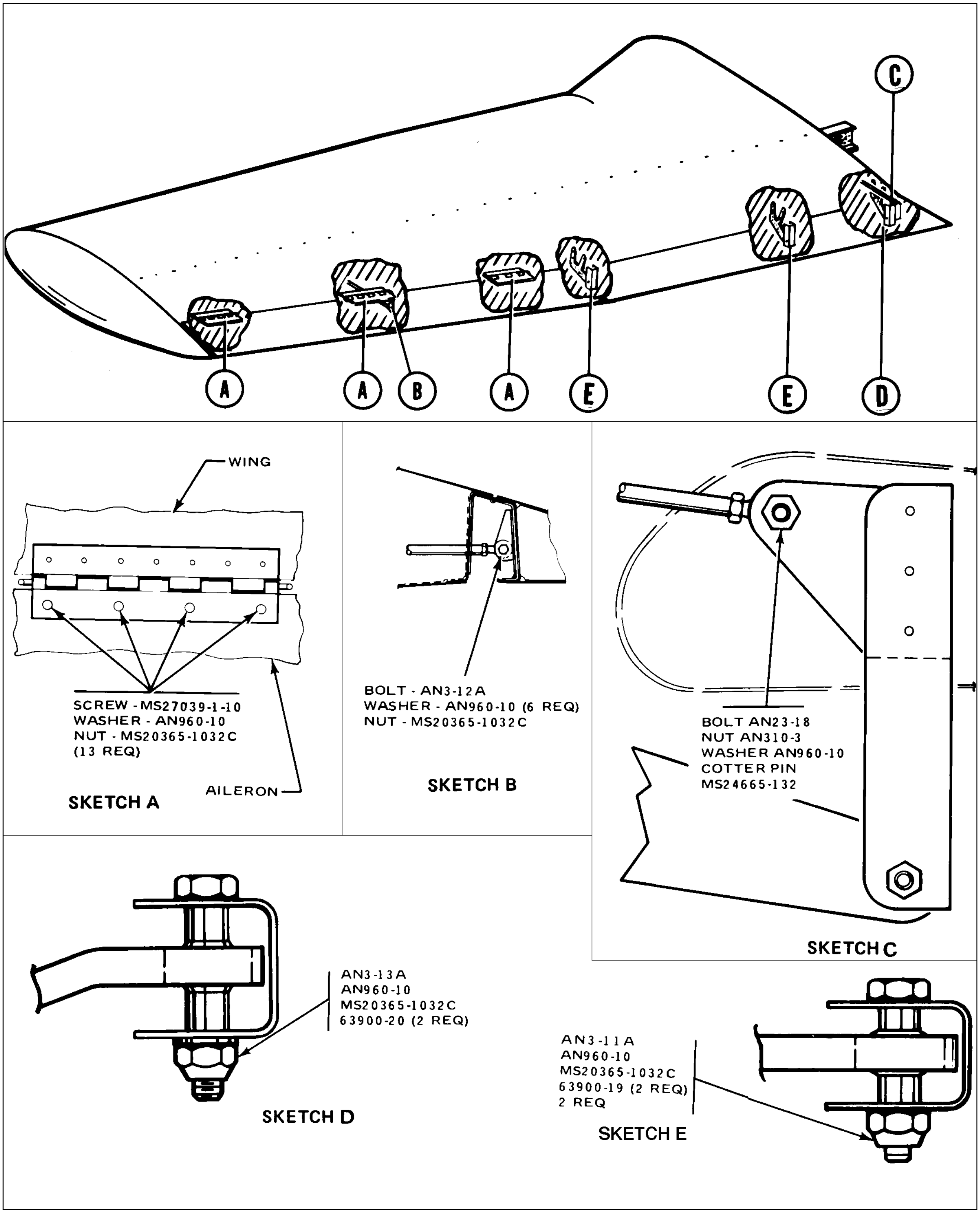
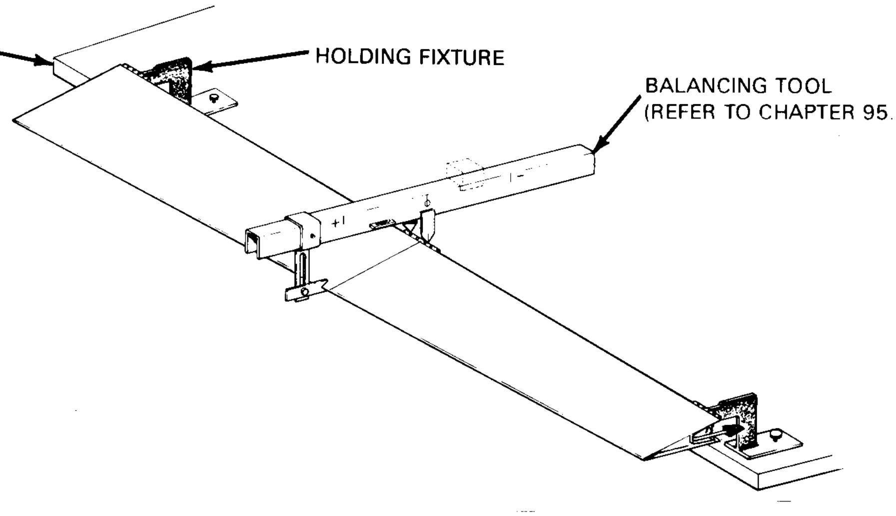


Figure 57-2. Aileron and Flap Installation



LEADING EDGE HEAVY	LEADING EDGE LIGHT
-5.0	-13.0

Figure 57-3. Aileron Balancing

6. Remove the tool from the control surface and balance the tool itself by adding or removing nuts or washers from the beam balancing bolt. When balancing the tool, the movable weight must be at the bar's hinge centerline.
7. After balancing the tool, reattach it to the control surface. Keep the beam positioned 90° from the control surface hinge line.
8. Determine balance of control surface by sliding movable weight along the balance beam.
9. Read the scale when the bubble in the level has been centered. Since the movable weight weighs three pounds, every inch it is moved from the center of the beam equals three inch-pounds of force.

If the static balance is not within the limits specified, proceed as follows:

1. Leading Edge Heavy: This condition is highly improbable; recheck measurements and calculations.
2. Trailing Edge Heavy: There are no provisions for adding weight to balance weight to counteract a trailing edge heavy condition; therefore, it will be necessary to determine the exact cause of the unbalance. If the aileron is too heavy because of painting over old paint, it will be necessary to strip all paint from the aileron and repaint. If the aileron is too heavy resulting from repair to the skin or ribs, it will be necessary to replace all damaged parts and recheck the balance.

REMOVAL OF WING FLAP. (Refer to Figure 57-2.)

1. Extend the flaps to their fullest degree and remove the bolt and bushing from the rod end bearing by use of an angle or offset screwdriver.
2. Remove the nuts, washers, bushing, and hinge bolts that hold the flap to the wing assembly.
3. Pull the flap straight back off the wing.

INSTALLATION OF WING FLAP. (Refer to Figure 57-2.)

1. Replace the wing flap by placing the flap into its proper position and inserting the hinge bolts, bushings, washers and nuts.
2. With the flap control in the full flap position, place the bushing on the outboard side of the rod end bearing and insert and tighten the bolt.
3. Operate the flap several times to be certain it operates freely.

—END—

CHAPTER

61

PROPELLER

CHAPTER 61-PROPELLER

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

PROPELLER ASSEMBLY.

REMOVAL OF PROPELLER. (Refer to Figure 61-1.)

—WARNING—

Before performing any work on the propeller, be sure the magneto and master switch is OFF and the mixture control is in the IDLE CUT-OFF position.

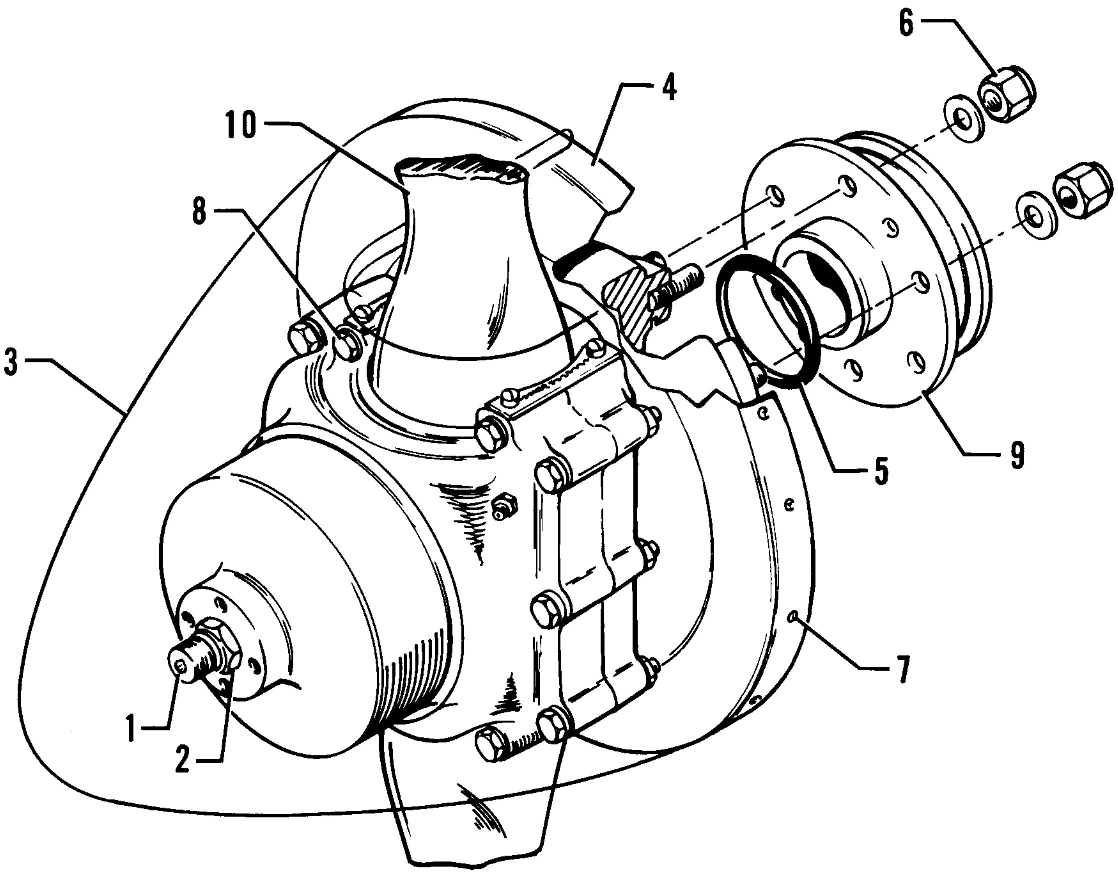
1. Remove the hardware that attaches the nose cowl and remove the cowl. The top and side panels may be removed for greater accessibility.
2. Remove the safety wire from the propeller mounting nuts and remove the nuts.
3. Place a drip pan under the propeller to catch oil spillage and pull the propeller from the engine shaft.
4. If the spinner and spinner bulkhead are to be removed, remove the spinner nose cap attaching screws and cap. Remove the spinner by removing the safety wire and check nut from the propeller at the forward end of the forward spinner bulkhead and the screws that secure the spinner to the aft bulkhead. The aft spinner bulkhead may be removed from the hub by removing the locknuts.

CLEANING, INSPECTION AND REPAIR OF PROPELLER.

—NOTE—

Do not attempt to disassemble the propeller any further than stated in this manual. For internal repairs and replacement of parts, the propeller should be referred to the Hartzell Factory or Certified Repair Station.

1. Check for oil and grease leaks.
2. Clean the spinner, propeller hub, and blades with a non-corrosive solvent.
3. Inspect the hub parts for cracks.
4. Steel hub parts should not be permitted to rust. Use aluminum paint to touch up, if necessary, or replate them during overhaul.
5. Check all visible parts for wear and safety.
6. Check blades to determine whether they turn freely on the hub pilot tube. This can be done by rocking the blades back and forth through the slight freedom allowed by the pitch change mechanism. If they appear tight and are properly lubricated, the propeller should be disassembled by an authorized Service Center.
7. Inspect the blades for damage or cracks. Nicks in the leading edges of blades should be filed out and all edges rounded, as cracks sometimes start from such places. Use fine emery cloth for finishing. (Refer to Figure 61-2 for propeller blade care.)
8. Check the condition of the propeller mounting nuts and studs.



1. LOW PITCH STOP
2. JAM NUT
3. SPINNER
4. BULKHEAD
5. O-RING
6. MOUNTING NUT, PROPELLER
7. SCREW, SPINNER ATTACHMENT
8. BOLT BULKHEAD
9. ENGINE FLANGE
10. BLADE, PROPELLER

Figure 61-1. Propeller Installation

9. Each blade face should be sanded lightly with fine sandpaper and painted, when necessary, with a flat black paint to retard glare. A light application of oil or wax may be applied to the surfaces to prevent corrosion.

10. Grease the blade hub through the zerk fittings. Remove one of the two fittings for each propeller blade; alternate the next time. Apply grease through the zerk fitting until fresh grease appears at the fitting hole of the removed fitting. Care should be taken to avoid blowing out the hub gaskets.

INSTALLATION OF PROPELLER. (Refer to Figure 61-1.)

—WARNING—

Before performing any work around the propeller be sure the magneto and master switch is OFF, and the mixture control is in the IDLE CUT-OFF position.

1. Clean the propeller and engine flanges.
2. Lubricate and install the O-ring in the propeller hub.
3. Rotate the prop shaft till the number 1 cylinder is on TDC.
4. With the index mark (“TC”) on the prop flange aligned with crankcase upper split line, install the propeller on the crankshaft.
5. Tighten the mounting nuts a few threads at a time until all are tight. Torque the nuts 60 to 70 foot pounds.
6. Safety the propeller mounting nuts.
7. Install spinner if removed and torque screws 35 to 40 inch-pounds.

CHART 6101. PROPELLER SPECIFICATIONS

Blade Angle°	Low Pitch (High RPM) High Pitch (Low RPM)	14.4° ± 0.2° 29° ± 1.0°
Measured at 30 inch station.		
Propeller RPM Setting	Engine Static High RPM	2575 RPM Max.
Propeller Torque Limits	Description Spinner Bulkhead (Aft) Propeller Mounting Spinner Attachment Screws	Required Torque (Dry) 20-22 foot-pounds 60-70 foot-pounds 35-40 inch-pounds

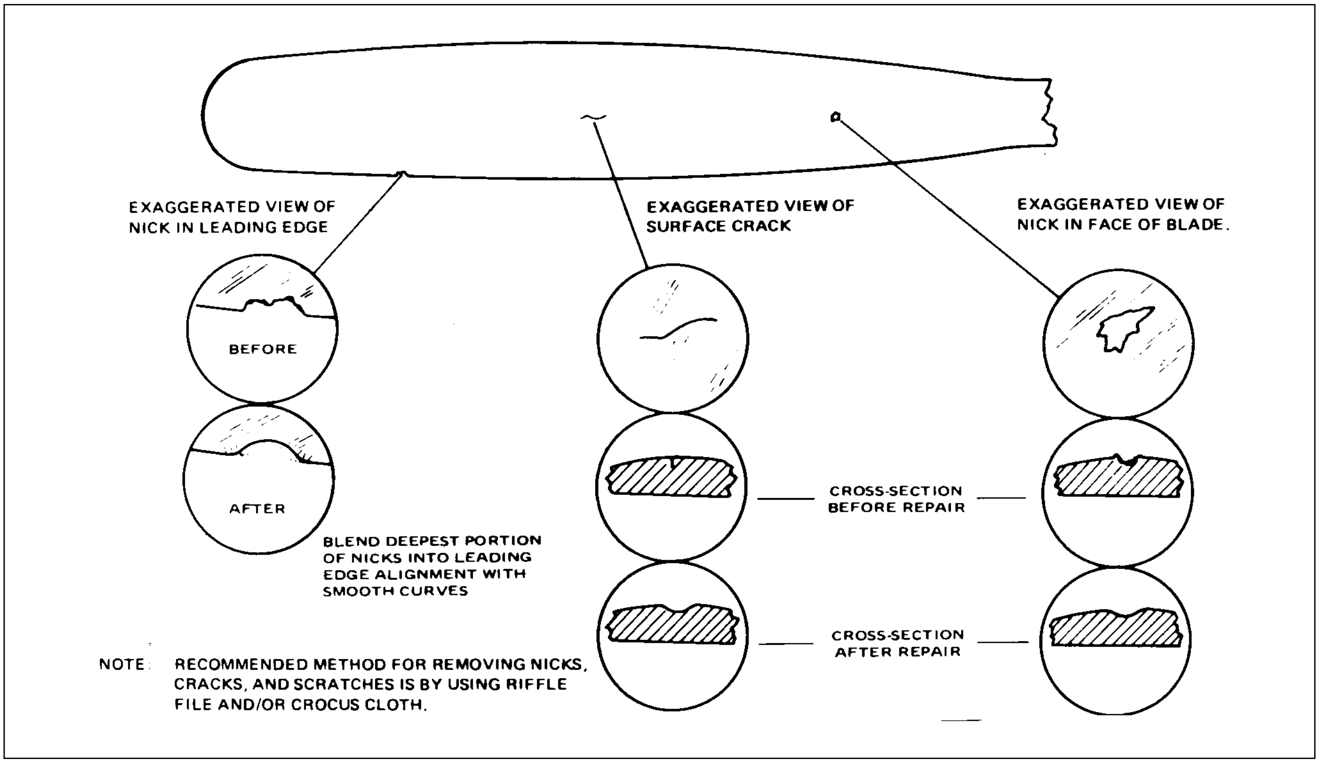


Figure 61-2. Propeller Blade Minor Repair

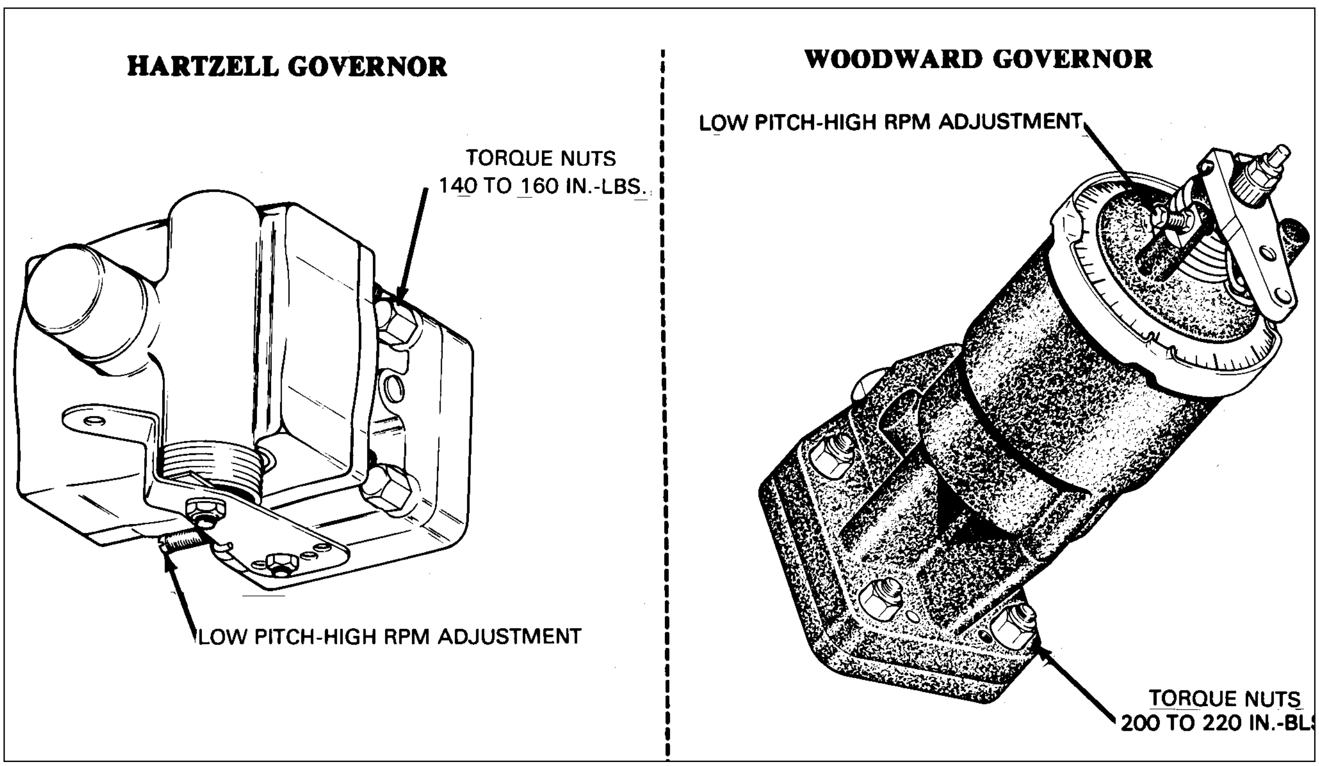


Figure 61-3. Propeller Governor

CHECKING PROPELLER BLADE TRACK.

Blade track is the ability of one blade tip to follow the other, while rotating, in almost the same plane. Excessive difference in blade track-more than .0625 inch-may be an indication of bent blades or improper propeller installation. Check blade track as follows:

1. With the engine shut down and blades vertical, secure to the aircraft a smooth board just under the tip of the lower blade. Move the tip fore and aft through its full "blade-shake" travel, making small marks with a pencil at each position. Then center the tip between these marks and scribe a line on the board for the full width of the tip.
2. Carefully rotate propeller by hand to bring the opposite blade down. Center the tip and scribe a pencil line as before and check that lines are not separated more than .0625 inch.
3. Propellers having excess blade track should be removed and inspected for bent blades, or for parts of sheared O-ring, or foreign particles, which have lodged between hub and crankshaft mounting faces. Bent blades will require repair and overhaul of assembly.

CONTROLLING.

REMOVAL OF PROPELLER GOVERNOR.

The propeller governor is mounted on the lower left forward portion of the engine crankcase. Remove the governor as follows:

1. Remove the lower cowl to gain access to the governor.
2. Disconnect the governor control cable end from the governor control arm.
3. Remove the governor mounting nuts and withdraw the governor from the mounting pad. Cover the mounting pad to prevent foreign material from entering the engine.

INSTALLATION OF PROPELLER GOVERNOR.

1. Clean the mounting pad and the governor drive shaft thoroughly.
2. Coat the mounting gasket with Dow Corning release agent or equivalent.
3. Lubricate the drive shaft with engine oil and install the governor on the mounting pad.
4. Tighten the mounting bolts evenly and tighten to a final torque as shown in Figure 61-3.
5. Connect the control cable to the control arm. Check to be sure the attachment bolt does not contact the governor body while moving the control arm through its full travel. Clearance should be .03 minimum.

RIGGING AND ADJUSTMENT OF PROPELLER GOVERNOR. (Refer to Figure 61-3.)

1. Start engine; park 90° to wind direction and warm in normal manner.
2. To check high RPM, low pitch setting, move the propeller control all the way forward. At this position the governor speed control arm should be against the high RPM fine adjusting screw. With the throttle full forward, observe engine RPM, which should stabilize between 2500 and 2575 RPM. A takeoff must be conducted during which the engine RPM should reach 2575 RPM and remain steady.
3. If the engine RPM does not read 2575 RPM in flight, the high RPM setting must be adjusted as follows:
   A. Land, shut down the engine and remove lower cowl access plug. (See Chapter 71, Figure 71-1.)

B. Adjust the governor by means of the fine adjustment screw for 2575 RPM. To do this, loosen the high RPM fine adjustment screw locknut and turn the screw in a clockwise direction to decrease engine speed or in a counterclockwise direction to increase engine speed.

—NOTE—

One revolution of the fine adjustment screw will increase or decrease the engine speed approximately 20 RPM.

C. Repeat Step 2 to ascertain proper RPM setting.

D. After setting the proper high RPM adjustment, run the self-locking nut on the fine adjustment screw against the base projection to lock, and install the lower cowl access plug.

4. With the high RPM adjustment complete, the control system should be adjusted so that the governor control arm will contact the high RPM stop when the cockpit control knob is .032 to .047 of an inch from its full forward stop. To adjust the control knob travel, disconnect the control cable end from the control arm; loosen the cable end jam nut and rotate the end to obtain the desired level clearance. Reconnect the cable end and tighten jam nut. (Lower cowl must be removed to accomplish this adjustment.)

5. It is usually only necessary to adjust the high RPM (low pitch) setting of the governor control system, as the action automatically takes care of the positive low RPM (high pitch) setting.

—END—

CHAPTER

70

STANDARD PRACTICES
ENGINES

CHAPTER 70 - STANDARD PRACTICES - ENGINE

TABLE OF CONTENTS/EFFECTIVITY

STANDARD PRACTICES - ENGINE.

The following suggestions should be applied wherever they are needed when working on the power plant.

1. To insure proper reinstallation and/or assembly, tag and mark all parts, clips, and brackets as to their location prior to their removal and/or disassembly.
2. During removal of various tubes or engine parts, inspect them for indication of scoring, burning or other undesirable conditions. To facilitate reinstallation, observe the location of each part during removal. Tag any unserviceable part and/or units for investigation and possible repair.
3. Extreme care must be taken to prevent foreign matter from entering the engine, such as lockwire, washers, nuts, dirt, dust, etc. This precaution applies whenever work is done on the engine, either on or off the aircraft. Suitable protective caps, plugs, and covers must be used to protect all openings as they are exposed.

—NOTE—

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

4. Should any items be dropped into the engine, the assembly process must stop and the item removed, even though this may require considerable time and labor. Insure that all parts are thoroughly clean before assembling.
5. Never reuse any lockwire, lockwashers, tablocks, tabwashers or cotter pins. All lockwire and cotter pins must fit snugly in holes drilled in studs and bolts for locking purposes. Cotter pins should be installed so the head fits into the castellation of the nut, and unless otherwise specified, bend one end of the pin back over the stud or bolt and the other end down flat against the nut. Use only corrosion resistant steel lockwire and/or cotter pins. Bushing plugs shall be lockwired to the assembly base or case. Do not lockwire the plug to the bushing.
6. All gaskets, packings and rubber parts must be replaced with new items of the same type at reassembly. Insure the new nonmetallic parts being installed show no sign of having deteriorated in storage.
7. When installing engine parts which require the use of a hammer to facilitate assembly or installation, use only a plastic or rawhide hammer.
8. Anti-seize lubrication should be applied to all loose-fit spline drives which are external to the engine and have no other means of lubrication. For certain assembly procedures, molybdenum disulfide in either paste or powdered form mixed with engine oil or grease may be used.

—CAUTION—

Ensure that Anti-seize compounds are applied in thin even coats, and that excess compound is completely removed to avoid contamination of adjacent parts.

9. Temporary marking methods are those markings which will ensure identification during ordinary handling, storage and final assembly or parts.

—END—

CHAPTER

71

POWER PLANT

CHAPTER 71-POWER PLANT

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

The purpose of this section is to provide instructions for the removal, minor repair, service and installation of the engine and components. For instructions on major repairs and overhauls, consult the appropriate publication of the component manufacturer.

DESCRIPTION.

The PA-28-201T is powered by a Teledyne Continental TSIO-360-FB turbocharged, overhead valve, air cooled, horizontally opposed, direct drive, wet sump engine rated at 200 hp from sea level to 12,000 feet density altitude.

The engine is enclosed by a cowling consisting of an upper, lower and nose section.

The propeller is a Hartzell constant speed, controlled by a governor mounted on the engine supplying oil through the propeller shaft at various pressures. Oil pressure from the governor moves the blades into high pitch (low RPM). The centrifugal twisting moment of the blade also tends to move the blades into low pitch.

Refer to Chapter 28 for description of fuel system and primer operation.

TROUBLESHOOTING.

Troubles peculiar to the power plant are listed in Chart 7101 along with the probable causes and suggested remedies. When troubleshooting engine, propeller or fuel system, always ground the magneto primary circuit before performing any checks.

CHART 7101. TROUBLESHOOTING (ENGINE)

Trouble	Cause	Remedy
Engine will not start.	No fuel gauge pressure - no fuel to engine.	Check fuel control for proper position, auxiliary pump "ON" and operating, feed valves open. Fuel filters open and tank fuel level.
	Have gauge pressure - engine flooded.	Turn off auxiliary pump and ignition switch; set throttle to "FULL OPEN" and fuel control to "IDLE CUTOFF," and crank engine to clear cylinders of excess fuel. Repeat starting procedure.
	Have gauge pressure - no fuel to engine.	Check for bent or loose fuel lines. Loosen line at fuel nozzle. If no fuel shows, replace fuel manifold valve.

CHART 7101. TROUBLESHOOTING (ENGINE) (cont.)

Trouble	Cause	Remedy
Engine starts but fails to keep running.	Inadequate fuel to fuel manifold valve.	Set fuel control in “FULL RICH” position; turn auxiliary pump “ON,” check to be sure feed lines and filters are not restricted. Clean or replace defective components.
	Defective ignition system.	Check accessible ignition cables and connections. Tighten loose connections. Replace defective spark plugs.
Engine runs rough at idle.	Improper idle mixture adjustment.	Readjust idle setting. Turn adjustment screw clockwise to lean mixture and counterclockwise to richen mixture.
	Fouled spark plugs.	Remove and clean plugs, adjust gaps. Replace defective plugs.
	Discharge nozzle air vent manifold restricted or defective.	Check for bent or loose connections. Tighten loose connections. Check for restrictions and replace defective components.
Engine has poor acceleration.	Idle mixture too lean.	Readjust idle mixture.
	Incorrect fuel-air mixture, worn control linkage or restricted air cleaner.	Tighten loose connections. Service air cleaner.
	Defective ignition system:	Check accessible cables and connections. Replace defective spark plugs.
	Malfunctioning turbocharger.	Check operation; listen for unusual noise. Check exhaust bypass screw and for exhaust system defects. Tighten loose connections.

CHART 7101. TROUBLESHOOTING (ENGINE) (cont.)

Trouble	Cause	Remedy
Engine runs rough at speeds above idle.	Improper fuel-air mixture.	Check manifold connections for leaks. Tighten loose connections. Check fuel control for setting and adjustment. Check fuel filters and screens for dirt. Check for proper pump pressure and readjust as necessary.
	Restricted fuel nozzle.	Remove and clean all nozzles.
	Ignition system and spark plugs defective.	Clean and regap spark plugs. Check ignition cables for defects. Replace defective components.
Engine lacks power, reduction in maximum manifold pressure or critical altitude.	Incorrectly adjusted throttle control, "sticky" linkage or dirty air cleaner.	Check movement of linkage by moving control from idle to full throttle. Make proper adjustments and replace worn components. Service air cleaner.
	Improperly adjusted waste gate valve.	Check exhaust bypass screw adjustment.
	Defective ignition system.	Inspect spark plugs for fouled electrodes, heavy carbon deposits, erosion or electrodes, improperly adjusted electrode gaps and cracked porcelains. Test plugs for regular firing under pressure. Replace damaged or misfiring plugs. Spark plug gap to be 0.015 to 0.019 in.
	Loose or damaged exhaust system.	Inspect entire exhaust system to turbocharger for cracks and leaking connections. Tighten connections and replace damaged parts.

CHART 7101. TROUBLESHOOTING (ENGINE) (cont.)

Trouble	Cause	Remedy
Engine lacks power, reduction in maximum manifold pressure or critical altitude. (cont.)	Loose or damaged intake manifolding.	Inspect entire manifold system for possible leakage at connections. Replace damaged components; tighten all connections and clamps.
	Fuel nozzles defective.	Inspect fuel nozzle vent manifold for leaking connection. Tighten and repair as required. Check for restricted nozzles and lines and clean or replace as necessary.
	Malfunctioning turbocharger.	Check for unusual noise in turbocharger. If malfunction is suspected, remove exhaust and/or air inlet connections and check rotor assembly for possible rubbing in housing, damaged rotor or defective bearings. Replace turbocharger if damage is noted.
	Exhaust system gas leakage.	Inspect exhaust system for gas leakage, gaskets at turbine inlet flanges, etc., and correct.
Low fuel pressure.	Restricted flow to fuel metering valve.	Check mixture control for full travel. Check for restrictions in fuel filters and lines; adjust control and clean filters. Replace damaged parts.
	Fuel nozzle vent system defective causing improper pressure regulation.	Check venting system for leaks at connections and other defects. Tighten connections and replace defective parts.
	Fuel control lever interference.	Check operation of throttle control and for possible contact with cooling shroud. Adjust as required to obtain correct operation.

CHART 7101. TROUBLESHOOTING (ENGINE) (cont.)

Trouble	Cause	Remedy
Low fuel pressure. (cont.)	Incorrect fuel injector pump adjustment and operation.	Check and adjust using appropriate equipment. Replace defective pump.
	Defective fuel injector pump relief valve.	Replace pump if cleaning and lapping valve does not correct problem.
	Air leakage in fuel pump pressurization line.	Locate cause of leakage and correct.
High fuel pressure.	Restricted flow beyond fuel control assembly.	Check for restricted fuel nozzles or fuel manifold valve. Clean or replace nozzles. Replace defective fuel manifold valve.
	Defective relief valve operation in fuel injector.	Check fuel injector pump control line from turbocharger for loose connections and defects. Tighten connections, replace damaged line.
	Restricted recirculation passage in fuel injector.	Replace pump.
	Air leakage in fuel gauge vent pressurization line.	Locate cause of leakage and eliminate.
Fluctuating fuel pressure.	Vapor in fuel system.	Normally operating the auxiliary pump will clear system. Operate auxiliary pump and purge system.
	Fuel gauge line leak or improperly purged line.	Purge gauge line and tighten connections.

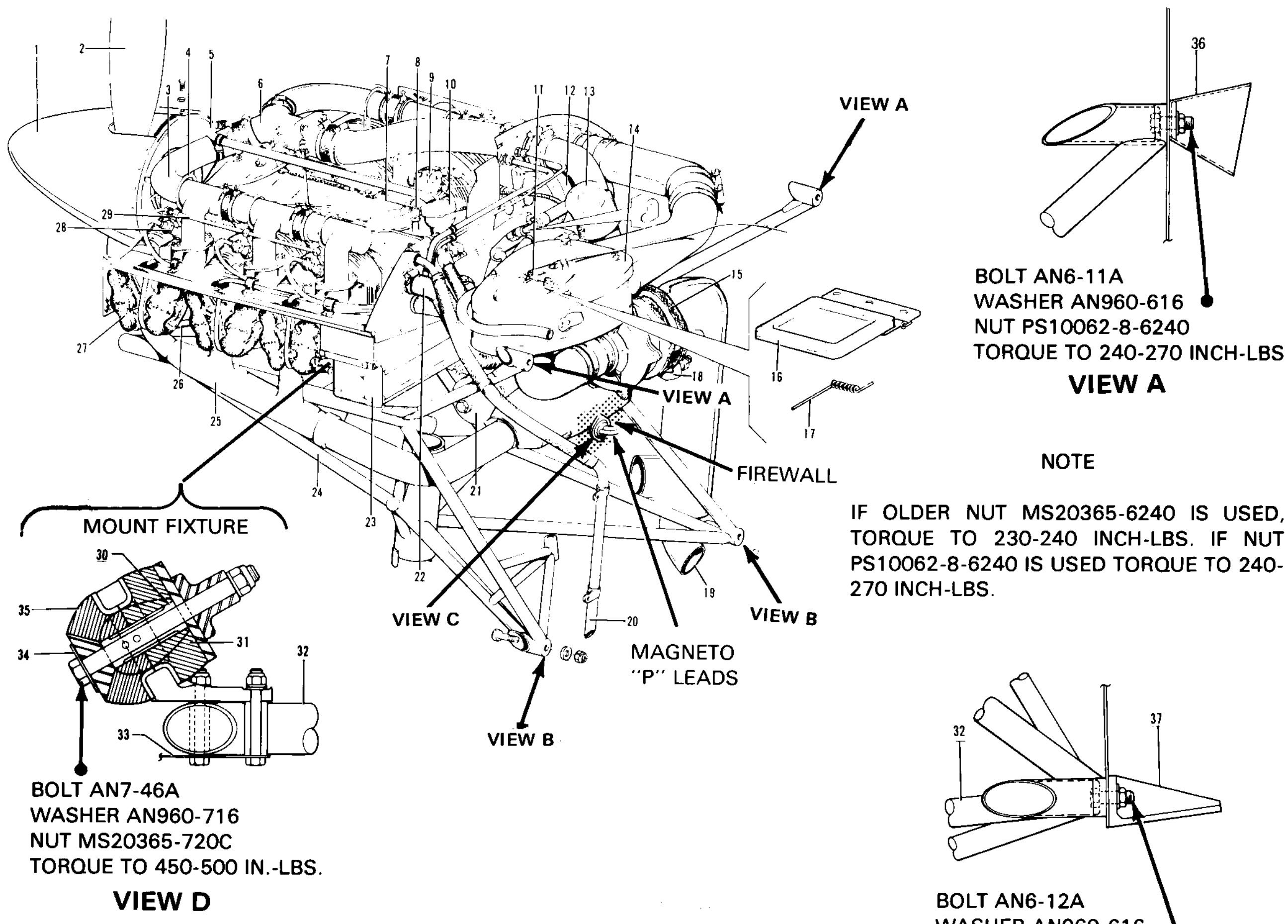
CHART 7101. TROUBLESHOOTING (ENGINE) (cont.)

Trouble	Cause	Remedy
Low oil pressure on engine gauge.	Insufficient oil in oil sump, oil dilution or using improper grade oil for prevailing ambient temperature.	Add oil or change oil to proper viscosity.
	High oil temperature.	Defective vernatherm valve in oil cooler; oil cooler restriction. Replace valve or clean oil cooler.
	Leaking, damaged or loose oil line connections - Restricted screens and filter.	Check for restricted lines and loose connection, and for partially plugged oil filter and screens. Clean parts, tighten connections, and replace defective parts.
	Leaking oil seal in turbocharger.	Check for oil in turbocharger exhaust outlet. Replace turbocharger.
	Defective check valve in turbocharger oil supply line.	Disassemble and clean valve or replace.
Poor engine idle cutoff.	Engine getting fuel.	Check fuel control for being in full “IDLE CUTOFF” position. Check auxiliary pump for being “OFF.” Check for leaking fuel manifold valve. Replace defective components.
White smoke exhaust.	Turbo choking oil forced through seal in turbine housing.	Clean or change turbocharger.

CHART 7102. ENGINE DATA

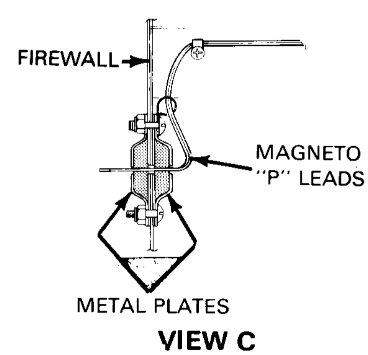
Model (Teledyne Continental)	TSIO-360-FB
Type Certificate Number	E9CE
Number of Cylinders	6 Horizontally Opposed
Bore (Inches)	4.44
Stroke (Inches)	3.88
Displacement (Cubic Inches)	360
Compression Ratio	7.5:1
Type of Propeller Drive, Flanged	Direct
Rated Horsepower at Sea Level, 2575 rpm	200
Fuel, Minimum Octane	100/130 or 100LL
Oil Sump Capacity	8 quarts
Oil Pressure (P.S.I.): @ Max. Continuous Horsepower	
Minimum	*30
Normal	30-60
Maximum	80
Oil Temperature (°F): @ Max. Continuous Horsepower	
Minimum	100
Normal	l 60-200
Maximum	240
Probe Location	Above Oil Filter Element
Cylinder Head Temperature (°F)	
No. 2 cyl.: @ Max. Continuous Horsepower	
Minimum	240
Normal (Desired)	300-400
Maximum	460
Magnetos	Bendix 25 Series
Left Bank	Fires 20° BTC Lower Right, Upper Left
Right Bank	Fires 20° BTC Lower Left, Upper Right
Firing Order:	
TSIO-360-FB	I-6-3-2-5-4
Spark Plugs (Shielded):	AC. SR86, S86R, HSR86 Auto Lt . PH26, PH260 Champ. REM38W, RHM38W, PHM38EP, RHM38E, REM38E, REM38P Red Seal. SE270, SE270P, SJ270, SJ270P
Torque	360 to 420 inch-pounds
Alternator	12 volt, 65 ampere
Starter	12 volt, Prestolite
Engine Dry Weight With Accessories (Approx.)	393 pounds
Turbocharger	Rajay

*WARNING-OPERATION OF ENGINE AT TOO HIGH AN RPM BEFORE REACHING MINIMUM OIL TEMPERATURE MAY CAUSE LOSS OF OIL PRESSURE.



VIEW B

WHEN CLAMPING WIRING ENSURE WIRING CLEARS METAL PLATES.



VIEW C

1. SPINNER
2. PROPELLER
3. INDUCTION MANIFOLD
4. FUEL LINE
5. OIL VENT LINE
6. THROTTLE BODY
7. THROTTLE CABLE
8. OIL DIPSTICK
9. FUEL INJECTOR MANIFOLD
10. OIL FILLER
11. ALTERNATE AIR DOOR MECHANISM
12. STARTER
13. PRESSURE RELIEF VALVE
14. INDUCTION AIR FILTER ASSEMBLY
15. TURBOCHARGER
16. ALTERNATE AIR DOOR
17. ALTERNATE AIR DOOR RETURN SPRING
18. EXHAUST BYPASS
19. EXHAUST AND HEAT MUFF ASSEMBLY
20. OIL BREATHER
21. OIL FILTER
22. ALTERNATOR COOLING TUBE
23. OIL COOLER
24. ENGINE MOUNT
25. EXHAUST MANIFOLD
26. PUSH ROD COVER
27. VALVE COVER
28. SPARK PLUG
29. DECK PRESSURE LINE
30. SPACER
31. TOP MOUNT
32. ENGINE MOUNT
33. HEAT SHIELD (RIGHT REAR MOUNT ONLY)
34. WASHER
35. BOTTOM MOUNT
36. TOP FITTING ASSEMBLY
37. BOTTOM FITTING ASSEMBLY

Figure 71-1. Engine Installation

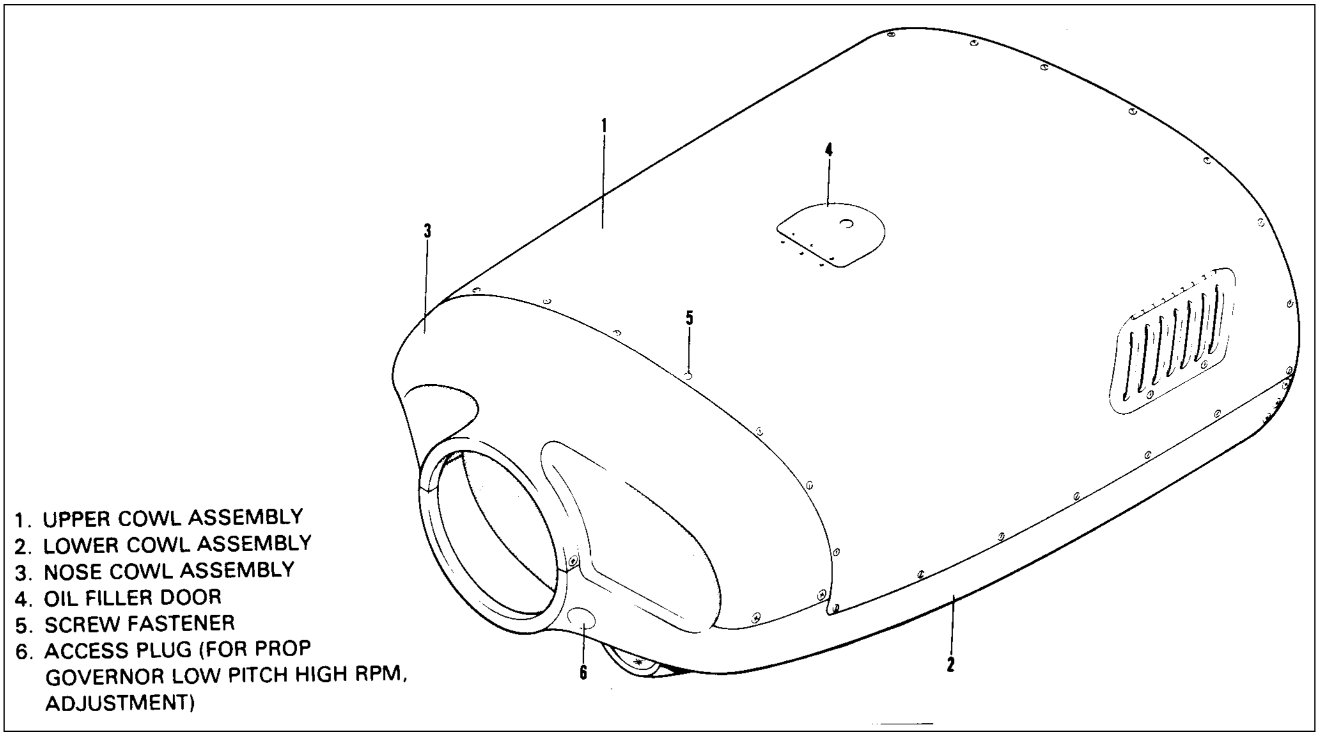


Figure 71-2. Engine Cowling Installation

REMOVAL OF ENGINE. (Refer to Figures 71-1.)

1. Turn off all electrical switches in the cockpit and disconnect the battery ground wire at the battery.
2. Move the fuel selector valve in the cockpit to the OFF position.
3. Remove the engine cowling as described under cowling section of this chapter.
4. Remove the propeller as described in Chapter 61.
5. Disconnect the starter positive lead and ground lead at the starter.
6. Disconnect the tachometer cable to the engine.
7. Disconnect the governor control cable at the governor and cable attachment clamps.
8. Disconnect the throttle and mixture cables from the fuel-air control unit.
9. Disconnect the cylinder temperature sender wire at No. 2 cylinder.
10. Disconnect the fuel pump supply line and vent line from the engine.
11. Disconnect the exhaust manifold at the turbocharger tubine inlet (“Y” connections) and at each exhaust manifold slip joint adjacent to No. 1 and 2 cylinders.

—NOTE—

In some manner identify all hoses, wires and lines to facilitate installation. Open fuel, oil, vacuum lines and fittings should be covered to prevent contamination.

12. Disconnect the magneto "P" leads at the magnetos.
13. Disconnect the engine vent tube at the engine.
14. Disconnect the engine oil temperature lead at the aft end of the engine.
15. Untie the ignition harness, hoses and lines at the aft end of the engine.
16. Disconnect the pneumatic pump lines at pump and remove fittings from pump.
17. Disconnect the oil pressure line at the engine.
18. Disconnect the fuel flow line at the left rear engine baffle.
19. Disconnect the manifold pressure line at the left rear side of the engine.
20. Disconnect the alternator leads and the cable attachment clamps.
21. Attach a one-half ton (minimum) hoist to the hoisting straps and relieve the tension from the engine mounts.

—NOTE—

Place a tail stand under the tail of the airplane before removing the engine.

22. Check the engine for any attachment remaining to obstruct its removal.
23. Drain the engine oil.
24. Remove the engine mounting bolts and lower mount assembly.
25. Carefully raise the engine and pull forward to clear the mount. Check to be certain there are no connections remaining to obstruct removal of the engine, and remove the engine from the aircraft and place on a suitable stand.

INSTALLATION OF ENGINE. (Refer to Figure 71-1.)

Prior to installing the engine, be sure to install all items that were removed after the engine was removed from the aircraft.

—NOTE—

Remove all protective caps and identification tags as each item is installed.

1. Install the shock mount in the engine mount and hoist the engine into position on the mount.
2. Install the lower shock mount assemblies and mounting bolts. Torque the bolts 450 to 500 inchpounds.
3. Route and connect the throttle and mixture control cables and adjust.
4. Route and connect the propeller governor control cable and adjust.
5. Connect the alternate air cable and adjust.
6. Reconnect all lines and hoses previously disconnected from the engine.

—NOTE—

Apply Lubon No. 404 to all male fuel system fittings. Do not allow to enter system.

7. Route and connect the electrical leads to the appropriate connections on the engine.
8. Connect the tachometer drive cable.
9. Connect exhaust manifold at the turbocharger turbine inlet (“Y” connection) and at each exhaust manifold slip joint adjacent No. 1 and 2 cylinders.

—NOTE—

Secure all cables, hoses and wires with clamps and Ty-strap in the same location as before removal.

10. Install the propeller and spinner per Chapter 61.
11. Service the engine with the proper grade and quantity of oil; refer to Chapter 12.
12. Be certain all switches are in the OFF position and connect the battery cables.
13. Install the engine cowling.
14. Make a final check of the security, location and installation of all lines, wires and cables.
15. Perform an operational check of the engine; inspect for leaks and make final adjustments to engine controls as required.

—NOTE—

Check exhaust pipe clearance. Minimum clearance to structure and cowl flap door opening should be 0.50 of an inch.

COWLING.

REMOVAL OF COWLING. (Refer to Figure 71-2.)

1. Release the fasteners securing the upper cowl and then remove the upper cowl.
2. Disconnect fuel drain flex line from the drain valve assembly.
3. Support the bottom cowl and remove the screws that attach the cowl to the upper nose cowl, engine mount and fuselage.

CLEANING, INSPECTION AND REPAIR OF COWLING.

1. The cowl should be cleaned with a suitable solvent and then wiped with a clean cloth.
2. Inspect the cowling for dents, cracks, loose rivets, damaged or missing fasteners and damaged fiberglass areas.
3. Repair all defects to prevent further damage. Fiberglass repair procedures may be accomplished according to Fiberglass Repairs, Chapter 51.

INSTALLATION OF COWLING. (Refer to Figure 71-2.)

1. Position the bottom cowl and secure with screw fasteners to the fuselage and engine mount.
2. Position and connect the upper nose cowl to the lower cowl.
3. Install the top cowl with attaching screw fasteners.
4. Connect the fuel drain flex line to the drain valve assembly.

MOUNTS.

REPLACEMENT OF ENGINE SHOCK MOUNTS. (Refer to Figure 71-1.)

1. Remove the engine cowling.
2. Relieve the engine weight on the mounts using a one-half ton hoist attached to the engine lifting points.
3. Remove the four engine mounting bolts and the lower half of the mount assemblies.
4. Carefully raise the engine just enough to remove the shock mounts. Check all lines, wires and cables for interference. Disconnect any lines and cables if necessary.
5. Check all components for wear, damage or cracks and install new mounting kit.
6. Lower the engine slowly and use mounting bolts to keep the components aligned.
7. When the engine is supported by the mount, check the mounts for proper seating.
8. Install the mounting bolt, nut, washer and torque 450 to 500 inch-pounds and safety.
9. Reconnect any lines, wires or cables that were disconnected and install engine cowling.

AIR INTAKES.

REMOVAL OF AIR FILTER.

1. Remove upper cowl.
2. Release the stud fasteners, remove the filter cover, and withdraw the filter element.

CLEANING INDUCTION AIR FILTER.

The air filter element should be cleaned as often as it becomes dirty, everyday under severe dust conditions. The filter element should be replaced if any holes or tears exist. When cleaning the filter, it is good practice to clean the filter box assembly with a clean cloth dampened with clean solvent.

—CAUTION—

Do not allow foreign materials to drop into, or otherwise enter the filter box assembly outlet duct to the turbocharger. Failure to take necessary precaution could cause failure of the turbocharger.

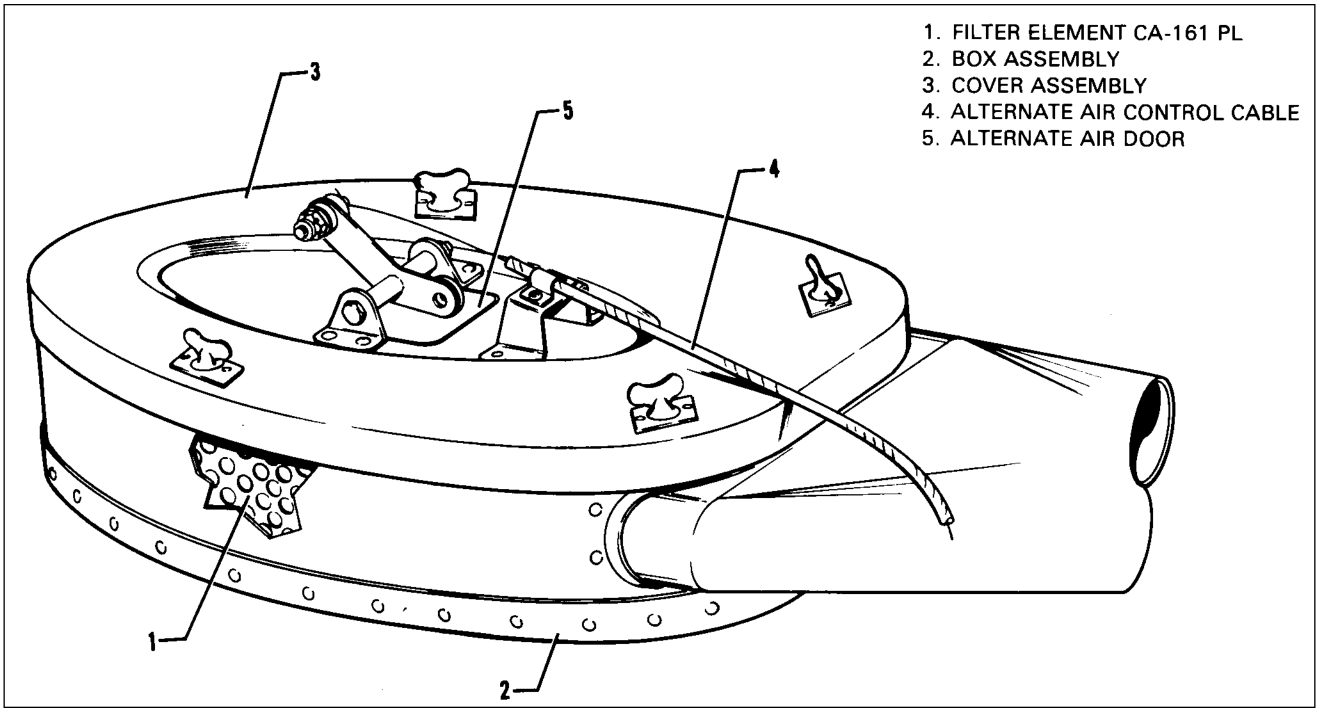


Figure 71-3. Induction Air Filter System Installation

1. To clean the filter, rap gently on a hard surface to remove embedded debris. Be careful not to damage the sealing ends.

—CAUTION—

Never wash the filter element in any liquid or soak it in oil. Never attempt to blow off dirt with compressed air.

INSTALLATION OF AIR FILTER (Refer to Figure 71-3.)

1. Properly position the filter element in the box assembly and secure the cover assembly with the stud fasteners.

—NOTE—

Check filter element for proper position by ensuring that the slightly raised section in the bottom of the box assembly is completely inside the filter element inner ring. After the cover assembly has been installed, open the alternate air door manually by depressing the door to ensure that no interference exists between the alternate air door and the filter element.

ALTERNATE AIR DOOR

The alternate air door is located in the alternate air box to provide a source of air to the engine should there be an air stoppage through the filter system. The following should be checked during inspection:

1. Check that air door seals are tight and the hinge and torsion spring are secure.
2. Adjust the control cable to position the roller on the arm assembly clear of the door in the closed position. Check that when the cockpit control is in the closed position the door is properly seated in the closed position.
3. Actuate the door by operating the control lever in the cockpit to determine that it is not sticking or binding.
4. Check the cockpit control cable for free travel.

—END—

CHAPTER

73

ENGINE FUEL SYSTEM

CHAPTER 73 - ENGINE FUEL SYSTEM

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

DESCRIPTION. (Refer to Figure 73-1.)

The fuel injection system is a multi-nozzle, continuous flow, altitude compensating system that regulates fuel flow to match engine operating conditions. The system consists of an engine driven fuel pump, a throttle body, a fuel manifold valve and fuel discharge nozzles.

The engine driven fuel pump is a positive displacement, rotary vane type pump with an integral vapor separator and altitude compensating aneroid valve.

The throttle body consists of a rotary valve metering unit attached to an air throttle that controls the flow of air to the engine. The position of the cam shaped edge of the rotary valve across the fuel delivery port and engine driven pump controls the fuel flow to the manifold valve and nozzles, thus controlling the fuel-air ratio. The adjustment of the engine and the fuel controls are described in Chapter 76.

The fuel manifold valve is the central point for dividing fuel to the individual cylinders. A diaphragm and plunger valve within the manifold valve raises or lowers by fuel pressure to open or close the individual fuel supply ports simultaneously.

The fuel discharge nozzles are an air bleed type nozzle with a calibrated orifice. A nozzle is installed in the cylinder head outside each intake valve for each cylinder.

DISTRIBUTION.

FUEL INJECTION SYSTEM MAINTENANCE.

1. Check all attaching parts for tightness.
2. Check all fuel lines for leaks, evidence of damage, or chafing by metal to metal contact.
3. Check control connections, levers, and linkages for safety.
4. Inspect nozzles for cleanliness with particular attention to air screens and orifices. Use a standard 1/2 inch spark plug type deep socket to remove nozzles. Do not remove shield to clean air screens. Do not use wire or other object to clean orifices. To clean nozzles, remove from engine and immerse in fresh cleaning solvent. Use compressed air to dry.
5. Unscrew strainer plug from fuel injection control valve and clean screen in solvent. Reinstall, safety, and check for leaks.
6. During periodic lubrication, add a drop of engine grade oil on each end of the air throttle shaft and at each end of the linkage between the air throttle and fuel metering valve.

—NOTE—

Do not use any form of thread compound on fuel line fittings. Use only a fuel soluble lubricant such as engine oil.

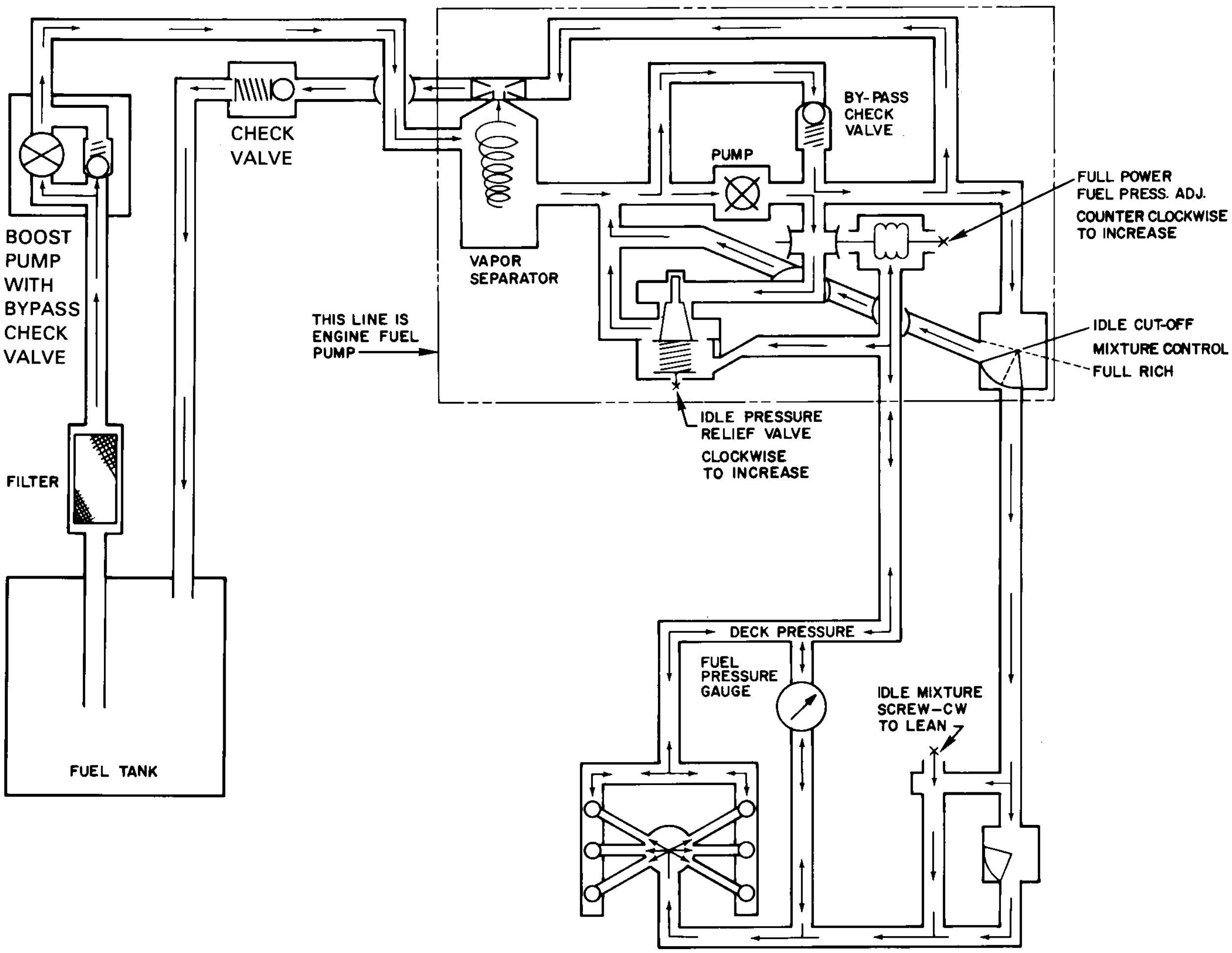


Figure 73-1. Schematic Diagram of Fuel Injection System

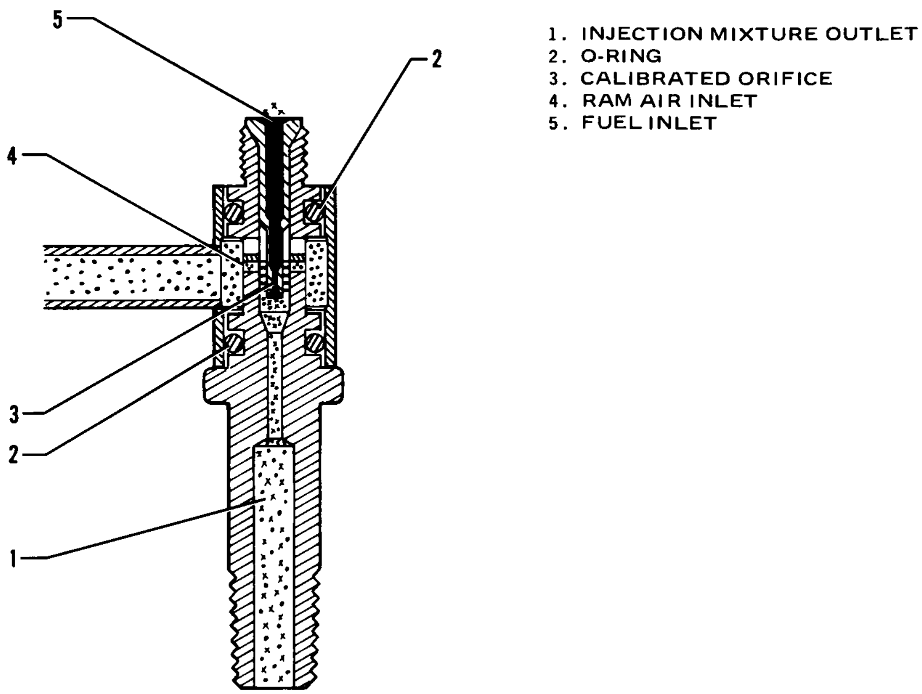


Figure 73-2. Fuel Injector Nozzle Assembly

FUEL INJECTOR NOZZLE ASSEMBLY (Refer to Figure 73-2.)

REMOVAL OF FUEL INJECTOR NOZZLES

1. Remove the cowling side access panels.
2. Disconnect the fuel line and remove the ram air line from the nozzle.
3. Use a standard 1/2 inch spark plug type deep socket to remove the nozzle.

CLEANING AND INSPECTION OF FUEL INJECTOR NOZZLES

1. To clean the nozzles immerse in fresh cleaning solvent, use compressed air to dry.

—CAUTION—

Do not use wire or other objects to clean orifices.

2. Inspect nozzles for cleanliness; pay particular attention to the orifices. Check the condition of the nozzle and cylinder threads.

INSTALLATION OF FUEL INJECTOR NOZZLES.

1. Carefully start the nozzles by hand to prevent cross-threading. Torque nozzle to 60 inch-pounds.
2. Connect the fuel line to the nozzle.
3. Reinstall cowling side panels.

—NOTE—

Refer to Chapter 76 Engine Controls for Power Plant rigging and setup procedures.

CHAPTER

74

IGNITION

CHAPTER 74 - IGNITION

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

—CAUTION—

Ascertain that the primary circuits of both magnetos are grounded before working on the engine.

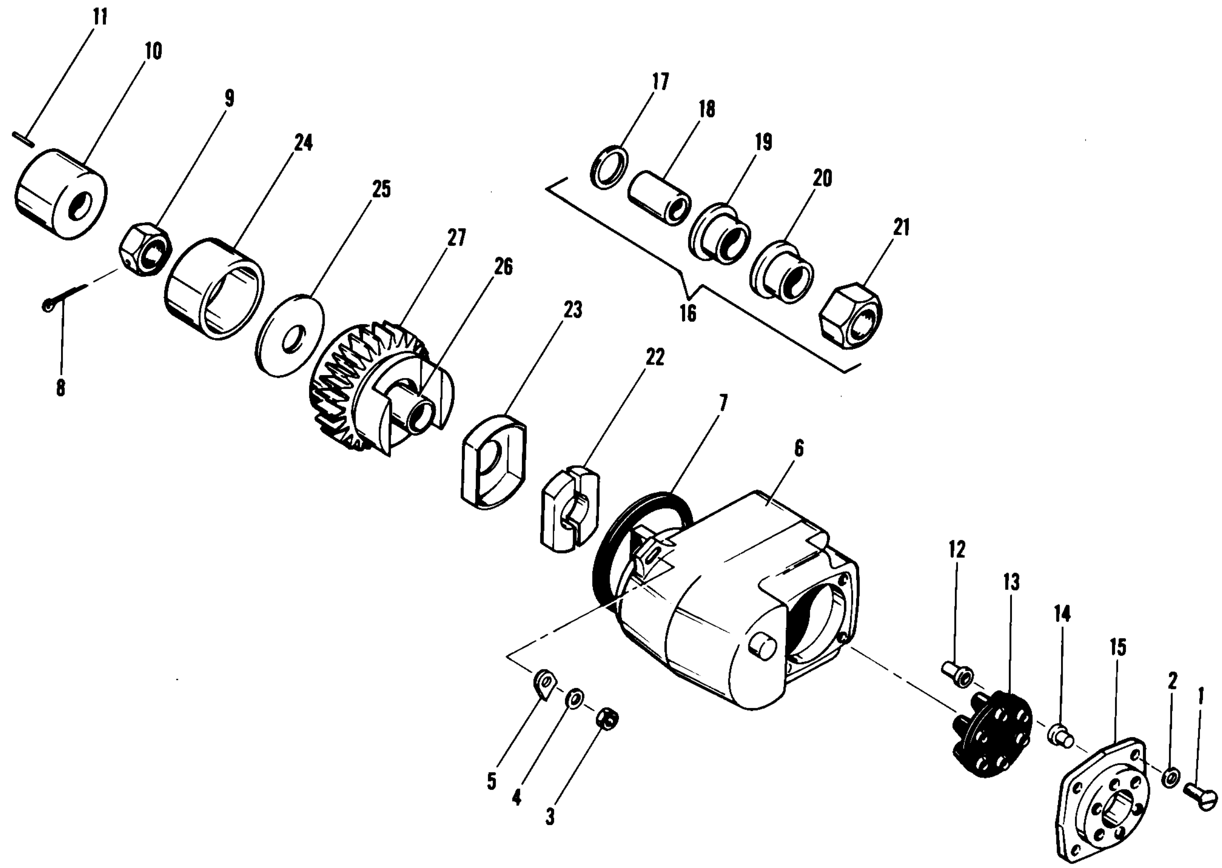
—NOTE—

The magneto service instructions in this manual cover minor repairs and timing. For further repairs and adjustments of the magnetos, it is recommended that the magneto manufacturer's service instructions be followed.

ELECTRICAL POWER SUPPLY.

INSPECTION OF MAGNETOS. (Refer to Figure 74-1.)

1. After the first 25 hour and 50 hour periods, and periodically thereafter, the contact assemblies should be checked. Examine the points for excessive wear or burning. Points which have deep pits or excessively burned areas should be discarded. Examine the cam follower felt for proper lubrication. If necessary, points can be cleaned by using any hard finished paper. Clean breaker compartment with dry cloth.
2. If engine operating troubles develop which appear to be caused by the ignition system, it is advisable to check the spark plugs and wiring first before working on the magnetos.
3. Should the trouble appear definitely associated with the magneto, the most effective measure is to install a replacement magneto which is known to be in satisfactory condition and send the suspected unit to the overhaul shop for test and repair.
4. Should this not be possible, a visual inspection may disclose the source of trouble. Remove the harness outlet plate from the magneto. Inspect for the presence of moisture and foreign matter on the rubber grommet and high tension outlet side of the distributor block. Check height of block contact springs. The top of the spring must not be more than 0.422 of an inch below the top of the tower as shown in Figure 74-2. If the springs are broken or corroded, replace them.
5. Inspect the distributor block for cracks or burned areas. The wax coating on the block should not be removed. Do not use solvents.
6. Check for excess oil in the breaker compartment. If present, it may mean a bad oil seal or oil seal bushing at the drive end. Check the magneto manufacturer's overhaul procedure.
7. Remove the breaker cover and harness securing screws and nuts and separate cover from magneto housing. Check contact assemblies to see that cam follower is securely riveted to its spring. Examine the contact points for excessive wear or burning. Figure 74-3 shows how the average contact point will look when surfaces are separated for inspection. Desired contact surfaces have a dull gray, sandblasted (almost rough) or frosted appearance over the area where electrical contact is made. This means that points are worn in and mated to each other, thereby providing the best possible electrical contact and highest efficiency of performance.
8. Minor irregularities or roughness of point surfaces are not harmful (refer to Figure 74-3, center); neither are small pits or mounds, if not too pronounced. If there is a possibility of pit becoming deep enough to penetrate pad, Figure 74-3, right, reject contact assembly.



1. SCREW
2. LOCK WASHER
3. NUT
4. LOCK WASHER
5. HOLD DOWN WASHER
6. MAGNETO
7. GASKET
8. COTTER PIN
9. NUT
10. GEAR SUPPORT SHAFT
11. PIN
12. IGNITION CABLE EYELET
13. DISTRIBUTOR CABLE GROMMET
14. IGNITION CABLE FERRULE
15. DISTRIBUTOR CABLE PLATE
16. GROUND TERMINAL KIT
17. WASHER
18. INSULATING SLEEVE
19. INNER FERRULE
20. OUTER FERRULE
21. COUPLING NUT
22. COUPLING BUSHINGS
23. RETAINER
24. NEEDLE BEARING
25. WASHER
26. PILOT SLEEVE BUSHING
27. MAGNETO DRIVE GEAR

Figure 74-1. Magneto Assembly

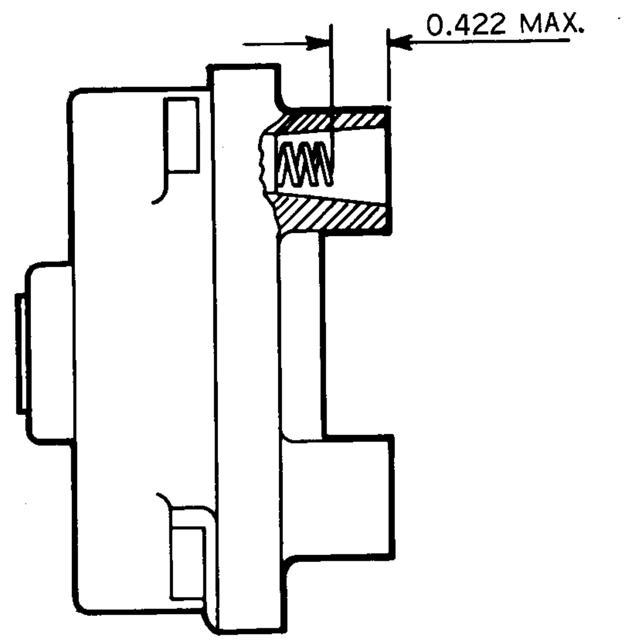


Figure 74-2. Contact Spring Inspection

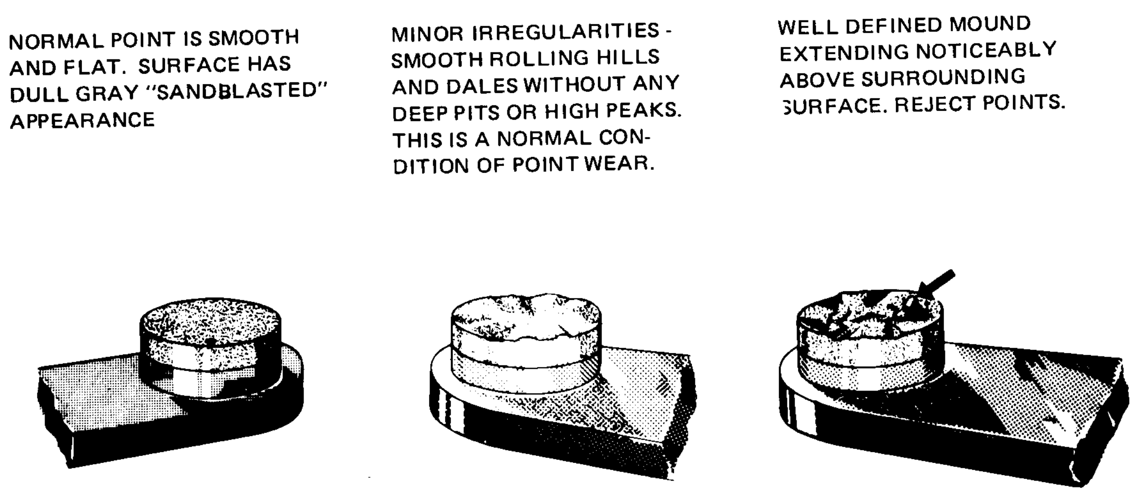


Figure 74-3. Contact Points

—NOTE—

No attempt should be made to stone or dress contact points. Should contact assembly have bad points or show excessive wear, the complete contact assembly should be replaced.

9. Check the condition of the cam follower felt. Squeeze felt tightly between thumb and forefinger. If fingers are not moistened with oil, re-oil using 2 or 3 drops of Bendix 10-86527 lubricant. Allow approximately 30 minutes for felt to absorb the oil. Blot off the excess with a clean cloth. Too much oil may foul contact points and cause excessive burning.
10. Inspect the felt washer in the distributor block for oil content. If the felt is dry, inspect the bronze bushing for wear. (Refer to manufacturer's overhaul instruction.) Oil felt washer with Bendix Distributor Block Lubricant Part No. 10-391200. Blot excess oil from washer until flat surfaces take on a "frosted" appearance and seat washer in its recess in block.
11. Check the capacitor mounting bracket for cracks or looseness. Using the Bendix 11-1767-1, -2 or -3 Condenser Tester or equivalent check capacitor for capacitance, series resistance and leakage. Capacitance shall be at least 0.30 microfarads. Series resistance should not be over 1 ohm at 500 kc.
12. Inspect coil leads for damaged insulations and terminals for tightness and soldered connection.
13. Inspect impulse coupling parts for excessive wear. Particularly check clearance between cam and flyweights of the cam assembly. Measure the clearance between the cam flyweights using the shank of a new No. 18 drill (0.169 inch diameter). If the drill will fit between cam and flyweight as shown in Figure 74-4, the cam assembly must be replaced. Check clearance between both flyweights and the cam of each cam assembly.
14. Check the clearance between each flyweight and each stop pin as follows:
    A. Bend the end of a stiff piece of wire into a right angle 0.125 inch long (maximum).
    B. Hold magneto as shown in Figure 74-5. Pull heel of flyweight outward with the hooked wire and make certain that feeler gauge of 0.010 inch minimum thickness will pass between stop pin and the highest point of the flyweight.

—NOTE—

A true and accurate check of the clearance between flyweight and stop pin can only be obtained by pulling the flyweight outward as described above. Do not attempt the check by pushing in on flyweight at point "A."

15. Check internal timing and reinstall and time magneto to engine.

REMOVAL OF MAGNETOS.

1. Remove the engine cowl.
2. Disconnect the "P" lead from the magneto.
3. Remove the harness outlet plate from the magneto by removing the four attaching screws.
4. Remove the two nuts and washers securing the magneto to the engine accessory housing.
5. Pull the magneto from the engine.

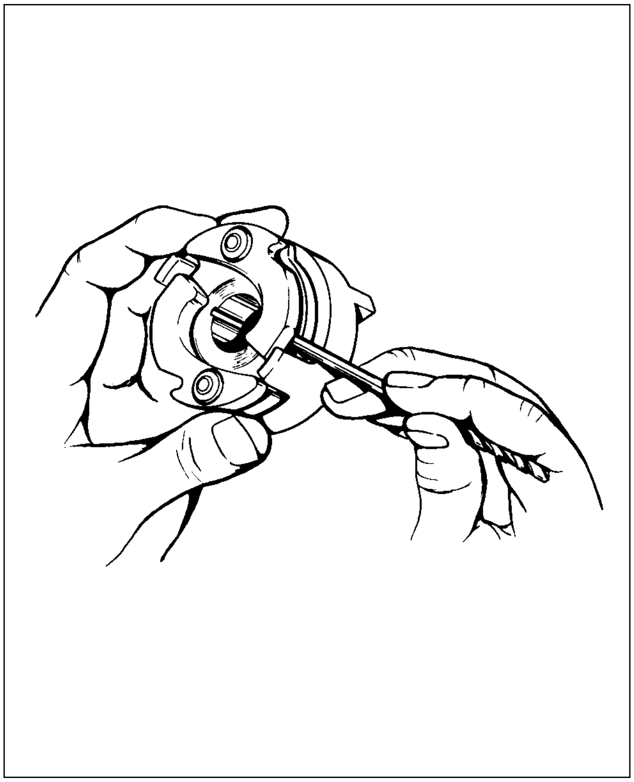


Figure 74-4. Impulse Coupling

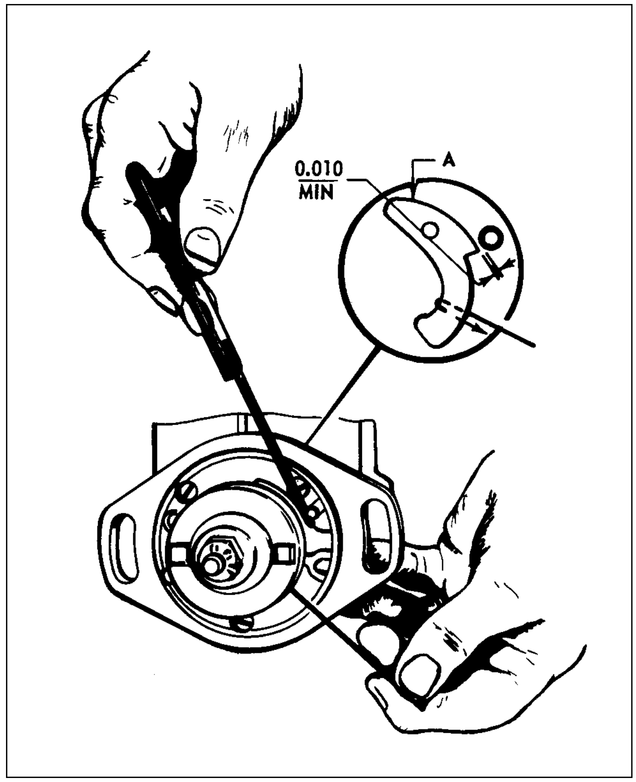


Figure 74-5. Flyweight Clearance of Impulse Coupling

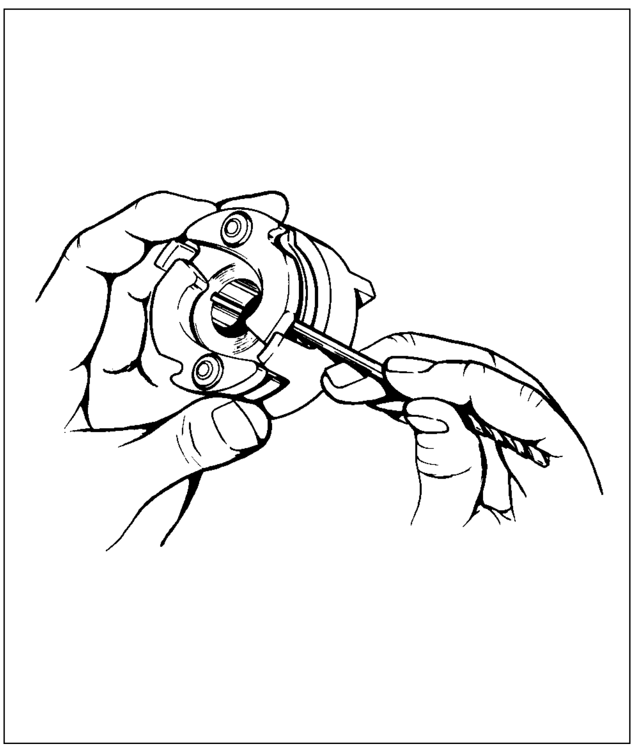


Figure 74-6. Rotor Holding Tool Installed

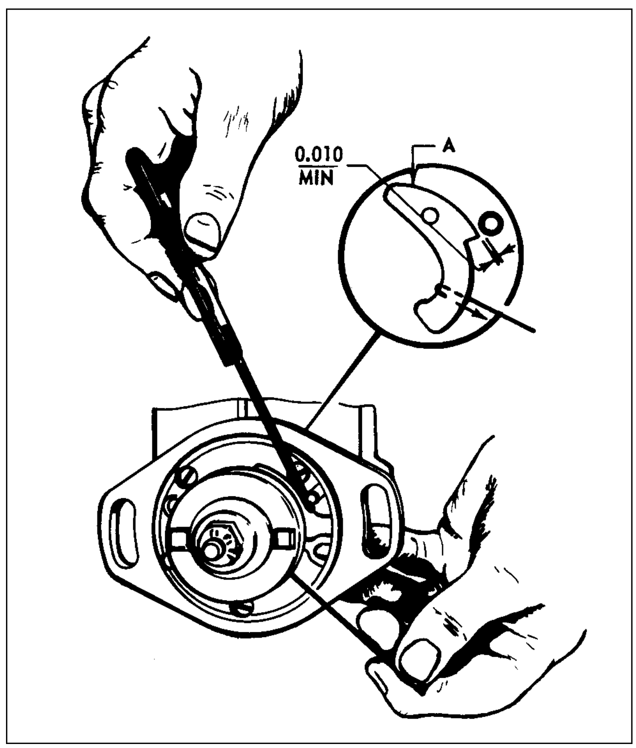


Figure 74-7. Timing Kit Installed

MAGNETO TIMING PROCEDURE. (Internal Timing)

When installing or adjusting breaker points and before timing the magneto to the engine, it is important that the internal timing of the magneto be correct. The recommended method of checking the internal timing of the magneto is to use the Bendix 11-8150 Timing Kit using the procedure described in sub-paragraph a. However, if a timing kit is not available, the cast-in timing marks in the breaker housing and a fabricated pointer may be used as described in sub-paragraph b.

1. Check the internal timing with the Bendix 11-8150 Timing Kit using the following procedure:
   A. Remove the magneto from the engine and remove the contact point cover.
   B. Loosen the nut securing the drive plate to the magneto shaft sufficiently in order to install the Bendix 11-8465 Rotor Holding Tool under the nut and flat washer as shown in Figure 74-6. Tighten the nut enough to hold the tool securely.
   C. Install the Bendix 11-8147 Plate Assembly to the breaker compartment of the magneto as shown in Figure 74-7.
   D. Remove the timing inspection plug from the top of the magneto and turn the rotating magnet in the direction of normal rotation until the painted chamfered tooth on the distributor gear is approximately in the center of the inspection window. Then turn it back until rotating magnet locates in its neutral position. Tighten adjustment knob of 11-8465 Rotor Holding Tool, holding the rotating magnet in the neutral position.

—CAUTION—

Tighten adjusting knob of rotor holding tool only enough to hold magnet shaft firmly. Do not overtighten.

   E. Install the Bendix 11-8149 Pointer Assembly on the cam screw and align pointer with the zero degree mark on the timing plate.
   F. Loosen adjusting knob of rotor holding tool and turn rotating magnet in normal direction of rotation until pointer indexes with the respective 10° mark (“E” gap). Tighten adjustment knob of rotor holding tool.
   G. With the Bendix 11-9110 Timing Light or equivalent, adjust main breaker contacts to just open at this position. Loosen holding tool and turn rotating magnet until breaker cam follower is on the high point of the cam lobe. Tighten holding tool and measure contact clearance. It must be 0.018 ± 0.006. If not, readjust breaker and recheck to be sure that contacts will open within “E” gap tolerance ±4°. Replace breaker assembly if “E” gap tolerances and contact clearance cannot be obtained.
   H. After timing is complete, tighten breaker securing screws to 20 to 25 inch-pounds and recheck settings. Remove timing kit parts.
2. The internal timing can be checked without a timing kit using the cast-in marks in the breaker compartment. These marks indicate “E” gap and limits (refer to Figure 74-8). The point in the center of the “E” gap boss indicates the exact “E” gap position. The width of the boss on either side of the point is the allowable tolerance of ±4°. In addition to these marks, the cam has an indented line across its end. When the indented line is aligned with the mark at the top of the breaker housing, the rotating magnet is in its “E” gap position. Check the timing using the following procedure:
   A. Install the Rotor Holding Tool 11-8465 under the drive shaft nut and washer as shown in Figure 74-6.

—NOTE—

The rotor holding tool facilitates the timing procedure. However, it is possible to manually hold the shaft at the specified angle when setting the breakers.

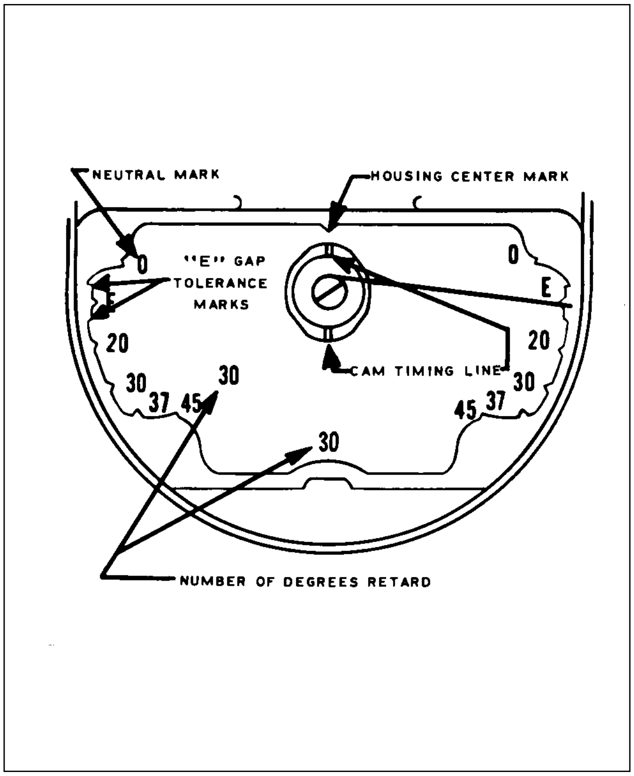


Figure 74-8. Cast-In Timing Marks

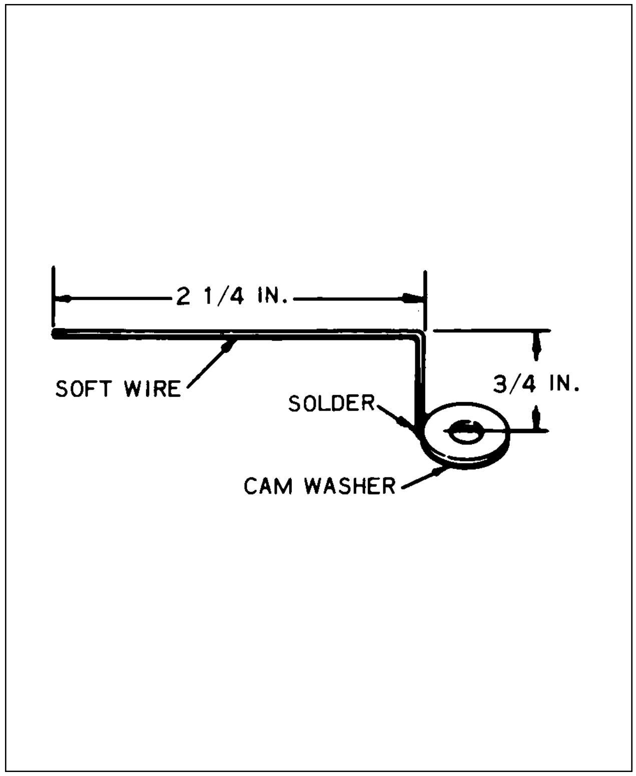


Figure 74-9. Fabricated Pointer

B. Turn rotating magnet in direction of rotation until painted chamfered tooth of distributor gear is just becoming visible in timing window. Continue turning rotating magnet until line on end of cam is aligned with mark at top of breaker housing. (Refer to Figure 74-8.) Tighten adjusting knob of the holding tool to hold rotating magnet.

C. Fabricate a pointer as shown in Figure 74-9 and install the pointer under the cam screw so the pointer indexes in the center of "E" gap position.

D. Connect the 11-9110 Timing Light or equivalent across breaker assembly. Adjust breaker contacts to just open at this position.

E. Loosen holding tool and turn rotating magnet until cam follower is on high point of cam lobe. Tighten holding tool and measure contact clearance. It must be 0.018 ± 0.006. If necessary, readjust breaker. Check to be sure contacts open within "E" gap tolerance. Replace breaker assembly if "E" gap tolerance and contact clearance cannot be obtained. Tighten breaker screws to 20 to 25 inch-pounds and recheck breaker settings.

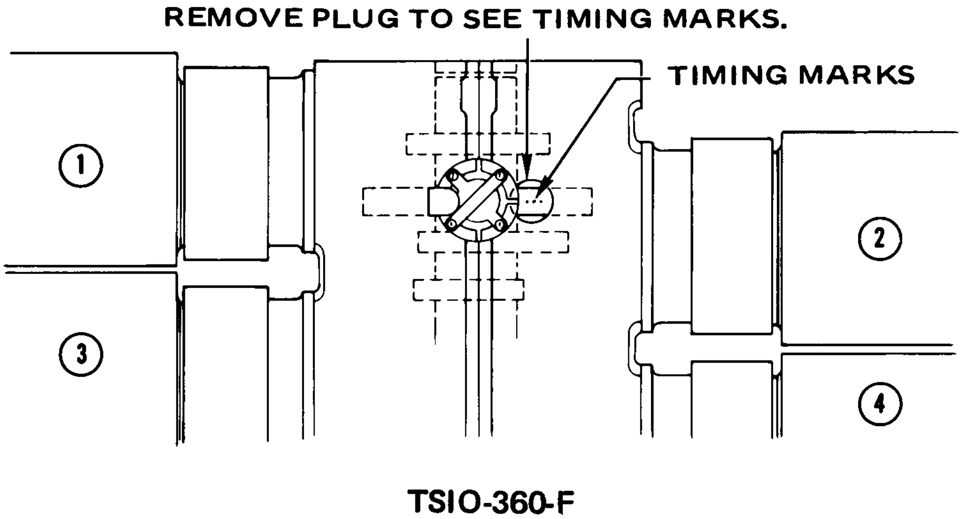


Figure 74-10. Engine Timing Marks

MAGNETO INSTALLATION AND TIMING PROCEDURE. (Magneto To Engine) (Refer to Figure 74-10)

1. The timing marks are on the outer edge of the crankshaft counterweight blade between No. 2 and No. 4 cylinders. The inspection plug between No. 2 and No. 4 cylinders on the left top side of the crankcase must be removed to view the marks on the crankshaft.
   A. Plug one spark plug hole of the No. 1 cylinder and place a thumb over the other plug hole. Have a second person stand in front of the engine and turn the crankshaft in a counterclockwise direction until pressure is felt on the thumb. No. 1 piston is coming up on the compression stroke.
   B. Remove the inspection hole plug and turn the crankshaft counterclockwise until the 20 degree BTC mark appears in the center of the inspection hole. A timing device as described in Service Bulletin M68-2, Rev. 1 may also be used.
   C. Remove the inspection hole plug from the magneto. Turn the magneto coupling until the painted chamfered tooth on the distributor gear is approximately centered in the inspection hole. Hold the magneto in its approximate installed position. Note carefully the position of the coupling drive lugs.
   D. Lubricate the gear support shaft with clean lubricating oil and install the drive gear assembly so the slots of the coupling bushings will be in the approximate position for aligning with the drive coupling lugs on the magneto.
   E. Insert the retainer into the gear hub slot. Apply a film of Lubriplate grease to each of the new rubber bushings and insert the bushings into the retainers, rounded long edges first.

F. Place a new gasket on the magneto flange. Install the magneto carefully so the drive coupling lugs mate with the slots of the drive bushings. Install and snug down the two sets of attaching screws. Do not tighten at this time.

G. Breaker point opening may be checked by use of a suitable timing light. Tap the magneto case with a non-marring hammer, counterclockwise (from the rear) to make certain the points are closed. After the timing light indicates that the points are closed, tap the magneto lightly clockwise until the points are open. Tighten the magneto attaching nuts.

H. Check timing by backing up crankshaft approximately 5 degrees and tapping gently forward until the timing light indicates opening of breaker points. If timing is correct, the 20 degree mark (midway between the 16 and 24 stamped on the crankshaft) will appear in the center of the inspection hole. The crankshaft has punch marks in 2 degree increments with 16 and 24 at each end. Tighten the magneto attachment nuts and replace the plug in the inspection hole on top of the engine.

DISTRIBUTION.

INSPECTION OF HARNESS.

1. Check the lead assemblies for nicks, cuts, mutilated braiding, badly worn section or any other evidence of physical damage. Inspect the spark plug sleeves for chafing or tears and damaged or stripped threads on coupling nuts. Check the compression spring to see if it is broken or distorted. Inspect the grommet for tears. Check all the mounting brackets and clamps to see that they are secure and not cracked.
2. Should a harness problem be suspected, integrity of the harness wiring may be checked using an ohmmeter, buzzer, or other suitable device such as the Bendix/ECD High Tension Lead Tester Kits, Part No. 11-8950 or 11-8950-1; check each lead for continuity. If continuity does not exist, harness wire is broken and must be replaced.
3. If an insulation failure is suspected, the condition of the insulation may be determined using the Bendix 11-8950 and the 11-8950-1 High Tension Lead Tester Kits manufactured by the Electrical Components Division, The Bendix Corporation, Sidney, New York.
4. Test Unit Preparation:
   A. Install two “C” cells in the battery holder in accordance with correct position.
   B. Check that red and black leads are open-circuited.
   C. Depress PRESS-TO-TEST push-button switch.
   D. Insure INDICATOR lamp flashes and GAP fires intermittently as long as PRESS-TO-TEST switch is depressed.
   E. Interconnect both red and black high voltage leads and again depress PRESS-TO-TEST switch. INDICATOR lamp only should flash. GAP does not fire.
   F. Disconnect black and red leads.
5. Insulation Test:
   A. Attach clip of red high voltage test lead to ignition harness lead terminal.
   B. Attach black test lead clip to lead ferrule.
   C. Depress PRESS-TO-TEST push-button switch.
   D. Observe that INDICATOR lamp flashes and GAP fires intermittently as long as PRESS-TO-TEST switch is held depressed.
   E. Whenever INDICATOR lamp flashes and GAP fails to fire, lead under test is defective.

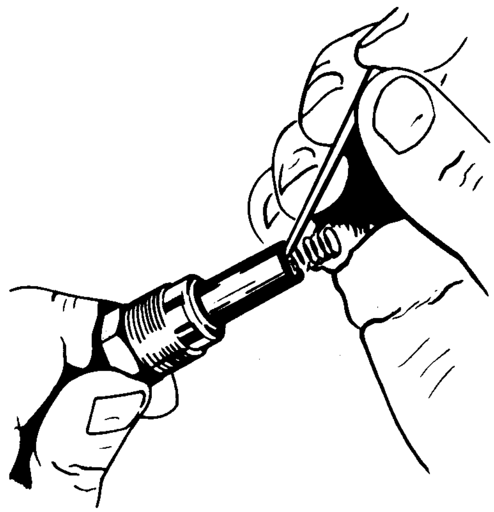


Figure 74-11. Removing Spring From Lead Assembly

F. When testing leads which are installed on an engine, it may be found that distributed capacitance causes the tester to reject good leads if the tester and red test lead are allowed to lay in close physical contact with the engine parts. For best results, keep the tester and the red high voltage lead well clear of the grounded metal parts of the engine.

G. On some engines, leakage through the magneto distributor to the magneto coil may occur if the distributor finger electrode is lined up with the lead under test. If this occurs, the tester will indicate a rejection. Before final rejection of a lead which has one end connected to the magneto, turn the engine slightly and repeat test to confirm the reading.

6. A second acceptable method for performing an insulation check is with a high voltage, direct current tester such as the TAKK Model 86 or 86A or an equivalent direct current tester capable of delivering a test potential of 10,000 volts. Connect ground lead of high voltage tester to outer shielding braid of a single lead. Connect plug terminal. Turn tester ON and apply 10,000 volts. The insulation resistance should be 100 megohms minimum. Proceed to check other leads of harness in the same manner.

REMOVAL OF HARNESS.

1. Disconnect the clamps that secure the wires to the engine and accessories.
2. Loosen the coupling nuts at the spark plugs and remove the insulators from the spark plug barrel well. Use caution when withdrawing the insulator so that the insulator spring will not be damaged.
3. Place a guard over the harness insulators.
4. Remove the harness assembly terminal plate from the magneto.
5. Remove the harness from the airplane.

MAINTENANCE OF HARNESS.

1. To replace contact springs, spring retainer assemblies or insulating sleeves, proceed as follows:
   A. Using a Bendix 11-7073 Needle or a mechanical pencil with the lead retracted, hook the end of the contact spring as shown in Figure 74-11.
   B. Using the needle or pencil, unscrew the spring.
   C. Slide the insulating sleeve and spring retainer assembly off the end of the lead assembly.
   D. Replace the defective component and reassemble as follows:
      (1) Fabricate a tool as shown in Figure 74-12 for installing the insulating sleeves over the cable terminals.
      (2) Push the tool through insulating sleeve and spring retainer assembly as shown in Figure 74-13. Screw the cable terminal into the tool.
      (3) Work the insulating sleeve and spring retainer assembly into position over the cable and unscrew the tool. Install the contact spring on the cable terminal.

—NOTE—

It may be necessary to lubricate the cable and insulating sleeve with a thin film of Dow-Corning 200 (200,000 centi-stokes) or commercial grade alcohol to facilitate assembly.

2. To replace one of the lead assemblies, proceed as follows:
   A. Remove the clamps and brackets from the applicable lead assembly. Cut the cable ties from the assembly and discard them.
   B. Cut off the condemned lead flush with the outer surface of the cable outlet plate.
   C. Grip the eyelet of the lead with a pair of pliers and pull the short length of conductor out of grommet and cable outlet plate.
   D. Using a 3 inch long, 0.270 of an inch diameter drift applied at outer surface of plate, drive out tapered ferrule and remaining pieces of insulation and shielding.
   E. To determine what length the new lead assembly should be cut to, proceed as follows:
      (1) Measure the length of the condemned lead assembly. Move the coupling nut back on the lead assembly and measure from the outer end of the ferrule at the spark plug end. (Refer to Figure 74-14.)

—NOTE—

Spare part leads are supplied in various lengths Use a lead which is longer than, but nearest to, the desired length.

   F. Cut the lead assembly to the length determined in Step E. Mark the ferrule on the spark plug end of the lead with a metal stamp, scribe or rubber stamp to correspond with the correct cylinder number.
   G. Starting at the spark plug location, thread the new cable through the grommets and clamps as necessary for the correct routing of the cut end of the cable to the magneto location.
   H. Remove the cable outlet plate from the magneto. Support the plate securely and using suitable cutting pliers, split and remove the eyelets from the leads adjacent to the lead being replaced. When splitting the eyelet, make certain that the wire strands are not cut. Removal of eyelets on adjacent leads will allow the grommet to be pulled away from the outlet plate to facilitate insertion of the new lead.

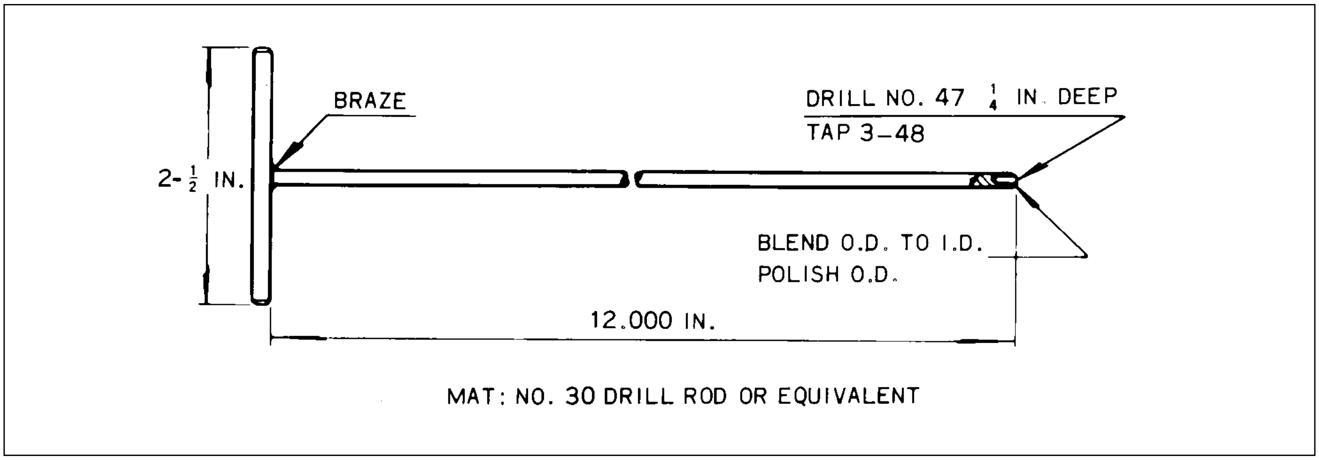


Figure 74-12. Assembly Tool

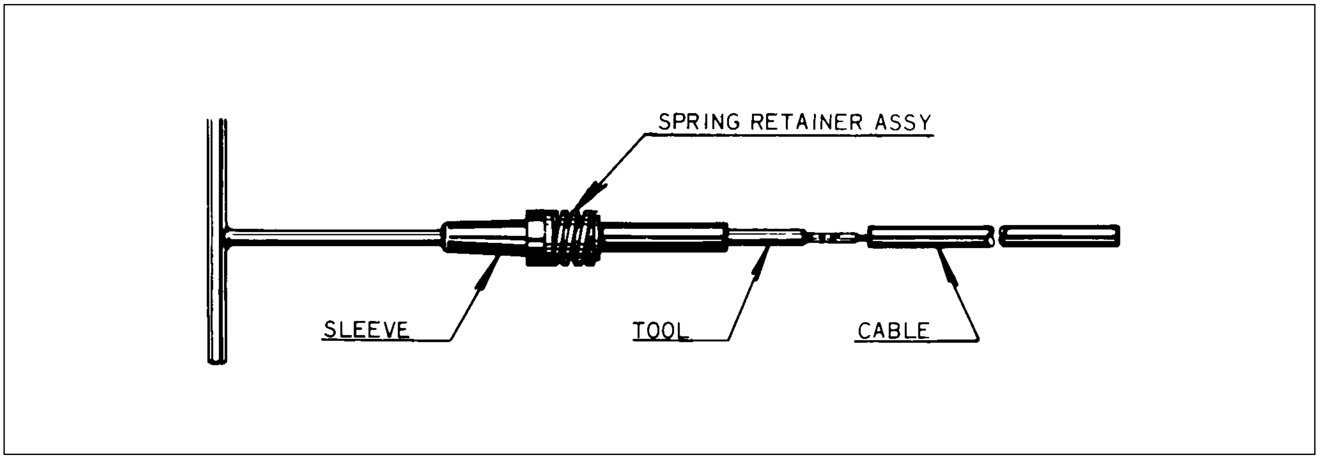


Figure 74-13. Assembly Tool Application

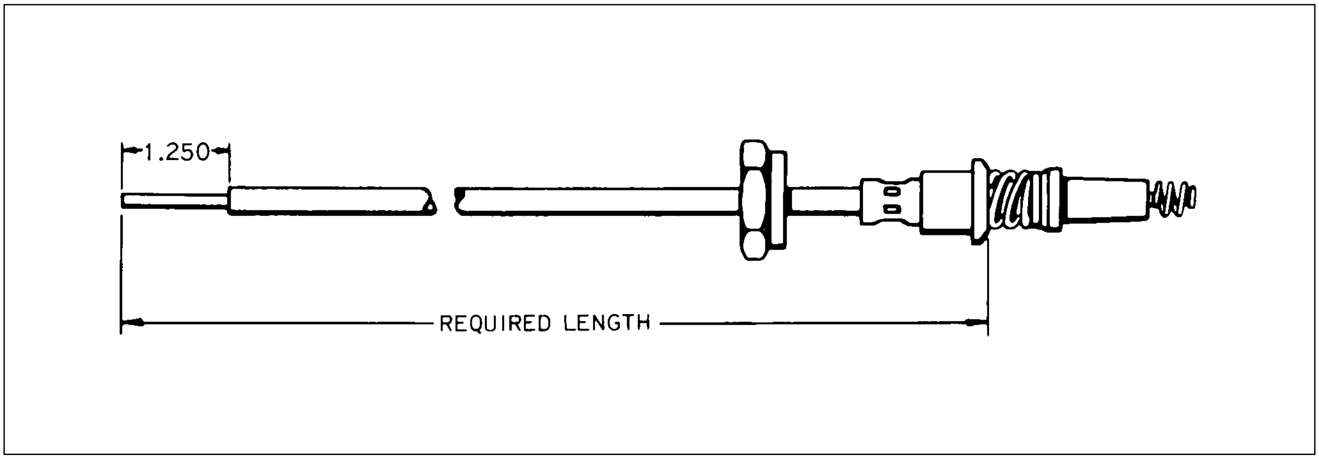


Figure 74-14. Measuring Lead Assembly Length

I. Assemble the lead to the cable outlet plate following the procedure in Steps J through Q.

—CAUTION—

Insure before every cutting or stripping procedure that braid has not worked back on lead by grasping lead in one hand and sliding the other hand firmly along lead toward the outlet plate. If braid is improperly located on lead, the lead may be trimmed to the wrong length.

J. Pass the lead through the proper hole in outlet plate. Position the Bendix 11-9596 or equivalent Braid Cutting Backup Tube between the braided shielding and insulation to protect the insulation. Cut enough braid from the lead to have 1-1/4 inch of insulation extending from end of braid.

—CAUTION—

Be sure the cutting backup tube is completely under the point at which the cut is to be made to prevent cutting or nicking insulation.

K. Slide inner ferrule under the braid. The braid should cover approximately two-thirds of the ferrule taper. Remove the blue silicone coating from the end of the braid over ferrule by lightly scraping with a knife or wire brush.

—CAUTION—

When removing silicone coating, care should be taken not to damage the braided wire shielding.

L. Pull the lead assembly back through cable outlet plate until cleaned braid binds in the outlet well. Position the Bendix 11-7074 Ferrule Seating Tool (Figure 74-15) over the insulation and firmly seat the ferrule by tapping the seating tool with a hammer or by using an arbor press.
M. Measure 1/2 inch from tapered ferrule and strip remaining insulation from wire. (Refer to Figure 74-16.)
N. Inset Bendix 11-7073 Needle (Figure 74-17) through the small hole of the grommet and over the stripped end of the wire. (Refer to Figure 74-18.) Slide grommet down needle until it seats tightly against the tapered ferrule.
O. Cut the wire 3/8 inch from the top of the grommet outlet. (See Figure 74-19.) Double the wire over as shown in A of Figure 74-20. Slide the eyelet over the doubled wire until it is firmly seated in the recess of the grommet outlet.
P. Using a suitable crimping tool or equivalent, crimp the eyelet to the wire. Approximately 1/32 inch of wire should extend from the end of the eyelet after crimping. See B of Figure 74-20.

—NOTE—

If the crimping tool is not available, a satisfactory connection can be made by soldering with Kester Flux 709 or equivalent and a noncorrosive solder. After soldering, clean solder joints using denatured alcohol.

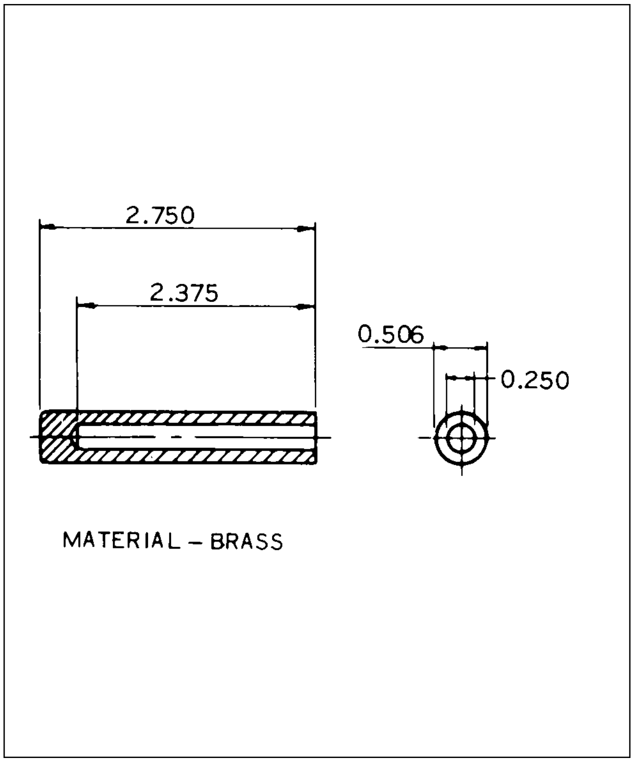


Figure 74-15. Ferrule Seating Tool

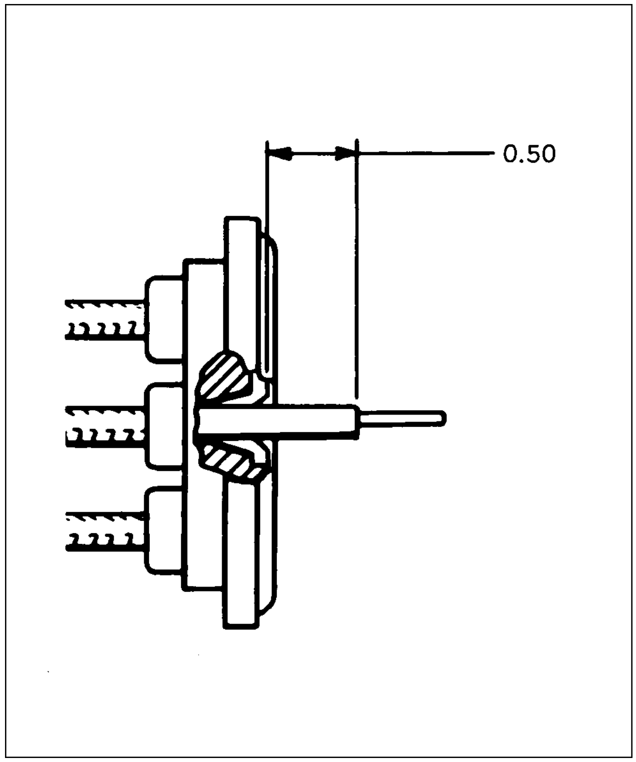


Figure 74-16. Measuring Wire From Top of Ferrule

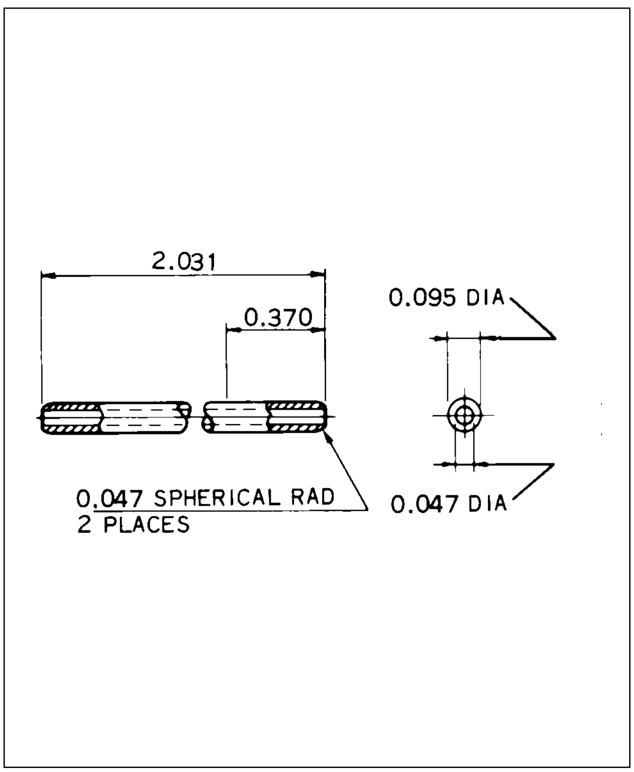


Figure 74-17. Needle

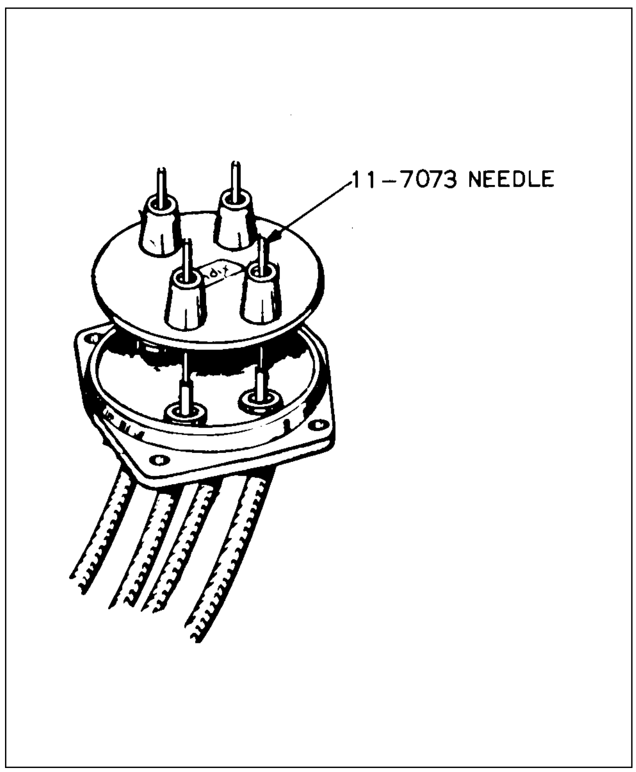


Figure 74-18. Installing Grommet Over Lead Assemblies

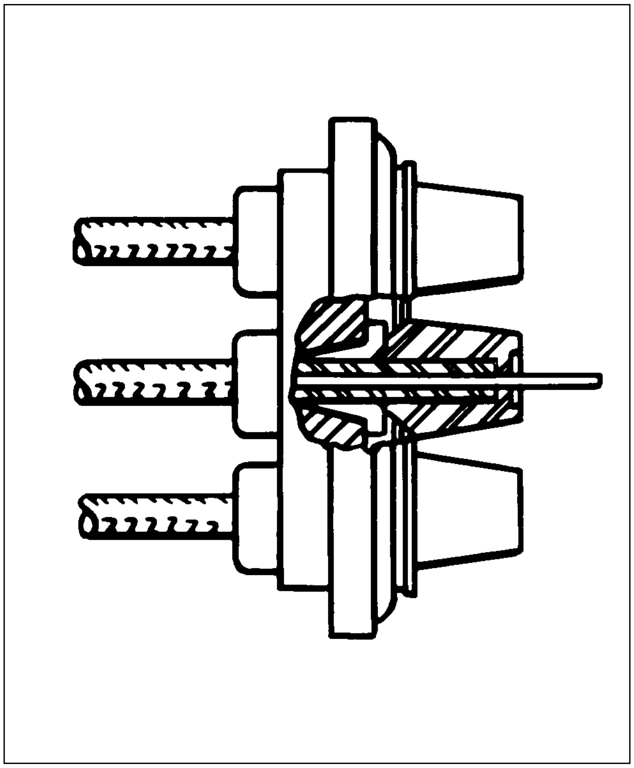


Figure 74-19. Lead Assembly Installed in Grommet

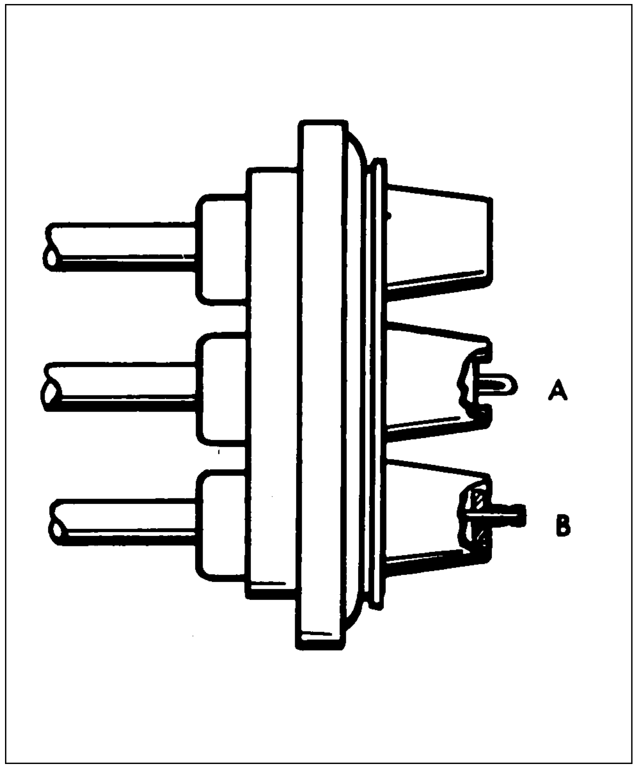


Figure 74-20. Wire Doubled Over For Installation of Eyelet

Q. Install the clamps and cable ties, as necessary, to secure the lead to the engine.

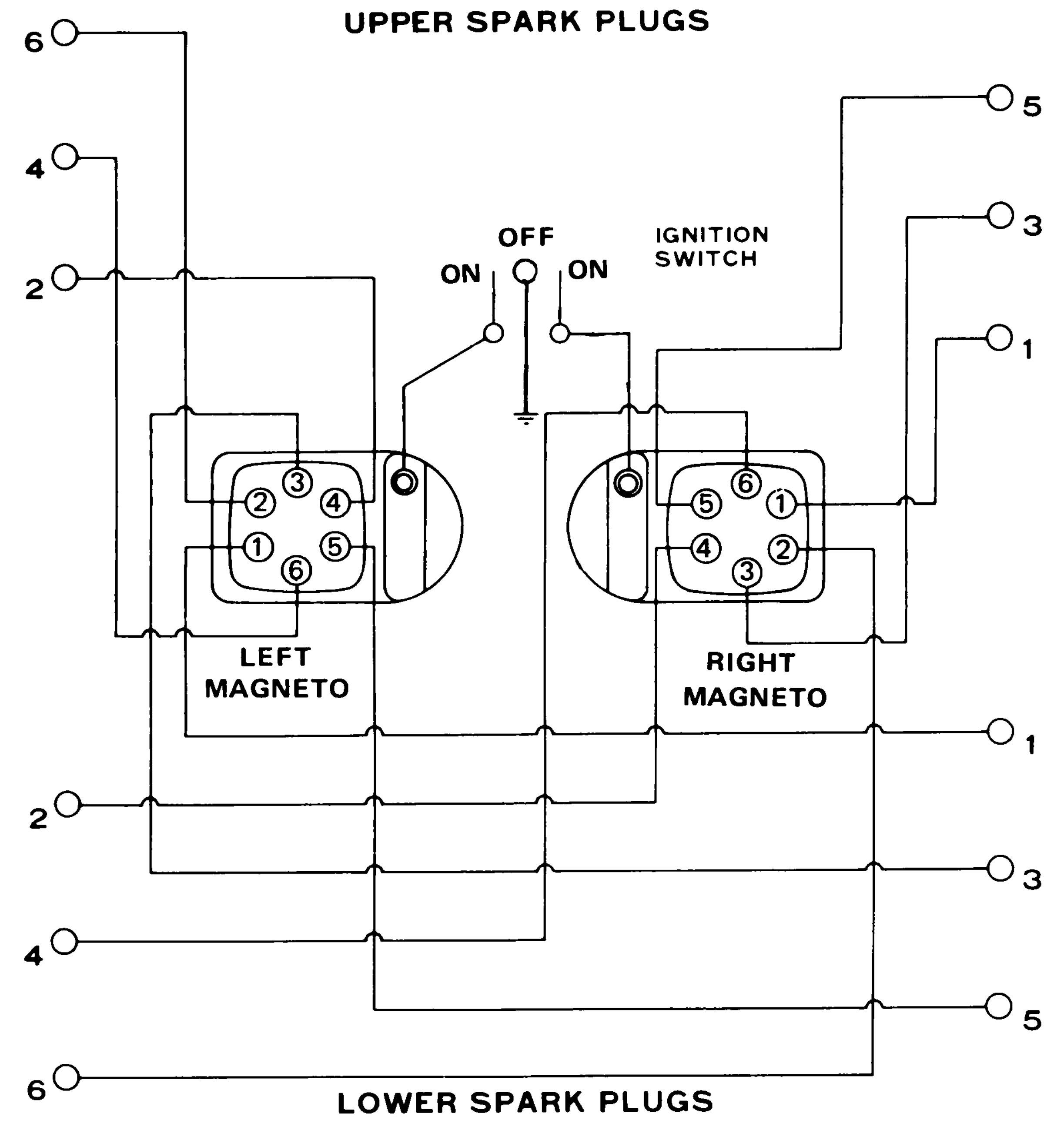
—CAUTION—

Leads should be dressed away from hot spots, such as manifolds and sharp edges which cause chafing.

INSTALLATION OF HARNESS.

Before installing the harness plate on the magneto, check the mating surfaces for cleanliness. Spray the entire face of the grommet with a light coat of Plastic Mold Spray, SM-O-O-TH Silicone Spray or equivalent. This will prevent the harness grommet from sticking to the magneto distributor block.

1. Place the harness terminal plate on the magneto and tighten the nuts around the plate alternately to seat the cover squarely on the magneto. Torque the nuts to 18 to 22 inch-pounds.
2. Route the ignition wires to their respective cylinders as shown in Figure 74-21.
3. Clamp the harness assembly in position.
4. Connect the leads to the spark plugs.



ENGINE FIRING ORDER	1	6	3	2	5	4
MAGNETO FIRING ORDER	1	2	3	4	5	6

Figure 74-21. Ignition Schematic

SPARK PLUGS.

REMOVAL OF SPARK PLUGS.

1. Loosen the coupling nut on the harness lead and remove the terminal insulator from the spark plug barrel well. (A crows foot adapter is needed to remove the lower spark plugs.)

—NOTE—

When withdrawing the ignition cable lead connection from the plug, care must be taken to pull the lead straight out and in line with the center line of the plug barrel; otherwise, a side load will be applied which frequently results in damage to the barrel insulator and connector. If the lead cannot be removed easily in this manner, the resisting contact between the neoprene collar and the barrel insulator will be broken by a rotary twisting of the collar. Avoid undue distortion of the collar and possible side loading of the barrel insulator.

2. Remove the spark plug from the engine. In the course of engine operation, carbon and other combustion products will be deposited on the end of the spark plug and will penetrate the lower threads to some degree. As a result, greater torque is frequently required for removing a plug than for its installation. Accordingly, the torque limitations given do not apply to plug removal, and sufficient torque must be used to unscrew the plug. The higher torque in removal is not as detrimental as in installation, since it cannot stretch the threaded section. It does, however, impose a shearing load on this section and may, if sufficiently severe, produce a failure in this section.

—NOTE—

Torque indicating handle should not be used for spark plug removal because of the greater torque requirement.

3. Place spark plugs in a tray that will identify their position in the engine as soon as they are removed.

—NOTE—

Spark plugs should not be used if they have been dropped.

4. Removal of seized spark plugs in the cylinder may be accomplished by application of liquid carbon dioxide by a conical metal funnel adapter with a hole at the apex just large enough to accommodate the funnel of a CO2 bottle. (Refer to Figure 74-22.) When a seized spark plug cannot be removed by normal means, the funnel adapter is placed over and around the spark plug. Place the funnel of the CO2 bottle inside the funnel adapter and release the carbon dioxide to chill and contract the spark plug. Break the spark plug loose with a wrench. A warm cylinder head at the time the carbon dioxide is applied will aid in the removal of an excessively seized plug.
5. Do not allow foreign objects to enter the spark plug hole.

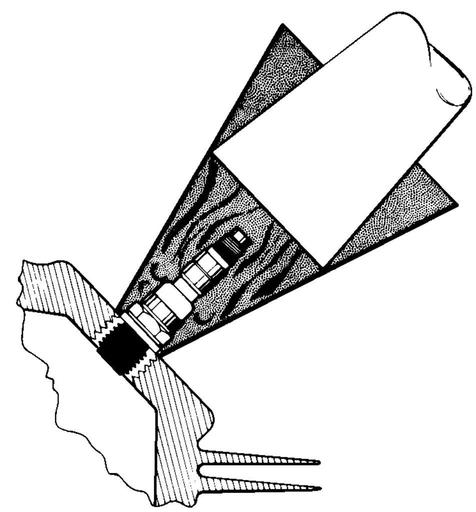


Figure 74-22. Removing Frozen Spark Plug

INSPECTION AND CLEANING OF SPARK PLUGS.

1. Visually inspect each spark plug for the following non-repairable defects:
   A. Severely damaged shell or shield threads nicked up, stripped or cross-threaded.
   B. Badly battered or rounded shell hexagons.
   C. Out-of-round or damaged shielding barrel.
   D. Chipped, cracked or broken ceramic insulator portions.
   E. Badly eroded electrodes worn to approximately 50% of original size.
2. Clean the spark plugs as required, removing carbon and foreign deposits.
3. Set the electrode at .015 to .018 inches.
4. Test the spark plug both electrically and for resistance.

INSTALLATION OF SPARK PLUGS.

Before installing spark plugs, ascertain that the threads within the cylinder are clean and not damaged.

1. Apply anti-seize compound sparingly on the threads and install gasket and spark plugs. Torque 360 to 420 inch-pounds.

—CAUTION—

Make certain the deep socket is properly seated on the spark plug hexagon as damage to the plug could result if the wrench is cocked to one side when pressure is applied.

2. Carefully insert the terminal insulator in the spark plug and tighten the coupling unit.

SWITCHING.

REMOVAL OF IGNITION SWITCH.

1. Insure the ignition switch is in the OFF position.
2. Gain access to and disconnect the power lead (+) from the battery.
3. Remove the ignition switch retaining nut from the switch on the forward side of the instrument panel and withdraw the switch from the panel.
4. Mark the wires and note their position on the switch then disconnect the wires.

INSTALLATION OF IGNITION SWITCH. (Refer to Figure 74-23.)

1. Attach wires to switch as shown in Figure 74-23.
2. Position the ignition switch in the instrument panel and secure with retaining nut.
3. Connect the power lead (+) to the battery and reinstall any access covers previously removed.

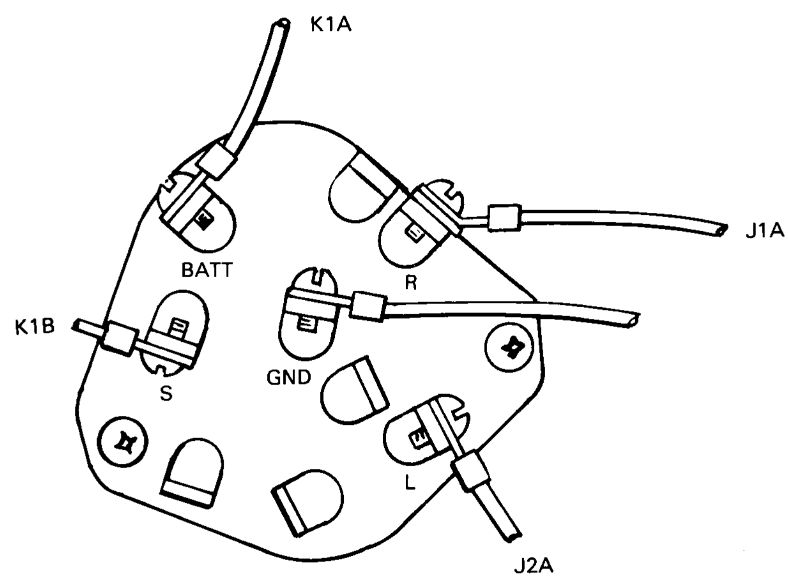


Figure 74-23. Ignition Switch Wire Positions

CHAPTER

76

ENGINE CONTROLS

CHAPTER 76 - ENGINE CONTROLS

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

Those controls that operate the engine are the throttle, propeller, and mixture controls. For more information pertaining to running in of the engine see the specific chapter.

POWER CONTROL.

RIGGING OF THROTTLE CONTROL. (Refer to Figure 76-1.)

1. Place the quadrant throttle lever full forward.
2. With the control arm on the fuel-air control unit in the full throttle position, rig the throttle quadrant lever to provide a minimum of .032 inches clearance from the forward stop. With the control arm at the idle stop, the quadrant throttle lever must have a minimum clearance of .032 inches from the aft stop.

RIGGING OF PROPELLER CONTROL. (Refer to Figure 76-1.)

1. Place the propeller control lever full forward.
2. With the propeller governor control arm in the low pitch (high RPM) position, rig the quadrant control lever to provide .047/.032 inches clearance from the forward stop.

RIGGING OF MIXTURE CONTROL. (Refer to Figure 76-1.)

1. Place the mixture control lever full forward.
2. With the mixture control arm on the engine fuel pump in the full rich position, rig the quadrant mixture lever to provide a minimum of .032 inches clearance from the forward stop.
3. With the mixture control arm at idle cut-off, the quadrant mixture lever must have a minimum of .032 inches clearance from the aft stop.

ENGINE SETUP PROCEDURES. The following procedures should be used to check and adjust the power plant to maintain the required operating limits and insure obtaining good setup results. It is important that the following leak check be made before proceeding with any actual system adjustments.

1. Leak Check - Gauge Lines:
   A. Disconnect the manifold pressure, deck pressure, and fuel pressure lines on the forward side of the rear engine baffle.
   B. Connect surgical tubing to the fuel flow (deck pressure) bulkhead fitting and evacuate the line until a 10 gallon per hour (maximum) positive indication on the fuel flow gauge is obtained. Clamp off the tubing and observe the gauge for a steady reading. Any change of this reading would indicate a leak in the system, which must be repaired prior to continuing with the setup procedures.

—NOTE—

A static system test unit can be used to leak check these lines.

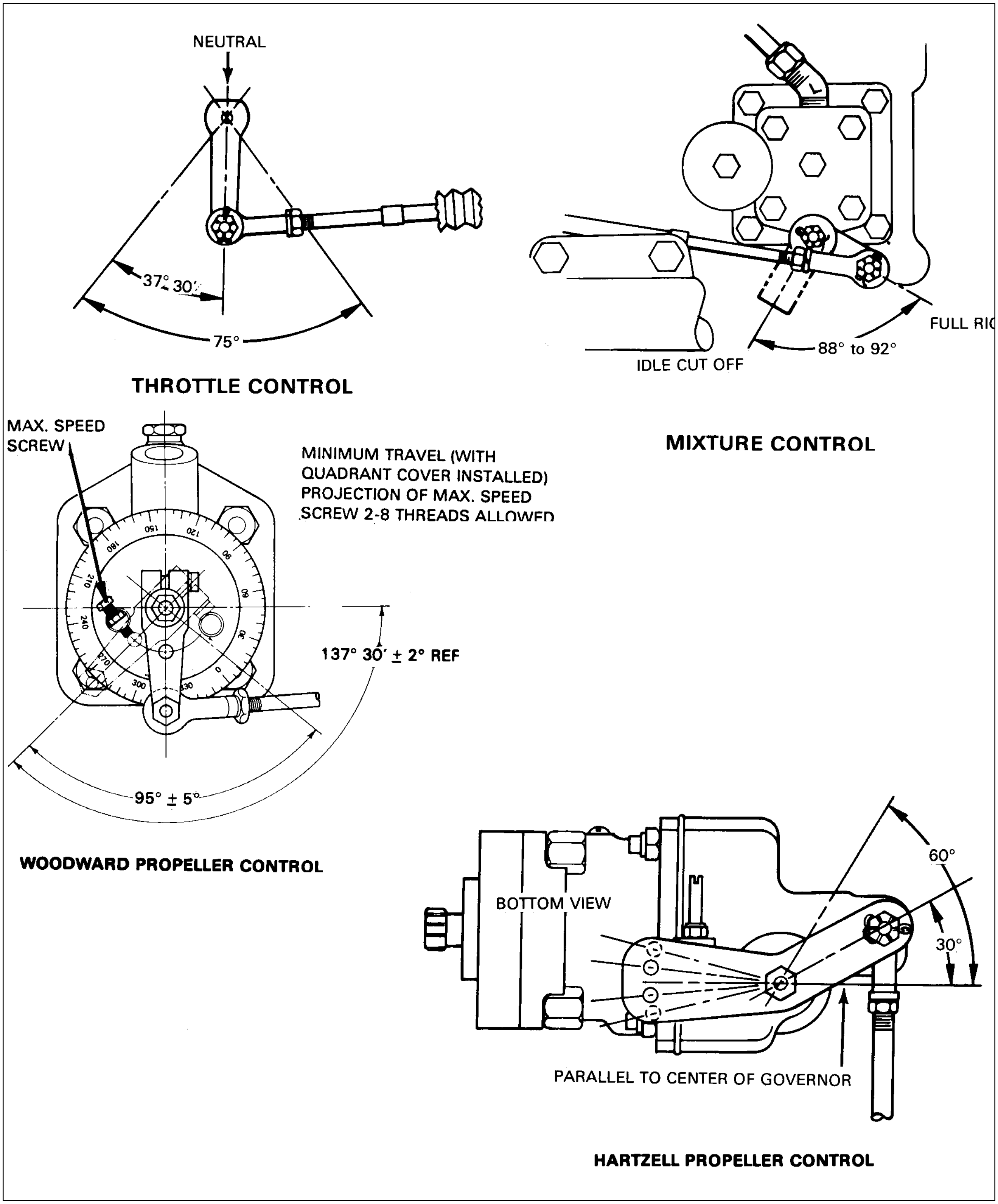


Figure 76-1. Engine Controls

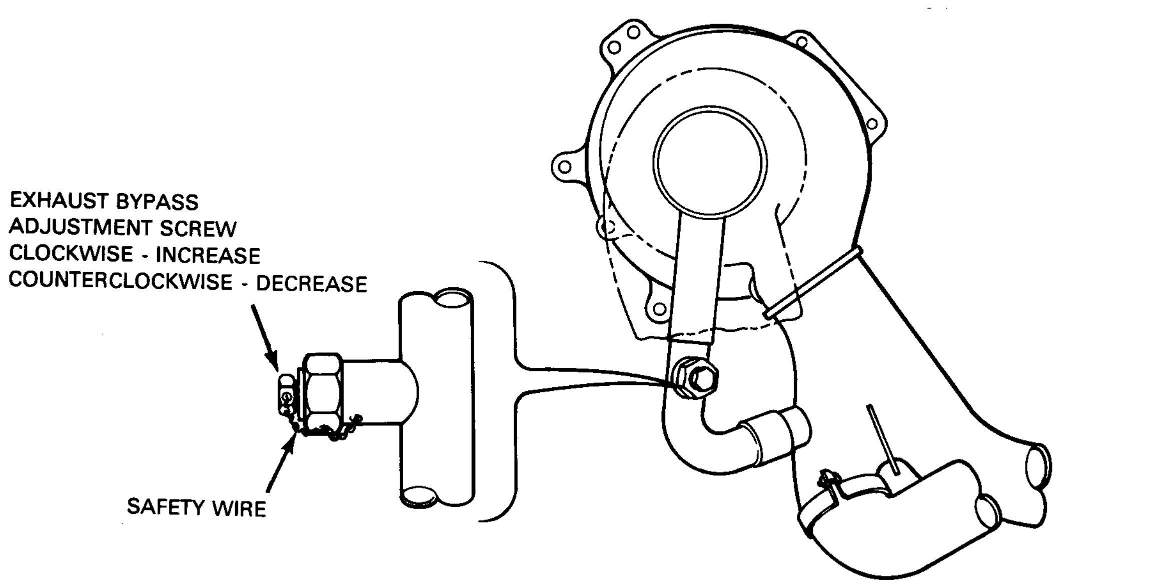


Figure 76-2. Exhaust Bypass Screw

C. Check the fuel pressure and manifold pressure lines in the same manner as given in Step B, except apply positive pressure to the lines. Do not exceed 4 pounds per square inch (psi) on the fuel pressure gauge, or 4 inches of mercury (In. Hg) increase on the manifold pressure gauge.
D. Visually inspect manifold pressure, deck pressure and fuel pressure lines forward of the engine rear baffle for general condition which could cause leakage. Check all “B” nuts for tightness.
E. Reconnect the manifold pressure, fuel flow and fuel pressure lines at the bulkhead fitting.
F. Disconnect the main fuel supply line to the engine driven fuel pump, at the rear engine baffle and using the auxiliary fuel pump, pump out approximately one quart of gasoline; then reconnect the line.
G. Using the electric fuel boost pump, purge the air from the fuel flow gauge line at the back of the instrument; then reconnect the line.

2. Exhaust Bypass Check: Ascertain that the exhaust bypass adjusting screw has from eight to nine threads showing below the jam nut. This screw is preset at the factory and should not require any adjustment, unless it is known that critical altitude is not correct; in this case, use procedure given in Step 11. (Refer to Figure 76-2.)

3. Idle Performance Check:

—NOTE—

It is extremely important that the engine be thoroughly warmed up. However, excessive engine temperatures must be avoided since setup temperature must closely parallel temperatures in flight.

   A. Remove the cap from the tee fitting on the right side of the throttle body. (Refer to Figure 76-3.)
   B. Install a 0-60 psig calibrated pressure gauge (vented to the atmosphere) to the tee, using a suitable length of flexible tube. The gauge should always be at the same lever as the fuel manifold valve when checking fuel pressure.
   C. Purge the air from the tube.

—CAUTION—

During all engine operations outlined in these instructions, exercise CAUTION to avoid harm or damage to personnel and equipment by propeller blast and rotating propeller blades.

4. Check and Adjustment of Idle Fuel Pressure:

—NOTE—

The following setup procedure is accomplished with the boost pump OFF and the engine thoroughly warmed up.

   A. Back off the idle speed adjusting screw two turns. (Refer to Figure 76-3.)
   B. Start engine and warm-up at 1500 to 1800 RPM until the oil pressure is in the green arc, cylinder head temperature is in the lower one-quarter of the green arc, and the oil temperature is 160° to 180° F.
   C. While maintaining 700 ± 25 RPM, set the idle fuel pressure at 6.5 ± 0.25 psi by adjusting the idle pump adjustment screw (refer to Figure 76-4, Item 6); clockwise adjustment increases pressure; counterclockwise adjustment decreases pressure.

5. Check and Adjustment of Idle Mixture: (Refer to Figure 76-3.)
   A. Operate the engine at 1500 to 1800 RPM until cylinder head temperature is in the lower one-quarter of the green arc, and the oil temperature is 160° to 180°F.
   B. Reduce the engine speed and stabilize it at 700 ± 25 RPM.
   C. Slowly, but positively, move the mixture control from the full rich position to the idle cut-off. The engine speed should increase 75 to 100 RPM before beginning to drop toward zero (upper cowling removed).
   D. If the engine increase is less than 75 RPM, adjust the idle mixture adjustment to enrich the mixture (counterclockwise). If the engine speed increase is more than 100 RPM, adjust the idle mixture to lean the mixture (clockwise). Recheck the adjustment as outlined in Step C, to insure the idle mixture is adjusted within limits specified.

6. Check and Adjustment of Idle Speed: (Refer to Figure 76-3.)
   A. With the idle fuel pressure and idle mixture set in accordance with instructions given in Steps 4 and 5, cylinder head temperature in the lower one-quarter of the green arc, and oil temperature at 160° to 180°F, set engine speed at 700 ± 25 RPM.
   B. Adjust the idle speed adjusting screw until contact is made with the throttle arm stop.

—NOTE—

After final adjustment, recheck the idle fuel pressure, mixture and speed to ascertain that all are within specifications given in previous steps.

7. Check and Adjustment for Full Power Performance: (Refer to Figure 76-4.)

—CAUTION—

Before attempting full power checks, be sure that the brakes are properly maintained and set, and that the ground conditions will not permit the wheels to slip during full power check.

—NOTE—

Fuel flows are given for sea level density altitude.

   A. Set the engine at 40.8 to 41.0 in. Hg manifold pressure (overboost light activated) and engine at 2575 ± 25 RPM. Readjust the throttle as required to maintain 40.8 to 41.0 in. Hg manifold.
   B. Fuel flow should be 23.0 to 23.5 gallons per hour (gph), with the mixture controls in the full rich position.
   C. If adjustment is required, loosen the jam nut on the adjusting screw located on the aneroid housing of the fuel pump. (Refer to Figure 76-4, Item 2.) Clockwise adjustment decreases fuel flow reading; counterclockwise adjustment increases fuel flow reading; one full turn will cause a 1.0 to 1.5 gph change. Use CAUTION when loosening and tightening the jam nut so as not to change settings or over torque the jam nut.

—NOTE—

If other than minor adjustments are required to the fuel flow, a complete investigation of interface systems is required.

8. Rechecking System:
   A. Recheck the idle settings per instructions 3, 4, 5 and 6 and adjust as required.
   B. Recheck Full Power Fuel Flow settings per instruction 7, and adjust as required.
   C. With engine operating at 2575 RPM (40.8 to 41.0 in. Hg manifold pressure), lean the mixture to obtain 21 gph fuel flow readings. The unmetered fuel pressure on the calibrated pressure gauge should be 40 to 43 psi.
   D. With engines operating at 2575 RPM and 40.8 to 41.0 in. Hg manifold pressure, mixture control full rich, reduce RPM and increase throttle until throttle is open; 41.0 in. Hg manifold pressure should be obtained at approximately 2225 ± 25 RPM.

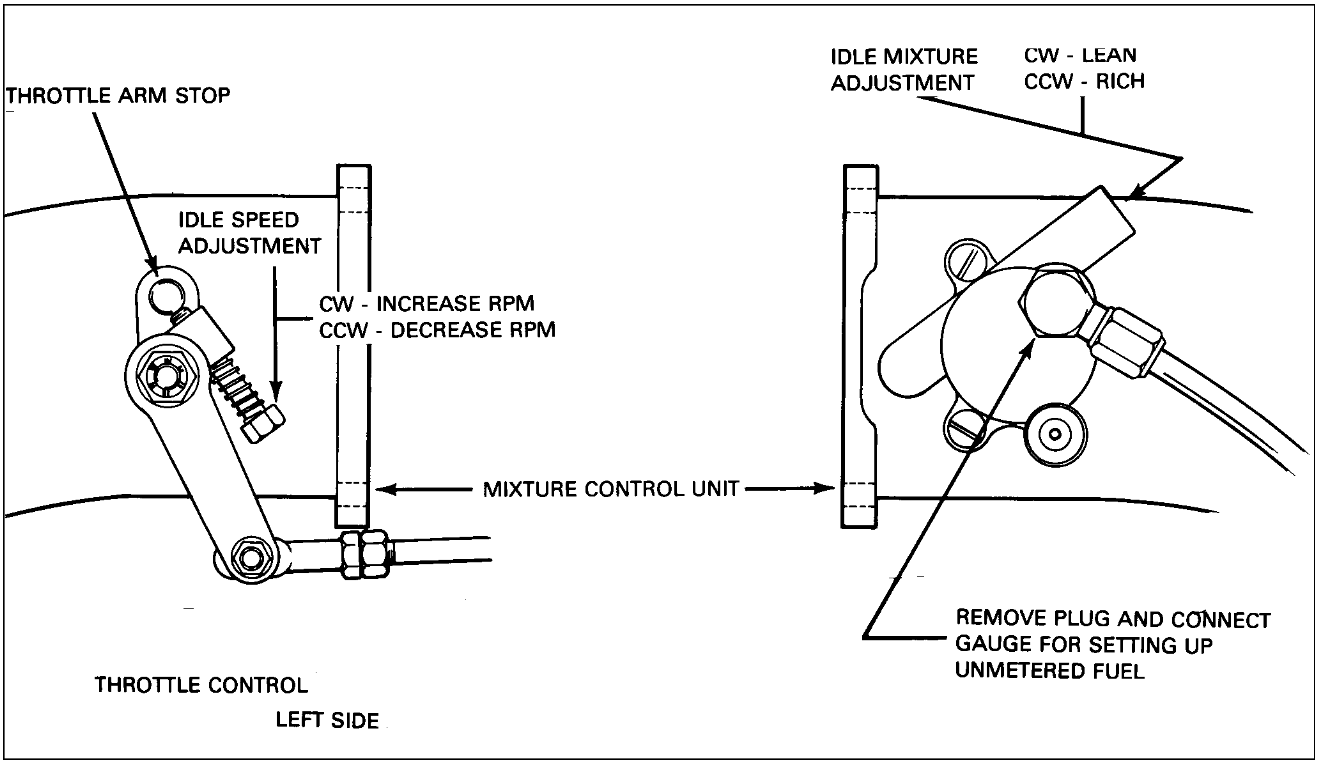


Figure 76-3. Idle Speed and Mixture Adjustment Points

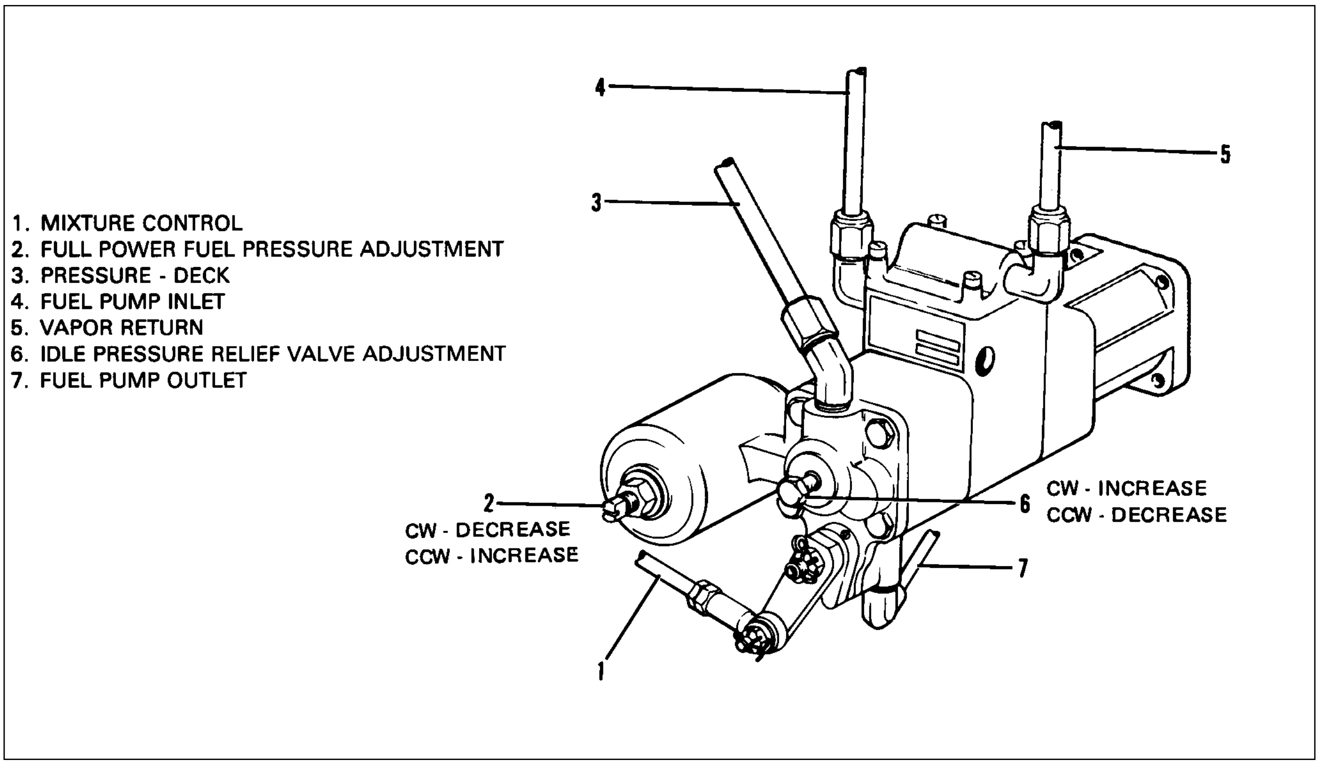


Figure 76-4. Sectional View of Altitude Compensating Fuel Pump Assembly

9. Remove the test equipment; safety wire the exhaust bypass screw and check nut to the bypass screw housing; reinstall the cap on the tee of the throttle body housing.
10. The accuracy of the cockpit fuel flow gauge at maximum power can be checked against a calibrated gauge by connecting the calibrated gauge at the manifold valve and maintaining the gauge on the same level as the valve while checking pressures and using Chart 7601.

—NOTE—

The calibrated gauge fuel line must be purged of air, and the reference side of the calibrated gauge vented to turbo discharge pressure.

11. Flight Test: (Refer to Chart 7602.) A complete flight test should be made for final adjustments of fuel flow and bypass valve. The following steps should be followed:
    A. At 8,000 feet density altitude, set the engine to operate at 2450 ± 25 RPM and 33.0 to 34.0 in. Hg manifold pressure.
    B. Lean the engine to 25°F rich of peak exhaust gas temperature (EGT).
    C. Fuel flow at these conditions should be 12.0 ± 0.5 gph.
    D. With full rich mixture, full throttle, 2575 + 0 -25 RPM, and 91 KTS. airspeed, the manifold pressure should decrease until the overboost light goes off (40.8 to 41.0 in. Hg), at some point between 11,500 feet minimum, 12,500 feet maximum density altitude. This point is known as the "critical altitude." At this point the fuel flow should be 22.0 to 24.0 gph indicated.
    E. If a discrepancy in critical altitude was noted, adjust the exhaust bypass valve. (Turning the exhaust bypass valve screw in one full turn will increase the critical altitude approximately 1,000 feet.) Adjustments of critical altitude in excess of 500 feet may require retrimming of the fuel flows at 100% power.
    F. With full rich mixture, 2575 RPM, 91 KTS. airspeed, and 1,000 to 3,000 feet density altitude, check the operation of the manifold pressure relief valve. Slowly advance throttle to the wide open position. The manifold pressure shall stabilize between 42.0 and 44.0 in. Hg; there shall be no loss of power, and the fuel flow indication shall be well over the red line. Do not exceed 41.0 in. Hg manifold pressure for more than ten seconds.

—NOTE—

Idle speed and idle mixture indication is a function of engine temperatures. Therefore, at normal ground idle temperatures (cylinder and oil temperature indications may or may not be "in the green") idle speed will be approximately 700 RPM, and the idle mixture check will result in a 25 to 50 RPM increase in engine speed.

CHART 7601. METERED FUEL ASSEMBLY CALIBRATION

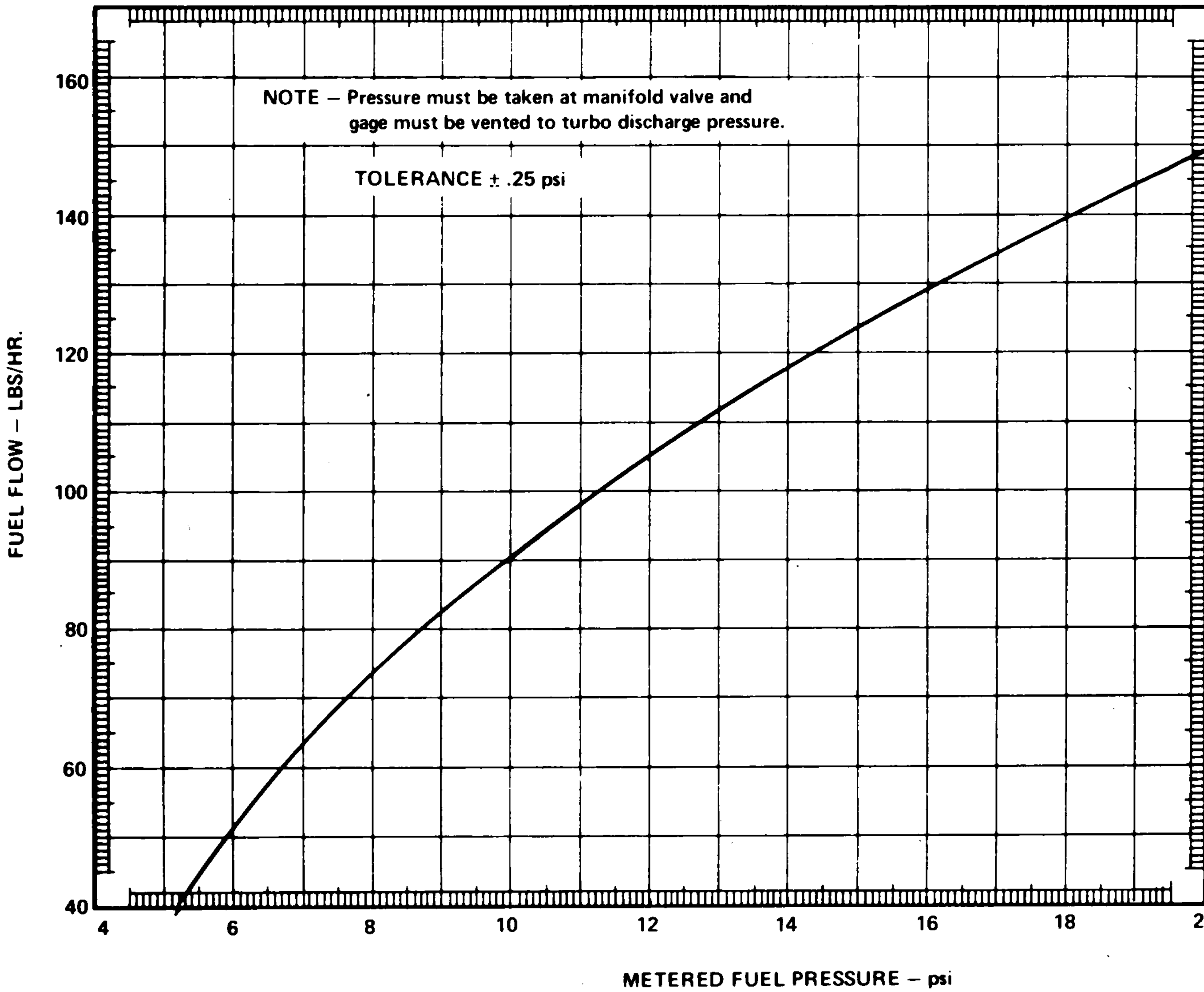
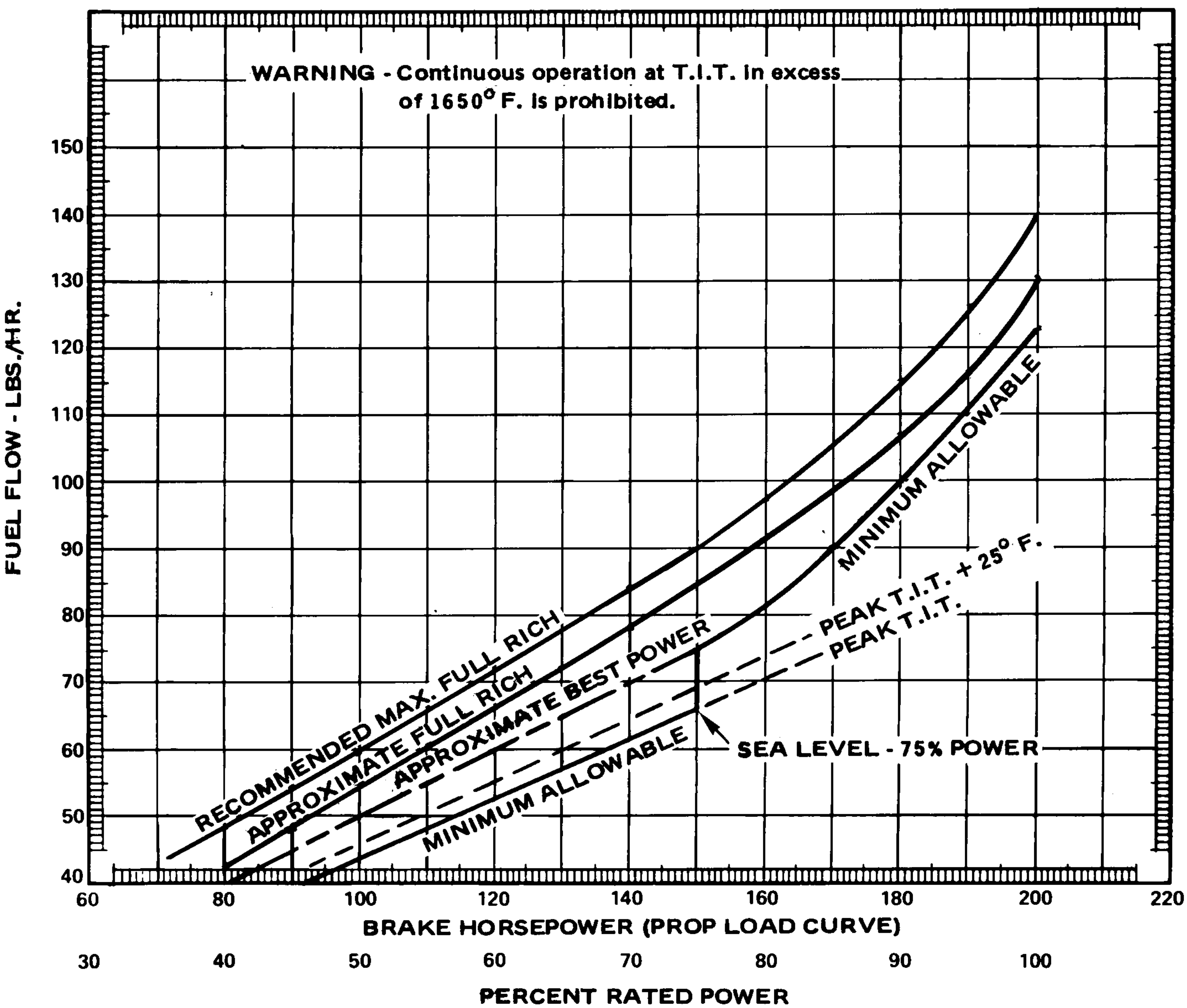


CHART 7602. LIMITS - FUEL FLOW VS. BRAKE H.P.



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CHAPTER

77

ENGINE INDICATING

CHAPTER 77 - ENGINE INDICATING

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

POWER.

MANIFOLD PRESSURE GAUGE.

The manifold pressure gauge is a vapor proof, absolute pressure type instrument. Pressure from the intake manifold of the engine is transmitted to the instrument through a line. A pointer indicates the manifold pressure available at the engine in inches of mercury.

TROUBLESHOOTING. (Refer to Chart 7701.)

CHART 7701. TROUBLESHOOTING (MANIFOLD PRESSURE INDICATOR)

Trouble	Cause	Remedy
Excessive error at existing barometric pressure.	Pointer shifted.	Replace instruments.
Excessive error when engine is running.	Line leaking.	Tighten line connections.
Sluggish or jerky pointer movement.	Defective instrument.	Replace instrument.
Dull or discolored marking.	Age.	Replace instrument.
Incorrect reading.	Moisture or oil in line.	Disconnect lines and blow out.

REMOVAL AND REPLACEMENT. (Refer to Chapter 39.)

TACHOMETER INDICATOR.

The tachometer is connected to the engine accessory by a flexible cable and provides an indication of crankshaft speed in revolutions per minute. The instrument has a recording mechanism for recording the time that the engine is in actual operation.

TROUBLESHOOTING. (Refer to Chart 7702.)

CHART 7702. TROUBLESHOOTING (TACHOMETER)

Trouble	Cause	Remedy
No reading on indicator either permanent or intermittent.	Broken shaft.	Replace instrument.
	Loose cable connections.	Tighten cable.
Pointer oscillates excessively.	Rough spot on, or sharp bend in shaft.	Repair or replace.
	Excessive friction in instrument.	Replace instrument.
Indicator changes in climb.	Excessive clearance in speed cup.	Replace instrument.
Pointer goes all the way to stop, more noticeable in cold weather.	Excessive lubricant in instruments.	Replace instruments.
Pointer jumps at idle.	Speed cup hitting rotating magnet.	Replace instrument.
Tachometer cable breaks.	Cable bent too sharply.	Reroute cable.

REMOVAL AND REPLACEMENT. (Refer to Chapter 39.)

CYLINDER HEAD TEMPERATURE GAUGE.

The cylinder head temperature gauge is in the instrument cluster, located on the instrument panel. This instrument measures the cylinder head temperature using a sender located in a cylinder head. The head location is determined by the engine manufacturer. It is an electrical instrument and is wired through the instruments circuit breaker.

TROUBLESHOOTING. (Refer to Chart 7703.)

CHART 7703. TROUBLESHOOTING (CYLINDER HEAD TEMPERATURE GAUGE)

Trouble	Cause	Remedy
Instrument shows no indication .	Power supply wire broken.	Repair wire.
	Defective instrument.	Replace instrument.
	Master switch off.	
Instrument goes all the way to upper stop.	Wire broken between sender and gauge.	Repair wire.
	Defective sender.	Replace sender.

REMOVAL AND REPLACEMENT. (Refer to Chapter 39.)

EXHAUST GAS TEMPERATURE GAUGE.

This instrument, which is commonly referred to as EGT, is used to aid the pilot in selecting the economical fuel-air mixture for cruising flight at a power setting of 75% or less. It is a sensing device to monitor the fuel-air mixture entering the engine cylinders. This gauge is not adjustable. If it is found defective after checking with the troubleshooting chart, it should be replaced.

—CAUTION—

When replacing leads, it is very important to use the same type and length of thermocouple wire, as the resistance of the leads is critical for the proper operation of this gauge.

REMOVAL OF EGT PROBE AND GAUGE.

1. Disconnect wires from the EGT gauge at the instrument panel.
2. Remove four bolts which secure the gauge to the instrument panel and remove the gauge.
3. Remove wires from the wire harness going to the engine.
4. Loosen the nut which secures the EGT probe to the exhaust transition area of the exhaust system and remove the probe.

CLEANING AND INSPECTION.

Unless mechanical damage is evident, broken glass, bent or broken pointers, or broken case, the following checks should be performed before removing the instrument.

1. Remove the probe from the exhaust transition area and check for broken weld (at tip end) or burnt off end.
2. Disconnect the lead wires at the instrument and check for poor electrical connections.
3. With leads connected to the instrument, heat the probe with a propane torch to a dull red. The meter should show a reading. If the pointer does not move, replace the meter.

—CAUTION—

Do not connect an ohmmeter across the meter. It will burn out the movement of the meter.

INSTALLATION OF EGT PROBE AND GAUGE.

1. Install the probe into the hole in the junction of the exhaust system which just precedes the exhaust turbine wheel and secure with locknut.
2. Route the thermocouple wires along with the existing wire harness to the instrument panel.
3. Install the EGT gauge into the instrument panel and secure with four bolts.
4. Connect the thermocouple wires to the rear of the EGT gauge.

TROUBLESHOOTING. (Refer to Chart 7704.)

CHART 7704. TROUBLESHOOTING (EXHAUST GAS TEMPERATURE GAUGE)

Trouble	Cause	Remedy
Gauge inoperative.	Defective gauge, probe or wiring.	Isolate defective circuit, replace defective probe or gauge.
Fluctuating reading.	Loose, frayed or broken electrical lead.	Tighten connections, and repair or replace defective leads.

—END—

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CHAPTER

78

EXHAUST

CHAPTER 78 - EXHAUST

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

DESCRIPTION.

The exhaust system of the PA-28-201T involves a turbocharger system, located aft of the engine, connected to the two banks of cylinders by two different sets of manifolds and pipes. The pipes interconnect at a "T" collector which is connected to the inlet of the exhaust drive turbine. Connected to the outlet turbine is the exhaust stack which is also built as a heat exchanger.

COLLECTOR.

REMOVAL OF HEAT EXCHANGER - EXHAUST PIPE. (Refer to Figure 78-1.)

TAIL PIPE (EXHAUST/EXCHANGER) LEAK TEST.

This test should be conducted at each 100 or 50 hour inspection, whichever is being conducted.

1. Remove the tail pipe.
2. Plug pipe inlet, outlet, and exchanger openings with one end capable of accepting an air pressure inlet fitting.
3. Connect a low pressure air supply (about 2 psi) to the inlet fitting.

—NOTE—

Do not use a soap or harsh detergent to find leaks since they may cause harmful corrosion, and pin holes in exhaust pipe.

4. Submerge the tail pipe in water.
5. Wherever air bubbles appear check for leaks or bad connections.
6. Remove exchanger cover and test in the same manner.
7. Repair or replace any fixture that leaks.
8. Upon completion of repairs, or receipt of new fixtures, complete a retest of the tail pipe.
9. Before reinstallation, ascertain all parts are dry.

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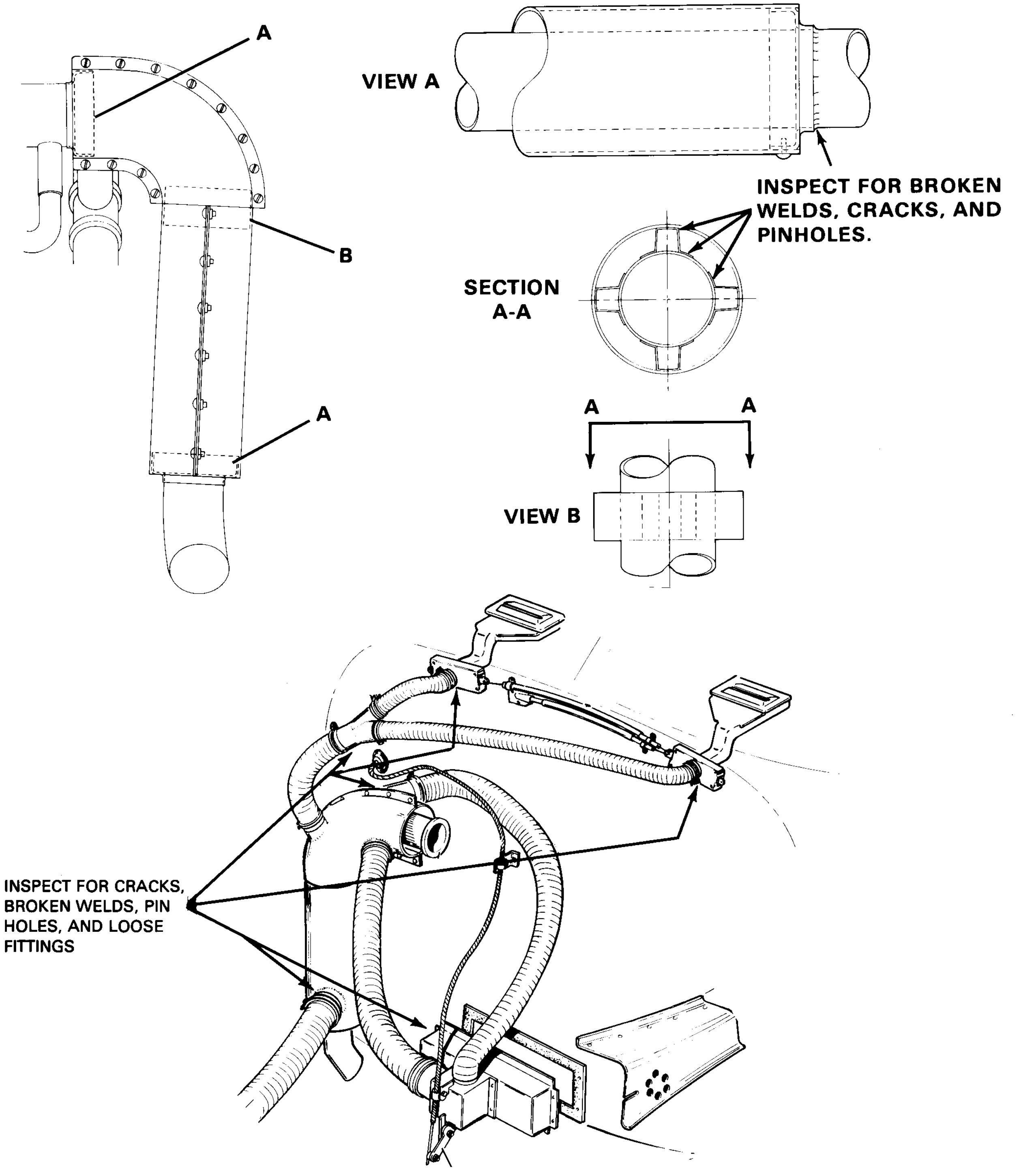

Figure 78-1. Tail Pipe (Exhaust/Exchanger) Inspection

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CHAPTER

79

OIL SYSTEM

CHAPTER 79 - OIL SYSTEM

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

DESCRIPTION.

The oil system is a wet sump, force feed system with a capacity of 8 quarts. A conventional dipstick is provided for determining the oil quantity.

When the engine is running, oil is drawn through a screen and pick-up tube which extends from the sump to a port in the crankcase. Oil then flows to the inlet of the gear type, engine driven oil pump and is forced under pressure through the pump outlet. A pressure relief valve prevents excessive oil pressure by allowing excess oil to be returned to the sump. After leaving the pump, the oil under pressure enters a full flow filter and is passed onto the oil cooler. If the filter element becomes blocked, a bypass relief valve will open to permit unfiltered oil to flow to the engine. An oil temperature control unit allows oil to bypass the oil cooler when the oil is cold. Some oil flows through the cooler to prevent congealing in cold weather. When the oil temperature reaches approximately 170° F, the oil temperature control unit actuates to close off the cooler bypass forcing the oil to flow through the cooler.

From the oil cooler oil enters the crankcase where it is directed to the bearing surfaces and other engine components requiring lubrication and cooling. The propeller governor boost engine oil pressure for operation of the propeller. A tap in the side of the crankcase supplies oil pressure for lubrication of the turbocharger bearings. Oil is carried to the turbocharger through an external line. After lubricating the turbocharger bearings it is drawn into a scavenge pump and forced back to the oil sump. Oil within the engine drains, by gravity, back into the sump.

OIL FILTER REPLACEMENT.

Refer to Chapter 12 for detailed information.

—NOTE—

For specific instructions dealing with the removal and installation of engine mounted indicating sensors, refer to the Continental Overhaul Manual.

INDICATING.

—NOTE—

For removal and installation of the following gauges, refer to Chapter 39.

ENGINE OIL PRESSURE.

The oil pressure gauge is mounted in a cluster arrangement on the instrument panel. The gauge is connected directly to the oil system through the turbocharger.

TROUBLESHOOTING OIL PRESSURE.

Troubleshooting solutions may be found in Chart 7901.

CHART 7901. TROUBLESHOOTING (ENGINE OIL PRESSURE GAUGE)

Trouble	Cause	Remedy
Excessive error at zero.	Pointer loose on shaft. Over-pressure or seasoning of bourdon tube.	Replace instrument.
Excessive scale error.	Improper calibration adjustment.	Replace instrument.
Excessive pointer oscillation.	Air in line or rough engine relief.	Disconnect line and fill with light oil. Check for leaks. If trouble persists, clean and adjust relief valve.
Sluggish operation of pointer or pressure fails to build up.	Engine relief valve open.	Clean and check.

ENGINE OIL TEMPERATURE.

The oil temperature indicator is mounted in the instrument cluster on the panel. This instrument provides temperature indications of the engine oil in degrees Fahrenheit. The temperature bulb sender is mounted in the top of the mounting flange of the oil cooler.

TROUBLESHOOTING OIL TEMPERATURE.

Troubleshooting solutions may be found in Chart 7902.

CHART 7902. TROUBLESHOOTING (OIL TEMPERATURE INDICATORS)

Trouble	Cause	Remedy
Instrument fails to show any reading.	Broken damaged bulb. Wiring open.	Check engine unit and wiring to instrument.
Excessive scale error.	Improper calibration adjustment.	Repair or replace.
Pointer fails to move as engine is warmed up.	Broken or damaged bulb or open wiring.	Check engine unit and wiring.
Dull or discolored marking.	Age.	Replace instrument.

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CHAPTER

80

STARTING

CHAPTER 80 - STARTING

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

DESCRIPTION AND OPERATION.

The starting motor consists of five major components: the commutator end head assembly, the brush set and plate assembly, the frame and field assembly, the armature, and the drive end head assembly. (Refer to Figure 80-1.)

When the starting circuit is energized, battery current is applied to the starting motor terminal. Current flows through the field coils, creating a strong magnetic field. At the same time, current flows through the brushes to the commutator, through the armature windings to ground. The magnetic force created in the armature combined with that created in the field windings begins to turn the armature.

TROUBLESHOOTING.

CHART 8001. TROUBLESHOOTING (STARTER)

Trouble	Cause	Remedy
Starter fails to operate.	Low battery charge.	Check and recharge if necessary.
	Defective or improper wiring or loose connections.	Refer to electrical wiring diagram and check all wiring.
	Defective starter solenoid or control switch.	Replace faulty unit.
	Dirty commutator.	If commutator is rough or dirty, smooth and polish with number 000 sandpaper. If too rough and pitted, remove and turn down. Blow out all particles.
	Shorted, grounded, or open armature.	Remove and replace with an armature known to be in good condition.
	Grounded or open field circuit.	Test, repair if possible or replace with a new part.

CHART 8001. TROUBLESHOOTING (STARTER) (CONT.)

Trouble	Cause	Remedy
Low motor and cranking speed.	Worn, rough, or improperly lubricated motor or starter gearing.	Disassemble, clean, inspect, and relubricate, replacing ball bearings if worn.
	Same electrical causes as listed under ‘“Motor fails to operate.”	Same remedies listed for these troubles.
Excessive arcing of motor brushes.	Binding, worn, or improperly seated brush or brushes with excessive side play.	See information above dealing with this trouble.
	Dirty commutator, rough pitted or scored.	Clean as outlined above.
Excessive wear and arcing of motor brushes.	Rough or scored commutator.	Remove and turn commutator down on a lathe.
	Armature assembly not concentric.	Reface commutator.

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CRANKING.

MAINTENANCE OF STARTING SYSTEM.

The starting circuit should be inspected at regular intervals, the frequency of which should be determined by the amount of service and the conditions under which the aircraft is operated. It is recommended that such inspection be made at each 100 hours and include the following:

1. The battery should be checked with a hydrometer to be sure it is fully charged and filled to the proper level with approved water. A load test should be made to determine battery condition. If dirt and corrosion have accumulated on the battery, it should be cleaned with a solution of baking soda and water. Be sure none of the solution enters the battery cells.
2. The starting circuit wiring should be inspected to be sure that all connections are clean and tight and that the insulation is sound. A voltage loss test should be made to locate any high-resistance connections that would affect starting motor efficiency. This test is made with a low-reading voltmeter while cranking the engine or at approximately 100 amperes, and the following limits should be used:
   A. Voltage loss from insulated battery post to starting motor terminal 0.3 volt maximum.
   B. Voltage loss from battery ground post to starter frame 0.1 volt maximum.

—NOTE—

If voltage loss is greater than the above limits, additional tests should be made over each part of the circuit to locate the high resistance connections.

3. On PA-28-201T airplanes no lubrication is required on the starting motor except at the time of overhaul. Soak new absorbent bronze bearings in SAE 20 oil before installation. Saturate the felt oiling pad in the commutator end head with SAE 20 oil. Allow excess oil to drain out before installing end head on motor. Put a light film of Lubriplate 777 on the drive end of the armature shaft before and after installing the drive end head.
4. The starting motor should be operated for a few seconds with the ignition switch off. This is to determine that the starter engages properly and that it turns freely without binding or excessive noise. Start the engine two or three times to check the starter drive assembly.

OVERHAUL OF STARTING MOTOR.

If during the above inspection any indication of starting motor difficulty is noted, the starting motor should be removed from the engine for cleaning and repair.

REMOVAL OF STARTING MOTOR.

To remove the starting motor from the engine, first disconnect the ground cable from the battery post to prevent short circuiting. Disconnect the lead from the starting motor terminal, then take out the mounting bolts. The motor can then be lifted off and taken to the bench for overhaul.

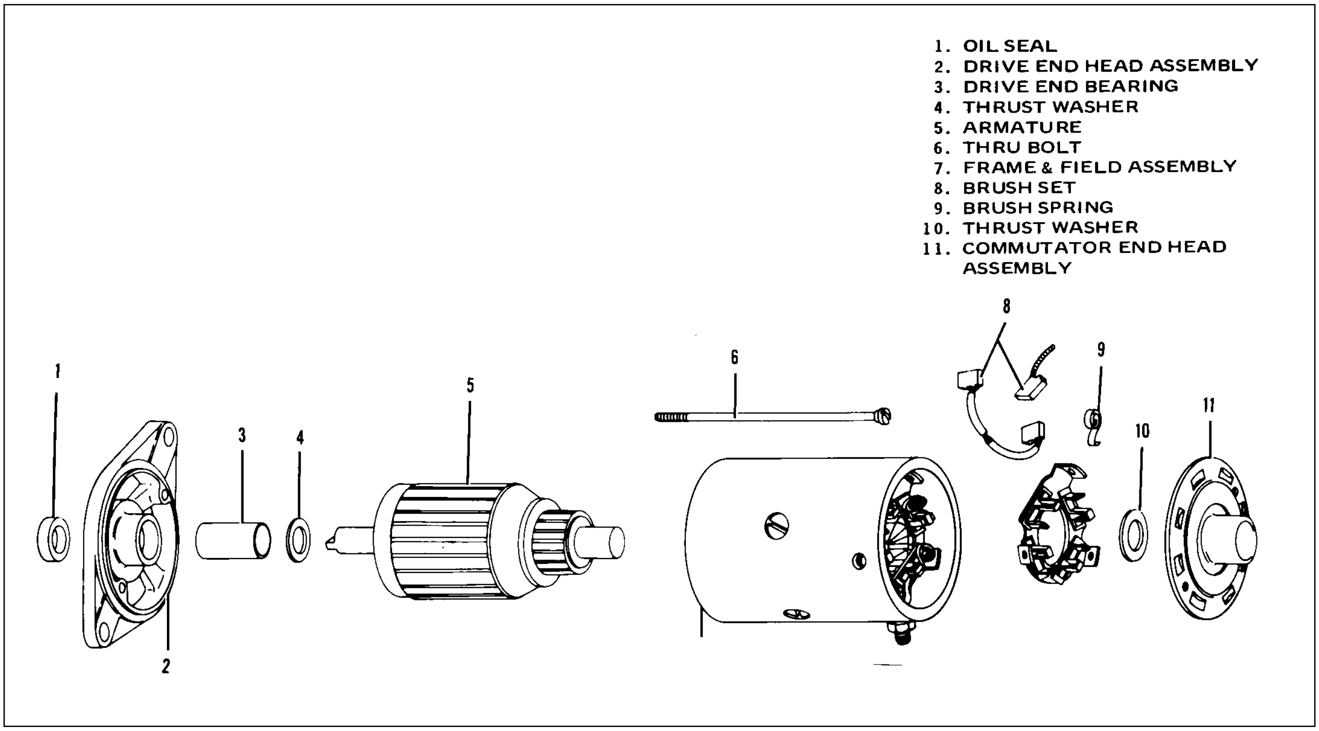

Figure 80-1. Exploded View of Starting Motor

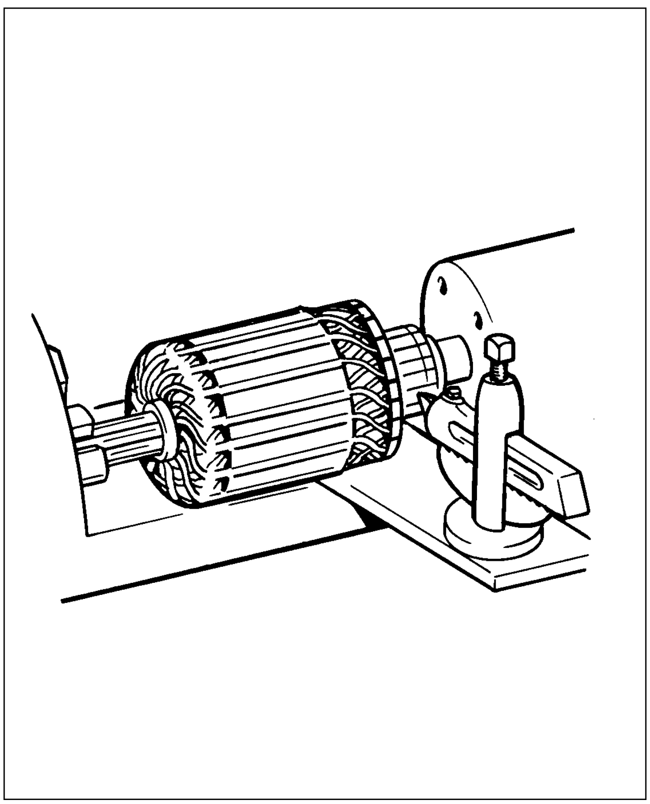

Figure 80-2. Turning Motor Commutator

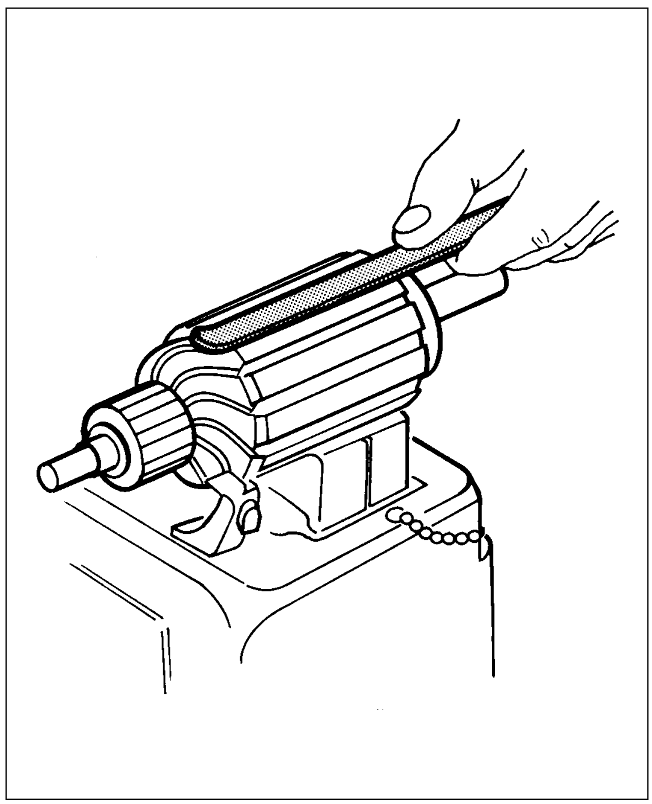

Figure 80-3. Testing Motor Armature for Shorts

DISASSEMBLY OF STARTING MOTOR.

1. Remove the safety wire and thru bolts from the commutator end and pull the end head from the frame.
2. Pull the drive end head and armature from the frame and separate the drive end from the armature.
3. The drive end bearing may be removed by pressing out of the drive end head.
4. Each part should be cleaned and inspected for excessive wear or damage. Bearing should be checked for proper clearance and evidence of roughness or galling. Oil and dirt should be removed from insulation and the condition of the insulation checked.

BRUSHES.

Check the brushes to see that they slide freely in their holders and make full contact on the commutator. If worn to half their original length or less, they should be replaced.

ARMATURE.

1. Check the commutator for uneven wear, excessive glazing or evidence of excessive arcing. If only slightly dirty, glazed or discolored, the commutator can be cleaned with 00 or 000 sandpaper. If the commutator is rough or worn, it should be turned in a lathe. (Refer to Figure 80-2.) The armature shaft should be inspected for rough bearing surfaces and rough or damaged splines.
2. To test the armature for grounds, a set of test probes connected in series with a 110-volt light should be used. Touch one probe to a commutator segment and the other to the armature core. If the test lamp lights, the armature is grounded and should be replaced.
3. To test for shorted armature coils, a growler is used. (Refer to Figure 80-3.) The armature is placed on the growler and slowly rotated by hand while a steep strip is held over the core so that it passes over each armature core slot. If a coil is shorted, the steep strip will vibrate.
4. A quick check for open circuits can be made by inspecting the trailing edge (in direction of rotation) of the commutator segments for excessive discoloration. This condition indicates an open circuit.

FIELD COILS.

1. Check the field coils for grounds (refer to Figure 80-4) by placing one test probe on the frame and the other on the starter terminal. Be sure the brushes are not accidentally touching the frame. If the lamp lights, the fields are grounded. Repair or replace.
2. Inspect all connections to make sure they are clean and tight and inspect insulation for deterioration.

BRUSH HOLDERS.

1. To test brushes, touch one test probe to the brush plate and the other to each brush holder.
2. The test lamp should light when the grounded brush holders are touched and should not light when the insulated brush holders are touched.

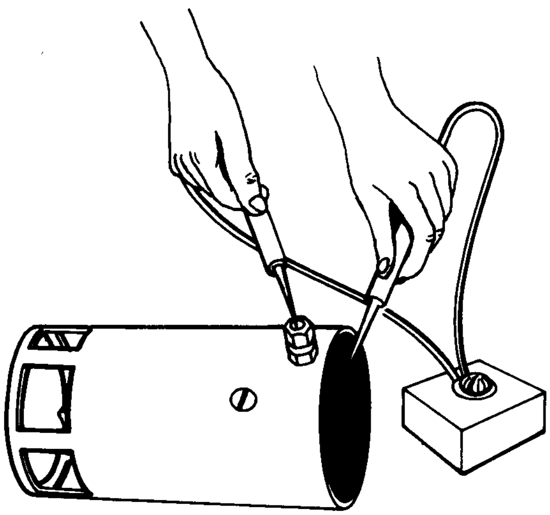

Figure 80-4. Testing Motor Fields for Grounds

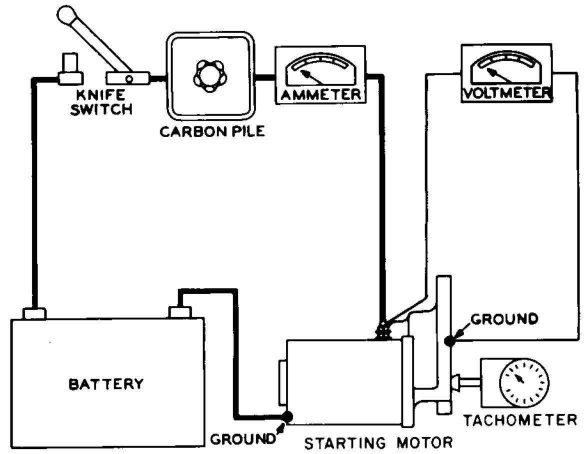

Figure 80-5. No Load Test Hookup

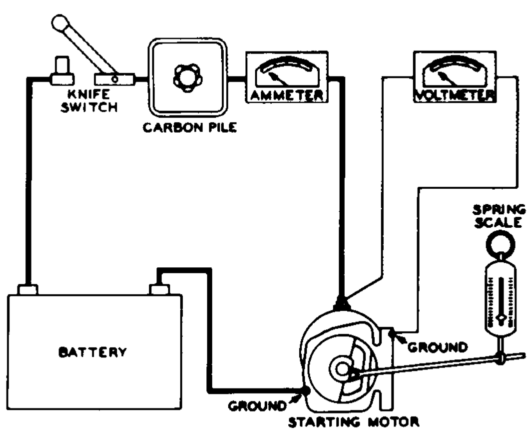

Figure 80-6. Stall - Torque Hookup

ASSEMBLY OF STARTING MOTOR.

1. When assembling the starting motor always use an arbor press and the proper bearing arbor for installing graphitized bronze bearings. Soak new absorbent bronze bearings in SAE 20 oil before installation. Saturate the felt oiling pad in the commutator end head with SAE 20 oil. Allow excess oil to drain out before installing end head on motor. Put a light film of Lubriplate No. 777 on the drive end of the armature shaft before and after installing the drive end head.
2. New brushes should be properly seated when installing by wrapping a strip of 00 sandpaper around the commutator (with the sanding side out) 1-1/4 to 1-1/2 times maximum. Drop brushes on sandpaper covered commutator and turn the armature slowly in the direction of rotation. Dust should be blown out of the motor after sanding.

—NOTE—

The spring tension is 32 to 40 ounces with new brushes. This tension is measured with the scale hooked under the brush spring near the brush and the reading is taken at right angles to the line of force exerted by the brush spring.

BENCH TESTS.

1. After the starting motor is reassembled, it should be tested to see that the no-load current at a certain voltage is within specifications as given in Chart 8002. To make this test, connect as shown in Figure 80-5. If current is too high, check the bearing alignment and end play to make sure there is no binding or interference. Two or three sharp raps on the frame with a rawhide hammer will often help to align the bearings and free the armature.
2. If no difficulty is indicated in the above test, a stall torque test may be made to see if the starting motor is producing its rated cranking power. Make test connections as shown in Figure 80-6.
3. If torque and current are not within specifications, check the seating of the brushes and internal connections for high resistance. If these checks are made and found to be in good order, replace frame and field assembly and retest starter.

STARTING MOTOR CONTROL CIRCUIT.

1. Inspect the control circuit wiring between the battery, solenoid and manual starting switches for breaks, poor connections and faulty insulation. Tighten all connections and make sure solenoid is firmly mounted and makes a good ground connection.

—NOTE—

If a solderless terminal on an aluminum cable is loose, corroded or otherwise unsatisfactory, it is recommended that the complete cable assembly be replaced instead of replacing or repairing the solderless terminal.

Should replacement of the complete assembly not be practical, it is permissible to replace the aluminum cable assembly with a copper cable assembly which is two sizes smaller (EX: An AL-1 aluminum cable assembly is replaced with an AN-3 copper cable assembly.) The new cable should be installed in accordance with AC-43-13-2A.

2. Check the voltage loss across the switch contacts during normal starting. If loss is in excess of 0.2 volts per 100 amperes, the solenoid should be replaced.
3. If solenoid fails to operate when the manual starting switch is turned on or if it fails to release when the manual starting switch is released, it should be removed and tested to specifications. If either opening or closing voltages are not to specifications, replace the solenoid.

STARTING MOTOR SERVICE TEST SPECIFICATIONS.

Prestolite specifications for 12-volt starting motors installed as standard equipment are shown on Chart 8002.

CHART 8002. STARTING MOTOR SERVICE TEST SPECIFICATIONS

Aircraft Model Motor Model	PA-28-201T MCL-6501
Min. Brush Tension Max. Brush Tension	32 oz. 40 oz.
No-Load Test Volt Max. Amps Min. R.P.M.	(75°F) 6 65 4900
Stall Torque Amps Min. Torque, Ft.-Lbs. Approx. Volts	 410 8 2.0

—END—

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CHAPTER

81

TURBINES

CHAPTER 81 - TURBINES

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

DESCRIPTION AND OPERATION.

The turbocharger system (Figure 81-4) consists of a turbine and compressor assembly, ground adjustable exhaust bypass screw and the necessary hose and engine air intake ducts. The ground adjustable exhaust bypass screw allows exhaust gas to bypass the turbine and flow directly overboard. In the closed position, the bypass screw diverts the exhaust gases into the turbine. The turbocharger requires little attention between overhauls. However, it is recommended that the items outlined in the Inspection Report be checked periodically.

TROUBLESHOOTING.

CHART 8101. TROUBLESHOOTING (TURBOCHARGER)

Trouble	Cause	Remedy
Smoking engine exhaust, loss of engine power, low boost pressure.	Dirty air cleaner, undersize air cleaner.	Clean or replace air cleaner as required.
	Restricted intake manifold or piping.	Remove restriction.
	Foreign matter or dirt accumulation on impeller.	Clean impeller. (See Major Inspection and Cleaning)
	Damaged impeller or turbine wheel.	Rebuild unit.
	Excessive oil leakage from seals.	Rebuild unit.
	Leaking intake or exhaust manifold connections.	Tighten all connections and replace gaskets where required.
	Excess back-pressure on turbine outlet.	Reduce restriction in exhaust ducting.
Noisy rotating assembly.	Damaged bearing or other components, causing rotating assembly to rub against housing.	Rebuild unit.
Excess oil in intake manifold or exhaust stack.	Oil carryover from air cleaner.	Service or replace air cleaner.
	Excessive oil leakage from seals.	Rebuild unit.

CHART 8101. TROUBLESHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
Boost pressure low, power low, clean exhaust.	Insufficient fuel supply to engine.	Check fuel system or reset fuel pump
Engine knock (gasoline).	Improper fuel.	Use recommended fuel.
	Excessive boost due to incorrect turbocharger, carburetor or other component.	Check engine manual and install correct components.
	Oil leakage from compressor seal.	Rebuild unit.
	Ignition timing incorrect.	Reset to specified timing.

TURBOCHARGER NOMENCLATURE.

Many unfamiliar terms may appear on the following pages of this manual. An understanding of these will be helpful, if not necessary, in performing maintenance and troubleshooting. The following is a list of commonly used terms and names as applied to turbocharging and a brief description.

TERM	MEANING
Supercharge	To increase the air pressure (density) above or higher than ambient conditions.
Supercharger	A device that accomplishes the increase in pressure.
Turbo-supercharger	More commonly referred to as a “Turbocharger” this device is driven by a turbine. The turbine is spun by energy extracted from the engine exhaust gas.
Compressor	The portion of a turbocharger that takes in ambient air and compresses it before discharging it to the engine.
Turbine	The exhaust driven end of the turbocharger unit.
Wastegate and Actuator (Exhaust By-Pass)	The wastegate is a butterfly type valve in the exhaust by-pass which, throughout its travel from open to closed, allows varied amounts of exhaust gas to by-pass the turbine, controlling its speed, hence the output of the compressor. The actuator is operated by a hydraulic piston operated by engine oil and cylinder with the piston linked to an arm on the butterfly valve shaft.

—NOTE—

Not used in this airplane configuration.

Ground Boosted or Ground Turbocharged	These phrases indicate that the engine depends on a certain amount of turbo-charging at sea level to produce the advertised horsepower. An engine that is so designed will usually include a lower compression ratio to avoid detonation.
Deck Pressure	The pressure measured in the area downstream of the turbo compressor discharge and upstream of the engine throttle valve. This should not be confused with manifold pressure.
Manifold Pressure	The pressure measured downstream of the engine throttle valve and is almost directly proportioned to the engine power output.
Normalizing	If a turbocharger system is used only to regain power losses caused by decreased air pressure of high altitude, it is considered that the engine has been “normalized”.
Overboost	An overboost condition means that manifold pressure is exceeding the limits at which the engine was tested and FAA certified and can be detrimental to the life and performance of the engine. Overboost can be caused by malfunctioning controllers or improperly operating wastegate in the automatic system or by pilot error in a manual controlled system. Refer to latest copy of Lycoming Service Bulletin No. 369.
Overshoot	Overshoot is a condition of the automatic controls not having the ability to respond quickly enough to check the inertia of the turbocharger speed increase with rapid engine throttle advance. Overshoot differs from overboost in that the high manifold pressure lasts only for a few seconds. This condition can usually be overcome by smooth throttle advance. A good method for advancing the throttle is a follows. After allowing the engine oil to warm up to approximately 140°F, advance the throttle to 28" to 30" manifold pressure, hesitate 1 to 3 seconds and continue advancing to full throttle slow and easy. This will eliminate any overshoot due to turbocharger inertia.
Bootstrapping	This is a term used in conjunction with turbo machinery. If you were to take all the air coming from a turbocharger compressor and duct it directly back into the turbine of the turbocharger, it would be called a bootstrap system and if no losses were encountered, it would theoretically run continuously. It would also be very unstable because if for some reason the turbo speed would change, the compressor would pump more air to drive the turbine faster, etc. A turbo-charged engine above critical altitude (wastegate closed) is similar to the example mentioned above, except now there is an engine placed between the compressor discharge and turbine inlet. Slight system changes caused the exhaust gas to change slightly, which causes the turbine speed to change slightly, which causes the compressor air to the engine to change slightly, which in turn again affects the exhaust gas, etc.

Critical Altitude — A turbocharged engine's wastegate will be in a partially open position at sea level. As the aircraft is flown to higher altitude (lower ambient pressures) the wastegate closes gradually to maintain the preselected manifold pressure. At point where the wastegate reaches its full closed position, the preselected manifold pressure will start to drop and this is considered critical altitude.

TURBOCHARGER.

REMOVAL OF TURBOCHARGER.

1. Remove the upper cowling.
2. Remove the turbocharger compressor and turbine assembly by the following procedure:
   A. Disconnect the oil supply and return lines from the center section of the turbo.
   B. Disconnect the air ducts from the compressor inlet and outlet, and the exhaust system from the turbine inlet and outlet.
   C. Remove safety wire securing the turbine insulation blanket and remove blanket.
   D. Remove the bolts that attach the turbocharger to the mounting bracket and remove the turbocharger assembly.

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ROUTINE TURBOCHARGER MAINTENANCE.

PERIODIC INSPECTION.

Whenever routine service of the engine is performed, inspect the turbocharger as follows:

1. Inspect the hoses and tubing of the air intake system between the air cleaner and turbocharger, and from the turbocharger to the intake manifold. Check for leakage due to cracks, damaged gaskets, loose clamps or connections, and restrictions due to kinks, collapsed hoses, or dented tubing.
2. Inspect for exhaust leakage from a cracked exhaust manifold, damaged gaskets, or loose turbocharger mounting.
3. Inspect the oil lines and fittings for kinks, damage, and leakage.
4. Note any unusual noises or vibration which would warrant further inspection of the turbocharger.
5. Observe engine exhaust. Excessive smoke may indicate a restricted air cleaner or intake piping, overfueling or faulty turbocharger operation.

MAJOR INSPECTION AND CLEANING.

Every 50,000 miles or after every 2,000 hours of operation, or particularly if trouble is suspected in the turbocharger, a major inspection of the turbocharger should be performed. This requires removal of the turbocharger from the engine.

—CAUTION—

Before removing, clean the entire turbocharger, air piping, and oil line connections with a stiff brush or whisk broom, followed by wiping with a cloth dampened with cleaning solvent. This precaution is necessary to prevent entrance of foreign materials into the engine and turbocharger system after removal.

Major inspection is as follows:

1. Remove the air cleaner piping from the turbocharger compressor housing inlet. Observe the condition of the impeller and housing. Carefully check the leading edges of the impeller blades for damage and for evidence of interference with the compressor housing.
2. Disconnect the oil lines and the intake manifold piping from the turbocharger. Support the turbocharger and remove the turbine housing clamp that secures the turbine housing, to the bearing house assembly. Remove the turbocharger from the turbine housing leaving the turbine housing mounted on the engine. Cover all openings to prevent the entrance of foreign materials.
3. Inspect the turbine wheel for cracks, erosion, nicked blade tips, and broken or missing blades. Inspect the turbine shield for warpage, rubbing, scoring, and erosion. Check for accumulations of carbon behind the turbine wheel and check for other defects that could interfere with proper turbocharger operation.

—NOTE—

The shield must be depressed against the tension of the spring ring to check for free rotation.

4. If the turbine and impeller do not rotate freely when the turbine shield is depressed away from the turbine wheel, the parts may be damaged or there may be interference due to foreign material. These conditions will necessitate the disassembly of the turbocharger for inspection. If there is no apparent damage, clean the unit and check for excessive end play as directed below.

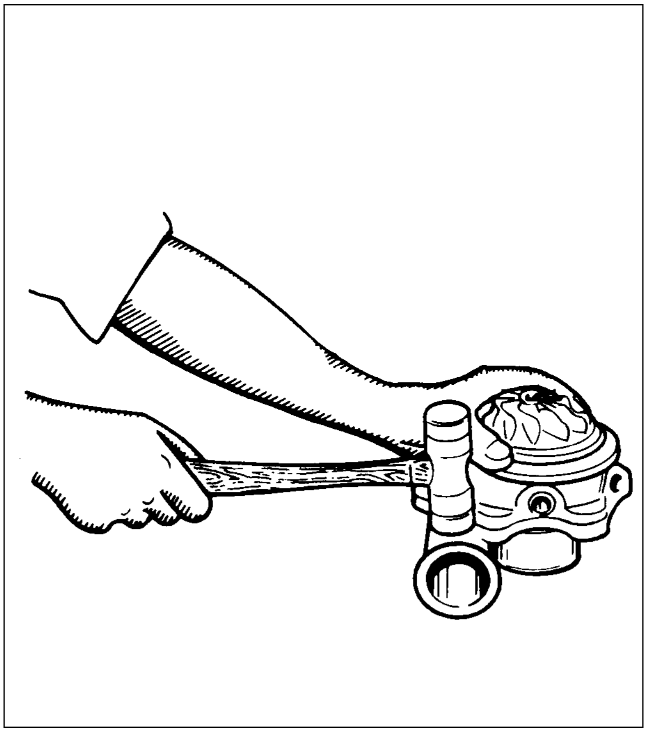

Figure 81-1. Removing Compressor Housing from Turbocharger

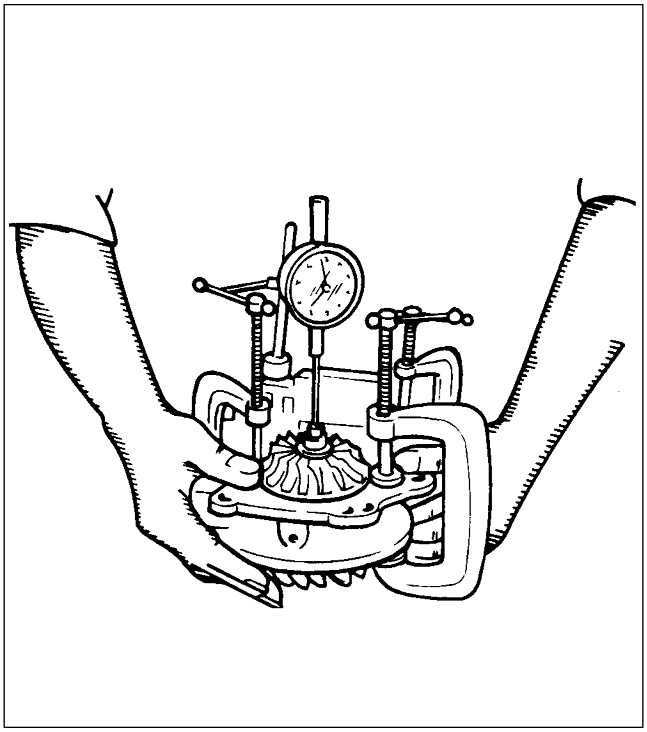

Figure 81-2. Measuring Turbine Shaft End Play

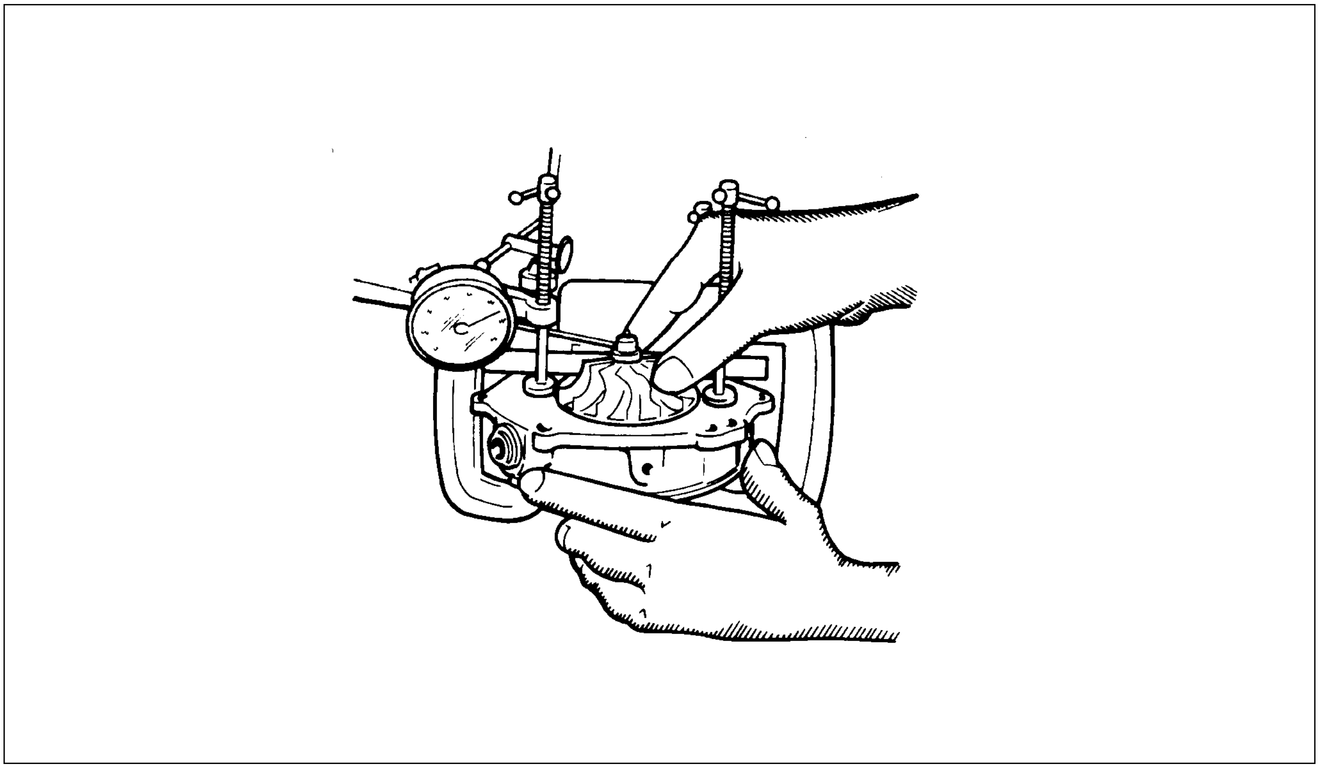

Figure 81-3. Measuring Turbine Shaft Radial Play

5. Remove the six bolts that secure the compressor housing to the turbocharger bearing housing; remove the compressor housing and gasket. If necessary, tap the compressor housing with a plastic hammer while holding the bearing housing as shown in figure 81-1.
6. If the impeller requires cleaning, use a nylon-bristled brush and a solvent such as diesel fuel or kerosene to remove accumulated dirt. Thoroughly clean the impeller and the compressor housing. Failure to remove all dirt may result in a more severe disruption of balance than that which existed prior to cleaning.

—CAUTION—

Never use caustic solution or other cleaner that may attack metal. Never use a wire brush that could score highly finished parts.

7. Use two C-clamps, as shown in figure 81-2 to overcome the tension of the spring ring and hold the turbine shield away from the turbine wheel.
8. Attach a dial indicator to the bearing housing so that the indicator point is resting on the end of the shaft. Push up on the turbine wheel as shown in figure 81-2 to measure shaft end play. The normal shaft end play is 0.005 to 0.009 inch. If shaft end play is excessive, rebuild the turbocharger.
9. Reposition the dial indicator so that the contact point is resting on the flat side surface of the impeller nut as shown in figure 81-3 and adjust the indicator dial at zero. Push from side to side as shown in figure 81-3 to determine the radial play of the shaft. Rotate the shaft slightly to get minimum readings on the nut flat. Maximum allowable radial play is 0.022 inch. If radial play is excessive, parts are worn and the turbocharger must be rebuilt.
10. If the unit is in satisfactory condition, position a new gasket on the compressor housing, making sure that the gasket surfaces are perfectly clean. Place the bearing housing in position; secure with six bolts. Tighten the bolts evenly and alternately to 80 to 100 inch-pounds.

INSTALLATION OF TURBOCHARGER.

1. Position turbocharger assembly on the mounting bracket and secure with attaching hardware.
2. Align exhaust system manifold turbo inlet and the turbine inlet and secure with clamp temporarily.
3. Tighten the large diameter center clamp securing the turbine housing to the turbocharger.

—NOTE—

The turbocharger is properly installed with the large diameter center clamp loose to allow rotation of the turbine housing during installation for proper alignment with the exhaust system inlet connection. Tighten clamp after alignment.

—WARNING—

When tightening any of the three V-band clamps, it is necessary to tap the clamp all around its circumference to insure proper seating. Do not rely on tightening alone for proper clamp seating.

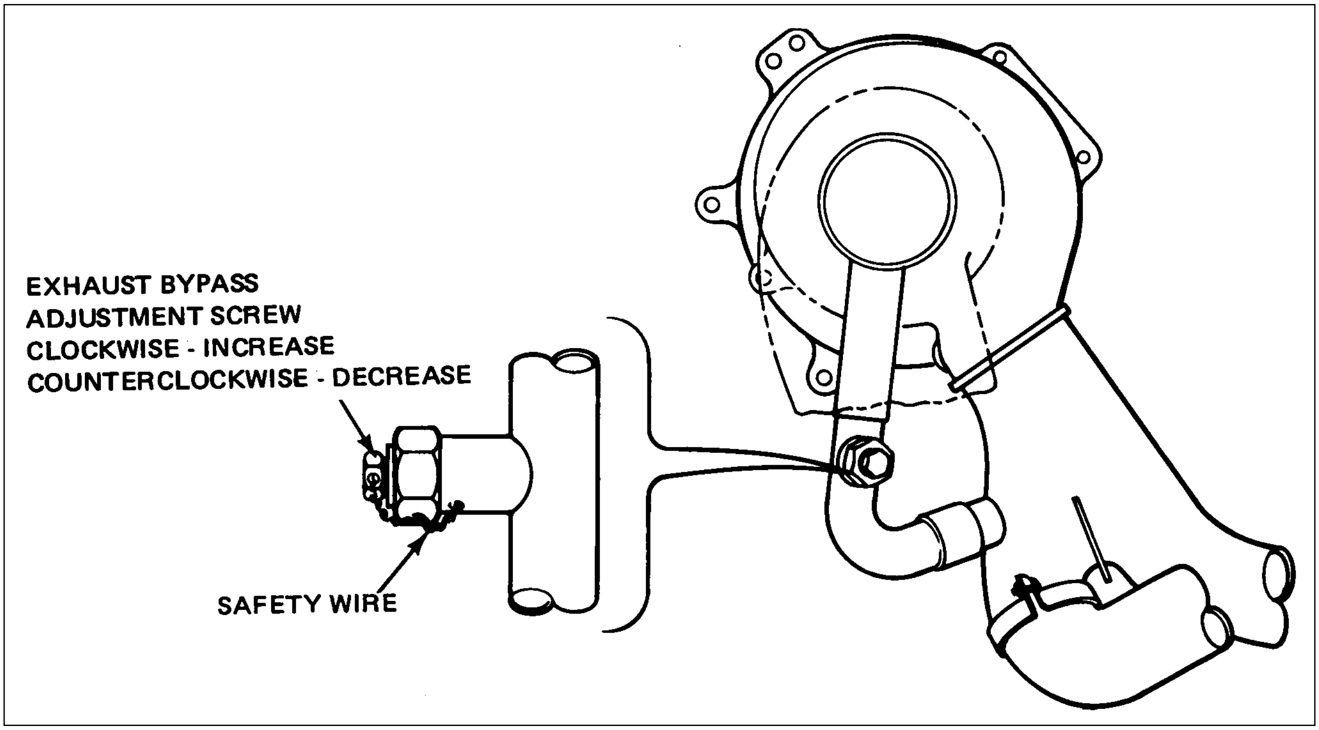

Figure 81-4. Exhaust Bypass Screw

4. Place turbine housing insulation blanket in proper position and safety blanket to turbocharger attaching hardware.
5. Position the exhaust tailpipe and exhaust bypass screw to the turbine outlet, aligning the tailpipe with the hole cut out in the lower cowl provided for it.

—NOTE—

Check the position of the exhaust bypass adjustment screw. If 8 minimum, 9 maximum threads are showing, below jam nut no adjustment is required. (See Figure 81-4.)

6. Tighten both turbine housing inlet clamps. (Refer to previous warning on tightening V-band clamps.)
7. Position the engine induction tube to turbocharger compressor outlet connector and the induction air inlet tube to the turbocharger compressor inlet connector in their proper locations and tighten the clamps.
8. Connect the oil supply and return lines to the turbocharger center housing. Connect the oil pressure cockpit gauge line if it was previously disconnected.
9. Perform engine ground run-up and check for normal engine functioning, excessive exhaust manifold leakage and oil leaks. Repair as necessary.
10. Install the upper cowling.

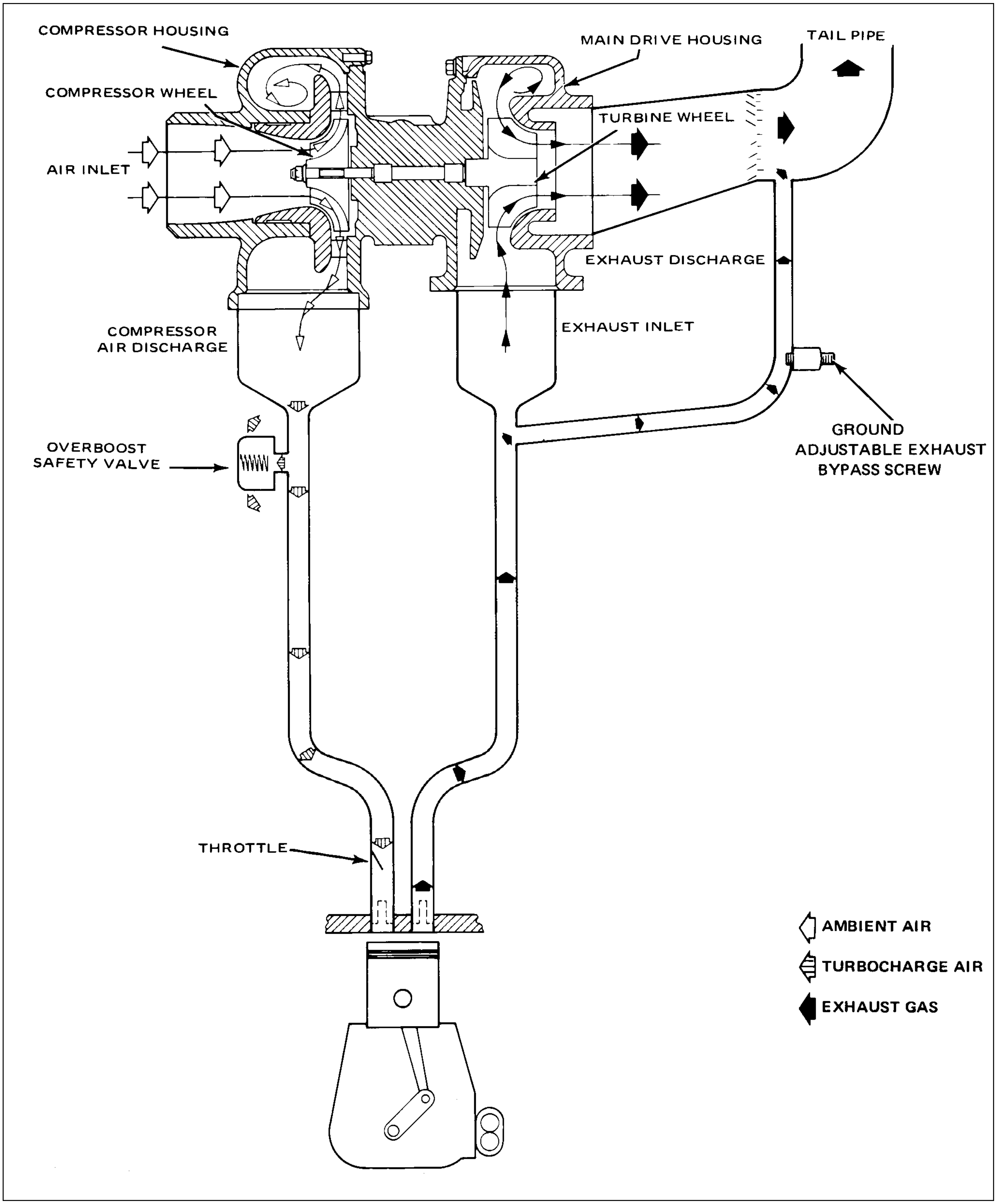

Figure 81-5. Schematic Diagram of Turbocharger System

ADJUSTMENT OF TURBOCHARGER. (Refer to Chapter 76 under Engine Set Up Procedures.)

—NOTE—

A complete inspection of the power plant system should be performed before any turbo adjustments are made.

OVERBOOST VALVE.

REMOVAL OF OVERBOOST VALVE.

1. Remove the four self-locking nuts, plain washers and bolts.
2. Lift the overboost valve assembly from the induction tube.
3. Remove the O-ring from the seating surface of the overboost mounting flange on the induction tube.

INSTALLATION OF OVERBOOST VALVE.

1. Install a new O-ring on the overboost mounting flange of the induction tube.
2. Position the overboost valve assembly on the mounting flange with the holes in the valve aligning with the holes in the flange.
3. Install the four bolts and secure with plain washers and self-locking nuts.

—END—

CHAPTER

91

CHARTS
AND
WIRING DIAGRAMS

CHAPTER 91 - CHARTS AND WIRING DIAGRAMS

TABLE OF CONTENTS/EFFECTIVITY

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TORQUES: The importance of correct application cannot be overemphazied. Undertorque can result in unnecessary wear of nuts and bolts as well as the parts they are holding together. When insufficient pressures are applied, uneven loads will be transmitted throughout the assembly which may result in excessive wear or premature failure due to fatigue. Overtorque can be equally damaging because of failure of a bolt or nut from overstressing the thread areas. The following procedures should be followed to assure that the correct torque is applied: (Refer to Chart 9101.)

1. Torque (self-locking fasteners) — Add the friction torque from Chart A for sizes 8 through 7/16 to the recommended torque from Chart B to get the final torque. This would be the actual reading on the torque wrench.
2. Torque (castellated and non-self-locking nuts) — Use only the torque given in Chart B. Unless otherwise specified, when castellated nuts are used with a cotter pin on moving joints, do not torque the nut. Turn the nut onto the bolt until proper grip is established and alignment with the cotter pin hole is achieved. TheN install the cotter pin.

GENERAL REQUIREMENTS:

1. Calibrate the torque wrench periodically to assure accuracy; recheck frequently.
2. Ascertain that the bolt and nut threads are clean and dry (unless otherwise specified by the manufacturer). If the bolt or nut is specified to be lubricated prior to tightening, the torque range should be reduced 50 percent.
3. Use a bolt length long enough to prevent bearing loads on the threads. The complete chamfer or end radius of the bolt or screw must extend through the nut.
4. Unique torques specified in the text of this manual supersede the torques given in Charts A and B.
5. Refer to the latest revision of Lycoming SSP 1776 for torques on parts used on Lycoming engines.
6. A maximum of two AN960 washers may be added under the bolt heads or nuts to correct for variations in material thickness within the tolerances permitted.
7. Limitations of the use of self-locking nuts, bolts and screws including fasteners with non-metallic inserts are as follows:
   A. Fasteners incorporating self-locking devices shall not be reused if they can be run up using only fingers. They may be reused if hand tools are required to run them up, providing there is no obvious damage to the self-locking device prior to installation.
   B. Bolts 5/16 inch diameter and over with cotter pin holes may be used with self-locking nuts. Nuts with non-metallic locking devices may be used in this application only if the bolts are free from burrs around the cotter pin hole.
   C. Do not use self-locking nuts at joints which subject either the nut or the bolt to rotation.
   D. Never tap or rethread self-locking fasteners. Do not use nuts, bolts or screws with damaged threads or rough ends.

CHART 9101. RECOMMENDED NUT TORQUES.

TABLE A

FRICTION DRAG TORQUE COARSE AND FINE

BOLT SIZE	FRICTION DRAG TORQUE (IN.-LBS.)
8*	
10	18
1/4	30
5/16	60
3/8	80
7/16	100

*APPLICABLE TO COARSE THREADS ONLY.

COARSE THREAD SERIES

	BOLTS Steel Tension			
	AN 3 thru AN 20 AN 42 thru AN 49 AN 73 thru AN 81 AN 173 thru AN 186 MS 20033 thru MS 20046 MS 20073 MS 20074 AN 509 NK9 MS 24694 AN 525 NK525 MS 27039			
	NUTS			
	Steel Tension		Steel Shear	
	AN 310 AN 315 AN 363 AN 365 NAS 1021 MS 17825 MS 21045 MS 20365 MS 20500 NAS 679		AN 320 AN 364 NAS 1022 MS 17826 MS 20364	
Nut-bolt size	Torque Limits in-lbs		Torque Limits in-lbs	
	Min.	Max.	Min.	Max.
8 –32	12	15	7	9
10 –24	20	25	12	15
1/4–20	40	50	25	30
5/16–18	80	90	48	55
3/8–16	160	185	95	110
7/16–14	235	255	140	155
1/2–13	400	480	240	290
9/16–12	500	700	300	420
5/8–11	700	900	420	540
3/4–10	1,150	1,600	700	950
7/8– 9	2,200	3,000	1,300	1,800
1 –8	3,700	5,000	2,200	3,000
1-1/8–8	5,500	6,500	3,300	4,000
1-1/4–8	6,500	8,000	4,000	5,000

CHART 9101. RECOMMENDED NUT TORQUES (cont.)

FINE THREAD SERIES												
	BOLTS Steel Tension				BOLTS Steel Tension				BOLTS Aluminum			
	AN 3 thru AN 20 AN 42 thru AN 49 AN 73 thru AN 81 AN 173 thru AN 186 MS 20033 thru MS 20046 MS 20073 MS 20074 AN 509 NK9 MS 24694 AN 525 NK525 MS 27039				MS 20004 thru MS 20024 NAS 144 thru NAS 158 NAS 333 thru NAS 340 NAS 583 thru NAS 590 NAS 624 thru NAS 644 NAS 1303 thru NAS 1320 NAS 172 NAS 174 NAS 517		Steel shear bolt NAS 464		AN 3DD thru AN 20DD AN 173DD thru AN 186DD AN 509DD AN 525D MS 27039D MS 24694DD			
	NUTS				NUTS				NUTS			
	Steel Tension		Steel Shear		Steel Tension		Steel Shear		Alum. Tension		Alum. Shear	
	AN 310 AN 315 AN 363 AN 365 NAS 1021 MS 17825 MS 21045 MS 20365 MS 20500 NAS 679		AN 320 AN 364 NAS 1022 MS 17826 MS 20364		AN 310 AN 315 AN 363 AN 365 MS 17825 MS 20365 MS 21045 NAS 1021 NAS 679 NAS 1291		AN 320 AN 364 NAS 1022 MS 17826 MS 20364		AN 365D AN 310D NAS 1021D		AN 320D AN 364D NAS 1022D	
Nut-bolt size	Torque Limits in-lbs		Torque Limits in-lbs		Torque Limits in-lbs		Torque Limits in-lbs		Torque Limits in-lbs		Torque Limits in-lbs	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
8 -36	12	15	7	9					5	10	3	6
10 -32	20	25	12	15	25	30	15	20	10	15	5	10
1/4-28	50	70	30	40	80	100	50	60	30	45	15	30
5/16-24	100	140	60	85	120	145	70	90	40	65	25	40
3/8-24	160	190	95	110	200	250	120	150	75	110	45	70
7/16-20	450	500	270	300	520	630	300	400	180	280	110	170
1/2-20	480	690	290	410	770	950	450	550	280	410	160	260
9/16-18	800	1,000	480	600	1,100	1,300	650	800	380	580	230	360
5/8-18	1,100	1,300	660	780	1,250	1,550	750	950	550	670	270	420
3/4-16	2,300	2,500	1,300	1,500	2,650	3,200	1,600	1,900	950	1,250	560	880
7/8-14	2,500	3,000	1,500	1,800	3,550	4,350	2,100	2,690	1,250	1,900	750	1,200
1 -14	3,700	4,500	2,200	3,300	4,500	5,500	2,700	3,300	1,600	2,400	950	1,500
1-1/8-12	5,000	7,000	3,000	4,200	6,000	7,300	3,600	4,400	2,100	3,200	1,250	2,000
1-1/4-12	9,000	11,000	5,400	6,600	11,000	13,400	6,600	8,000	3,900	5,600	2,300	3,650

—NOTE—

For more details on torquing, refer to FAA Manual AC43.13-1A.

—CAUTION—

Do not overtorque fittings.

—NOTE—

When flared fittings are being installed, ascertain that the male threads are properly lubricated. Torque the fittings in accordance with Chart 9102.

CHART 9102. FLARE FITTING TORQUES

	TORQUE—INCH-POUND					
TUBING OD INCHES	ALUMINUM - ALLOY TUBING FLARE - AND 10061 OR AND 10078		STEEL TUBING FLARE AND 10061		HOSE END FITTING AND HOSE ASSEMBLIES	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
1/8	— — —	— — —	— — —	— — —	— — —	— — —
3/16	— — —	— — —	90	100	70	100
1/4	40	65	135	150	70	120
5/16	60	80	180	200	85	180
3/8	75	125	270	300	100	250
1/2	150	250	450	500	210	420
5/8	200	350	650	700	300	480
3/4	300	500	900	1000	500	850
1	500	700	1200	1400	700	1150
1-1/4	600	900	— — —	— — —	— — —	— — —
1-1/2	600	900	— — —	— — —	— — —	— — —
1-3/4	— — —	— — —	— — —	— — —	— — —	— — —
2	— — —	— — —	— — —	— — —	— — —	— — —

CONVERSION TABLES

1. These charts contain the various conversion data that may be useful when figuring capacities, lengths, temperatures, and various weights and measures from the English system values to the metric system values or back again.

2. The English system is in use by England and the United States. All other countries use the metric system.

3. Procedure for Converting Inches to Millimeters. (Refer to Chart 9103.)

   A. Example: Convert 1.5 inches to millimeters.

      (1) Read down inches column to 1. inches.
      (2) Read across top inch column to 0.5.
      (3) Read down and across to find millimeters (1.5 inches is 38.10 millimeters).

4. Procedure for Converting Fahrenheit (°F) and Celsius (°C) (Centigrade) Temperature. (Refer to Chart 9103.)

   A. Read number in middle column, if in degrees Celsius (° C), read Fahrenheit equivalent in righthand column. If in degrees Fahrenheit (°F), read Celsius equivalent in left-hand column.

      (1) 70°F =21.1°C
      (2) 30°C =86.0°F.

CHART 9103. CONVERSION TABLES (cont)

INCHES TO MILLIMETER

INCHES	0.0000	0.0001	0.0002	0.0003	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009
					MILLIMETER					
0.000		0.0025	0.0050	0.0076	0.0101	0.0127	0.0152	0.0177	0.0203	0.0228
0.001	0.0254	0.0279	0.0304	0.0330	0.0355	0.0381	0.0406	0.0431	0.0457	0.0482
0.002	0.0508	0.0533	0.0558	0.0584	0.0609	0.0635	0.0660	0.0685	0.0711	0.0736
0.003	0.0762	0.0787	0.0812	0.0838	0.0863	0.0889	0.0914	0.0939	0.0965	0.0990
0.004	0.1016	0.1041	0.1066	0.1092	0.1117	0.1143	0.1168	0.1193	0.1219	0.1244
0.005	0.1270	0.1295	0.1320	0.1346	0.1371	0.1397	0.1422	0.1447	0.1473	0.1498
0.006	0.1524	0.1549	0.1574	0.1600	0.1625	0.1651	0.1676	0.1701	0.1727	0.1752
0.007	0.1778	0.1803	0.1828	0.1854	0.1879	0.1905	0.1930	0.1955	0.1981	0.2006
0.008	0.2032	0.2057	0.2082	0.2108	0.2133	0.2159	0.2184	0.2209	0.2235	0.2260
0.009	0.2286	0.2311	0.2336	0.2362	0.2387	0.2413	0.2438	0.2463	0.2489	0.2514

INCHES	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
					MILLIMETER					
0.00		0.025	0.050	0.076	0.101	0.127	0.152	0.177	0.203	0.228
0.01	0.254	0.279	0.304	0.330	0.355	0.381	0.406	0.431	0.457	0.482
0.02	0.508	0.533	0.558	0.584	0.609	0.635	0.660	0.685	0.711	0.736
0.03	0.762	0.787	0.812	0.838	0.863	0.889	0.914	0.939	0.965	0.990
0.04	1.016	1.041	1.066	1.092	1.117	1.143	1.168	1.193	1.219	1.244
0.05	1.270	1.295	1.320	1.346	1.371	1.397	1.422	1.447	1.473	1.498
0.06	1.524	1.549	1.574	1.600	1.625	1.651	1.676	1.701	1.727	1.752
0.07	1.778	1.803	1.828	1.854	1.879	1.905	1.930	1.955	1.981	2.006
0.08	2.032	2.057	2.082	2.108	2.133	2.159	2.184	2.209	2.235	2.260
0.09	2.286	2.311	2.336	2.362	2.387	2.413	2.438	2.463	2.489	2.514

INCHES	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
					MILLIMETER					
0.0		0.254	0.508	0.762	0.016	1.270	1.524	1.778	2.032	2.286
0.1	2.540	2.794	3.048	3.302	3.556	3.810	4.064	4.318	4.572	4.826
0.2	5.080	5.334	5.588	5.842	6.096	6.350	6.604	6.858	7.112	7.366
0.3	7.620	7.874	8.128	8.382	8.636	8.890	9.144	9.398	9.652	9.906
0.4	10.160	10.414	10.668	10.922	11.176	11.430	11.684	11.938	12.192	12.446
0.5	12.700	12.954	13.208	13.462	13.716	13.970	14.224	14.478	14.732	14.986
0.6	15.240	15.494	15.748	16.002	16.256	16.510	16.764	17.018	17.272	17.526
0.7	17.780	18.034	18.288	18.542	18.796	19.050	19.304	19.558	19.812	20.066
0.8	20.320	20.574	20.828	21.082	21.336	21.590	21.844	22.098	22.352	22.606
0.9	22.860	23.114	23.368	23.622	23.876	24.130	24.384	24.638	24.892	25.146

CHART 9103. CONVERSION TABLES (cont)

INCHES TO MILLIMETER

INCHES	0.00	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
	MILLIMETER									
0.		2.54	5.08	7.62	10.16	12.70	15.24	17.78	20.32	22.86
1.	25.40	27.94	30.48	33.02	35.56	38.10	40.64	43.18	45.72	48.26
2.	50.80	53.34	55.88	58.42	60.96	63.50	66.04	68.58	71.12	73.66
3.	76.20	78.74	81.28	83.82	86.36	88.90	91.44	93.98	96.52	99.06
4.	101.60	104.14	106.68	109.22	111.76	114.30	116.84	119.38	121.92	124.46
5.	127.00	129.54	132.08	134.62	137.16	139.70	142.24	144.78	147.32	149.86
6.	152.40	154.94	157.48	160.02	162.56	165.10	167.64	170.18	172.72	175.26
7.	177.80	180.34	182.88	185.42	187.96	190.50	193.04	195.58	198.12	200.66
8.	203.20	205.74	208.28	210.82	213.36	215.90	218.44	220.98	223.52	226.06
9.	228.60	231.14	233.68	236.22	238.76	241.30	243.84	246.38	248.92	251.46

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CHART 9103. CONVERSION TABLES (cont)

CENTIGRADE—FAHRENHEIT CONVERSION TABLE

Example: To convert 20°C. to Fahrenheit, find 20 in the center column headed (F—C); then read 68.0°F. in the column (F) to the right. To convert 20°F. to Centigrade; find 20 in the center column and read -6.67°C. in the (C) column to the left.

C	F—C	F	C	F—C	F
-56.7	-70	-94.0	104.44	220	428.0
-51.1	-60	-76.0	110.00	230	446.0
-45.6	-50	-58.0	115.56	240	464.0
-40.0	-40	-40.0	121.11	250	482.0
-34.0	-30	-22.0	126.67	260	500.0
-38.9	-20	-4.0	132.22	270	518.0
-23.3	-10	14.0	137.78	280	536.0
-17.8	0	32.0	143.33	290	554.0
-12.22	10	50.0	148.89	300	572.0
-6.67	20	68.0	154.44	310	590.0
-1.11	30	86.0	160.00	320	608.0
4.44	40	104.0	165.56	330	626.0
10.00	50	122.0	171.11	340	644.0
15.56	60	140.0	176.67	350	662.0
21.11	70	158.0	182.22	360	680.0
26.67	80	176.0	187.78	370	698.0
32.22	90	194.0	193.33	380	716.0
27.78	100	212.0	198.89	390	734.0
43.33	110	230.0	204.44	400	752.0
38.89	120	248.0	210.00	410	770.0
54.44	130	266.0	215.56	420	788.0
60.00	140	284.0	221.11	430	806.0
65.56	150	302.0	226.67	440	824.0
71.00	160	320.0	232.22	450	842.0
76.67	170	338.0	257.78	460	860.0
82.22	180	356.0	243.33	470	878.0
87.78	190	374.0	248.89	480	896.0
93.33	200	392.0	254.44	490	914.0
98.89	210	410.0	260.00	500	932.0

CHART 9103. CONVERSION TABLES (cont.)

MULTIPLY	BY	TO OBTAIN
CENTIMETERS	0.3937 0.03281	IN. FT.
CU. CENTIMETERS	0.001 0.06102 0.0002642	LITERS CU. IN. U.S. GAL.
CU. FT.	28.320 1.728 7.481 28.32	CU. CM. CU. IN. U.S. GAL. LITERS
CU. IN.	16.39 0.01639 0.004329 0.01732	CU. CM. LITERS U.S. GAL. QUARTS
CU. METERS	1000000 35.314 61.023 264.17 999.97	CU. CM. CU. FT. CU. IN. GAL. LITERS
FEET	0.3048 12.000 304.8 0.3333	METERS MILS. MM. YARDS
FT.-LB.	0.1383 0.001285 0.000000376	M-KG BTU KW-HR
FLUID OZ.	8 29.6	DRAM CU. CM.
GAL., IMPERIAL	277.4 1.201 4.546	CU. IN. U.S. GAL. LITERS
GAL., U.S. DRY	268.8 0.1556 1.164 4.405	CU. IN. CU. FT. U.S. GAL., LIQ. LITERS
GAL., U.S. LIQ.	231.0 0.1337 3.785 0.8327 128	CU. IN. CU. FT. LITERS IMPERIAL GAL. FLUID OZ.
IN.	2.540 .08333	CM. FT.
JOULES	0.000948 0.7376	BTU FT.-LB.

MULTIPLY	BY	TO OBTAIN
KILOGRAMS	2.205 35.27 1000	LB. OZ. GRAMS
LITERS	1000 61.03 0.03532 0.2642 0.22 1.057	CU. CM. CU. IN. CU. FT. U.S. GAL. IMPERIAL GAL. QUARTS
METERS	39.37 3.281 1000	IN. FT. MM.
METER-KILOGRAM	7.233 9.807	FT.-LB. JOULES
OUNCES, AVDP	0.0625 28.35 437.5	LB., AVDP GRAMS GRAINS
OUNCES, FLUID	29.57 1.805	CU. CM. CU. IN.
LB., AVDP	453.6 7000 16.0	GRAMS GRAINS OUNCES
SQUARE INCH	6.4516	SQ. CM.
POUND PER SQUARE INCH (PSI)	0.0703	KG-CM SQUARED
STATUTE MILE	1.609 0.8684	KILOMETER NAUTICAL MILE
NAUTICAL MILE	1.151	STATUTE MILE
QUART	.9463	LITER
MILLIMETER	1000	MICRON
MICRON	0.001 0.000039	MILLIMETER INCH
INCH POUNDS	11.521	METER GRAMS
INCH OUNCES	0.72	METER GRAMS
POUNDS	0.453	KILOGRAMS

CHART 9103. CONVERSION TABLES (cont.)

DECIMAL CONVERSIONS

4THS	8THS	16THS	32NDS	64THS	TO 3 PLACES	TO 2 PLACES	M.M. EQUIV.
				1/64	.016	.02	.397
			1/32		.031	.03	.794
				3/64	.047	.05	1.191
		1/16			.062	.06	1.587
				5/64	.078	.08	1.984
			3/32		.094	.09	2.381
				7/64	.109	.11	2.778
	1/8				.125	.12	3.175
				9/64	.141	.14	3.572
			5/32		.156	.16	3.969
				11/64	.172	.17	4.366
		3/16			.188	.19	4.762
				13/64	.203	.20	5.159
			7/32		.219	.22	5.556
				15/64	.234	.23	5.593
1/4					.250	.25	6.350
				17/64	.266	.27	6.747
			9/32		.281	.28	7.144
				19/64	.297	.30	7.540
		5/16			.312	.31	7.937
				21/64	.328	.33	8.334
			11/32		.344	.34	8.731
				23/64	.359	.36	9.128
	3/8				.375	.38	9.525
				25/64	.391	.39	9.922
			13/32		.406	.41	10.319
				27/64	.422	.42	10.716
		7/16			.438	.44	11.112
				29/64	.453	.45	11.509
			15/32		.469	.47	11.906
				31/64	.484	.48	12.303
					.500	.50	12.700

4THS	8THS	16THS	32NDS	64THS	TO 3 PLACES	TO 2 PLACES	M.M EQUIV.
				33/64	.516	.52	13.097
			17/32		.531	.53	13.494
				35/64	.547	.55	13.891
		9/16			.562	.56	14.288
				37/64	.578	.58	14.684
			19/32		.594	.59	15.081
				39/64	.609	.61	15.478
	5/8				.625	.62	15.875
				41/64	.641	.64	16.272
			21/32		.656	.66	16.669
				43/64	.672	.67	17.065
		11/16			.688	.69	17.462
				45/64	.703	.70	17.859
			23/32		.719	.72	18.256
				47/64	.734	.73	18.653
3/4					.750	.75	19.050
				49/64	.766	.77	19.447
			25/32		.781	.78	19.844
				51/64	.797	.80	20.241
		13/16			.812	.81	20.637
				53/64	.828	.83	21.034
			27/32		.844	.84	21.431
				55/64	.859	.86	21.828
	7/8				.875	.88	22.225
				57/64	.891	.89	22.622
			29/32		.906	.91	23.019
				59/64	.922	.92	23.416
		15/16			.938	.94	23.812
				61/64	.953	.95	24.209
			31/32		.969	.97	24.606
				63/64	.984	.98	25.003
					1.000	1.00	25.400

CHART 9104. DECIMAL/MILLIMETER EQUIVALENTS OF DRILL SIZES

Decimal/Millimeter Equivalents of Drill Sizes From 1/2" to No. 80

Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.
1/2	0.500	12.7000	G	0.261	6.6294	5/32	0.1562	3.9687	51	0.067	1.7018
31/64	0.4843	12.3031	F	0.257	6.5278	23	0.154	3.9116	52	0.0635	1.6129
15/32	0.4687	11.9062	E-1/4	0.250	6.3500	24	0.152	3.8608	1/16	0.0625	1.5875
29/64	0.4531	11.5094	D	0.246	6.2484	25	0.1495	3.7973	53	0.0595	1.5113
7/16	0.4375	11.1125	C	0.242	6.1468	26	0.147	3.7338	54	0.055	1.397
27/64	0.4218	10.7156	B	0.238	6.0452	27	0.144	3.6576	55	0.052	1.3208
Z	0.413	10.4902	15/64	0.2343	5.9531	9/64	0.1406	3.5719	3/64	0.0468	1.1906
13/32	0.4062	10.3187	A	0.234	5.9436	28	0.1405	3.5687	56	0.0465	1.1811
Y	0.404	10.2616	1	0.228	5.7912	29	0.136	3.4544	57	0.043	1.0922
X	0.397	10.0838	2	0.221	5.6134	30	0.1285	3.2639	58	0.042	1.0668
25/64	0.3906	9.9212	7/32	0.2187	5.5562	1/8	0.125	3.1750	59	0.041	1.0414
W	0.386	9.8044	3	0.213	5.4102	31	0.120	3.048	60	0.040	1.016
V	0.377	9.5758	4	0.209	5.3086	32	0.116	2.9464	61	0.039	0.9906
3/8	0.375	9.5250	5	0.2055	5.2197	33	0.113	2.8702	62	0.038	0.9652
U	0.368	9.3472	6	0.204	5.1816	34	0.111	2.8194	63	0.037	0.9398
23/64	0.3593	9.1262	13/64	0.2031	5.1594	35	0.110	2.794	64	0.036	0.9144
T	0.358	9.1281	7	0.201	5.1054	7/64	0.1093	2.7781	65	0.035	0.899
S	0.346	8.7884	8	0.199	5.0546	36	0.1065	2.7051	66	0.033	0.8382
11/32	0.3437	8.7300	9	0.196	4.9784	37	0.104	2.6416	1/32	0.0312	0.7937
R	0.339	8.6106	10	0.1935	4.9149	38	0.1015	2.5781	67	0.032	0.8128
Q	0.332	8.4328	11	0.191	4.8514	39	0.0995	2.5273	68	0.031	0.7874
21/64	0.3281	8.3337	12	0.189	4.8006	40	0.098	2.4892	69	0.029	0.7366
P	0.323	8.2042	3/16	0.1875	4.7625	41	0.096	2.4384	70	0.028	0.7112
O	0.316	8.0264	13	0.185	4.699	3/32	0.0937	2.3812	71	0.026	0.6604
5/16	0.3125	7.9375	14	0.182	4.6228	42	0.0935	2.3749	72	0.025	0.635
N	0.302	7.6708	15	0.180	4.572	43	0.089	2.2606	73	0.024	0.6096
19/64	0.2968	7.5387	16	0.177	4.4958	44	0.086	2.1844	74	0.0229	0.58166
M	0.295	7.4930	17	0.173	4.3942	45	0.082	2.0828	75	0.021	0.5334
L	0.290	7.3660	11/64	0.1718	4.3656	46	0.081	2.0574	76	0.020	0.508
9/32	0.2812	7.1425	18	0.1695	4.3053	47	0.0785	1.9939	77	0.018	0.4572
K	0.281	7.1374	19	0.166	4.2164	5/64	0.0781	1.9844	1/64	0.0156	0.3969
J	0.277	7.0358	20	0.161	4.0894	48	0.076	1.9304	78	0.016	0.4064
I	0.272	6.9088	21	0.159	4.0386	49	0.073	1.8542	79	0.0145	0.3683
H	0.266	6.7564	22	0.157	3.9878	50	0.070	1.778	80	0.0135	0.3429
17/64	0.2656	6.7462									

DRILL SIZES AVAILABLE:
Drill may be obtained in regular sizes to a 4 inch diameter, and increase in 64ths of an inch.
The regular metric drills vary from 2 to 76mm. and increase in 0.5mm. variations.

CHART 9105. LIST OF CONSUMABLE MATERIALS

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Fuel, Engine	100 octane green/blue (See Note 1)		
Oil, Engine	See Chart 1201		
Corrosion Preven-Tive Compound and Broken Oil	MIL-C-6529 Type II Per Lycoming Service Letter L121A		
Lubricating Oil (General Purpose Low Temperature)	MIL-L-7870A	Royco 363	Royal Lubricant Co. River Road Hanover, N.J. 07936
Oil Filter			
Air Filter			
Fluorocarbon Re-lease Agent and Dry Lubricant	MIL-L-60326	#MS-l22 (Purch)	
Lubricating Oil		MAG-1 and Aero Lubriplate (Purch)	Fiske Bros. Refining Co. 129 Lockwood Street Newark, N.J. 07105
Lubricating Grease (General Purpose Superseded by MIL-G-81322)	MIL-G-7711	Regal AFB2	Texaco Inc. 135 East 42nd Street New York, N.Y.
		Aeroshell Grease No. 6	Shell Oil Co. 50 West 50th Street Box 95 New York, N. Y. 07936
		Royco II	Royal Lubricants Co. River Road Hanover, N.J. 07936
Lubricating Grease (High Temperature)	MIL-G-81322B (See Note 2)	Mobilgrease 28	Mobil Oil Corp. Shoreham Building Washington, D.C.
		Royco 22	Royal Lubricants Co. River Road Hanover N.J. 07936

CHART 9105. LIST OF CONSUMABLE MATERIALS (cont)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Lubricating Cirease (Aircraft and Instru- ments, Low and High Temperature)	MIL-G-23827A (See Note 2)	Supermil Grease No. A72832	American Oil Co. 910 South Michigan Ave. Chicago, Ill. 60680
		Royco 27A	Royal Lubricants Co., River Road, Hanover, N.J. 07936
		Aeroshell Grease 7	Shell Oil Co., 50 West 50th Street P.O. Box 95 New York, N.Y. 07936
Lubricating Grease (All Purpose)	MIL-G-3545C	Texaco Marfax All Purpose Grease	Texaco Inc. 135 E. 42nd St. New York, N.Y 07936
		Mobile Mobilgrease 77 (or Mobilux EP2)	Mobile Oil Corp. Shoreham Building Washington, DC.
		Shell Alvania EP Grease 2	Shell Oi1 Co.
Oil, Air Conditioner		Suniso #5GS	Virginia Chemical and Smelting Co. West Norfolk, Va.
		Texaco Capella "E"	Texaco Inc. 135 East 42nd St. New York, N.Y. 07936
Hydraulic Fluid	MIL-H-5606C	756D	Royal Lubricant Co. River Road Hanover, N.J. 07936
		TL-5874	Texaco Inc. 135 East 42nd Street New York, N.Y. 07936
		PED 3565	Standard Oil Co. of California 225 Brush Street San Francisco 20, Cal.

CHART 9105. LIST OF CONSUMABLE MATERIALS (cont)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Sealer		PR 1321 B-1/2	Products Research Co. 2919 Empire Avenue Burbank, Cal. 91504
Solvent	PD680		
Toluol	TT-T-548		
Buffing and Rubbing Compounds		Automotive Type - DuPont #7	DuPont Company Wilmington, Del. 19898
		Ram Chemical #69 x 1	Ram Chemicals Gardena, Cal. 90248
		Mirror Glaze #l	Mirror Bright Polish Co., Inc. Irvin, Cal. 92713
Cleaners		Fantastic Spray Perchlorethylene VM&P Naptha (Lighter Fluid)	Local Suppliers
ABS-Solvent Cements		Solarite #11 Series	Solar Compounds Corp. Linden, N.J. 07036
Solvents		Methylethyl Ketone Methylene Chloride Acetone	Local Suppliers
Epoxy Patching Compound		Solarite #400	Solar Compounds Corp. Linden, N.J. 07036
Hot Melt Adhesives Polyamids and Hot Melt Gun	Stick Form 1/2 in. dia. 3 in. long		Sears Roebuck & Co. or Most Hardware Stores
Sealant		PRC5000	Behr-Manning Division Norton
Teflon tape	.003 x .50 wide/-1 MIL-T-27730	76381	Minnesota Mining & Manufacturing Co. 3M Center St. Paul, MN 55101

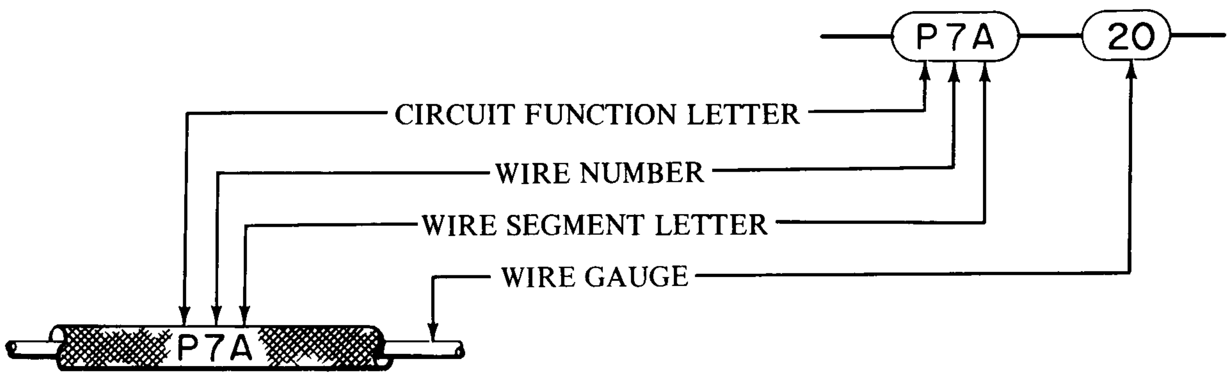
CHART 9105. LIST OF CONSUMABLE MATERIALS (cont)

MATERIAL	SPECIFICATION	PRODUCT	VENDOR
Teflon Tape (cont.)	.003 x .50 wide/-1 MIL-T-27730	97820	Shamban, W.S. & Co. 713 Mitchell RD. Newburn Park, CA. 91320
	.003 x .25 wide/-2 MIL-1 27730	99742	Johnson & Johnson Permacel Division 501 George St. New Brunswick, NJ 08903
Tapes, Vinyl Foam	1/8 in. x 1 in. 510 Series, Type II		Norton Tape Division Troy, New York
Black Vinyl Plastic	2 in. x 9 mil. and/or 1-1/2 in. x 9 mil.		Norton Tape Division Troy, New York
Vinyl Foam	1 in. x 1/8 in. 530 Series, Type I		Norton Tape Division Troy, New York
Cleaner		Prep-Sol No. 39195	Dupont 1007 Market St. Wilmington, Del. 19898
Adhesive		Carboline F-1	Carboline Co. 328 Hanley Ind. Ct. St. Louis, MO 63144
		Scotch Grip 2210	3M Co. Adhesive Coatings and Sealers Div. 3M Center St. Paul, Min. 55101
		Proco Adhesive	Protective Coatings Inc. 807 N. Fremont Ave. Tampa, Florida
Rain Repellant	FSCM 50159	Repcon	Unelco Corp. 727 E. 110th St. Chicago Ill. 60628

—NOTES—

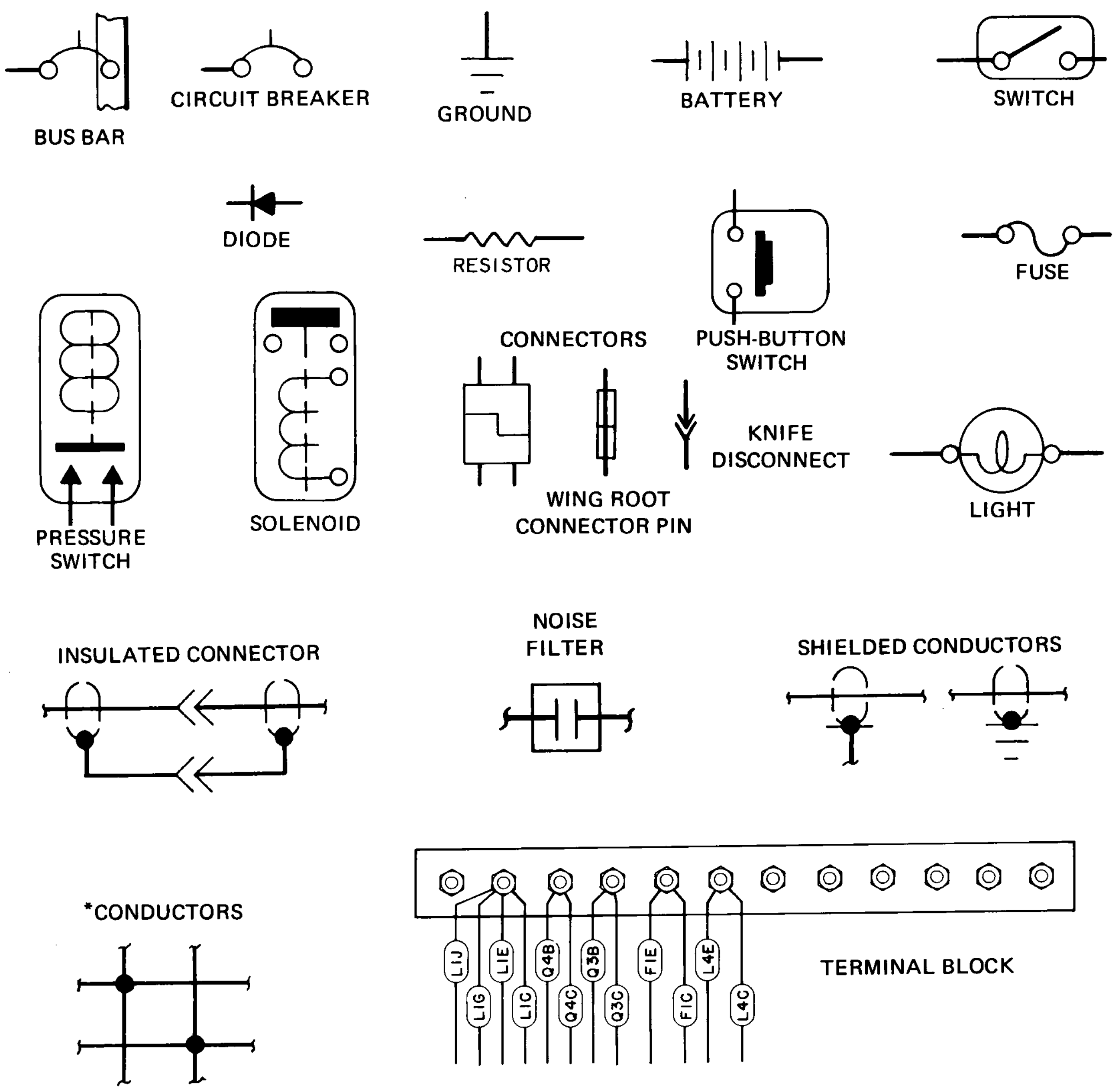
1. ***If 100 octane (green) fuel is not available, use 100 octane low lead (blue) fuel.***
2. ***Precautions should be taken when using MIL-G-23827 and MIL-C-81322, since these greases contain chemicals harmful to painted surfaces.***

CHART 9106. ELECTRICAL WIRE CODING



CIRCUIT FUNCTION LETTER	CIRCUITS
A	AUTOPILOT
C	CONTROL SURFACE
F	FLIGHT INSTRUMENT
G	LANDING GEAR
H	HEATER - VENTILATING & DEICING
L	LIGHTING
P	POWER
Q	FUEL, OIL & ENGINE INSTRUMENT
RP	RADIO POWER
RZ	RADIO AUDIO
J	IGNITION
W	WARNING
K	STARTER

CHART 9107. ELECTRICAL SYMBOLS



*CONDUCTORS: CROSSINGS AND JUNCTIONS OF CONDUCTORS. THE DOT AT THE INTERSECTION INDICATES A JOINING OF CONDUCTORS.

ELECTRICAL SCHEMATICS

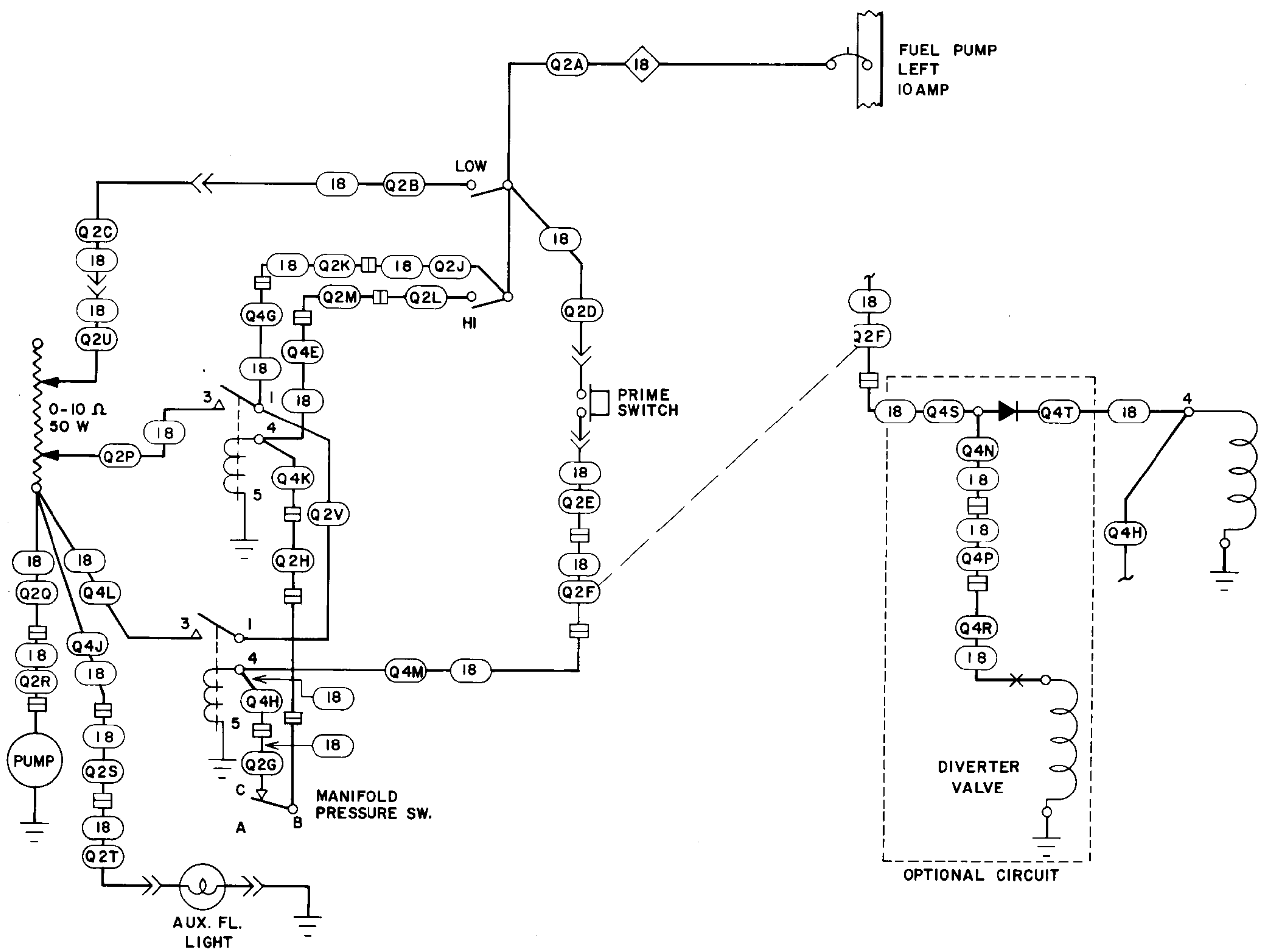


Figure 91-1. Fuel Pump

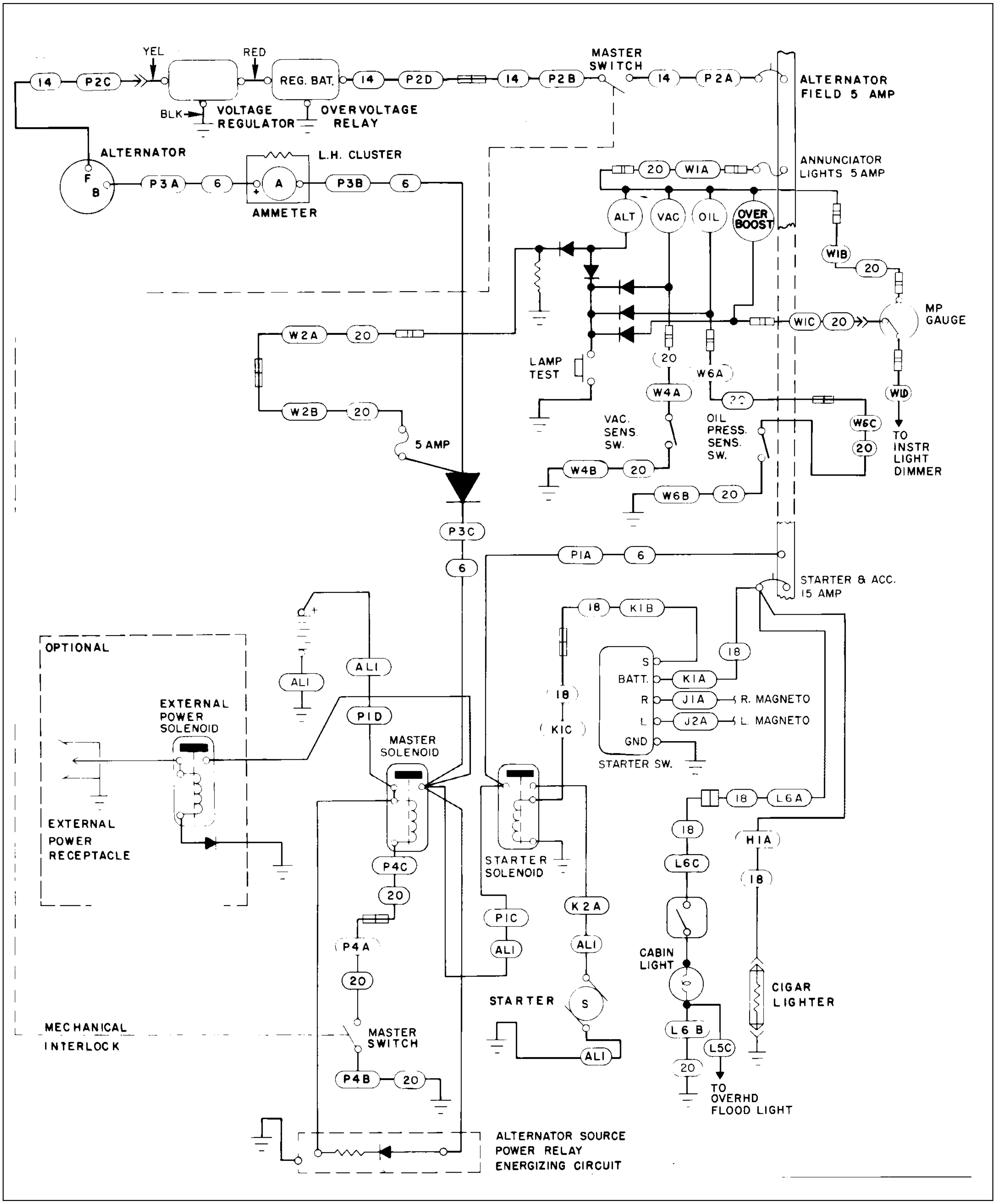


Figure 91-2. Alternator, Starter and Annunciator Panel, Cabin Light, Cigar Lighter and Optional External Power Receptacle

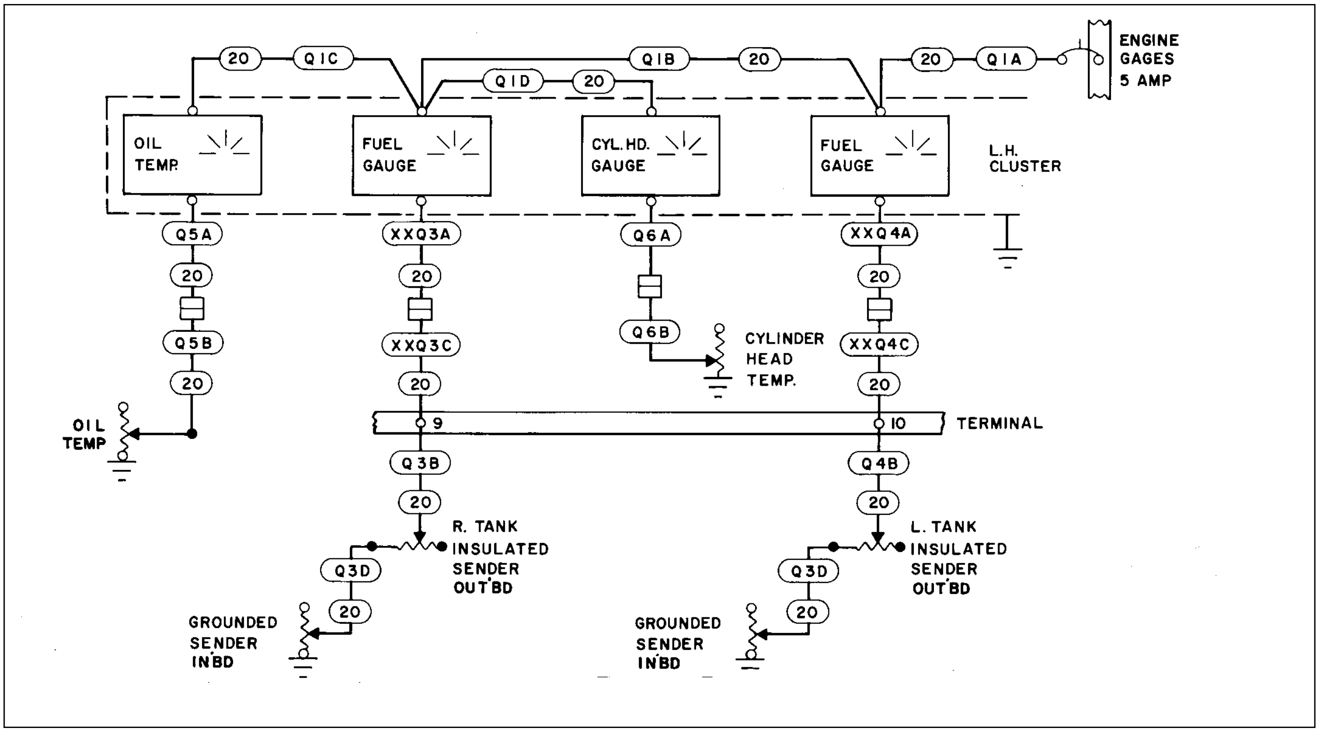


Figure 91-3. Engine Gauges

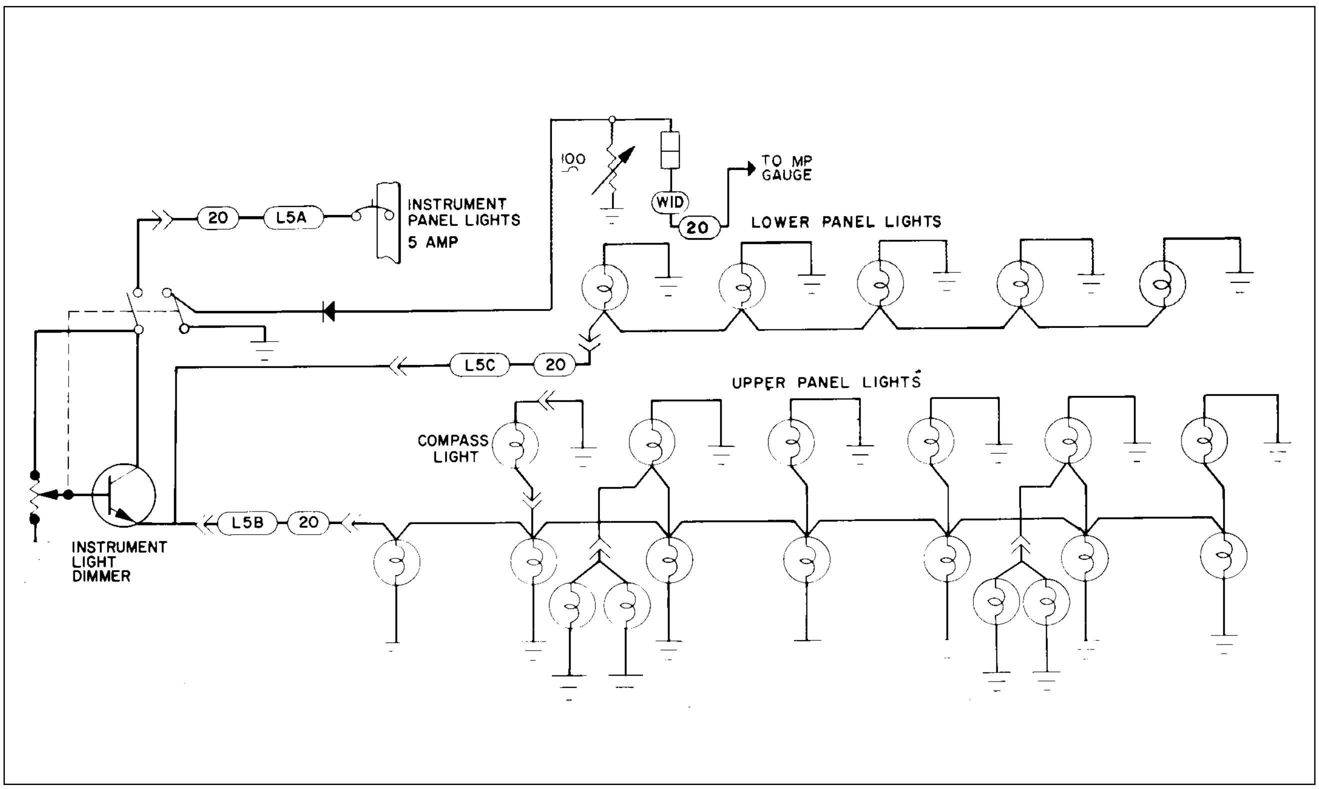


Figure 91-4. Instrument Lights

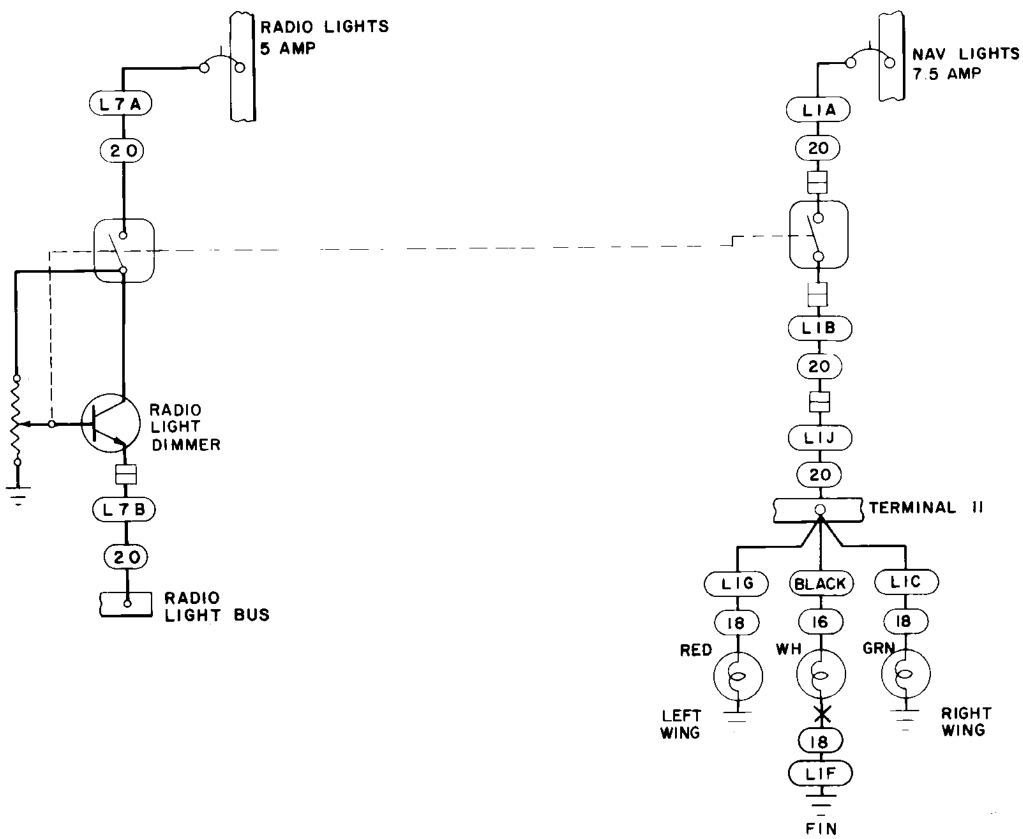


Figure 91-5. Radio and Navigation Lights

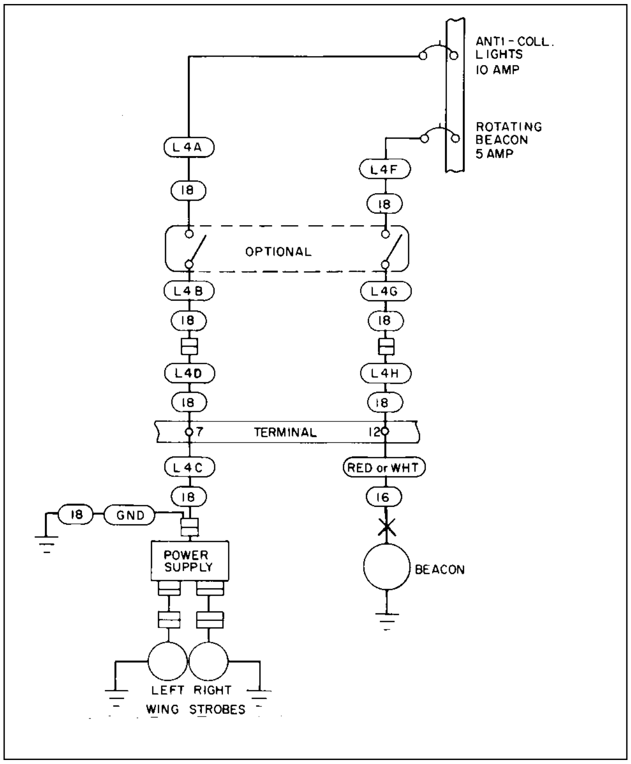


Figure 91-6. Anti-Collision Lights

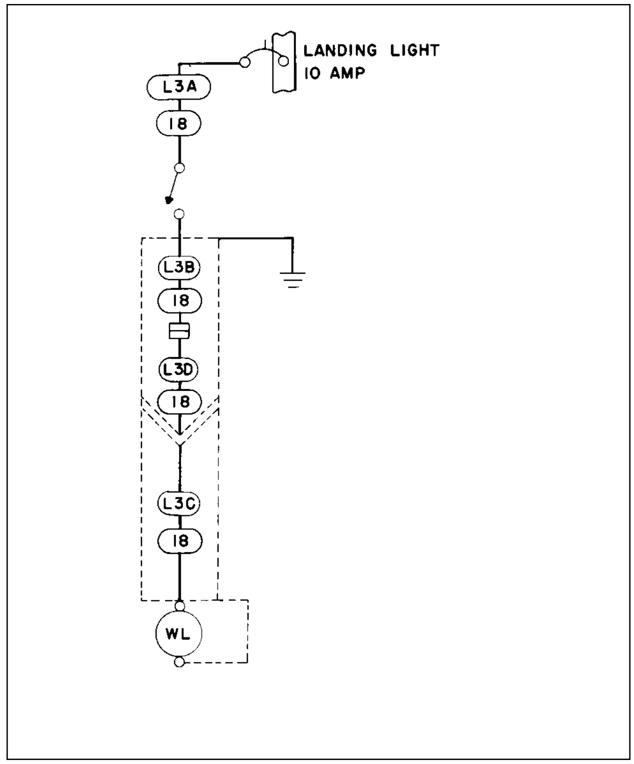


Figure 91-7. Landing Light

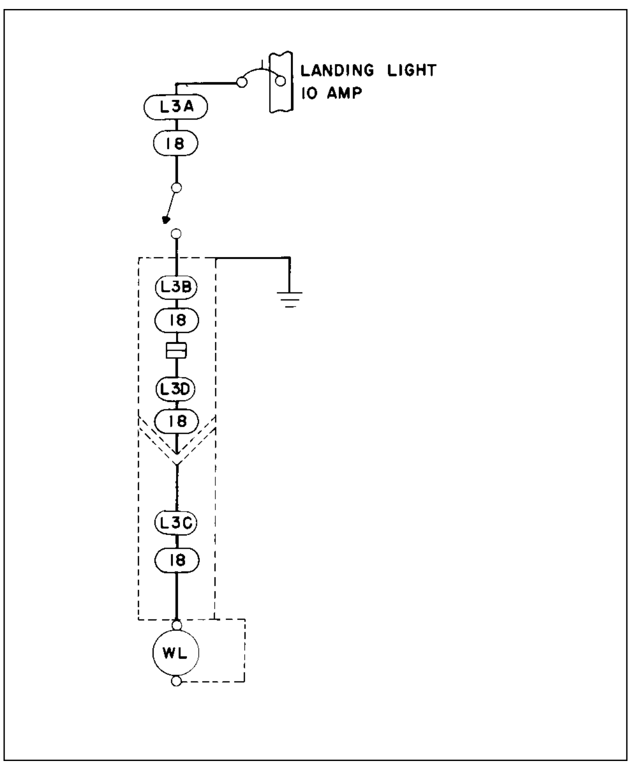


Figure 91-8. Overhead Lights

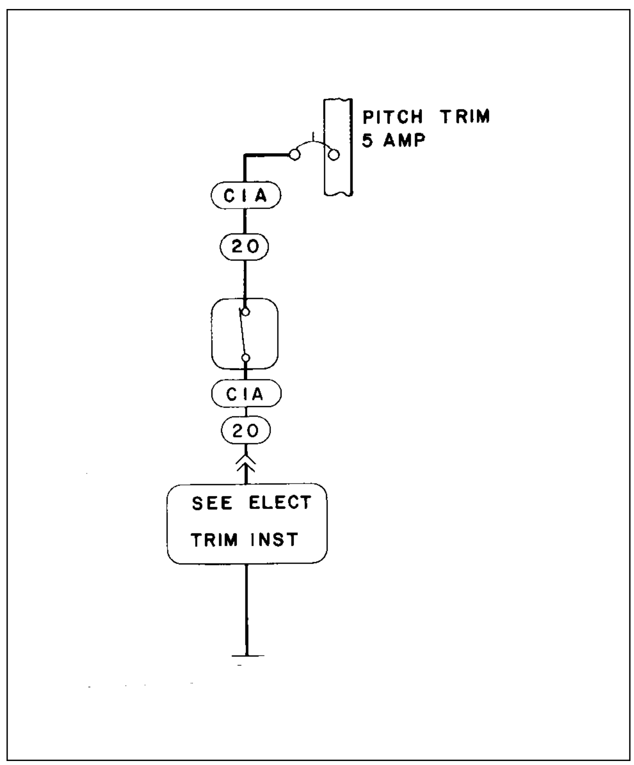


Figure 91-9. Pitch Trim

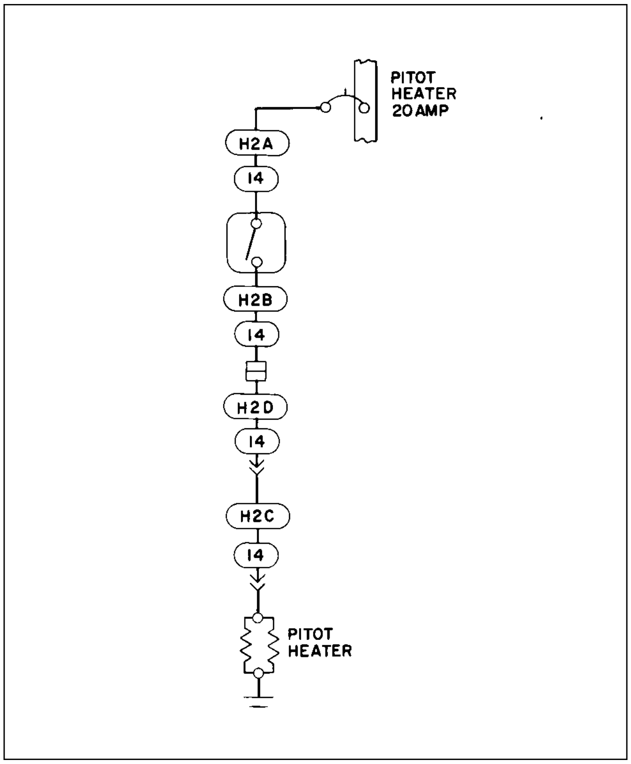


Figure 91-10. Pitot Heat

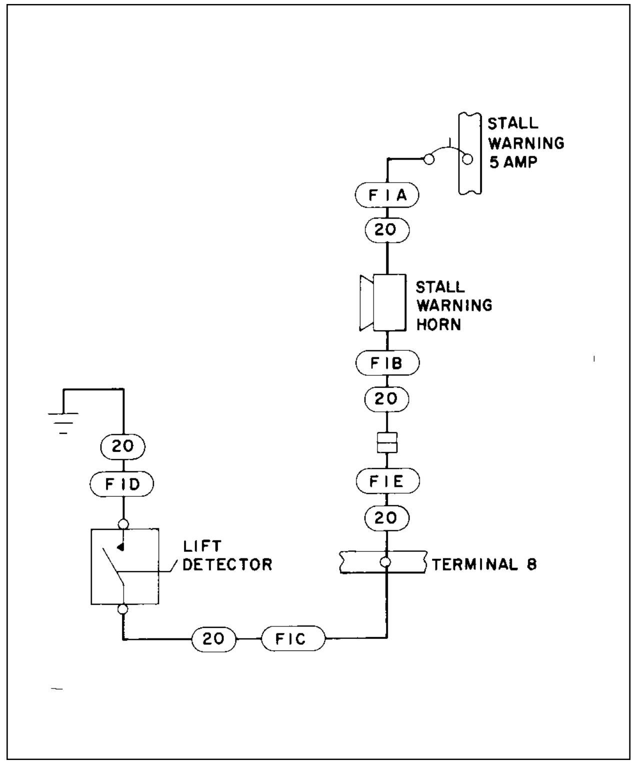


Figure 91-11. Stall Warning

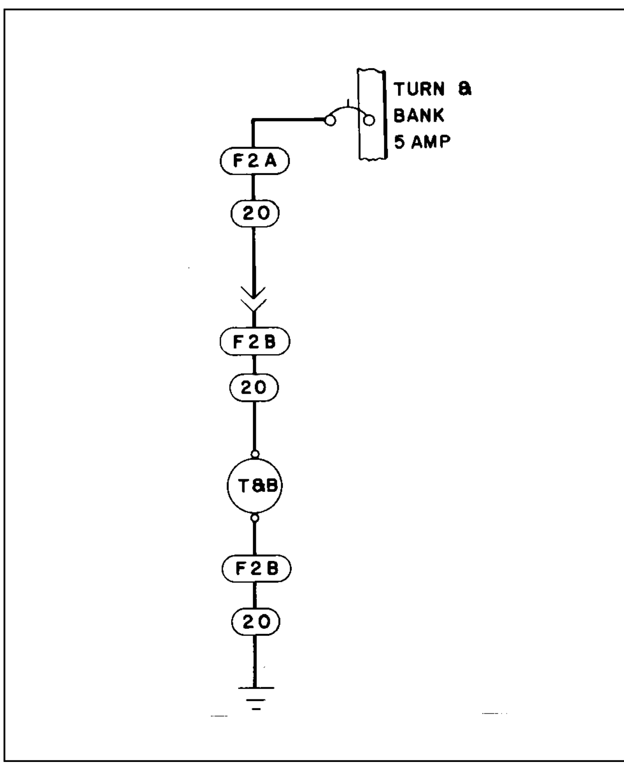


Figure 91-12. Turn and Bank

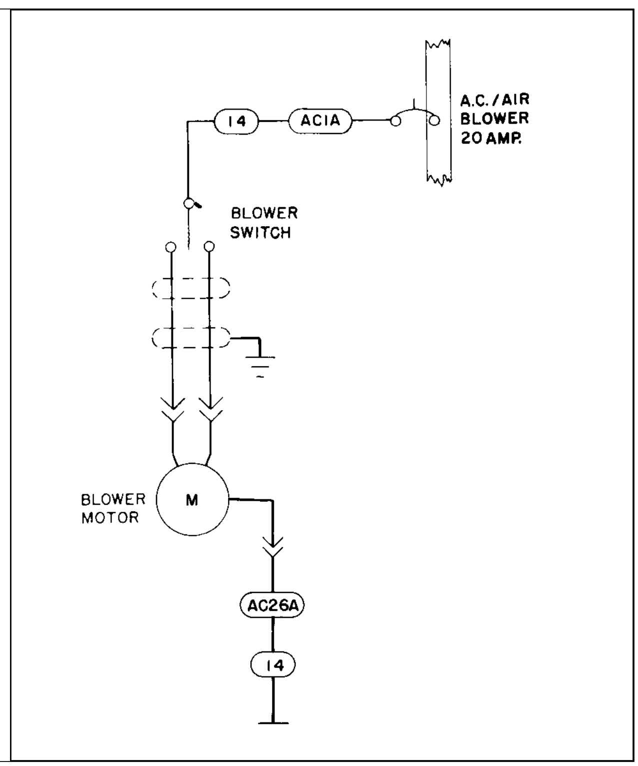


Figure 91-13. A.C/Air Blower

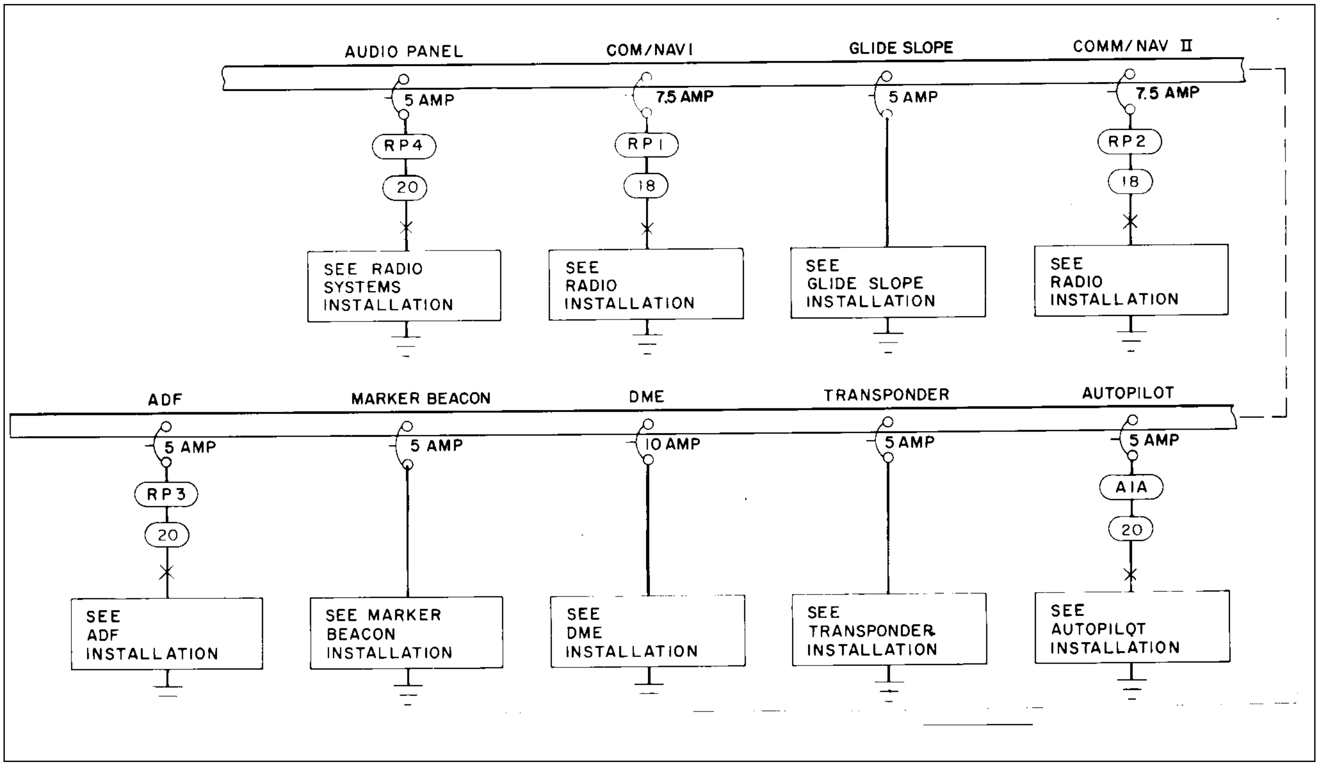


Figure 91-14. Avionics Generalized

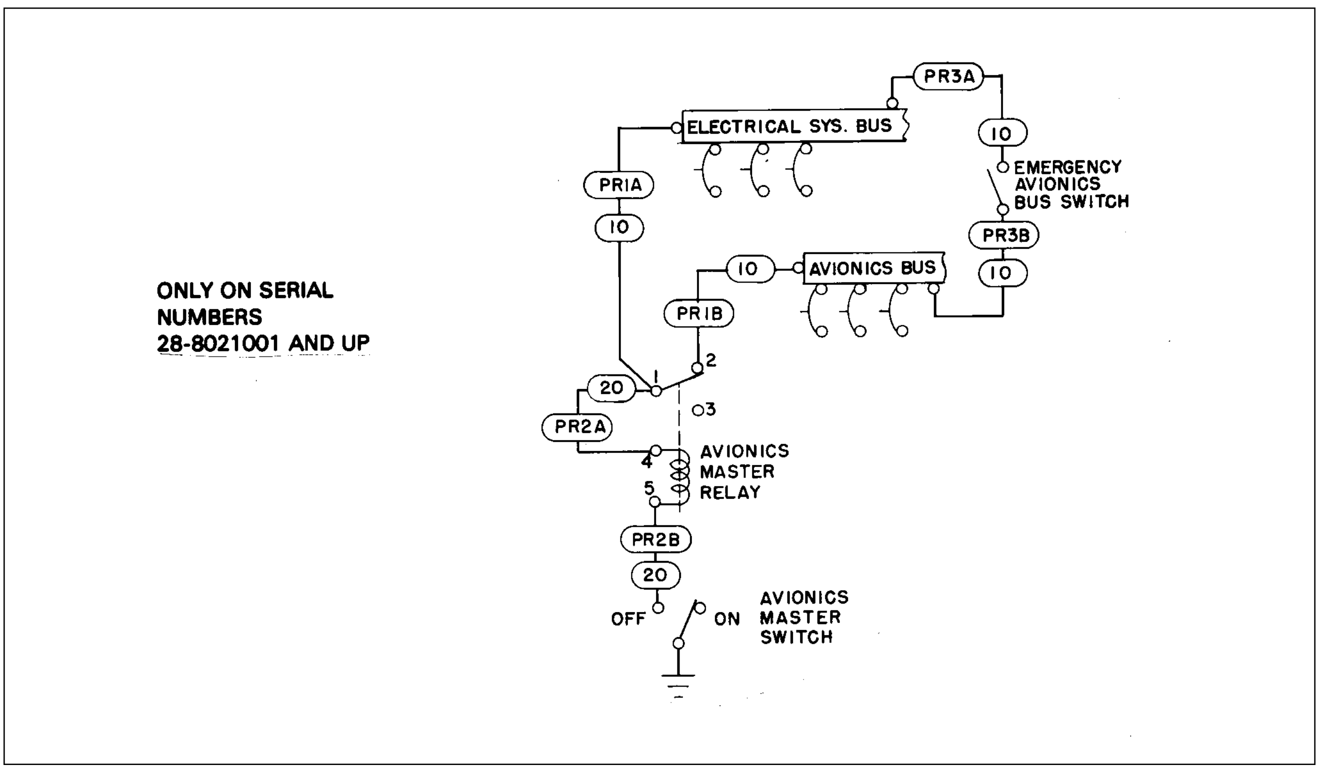


Figure 91-15. Avionics Master Switch (Optional)

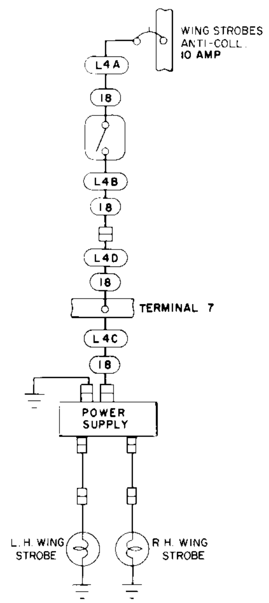


Figure 91-16. Anti-Collision Wing / Strobe

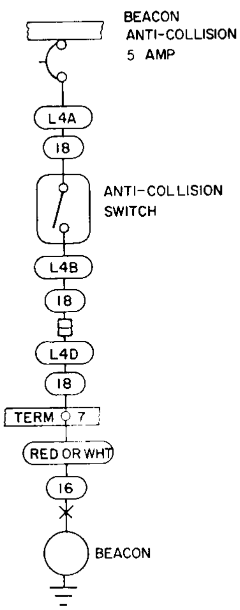


Figure 91-17. Rotating Beacon

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CHAPTER

95

SPECIAL PURPOSE EQUIPMENT

CHAPTER 95-SPECIAL PURPOSE EQUIPMENT

TABLE OF CONTENTS/EFFECTIVITY

GENERAL.

This chapter contains various equipment of a special nature used to perform maintenance on the PA-28-201T.

TOOLS AND TEST EQUIPMENT.

Some special tools other than normal shop tools will be required to service the aircraft. An illustrated list of tools required follows.

—NOTE—

Tools with Part Numbers given are available through the Piper Service Department. Specifications for fabricated tools may be found referring to the appropriate illustration figure number in the maintenance manual following the list of tools.

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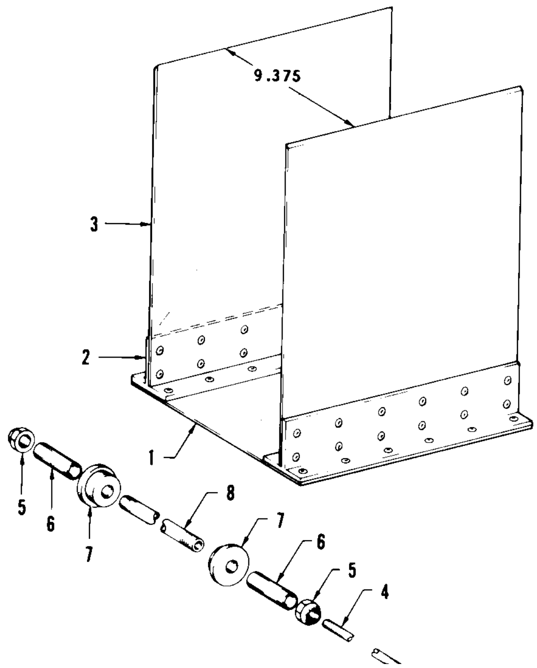

The following list of materials were used in making the balancer:

-1	1 ea.	Base	12 x 11	0.190 2024 T3 clad aluminum alloy
-2	2 ea.	Tee	2.5 x 2 x 11	0.190 2024 T4 extruded aluminum alloy
-3	2 ea.	Sides	14 x 11	0.125 2024 T3 clad aluminum alloy
-4	1 ea.	Axle	0.125 x 10.25	4130 steel, normalized
-5	2 ea.	Nuts	AN 365-624	
-6	2 ea.	Spacer	0.50 x 2.25	5052-0 aluminum tubing
	2 ea.	Spacer	0.50 x 1.25	5052-0 aluminum tubing
-7	2 ea.	Bushing	1.480 x 1.625 x 1.00	phenolic or aluminum
	2 ea.	Bushing	2.240 x 1.37 x 1.00	phenolic or aluminum
-8	1 ea.	Pipe	1/8 x 9.3	black steel pipe
*	2 ea.	Bearings	Save two of each size worn wheel bearings from previous inspections.	

Figure 95-1. Tire Balancer Fixture

TIRE BALANCER BUILDING INSTRUCTIONS.

1. Chamfer top edges of -3 sides, leaving 1/16 inch flat on top inboard edge. Rivet -2 tee's to -3 sides using AN470-AD5 rivets 2" spacing. Use AN426-AD5 rivets 2" center to center to secure -2 tee's to -1 base. If tee extrusion is unavailable, heavy angle extrusion could be used. -3 sides must be vertical.
2. The -4 axle must slide through the -8 pipe. The -5 nuts were made by reaming the existing threads in the AN365-624 nuts with an R drill, then tapping with a 1/8-27 pipe tap.
3. The -6 spacers were made from 1/2 inch aluminum tubing. The two lengths of spacers are suitable for balancing most any aircraft wheel.
4. The -7 bushings may be made from one inch phenolic or aluminum using a 1-1/2 inch hole saw to cut out the smaller bushing and a 1-3/4 hole saw to cut out the larger. By inserting a 1/4 inch long threaded bolt through the pilot hole and securing with a washer and nut, a drill press and file may be used to make the off-set on the bushing. The turned-down part should just slide inside the bearing race. Ream the pilot hole to slide over the -8 pipe threads.
5. The -8 pipe was made from a piece of 1/8 inch black pipe and threaded with a 1/8-27 pipe die. Thread 3 inches in from each end of the pipe.

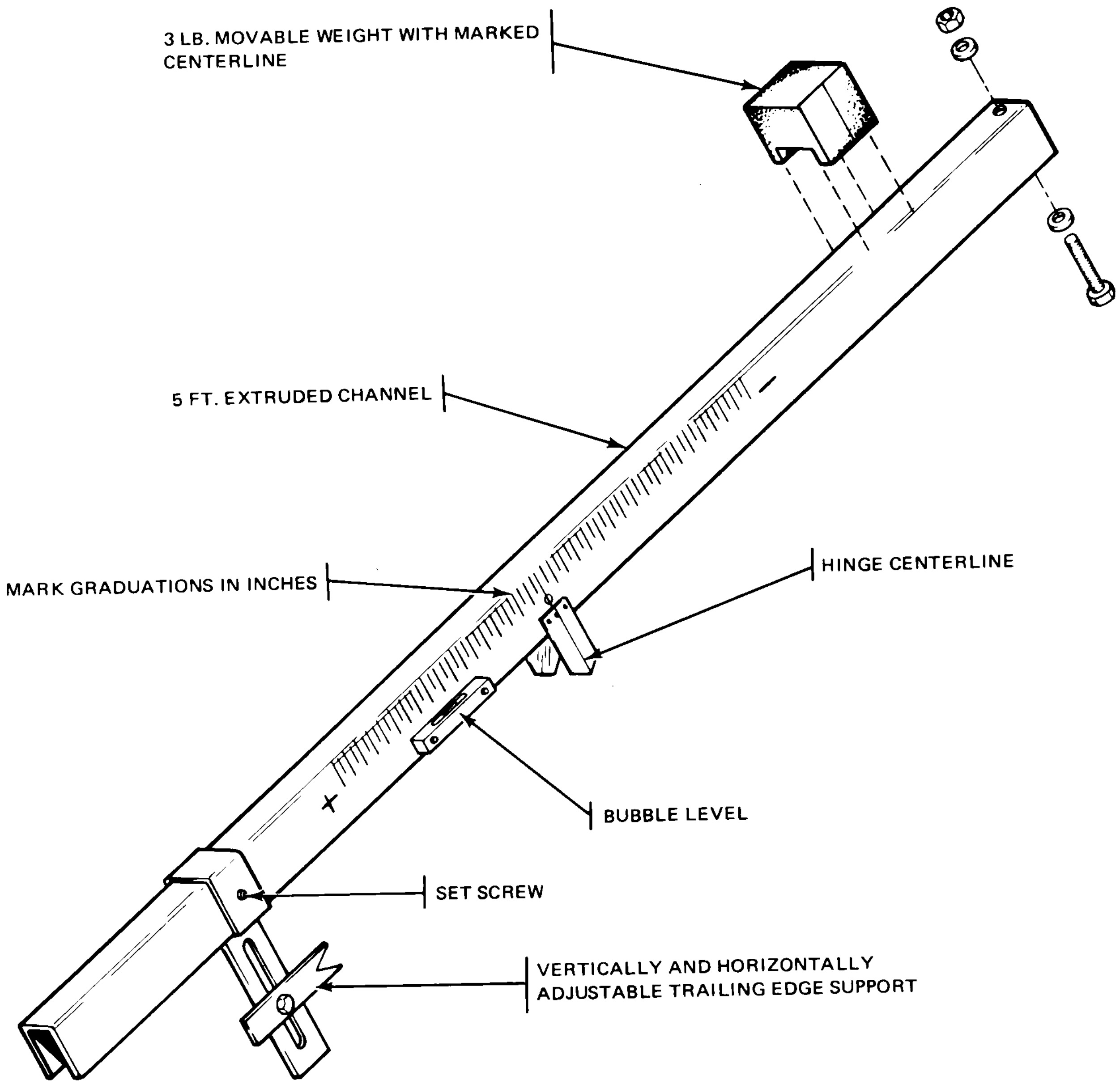

Figure 95-2. Control Surfaces Balancing Tool

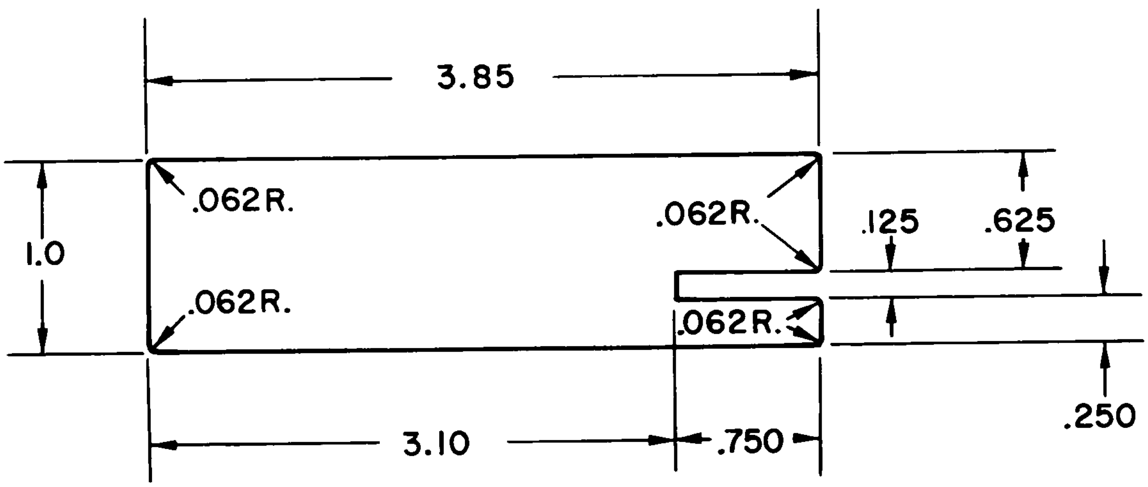

Figure 95-3. Aileron Bellcrank Rigging Tool

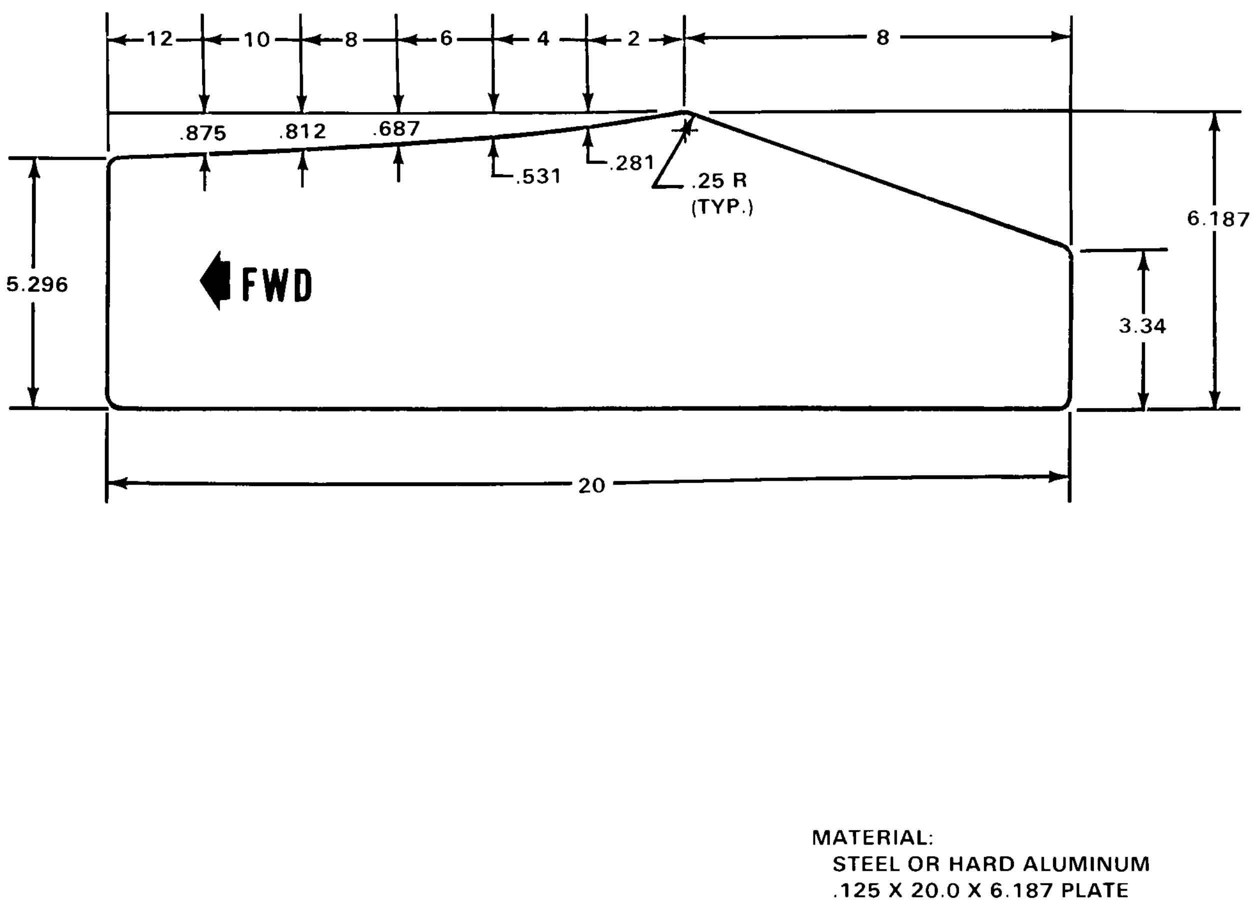

Figure 95-4. Rudder Rigging Tool

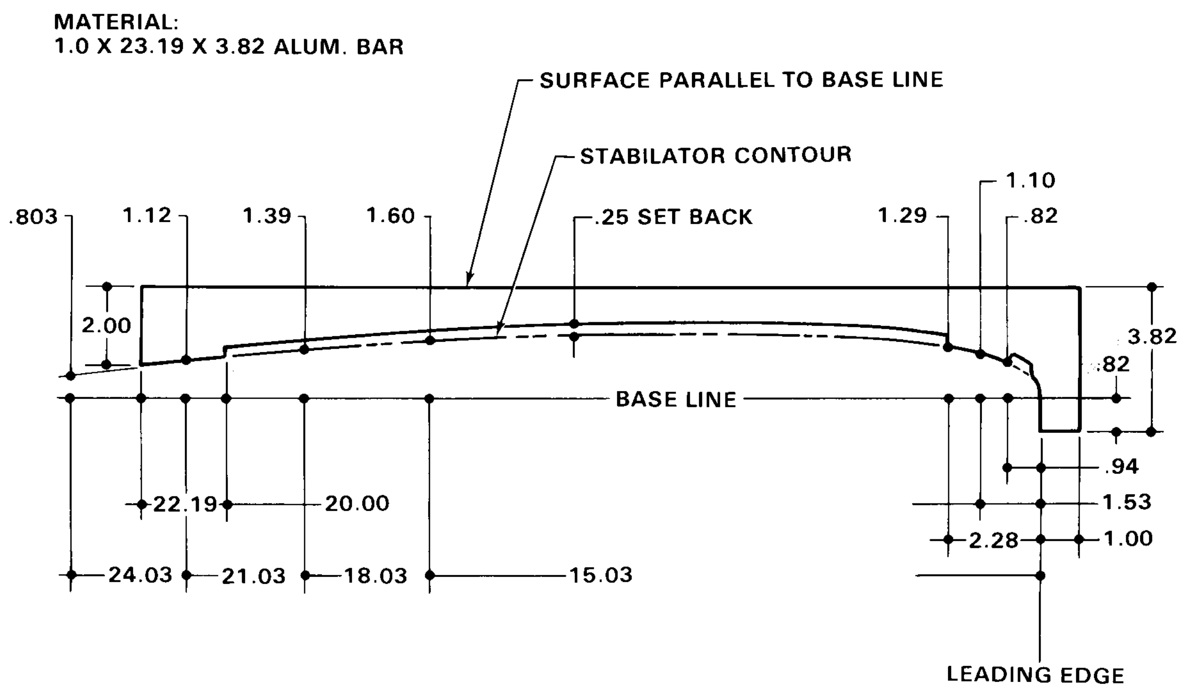

Figure 95-5. Stabilator Rigging Tool

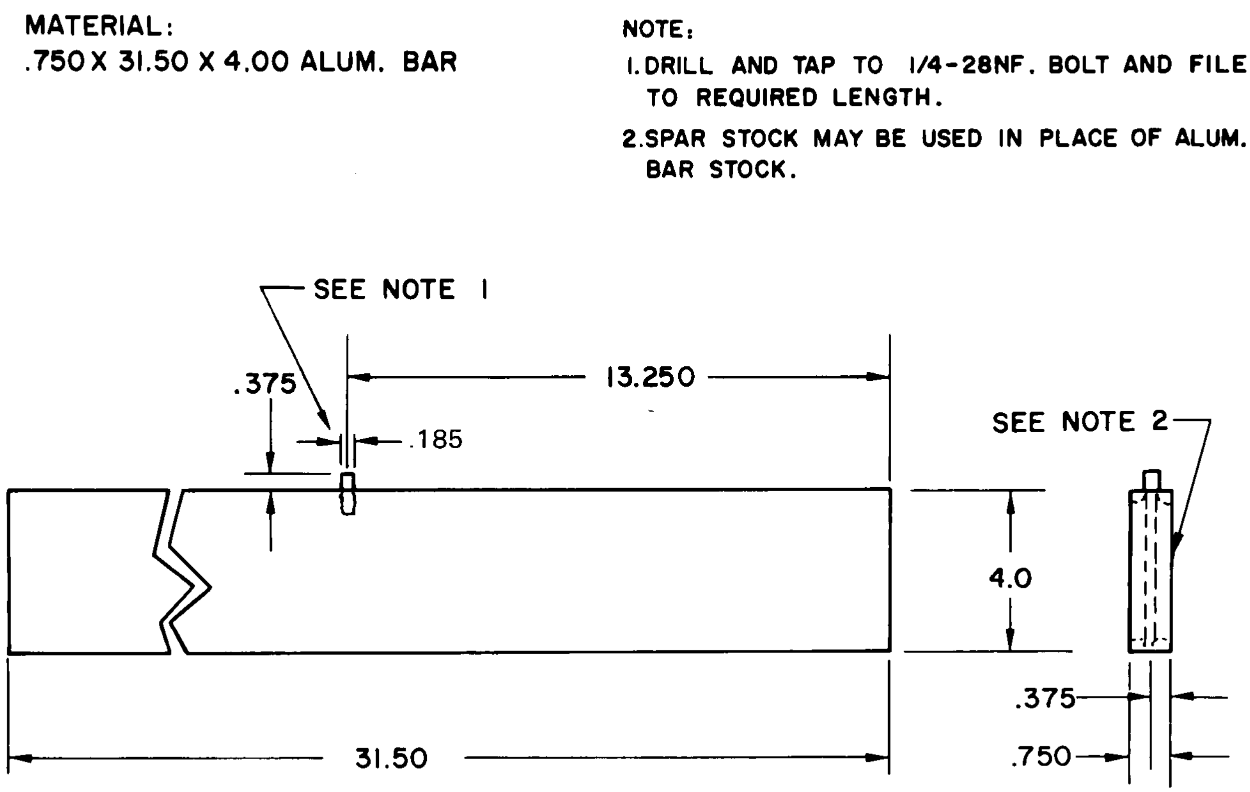

Figure 95-6. Aileron and Flap Rigging Tool

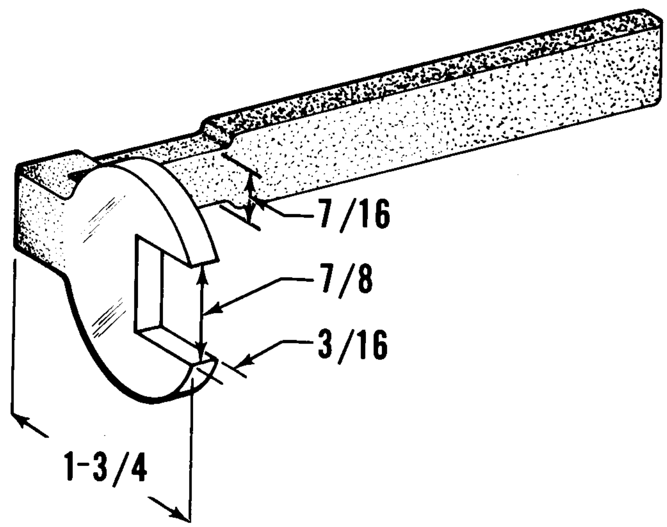

Figure 95-7. Fabricated Tool for Baggage Door Lock

—END—

GRIDS 2K21 THRU 2L24
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